The ScottMadden ENERGY INDUSTRY UPDATE

AS YOGI BERRA MIGHT SAY...

> You've got to be careful if you don't know where you're going, 'cause you might not get there.
>
> YOGI BERRA

Volume 16 - Issue 2

TABLE OF CONTENTS

“I wish I had an answer to that, because I’m tired of answering that question.”

YOGI BERRA

EXECUTIVE SUMMARY

As Yogi Berra Might Say…

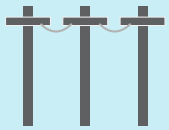
Yogi Berra once said, **"You've got to be careful if you don't know where you're going, 'cause you might not get there!"** That phrase characterizes the uncharted territory in which the energy utility industry finds itself today, the challenge of making strategic decisions, and the importance of setting a direction.

Continued low natural gas prices and increasing interest in renewable energy resources are affecting viability of non-greenhouse gas non-emitting nuclear plants as well as other generation resources. The EPA's proposed Clean Power Plan remains in litigation, with states divided on whether to plan for implementation, or what that might look like. And utilities are seeking earnings growth in the face of continued slow to flat energy consumption growth. These trends call for some orientation on the part of industry decision makers: a road map, sign, and markers, and a sense of direction.

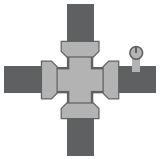
Some Highlights of this ScottMadden Energy Industry Update	
Evolving supply and demand patterns	• Declining energy consumption growth continues to be an electric industry phenomenon, even as the world slowly grows out of the Great Recession. But drivers of this trend are not as simple as the conventional wisdom. Instead, they are more multi-dimensional and nuanced; one must take a look at things like geography and customer mix along with drivers of energy intensity • On the supply side, increasing levels of renewables are strengthening the projected "duck curve" effect sooner than expected, with implications for the grid and other power supply resources. However, despite what many believe, the duck curve (as currently observed) is not caused by rooftop solar. In fact, an understanding of the real cause suggests "ducks" could be migrating from California to other states sooner than expected
Evolving regulatory constructs	• As distributed resources proliferate, and natural gas prices threaten some installed generation, adjustments to market constructs are creating a hybrid system—one that is neither fish nor fowl—with ramifications for energy investment and conflicting directives between state and federal regulators • New York's Public Service Commission has issued its Track 2 Order in its Reforming the Energy Vision docket, ushering in a series of utility filings that potentially rethink incentives, performance, and rate design, seeking to encourage non-wires alternatives while keeping electricity affordable—a potentially tall order • Meanwhile, Mexico continues to restructure its energy industries, seeking to grow investment, lower rates, and expand energy access, while employing some mechanisms familiar to the United States and Canada (such as independent system operators) and diminishing the traditional roles of state-sponsored energy champions
Adapting utility strategies	• Utility executives are looking at different strategies—organic and other—to grow earnings in light of flagging growth in volumetric sales. Some of these strategies are "déjà vu all over again" approaches like energy services and rate base investment • Mergers and acquisitions are one method of growth, and a number of large transactions have been recently announced. But even where the acquirers are similar (e.g., large integrated utilities) as are their M&A partners (e.g., large gas companies), rationales and strategies differ

CEO THEMES:
SEEKING GROWTH

Different strokes for different folks:
Companies respond with growth strategies in a low energy demand growth environment.

Sectors	Selected Company Comments
 **Electric Utilities:** Explore Grid, Regulatory, and Gas Options	• Aggressively pursue re-regulation of asset base due to the state of competitive generation (or move the "bright line" between state jurisdiction and wholesale markets) • Invest in emerging technologies and grid modernization: AMI, DERs, microgrids, EV charging infrastructure • Expand presence in gas sector through acquisition, pipeline investments • Pursue policy fixes and wholesale market rule changes to address imperiled nuclear, fossil generation, DG cost structure • Transition from coal-fired generation to gas-fired, renewables, DR, and EE • Invest in "what's next" for customers (e.g., mobile interaction, commercial rooftop solar, water and energy services for C&I customers) • Expand into services and behind the meter
 **Electric Delivery Companies:** Engage Customers and Invest	• Improve customer satisfaction by offering tailored solutions to help them save energy • Invest in AMI, EE, and customer programs • Expand communication with customers (change management) • Maintain capex in core business while investing in new business opportunities and divesting those that fail to be predictable/profitable • Remain focused on reliability and workforce safety
 **IPPs and Merchant Generators:** Position for Tighter Markets	• Deleverage by increasing available capital, including asset sales • Continue retiring coal units and units that do not clear capacity auctions, while taking advantage of revenue opportunities in renewables • Leverage long heat rate positions when markets tighten and scarcity increases • Decrease hedges gradually to act on price volatility and price appreciation in forward markets • Lobby against hybrid market designs

CEO THEMES

Sectors	Selected Company Comments
 **Gas Pipelines:** Shore up Balance Sheet and Continue to Expand	• Grow stable, fee-based revenues through continued infrastructure investments and expansion capital program • Maintain strong balance sheet and liquidity; reduce or manage dividend payouts • Leverage drop-down opportunities through MLPs • Capitalize on expanding natural gas market: maintain strategic balance of demand-pull business in growing markets and significant supply basin exposure • Leverage asset footprint to seek out attractive capital investment opportunities—both expansion and acquisition
 **Gas LDCs:** Optimize the Regulated Business Model	• Continue to execute low-risk regulated growth strategy by investing in infrastructure—both new and existing, including leveraging proposed new PHMSA rules • Minimize gap between earned and authorized return on equity through rigorous cost control • Maintain customer growth rate and diversification; grow large government and commercial volumes • Complement core business with strategic, energy-related joint ventures • Grow dividend while maintaining investment-grade credit metrics and sustaining ample liquidity

NOTES:
AMI means advanced metering infrastructure; DERs means distributed energy resources; DG means distributed generation; EE means energy efficiency; C&I means commercial and industrial; MLPs means master limited partnerships
SOURCES:
Company filings, annual reports, and web sites; industry analyst reports; ScottMadden analysis

EARNINGS GROWTH STRATEGIES:
LOOKING BEYOND "NO REGRETS" INVESTMENTS

Utilities are shifting focus back to the core business, increasing grid investments, and testing expanded customer-centric offerings.

Approach	Strategy	Examples
"Reinforce the Tried and True"	*Continuing regulated investments in core infrastructure*	• **Duke Energy** plans to invest $5.1 billion in new generation, $4.9 billion in T&D expansion, and $8.1 billion in environmental, nuclear fuel, and discretionary additions by 2020 • **Dominion Resources** plans to invest $15.7 billion in T&D upgrades, new generation, an LNG facility, and a new gas pipeline by 2020
"Build the Platform"	*Accelerating investments in system digitization and automation*	• **Exelon** plans to invest $25 billion in critical infrastructure, smart grid technologies, reliability measures, and customer service programs across its regulated utilities by 2020 • **Southern California Edison** plans to invest $2.3 billion in DER-related upgrades by 2018
"Optimize the Rate Structure"	*Redesigning rates to reflect the changing industry landscape*	• **Arizona Public Service** is currently pursuing mandatory demand charges, a three-part rate, and a reformed lost fixed-cost recovery (LFCR) adjustment for its residential customers with rooftop solar • **Sacramento Municipal Utility District** now offers optional time-of-use rates for customers that own DERs and plans to expand its program to all customers in 2017
"Explore the (Relatively) Unconventional"	*Expanding into energy services*	• In March 2016, **Edison International** launched Edison Energy, merging four stand-alone service companies into one seamless offering for commercial and industrial customers • In February 2016, **Southern Company** announced its acquisition of PowerSecure, a 15-year-old business that focuses on building and managing distributed generation assets and microgrids
"Consider the Inorganic"	*Assessing external growth opportunities through acquisitions and joint ventures*	• In August 2016, **NextEra Energy** proposed its $18.7 billion acquisition of Oncor Electric Delivery Company, which would bolster its position in Texas by adding a distribution utility to its current portfolio of merchant generation and regulated transmission assets • **Dominion Resources**, **Duke Energy**, and **Southern Company** have each recently announced major acquisitions of natural gas utilities and pipelines in an effort to diversify their regulated business mix

Déjà Vu All over Again?

After the initial wave of retail restructuring in the 1990s, utility-affiliated energy service companies (ESCOs) emerged to provide turnkey energy solutions linked with competitive commodity sales. Some flourished, some exited the market. Other non-utility ESCOs like AECOM and Ameresco grew as well.

Utility ESCOs may be making a comeback now, as utilities seek other revenue streams. What's different this time? A lack of core energy sales growth; improved, broader (think distributed solar), and cheaper technology; and internet-of-things linkages. Time will tell whether customers will pay for "negawatts" and ESCOs can keep their costs to deliver competitive with local vendors and large, well-scaled non-utility ESCOs.

NOTES:
DER means distributed energy resources
SOURCES:
SNL Financial; industry news; investor presentations; company annual reports; EIA; GTM; Rocky Mountain Institute

MERGERS AND ACQUISITIONS:
CONSOLIDATION AND CONVERGENCE

Gas and electric utilities continue to look for opportunistic acquisitions, especially in the rate-regulated utility and pipeline space.

Many Strategies, One Rationale: Sustainable Growth

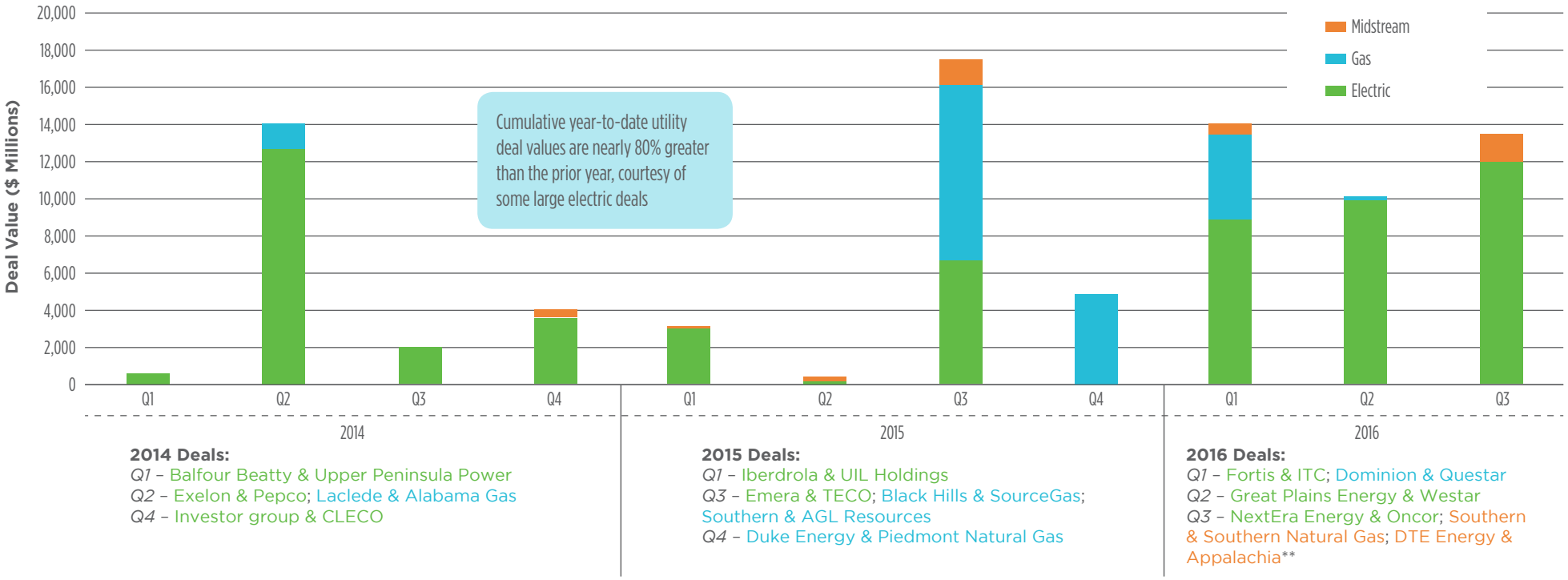
- Merger activity continued apace into 2016, with 17 transactions totaling more than $37 billion announced through late September (see Fig. 1)
- Q2 and Q3 saw buyers shift their focus to peers in search of geographic adjacencies and economies of scale (Great Plains/ Westar) and portfolio diversification (Algonquin/Empire District and NextEra/Oncor)
    - › Each buyer expects these deals to be meaningfully accretive
    - › The deals allow them to realize the top ends of their forecasted annual EPS growth (~6% to 10%) in addition to expanding their regulated rate bases
- As a particularly active player year-to-date, Southern acquired PowerSecure, an unregulated energy services company specializing in managing distributed energy resources, in February and purchased a 50% equity stake in the Southern Natural Gas Pipeline in July
- Some players continued to expand their midstream gas capabilities as a core business (Dominion/Questar, DTE Energy/Appalachia) or as a continuation of a convergence play tied to increasing amounts of gas-fired generation and increased midstream participation (Southern)

> "...It's likely not a coincidence that vertically integrated electric utilities target T&D-only electric or gas utilities as prime acquisition targets. They have only one shot for a large acquisition using their balance sheet capacity, and as such they are likely to pick a utility with the most sustainable business model..."
>
> *–Angie Storozynski, Macquarie Research*

Some Big Pipeline Mergers in 2016: Betting on a Demand Rebound

- In July 2016, Canadian firm TransCanada acquired Columbia Pipeline Group, owner of 15,000 miles of U.S. pipeline, gathering, and processing assets from New York to the Gulf of Mexico, in a transaction valued at more than $12 billion
- More recently, in late September, Alberta-based Enbridge announced it was buying U.S. pipeline giant Spectra Energy Group for nearly $43 billion. Spectra owns more than 87,000 miles of gas pipelines
- Both reflect positioning for expected increases in gas demand, geographic expansion, and improved access to transport capacity from northeast U.S. (i.e., Marcellus) gas resources

Figure 1: U.S. Energy Utility and Selected Midstream Sector Deal Value by Announcement Date (Quarter) and by Target Sector Type (in $ Millions)*



Source: SNL Financial

Expect More of the Same, But What about Interest Rates?

- Citing declining consumption and impending environmental regulation, analysts expect vertically integrated utilities with substantial generation capex allocations to increasingly seek out inorganic (electric and/or gas) T&D opportunities as a means of achieving growth while limiting their regulatory risk
- For similar reasons, analysts also expect utilities to increasingly partner with and invest in unconventional energy services and emerging technology developers in order to establish complementary revenue streams and avoid competitive threats
- Interest rates remain a key concern for the pace of future utility M&A. Should rates rise, authorized returns on equity could be driven upward, and the associated increase in the cost-of-debt capital could make more deals less EPS accretive. This would have the effect of shifting preferences back toward organic growth

NOTES:
*Includes sales of minority interests, deals announced but not closed, and joint venture investments (e.g., Southern and Kinder Morgan's Southern Natural Gas JV); deal value is equity portion of acquisition value, excluding debt assumption. **Not reflected in deal value summary
SOURCES:
SNL Financial; Macquarie Research; UBS; Morgan Stanley; J.P. Morgan; Barclays; ScottMadden analysis

“

It’s not too far,
it just seems like it is.

”

YOGI
BERRA

RATE AND REGULATORY ISSUES

NEW YORK REV TRACK 2:
PUBLIC SERVICE COMMISSION RULES ON UTILITY REVENUE MODEL

Track 2 Order provides a framework, but many specifics are to be determined.

A Path Forward: Framework Addresses Rate Design and Utility Earnings

- Building on previous REV actions, the NYPSC issued an order in May 2016, outlining reforms to the utility revenue model and rate design
- The reforms are intended to encourage utilities to modernize the power system by better aligning utility shareholder financial interest with consumer interest
- The order directs near-term rate-design changes and establishes four types of earning opportunities for utilities:
  - Traditional cost-of-service earnings
  - Earnings tied to reducing or deferring capital spending while providing consumer benefit through the development of non-wires alternatives projects (e.g., Brooklyn Queens Demand Management Program)
  - Transitional outcome-based performance measures called earning adjustment mechanisms (EAMs)
  - Market-facing revenues for providing value-added services through the distributed system platform called platform service revenues (PSRs)
- But a number of the specifics are to be spelled out in future rulings (see Fig. 1)
- Utilities are expected to file Track 2 proposals under a tight schedule (see Fig. 2)

> This [Track 2] order provides directional guidance for long-term reform and a carefully measured set of near-term actions designed to facilitate needed change while maintaining traditional principles of gradualism, equity, and opportunity to earn fair returns on investment.
>
> *–New York Public Service Commission*

Figure 1: Myriad, Though Not Completely Coordinated, Mechanisms for Track 2 Implementation

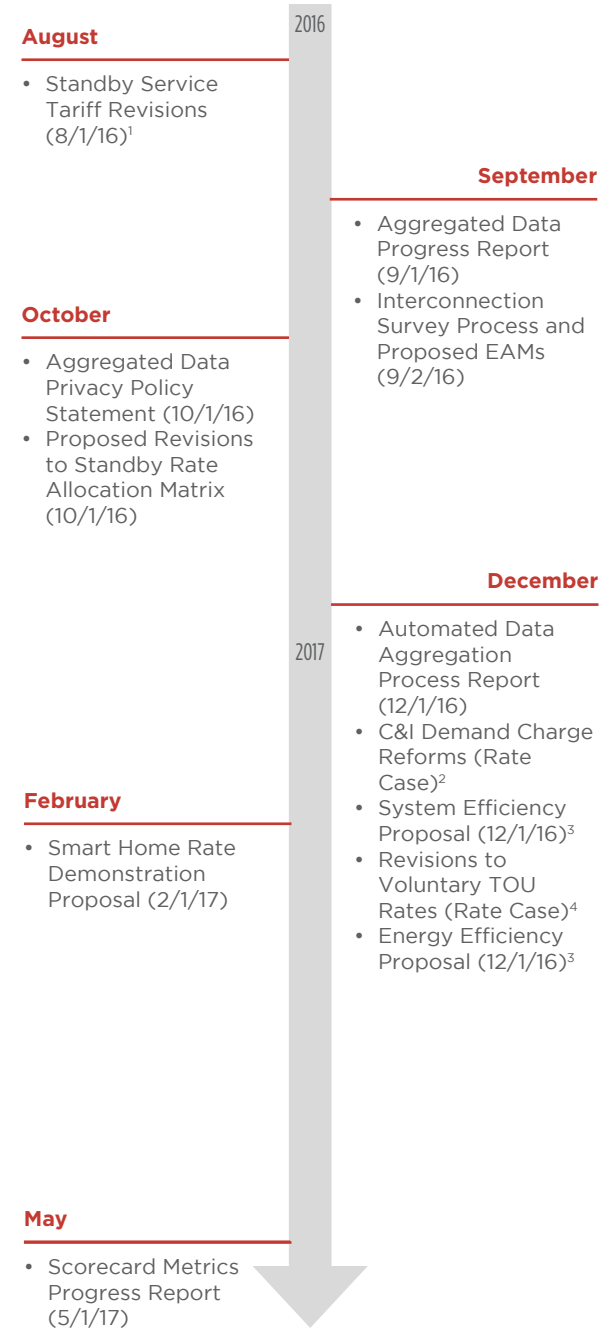
Ticktock: Rate Design Focuses on Time-Sensitive Rates, Increasing Participation

- NYPSC requires utilities to examine participation in voluntary time-of-use rates, develop improved promotion and education, and propose Smart Home Rate demonstration projects
- In addition, utilities must examine existing C&I demand charges in upcoming rate cases to determine if they can be made more time sensitive
- NYPSC also directed Commission staff to scope a study analyzing impacts of a range of mass-market rate reform scenarios, including opt-out time-variable rates

Near-Term Transition: Earning Adjustment Mechanisms

- The Commission views EAMs as a bridge to market-based revenues, which they expect to eventually provide predictable and meaningful contributions to utility revenue requirements (see Fig. 3)
- The Commission noted a preference toward outcome-based metrics (as opposed to utility inputs or program targets, for example) that avoid reliance on counterfactuals
- Utilities may earn up to a total of 100 additional basis points annually across all EAMs, translated into an absolute dollar figure to avoid incentive to grow rate base
- The financial details of EAMs will be developed in rate proceedings; specific EAMs (or combinations of EAMs) proposed and the relative weight of each EAM can vary by utility
- A scorecard will be used to develop and track additional outcome-based metrics (e.g., greenhouse gas reduction) that may become EAMs in the future

Figure 2:
New York REV Track 2 Utility Filing Deadlines—A Lot in a Little Time



NOTES TO FIGURE 2:
Deadlines as of mid-October 2016. [1] All utilities with the exception of ConEdison; [2] Next rate case or no later than 4/1/17; [3] Assumed next rate case; [4] With next rate filing or no later than this 6/1/17 for utilities that have rate plans expiring after 1/1/18

Long-Term Utility Business: Platform Service Revenues

- PSRs are defined as utility revenues associated with the operation or facilitation of distribution-level markets; the Commission anticipates the precise nature of PSRs will evolve over time
- A PSR may come from monopoly functions or competitive value-added services (see Fig. 4)
- Competitive value-added services will be evaluated against the following criteria to ensure market benefits:
  - Service facilitates the growth and operation of markets
  - Whether the existing third-party market adequately serves all sectors of the market
  - Utility economies of scale or expertise are likely to cost-effectively stimulate the market
  - Utility service is likely to prevent other providers from entering the market
  - The extent to which a utility has proposed placing shareholder funds at risk
- Pricing of PSRs will not be strictly cost based, but rather will respond to market developments while optimizing value for ratepayers
- Platform services for which utilities may earn revenues are not pre-specified and will be subject to explicit Commission approval

Figure 3

Building New Markets: List of Initial EAMs

- **System Efficiency:** Utilities will propose system efficiency targets that include both peak-reduction and load-reduction factors over a period of five years
- **Energy Efficiency:** Commission will adopt efficiency targets, incremental to existing requirements, following recommendations from the Clean Energy Advisory Council
- **Interconnection:** Utilities to propose threshold requirement based on adherence to timelines and positive adjustment based on application quality and satisfaction of applicants
- **Customer Engagement (Optional):** Utilities may propose specific metrics (e.g., opt-in time-of-use rates), but none are required due to the fundamental importance of customer engagement in other outcomes

Figure 4

Potential Moneymakers: Example Platform Service Revenues

- Customer origination via the online portal
- Data analysis
- Co-branding
- Transaction and/or platform access fees
- Optimization or scheduling services that add value to DER
- Advertising; energy services financing
- Engineering services for microgrids
- Enhanced power quality services

Playing the Long Game: Traditional Rate Making to Remain Prominent in Near Term

- Outcomes are not tied to an explicit timeline to allow developments to occur at a pace established by market participants
- Rate proceedings, including the recent joint filing by Consolidated Edison, will be a critical venue for the refinement and implementation of EAMs. Meanwhile, demonstration projects currently underway are likely to inform development of PSRs
- In rate plans, utilities will be encouraged to displace capital expenditures with third-party DERs where cost effective and retain earnings on capital already in base rates, until rates are reset in their next rate case*
- As New York continues along this journey, expect traditional cost-of-service earnings to provide the majority of utility earning in the near term

NOTES:
REV means New York's "Reforming the Energy Vision" energy planning and related regulatory docket; NYPSC is the New York Public Service Commission; C&I means commercial and industrial; DER means distributed energy resource. *This is referred to as clawback reform
SOURCES:
NYPSC; SNL; Energy Collective; industry news; ScottMadden analysis

BATTLE LINES: DANCING ALONG THE BOUNDARY BETWEEN FEDERAL AND STATE ENERGY JURISDICTION

As states assert their energy policy preferences in new ways, there is contested ground at the formerly "bright line" of federal-state jurisdiction.

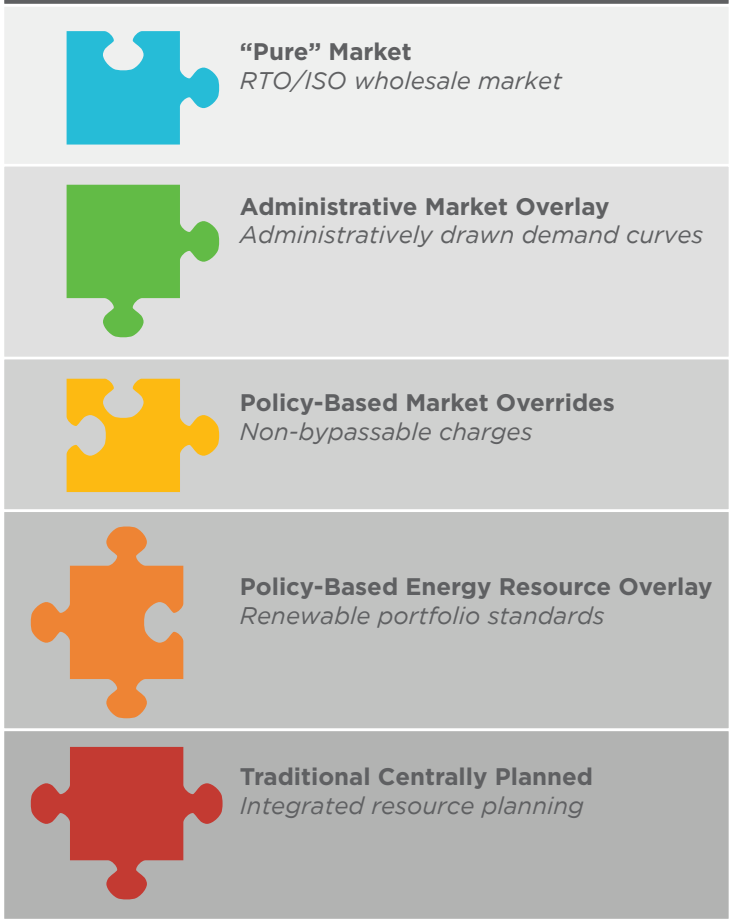
Making a Market...and Adjusting It...and Adjusting It

- When FERC restructured the power industry in 1996 through Order 888 and the subsequent establishment of regional transmission organizations and energy markets, it sought in part to unleash market forces to help drive down prices in an "inherently competitive" power generation sector
- Over time, "pure" wholesale electricity markets have been adjusted through a number of administrative (rules-based) mechanisms, including:
  - Price caps
  - Minimum offer price rule
  - Administratively drawn demand curves
  - Capacity markets
  - Capacity performance products
- More recently, PJM has proposed an approach to change capacity auction design to effectively remove subsidized capacity resources, and commensurate load, for purposes of calculating capacity values (nudging prices upward). This would result in administratively determined market-clearing prices

States Assert Their Interests

- States have some overlapping but additional interests other than the "just and reasonable rates" principle that governs federal oversight
- Increasingly, states are expanding their involvement in areas that touch upon energy and trying to manage outcomes
  - Expanding and incentivizing renewables and distributed energy resources
  - Suppressing price increases and spikes for state residents and businesses
  - Encouraging generation development and retention of existing power plants
  - Implementing environmental and carbon policies that may differ from their neighboring states
- To that end, states have introduced approaches affecting their regulated utilities that can create a hybrid system and can potentially work counter to federally approved market design (see Fig. 1)

The Energy Markets Puzzle: How the Pieces Fit Together Matters



- There is a range of options between "pure market" and "pure centrally planned"
- We are combining them in unanticipated ways, like putting pieces together from different puzzles
- This can produce unintended consequences

Figure 1: Some Recent State Actions Drawing State-Federal Conflict into Focus

Area	Situation	Status
PURPA and Community Solar Rates	• Maryland implements pilot community solar (CS) regulations • Local utility "must use" excess CS generation and compensate it at retail rate • Regulation applied to cooperatives as well as investor-owned utilities • Utilities argue that: › They can only use excess CS by reselling to customers, thus it is a wholesale sale, subject to Federal Power Act › CS generator must be a "qualified facility" under PURPA › CS generation offtake, therefore, should be compensated at wholesale avoided cost rate, not retail rate per Maryland rule	• Pending before FERC • Could use the same reasoning that led to Order 745 (DR compensation) being upheld by the Supreme Court in early 2016…or not
Ohio Power Plant Income Guarantees	• Ohio PUC approved a subsidy plan providing income guarantees to FirstEnergy's and AEP's Ohio utilities for their share of the output from certain "vital" power plants (largely aging coal plants) that face economic challenges • Cost of the eight-year subsidy plans would be recovered through a non-bypassable distribution "rider charge" assessed to all end-use customers (including those with competitive energy suppliers) in the Ohio service territories • Power suppliers challenged the guarantees as possibly distorting wholesale prices if bid into market	• Pending before FERC; decision expected early 2017 • FERC requires that the power purchase agreements (PPAs) implementing Ohio plan be filed and approved before implementation, voicing concern over benefits transfers from captive customers to shareholders from PPAs
New York Zero Emissions Credits (ZECs)*	• New York has proposed awarding ZECs to certain nuclear plants, rewarding their carbon-free characteristics and incenting them to remain online • ZECs are calculated using the federal estimate for social cost of carbon, carbon emissions credit values, and an avoided energy cost based upon a forecast $39/MWh reference price • Some power suppliers and fossil fuel providers oppose the plan, claiming it will suppress prices in the New York ISO	• No challenge before FERC has been lodged • Some observers believe that the ZECs will pass muster because they do not adjust a wholesale rate, but rather reward a clean attribute, like other emissions credit schemes

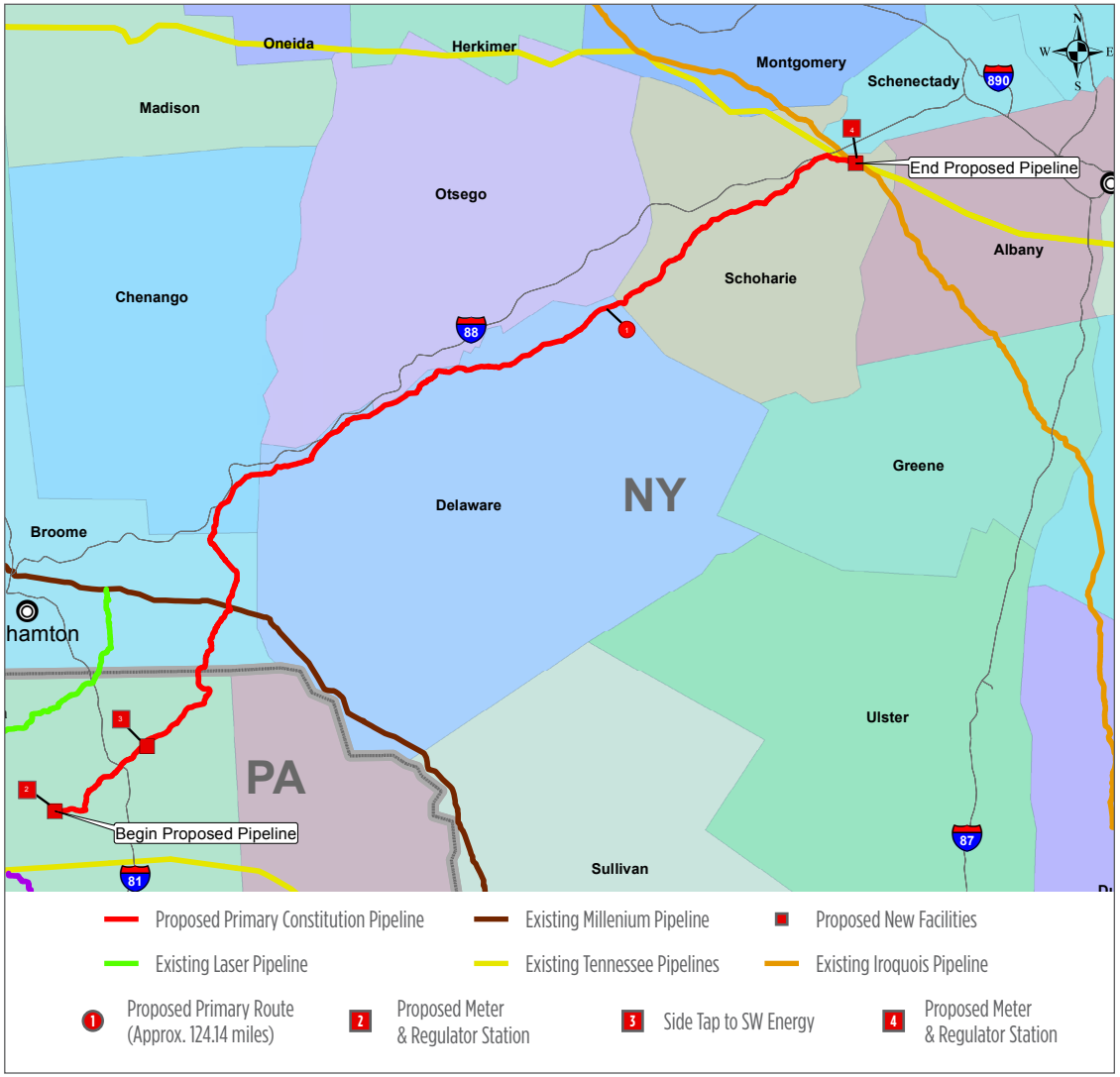
A Delicate, but Uncertain, Balance

- Recent Supreme Court decisions have been narrowly tailored to avoid categorically affording federal or state primacy, i.e., not rejecting "other measures states might employ to encourage development of new or clean generation" so long as it is "untethered" from wholesale market participation
- This also has the effect of making the so called "bright line" between state and federal jurisdiction hard to see. The uncertainty about whether a state policy or incentive crosses into FERC regulatory turf could lengthen lead time and increase risk and related costs for power resource investment
- The Energy & Commerce Subcommittee of the House Energy & Commerce Committee has begun hearings to examine the Federal Power Act in light of the evolution and jurisdictional conflicts in the organized wholesale electric markets

Gas Pipelines Feel the Friction, Too

- The Constitution pipeline is a proposed $683 million, 124-mile, 2 BCF/day pipeline linking shale gas resources in Pennsylvania to pipelines in New York
- FERC typically has plenary jurisdiction over interstate pipeline siting, permitting, and approval under the Natural Gas Act (NGA)
- States have some jurisdiction over environmental matters in collaboration with EPA, but typically approve permits for projects that have gone through the exhaustive FERC approval process, which includes an environmental impact statement
- In April 2016, two years after the pipeline's application, New York's Department of Environmental Conservation, under pressure from local and environmental groups, denied a Clean Water Act permit for the project, saying it failed to adequately address potential water impacts
- Three other New York pipeline projects are dealing with various permitting issues and delays in New York
- A federal appeals court hearing is docketed, with FERC and others weighing in, arguing the NGA is intended to balance local and national interests in energy infrastructure development
- Gas industry observers note that state-level challenges could discourage investment, delay pipeline development, and risk supply shortfalls and higher prices in pipeline-constrained areas like New England

Proposed Constitution Pipeline (as of July 2013)



Source: Constitution Pipeline

NOTES:
*For more discussion of this area, see discussion of nuclear power trends on page 38 of this report
SOURCES:
Industry news; SNL Financial; Van Ness Feldman; UBS Securities; U.S. House of Representatives (https://energycommerce.house.gov/hearings-and-votes/hearings/federal-power-act-historical-perspectives); ScottMadden analysis

“

The future ain’t
what it used to be.

”

YOGI
BERRA

INFRASTRUCTURE AND TECHNOLOGY

MICROGRIDS EXPAND: NEARLY 180 MICROGRIDS TODAY, ACCOUNTING FOR MORE THAN 1.9 GWS OF CAPACITY

The number and dispersion of microgrids is growing, combined heat and power dominates, but interest in solar grows.

Grid Transformation Is an Emerging Driver of Microgrid Activity

- After Superstorm Sandy, interest in microgrids grew, fed by resilience initiatives
- Now, interest in resilience coupled with lower solar installed costs, favorable SREC pricing, and grid transformation efforts aimed at "greening" the grid (such as New York's Reforming the Energy Vision) have led to an uptick in planned projects

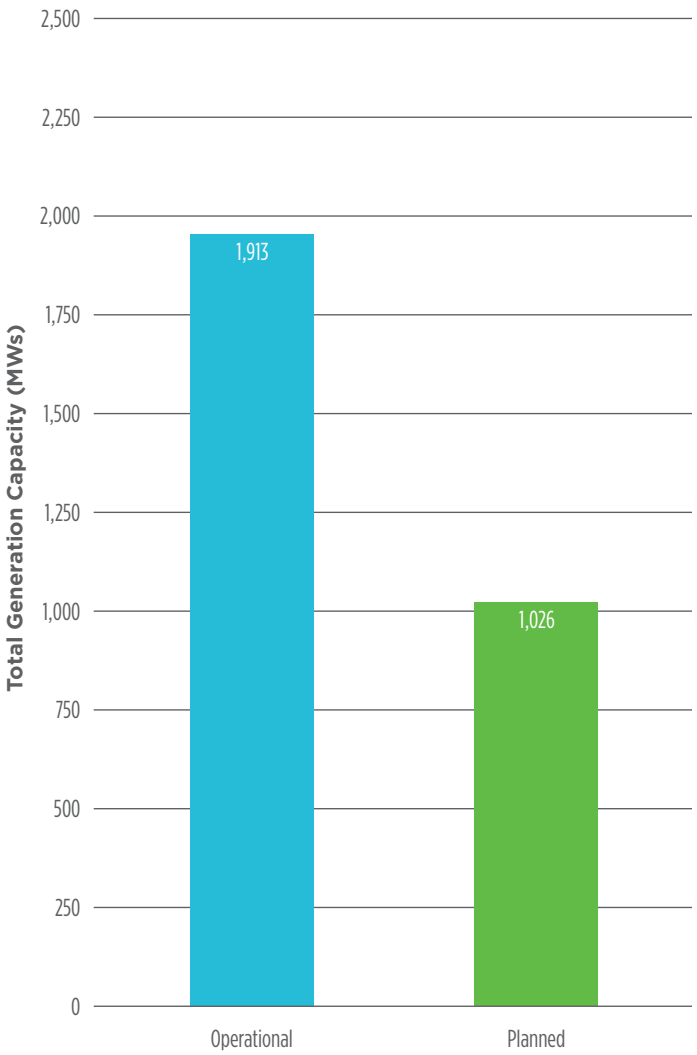
Traditional Applications and Technologies, However, Continue to Account for Most Installed Microgrids

- The MUSH sector—military, university, schools, and hospitals—and communities (largely remote*) continue to comprise the primary microgrid hosts, but there is also growth in non-remote* communities and data centers
- Data centers are an increasing source of microgrid growth, perhaps unsurprising because of their "always on" requirements
- And while solar- and battery-based microgrids are much discussed, natural gas-fired combined heat and power microgrids continue to dominate the market in terms of capacity
- However, we may be one "killer app" or disruptive technology away from more rapid microgrid penetration (e.g., "in-the-money" storage, an economic Stirling engine, etc.)

What Is a Microgrid?

> A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode.
>
> *–U.S. Dept. of Energy*

U.S. Installed Microgrid Capacity** (in MWs)

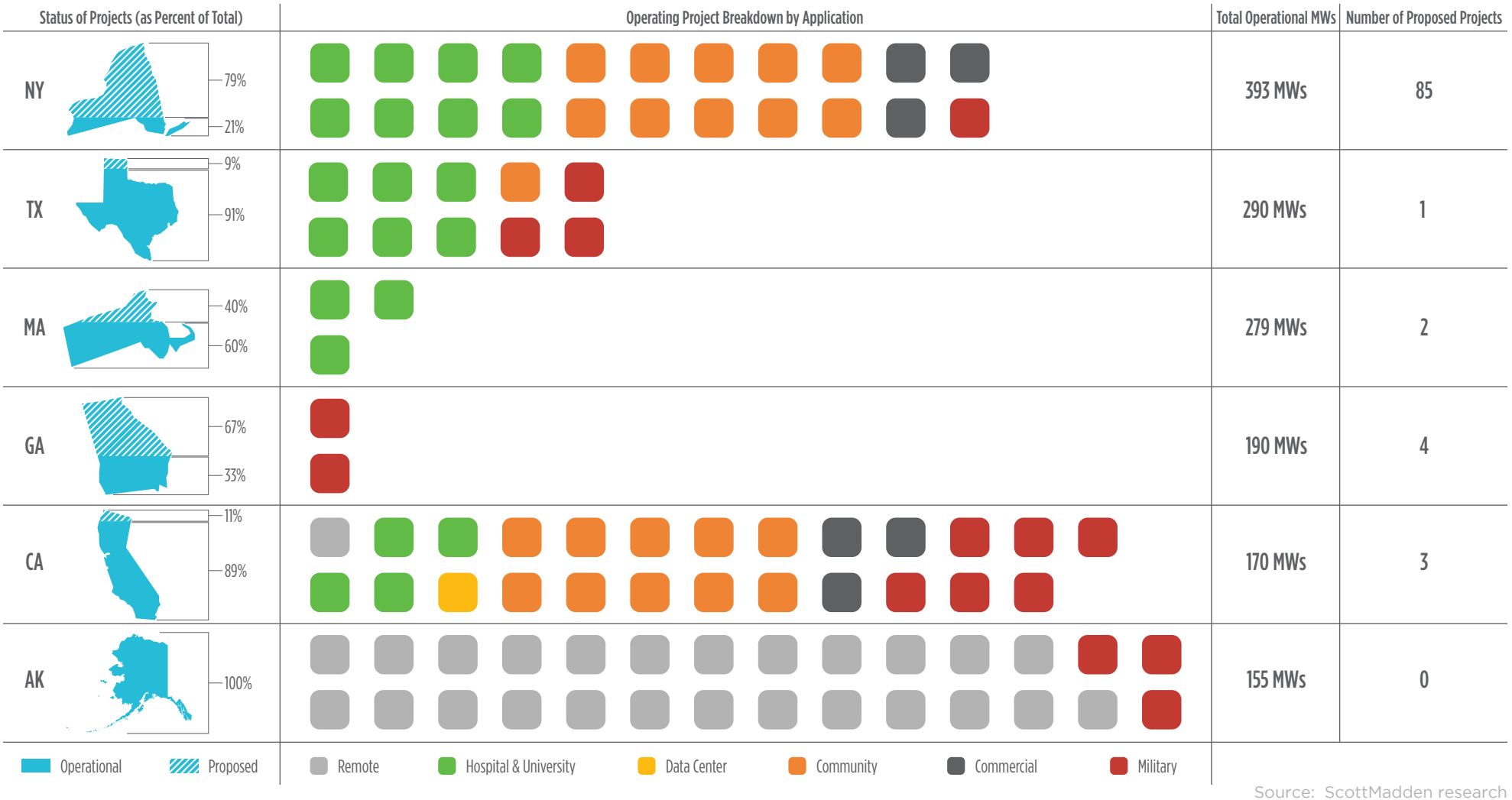


Source: ScottMadden analysis and research

A Few Big Projects Can Make a Difference in the Rankings

- Most microgrids, including proposed projects, continue to be relatively small (around 1 MW or less)
- Among proposed projects, there are a number of feasibility tests/pilot projects
- Current and proposed projects are concentrated in a few highly populated states and Alaska
- Note that a few large projects can vault a state into a leadership position. Some examples:
  - Colorado's 300-MW Niobrara Data Center Energy Park (under development)
  - In Georgia, Robins Air Force Base provides up to 160 MWs
  - In Massachusetts, the Medical Area Total Energy Plant provides up to 256 MWs for five Harvard University hospitals

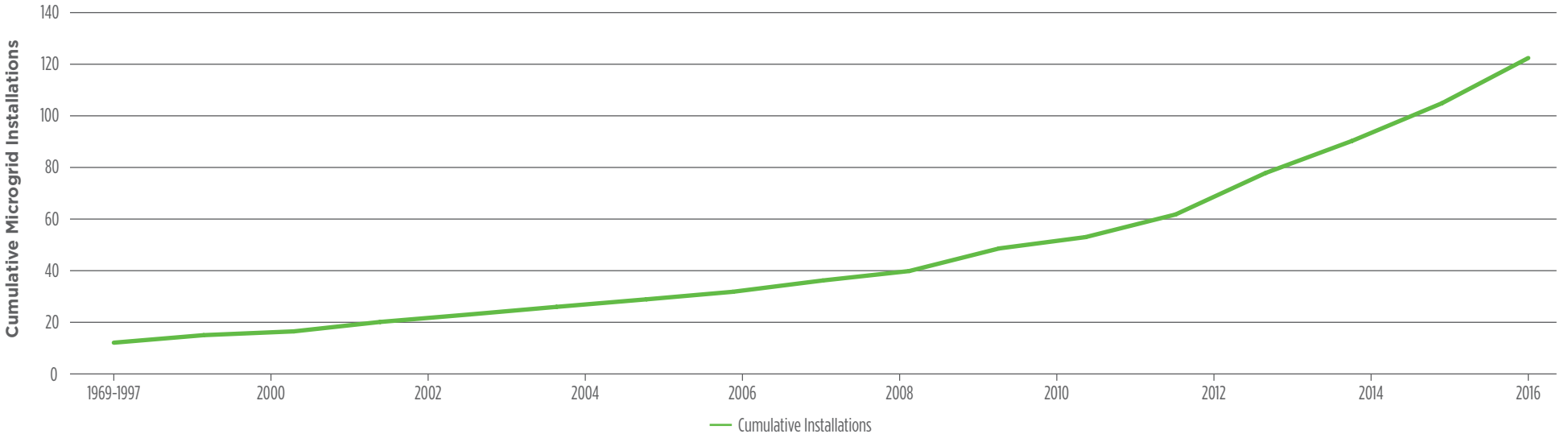
Selected States with Largest Operating Microgrid Capacity



Source: ScottMadden research

MICROGRIDS EXPAND

Annual U.S. Microgrid Installations Are Growing Steadily***



Source: ScottMadden analysis and research

Utility Strategies: Embracing a Distributed Future

- *Keeping in Front of the Meter:* Chicago's ComEd is seeking $250 million under proposed Illinois legislation (Next Generation Energy Plan) to fund five microgrid projects
  - The first project is under way with an assist from the Department of Energy: a 10-MW solar-storage system in Bronzeville, IL that could island and also join with a microgrid operated by Illinois Institute of Technology
  - ComEd's microgrids would not be behind the meter, but would require regulatory exceptions since the utility is currently barred from owning generation assets
- *Mind Your Military:* Georgia Power is leveraging its increasing involvement in solar power and military installations within its footprint to develop solar resources and microgrids on those bases
  - In June 2016, it opened a 30-MW solar facility at Fort Benning
  - And in early 2016, Southern Company (its parent) completed a $431 million acquisition of behind-the-meter generation and controls owner PowerSecure
- *3Ps:* Another emerging model is public-private partnerships involving mixed ownership of "public purpose" facilities—one example, an announced microgrid at the Port of Los Angeles
- *Rate Base Inclusion:* Inclusion of critical structure in rate base is an important consideration for utilities, for defense and for offense

NOTES:
SRECs are solar renewable energy credits. *Remote applications are for power provision in geographic regions not served by a traditional electricity grid (e.g., islands, remote locations); **Figures reflect available data as of July 2016. Operating microgrids are installed and operational and include demonstration projects. Proposed microgrids include those that have been proposed and/or feasibility study has begun, and the project may or may not yet be funded and those that have been announced as intended, but no specific development activity has begun. Not all projects in the dataset have published capacity figures. ***Chart reflects only those projects for which a start date was identified
SOURCES:
GTM/SEIA; NREL SAM; DOE; EIA; DSIRE; NV Energy; ScottMadden research

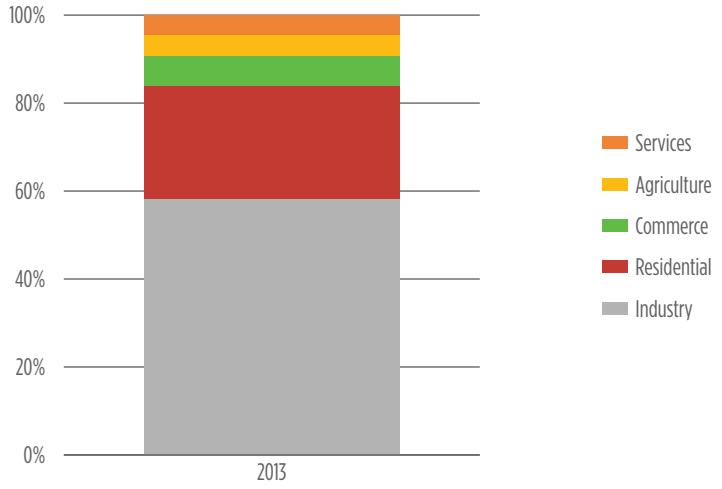
MEXICAN ENERGY REFORM:
SPURRING ENERGY INFRASTRUCTURE GROWTH

The Mexican government seeks to improve energy sector performance by attracting private sector capital, ownership, and operators.

Getting More out of Mexico's Energy Sector

- Mexico enacted reform of its petroleum, natural gas, and electricity sectors in 2013 under President Peña Nieto
- Mexican GDP has been growing at about 4% annually, with energy projected to grow 3% to 4% annually over the next 15 years
- Industrial customers are the biggest consumers of electricity in Mexico—nearly 60% of retail sales (see Fig. 1)
- However, the Mexican energy sector has been fraught with inefficiency—historically, industrial electricity costs have been more than 70% higher than in the United States; T&D energy losses in 2014 were about 14%; and hydrocarbon production was declining
- Moreover, the government wants to attract new infrastructure investment, increased renewable installations, technology, and know-how without relying exclusively upon government investment

Figure 1: Mexico Electric Consumption by Sector (2013) (% of Total)



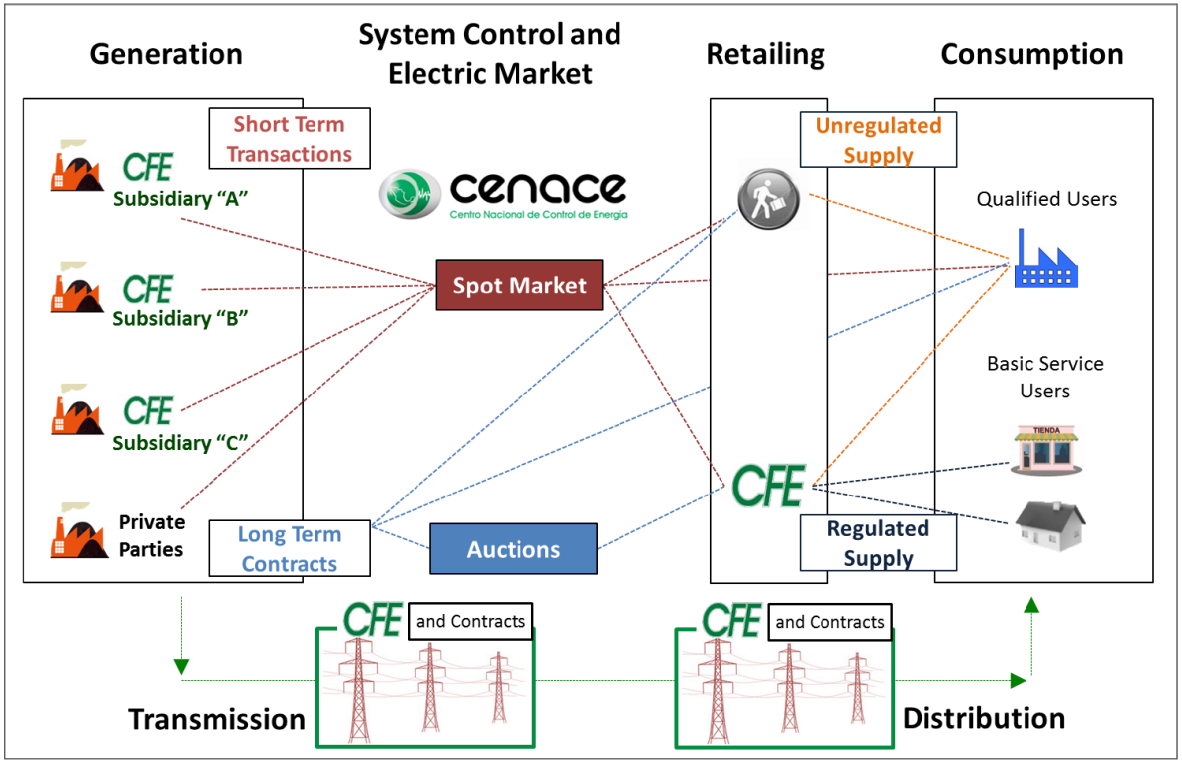
Source: World Economic Forum

Key Issues with Mexican Energy Reform	
Lingering Giants	Will state-owned companies have a continued, outsized influence both on supply and demand with implications for true competition, transparency, and access by new entrants?
Shale Development	How long before increased Mexican gas production will reduce gas pipeline imports from the United States?
Funds Available	Can Mexico attract the amount of capital needed for planned reform and buildout?
Sufficient Cheap Clean Power	Will planned clean power development be enough, and cheap enough, to meet growing power needs, especially for the industrial sector?

Electric Market Opens with Estimated Need for 60 GWs of New Generation

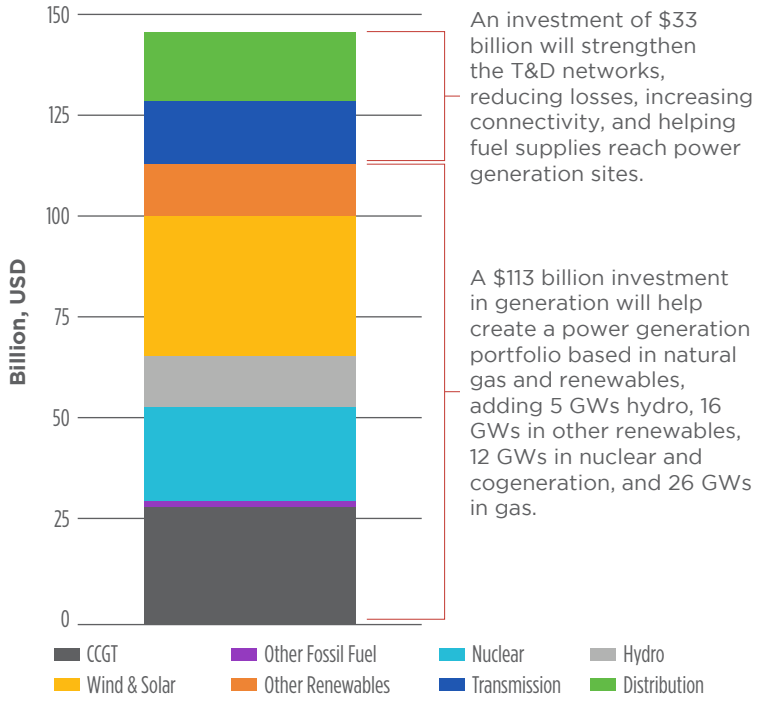
- Mexico's electric power sector has traditionally been dominated by the vertically integrated monopoly state utility, CFE
- Under reform, an Order 888-style restructuring will form an independent wholesale grid operator (CENACE) that will assume control of the transmission system and manage both system operations and a spot energy market (see Fig. 2)
- Reform is expected to help Mexico add an estimated 60 GWs of new generation (at an estimated $90 to $113 billion) by 2029, much of which is expected to be gas fired and more efficient than the current mix of old gas and oil units (see Fig. 3)
- This expansion will also include 32.5 GWs of clean generation (renewables and nuclear), consistent with the ambitious national goal of 50% clean energy by 2050. The majority of new capacity from the two CENACE-run auctions to date has been awarded to solar (at low prices)
- Mexico also targets grid investment of $26 to $33 billion by 2029 for 25,000 kilometers of transmission lines, increasing integration with the United States and Central America and improving internal power movement

Figure 2: Structure for Mexico's New Power Market



Source: SENER

Figure 3: Mexico Plans to Invest up to $146 Billion in Its Electric System through 2029 (Planned Investment 2015–2029)

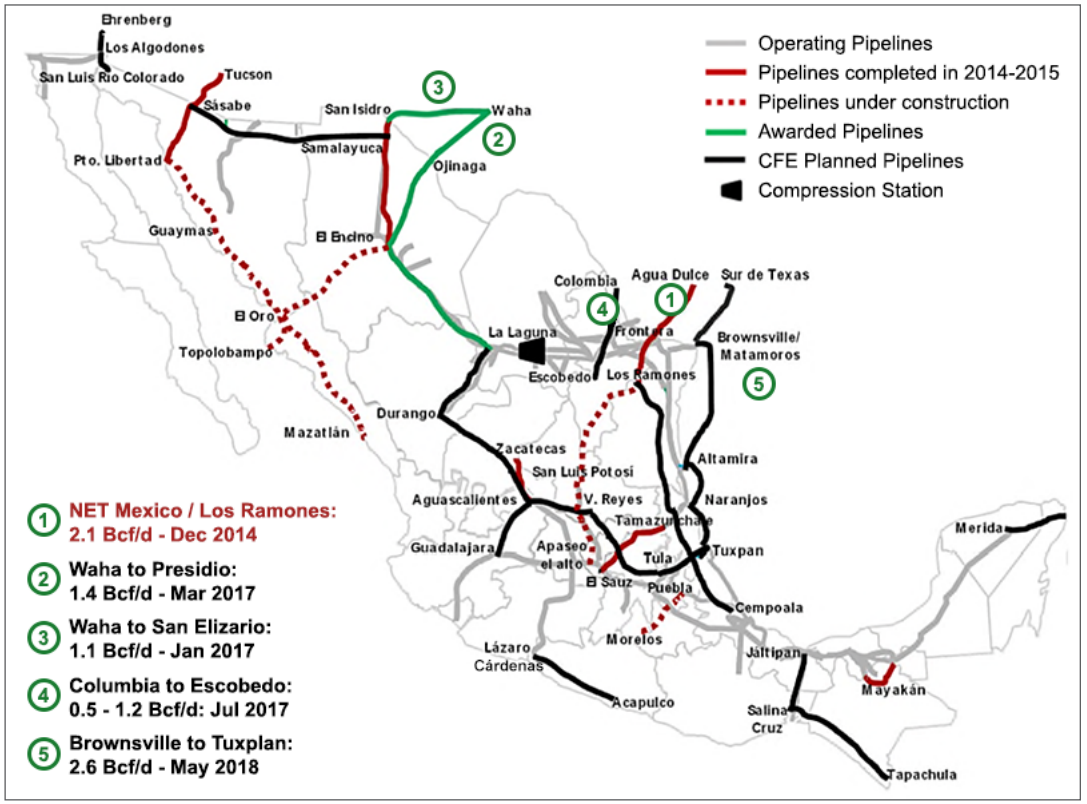


Source: World Economic Forum

Natural Gas Infrastructure: Pending Reform, Increasing U.S. Imports Keep Coming

- Mexico natural gas market reform is under way as well, "de-integrating" Pemex from the value chain. Pipeline owner and operator CENAGAS is making capacity available on an open-access basis via competitive bids and developing a vigorous secondary market—with the goal of divesting the majority of non-Pemex demand to third-party gas marketers
- As with electric transmission, Mexico wants to expand cross-border pipeline infrastructure along the western half of Mexico and some east-west linkages (see Fig. 4)
- Longer term, Mexico hopes to develop its own shale gas, estimated at 545 TCF of technically recoverable resources
- In the interim, Mexico's increasing needs for natural gas—principally to fuel expected new (12 GWs) and repowered (1.6 GWs) gas-fired power generation and encourage new industrial development—are increasingly being met with U.S. imports
    - › Pipeline exports from the United States to Mexico grew 45% to about 2.9 BCF/day in 2015; interim reports suggest that growth has continued apace into 2016
    - › Wood Mackenzie estimates that with 6 BCF/day for power generation and 1 BCF/day industrial growth through 2025, the gas market could grow to 9 BCF/day or more
- To meet demand and provide flexibility, U.S.-to-Mexico pipeline capacity is projected to grow to around 14.7 BCF/day

Figure 4: Mexican Pipeline Infrastructure Buildout



Sources: BP; SENER; EIA

SOURCES:
World Economic Forum; Wilson Center; Mexico Ministry of Energy (SENER); EIA; Platts; Natural Gas Intelligence; industry news; Wood Mackenzie; BP; ScottMadden analysis

“It was hard to have a conversation with anyone, there were too many people talking.”

YOGI BERRA

CLEAN TECH AND ENVIRONMENT

THE 51ST STATE: DEVELOPING A PRACTICAL ROAD MAP FOR DISTRIBUTED ENERGY RESOURCES

Industry provides Smart Electric Power Alliance (SEPA) insight.

SEPA's "Homework Assignment": Define a Path to a DER Future

- SEPA launched the 51st State Initiative with two primary objectives:
  - Create equitable business models and integrated grid structures to ensure that electricity is provided safely, reliably, efficiently, affordably, and cleanly
  - Meet customer demand in the near and long term for solar and other distributed energy resource (DER) assets
- In Phase II of the initiative, SEPA sought road maps from industry stakeholders detailing the steps required to transition to high DER penetrations and ensure success for all stakeholders
- To encourage thought leadership, the road maps were to be set in a hypothetical "51st state"
- ScottMadden was one of 14 industry stakeholders to submit a "51st state road map"

Illustrative Scenario: Wires-Only Investor-Owned Utility Transitions to Hypothetical "51st State"*

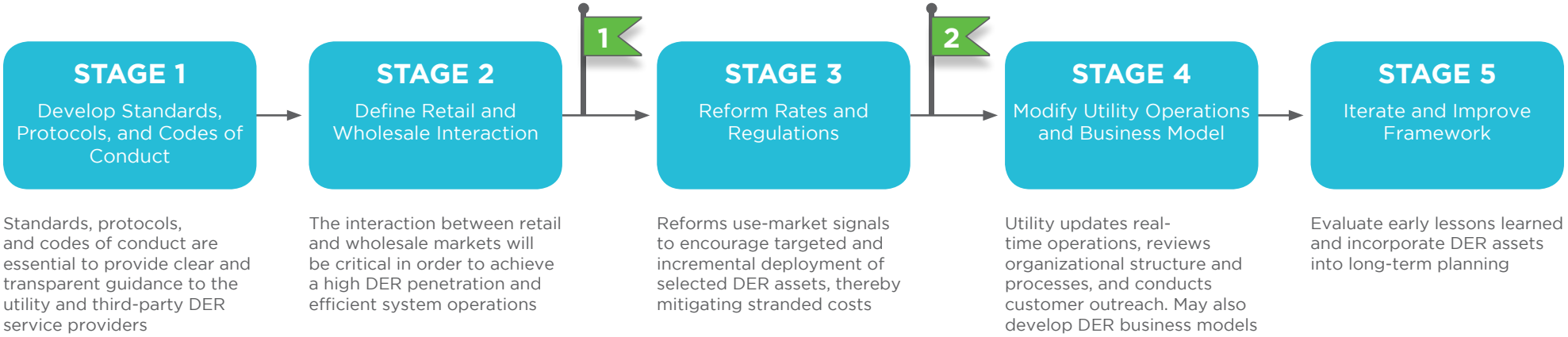
Current State	Future State

• Utility serves urban and rural customers in deregulated market; may not own generation assets
• RTO/ISO manages wholesale market
• Retail net metering produces small but growing base of distributed solar PV
• No other renewable policy support
	• Net metering replaced with rate rider providing payment/charge to customers with DER assets
	• Rate rider commensurate with value provided to electric system:
	  › Based on time and location of individual installation
	  › May change over time
	  › Utility may own DER assets

Our Key Finding: Leverage the Natural Advantage of Utilities

- Some stakeholders believe that the electric utility is the primary barrier to widespread deployment of DER assets
- However, ScottMadden has found that high DER penetrations can be achieved without necessarily creating a radically different regulatory and business construct for the electric industry
- Instead, the natural advantages of the electric utility can be leveraged to accelerate DER deployment and penetration
- Notably natural advantages of the utility include:
  - **Customer Relationship:** The utility is well positioned to introduce and educate customers about DER technologies and options
  - **System Management:** The utility has long managed the dynamic electric system and is best positioned to continue to serve in this role
  - **Reliability and Security:** As the composition of the grid changes, the utility will need to continue to meet reliability and security standards
  - **Transaction Costs:** The utility is in the best position to "balance" transaction costs during operations and avoid costly administrative overlays

High-Level Framework for the Path to a Hypothetical "51st State"



But Where to Begin? Build a Platform with "No Regrets" Actions

- Electric utilities may consider how to build a robust and flexible platform capable of supporting high DER penetrations. Immediate "no regrets" options to consider include:
  - **Data Infrastructure:** Develop IT processes and infrastructure to allow the real-time exchange of large volumes of data generated from DER assets
  - **Regulatory Strategy:** Develop a regulatory model and strategy to shape DER growth on the electric grid, evolving the current model which is focused on long-range planning of larger resources
  - **Real-Time Operations:** Refine real-time operations to provide more granular insight into grid operations (e.g., expanded grid visualization or distribution automation tools)
  - **Distribution Planning:** Develop processes and methodologies that integrate DER into long-term distribution planning

NOTES:
*Table reflects the current and future state examined by ScottMadden in its Phase II road map submission
SOURCES:
SEPA; ScottMadden analysis. For further information, see ScottMadden's white paper, "The 51st State Initiative" (Apr. 2016), available at http://www.scottmadden.com/insight/the-51st-state-initiative/

CLEAN POWER PLAN:
LANDMARK EPA CLIMATE RULE GETS ITS DAY IN COURT

Debate over the EPA's Clean Power Plan comes to a head in federal appeals court.

Who Will Ultimately Determine the Fate of the Clean Power Plan?

- The D.C. federal appeals court is the next stop for the myriad lawsuits (now consolidated) which have been filed against the CPP by a host of different groups; some filed before the rule was finalized
- The court made a surprise decision in May to bypass normal review by a three-judge panel in favor of en banc consideration: all 10 judges* on the circuit will hear the case, presumably to provide a more definitive decision
- Regardless of the D.C. Circuit's decision, parties are expected to petition the Supreme Court to take up the case; it is unclear whether or not it will agree to hear an appeal
- If the currently vacant seat on the Supreme Court is not filled but the Court hears an appeal of the CPP, there remains the possibility for a 4-4 split decision, which would uphold the D.C. Circuit's decision

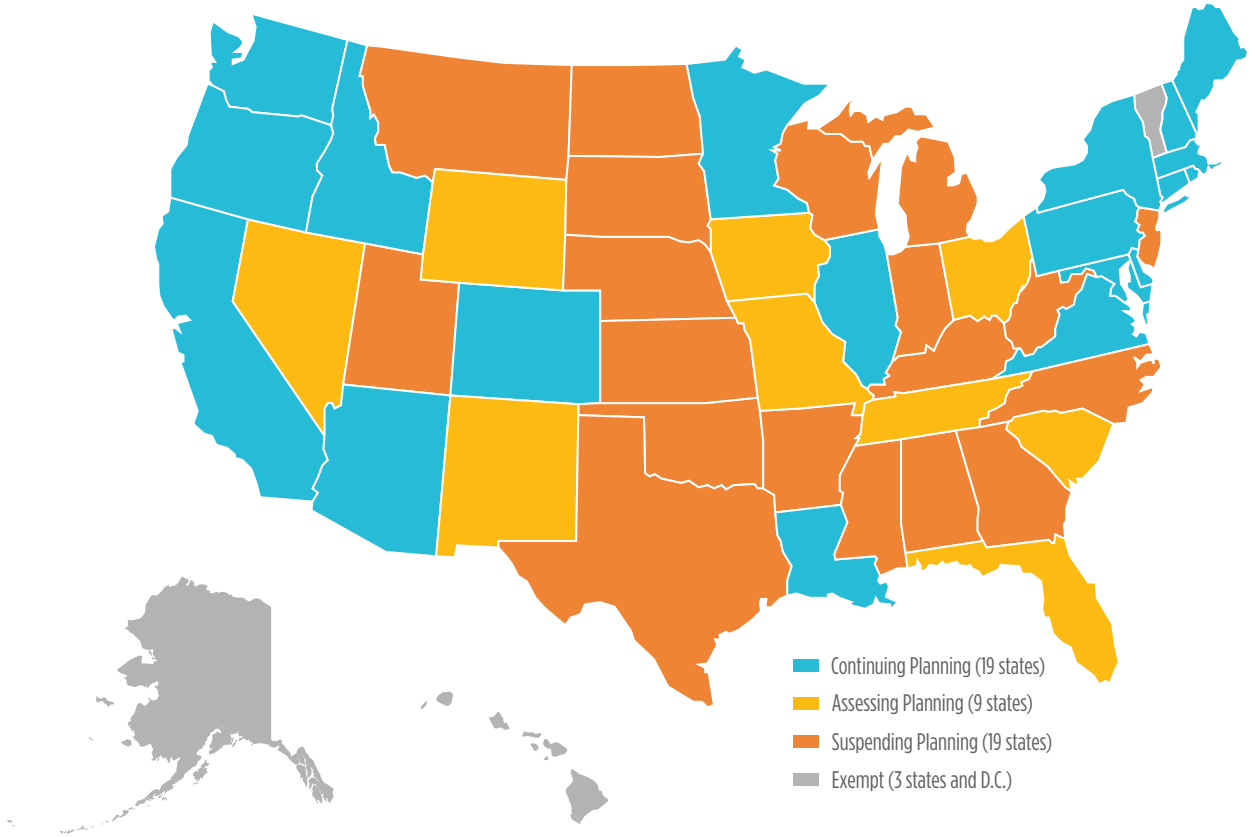
Figure 1

Key Issues Being Argued before the D.C. Circuit Court of Appeals	
Statutory Issues	• Whether "generation shifting" (from coal to lower emitting sources) is so "transformative" that the CPP requires clear indication of approval from Congress and that EPA does not benefit from usual judicial deference to administrative rulemaking • Whether EPA's "best system of emission reduction"—mandated by the CPP—impermissibly goes "outside the fence" in regulating other than pollution sources
Clean Air Act Interpretation Issues	• Whether the EPA developed unlawfully duplicative rules for coal-fired power plants by issuing the CPP pursuant to CAA §111(d) (existing source standards) as they are already subject to toxic air pollutant standards under CAA §112
Constitutional Issues	• Whether the CPP violates principles of federalism (reserving power to the states not delegated to the U.S. government) by meddling with state authority to regulate in-state energy resources
Notice Issues	• Whether the final CPP differs so dramatically from the proposed rule as to require a new notice and opportunity to comment federal administrative law
Regulatory Record Issues	• Whether the goals mandated in the final CPP, which were quite different from those in the draft rule, are achievable and whether they will create potential electric reliability problems

The Stage Is Set: EPA CPP Allies and Opponents and Key Arguments

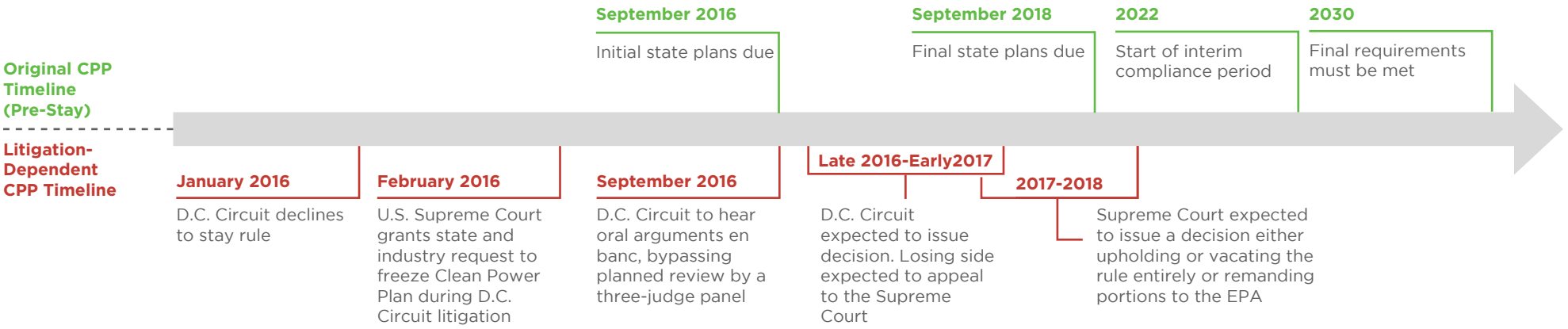
- With battle lines firmly established through years of debate, familiar foes take sides—with no shortage of contrasts among states, industry groups, environmentalists, labor groups, and plenty of attorneys—on the most significant federal action ever taken to address climate change
  - Proponents:
    - 18 states
    - Cities, counties, and mayors
    - Various industry groups, including some utilities
    - Public health groups
    - Environmental organizations
  - Opponents:
    - 28 states
    - Many power generators, utilities, public power, and electric cooperatives
    - Some members of Congress
    - Labor unions
    - Coal and mining industries
- The starting bell has rung: On September 27, in an overflowing courtroom, the D.C. Circuit heard nearly seven hours of oral argument (twice the time budgeted) that focused on a few key issues (see Fig. 1)
- The longest argued questions related to statutory authority: the limits of EPA authority and its ability to regulate outside the fence line

Figure 2: State Clean Power Plan Compliance Planning Activities since the Supreme Court Stay of the Rule



Source: E&E News

Figure 3: Clean Power Plan Actual and Projected Timeline since the Supreme Court Stay of the Rule



Source: E&E News

With Ultimate Resolution Still Years Away, Industry Moves forward with Some "Uncertainty Fatigue"

- CPP remains frozen, and state compliance plans (and deadlines) remain in flux, as the range of state responses for planning has been largely unchanged since the stay was issued (see Figs. 2 and 3)
- If the Supreme Court takes up the case on appeal, a final decision may not be handed down before 2018, dangerously close to a deadline for final state implementation plans (absent tolling of the compliance deadline) of September 2018
- In the meantime, the electric utility industry is forced to address many open questions in lieu of final resolution of the CPP
  - Viability of existing generation assets and priorities for future utility investment
  - Potential impacts on the electric system and wholesale energy markets
  - The future of regional trading schemes and allowance prices
  - Components of a "no regrets" balance of supply and demand resources that is CPP compliant and potential cost implications (if the rule is upheld)

> When an agency claims to discover in a long extant statute an unheralded power to regulate 'a significant portion' of the American economy, we typically greet its announcement with a measure of skepticism. We expect Congress to speak clearly if it wishes to assign to an agency decisions of vast economic and political significance.
>
> *–Justice Antonin Scalia, Utility Air Regulatory Group v. EPA (2013)*

NOTES:
CPP means Clean Power Plan; CAA means Clean Air Act. *Excluding Supreme Court nominee Merrick Garland who has recused himself from the case, leaving the court with an even number of judges, and the (unlikely) possibility of a split decision in the D.C. Circuit Court
SOURCES:
Industry news; SNL Financial; Dentons; Inside EPA; E&E Publishing; ScottMadden analysis

If the world were perfect,
it wouldn't be.

YOGI
BERRA

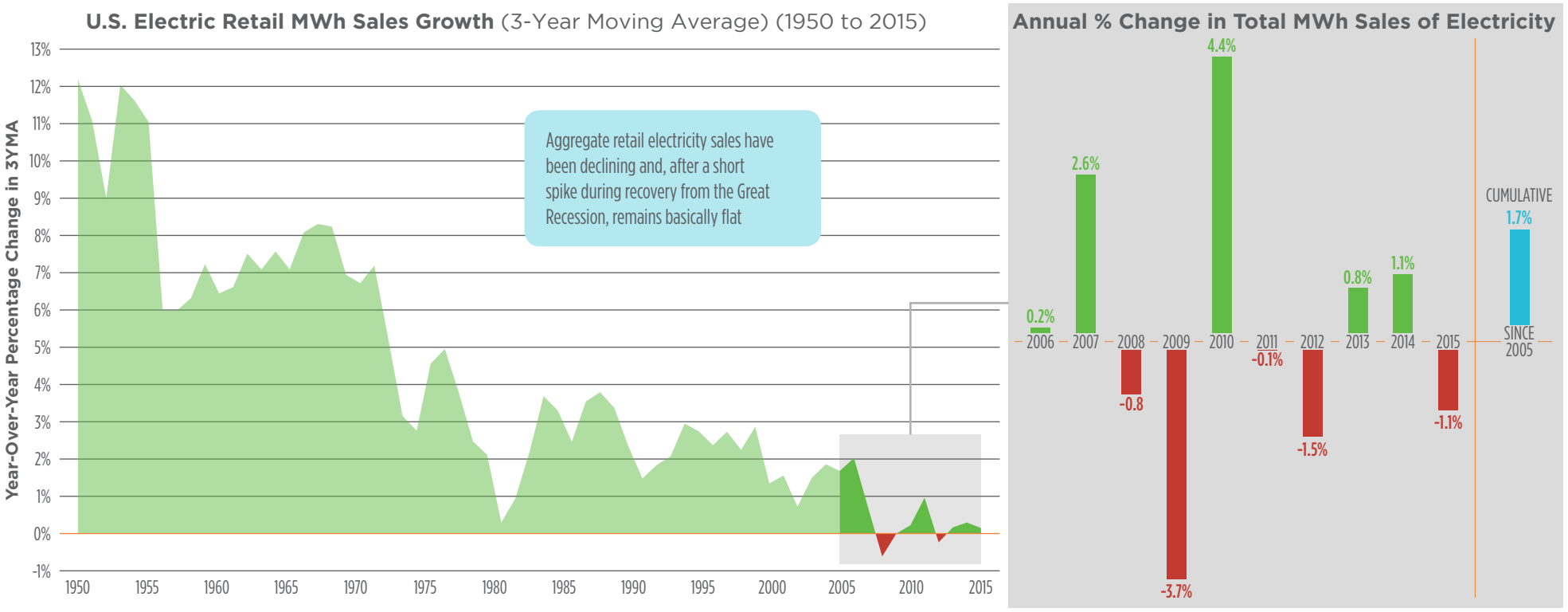
DECLINING ELECTRIC DEMAND:
NUANCES TO THE NOT-SO-SIMPLE STORY

Analyzing the well-publicized trend reveals interesting variations and linkages.

Reading the Headlines: Where'd the Load Growth Go?

- Retail sales of electricity have declined five out of the past eight years, with MWh sales increasing only 1.7% cumulatively since 2005
- Industry consensus views recent performance as the continuation of a historical downward trend in demand growth (see Fig. 1). However, opinions differ on the primary causes of decline and whether the decline will continue
- Many observers suggest some combination of macro phenomena, including de-industrialization, slowing population and GDP growth, and large-scale energy efficiency improvements
- Much has been attributed to lower energy intensity, but that measure contains many potential drivers and attributing causation has challenged analysts
- Revenues per MWh, however, have continued to grow, even as volumetric sales growth has been slowing

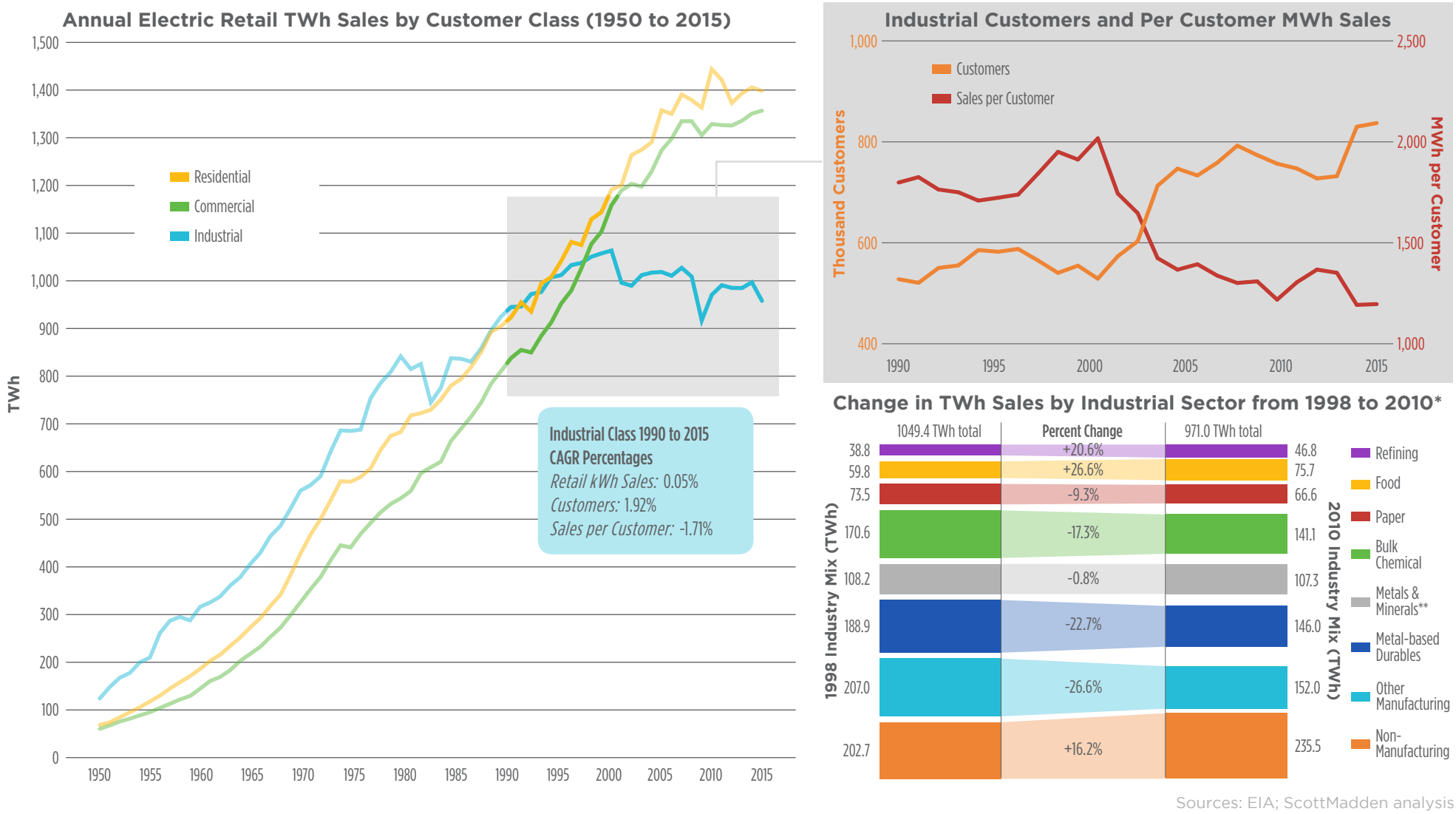
Figure 1



Source: EIA

U.S. industrial electricity consumption, both aggregate and per customer, has been trending downward for a number of years as usage shifts between sectors.

Figure 2



Sources: EIA; ScottMadden analysis

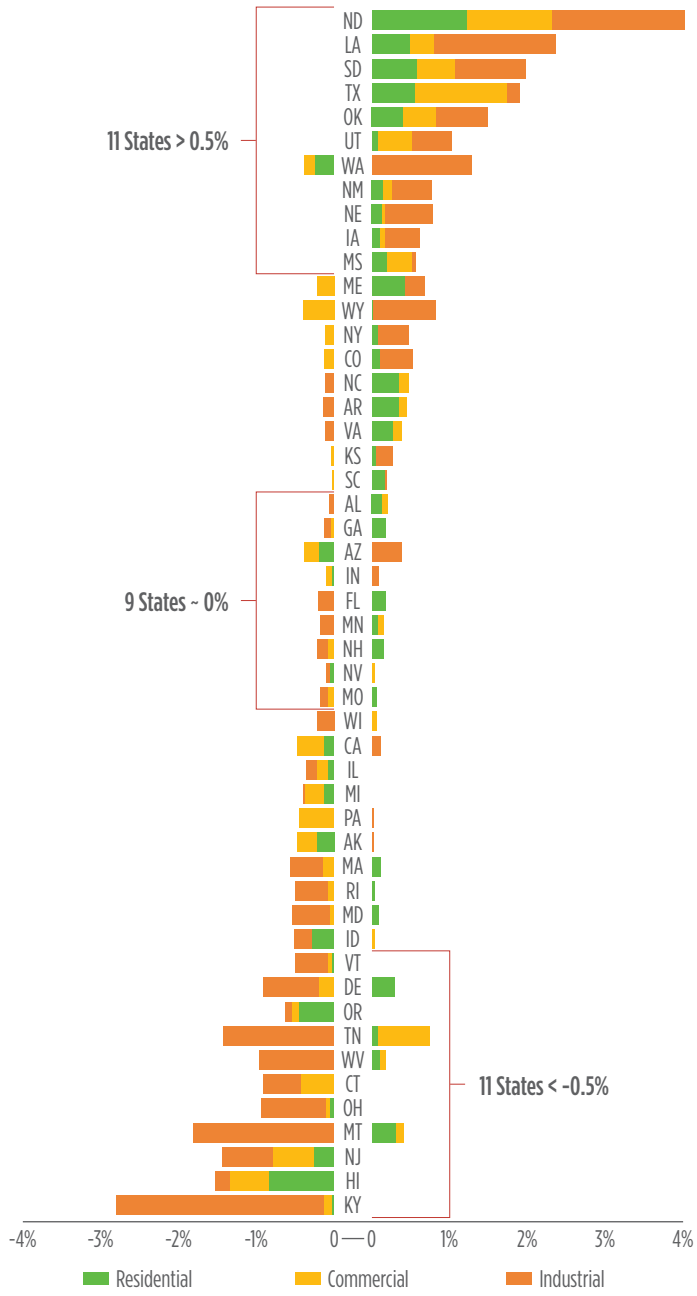
Identifying the Culprit: Industrial Did It

- Decomposing the trend into customer classes exposes their relative contributions and declining industrial retail sales is the drag on aggregate growth (see Fig. 2)
- While industrial "did it," the reason is not de-industrialization—or declining numbers of industrial customers; in fact, industrial customer count has grown
- Instead, a shift is occurring and the industrial mix has changed: highly energy-intensive industries, such as bulk chemicals and mining, are giving way to an increasing number of more-efficient industries such as high-tech manufacturing
- Refining is among the only energy-intensive industries to have grown significantly since 2008, almost entirely due to the shale revolution
- Although industrial did it, both residential and commercial are accomplices – retail sales for both classes have experienced limited to no growth since the Great Recession in 2008
    - › The confluence of slowing population growth and increased efficiency gains from buildings codes, appliance standards, LED lighting, and utility programs has recently flattened residential demand
    - › Commercial demand, on the other hand, has begun to recover from the effects of the recession as a result of stabilizing customer growth and continued construction of more energy-intensive public facilities, data centers, hospitals, and food sales sites

Growth Sightings: All Regions are Not Created Equal

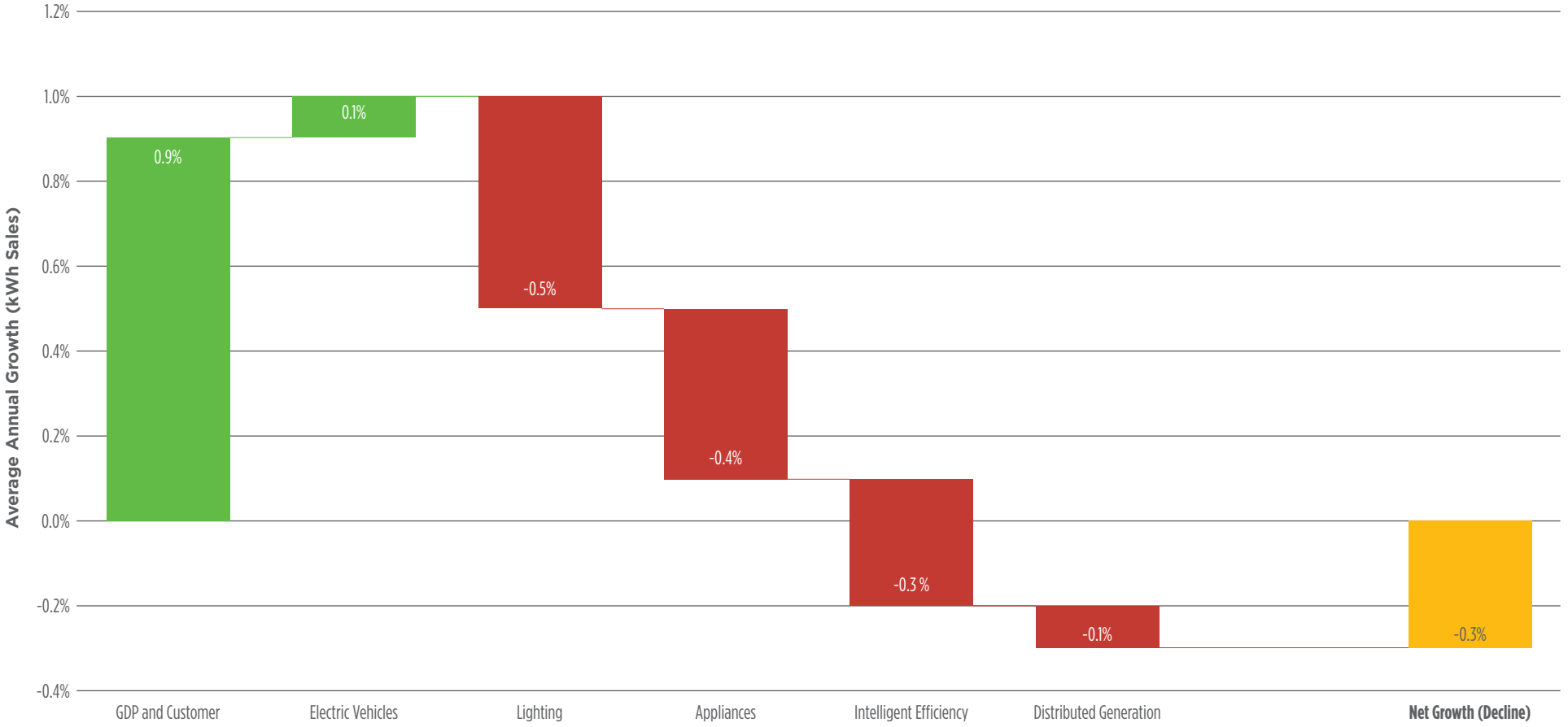
- There is considerable dispersion in growth rates, state by state
    - › Regions with significant oil and gas resources (e.g., around Texas and Oklahoma and North Dakota and nearby states) have averaged greater than 0.5% annual sales growth since 2008 (see Fig. 3)
    - › The only states outside these regions to have experienced similar growth were Utah and New Mexico (oil and gas) and Washington and Mississippi (oil refining)
    - › On the other hand, states that relied on mining, metals-based durables, etc., show precipitous declines
    - › Thirty-six states averaged either negative or no annual sales growth since 2008
- While the remaining regions have experienced varied population and commercial customer growth, thus affecting their residential and commercial sales, an interesting observation is that the underperforming regions house industries most affected by lower consumer expenditures or offshoring (e.g., apparel and furniture, low-tech manufacturing, and plastics)

Figure 3: Weighted Electric Retail Sales CAGR (2008 to 2014)



Source: EIA

Figure 4: Estimated Average Annual Electricity Demand Impact of Various Factors (2015-2025)



Source: Morgan Stanley Research

A "New Normal" for Electricity?

- Effects of the Great Recession have made analysis of this period challenging, making it uncertain whether flat-lining commodity sales constitute a "new normal" for the industry
- Electricity consumption for space heating and lighting continues to decline, even as home sizes increase, and one analyst sees continued negative growth that may not be priced into electric utility stock prices (see Fig. 4)
- Utilities, for their part, may seek to offset potential revenue through full or partial decoupling, investing in energy efficiency, smart appliances, energy services, and other revenue-generating businesses that can monetize this trend

NOTES:
*Figures reflect available respective 1998 and 2010 EIA Manufacturing Energy Consumption Survey data and EIA estimates; **Metals & Minerals includes glass, cement, iron and steel, and aluminum
SOURCES:
EIA; ACEEE; Federal Reserve; Morgan Stanley; ScottMadden analysis

REVISITING THE "DUCK CURVE": WHEN IS A DUCK NOT A DUCK?

A closer look at the "duck curve" reveals a surprising cause.

Duck Curve 101: Tried and True or Urban Myth?

- The California Independent System Operator (CAISO) coined the term "duck curve" to refer to its system's load net of variable generation resources (i.e., wind and solar)
- Originally the curve was a forecast, showing the expectation of increased risk of over generation, stress from rapid ramping, and the need for system flexibility
- While some may have interpreted the curve as being driven by variable distributed resources (especially rooftop solar), the belly of the duck is primarily the effect of penetration of utility-scale solar
- Recently, the CAISO noted that the belly of the duck is getting deeper, more quickly than originally projected

What We Confirmed: If It Walks Like a Duck…

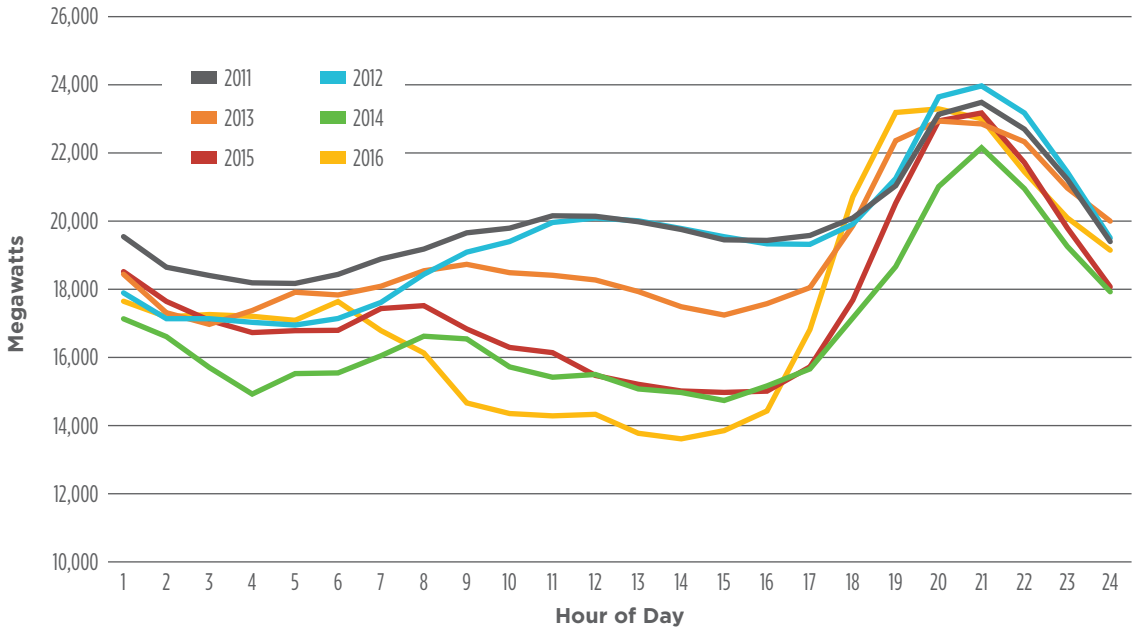
- We examined actual average hourly production data from CAISO for the past 5.5 years and confirmed that there is a duck-curve effect and it is indeed getting more pronounced (see Fig. 1)
- Daytime minimum net load (i.e., the belly of the duck) has declined 23%, from an annual low of 18,531 MWs in 2011 to 14,355 MWs in 2015
- Similarly, the annual maximum three-hour ramp (i.e., the neck of the duck) has increased 62%, jumping from 6,245 MWs in 2011 to 10,091 MWs in 2015
- Interestingly, however, while it is often depicted as a typical March day, the effects can be seen in many months throughout the year

Defining "Duck Curve" Terminology

The key to understanding the duck curve is the distribution among total load, system load, and net load

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

Figure 1: Lowest March Daytime Net Load (2011-2016)

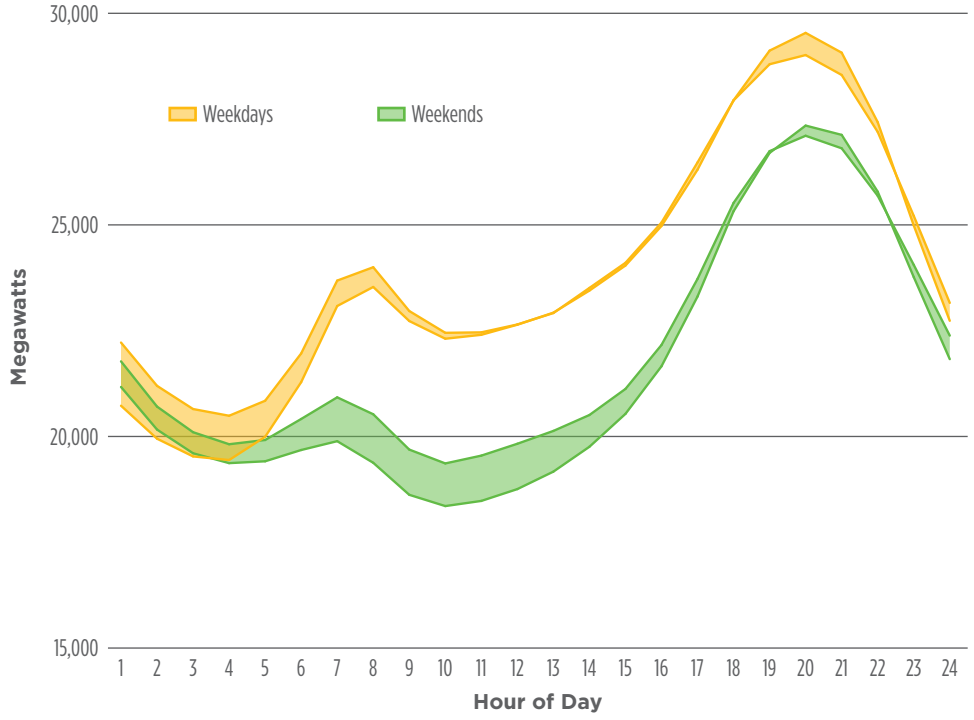


Source: CAISO, ScottMadden analysis

Yes, But It Depends...: Ducks Come in Many Breeds

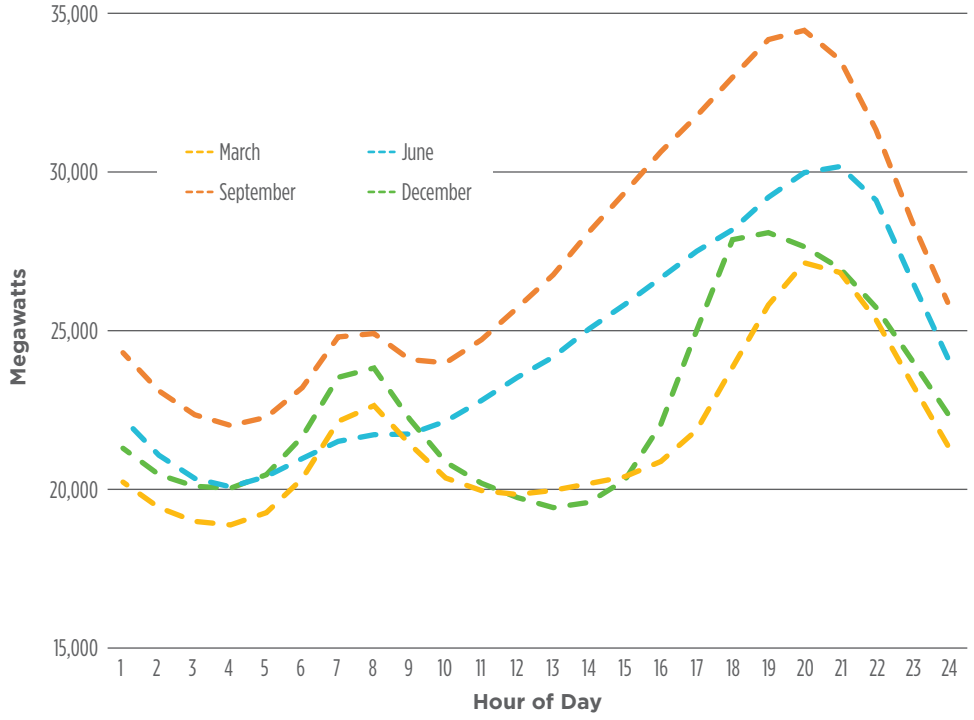
- Duck curve effects depend upon day of the week (see Fig. 2)
  - Weekends have steeper ramp-ups, presumably due to lighter mid-afternoon load weekdays
  - In 2015, the average three-hour weekend ramp was 10% steeper than the average three-hour weekday ramp
- Seasonality plays a part in the duck curve's shape (see Fig. 3)
  - While a "typical spring day" is often shown for this effect, spring does not necessarily have the most aggressive ramping effects of the duck curve
  - In 2015, the average three-hour ramp in December was 44% larger than the average three-hour ramp in March
  - Currently, the duck curve effect is not pervasive in summer months, due to higher system loads
- The type of intermittent resources on the system matters
  - As California's aggressive renewable portfolio standard continues to drive variable generation resource installations, utility-scale solar is having an increasingly greater effect on net load
  - No appreciable effect of distributed, behind-the-meter solar resources is detected in the data...yet: system load continues to remain fairly consistent with historical patterns (see Fig. 4)
  - Wind, while a significant resource, is not a primary cause of the duck curve effect

Figure 2: Average Net Load by Day of the Week (2015)



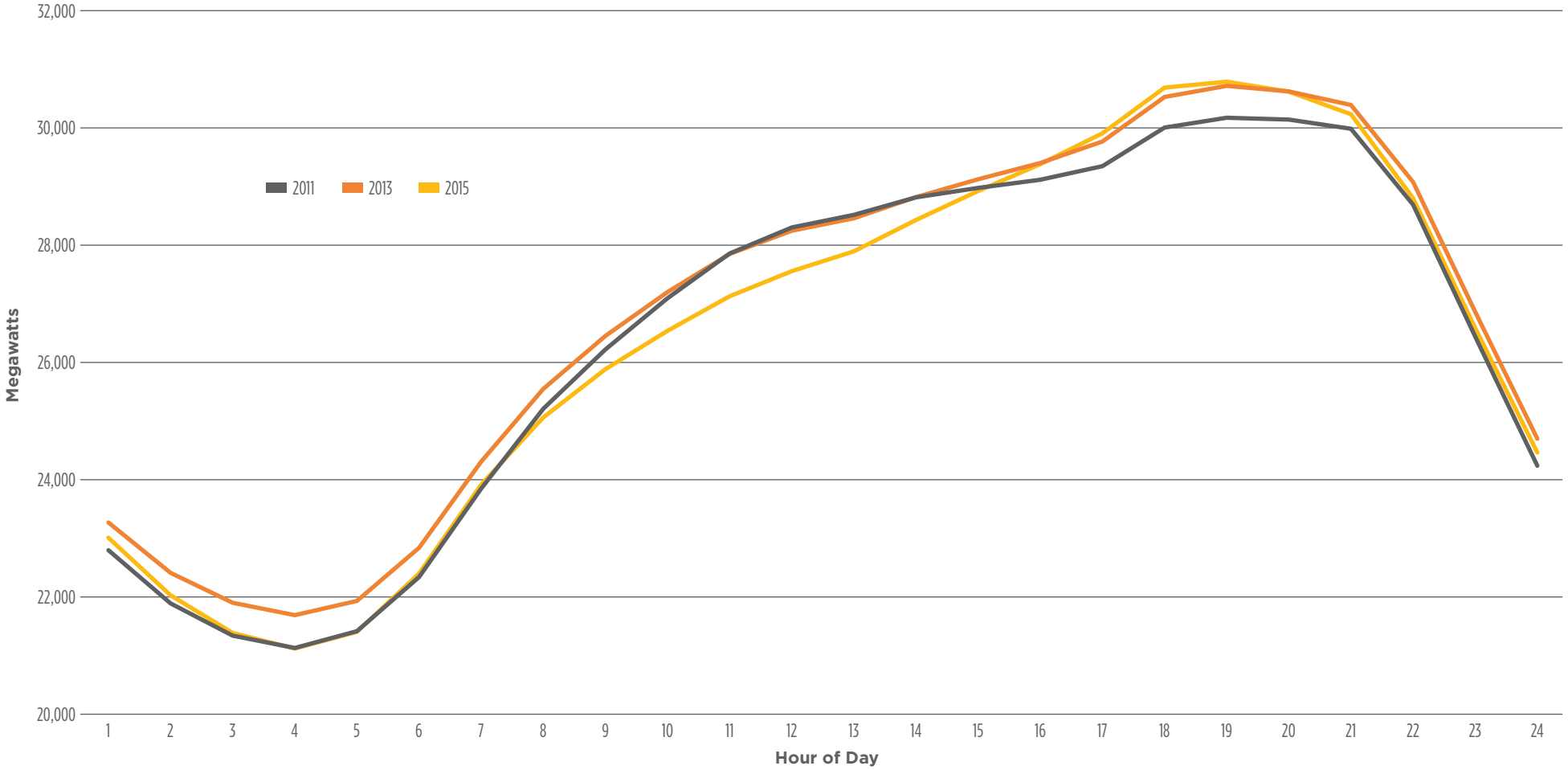
Source: CAISO, ScottMadden analysis

Figure 3: Average Net Load by Select Months (2015)



Source: CAISO, ScottMadden analysis

Figure 4: California Average System Load (2011-2015)



Source: SNL Financial, ScottMadden analysis

Implications: Different Strategies for Duck Hunting

- As utility-scale solar resources are key causes of system operations challenges of the duck curve, approaches to managing these challenges are perhaps more easily controllable than if distributed energy resources were the cause
- By implication, utilities without significant rooftop solar or net metering could still eventually see duck curve effects where utility-scale solar is growing rapidly. For example, North Carolina is already expecting solar to inject energy significantly in excess of system needs by 2020
- Scale and cost of incentives and investments to mitigate or meet steep ramping effects may differ depending upon whether ramping is limited to certain seasons or particular days of the week or if it is more pervasive

SOURCES:
CAISO; FERC, EIA; SNL Financial; industry news; ScottMadden analysis

NUCLEAR POWER: HOW DO YOU REDUCE EMISSIONS WITH THE LARGEST ZERO EMISSIONS SOURCE AT RISK?

Gas and, increasingly, renewable generation pressure nuclear. But could clean energy credits be the answer?

Tough Times for Nukes in the Market

- Nuclear power continues to face low market clearing prices due to:
  - Cheap natural gas prices
  - Renewables, benefiting from declining installed costs and policy support
- Some nuclear units are not even earning value as capacity—for example, Exelon's Three Mile Island did not clear PJM's most recent capacity auction; only a portion of its Byron plant cleared
- Moreover, the outlook is not improving, especially as electric consumption is growing tepidly

Announced Nuclear Plant Closures

1. Clinton - 1,078 MWs
2. Diablo Canyon Unit 1 - 1,122 MWs
3. Diablo Canyon Unit 2 - 1,118 MWs
4. Fort Calhoun - 479 MWs
5. FitzPatrick - 852 MWs*
6. Oyster Creek - 637 MWs
7. Pilgrim - 684 MWs
8. Quad Cities Unit 1 - 908 MWs
9. Quad Cities Unit 2 - 911 MWs

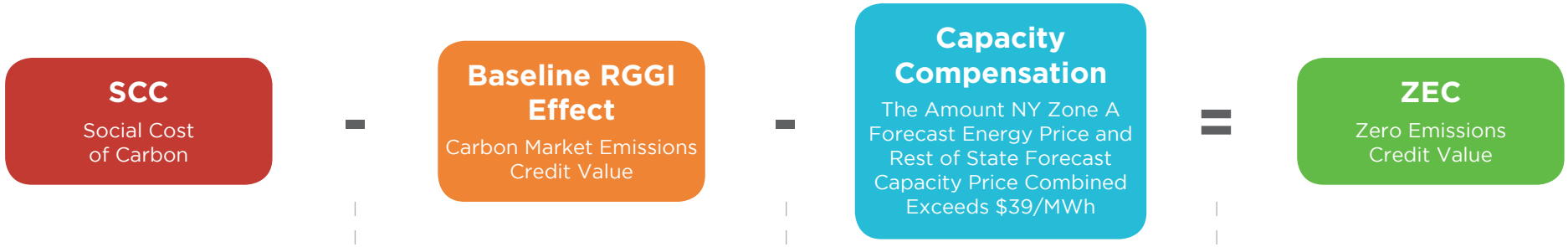
Bidding Farewell: Should I Stay or Should I Go?

- More than 6 GWs of nuclear capacity retirement have been announced. Some examples:
  - Quad Cities and Clinton, both in Illinois, have been affected by the Midwest's migration to gas generation and failure to date to win financial support from the state
  - Diablo Canyon is slated for retirement by 2025 in the face of increasing demand for renewable resources, required investment for safety and seismic concerns, and flattening or negative load growth
- Many other units face stark decisions: will investments in facilities and safety improvements for relicensing be compensated by the market?
- Moreover, the Clean Power Plan affords no credits for keeping existing nuclear plants online
- Analysts believe among those most vulnerable are small, single-unit plants and merchants in low capacity value markets
- A coming catalyst for closure decisions, should the market environment remain the same, may be those units that are due for relicensing but face significant capex needs

New York's Approach: But Will Zero Emissions Credits Catch On?

- New York, facing the potential closure of upstate New York plants and associated job losses, approved in August 2016 an approach to compensate nuclear's zero emissions
- Under the new approach some, but not all, out-of-market nuclear plants receive zero emissions credits (ZECs), which are to be issued under 12-year contracts beginning April 2017 in two-year tranches
- The value of the ZECs is based upon EPA's social cost of carbon based on a formula that nets out carbon and capacity market value of the plant (see Fig. 1); over time, ZECs escalate in value (like the federal construct)
- But ZECs are not without complication or controversy
    - Indian Point is ineligible for now because of its location in a more transmission-constrained area (higher revenues), and it has been under political fire for its proximity to New York City
    - ZECs are set to expire in 2029, and it is unclear whether covered plants might still shutter at that time, so ZECs may only preserve plants as a bridge to a different fuel mix in the long term
    - Cost of the credits is estimated to total $250 to $400 million in subsidy for upstate New York plants Ginna, Nine Mile, and FitzPatrick; downstate interests have objected to underwriting power that they do not believe they receive
    - New York's proposal of ZECs was the "policy signpost" that persuaded Exelon Corp. to purchase FitzPatrick, which had been slated for retirement, from Entergy Corp.
    - Finally, the ZEC formula, tagged to a $39/MWh cap effectively projects or targets a capacity value over more than a decade that is speculative at best
- Other states are watching to see how the New York construct works out. In New Jersey, for example, PSEG is advocating for ZEC-type support

Figure 1: Breaking down the Zero Emissions Credit Equation

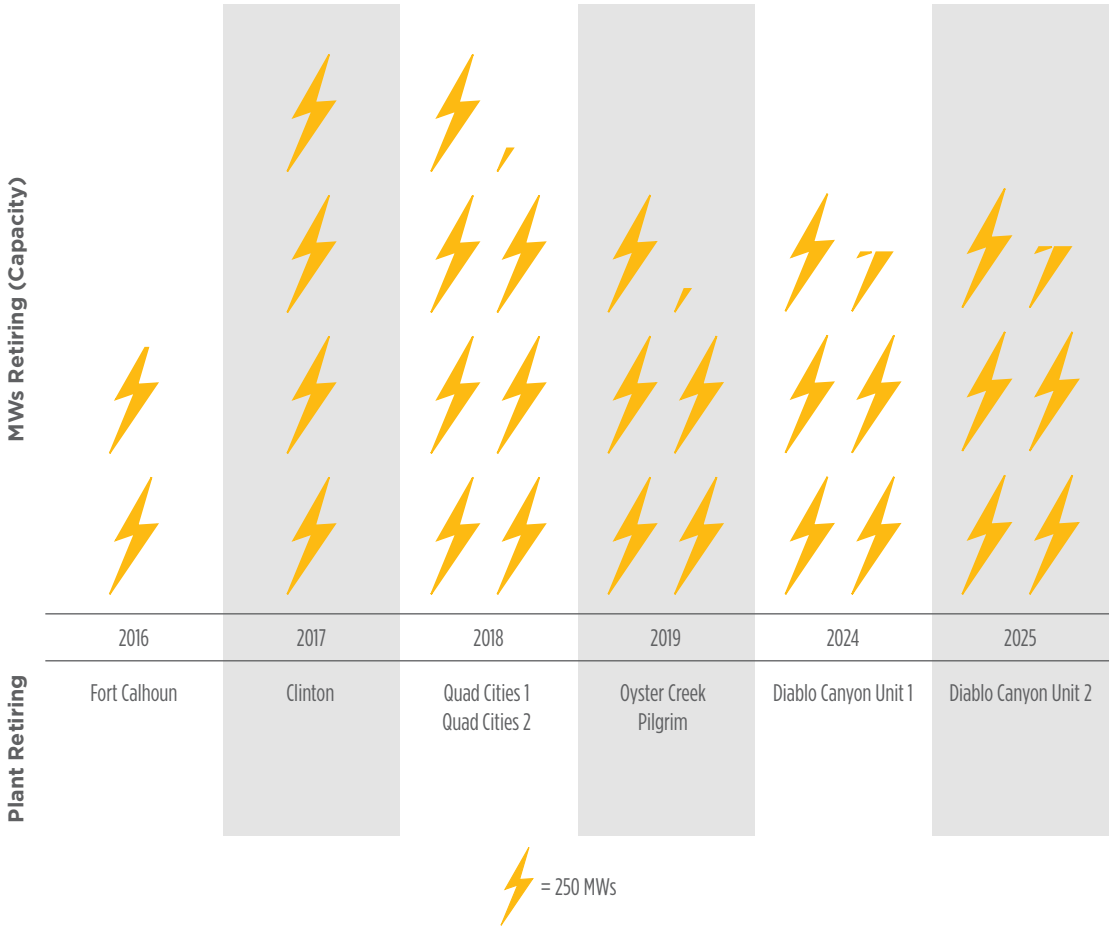


Retirement, Even for Nuclear Plants, Requires a Nest Egg

- Some retirements, such as Diablo Canyon, will reduce rate base, absent the addition of new assets to offset this loss
- Decommissioning costs are also a consideration as near-term retirement will cause acceleration of those liabilities
- Finally, depending upon the technology or demand-side solution, investment in replacement resources could prove expensive and/or cause a meaningful increase in greenhouse gas emissions (see Fig. 2)

Figure 2

More than 6 GWs of Announced Retirements of Currently Operating Nuclear Plants (by Retirement Year)*



If their output was displaced by...

Advanced Natural Gas Combined Cycle Units

- At a 70% capacity factor, would require incremental capacity of **almost 9 GWs**
- Would require overnight capital costs of **more than $9 billion**
- Could lead to incremental annual carbon dioxide emissions of **more than 21 million tons**

Onshore Wind Units

- At a 55% capacity factor, would require incremental capacity of **more than 11 GWs**
- Compared with current installed capacity of **74.8 GWs**
- Would require overnight capital cost of **more than $17.5 billion**

Utility-Scale Solar Photovoltaic Units

- At a 30% capacity factor, would require incremental capacity of **about 21 GWs**
- Compared with current installed or under construction capacity of **26.1 GWs**
- Would require overnight capital cost of **nearly $50 billion**

NOTES:
*Entergy, which announced that its FitzPatrick plant would close in 2017, sold that plant to Exelon, which is expected to keep the plant open in light of the ZEC construct discussed here.

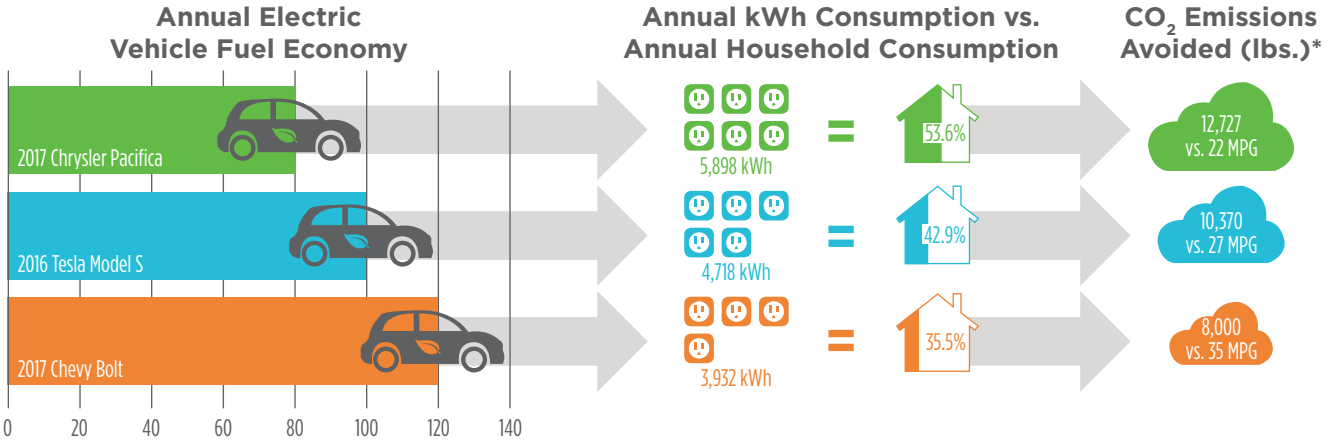
SOURCES:
UBS Securities; industry news; Nuclear Energy Institute; GTM Research; American Wind Energy Association; EIA; ScottMadden analysis

THE INDUSTRY IN CHARTS

At average usage rates and current efficiencies, electric vehicles could provide a sales boost comparable to part of a typical house…

Setting the Stage: The Assumptions

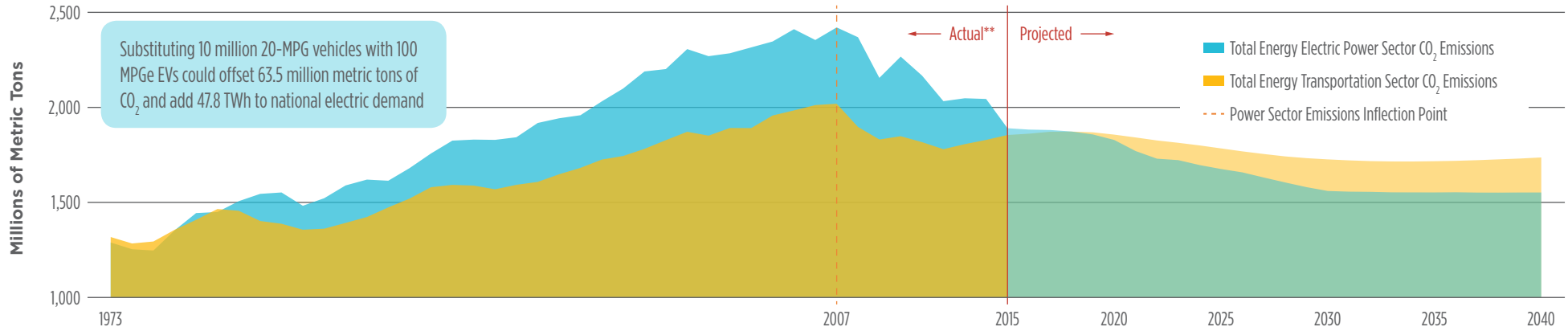
- Average annual electric consumption per household = 11,000 kWh
- Average miles driven annually for typical passenger vehicle = 14,000
- One gallon of gas = 33.7 kWh



Sources: EIA; DOT; EPA; ScottMadden analysis

…As the transportation and power sector are about to trade places in terms of aggregate greenhouse gas emissions.

Actual and Projected Power Sector and Transportation Sector CO_2 Emissions (in Millions of Metric Tons)



Source: EIA, Monthly Energy Review (Sept. 2016); EIA, Annual Energy Review 2016 (Sept. 2016); ScottMadden analysis

NOTES:
*Avoided CO_2 emissions in 000s of lbs. vs. comparable fuel efficiency internal combustion engine at fuel efficiency noted (does not factor in power supply emissions from vehicle charging). **Includes preliminary estimate for 2015

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.

To view these and other insights, please visit our **Insights Library**.

Clean Tech & Sustainability	• *Revisiting the California Duck Curve* • *Energy Storage Companies Diversify by Incorporating Energy Storage Management Systems into Offerings*
Energy Cybersecurity	• *Cybersecurity Threats in the Energy Industry*
Fossil Generation	• *Have Oil Prices Hit Rock Bottom?* • *Management's Guide to Coal Plant Decommissioning*
Grid Transformation	• *From Bitcoins to BTUs: How Blockchains Are Opening the Industry to New, Non-Utility Players* • *New York PSC Issues Order to Re-shape the Utility Business Model* • *FERC Order No. 1000: Five Years On*
Natural Gas	• *New Federal Pipeline Safety Law Expands PHMSA's Responsibilities* • *Recent Mergers and Acquisitions of Natural Gas Companies*
Nuclear Power	• *A Business Case for Advanced Outage Management*
Public Power and Electric Cooperatives	• *Five Legislative Priorities of the American Public Power Association*
Regulation and Rates	• *Managing Regulatory Risks – Rating Agencies Believe It Is Essential for Utilities* • *Are Traditional Weather Normalization Practices Used by Utilities in the Ratemaking Process Appropriate Given Increased Climate Variability?*
Utility Management	• *Inventory Management: What Factors Contribute to Higher Inventory in Generation Warehouses?* • *Effective Generation Fleet Management*

Stay Connected

Get the latest highlights and noteworthy developments in our topical **Minute** series. See **scottmadden.com** for more.

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 November 13-18, 2016, to discover ways Australian utilities and partners are deploying DERs and how customers are responding to this market shift.

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**.

Contact Us

Brad Kitchens
President & CEO
sbkitchens@scottmadden.com
404-814-0020

Stuart Pearman
Partner
Energy Practice Leader
spearman@scottmadden.com
919-781-4191

Chris Vlahoplus
Partner
Clean Tech & Sustainability Practice Leader
chrisv@scottmadden.com
919-781-4191

Cristin Lyons
Partner
Grid Transformation Practice Leader
cmlyons@scottmadden.com
919-781-4191

Greg Litra
Partner
Energy, Clean Tech, and Sustainability Research Lead
glitra@scottmadden.com
919-781-4191