RECALIBRATION

THE SCOTTMADDEN ENERGY INDUSTRY UPDATE

Volume 18 - Issue 1

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VIEW FROM THE EXECUTIVE SUITE

EXECUTIVE SUMMARY

Recalibration

Recalibration (noun): "re-standardizing (as a measuring instrument) by determining the deviation from a standard so as to ascertain the proper correction factors"

We are well over a year into a new Presidential administration, changes in policy and priorities—as well as changes in personnel in agencies like the Federal Energy Regulatory Commission—continue to affect the energy industry. Tax reform, environmental regulation, and wholesale power market resource debates are affecting strategic and financial options for utilities.

But changes in our business context are not limited to federal policies. Technological development continues, driving interest in energy resources like solar and energy storage. And states are responding, seeking alternative regulatory approaches that accommodate new technologies while enhancing the grid and enabling future innovation. Private enterprise is responding too, with new tools and business approaches such as corporate renewable power purchase agreements.

In this issue of the *ScottMadden Energy Industry Update*, we look at some of the emerging and continuing trends in the industry, with the hope that it will help energy executives "recalibrate" as our industry anticipates, and creates, the next "new normal."

Some Highlights of This ScottMadden Energy Industry Update	
Recalibrating to Technology	• As some industry participants look to pilot energy storage applications and battery technology continues to get cheaper, attention shifts to ownership models, pricing, and regulatory constructs to support development • With much popular press being given to artificial intelligence and robots, robotic process automation is a technology that is here right now, and companies, including utilities, are interested in its capabilities for organizational efficiency and cost reduction
Recalibrating for Policy Changes	• Federal tax reform passed in late 2017, and utilities and state regulators examine, and define, what it means for shareholders and ratepayers in terms of incentives, refunds, rate changes, and cash flows for the near and long term • As the U.S. Environmental Protection Agency shifts policy dramatically from the prior administration—and rethinks power sector greenhouse gas emissions policy—we look at what has happened and what the shift portends • Amid the sometimes acrimonious discussion of grid resilience, FERC seeks to ensure reliability at "just and reasonable" rates but must deal with many facets that impact resilience—prices and market integrity, state energy initiatives, fuel adequacy, and resource composition, among others
Recalibrating for Lessons Learned	• The Smart Electric Power Alliance and a group of energy executives went to Europe to understand how utilities in Belgium and The Netherlands are approaching climate change goals, adapting grid capabilities, and adopting changes in energy technologies. A key takeaway: We all still have much to learn • Massachusetts has been a leader in policy innovation for renewables, retail competition, and distributed energy resources, and we look at how it has begun to embark on grid changes and regulatory adaptations to further its various policy goals

TAX REFORM FOR UTILITIES: KIND OF A DRAG?

After much attention during the start of the Trump Administration, on December 22, 2017, Congress enacted the Tax Cuts and Jobs Act (or H.R. 1). The comprehensive legislation contains significant changes in both individual and business taxation but exempts regulated utilities from key provisions limiting interest deductibility and allowing immediate expensing of capital expenditures.

What the Investment Community Is Saying: Potential Impacts of Tax Reform

"Managements' responses to defend their credit profiles in the face of prospective lower **cash flow** will be key."
– Fitch Ratings

"Onus [is] on managements to persuade regulators that using tax headroom creatively… might be preferable to fast-tracking **customer refunds**."
– Deutsche Bank

"Longer term, the reduction in deferred tax liability translates into an **increase in rate base**, which should increase the earnings power of the utility sector."
– SunTrust Robinson Humphrey

"We expect **renewable development** to continue in earnest regardless of dampened demand for tax equity financing from foreign firms."
– Gabelli & Company

Impacts of Key Tax Reform Provisions on Energy Companies

	Electric & Gas Utilities	Holding Companies	Renewables Developers	Independent Power Producers & Merchant Power Producers
Corporate Tax Rate Reduction	• Near-term drag on free cash flow • Long-term slightly negative as most utilities are not cash taxpayers • Reduced deferred interest liability increases rate base, but additional capital may be needed	• Potential dividend constraints pending with cash flow issues • Companies with large, unregulated operations see benefits of stimulative provisions	• Slightly lower benefit of net operating losses	• Bottom-line benefit of lower tax rate
Bonus Depreciation	• Utilities exempt (only one of two industries); no impact vs. existing situation	• Depends: positive for firms with significant non-regulated operations	• Slightly positive as deprecation benefits will occur sooner in projet life	• For profitable firms, serves as improved tax shield
Loss of Interest Deductibility	• Utilities exempt; no impact vs. existing situation	• Holding companies not burdened if they can allocate a meaningful amount of debt to utility operations, but allocation method is unclear	• Slightly negative for projects with debt financing, although most projects remain financed largely with equity	• Negative for companies with large debt balances
Base Erosion Anti-Abuse Tax (BEAT)	• Negligible impact	• Negligible impact	• Slightly negative impact for tax equity investment and ability to use tax credits but offset by 80% • Looming offset expiry (2025) could dampen investment	• Negligible impact

Financial Impact Legend: Positive | Neutral or Negligible | Negative

Key Business Tax Provisions of Tax Cuts and Jobs Act Impacting Energy and Utility Companies

	What's Different	What It Means
Top Corporate Income Tax Rate	• Reduced from 35% to 21%	Lower tax liability but also lower tax shields for depreciation on capital investment
Net Operating Losses (NOLs)	• Applies to NOLs 2018 and after • No carryback (formerly 2 years); carryforward indefinitely (formerly 20 years) • Deduction limited to 80% of taxable income	Reduction or impairment in value of NOL tax asset to any prior year tax liability
Bonus Depreciation	• 100% expensing of capital expenditures for qualified property before 2023, falling 20% each year thereafter (formerly 50% in Year 1, balance over property life) • Regulated utility property is not qualified property and thus exempt, depreciable as before	Modified accelerated depreciation (MACRS) still applies but at lower first-year rates; MACRS was set to phase down by 2020 – it is unclear what, if anything, replaces it
Interest Deduction	• Interest deduction disallowed for net interest >30% of business income (formerly fully deductible) • Regulated utilities are exempt from limitation	Utilities that use normalization of accumulated deferred interest taxes (over the life of the property) will spread the tax adjustment (difference in rates) over time
Investment Tax Credits/Production Tax Credits	• Slightly changed: ITC step-down beginning 2020; PTC stepping down, expiring for projects commencing construction after 2019	Little effect (except BEAT below) on renewables development
BEAT	• Imposes minimum tax on a U.S. corporation's "modified taxable income" (MTI)* • Tax equals (i) 10% of MTI less (ii) regular tax liability minus tax credits (but allowing 80% of, e.g., renewable production credits and energy investment tax credits)	Potentially eliminates some value of credits (including renewable energy) for foreign tax equity investors

Issues and Uncertainties with the Legislation Remain

Transition rules
- What will be the transition rules?

Consolidated tax adjustments
- Are utility ratepayers entitled to benefit from tax benefits of unregulated affiliates, which would ignore ring-fencing, would typically be applied asymmetrically (ratepayers get benefits but don't bear liabilities), and would effectively lower return on equity below the allowed rate?

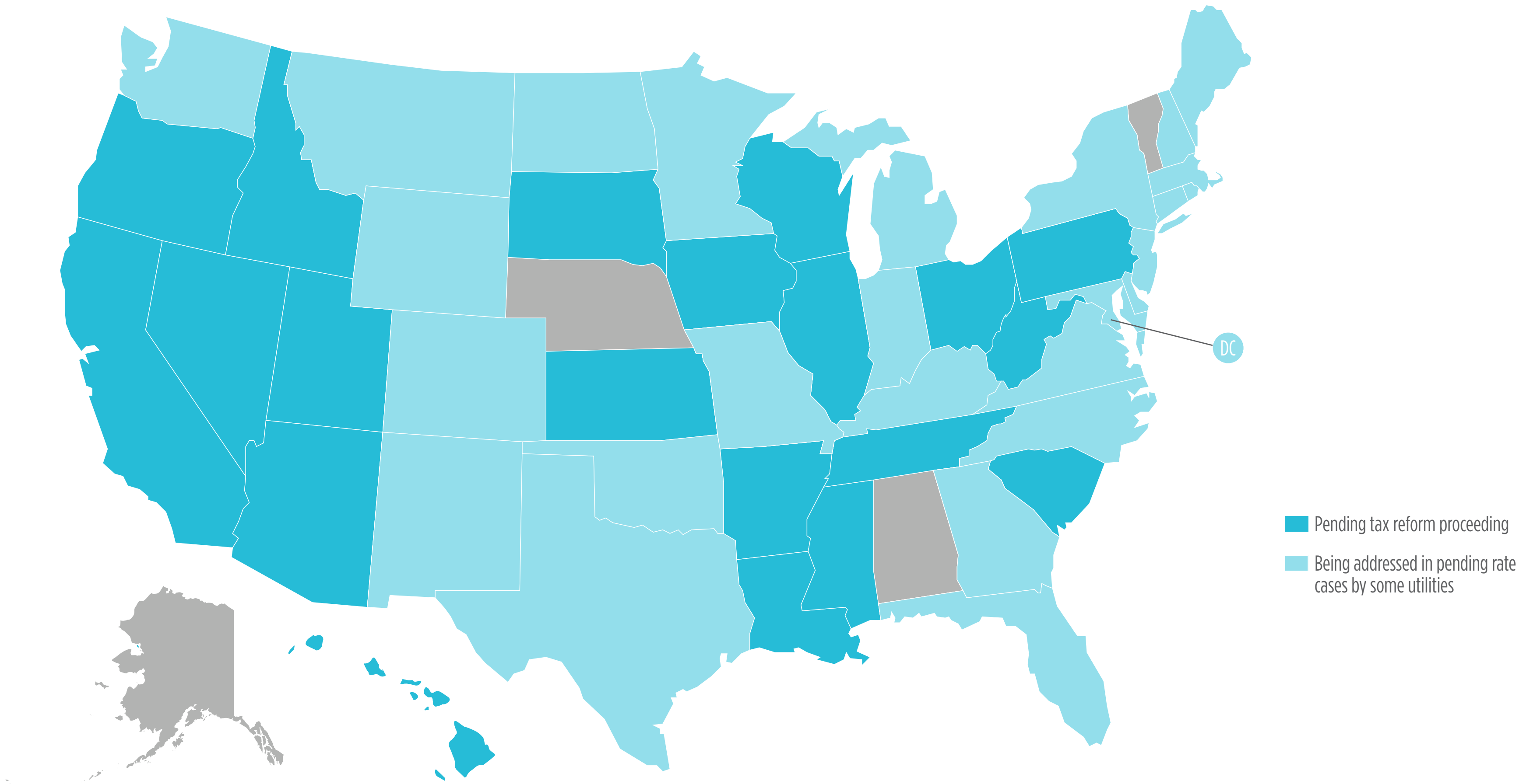
Timing of excess accumulated deferred income taxes (ADIT) reduction
- How best to assess individual property life for purposes of unwinding ADIT balances?
- Will state PUC discretion complicate efforts at timing this unwinding and potentially accelerate customer refunds, creating cash flow issues?

Securities and Exchange Commission (SEC) disclosures
- How long will the SEC allow companies to "measure and recognize the effects" of tax reform?

State regulatory adjustments
- How are states approaching tax reform, and how does it vary? Some states are being prospective with the "known and measurable change" from tax reform, while others are asking utilities to accrue a regulatory liability to be addressed in the utility's next rate case

Overseas investment
- How will territorial tax rules affect utility holding companies with meaningful overseas operations?

Tax Reform-Related Regulatory Activity (as of Feb. 28, 2018)



Sources: S&P Global Market Intelligence/Regulatory Research Associates

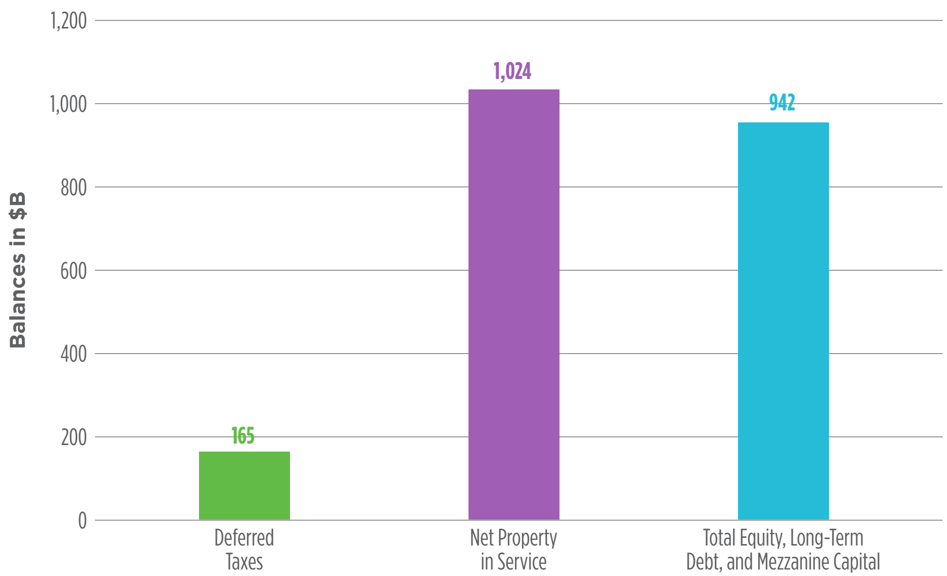
Different Public Utility Commissions (PUCs) Are Taking Different Approaches to Tax "Give-Backs"

- States have begun looking at how utilities can pass tax savings back to customers without delay
- Some proceedings have been initiated by state PUCs, while other inquiries are in the context of an ongoing rate case or have been initiated by utilities themselves
- In lieu of immediate reductions, some jurisdictions are employing a wait-and-see approach to provide some rate stability, especially as some utilities expect additional capex may offset tax reductions
- Other jurisdictions are not as patient: New Jersey, for example, has asked its utilities to make filings that include proposed revenue requirements reflecting the lower tax rate (effective April 1) and a mechanism to return deferred balances to ratepayers
- Energy and utility companies are concerned about cash flows with the effects of both immediately passing through tax savings and potentially accelerating unwinding of deferred tax balances

Increased Rate Base and a Need for Capital?

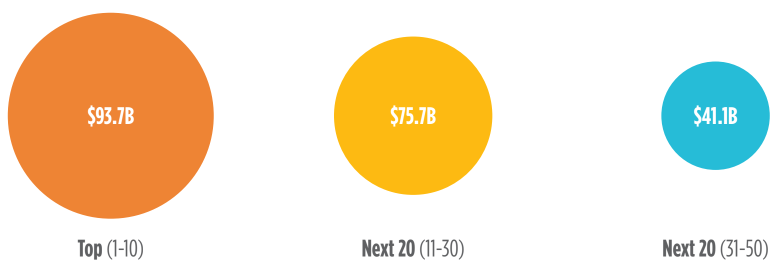
- For investor-owned utilities, deferred taxes are frequently netted against rate base as a reduction
- Assuming reduction of ADIT balances over time through normalization, utilities may benefit from an increased rate base
- However, pass-through of tax savings and unwinding ADIT balances (discussed earlier) has cash flow consequences and may also require the balance sheet to be shored up through stock or debt issuance
- Assuming the approximately $165B value of ADIT as of Q3 2017, amortization over anywhere from 5 to 15 years could yield incremental utility capital markets activity of about $11B to $33B
- Different utility operating companies have very different levels of ADIT ranging from a few hundred thousand to nearly $14B, with values of ADIT equivalent to nearly half of the value of net utility plant

Deferred Tax Balances for Investor-Owned Utilities Compared with Net Plant and Book Capitalization (as of Q3 2017)**



Sources: Edison Electric Institute; ScottMadden analysis

How the Top 50 Electric and Diversified Operating Company Deferred Tax Balances Compare***



Sources: Edison Electric Institute; ScottMadden analysis

NOTES:
*MTI is taxable income for the taxable year, determined without regard to (A) any "base erosion tax benefit" (e.g., depreciation) with respect to any "base erosion payment" (i.e., paid or accrued to related party foreigners) or (B) the base erosion percentage of any net operating loss deduction (McDermott, Will & Emery); **net PP&E excluding nuclear fuel, construction work-in-progress, and other property; ***reported deferred income tax liabilities—may include deferred tax credits. All balances as of Q3 2017, except CenterPoint Energy, is as of year-end 2016.
SOURCES:
Ballard Spahr, Tax Truths (Jan. 2018); Edison Electric Institute; H.R. 1, Tax Cuts and Jobs Act Conference Report, No. 115-466 (Dec. 15, 2017); industry news; investment bank analyst reports; legislative summaries; R.W. Baird, Highlights of the Final Tax Cuts and Jobs Act (updated Dec. 21, 2017); Tax Policy Center; S&P Global Market Intelligence; ScottMadden analysis

ENERGY SUPPLY, DEMAND, AND MARKETS

RESILIENCE AND RESOURCES: MARKETS TAKE NOTICE

After an unorthodox catalyst, FERC begins an inquiry into resilience.

FERC Initiates Factfinding on Resilience in RTOs and ISOs*

- In January 2018, FERC rejected a call from the Department of Energy to promulgate a rule requiring wholesale power markets to price generation resources that provide system resilience, particularly those with on-site fuel supply
- FERC, however, acknowledged the importance of resilience and initiated a new proceeding to investigate resilience in bulk power systems, receiving comments from RTOs and ISOs in mid-March, with comments due from others by mid-May

Separate but Related

In its order initiating an inquiry into bulk power resilience, FERC noted that reliability and resilience are related but separate concepts, soliciting comments on its working definition of resilience:

"The ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event."

– FERC

Expanding the Frame

- Early comments from grid operators have focused on a broad definition of resilience. For example, Midcontinent ISO believes the definition of resilience should "include the ability to adapt to ongoing changes and supply portfolio evolution to ensure that grid performance remains reliable"
- With a broad definition of resilience, and a focus on the transformation of the generation resource mix, FERC is expected to use its traditional approach—fuel neutral, market based, with appropriate standards—to address resource requirements for resilience
- Given FERC's inquiry, some expect that the commission will pursue some kind of market reform to encourage retention or development of resources that support resilience
- A key issue for the industry: To what extent have stakeholders conflated debates over the role of power markets, state imperatives, the need for reliability and resilience, and advocacy for certain energy resource types, making solutions more difficult and less durable?

You keep me hangin' on…or not.

For Now, FERC and Market Operators Work to Price Subsidized Energy Resources

- In parallel with its resilience proceeding, FERC has entertained proposals from ISO New England (ISO-NE) and PJM Interconnection (PJM) on market pricing adjustments that account for subsidies intended to preserve state-supported resources
- ISO-NE proposed, and FERC accepted, a proposal that would provide for two auctions for capacity resources
  - The first auction would determine which resources clear and a capacity price
  - A second "substitution" auction would allow cleared resources willing to retire (presumably due to low expected energy prices) to be "bought out" and buyers to assume their capacity obligation
- In an unusual, but not unprecedented move, PJM submitted two alternative proposals and asked FERC to choose
  - Under one option, proposed by PJM staff, PJM would conduct a two-stage process
    - Stage 1 would determine the resources eligible for capacity payments
    - Stage 2 would determine the price by which resources would be compensated. In Stage 2, PJM would administratively determine unsubsidized prices. It would then re-form the supply stack based on the calculated prices, in effect eliminating the effect of subsidies from price formation
  - Its second option would require resources to bid at or above their unsubsidized cost

For Now, Utilities Are Dealing with At-Risk Resources on a Case-by-Case Basis

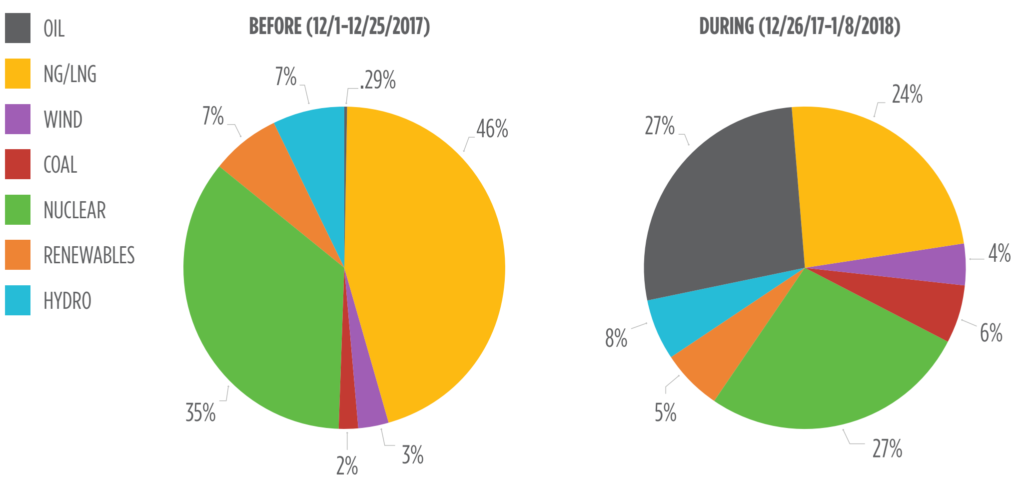
- As both resilience proceedings and market fixes to address retiring dispatchable generation are making their way through FERC, grid operators and generation owners are dealing with unpleasant economics one situation at a time
- FirstEnergy announced, for example, that it would be closing three nuclear plants comprising 4 GWs of generation as its FirstEnergy Solutions generation business declared bankruptcy
  - FirstEnergy has sought emergency intervention from PJM and from DOE to receive additional compensation to preserve the plants, but reception to its proposals has been cool
  - Previous contested efforts by the Public Utilities Commission of Ohio (PUCO) to provide for financial subsidies and power purchase agreements between Ohio utilities and their unregulated affiliates have been reversed by state court and FERC decisions. In response, PUCO's chairman has conceded, saying, "We're out of the generation business"
- In New Jersey, state legislators recently enacted contentious zero-emissions credit legislation (which also contained renewable energy provisions) proposing financial support (via retail charges) for two PSEG-owned nuclear stations, Salem and Hope Creek, which are at risk of retirement in the face of low-priced gas-fired and renewable generation in the region
- In New England, ISO-NE is using reliability must-run types of arrangement to keep certain resources from retirement and is providing enhanced compensation through "pay-for-performance" incentives
- A key question for debate: Does this phenomenon reflect irrevocable loss of valuable generating resources due to market imperfections or failure, or is it Schumpeterian "creative destruction" as the market sweeps out the old to make room for the new, or both?

Of bomb cyclones and polar vortices.

Grid Operators Assess Effects of a Recent Cold Snap and Look Ahead

- From December 27, 2017, through January 8, 2018, much of the eastern United States was affected by intense winter storms—bomb cyclones—bringing strong winds, heavy precipitation, and cold temperatures
- PJM and the National Energy Technology Laboratory (NETL) prepared assessments of how this stretch of weather impacted power system performance
- Grid operators agreed that performance during this cold snap was improved from the polar vortex experienced in winter 2014–15
    - One reason: Temperatures did not fall as low as during the 2014–15 polar vortex
    - Further, cold weather preparation and emergency operations were improved, and capacity performance products were believed to ensure better resource availability
- A key concern arising out of the 2017–18 bomb cyclones is the dependence upon oil-fired units in both New England and the Mid-Atlantic
- ISO-NE recently studied potential long-term (10-year) reliability issues arising from fuel security risk and found that, absent additional pipeline capacity or increased availability of LNG, by 2024–25, energy shortfalls due to fuel-supply inadequacy would require a range of operating procedures and emergency actions, up to and including load shedding

New England's Bomb Cyclone Experience:
ISO-NE Fuel Mix before and during Two-Week Cold Snap



Source: ISO-NE State of the Grid, p, 23

Industry Assessments

PJM	"Overall, all resources performed well during the recent cold snap...For 2018, these [outage] figures were not driven by a loss of a few larger units, but rather a combination of full outages and partial reductions across many generators."
ISO-NE	"Fuel-security risk...particularly in winter is the foremost challenge to a reliable power grid in New England." "Energy shortfalls due to inadequate fuel would occur with almost every fuel-mix scenario in winter 2024-2025, requiring frequent use of emergency actions to keep power flowing and protect the grid."
NETL	"Natural gas prices and availability for power [during the 2017-18 bomb cyclone] resulted in units with dual-fuel capability...playing an important role. Fuel switching enabled units, which would have otherwise been uneconomic or taken offline due to natural gas prices, to provide [sic] resilient capacity by firing fuel oil...."

NOTE:
*RTO is regional transmission organization; ISO is independent system operator.
SOURCES:
FERC Order on Grid Resilience in Regional Transmission Organizations and Independent System Operators, AD18-8-000, 162 FERC ¶ 61,012 (Jan. 8, 2018); stakeholder filings pursuant to AD18-8; S&P Global Market Intelligence; *Wall Street Journal*; PJM Interconnection, *PJM Cold Snap Performance: Dec. 28, 2017 to Jan. 7, 2018 (Feb. 26, 2018)*; ISO New England, *Operational Fuel-Security Analysis* (Jan. 17, 2018); National Energy Technology Laboratory, *Reliability, Resilience and the Oncoming Wave of Retiring Baseload Units, Volume I: The Critical Role of Thermal Units During Extreme Weather Events* (Mar. 13, 2018); ISO New England, "ISO on Background–State of the Grid: 2018" (Feb. 27, 2018) (ISO-NE State of the Grid)

RENEWABLE NATURAL GAS:
RENEWED INTEREST IN A LONG-ESTABLISHED RESOURCE

As states and provinces become more active in promoting greenhouse gas (GHG) emissions reductions, including reductions from natural gas distribution, some firms are taking a look at renewable natural gas (RNG)—or biogas—as a potential decarbonization opportunity.

Looking at the Product "In the Pipe"

- U.S. states and Canadian provinces, and gas utilities themselves, are increasingly looking beyond just delivery but also at the product "in the pipe" for GHG reduction
- California has had a low-carbon fuel standard (LCFS) since January 2007, and the LCFS, along with California's cap-and-trade program, encourages (among other things) use of RNG as an alternative fuel
- California also enacted Senate Bill 1383, which seeks reductions in power GHG emissions, like methane, and directs gas utilities to pilot dairy biomethane projects to interconnect with the pipeline system, with costs includible in rate base

Going beyond Historical Uses of RNG

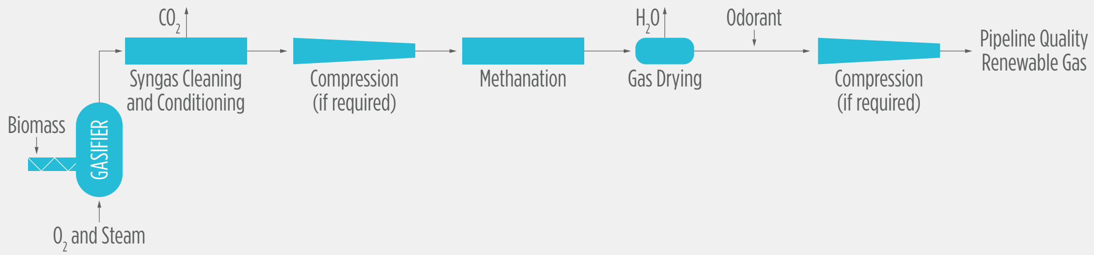
- Historically, landfill and digester gas has been used primarily on-site or in nearby industrial facilities for power generation or direct use, since accessing a distribution pipeline and cleaning biogas to pipeline grade can be costly, depending in part upon proximity to local pipelines
- In California, for example, gas monitoring, cleaning, and interconnection costs can range from $1.5M to $3.5M per dairy or feedlot site

What Is RNG?

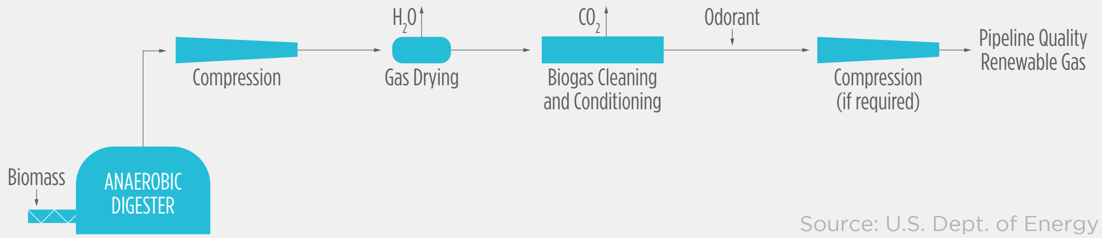
RNG is natural gas derived from organic waste material, e.g., food waste, garden and lawn clippings, animal and plant-based material, and degradable carbon sources (such as paper, cardboard, and wood).

RNG is produced primarily through one of the following processes:

Thermal Gasification
- Uses high temperature to convert biomass to syngas, then refined to RNG
- Typically uses low-moisture feedstocks like woody biomass or crop residuals



Anaerobic Digestion
- Uses microorganisms in a zero-oxygen environment to break down biomass into methane and then refines it to RNG
- Typically uses high-moisture organic feedstocks like animal manure, landfill organic waste, or wastewater

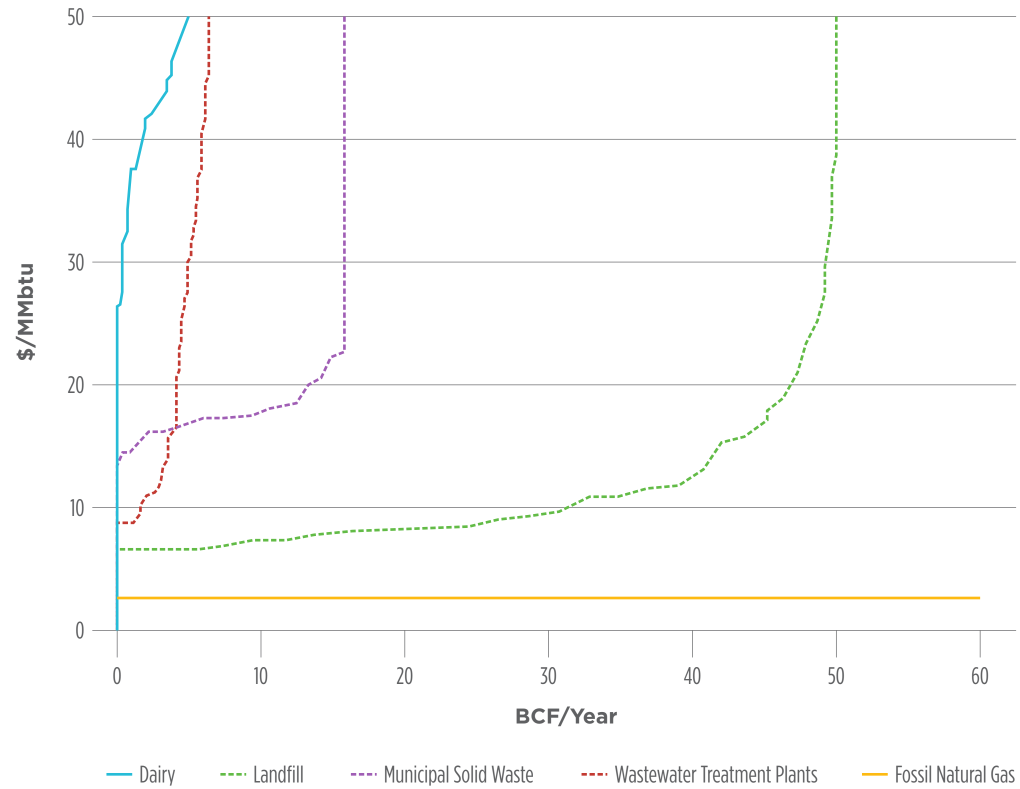


Source: U.S. Dept. of Energy

Resource Potential and Economics

- In the United States, a 2014 estimate of potential renewable gas (methane) from anaerobic digestion totaled 756 BCF (by comparison, 2017 U.S. natural gas residential consumption was 4,422 BCF)
- Total potential, however, can be significantly greater than economic potential: Economic potential for RNG is highly dependent upon its production cost, conventional natural gas prices, available payments for GHG reductions (such as California's LCFS), as well as values of biofuels under EPA's Renewable Fuel Standards (RIN credits)
- There are also economies of scale in production of biogas, gas upgrading, and interconnection
- One study found that at market natural gas prices of more than \$3/MMBTU, California could achieve market penetration of 14 BCF of RNG by the 2020s with LCFS credits of \$120/ton of CO_2 (higher penetration with RIN credits as well)
- Canadian policymakers and gas companies are increasingly interested in RNG
    - Programs at the provincial (LCFS) and federal (Clean Fuel Standards) level may encourage use of RNG; possible federal carbon pricing mandates could add impetus
    - Quebec, for example, is targeting distributed natural gas to include 5% of "renewable" gas
    - Canada's natural gas utilities have set a target of 5% RNG-blended natural gas in the pipeline distribution system by 2025 and 10% by 2030. A key question is what those targets get applied to: All throughput? Retail consumption?
    - One limiting factor: Much of Canada's biogas resource is biomass—specifically forest and agricultural residues—which is relatively expensive (~C\$25/gigajoule, or more than \$20/MMBTU)*

Illustrative California RNG Supply Curve by Source



Sources: California Air Resources Board; UC Davis

U.S. Anaerobic Digestion Biogas Potential by Source (Total of ~756 BCF/year)

Landfills	500.8 BCF/year
Wastewater treatment plants	110.7 BCF/year
Animal manure	90.1 BCF/year
Industrial, institutional, and commercial organic waste	54.8 BCF/year

Source: NREL

While resource availability is significant and RNG projects are proliferating (see figures), there are both enablers and barriers to expansion of RNG.

Enablers and Barriers to RNG Market Penetration

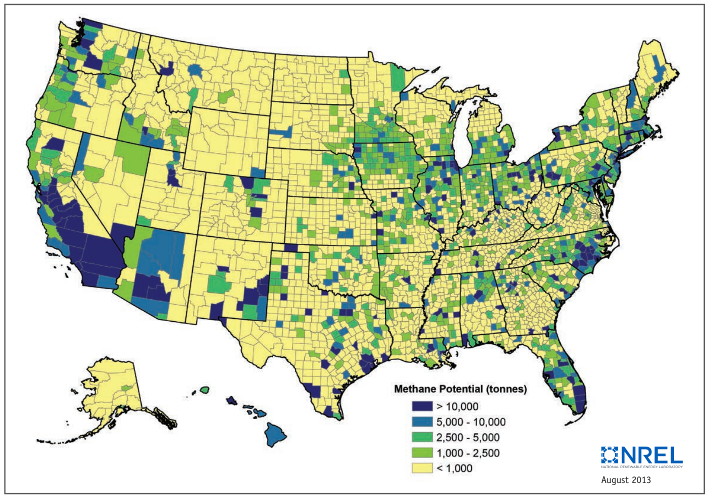
Enablers

- Government support and funding for projects and RNG technology enhancements or funding to offset capital cost vs. conventional natural gas
- Policy mandates (low carbon, clean or renewable fuel standards) or targets
- Carbon pricing
- Availability of biogas resources
- Clustering of sources (e.g., dairy farms)
- Longer-term price certainty for environmental credits
- Financial support for RNG upgrading and cleaning

Barriers

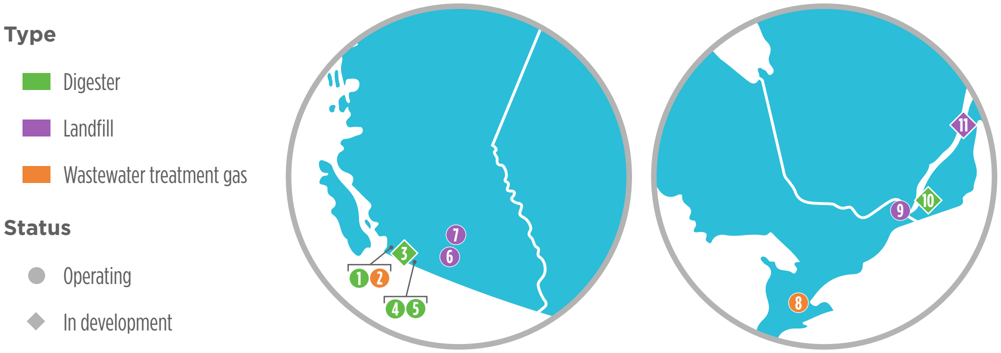
- Affordability and economics at proposed volumes
- Effects of natural gas prices on RNG project economics (i.e., continued low geological natural gas prices)
- Meeting specifications for various use cases (e.g., gas quality standards)
- Access to distribution systems, especially for remote
- Low public awareness of RNG
- Incentives that vary by market or state
- Permitting process and acceptance are unique to each project

Estimated U.S. Methane Generation Potential for Select Biogas Sources by County (Aug. 2013)**



Source: NREL

Canadian RNG Projects Operating and in Development as of 2017



1. **Delta, BC**
   Start Date: 2014
   RNG Production: 1,348 homes/year
2. **Richmond, BC**
   Start Date: 2016
   RNG Production: 505 homes/year
3. **Surrey, BC**
   Start Date: 2017
   RNG Production: 1,100 homes/year
4. **Chiliwack, BC**
   Start Date: 2015
   RNG Production: 1,348 homes/year
5. **Abbotsford, BC**
   Start Date: 2010
   RNG Production: 2,527 homes/year
6. **Kelowna, BC**
   Start Date: 2014
   RNG Production: 3,032 homes/year
7. **Salmon Arm, BC**
   Start Date: 2013
   RNG Production: 1,011 homes/year
8. **Hamilton, ON**
   Start Date: 2011
   RNG Production: 2,695 homes/year
9. **Terrebonne, QC**
   Start Date: 2014
   RNG Production: 28,000 homes/year
10. **St. Hyacinthe, QC**
    Start Date: 2017
    RNG Production: 5,054 homes/year
11. **Rivière du loup, QC**
    Start Date: 2016
    RNG Production: 1,350 homes/year

Source: Canadian Gas Ass'n

NOTES:
*1 gigajoule ≈ 0.947817 MMBTU; at Mar. 6, 2017, C$1 = $0.77 USD; **includes methane potential from wastewater, animal manure, landfills (candidate landfills only as defined by the EPA's Landfill Methane Outreach Program), and industrial, institutional, and commercial organic waste. It does not consider other lignocellulosic material or lipids.
SOURCES:
California Air Resources Board; California Energy Comm'n; Canadian Gas Ass'n; Energy Information Administration; DOE; industry news; NREL; National Grid; ScottMadden analysis

INFRASTRUCTURE AND TECHNOLOGY

MASSACHUSETTS:
LAYING THE GROUNDWORK FOR DISTRIBUTED ENERGY RESOURCES

Continued and growing interest in accommodating distributed energy resources (DERs).

DER Debates Move from Theory to Practice in Jurisdictions around the United States as Penetration Rates Approach Critical Mass

- Some states are beginning to see long-expected impacts of DERs, as conventional rate structures and rate constructs are strained and replaced—and modern grid capabilities are put to the test
  - **Arizona:** "Value-of-solar" proceeding established an alternative to net energy metering (NEM), and recent APS rate settlement involves transitioning all new retail customers to time-of-use (TOU) or demand-based rate by default, beginning in 2018
  - **California:** "Residential Rate Reform" proceedings include implementing a new minimum bill and transitioning all residential customers to opt-out TOU rates, beginning in 2018
  - **Hawaii:** "Grid Modernization Strategy" proceedings prescribe aggressive investments in network infrastructure upgrades to accommodate extraordinary recent growth in DERs, with far more expected in order to achieve 100% renewables by 2045

Others Are Preparing for More DERs in the Near Future

- **New York:** "Reforming the Energy Vision" proceedings are continuing apace, transforming the utility business model and delivering on aggressive grid modernization initiatives, to set the stage for a distributed low-carbon electric system in the future
- **Illinois:** Recent legislative developments are combining elements of traditional ratemaking with performance-based rates to create incentives for utilities to make incremental network upgrades, while directly encouraging DER investments via NEM and renewable portfolio standard (RPS) carve-outs for Illinois-sited resources

What Is the Situation in Massachusetts?

- The Commonwealth has a long history of leadership and innovation and of challenging traditional utility business models
  - Restructuring was completed in 1997, at the front end of similar major regulatory reform in the United States
  - Massachusetts was an early leader in energy efficiency (EE), establishing the frameworks and incentives for utilities to participate in achieving industry-leading savings
  - By establishing favorable NEM provisions for DERs and setting aggressive RPS targets, Massachusetts has consistently encouraged deployment of both large- and small-scale renewables
  - The question is: Will recent regulatory and legislative initiatives support Massachusetts' continued leadership position?

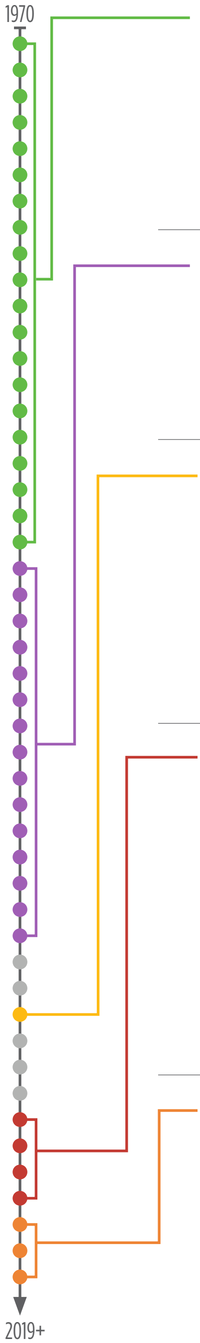
A Closer Look

ScottMadden and SEPA studied developments in Massachusetts to understand the current state of the market, assess recent developments, and evaluate the degrees of transformation. How far will the Commonwealth go to facilitate deployment of DERs, distribution system technologies, etc.?

Snapshot of MA's Market Structure

- Territory: Mixed (urban and rural)
- Types of utilities/structure: Majority IOU
- DER penetration: Moderate (sixth in U.S. residential PV solar)
- Wholesale market: ISO-NE
- Retail market: Fully deregulated, with community choice aggregation
- Renewable policy: RPS increased in 2008 and again recently
- NEM: Established in 1982, revamped in 2017

Key Electric Regulatory Developments in Massachusetts



1970s to 1980s: Early Interest in Efficiency and Renewables

- Prompted in part by the oil crisis of the 1970s, Massachusetts began seeking opportunities for efficiency and diversity of supply in response to high energy prices
- Massachusetts Department of Public Utilities (DPU) first authorized NEM in 1982
- Massachusetts and California were the first two states to explore the potential role of demand-side resources in energy markets, beginning with efficiency in the late 1980s (before establishment of wholesale electricity markets)

1990s to Early 2000s: Restructuring and Retail Deregulation

- The Electric Industry Restructuring Act of 1997 (Restructuring Act) required IOUs to sell their generation assets and become wires-only distribution utilities
- The Restructuring Act also included Massachusetts's first RPS for all retail electricity suppliers
- In 2002, RPS targets were set at 1% by 2003 increasing 0.5% each year, targeting 4% by 2009

2008: Green Communities Act (GCA) of 2008

- The GCA represented a shift in energy policy intended to encourage the adoption of EE and renewables. Specifically, it:
  - Required utilities to develop three-year plans to acquire all EE through ratepayer-funded surcharges
  - Authorized expanded NEM programs and higher caps
  - Expanded RPS requirements
  - Allowed utilities to own/operate solar photovoltaic
  - Authorized utility smart grid pilot programs

2012 to 2015: Grid Modernization Plan (GMP)

- In 2012, the Massachusetts DPU began work on the GMP by hosting workshops with stakeholders
- The Massachusetts DPU incorporated comments and issued the final GMP order in 2014, and utilities were required to file their plans in 2015 to realize four key objectives:
  - Reducing the effects of outages
  - Optimizing demand
  - Integrating distributed resources
  - Improving workforce and asset management
- To date, no decision has been rendered on any of the draft plans submitted by the three utilities

2016 to 2018: Recent Policy Developments

- RFP for long-term contracts for delivery of 9.45 TWh of clean energy, beginning in 2020, being negotiated with New England Clean Energy Connect transmission project and Hydro-Quebec
- RFP 83C for 1,600 MWS of offshore wind energy by 2027, issued in June 2017
- Energy storage procurement target set at 200 MWh by 2020 as part of the Energy Storage Initiative, including $10M in funding for demonstration projects

California of the East?

Accomplishing Some Objectives with More Work Left

- Key positives from transformative efforts to date
  - **Inclination:** Strong political will to push for more clean energy sources, to make room for models that work, and long history of flexibility in accommodating new resources and new objectives
  - **Engagement:** Well-established, functioning stakeholder forums which have successfully facilitated multiple major changes in the market to date
  - **Incentives:** Strong incentives for investments in efficiency, paired with decoupling, have laid the groundwork to meet and exceed goals in recent years
- Some challenges remain
  - **Limited automated metering infrastructure (AMI):** Limitations of physical assets, particularly the lack of AMI, may be impeding multiple potential positive market developments, including innovative rate designs and DER-related product offerings
  - **Enough choice?:** While retail deregulation provides customer choice, that choice may be insufficient if rate offerings do not include time-variant options (e.g., rates which provide customers the opportunity to achieve savings by reducing or shifting demand and energy usage in response to time-variant price signals). Complicating matters further, Massachusetts's attorney general has issued a report calling for an end to competitive energy supply for individual residential customers
  - **Regulatory uncertainty:** Grid modernization plans solicited by the Massachusetts DPU and aimed at (among other things) enabling DERs have been under consideration by the DPU since August 2015; it is unclear when they will be acted upon and what amount of proposed expense the DPU will deem reasonable

Looking Ahead: Things to Watch

- **Continued favorable treatment of EE investments (and investments in other demand-side resources)** – Will successful models continue to hold up?
- **Market response to energy storage mandate** – Will deployment of energy storage in the Commonwealth have the desired effects on the market?
- **Future of GMPs and AMI** – Will the GMPs be delivered as proposed by the utilities? If so, what will it cost, and what is the impact on rates? If not, how will the need for foundational grid modernization investments be met?
- **Impact of "Minimum Monthly Reliability Charges"** – Massachusetts DPU recently approved Eversource Energy's proposal for mandatory demand changes, higher monthly customer charges, and lower per kWh charges (for energy supplied back to the grid) for NEM customers: Will this have a significant impact on DERs?

Spotlight on Energy Efficiency: EE Performance Incentives in Massachusetts

- Massachusetts instituted performance incentive (PI) regulations to encourage the development of EE initiatives in the state
- The GCA included provisions for a three-year state-wide approach to achieve "all available cost-effective" savings, including PIs. Two elements of PIs:
  - *Savings (61.5%)* – Rewards for acquiring additional lifetime energy and demand savings and project-associated other energy and non-energy benefits
  - *Value (38.5%)* – Rewards for seeking additional cost-effective savings and non-energy benefits and doing so cost efficiently
- Key features of the PI program are as follows:
  - *PI Pool*
    - The statewide design-level PI pool is determined during the planning process
    - 2013-2015: PI was 6% and 3.7% of total electric and gas program administration costs, respectively
    - These amounts are pre-tax
  - *Program Administrator (PA) Allocation*
    - The pool is divided by planned statewide benefits and net benefits to calculate payout rates
    - PI allocated to each individual PA based on its proportion of planned benefits and net benefits
  - *Potential PI*
    - Earned at the portfolio level
    - Threshold: minimum amount of benefits/net benefits needed to earn PI
    - Design: equal to the PI pool, included in each PA's budget
    - Exemplary: maximum amount of PI, sets percentage of design
- Statewide, electric PAs earned 111% of the planned performance incentive during the 2013–2015 period

SOURCES:
SEPA (https://sepapower.org/our-focus/51-state-initiative/); SEPA and ScottMadden, *51st State Perspectives: DERs Are Coming and Illinois Is Ready for Them*; SEPA and ScottMadden, *51st State Perspectives: Distributed Energy Resources Integration: Policy, Technical, and Regulatory Perspectives from New York and California*; Massachusetts Department of Public Utilities; Massachusetts Department of Energy Resources (DOER) (see www.puc.nh.gov/EESE%20Board/EERS_WG/eeac_performance_incentive_mechanism_presentation.pdf); Massachusetts Energy Consumers Alliance; Massachusetts Clean Energy (at https://macleanenergy.com/); Massachusetts Energy Efficiency Advisory Council (MAEEAC); American Council for an Energy-Efficient Economy; ISO New England; industry news; utility regulatory filings; ScottMadden, SEPA analysis

ENERGY STORAGE: MORE THAN A FEELING

Energy storage is charging up.

Energy Storage Ramps Up

- Globally, North America is leading the way with commercial and demonstration grid-scale energy storage projects
- GTM Research projects that cumulative installed U.S. energy storage will grow from 867 MWs in 2017, to more than 3.7 GWs in 2020 and more than 11.6 GWs by 2023, 13 times the size of 2017's installed base
- It is estimated that the annual energy storage market will grow to more than $3.7B over the same period
- A use case already showing promise: Solar-plus-storage recently beat out natural gas and won an open-RFP in Arizona to provide peaking services

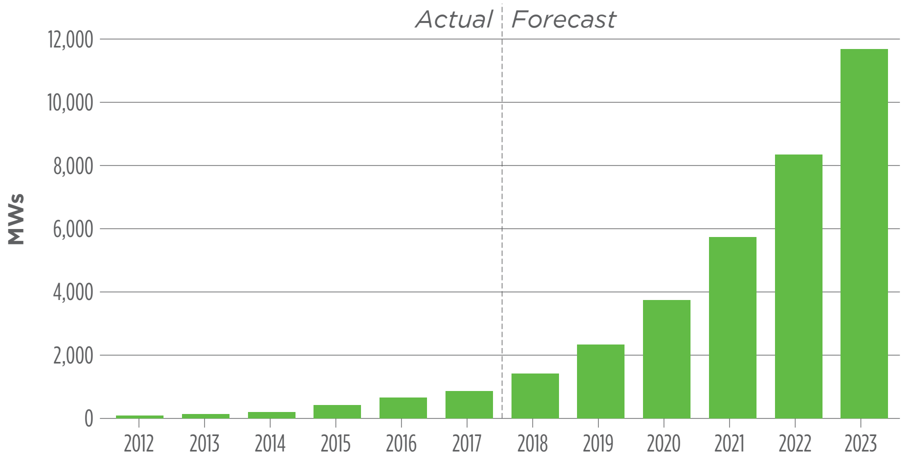
What's Driving the Increase in Activity?

- Falling prices for lithium-ion (Li-ion) batteries, due to demand from electric vehicles, and a decline in balance-of-system costs are causing energy storage costs to fall precipitously, enhancing its cost competitiveness
- Advances in energy storage technology, in particular battery duration and efficiency, have made energy storage attractive for certain use cases
- Growing constraints on the development of new transmission combined with increased need for new transmission to manage integration elevates storage as an alternative

Li-Ion Batteries Are the Technology of Choice (for Now)

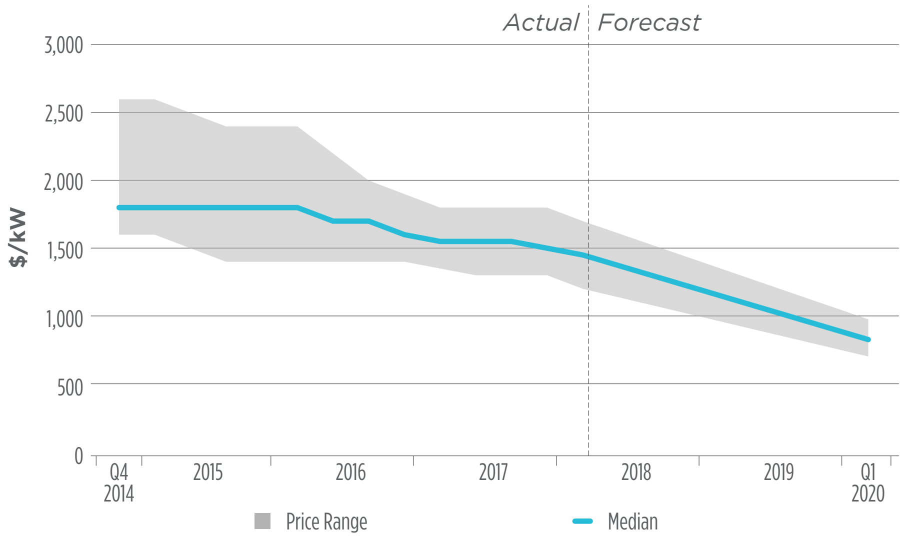
- Li-ion prices are falling faster than other technologies, due to scale economies from increasing demand for electric vehicles
- Li-ion batteries dominated the non-hydro energy storage market with a market share of 96.9% in 2017
- Even for long-duration applications, simply buying "more" Li-ion is proving to be an effective strategy given its declining costs, putting competitive pressure on other technologies

Cumulative Energy Storage Deployments by Year (MWs)



Source: GTM Research/ESA

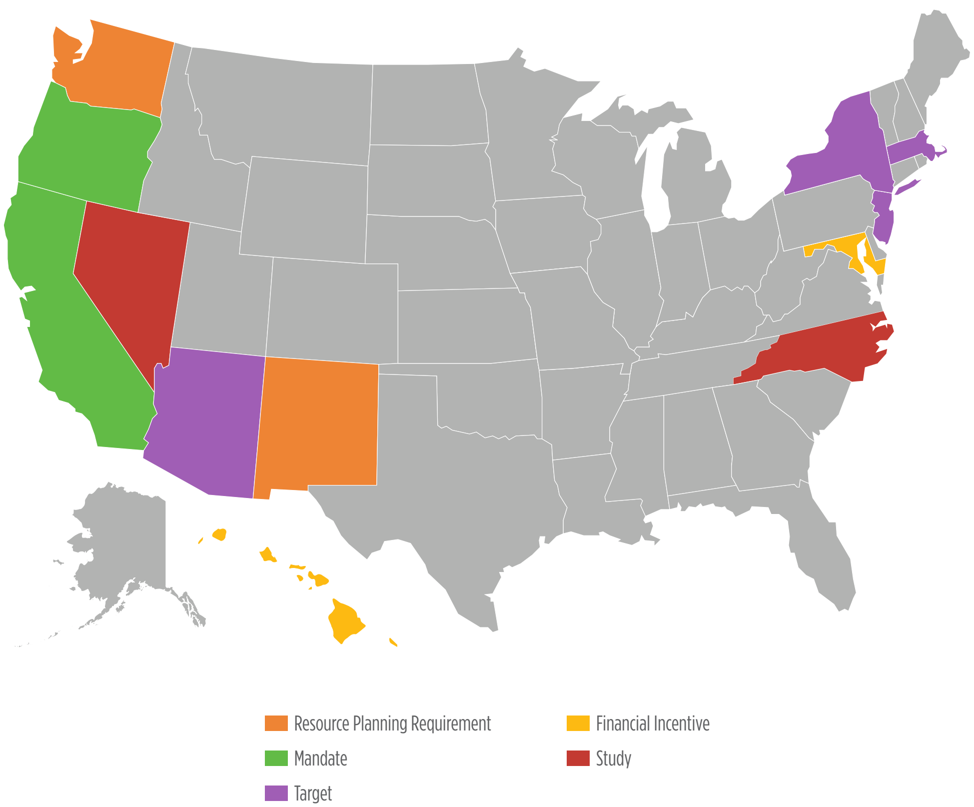
Front-of-the-Meter Energy Storage Price Trends (Two-Hour Duration Applications) ($/kW)



Source: GTM Research/ESA

States are making it happen.

Selected State Policies Promoting or Investigating Energy Storage



ARIZONA's proposed Energy Modernization Plan includes an energy storage deployment target of 3 GWs by 2030

CALIFORNIA PUC mandates electric utilities install 500 MWs of behind-the-meter storage on top of an existing 1,325-GW mandate

HAWAII approved a tariff which pays customers to export electricity to the grid from their energy storage system during off-peak hours

MARYLAND became the first state to offer tax credits for energy storage systems, allocating $750K for systems installed in 2018

MASSACHUSETTS set a 200-MWh energy storage target for electric distribution companies by 2020; proposed a clean peak standard

NEVADA's state legislation ordered the state's PUC to investigate if establishing an energy storage procurement requirement for utilities would be in the interest of the public

NEW JERSEY offers an incentive of $300/kWh of energy capacity for electric storage installations that are paired with renewable energy systems; sets 2 GWs by 2030 storage target

NEW MEXICO requires utilities to evaluate energy storage as an energy source in future integrated resource plans (IRPs)

NEW YORK announced an energy storage deployment target of 1.5 GWs by 2025

NORTH CAROLINA commissioned a study to assess feasibility of energy storage and possible value to consumers

OREGON mandates electric utilities must procure at least 5 MWh of energy storage by 2020

WASHINGTON regulators have directed utilities to include energy storage in future IRPs

Sources: Industry news; ScottMadden research

FERC Gives an Assist

In February 2018, FERC issued a rule addressing participation of energy storage resources in electricity markets operated by RTOs and ISOs, enhancing their potential revenues in those markets. Specifically, those markets should:

- Allow storage resources to participate in all capacity, energy, and ancillary services markets with products they are technically capable of providing
- Ensure that storage resources can be dispatched and establish the wholesale market clearing price as a wholesale seller and/or buyer (including paying only the wholesale price for charging)
- Account for storage's physical and operational characteristics and set a minimum size requirement that does not exceed 100 kW

Given storage's versatility (distribution and transmission support), federal and state policies will require coordination.

Procurement challenges: apples vs. oranges.

Different Products, Different Prices

- As utilities increase storage procurement activity, comparing the range of options available is becoming more challenging
- Storage providers can offer different features and provide different grid value depending upon technology, scale, battery duration, location (with proximity to load providing theoretically greater benefits), or use case ("clean peak" product, non-wires alternative to transmission distribution (T&D) updgrade deferral, capacity, energy, ancillary services, etc.)

Ownership Models Vary

- Vendors are also offering a range of different ownership/operating models which, in addition to product considerations noted above, can impact pricing proposals
- For example, a vendor may propose outright sale of a system, lease, tolling arrangement (based upon fuel or power price for system charging), or "storage as a service," depending upon which storage capabilities a vendor plans to retain and market to others

So What Am I Paying For?

- Given the heterogeneity of applications and ownership models for energy storage, there is no common unit of price evaluation
- Pricing may take the form of $/MW, $/MWh, fixed or variable payments, or upfront payment, among others
- Storage procurement, then, requires thoughtful consideration of constructs and criteria for evaluating proposals

Energy Storage Has Potential to Provide Multiple Products

Capacity Support

As a supply resource, energy storage can act as additional capacity that provides energy back to the grid when needed to match load or augment existing generation.

Examples:
- Electric energy time shift (arbitrage)
- Variable generation smoothing
- Electric supply capacity
- Capacity deferral/peak demand management
- Spin/non-spin reserves

Customer Services

Storage can be deployed behind the meter to provide a variety of services directly to energy end users. Behind-the-meter storage is expected to grow from 34% of energy storage installations in 2017 to roughly 50% in 2022.

Examples:
- Demand charge management
- Back-up power
- Retail electric energy time-shift/ bill management
- Solar self-consumption
- Microgrids

Grid Support

As a grid resource, storage provides value to T&D systems by allowing T&D owners to defer upgrades, mitigate congestion, and provide ancillary services such as frequency regulation, voltage support, and reserve power to help stabilize the grid.

Examples:
- Peak load shaving
- Frequency regulation
- T&D upgrade deferral
- System ramping, dynamic voltage control
- Hosting capacity optimization
- Congestion relief

Source: ScottMadden analysis

Benefit stacking is necessary—or is it?

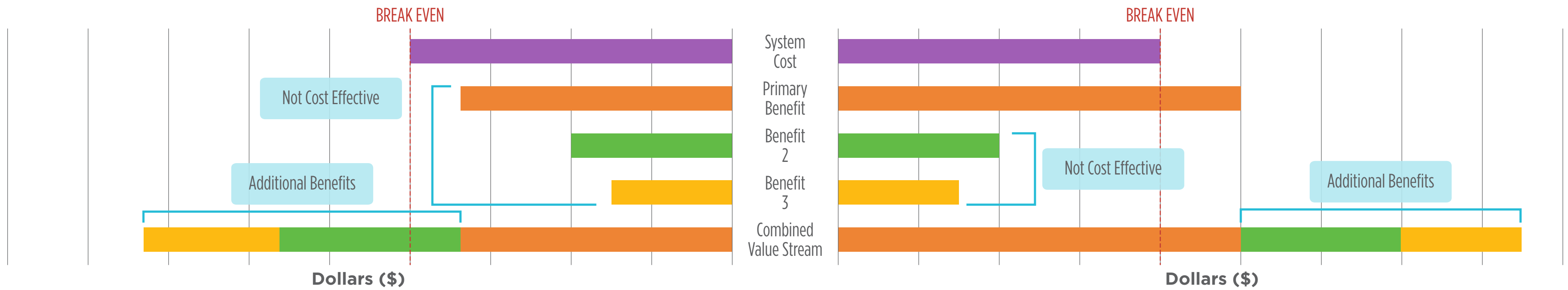
The Benefits of Benefit Stacking

- A key value of storage is its ability to support multiple applications, often with a single asset
- In many energy storage applications, the primary application may only use between 1% and 50% of the storage system's lifetime capacity
- Historically, "stacking" benefits—combining quantifiable avoided costs and additional revenue potential—from multiple applications was necessary in many areas to come up with a positive cost-vs.-benefit determination

Improving Economics

- Energy storage, in some cases, is becoming economical even without benefits stacking (single use cases)
- For example, some recent power purchase agreements for solar-plus-storage applications are seen as increasingly competitive with peaking gas-fired resources (Tucson Electric Power, e.g., signed a PPA for solar plus storage they said had an all-in cost less than 4.5¢/kWh over 20 years)
- Transmission and distribution deferral or non-wires alternatives, especially for geographically challenging wires projects (e.g., under water, environmentally sensitive locations, etc.), can also be economically attractive
    - One example: Arizona Public Service (APS) is installing a pair of 4-MWh battery storage systems instead of upgrading 20 miles of transmission and distribution lines
    - The storage system's primary use case is to provide power during peak days, but APS will gain additional benefit as the system provides grid support services the rest of the year
- Storage can receive the investment tax credit when charged by renewable energy more than 75% of the time

Energy Storage Dependent on Value Stacking for Economic Viability | **Additional Benefits Gained beyond Primary Use Case**



Source: ScottMadden analysis

SOURCES:
Arizona, California, Hawaii, New Mexico, and Washington Utilities Commissions; Bloomberg New Energy Finance, *2018 Sustainable Energy in America Factbook* (February 2018); Arizona Public Service Corporation; FERC Order 841 (issued Feb. 15, 2018); GTM Research & Energy Storage Association, *U.S. Energy Storage Monitor: 2017 Year in Review and Q1 2018 Full Report* (March 2018); industry news; K&L Gates; Maryland Energy Administration; Massachusetts Dept. of Energy Resources; Massachusetts, Nevada, New York, and Oregon legislatures; New Jersey's Clean Energy Program; New York Governor's Office; ScottMadden analysis

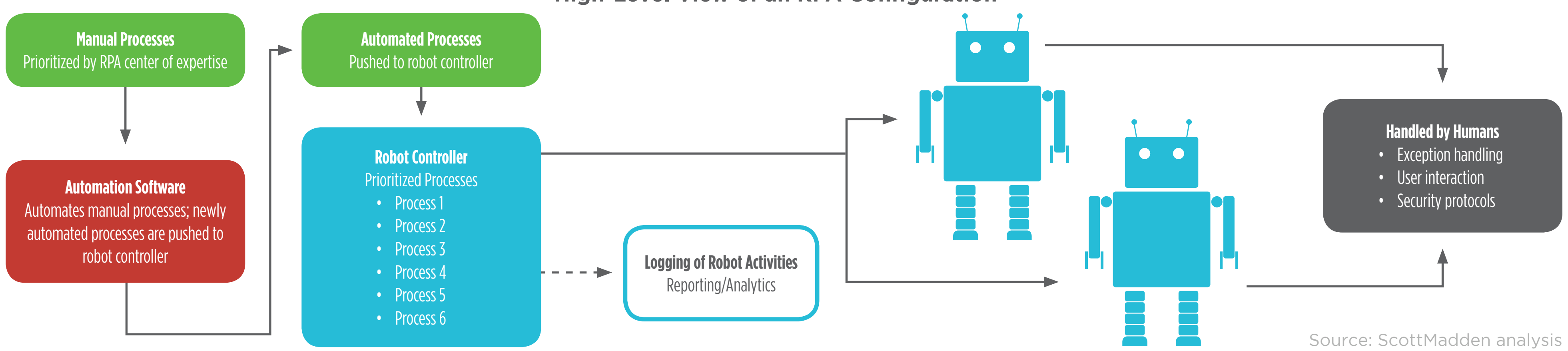
ROBOTIC PROCESS AUTOMATION: A STEP TOWARD ARTIFICIAL INTELLIGENCE

Many companies, including energy and utility companies, are implementing robotic process automation (RPA)—the next iteration of digital transformational tools.

RPA: An Overview

- RPA is the application of a cost-effective software that mimics human action and connects multiple fragmented systems together through automation without changing the current enterprise IT landscape
  - › RPA is not a panacea that will automate an entire process. RPA's "logic-based software" is best used to automate:
    - Manual, repetitive steps in digital systems
    - Time-consuming processes
    - Rule- or logic-driven steps
    - Processes with static rules
  - › RPA can integrate connections between systems that may have been too costly or difficult to join via application integration or enterprise systems
- Automated processes are created in automation software and pushed to the robot controller which manages the robots running these automated processes
  - › RPA defines steps at the "keystroke" level of detail using RPA "bots"
  - › Most RPA products are broadly comprised of three fundamental elements:
    - The automation software allows a user to map the sequences of step-by-step instructions that a robot can follow
    - A robot controller provides a master repository of assigned jobs, schedules and assigns work to robots, and monitors progress
    - The software robots themselves carry out instructions by interacting with business applications to process transactions
- One survey of global business executives says that more than 40% of companies are actively piloting or implementing RPA

High-Level View of an RPA Configuration



Source: ScottMadden analysis

ROBOTIC PROCESS AUTOMATION

Once RPA is explored and implemented, organizations can consider the next evolution to artificial intelligence solutions for selected, non-routine processes requiring judgment.

Finance and Accounting	• Support financial close (data extraction, document population) • Invoice and payment processing • Bank reconciliations • Time and expense review and reporting • A/R and A/P management • Account opening/closure
Metering/Billing Functions	• Elimination of manual intervention for complex billing situations (multiple meters, NEM, consolidated billing, etc.) • Extract and transfer data across systems • Correlation of misreads/meter validation
Audit/Controls	• Continuous monitoring of sensitive data/systems (personal, identifiable information, protected health information, trade secrets) • Cross-system verifications (ensuring payments match bank deposits)
HR	• Recruitment/posting • On- and off-boarding procedures • Training and development • Updating multiple information systems (e.g., leave, change of circumstances, payroll)
Customer Service	• Account setups/disconnections/transfers • Records and complaint management • Cross-platform data references • Automated customer outreach
Supply Chain	• Order and delivery processing and management • Contract term review • Supplier and contract management • Vendor comparison (terms, pricing)
Regulatory	• Tariff reviews • Data extraction and population of regulatory compliance documents, filings, exhibits, work papers
IT	• Data analytics • Routine system maintenance • Help desk management

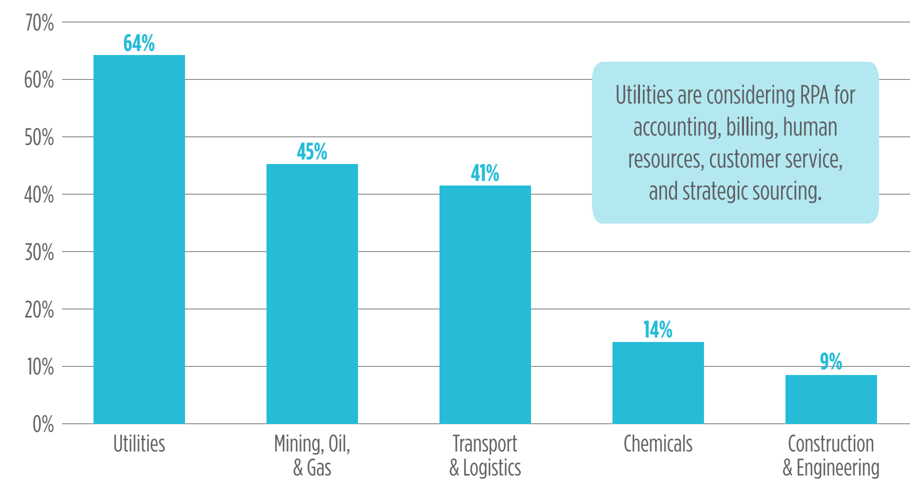
Illustrative Annual Cost for Corporate Functions

RPA Savings Greater than Offshoring Labor

- Enables pilots to be completed in 8 to 12 weeks
- Increases scalability as robotic tools are replicable across geographies and business units
- Reduces human error as automation phases out human intervention
- Ensures a complete and accurate audit trail

Source: ScottMadden analysis

Percent of RPA Vendors Who Have Clients in the Following Selected Industries



Source: ScottMadden analysis

SOURCES:
Intelligent Automation Universe H1 2017 – Software Vendors Market Footprint; Shared Services Outsourcing Network; Utility Dive; ScottMadden analysis

RATE AND REGULATORY ISSUES

BEYOND TRADITIONAL COST-OF-SERVICE RATEMAKING: ALTERNATIVE APPROACHES GET TRACTION

Old models challenged, fresh regulatory approaches needed.

Traditional Unit-Based, Cost-of-Service Ratemaking Worked Well for More Than a Century, but Things Are Changing

- **Slowing energy demand growth:** Reliance on volumetric charges to recover fixed utility costs is not efficient in an environment of slower load growth, slower economic growth, and decreasing unit cost of renewable energy (not to mention utility costs increasing faster than sales)
- **Balancing costs and incentives in a period of change:** Regulators and advocates are seeking the right economic incentives to balance efficient deployment of capital, incentives to innovate, regulatory lag, retention of service quality, reasonable cost of service, and rate base expansion
- **New players and new cost drivers:** States are looking at alternative ratemaking approaches to encourage consideration of DERs, reduce frequency of rate cases, and decouple cost recovery from load growth
- **Policy-driven capital expenditures:** New policy objectives are driving capital expenditures which are unrelated to customer growth and volumetric revenue for utilities (e.g., grid modernization, resilience improvements, cybersecurity needs, and efficiency measures)

Other Industry Forces Are Increasing the Pace of Change and Exposing More Fissures in the Traditional Utility Model

- Renewable energy costs are continuing to decline
- Traditional boundaries between consumers and producers are eroding as more customers are investing in DERs
- Lines between supply and demand resources (i.e., generation and load) are becoming blurred as new technologies, like energy storage, proliferate

Alternative ratemaking mechanisms have been spurred by a desire to improve utility performance, public policy mandates, restructuring of wholesale electric markets, technological progress, and declining electricity demand growth.

Industry Trends That Are Encouraging New Approaches to Ratemaking

Revenue Requirements	Cost-Recovery Mechanisms
• Grid modernization • Renewable resource targets • GHG emissions targets	• Cost causation changes • Peak load/demand management • DERs/net metering • Electric vehicle penetration

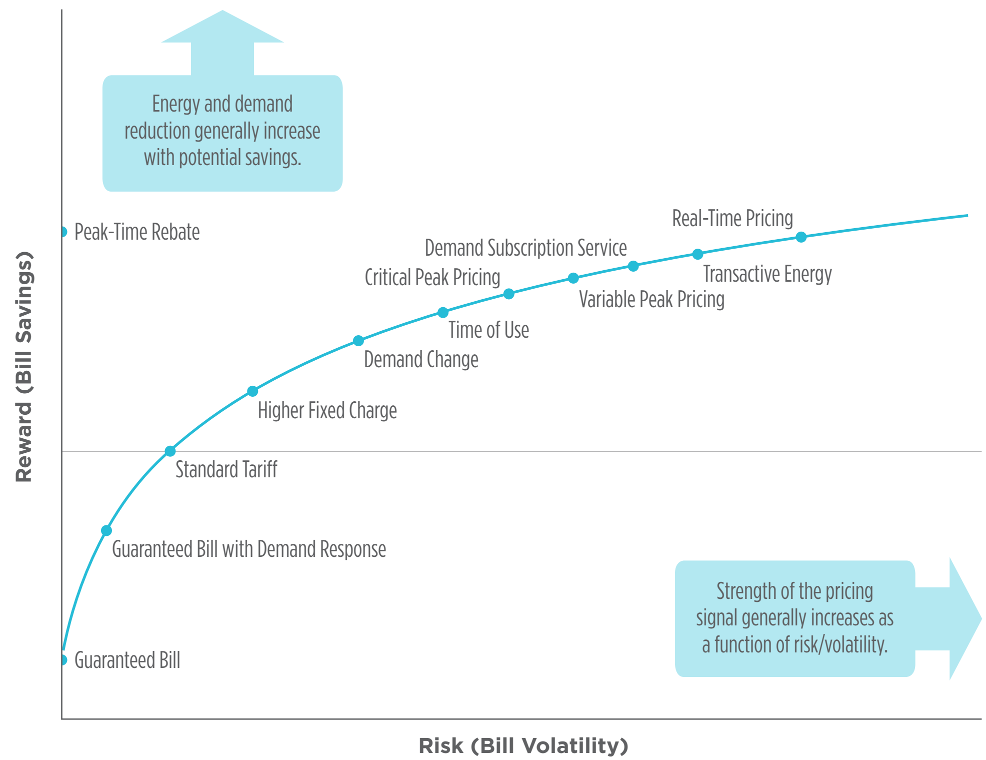
Design thinking meets technology enablement.

Rate design is only one element of the broader ratemaking process undergoing widespread change right now, but a confluence of factors is pushing some "alternative" rate designs out of the lab and into practice as viable mass-market options for large segments of some utilities' customers—and utilities and customers are each finding something to like.

Innovation to Implementation: Beyond Pilots and Demonstrations

- Widespread AMI adoption and implementation is providing utilities and customers with visibility into hourly residential customer energy usage needed to broadly deploy time-variant rate options
- Continued proliferation of consumer technologies is reducing the "transaction costs" of sending and responding to more granular and frequent price signals, and the household appliances equipped for the internet of things are making it easier for customers to automate usage parameters
- Utilities are seeking new tools to accomplish their objectives:
    - Decoupling recovery of fixed charges from volumetric usage and providing revenue stability where usage is declining
    - Promoting EE and demand management measures
    - Reducing or shifting system peak and promoting off-peak system utilization and/or energy usage reduction
    - Deferring system costs and T&D expansion needs
- Customers, too, seeking options, with diverse preferences, including:
    - Reduced volatility – Some customers value more rate/cost stability, and they may be willing to forego the lowest potential cost to get it
    - Increased savings opportunity – Other customers value savings and cost more than stability, and they may be willing to assume more rate/cost risk in exchange for greater opportunities to save
    - Improved control – Many customers are interested in how their behaviors relate to energy usage, and customers want control

Efficient Pricing Frontier: Balancing Potential Bill Savings vs. Potential Bill Volatility



Source: The Brattle Group

The "big three" rate approaches: three rate structures using different forms of time-varying price signals are emerging as mass-market options for utilities.

Selected Time-Variant Electric Rate Approaches

Approach	Time-of-Use Rates (TOU)	Critical Peak Pricing (CPP)/ Critical Peak Rewards (CPR)	Demand Pricing
Definition	Price for usage over (typically) broad blocks of hours is predetermined and constant	Increased price for usage at deemed "critical" periods of high prices or certain system conditions	Charges based on peak demand in previous billing period(s)
Key Design Element	Peak-to-off-peak ratio: The difference between on-peak and off-peak pricing (peak-to-off-peak price (POPP) ratio) is the key driver of customer response	Transaction costs: Cost to send the signal (utility) and cost to respond (customer), combined with customer's ability to respond to the signal	Selection of peak: Type and timing (e.g., coincident vs. non-coincident) must reinforce approach to cost causation (e.g., customer-specific costs driven by non-coincident peak vs. marginal system-level costs driven by coincident peak)
Demand Reduction*	As low as 6% in response to lower POPP differentials to 18% in response to higher price differentials—and higher with technology	11% with rebate pricing structure vs. 25% for CPP structure, and demand reduction increases with both structures when combined with programmable communicating thermostats	Peak-period reductions of 5% to 41%, widely variable and dependent on specific program design
Other Notes	• Trade-off between precision (alignment of design with the system's needs) and practicality (customer's need for simplicity) • Volumetric price	• All programs are tailored to the unique system and customer profiles of each utility, and CPP is often paired with TOU • Volumetric price	• Higher-usage customers are more likely to optin to these programs • Solar PV customers are highly grid reliant and may have limited ability to respond to price signals • Not volumetric
Signal Timing	• Ex ante	• Ex ante	• Ex post
Response Lead Time	• Long lead time–pricing structures are known at the time of enrollment	• Short lead time—event timing might not be known until hours or days in advance	• Long lead time—pricing structures are known at the time of enrollment
Prevalence/ Adoption	• Rates available in 49 of 50 states and D.C., but adoption rates remain low (~4% to 5%)	• Rates available in 49 of 50 states and D.C., but adoption rates remain low (~4% to 5%)	• Residential rates currently offered by ~30 utilities in 17 states (more common for C&I) • Mandatory demand tariffs are being instituted/considered for solar PV customers in some places with high penetrations

Performance-based ratemaking is making a comeback: a Bay State example.

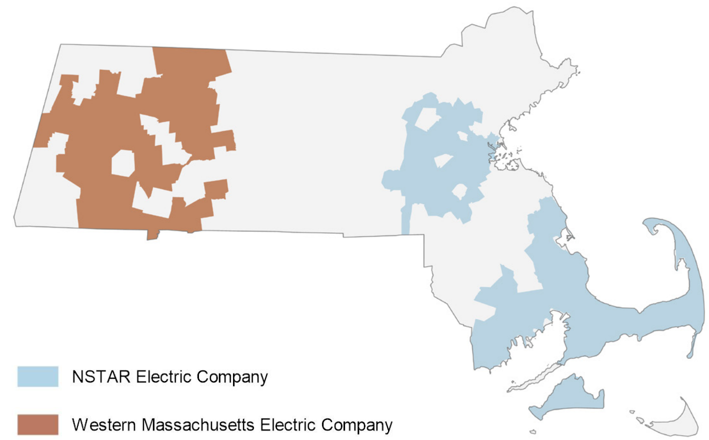
Grid Modernization, DERs, and Net Metering Set the Stage

- Many states, including Massachusetts, have been pursuing grid modernization efforts, partly motivated by increasing or expected DERs (principally rooftop solar)
- Responding to a 2015 mandate, Eversource Energy's Massachusetts utilities proposed $400M in incremental capital investment over five years
- Massachusetts has had NEM since 1982, but it has been subject to caps. Interest in net-metering has been increasing, and in April 2016, net-metering caps (as % of historic peak load) were increased to 15% or 1,727.25 MWs
- Credits for net-metered energy are at the retail rate, except solar net-metered facilities allocated to the cap after January 8, 2017, are credited at 60% of the full retail rate

Eversource Proposes Monthly Charges and Performance-Based Rates

- As a compromise for increasing NEM caps, implementing electric vehicle and storage projects, and recognizing potential cross-subsidization issues, Massachusetts regulators approved a "Monthly Minimum Reliability Charge" (MMRC) proposed by Eversource
- This MMRC includes a mandatory demand charge, higher monthly customer charges, and lower per kWh charges
- In tandem with MMRC, regulators approved a performance-based rate mechanism that included the following:
    - An annual rate adjustment, pursuant to a revenue cap formula (unaffected by the number of customers), which would be a substitute for its traditional capital cost-recovery mechanism
    - Five-year performance targets, intended to reduce the number of base rate cases
    - Performance metrics, to be determined, focused on improvements to customer service and engagement, reductions in system peak, and progress toward climate adaptation and GHG reduction
    - An earnings-sharing mechanism, with a 200-basis-point deadband: Incremental earnings of 200 basis points or more above allowed ROE (10%) will be shared—75% to ratepayers; 25% to Eversource
- The demand charges are controversial, and solar energy advocates will be watching to see what impacts this mechanism will have on solar development in Massachusetts

Eversource Energy Electric Service Territory in Massachusetts



Source: S&P Global Market Intelligence

> At the same time as its sales are declining,...[Eversource's] distribution system is growing and its capital and operating costs are increasing in ways that it has not experienced in the past... The approach we adopt must address lost sales growth and allow Eversource to best meet its public service obligations...and ensure that the Commonwealth's clean energy goals are met.
>
> — *Massachusetts Dept. of Public Utilities*

Changing paradigms: what are the rewards and risks?

Key Issues and Considerations with Adjustment of Regulatory Paradigms from Cost-Based Regulation to Other Models	
Behavioral Shifts and Customer Acceptance	• Alternative rate mechanisms can effect state policy objectives, e.g., GHG emissions reduction, renewables, and EE • While regulatory and financial incentives can play a significant role in behavior, conservation and efficiency require longer-term shifts in those incentives • Customers may object to paying as much or more on their utility bill, while consuming less • Customers' stated preferences (e.g., efficiency) may be belied by actual responses
Stranded Investment	• Switching regulatory models can lead to some stranded investment, which will require debate over what losses should be compensable, how much should be awarded, and how to recover those costs
Cost Causation	• While hotly debated, some mechanisms (e.g., grid charges) attempt to ensure against cross-subsidization
Timely Recovery	• Performance-based mechanisms can provide stable funding with incentives for utility operating efficiency
Time Horizon	• Current system and regulatory framework were developed over decades; unwinding or transitioning will likewise take time
Proving the Counterfactual	• Performance-based regulation (PBR) frequently involves judging utility performance vs. what it would have been without PBR, which invites contentious interpretations if costs are not what advocates believe they "should" be
"Regulation Leakage" Risk	• Initial transitions to new models with new incentive schemes in isolated areas may lead to unintended temporary reliance on adjacent systems still under the traditional model for reliability, supply adequacy, and cost containment—though this will be less likely if new incentives become more uniform and prevalent
Accountability	• Unclear how traditional utility regulatory concepts are applicable—obligation to serve, used and useful, just and reasonable rates, prudence, etc.—translate equitably to all players in some new regulatory models
Level Playing Field	• Depending upon the regulatory model (i.e., degree of third-party vs. utility service competition), utility may have incumbency, affiliate, and brand advantages that need to be accounted for

NOTES:
*Upper and lower bounds of ranges above estimated from ScottMadden synthesis of recent research on assorted recent pilots from utilities around North America.

SOURCES:
The Brattle Group, “A Walk on the Frontier of Rate Design,” presented at Western Farmers Electric Cooperative’s Residential Demand Workshop, Oklahoma City, OK (Oct. 5, 2017), Rocky Mountain Institute; SmartGrid.gov; U.S. Dept. of Energy; National Association of Regulatory Utility Commissioners; American Public Power Association; S&P Global Market Intelligence/Regulatory Research Associates; Massachusetts Dept. of Public Utilities; Massachusetts Net Metering Guide, at https://www.mass.gov/guides/net-metering-guide, accessed Apr. 17, 2018; Database of State Incentives for Renewables & Efficiency; industry news; ScottMadden research

CLEAN POWER PLAN REPEAL AND REPLACEMENT: WHAT'S NEXT?

EPA repeals the Clean Power Plan...

EPA Reverses Course

- In October 2017, EPA proposed a rule repealing the controversial Clean Power Plan (CPP)
- The CPP had been embroiled in litigation (West Virginia vs. EPA) and was in the process of rehearing before the federal D.C. Circuit Court of Appeals

Points of Contention

- The key issues in litigation, as well as among the current EPA administrator's objections, were the following:
  - *Inside the fence:* The CPP regulates emissions from one thing with rules about another. "Best system of emissions reduction" in the past has always referred to the source of emissions (i.e., the plant inside the fence) not steps the owner could take with other sources at other locations
  - *State policy:* The CPP crosses the line into state jurisdiction over energy policy. CPP's building block structure—(1) heat rate improvement, (2) shifting generation to lower-emitting natural gas combined-cycle units, and (3) substituting zero-emitting renewable resources—constitutes broad energy policy, which is the province of the states and goes beyond the text and prior interpretation of the Clean Air Act (CAA)
- EPA proposed repeal as necessary since CPP could only work with generation shifting, so removing those "outside the fence" building blocks would not be sufficient to permit compliance
- Debate over the propriety of repeal continues, as environmental organizations and some states challenge the sufficiency of analysis behind repeal, while others will await the outcome of both repeal and replacement activity

Tallying Costs and Benefits

- Key in EPA's regulatory impact analysis, which is being finalized, is its divergence from the Obama EPA's cost-benefit analyses supporting the CPP, in particular:
  - Narrowing social cost of carbon, limiting domestic benefits vs. the global benefits used by the Obama administration
  - Eliminating reliance on co-benefits (meaning benefits from deduction in non-carbon emissions) (i.e., particulate matter and ozone) because of data gaps and uncertainty in benefits
  - Changing from a reduction in CPP cost to a "benefit"
- EPA estimates those and other adjustments it now thinks are appropriate add up to $33B in costs to be avoided vs. Obama EPA calculations of $8.4B

What a Long, Strange Road It's Been: Timeline for Selected EPA GHG Regulatory Activity

2006

April 2, 2007
GHG regulation authority upheld by Supreme Court (Massachusetts vs. EPA)

December 15, 2009
EPA endangerment finding that GHGs endanger public health and welfare

June 20, 2011
Supreme Court holds that EPA has primacy in regulating GHGs from power plants (American Electric Power vs. Connecticut)

August 3, 2015
CPP promulgated

February 9, 2016
CPP challenged in federal court; Supreme Court stays implementation

September 2016
First compliance date under original CPP (state implementation plan)
D.C. federal appeals court hears CPP challenge en banc (West Virginia vs. EPA)

March 2017
Executive order to revisit "burdensome" regulation

October 2017
EPA proposes repeal of CPP (NOPR)

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

February 26, 2018
Deadline for comments on CPP replacement ANOPR

April 26, 2018
Deadline for comments on CPP repeal NOPR

December 2018
Possible date for action on NOPR and ANOPR (posited by some observers)?

2019+

…But floats an inquiry on a CPP replacement.

ANOPR Issued with Comments on a Short Fuse

- In December 2017, EPA released an advance notice of proposed rulemaking (ANOPR), seeking input into GHG guidelines for existing generating units that would succeed the CPP
    - In the ANOPR, EPA acknowledged that the endangerment finding upheld the Supreme Court decision in Massachusetts vs. EPA, which held that the CAA was broad enough so that GHGs constituted air pollutants within the meaning of the CAA
    - Interestingly, while some states and industry advocates have urged EPA to reverse the endangerment finding that motivates a CPP successor rule, EPA did not question its jurisdiction to regulate GHGs in the ANOPR
- The ANOPR contemplates replacing the CPP with a possible new existing source GHG regulation under 111(d) of the CAA
    - Section 111(d) provides that states "take the first cut" at standards of performance and implementation and enforcement
    - EPA, in the ANOPR, seeks comments on roles, responsibilities, and limitation of state and federal government and the appropriate scope of a rule and associated technologies and approaches (see table)

Preparing to Play Defense?

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

Selected Themes in Comments on New Guidelines for Existing Generating Units (EGUs)

- Roles and responsibilities of the states vs. EPA and the role of EPA in developing emission guidelines and discretion of states to depart from guidelines
- How to define "best system of emission reduction"
- Whether emission guidelines should include limits that are "presumptively approvable" if adopted by states and whether there should be binding federal emissions rates
- Use of carbon capture and storage (CCS) as a compliance option and whether to adopt approach in current New Source Performance Standards for CCS
- Criteria for determining "affected sources" (e.g., minimum MWs, technology type, etc.) under a new rule
- Interactions between GHG limits for existing sources and other programs (e.g., New Source Review, New Source Performance Standards, permitting criteria)
- Potential for tailored, unit-by-unit standards and possible subcategorization (e.g., remaining useful life or boiler/turbine type, fuel, and operating profile of EGU)
- Potential for and effect of heat rate improvement, given changes in historical operation of units, response to variable demand, and impact of "rebound effect" from such improvement
- Use of rate-based vs. mass-based standards and any requirements to facilitate trading, including translation of compliance instruments between schemes, including between state and federal schemes

Some states and cities move forward with their own GHG reduction efforts.

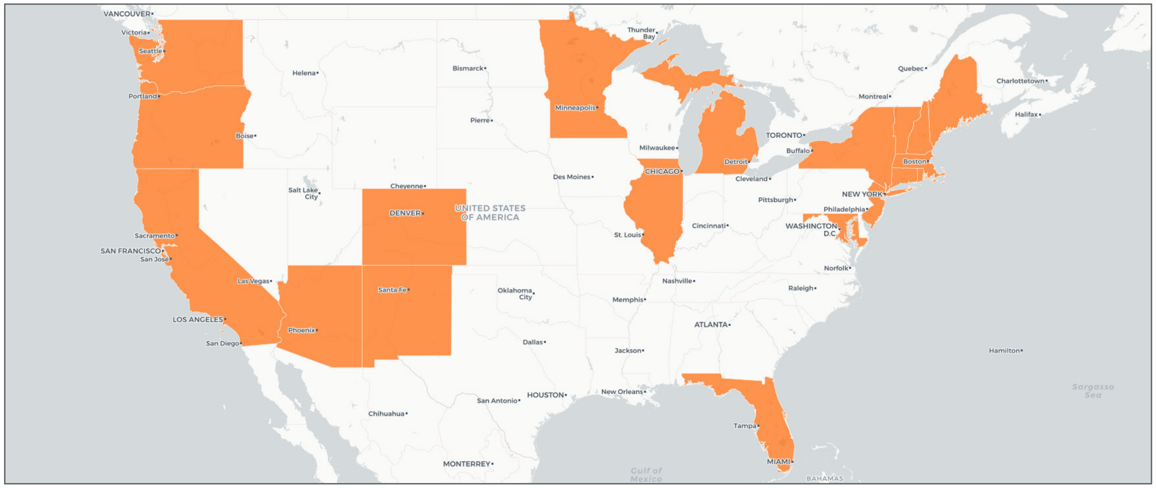
Moving Ahead with More Local Approaches

- In the wake of President Trump's withdrawal from the Paris Agreement, states and cities have continued to pursue both GHG reduction and, in many cases, voluntary action consistent with the goals of the agreement
- As of October 1, 2017, 20 U.S. states and 110 U.S. cities have enacted GHG targets
- Moreover, 20 states and 455 cities have pledge to support the Paris Agreement through non-federal policies

Some Notable Recent Activity

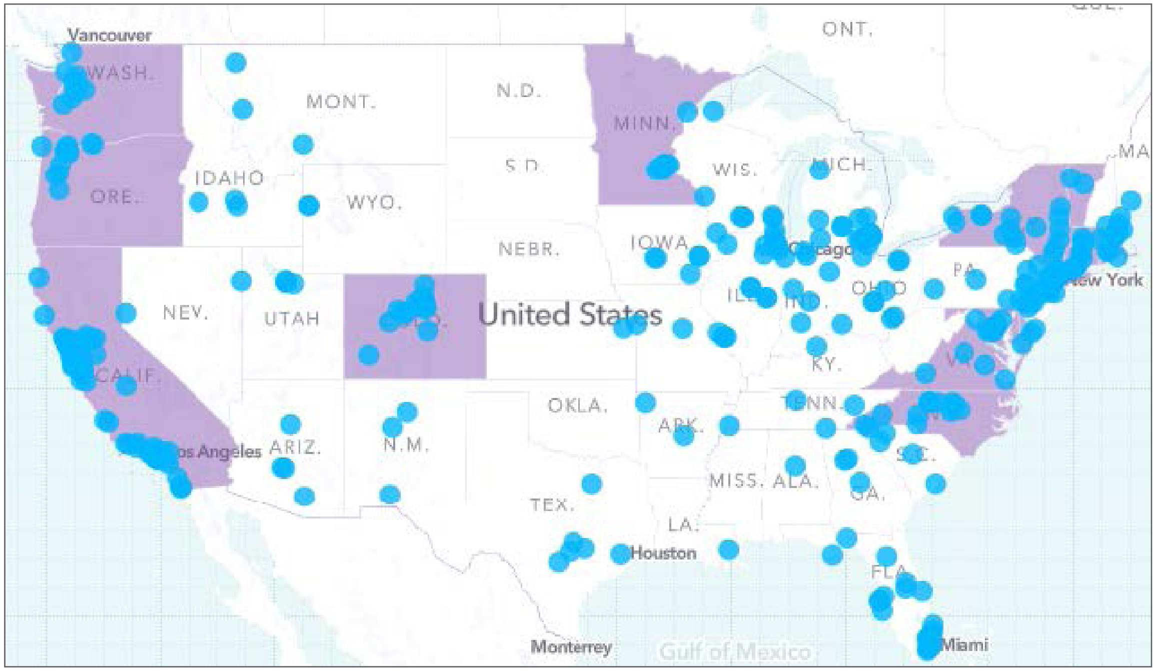
- California, which had an existing cap-and-trade program for GHGs (1990 levels by 2020), extended that program, with a target 40% below 1990 levels by 2030. This legislation also, among other things:
  - Directs regulators to set a GHG allowance price ceiling
  - Establishes "price containment points" for allowances
  - Limits offsets and use of out-of-state credits
- New Jersey and Virginia have responded by pursuing re-joining and joining, respectively, the Regional Greenhouse Gas Initiative, likely by 2020
- Further, in May 2017, Virginia's governor instructed the Virginia Department of Environmental Quality to develop regulations to reduce carbon emissions from power plants through existing authority under state law
- Some states continue to pursue GHG reductions through renewable portfolio standards. Hawaii, for example, has become the first state in the nation to commit to achieve 100% renewable electricity (by 2045), with interim targets of 30% by 2020, 40% by 2030, and 70% by 2040

U.S. States with GHG Emissions Targets



Source: Center for Climate and Energy Solutions

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



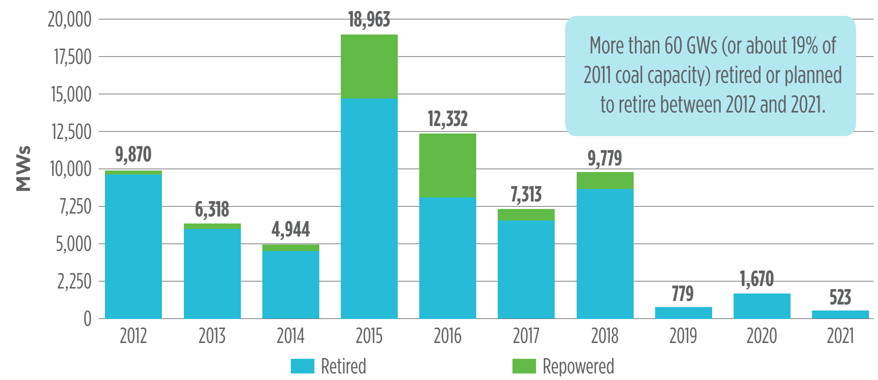
Source: Bloomberg New Energy Finance

But will it matter?

Fossil Units Are Still under Pressure

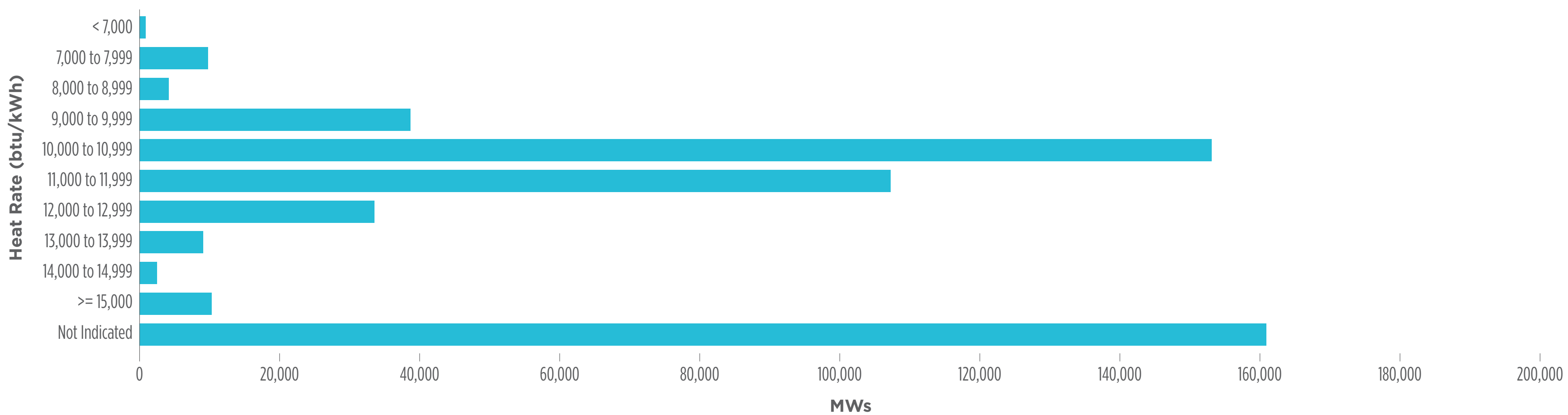
- Despite uncertainty around ultimate implementation of the CPP, more than 49 GWs of coal-fired generation have been retired between 2012 and 2017, with about 11.6 GWs scheduled from 2018 to 2021
- Some plants have been repowering to gas, and to a lesser extent biomass, with more than 14.5 GWs having proposed or completed conversion since 2011
- Of the remaining units, a majority have heat rates of 10,000 btu/kWh or greater (compare average estimated heat rates in PJM between January and September 2017 of 6,679 btu/kWh for combined-cycle units and 9,250 BIC/kWh for coal plants)
- It remains to be seen how much current fossil-fueled generation might need to remain for grid stability, pending replacement with other resources

U.S. Announced and Actual Retired and Repowered Coal-Fired Generating Capacity by Effective Year (MWs) (as of March 2018)



Sources: S&P Global Market Intelligence; ScottMadden analysis

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



Sources: S&P Global Market Intelligence; ScottMadden analysis

NOTES:
*Hawaii and Puerto Rico have also pledged to the Climate Alliance but are not visible on the map. Other state members not clearly visible include Massachusetts, Maryland, Rhode Island, Vermont, and Delaware. **Includes combined-cycle, steam turbine, and integrated gasification technologies only.

SOURCES:
Advanced Notice of Proposed Rulemaking, State Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units, Docket No. EPA-HQ-OAR-2017-0545, 82 Fed. Reg. 61507 (Dec. 28, 2017); Congressional Research Service, Clean Power Plan: Legal Background and Pending Litigation in West Virginia vs. EPA (Mar. 8 2017); industry news; Inside EPA; Megawatt Daily; Monitoring Analytics, LLC, *Q3 State of the Market Report for PJM: January through September*, Section 7, Table 7-3 (Nov. 9, 2017); Proposed Rule, Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Generating Units, Docket No. EPA-HQ-OAR-2017-0355, 82 Fed. Reg. 48035 (Oct. 16, 2017); S&P Global Market Intelligence "Coal Retirement Plans Increasing Despite Federal Focus on Grid Reliability" (Oct. 11, 2017); S&P Global Market Intelligence; ScottMadden analysis

CLEAN TECH AND ENVIRONMENT

UPDATE ON EUROPE:
HEAD OF THE CLASS OR MIDDLE OF THE PACK?

The Smart Electric Power Alliance and ScottMadden fact-finding mission to Europe explored progress in two countries as they transition and scale toward a clean energy future.

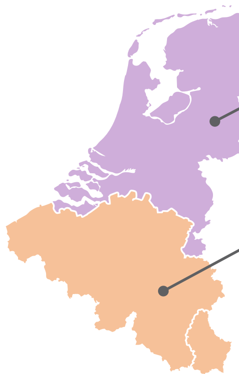
The Grass Seems Greener on the Other Side of the Pond

- Europe is often perceived as highly adept at transforming to a clean energy future because of their growing renewable capacity, declining GHG emissions, and emerging smart city activities
- In October 2017, utility executives from the United States traveled to Belgium and The Netherlands to view the progress and identify key lessons
- Contrary to expectations, we found Europeans actually struggling with many of the same challenges being addressed in the United States

The Key Strength in Europe Is a Long-Term Vision

- Through a top-down approach, Europe has adopted significant long-term climate and energy policies (see right)
- The long-term commitments to decarbonize provide energy companies and electric utilities clarity and an opportunity to align business strategies with a long-term vision
- We expected this alignment to provide a clear pathway to new technologies and business models, yet we found many investments still do not make sense under strict business case assumptions
- Instead, those making progress were changing their culture to invest for the long term, even if the short-term business case is not clear
- Among these companies, the common approach was to make small bets, fail fast, and learn from the experience

Belgium and The Netherlands: Adjacent but Different



The Netherlands
- Generation fuel mix: 15% renewables; 46% gas; 35% coal; 4% other
- Electric consumption per capita: 6.73 MWh
- CO_2 emission per capita: 9.21 tons

Belgium
- Generation fuel mix: 18% renewables; 53% nuclear; 25% gas; 3% other
- Electric consumption per capita: 7.59 MWh
- CO_2 emissions per capita: 8.25 tons

European Union Decarbonization Targets

2010

2020:
- 20% reduction of GHG emissions
- 20% minimum share of renewables
- 20% improvement in EE

2030:
- 40% reduction of GHG emissions
- 27% minimum share of renewables
- 27% improvement in EE

2040:
- 60% reduction of GHG emissions

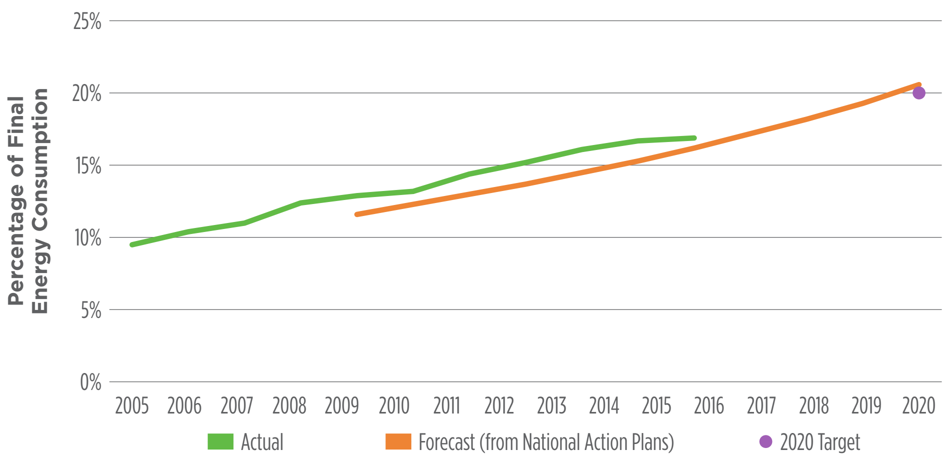
2050:
- 80%–90% reduction of GHG emissions

2060

The Results Indicate Impressive Progress on Renewable, Climate, and Smart City Efforts

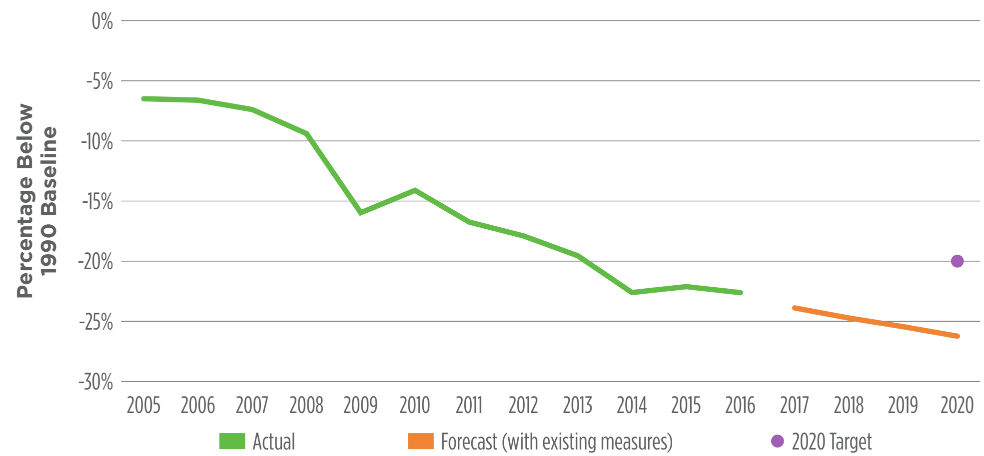
The European Union is on track to obtain 20% of energy consumption from renewable resources by 2020 and has already surpassed its target to reduce GHG emissions by 20% by 2020.

Renewable Energy Use in European Union



Sources: Edie.net; European Environment Agency

GHG Emissions in European Union



Sources: Edie.net; European Environment Agency

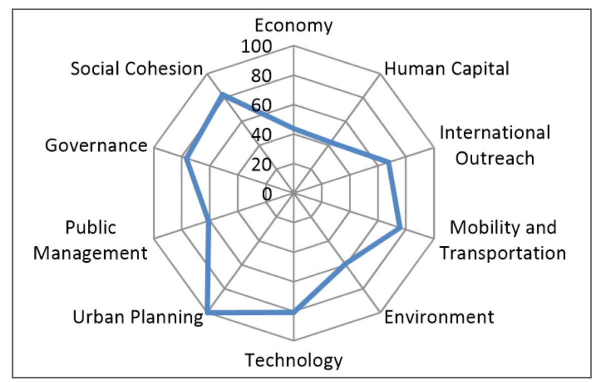
Europe's Smart City Aspirations

The IESE Cities in Motions Index—a prominent smart city ranking—evaluates 180 cities across 52 criteria in 10 key dimensions: economy, human capital, technology, the environment, international outreach, social cohesion, mobility and transportation, governance, urban planning, and public management. In 2017, Europe accounted for 9 of the top 25 cities.

Global Rank of European Smart Cites

#2 – London
#3 – Paris
#9 – Berlin
#10 – Amsterdam
#13 – Zurich
#15 – Vienna
#17 – Geneva
#19 – Munich
#25 – Stockholm

Amsterdam's Smart City Attributes



Source: IESE Business School

Amsterdam's Innovative ArenA

In 2016, the Amsterdam ArenA—an outdoor sports stadium—announced Nissan and Eaton would repurpose 280 new and used Nissan Leaf batteries to create a 3-MW energy storage system to provide back-up power and grid balancing services.

A Lurking Challenge Remains: Integration of DERs

- Despite the appearance of progress, Europe does not have all the answers as they work to move DERs from pilot to scale
  - *Market Rules*: Europeans are still determining market rules and the role of each stakeholder. One pressing question: Who should set standards and manage DERs? In particular, should it be the transmission or distribution system operators?
  - *Data Management*: In the world of big data, European stakeholders are struggling to tease out valuable insights while addressing a litany of concerns from data privacy to cybersecurity. In order to address cyber concerns, one utility went so far as disabling the remote disconnect of AMI meters. Europeans are actually looking to the United States for data management models
  - *Business Models*: Despite demonstrating possible applications of new technologies, the business models currently do not support scaling. For example, some innovative vehicle-to-grid technologies being demonstrated aggregate electric vehicle batteries, but there currently is no source of compensation for the potential grid services in the current market structure at the distribution level

Key Lessons Focus on Vision, Culture, and Perseverance

- Despite the surprises, there were clear lessons for electric utilities in the United States:
  - **Develop long-term vision**
    - The United States should not expect a European-style climate vision
    - Instead, electric utilities should ask internally: What are we for?
    - Once defined, work to align stakeholders around long-term vision
  - **Shift culture to align with long-term investments**
    - Use long-term vision to shift culture to long-term investments
    - Even if business case fails, small bets aligned with long-term vision can provide valuable learning opportunities
  - **Persevere with DER learning curve**
    - There is no fancy technology that simplifies adoption and scaling of DERs
    - Utilities must continue to do the hard work of integrating DERs
    - In addition, continue to monitor progress being made in Europe

SOURCES:
Edie.net; European Environment Agency; IESE Business School; IEA, Belgium and Netherlands Energy System Overviews (2016 data); SEPA Belgium & Netherlands Executive Fact-Finding Mission (Oct. 2017)

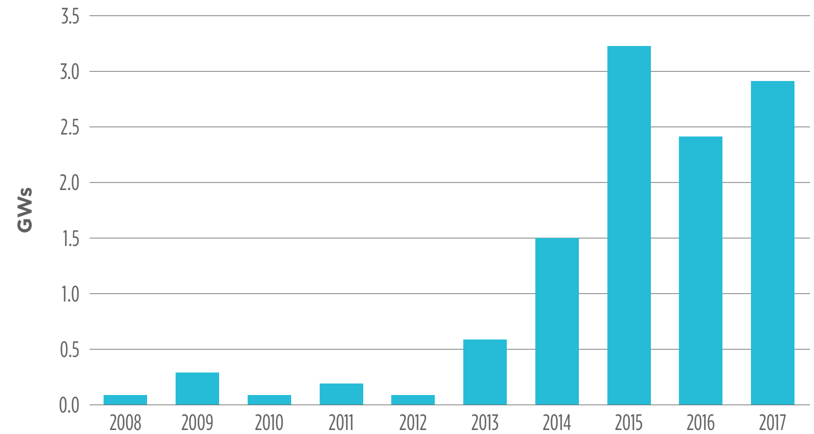
CORPORATE RENEWABLE POWER PURCHASE AGREEMENTS: A BOOST FOR RENEWABLE ENERGY DEVELOPMENT

Corporate renewable power purchase agreements (PPAs) are growing, but there are complexities.

Trends in U.S. Corporate Renewable PPAs

- In a recent survey, large corporations signaled the top reasons for renewable energy procurement are to address climate goals and demonstrate corporate leadership
- Corporations have a growing number of options when procuring renewable electricity: develop customer-owned, on-site generation, purchase renewable energy certificates (RECs), participate in utility green tariffs, or sign a PPA directly with a renewable energy project
- Often cited as a key driver for renewable energy growth, new corporate renewable PPAs in the United States totaled 2.9 GWs in 2017, down from a 2015 peak of 3.2 GWs with cumulative contracted capacity from all corporate renewable buyers totaling nearly 12 GWs (see chart)
- Companies signing corporate PPAs include big names from many different sectors: Alphabet, Amazon, Dow Chemical, Facebook, General Motors, Microsoft, Procter & Gamble, and Walmart
  - The majority of corporate renewable PPA contracts are for wind resources, due to their competitive economics
  - The largest U.S. corporate renewable buyers, Google and Apple, had each secured more than 500 MWs of capacity in U.S. generation in 2017 (see chart)
  - A recent Moody's report cites three common attributes among corporate renewable buyers: high credit ratings, significant financial flexibility, and robust liquidity
- The corporate renewable PPA trend is likely to continue as corporate buyers and nonprofit stakeholders organize, share lessons learned, and set aggressive goals
  - The Renewable Energy Buyers Alliance seeks to help corporations purchase 60 GWs of additional renewable energy in the United States by 2025
  - As of March 2018, 127 companies committed to 100% renewable electricity through the RE100 Initiative; the commitments reflect more than 161 TWh/year of global electricity demand

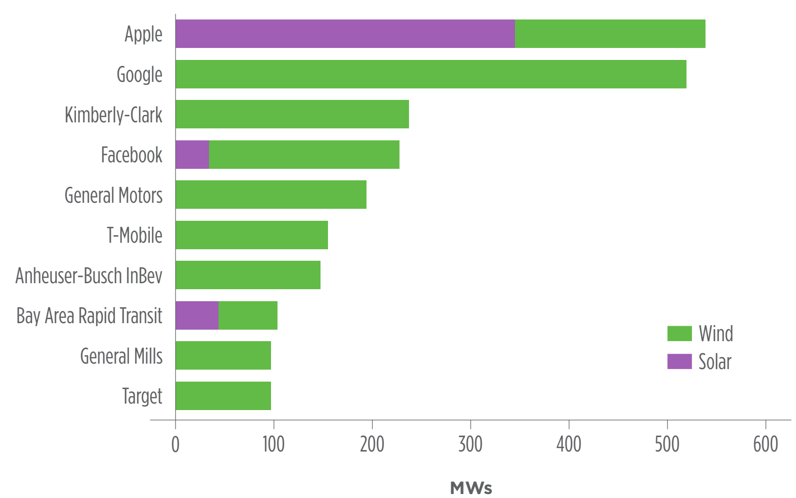
Annual U.S. Renewable Capacity Contracted by Corporations (in GWs)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cumulative (GWs)	0.1	0.4	0.5	0.7	0.8	1.4	2.9	6.1	8.5	11.4

Source: BNEF

Renewable Contract Volume by Largest U.S. Corporate Offtakers in 2017 (by Type)



Source: BNEF

CORPORATE POWER PURCHASE AGREEMENTS

There are two types of corporate renewable PPAs: physical and virtual.

A Physical or "Sleeved" PPA

Designed to provide a contract path for physical delivery of renewable energy to a corporate buyer

- Physical PPAs function similar to the PPAs signed by electric utilities:
    - A corporate buyer signs a contract with a renewable project for energy and RECs
    - A simultaneous contract with a "sleeving fee" is signed with a utility or energy service provider (ESP); it authorizes the entity to offtake and manage energy from the renewable project and covers transmission costs
- Physical PPAs are well suited for corporate buyers seeking renewable generation for a single facility within the same electric region or market as the facility (e.g., PJM)

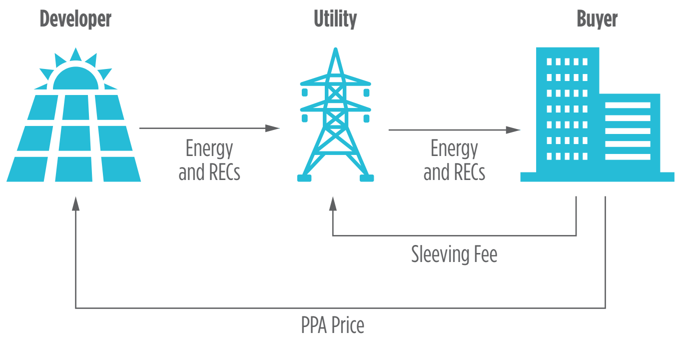
A Virtual or Synthetic PPA

Provide greater flexibility by avoiding the complexity of a set of contracts for physical delivery of energy

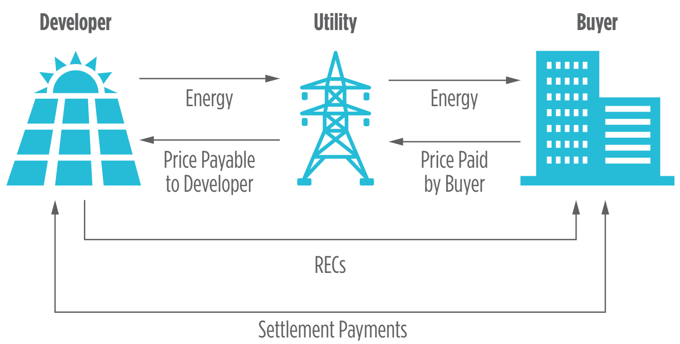
- Virtual PPAs are often structured as a contract for differences, providing a renewable project a floor price for its electrical output
    - A corporate buyer signs a contract with a renewable project for energy and RECs at fixed rate or strike price
    - The renewable project sells energy into wholesale market and receives a market payment, while the corporate buyer purchases electricity from their normal provider (e.g., utility or ESP)
    - The virtual PPA is "settled financially" between the corporate buyer and renewable project on a net basis (e.g., once a month)
        - The renewable project sends the corporate buyer a settlement payment if the wholesale power price is above the strike price
        - The corporate buyer sends the renewable project a settlement payment if wholesale power price is below the strike price
    - RECs generated from the renewable project are transferred to the corporate buyer
- Virtual PPAs are attractive when the corporate buyer is offsetting load at multiple locations or when the buyer and seller are not in the same electric region or market

Corporate Renewable PPA Structures

Physical PPA Structure



Virtual PPA Structure

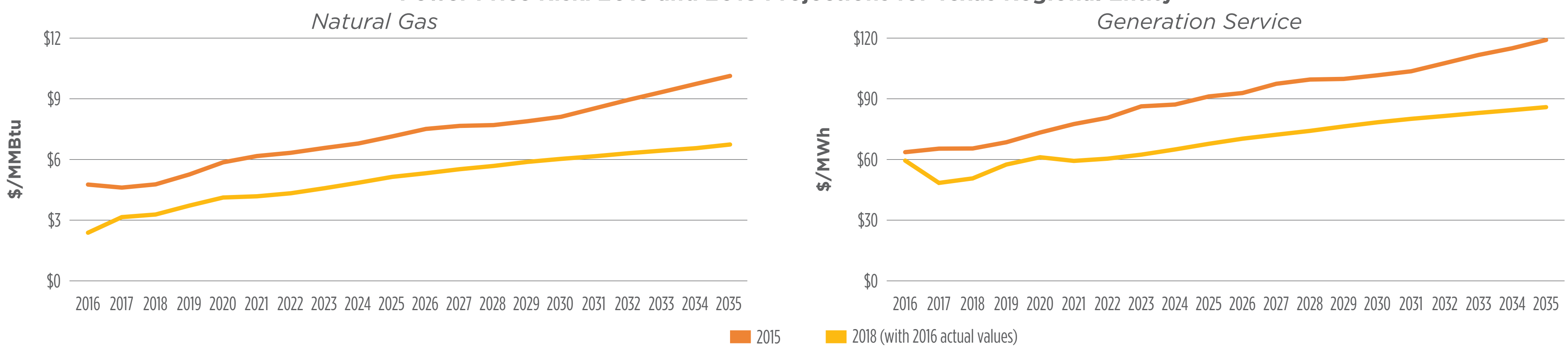


Sources: WBCSD; ScottMadden

The Challenges and Implications of Virtual PPAs

- Virtual PPAs, which are a popular approach among corporate renewable buyers, come with unique challenges that must be addressed
    - **Power Price Risk** – While PPAs' prices may mitigate price volatility, that is different than guaranteeing the lowest price. Low natural gas prices have driven down wholesale power prices (see chart below). Market participants note that early corporate PPAs may be underwater (i.e., buyers are paying more for renewable electricity than the current wholesale price of electricity). More corporate renewable buyers may begin to use protective puts and other financial measures to hedge risk, introducing complexities and risks of their own
    - **Basis Risk** – This represents the price differential between the node where the power enters the electric grid and the trading hub where power is settled. Price differential can be significant in regions with considerable development of renewable resources (e.g., ERCOT and SPP). Some early corporate buyers encountered unexpected basis risk. To reduce risk, corporate renewable buyers are opting for contracts in markets with less renewable penetration
    - **Accounting Treatment** – Synthetic PPAs may require derivative accounting treatment which results in the contract appearing in the corporate balance sheet and being regularly marked to market. Corporate renewable buyers often involve accounting teams very early in deals to ensure PPAs are structured to avoid derivative accounting

Power Price Risk: 2015 and 2018 Projections for Texas Regional Entity



Source: EIA

- The growing corporate PPA trend may have widespread implications ranging from corporate supply chains to electric system planning
    - With many big corporations setting aggressive renewable goals and signing PPAs, the next frontier is driving corporate PPAs into the supply chain
        - For example, Walmart announced Project Gigaton in April 2017 an effort to remove a gigaton of GHG emissions from its supply chain by 2030
    - Energy service providers are now offering specialized services to corporate renewable buyers
        - Some of the larger players include MP2 Energy (which was recently acquired by Shell), Altenex (a subsidiary of Edison International), and Renewable Power Direct (which has a services agreement with Tenaska Power Services)
    - In addition, matchmaking platforms are emerging from companies, such as LevelTen Energy, to aggregate demand from several buyers and match to renewable project

  - Some market participants have even suggested corporate renewable buyers are beginning to influence the electric system as new capacity is being directed to where corporate PPAs are easiest to structure, rather than locations that align with traditional system planning
- Utilities may offer "green tariffs" as an alternative to corporate renewable PPAs, but these are not without their own challenges
  - Seventeen green tariffs in 13 states have brought online just 0.9 GW of new renewables since 2015
  - Green tariff models have proven useful for new load, but challenges exist in providing options to existing load without stranding existing generation assets—the Puget Sound Energy Green Tariff is the only program that matches existing load to new renewable generation

Spotlight on Google: Sourcing 100% Renewable Energy

- In 2012, Google committed to purchase enough renewable energy to match 100% of global operations (i.e., data centers and offices)
- The company reached the milestone in 2017 by directly purchasing 2.6 GWs of renewable energy and associated RECs in five countries across three continents
- An important nuance is Google's annual and global approach: Total purchases equal total consumption, but purchases do not necessarily match load or even exist on the same electric grid
- As the largest global corporate purchaser of renewable energy, Google's stated ambitions for the future include:
  - A more regional approach to renewable energy procurement (e.g., purchasing renewable energy on grids that support operations)
  - Pursuit of 24/7 clean energy (e.g., leveraging technologies that can provide renewable energy on an hour-by-hour basis every day of the year)

"This Green Energy Is for You"

In January 2018, AB InBev announced that the Budweiser brand switched all U.S. brewing to renewable electricity, and a 100% renewable energy label would appear on U.S. bottles and cans. Renewable electricity is procured from the 300-MW Thunder Ranch Wind Farm in Oklahoma.

Marketing Renewable Energy Claims Requires Careful Wording

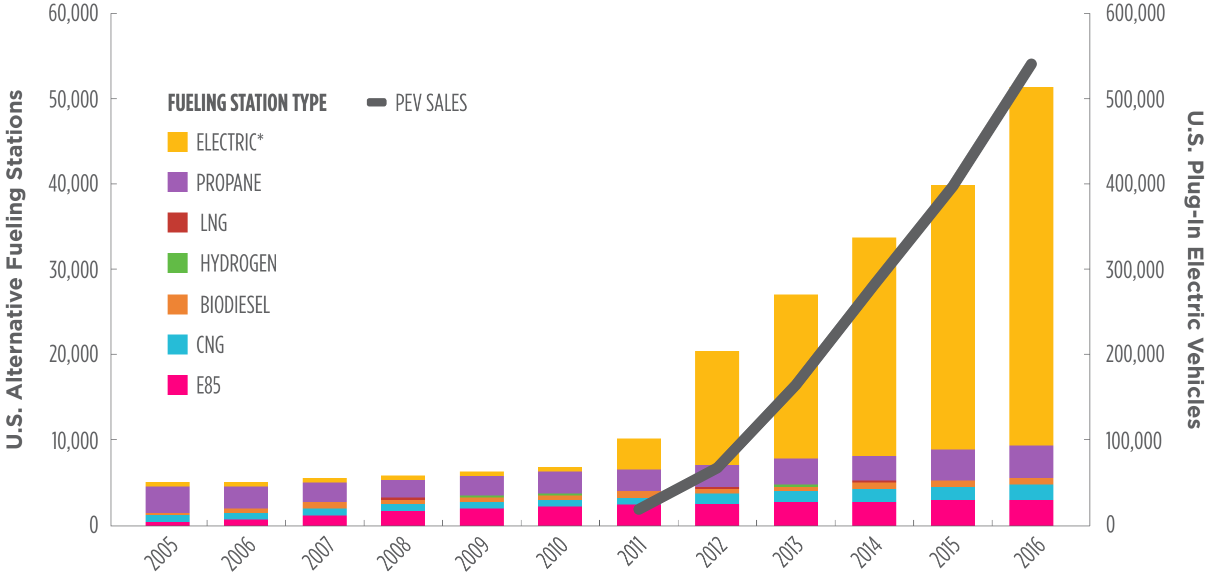
- Since 1996, the Federal Trade Commission (FTC) has issued "Green Guides" to help marketers avoid making environmental claims that mislead consumers
- In 2012, the FTC expanded guidance to include renewable energy marketing claims
- Corporations must carefully consider both marketing claims and REC accounting
  - In order to claim a product is "made with renewable energy," all processes must be powered with renewable energy or non-renewable energy matched by RECs which are retired by the company
  - A company that manufacturers with non-renewable electricity but assembles with renewable electricity may only claim "assembled using renewable energy"
  - A company that generates on-site renewable electricity (e.g., rooftop solar) and sells the RECs may not claim it uses renewable energy

SOURCES:
Apex Clean Energy; Baker McKenzie; BNEF; EIA; EPA; FTC; Google; GreenBiz Group; Norton Rose Fulbright; RE100; REBA; Reuters; SNL; Utility Dive; WBCSD; ScottMadden analysis

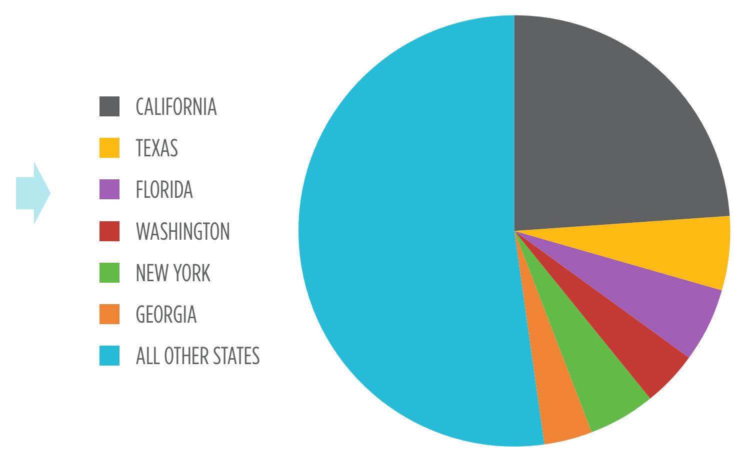
THE INDUSTRY IN CHARTS

THE ENERGY INDUSTRY: BY THE NUMBERS

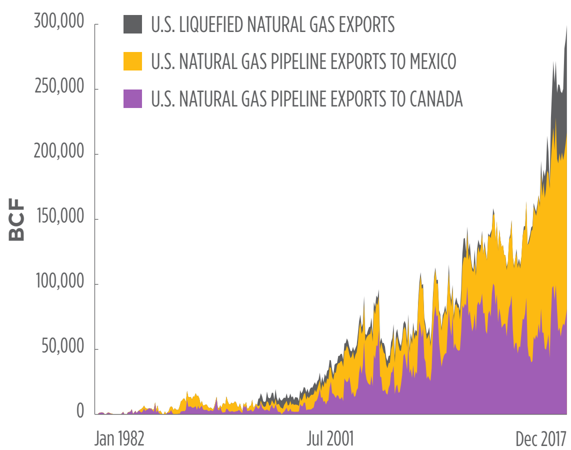
U.S. Alternative Fueling Stations by Type and U.S. Plug-In Electric Vehicle (PEV) Sales



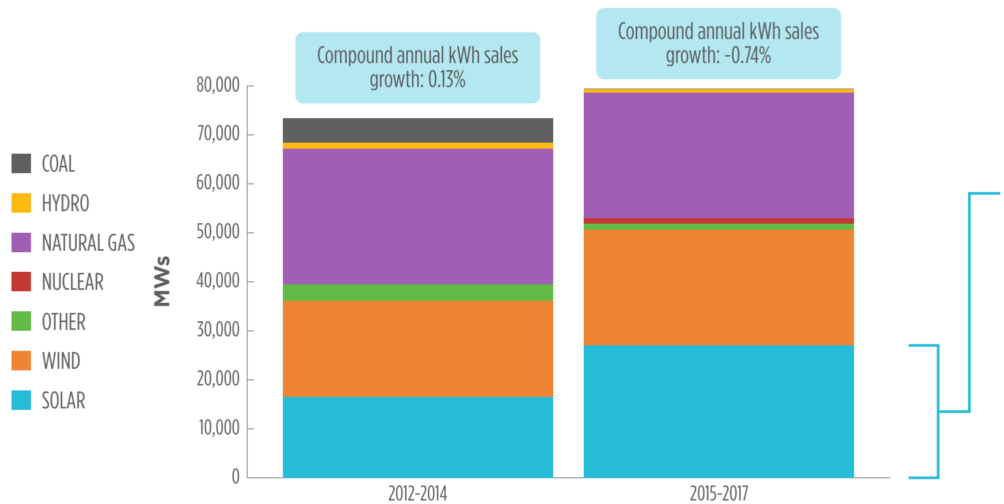
Electric Charging Stations for Selected States (2016) (As % of Total Charging Stations)



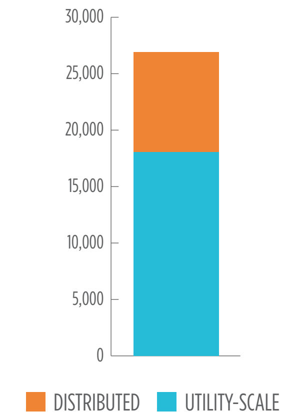
Monthly U.S. Natural Gas Pipeline and LNG Exports



U.S. Power Generation Capacity Additions by Fuel Type (2012–17)



Solar Installations by Type (2015–17) (in MWs)



NOTE:
*Electric charging stations counted by number of plugs (rather than by number of geographic locations).
SOURCES:
U.S. Dept. of Energy Alternative Fuels Data Center; U.S. Energy Information Administration, *Natural Gas Monthly* (Mar. 2018) and *Electric Power Monthly* (Mar. 2018); S&P Global Market Intelligence; ScottMadden analysis

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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.

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ScottMadden is proud to join the Smart Electric Power Alliance in a fact-finding mission October 14–19, to explore the powerful discoveries and course corrections of the United Kingdoms' most recent energy experimentations, including performance-based energy price schemes, transactive energy projects, and flexibility markets.

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
919-781-4191

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

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

Bob Hevert
Partner
Rates, Regulation, & Planning Practice Leader
bhevert@scottmadden.com
508-202-7923

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