WORK SESSION DOCUMENT
APPENDIX
GOVERNOR'S COMMITTEE ON ENERGY CHOICE
Technical Working Group on Innovation, Technology and Renewable Energy
Policy Recommendations to be Presented for Consideration
by the Full Committee on Energy Choice

This appendix includes all of the documents, such as PowerPoints or handouts, provided by those who made presentations to the Technical Working Group. Following is a list of the witnesses who provided those documents in the order in which they appeared before the TWG. Following that, this appendix includes a list of those presentations, including their supporting documentation, that were made to the full Committee on Energy Choice and are pertinent to the TWG's assigned topics.

1. Maria Robinson, Associate Director of Energy Policy and Analysis, Advanced Energy Economy – Ms. Robinson presented before the working group on Aug. 9, 2017 and reviewed market structures and whether RPS encourages continued development of Nevada's renewable resources.

2. Amanda Levin, Climate and Energy Advocate, Natural Resources Defense Council. Ms. Levin presented before the working group on Aug. 9, 2017 and discussed the relationship between RPS and Nevada's role as a regional leader in the development of cost-effective energy generation. Ms. Levin also provided historical information for other states that have both an open retail market and RPS. Ms. Levin's presentation provided information indicating that an RPS and an open retail market are not inherently intertwined and not inherently in conflict, such that should the legislature revisit Nevada's RPS, passage of ECI would neither inhibit nor enable that legislative review.

3. Anthony Star, Director, Illinois Power Agency. Mr. Star presented before the working group on October 10, 2017, and reviewed his agency's role in supporting the development of renewable energy, energy efficiency and other clean energy incentive programs. Mr. Star's presentation also informs other issues discussed in this document.

4. Pat Egan, Senior Vice President of Renewable Energy and Smart Infrastructure, NV Energy – Mr. Egan presented before the working group on Oct. 10, 2017, and reviewed current NV Energy programs related to energy efficiency, demand-side management, energy storage, and recently approved legislative measures from the 2017 Legislative Session.

5. Phil Pettingill, Director, Regional Integration, California ISO. Mr. Pettingill presented on October 10, 2017 and provided an overview of CAISO's increasing integration of distributed energy resources into the ISO market.

6. Jason Burwen, Policy and Advocacy Director, Energy Storage Association. Mr. Burwen presented before the working group on December 5, 2017, and reviewed current advances in storage technology and policies that support its further development and implementation.

7. Marta Tomick, Program Director, Vote Solar. Ms. Tomick presented before the working group on Dec. 5, 2017 and provided an overview of community solar programs in restructured markets and reviewed issues to consider in integrating community solar programs under a restructured energy market. Ms. Tomick's presentation. Ms. Tomick's presentation also provided information indicating that community solar programs and an open retail market are not inherently intertwined and not inherently in conflict, such that should the legislature revisit Nevada's enabling of community solar opportunities, passage of ECI would not inhibit nor enable that legislative review.

8. Justin Barnes, EQ Research, LLC. Mr. Burwen presented before the working group on January 23, 2018 and discussed retail choice and net metering considerations.

9. Hank James, Executive Director, Nevada Rural Electric Association (NREA) and Jesse Wadhams, Fennemore Craig. Mr. James and Mr. Wadhams presented before the working group on January 23, 2018, and reviewed the structure of its members, Nevada's rural electric cooperatives, power districts and municipal utilities. This presentation also broadly described how NREA members provide options for renewable energy programs within their services territories.

10. Chris Neme, Energy Futures Group Consulting. Mr. Neme presented before the working group on February 6, 2018. Mr. Neme described how energy efficiency can be a resource for energy, capacity, transmission and distribution, and provided options for how these programs can be offered in a retail choice market.

11. Sue Tierney, Analysis Group, presented to the Committee on Energy Choice on November 7, 2017 and provided information pertinent to this TWG on how other states with customer choice have implemented renewable portfolio standards.

RPS IN RESTRUCTURED STATES

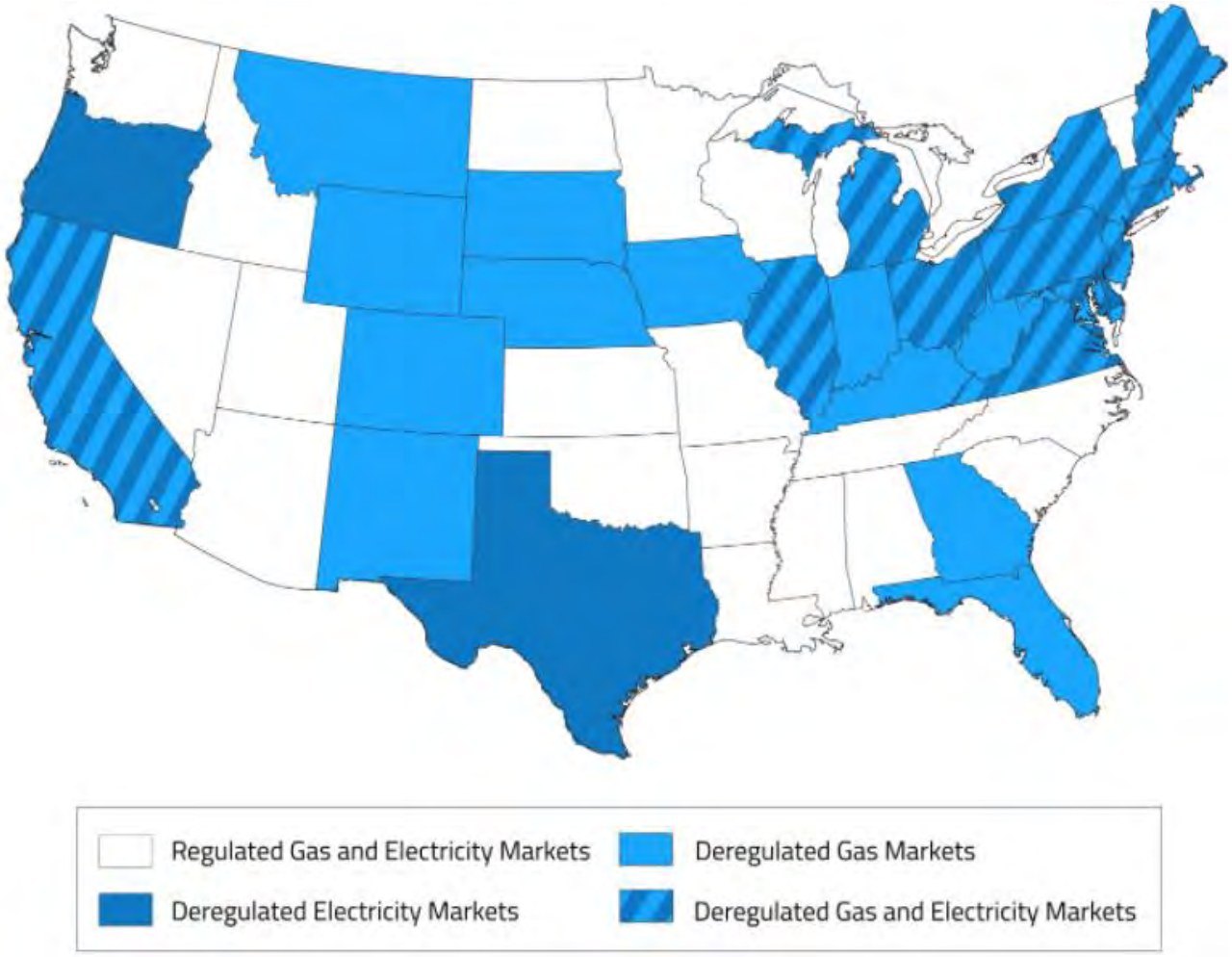
NV Energy Choice Task Force

August 9, 2017

Key decisions to be made

- How to handle stranded assets?
  - Income approach – determining market value of the asset (New England)
  - Full recovery of generation and regulatory costs (Ohio)
  - What's the date of stranded cost calculation?
- Does the state join an RTO?
- **How does an RPS come into play?**
- **How does the state encourage forward contracting?**

RPS was instituted as a reaction to deregulation



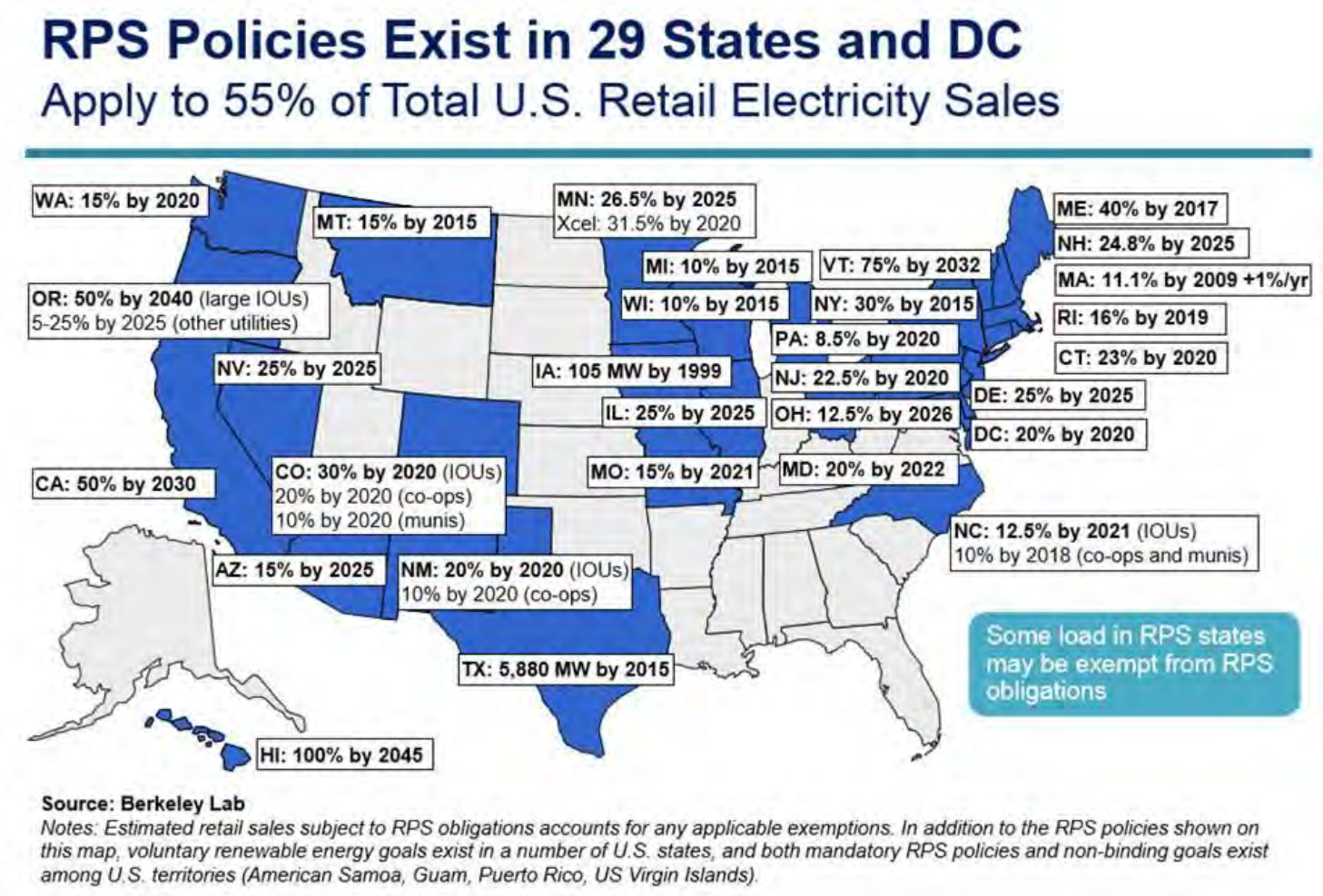
Source: https://www.electricchoice.com/map-deregulated-energy-markets/

Restructuring either provided savings to consumers or had little visible impact

- Although rate increases were seen after restructuring, most of that increase was due to rising natural gas prices.
  - Massachusetts' retail customers saved $1.7 billion during the first three years of restructuring.
  - Connecticut's 2011 review of deregulation found that in 1998 (the year Connecticut passed its deregulation legislation) the unweighted average rate in the 14 deregulated states was 3¢ per kilowatt-hour (kwh) above the average in the other 35 states covered in this analysis. Since then, the difference has remained between 2¢ and 4¢ per kwh and was 3¢ per kwh for the first four months of 2011.

Source: http://www.mass.gov/eea/docs/doer/electric-deregulation/mm3.pdf; https://www.cga.ct.gov/2011/rpt/2011-R-0274.htm

RPS was often instituted alongside deregulation



Source: Berkeley Lab

Notes: Estimated retail sales subject to RPS obligations accounts for any applicable exemptions. In addition to the RPS policies shown on this map, voluntary renewable energy goals exist in a number of U.S. states, and both mandatory RPS policies and non-binding goals exist among U.S. territories (American Samoa, Guam, Puerto Rico, US Virgin Islands).

More than half of U.S. electricity sales happen in a market with an RPS, LBNL reports. *LBNL 2016 RPS update*

Retail rates are unlikely to be impacted due to RPS

- Lawrence Berkeley National Labs recently published a review of RPS rate impacts. Some of its conclusions include:
  - Retail electricity rates have, on a national basis, been flat for roughly a decade
  - **States endowed with high-quality wind and/or solar resources have, in some cases, likely witnessed rate decreases**
  - State RPS policies have generally increased rates, but the estimated magnitude of historical and forecasted rate impacts span a wide range

Source: https://emp.lbl.gov/sites/all/files/lbnl-1007261.pdf; http://www.mass.gov/eea/docs/doer/electric-deregulation/mm3.pdf

Having an open market doesn't guarantee clean energy in the state

- Although purchasers have the option to choose renewable energy, it's important to set up a system that makes that choice easy and accessible to all consumers.
- Potential option: The POLR should provide a standard offer of 100% clean energy?
- An RPS also guarantees clean energy production and provides a hedge against future federal environmental regulations and reduce future stranded assets.
- Nevada's cities and counties should consider aggregate purchasing for RE power (esp. those that used NV Energy's green tariff).

How to encourage developers to bring projects into Nevada in 5 years leading up

- Solar developers definitely want to be a part of the market
  - Permitting hurdles – BLM owns most of the land that would be best for solar production
- Provide a centralized purchasing authority to offer an option beyond a REC-purchase-only RPS to provide certainty
- A predictable increase in demand through greater adoption of PEVs and EVSE infrastructure

Potential policy proposal for easing into restructuring

- Arizona explored restructuring in 2012 and approved a short-term test pilot.
  - **Nevada might consider a test pilot just for commercial and industrial class prior to the full 2023 move to deregulation.** This pilot could be instituted via legislation after the 2018 ballot initiative.
- Moving from a cost-of-service ratemaking to a market-based ratemaking process could lead the PUC to open up new dockets to explore how to incorporate DER into the grid.

Questions?

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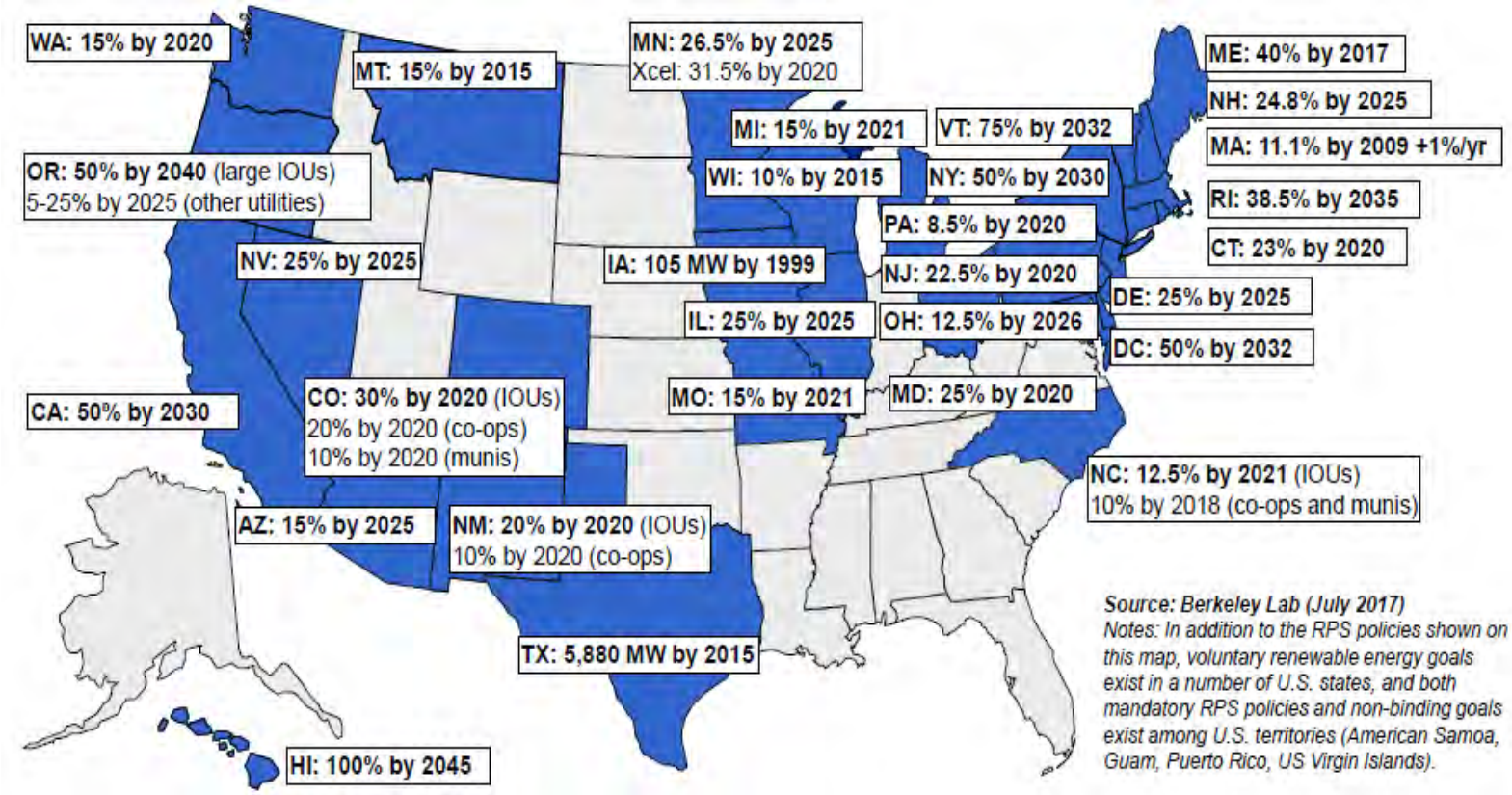
Renewable Standards:
Clean Energy Development & Other Impacts

Amanda Levin
August 9, 2017

Renewable Standards and Clean Energy Development

Status of Standards in U.S.



- 29 states and DC have binding renewable portfolio standards (RPS).
- These binding standards now cover 56% of all electricity sales in the U.S.
- Most RPS have been in place for over a decade, providing analysts and policymakers with robust data and evidence on the customer, economic, and environmental impacts of these policies.

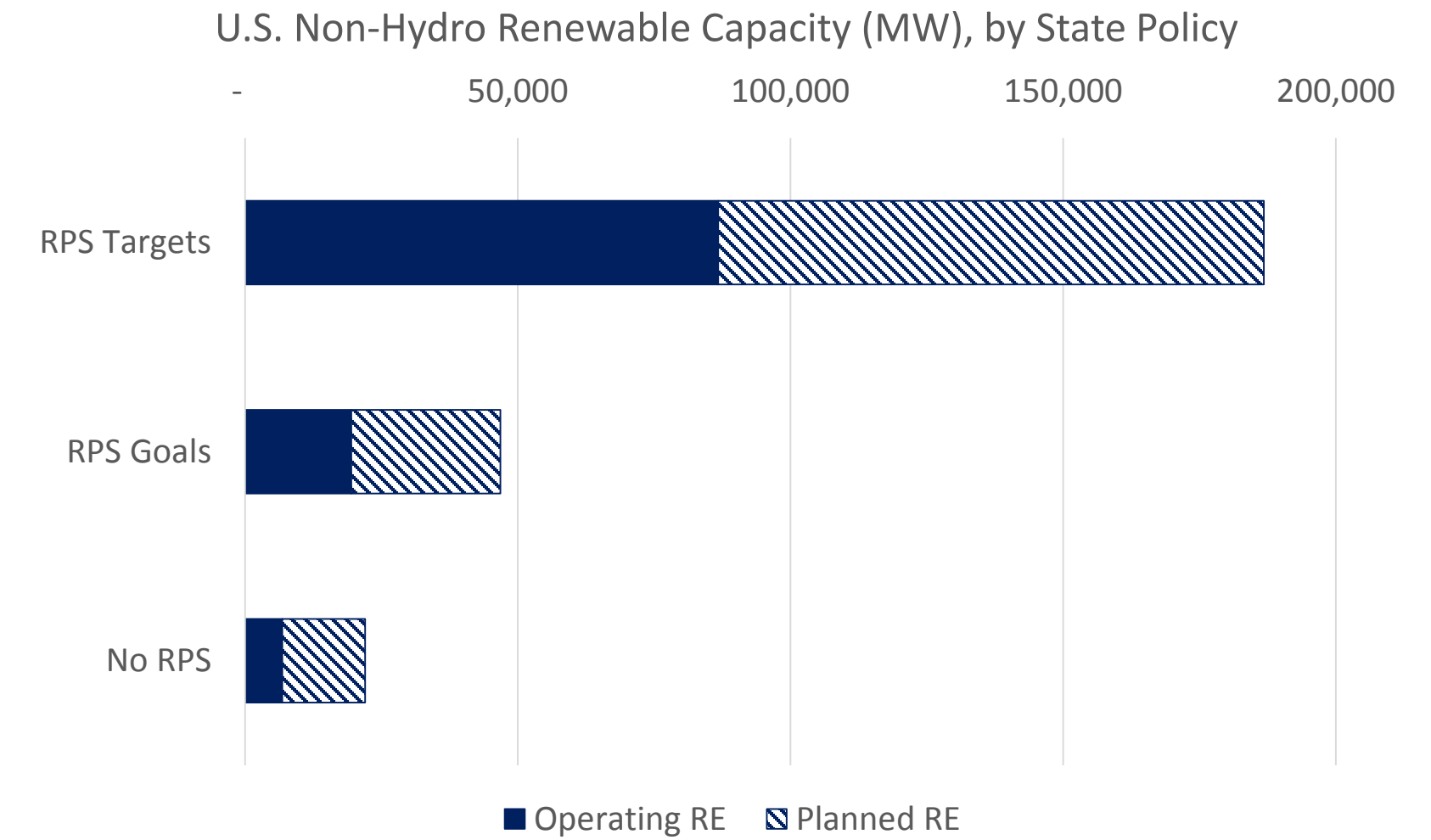
The Basics of RPS

1. A Renewable Portfolio Standard (RPS) is a regulation that requires electricity providers or utilities to generate a portion of electricity supply from renewable energy sources, such as wind, solar, biomass, and geothermal.
2. RPS policies and rules vary across states. State-specific elements include:
    a. Target levels and timeframe;
    b. Entities covered;
    c. Eligible technologies, such as rules related to fuel source, size, operational date, location, and deliverability of the energy;
    d. Use of tiers, carve-outs, or multipliers;
    e. Contracting requirements and procurement planning;
    f. Cost caps, alternative compliance payments

Standards have been a major driver of renewable energy development in U.S. in past

1. More than 50% of all non-hydro renewable power built since 2000 was to meet RPS requirements.
2. The U.S. has added an average of 6 GW of new renewable power annually to meet RPS needs over the past decade.
3. In 2016, renewable portfolio standards required utilities to procure an additional 146 TWh of renewable energy above 2000 levels.
    a. This is enough to power 13.5 million U.S. homes for a whole year.

States with standards have the seen the bulk of U.S. renewable energy development



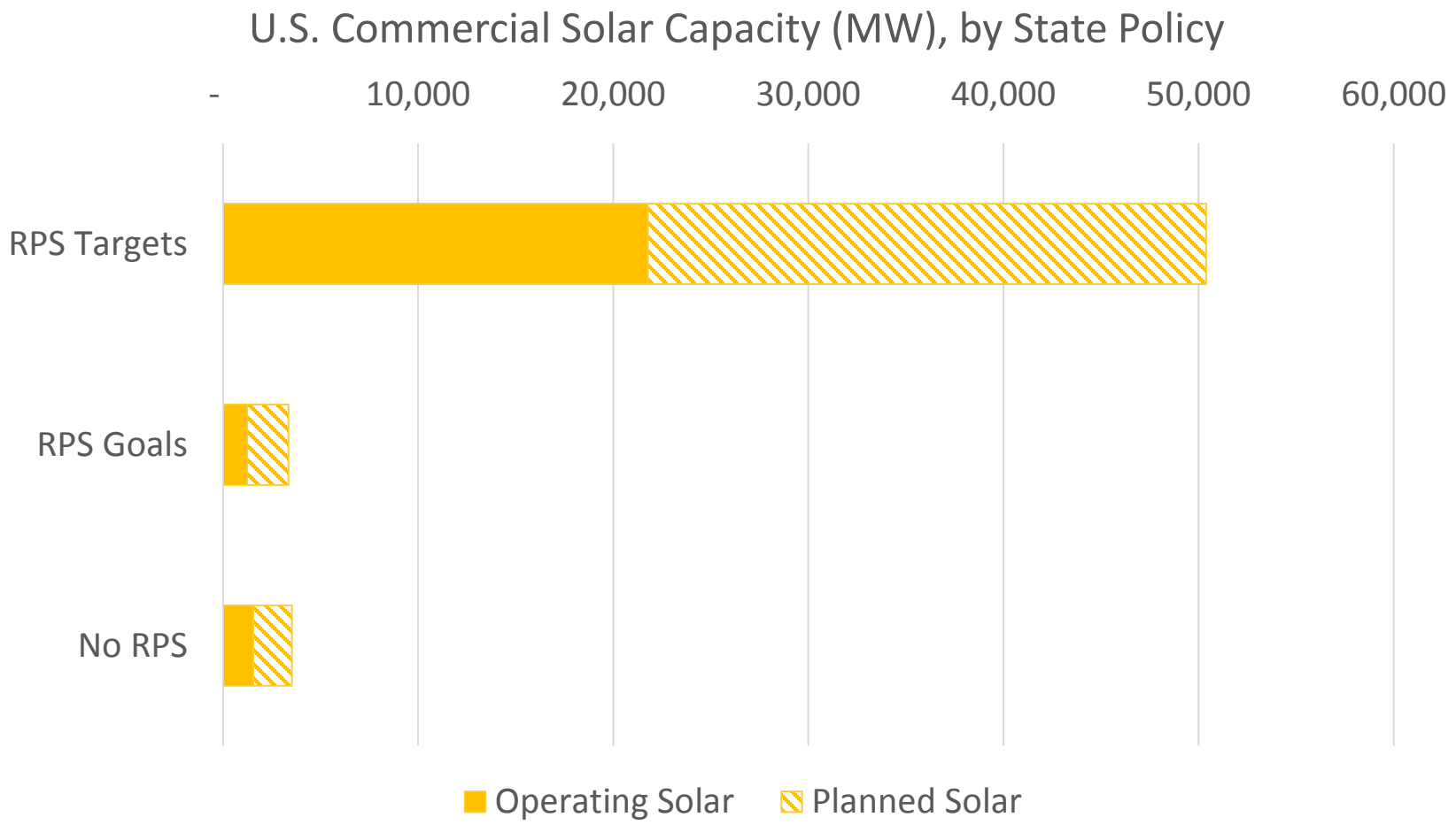
The role of RPS has changed in recent years, in certain regions

1. Actual renewable growth has outpaced RPS needs in recent years.
    a. This is due mainly to economic, non-RPS wind in the Midwest and Texas. However, in the West, actual RE growth has matched closely with RPS needs.
2. In the last year or two, there as been a significant shift in what resources are built to meet RPS demand.
    a. While wind energy makes up more than half of all RPS capacity built since 2000, solar made up almost 80% of RPS builds in 2016.

Standards will be a driver of renewable growth in the future

1. Existing RPS requirements will still require roughly a 50% increase in U.S. RE generation by 2030.
    a. This is about an additional 55 GW of new wind and solar capacity by 2030.
2. Estimated that Nevada will need to procure enough additional renewable energy to meet another 10% of state electricity sales in 2030.

Solar builds are overwhelmingly located in states with renewable standards.



RPS-driven projects already support a large number of U.S. jobs and economic activity

1. Renewable projects built to meet RPS demand supported 200,000 U.S. jobs in 2013 and contributed around $20 billion to the U.S. economy (GDP) that year.
2. The federal government estimates that meeting existing requirements will support around 134,000 U.S. jobs a year over.
    a. Strengthening these standards nationwide could support over 325,000 U.S. jobs annually.

Rate impacts have been small, and even negative in certain states

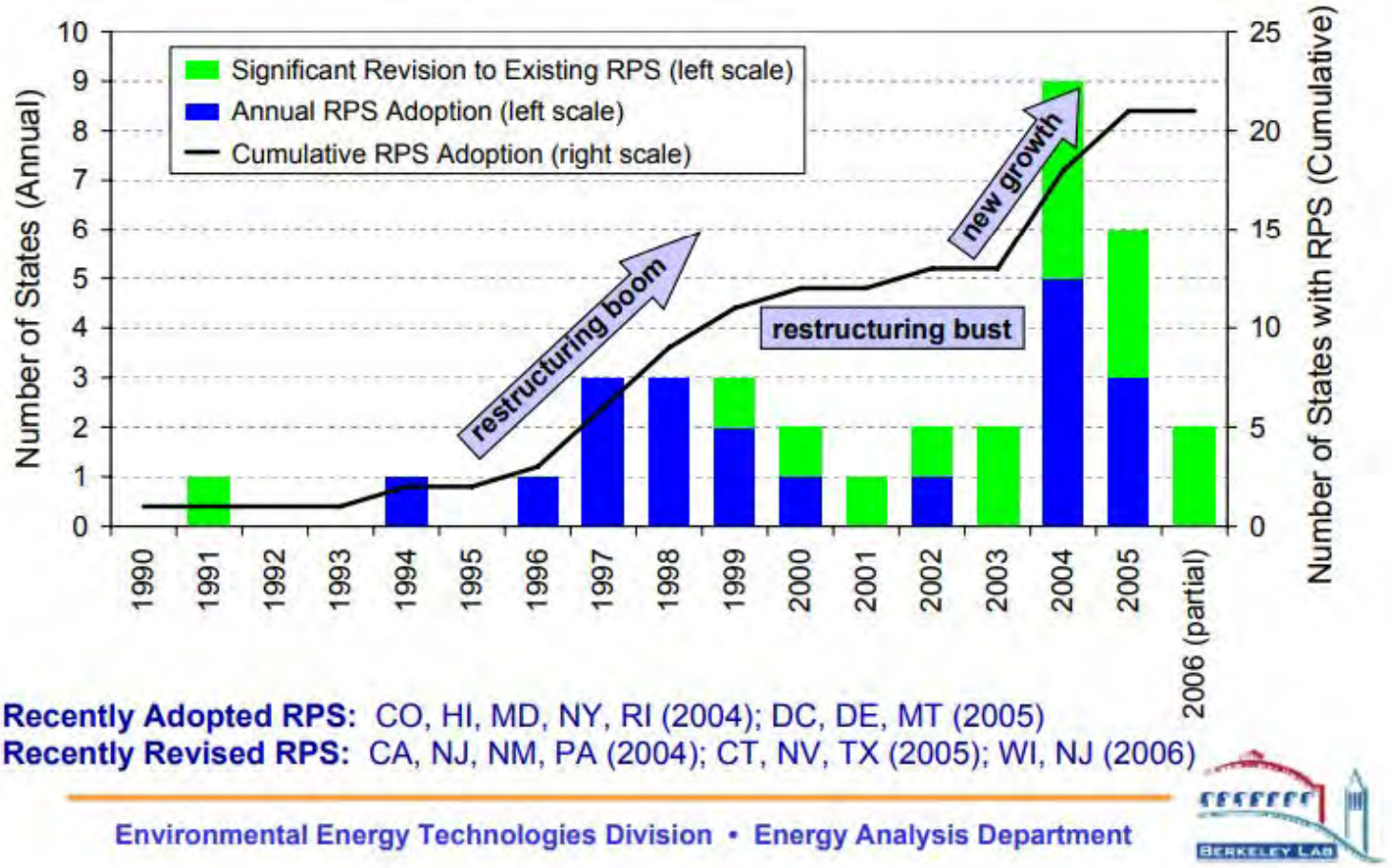
1. Studies of RPS impacts have found compliance costs are small, on average, and can be negative in certain cases
    a. The national labs annually track the costs of RPS compliance. Compliance costs average 1.8% of consumer bills across states with binding targets in 2015.
2. Most studies expect rate impacts will be less than 1% in the final RPS target year (e.g. 2025, 2030). About five states have projected net reductions in rates by the target year.
3. Rate impacts are expected to remain low, even as RPS standards increase, due to falling renewable energy costs.
    a. Wind and solar power purchase agreements (PPAs) are already as cheap or cheaper than the wholesale power prices in parts of the U.S., making these resources a least-cost option.

Standards have helped mitigate wholesale power prices and slow rate growth

1. Once built, renewable projects have minimal costs to run. By adding low-cost energy to the market, it reduces the need to rely on higher-cost resources.
2. Average electricity prices in RPS states have grown at a significantly slower pace than non-RPS states.
3. Renewable energy can also help reduce upward pressure on gas prices, which can result in significant heating cost savings for consumers (up 1.9 ¢/kWh-RE of gas savings)

How have Retail Choice and RPS interacted?

The history of RPS in U.S. is interconnected with history of retail choice



Customer choice will not, and was not intended to, by itself guarantee more clean energy or the resulting economic benefits.

Standards in restructured states

	RE Ranking + Context
CT	**Established in tandem with restructuring (1998),** applies to utilities and retail suppliers; 27% by 2020
DE	Established in 2005, applies to utilities and retail suppliers; 25% by 2025
IL	***Established in "re-regulation" bill*** that created the Illinois Power Agency (IPA) which procures power for default service; 25% by 2025 for both utilities and retail suppliers
ME	**Established as part of restructuring legislation**; 40% by 2017, applied to both utilities and retail suppliers
MD	Established in 2005; 25% by 2020, applied to all utilities and retail suppliers
MA	**Established as part of restructuring legislation**; 15% by 2020, with 1% each year thereafter, applied to both utilities and retail suppliers
NH	Established in 2007; 24.8% by 2025, applied to both utilities and retail suppliers
NJ	**Established in tandem with restructuring (1999);** 20% by 2002 + 4% solar by 2027, applied to both utilities and retail suppliers
NY	Established 2004; revised Dec. 2016 to 50% RE by 2030, applied to all utilities and retail suppliers
OH	***Established in 2008 as part of broad restructuring legislation***; 12.5% by 2026, applied to both utilities and retail suppliers
PA	Established in 2004; 18% alternative energy, applied to both utilities and retail suppliers
RI	Established in 2004; 38.5% by 2035, applied to both utilities and retail suppliers
TX	**Established during restructuring transition (1999);** 10 GW of RE capacity by 2025 (reached in 2009)
DC	Established in 2005; 50% by 2032, applied to both utilities and retail suppliers

A few common elements of RPS in restructured states

1. Most restructured states used RECs (Renewable Energy Credits) and Alternative Compliance Payments (ACP) to meet RPS requirements
    a. RECs are the environmental value of renewable generation and can be bought and sold on a market. RECs do not need to be tied with consumption of the actual renewable generation
    b. ACP is a set $ per MWH penalty for any supplier who does not procure enough RECs. Serves as a backstop if competitive suppliers are coming up short.
2. Requirements cover both utilities and retail suppliers. Utility requirements tend to reflect default or standard-offer load.

Learning Curve: RPS Issues in Restructured States

1. The overwhelming reliance on short-term purchases of RECs created a few main issues:
   a. Without long-term contracts, it can be difficult for developers to get financing for renewable projects.
   b. In addition, the REC market can be volatile, resulting in large variations in RPS compliance costs across years.
   c. Because RECs are not tied to deliverability of the energy, it can slow growth of renewable energy in the state or region where the REC is actually meeting RPS requirements.
   d. Ensuring local energy development to maintain a diverse and reliable system can be a challenge in restructured states.
2. Some restructured states have also come across issues with the collection and use of alternative compliance payments.
   a. Tended to be occur where the ACP was designed as the standard compliance method for retail suppliers, rather than a penalty mechanism.

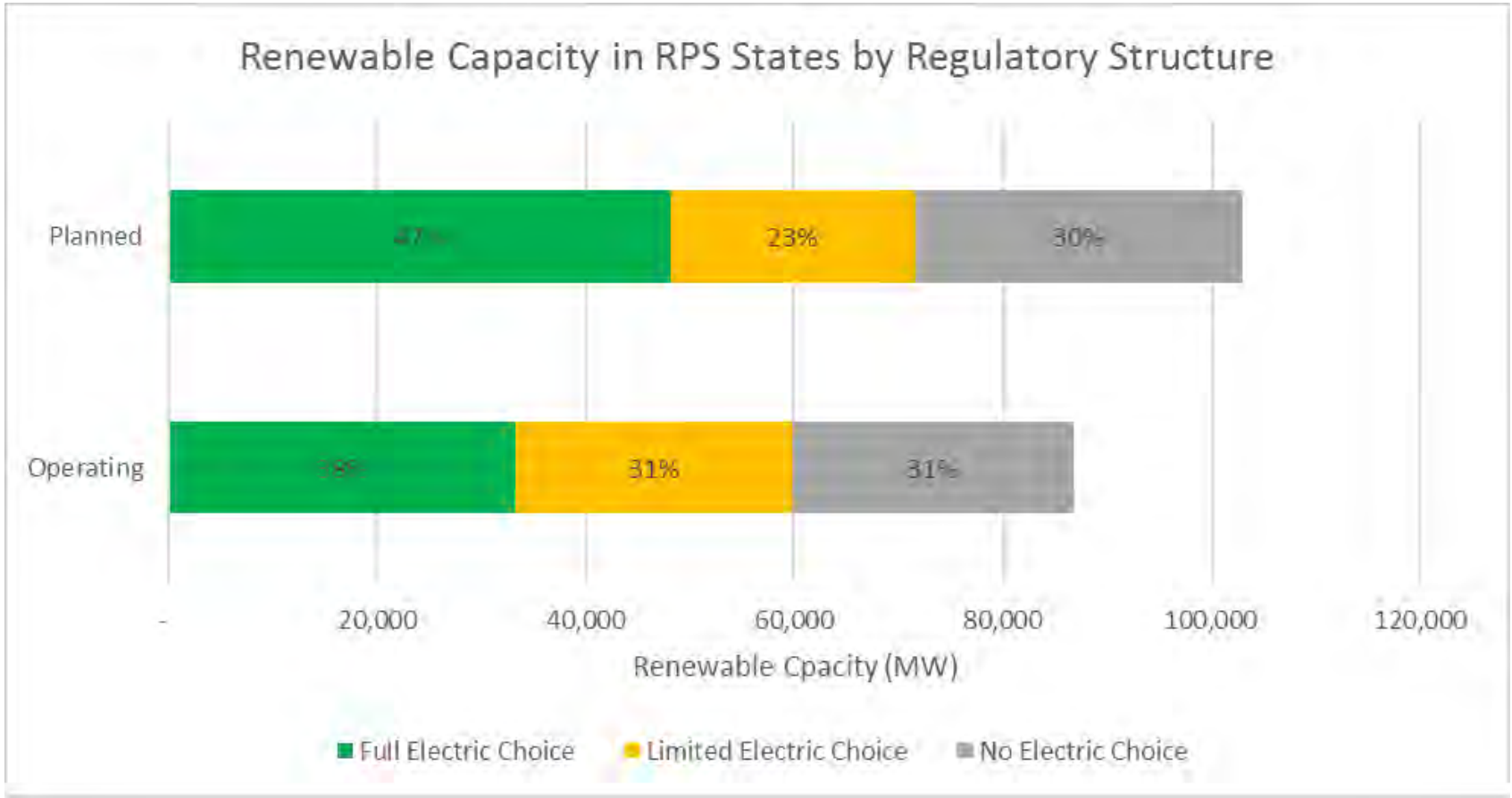
How have standards been modified to address historic issues?

- Requirement to procure long-term contracts with renewable generators
- Geographic restrictions on RECs (such as deliverability requirements, usually set at regional grid level)
- Established rules around use of ACP funds (e.g. in-state community solar, rooftop solar deployment)
- Technology carve-outs (e.g. storage, offshore wind, solar, industrial CHP).
- Tiers that have in-state and/or operational date restrictions.

Recent structural modifications to RPS requirements in restructured states

	Modification
CT	Updated to require utilities enter long-term contracts (15 years) for RE facilities, both small-scale and large-scale. The state environmental agency (DEEP) can solicit proposal, select qualifying proposals, and require distribution companies to enter into long-term contracts. Geographic restrictions on eligible projects. Process upheld by appeals court in June 2017.
NY	Revised to include a “new resource” tier and “maintenance” tier, with geographic restrictions. Long-term contracts done through central procurement process (NYSERDA); new order works to shift RPS obligations from distribution utilities to suppliers. NY structure seeks to promote customer choice and clean energy access for all consumers, with specific measures to support robust voluntary green markets, ESCO and DER markets, and community renewable projects.
IL	Revised to include provisions that set explicit, long-term (15-yr) new build requirements that will ensure that renewable energy credits are supplied by new construction of wind and solar projects in the state, including community solar, low-income solar, brownfield solar, and distributed generation projects. The Illinois Power Agency (IPA) is now tasked with procuring RECs to meet all requirements. Future funding will come through fees on all customer bills and will be held by utilities to be used by IPA. Alternative Compliance Payments will now also be made directly to utilities.
MA	State has passed complementary bills setting specific targets for energy storage, offshore wind, and solar. To be procured through long-term agreements by distribution utilities.

Retail choice states can have robust clean energy development



Challenges of retail choice and the role of standards

1. Customer choice does not, by itself, guarantee more clean energy, full market access, or innovative customer options. Choice should not undermine state policy or economic development objectives, and can complement and enhance policy objectives when done right. Renewable standards can help serve two vital roles:

    1. **Ensuring customer protection**: an RPS can make sure all customers get a minimal amount of RE and help support the state's shift to clean energy without significant price impacts. Renewable funds and carve-outs can also serve to ensure all customer have access to clean energy opportunities.

    2. **Ensuring adequate investment in capital intensive infrastructure**: restructuring can impact many investments including: transmission, metering infrastructure, energy efficiency, generation, and reliability. The state must ensure minimum standards and adequate investment in all of these areas through new rules, robust oversight, and investment frameworks.

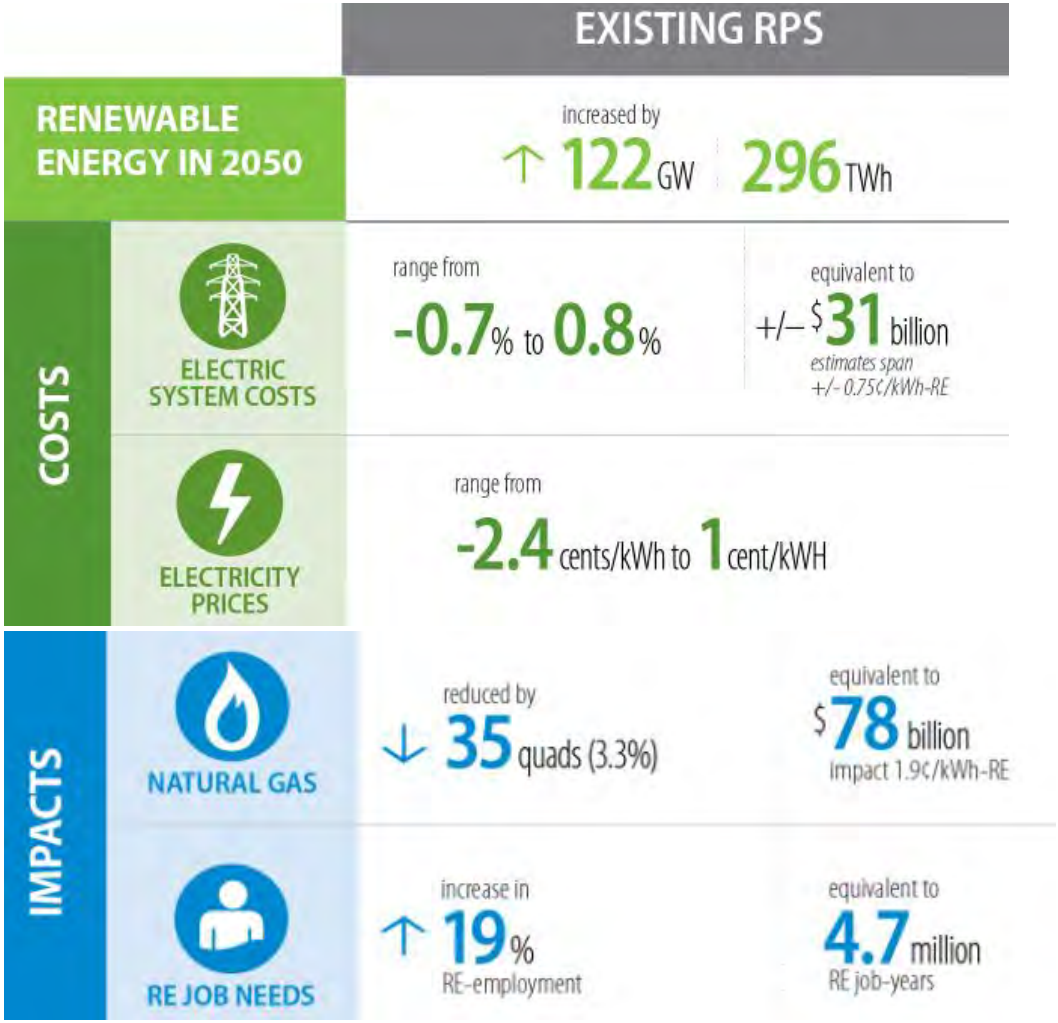
Other mechanisms to encourage clean energy under retail choice

1. Some restructured states have required the default provider to offer innovative, regulated rate options for all customer classes.
    a. This includes 100% renewable/green pricing plans and dynamic pricing options (e.g. time-of-use, real time pricing)
2. States are also exploring ways to incentivize customer-sided renewables and efficiency through market-based programs.
    a. This includes rules and assistance for those interested in: solar leasing, community solar, demand response providers (e.g. ESCOs), etc.
    b. Customer protection and data sharing protocols are also essential to ensure that all retail suppliers can provide customers with the full suite of services and rate options, while protecting customers in the marketplace.

Thank you

APPENDIX SLIDES

Expected Benefits of RPS

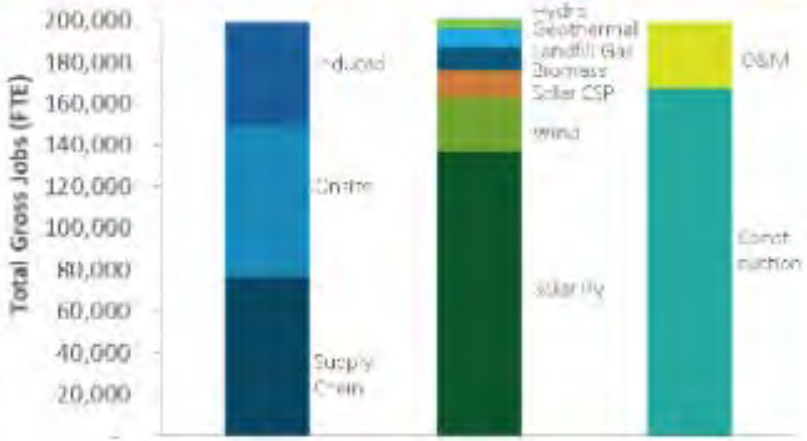


Summary of Key Results: Physical Impacts

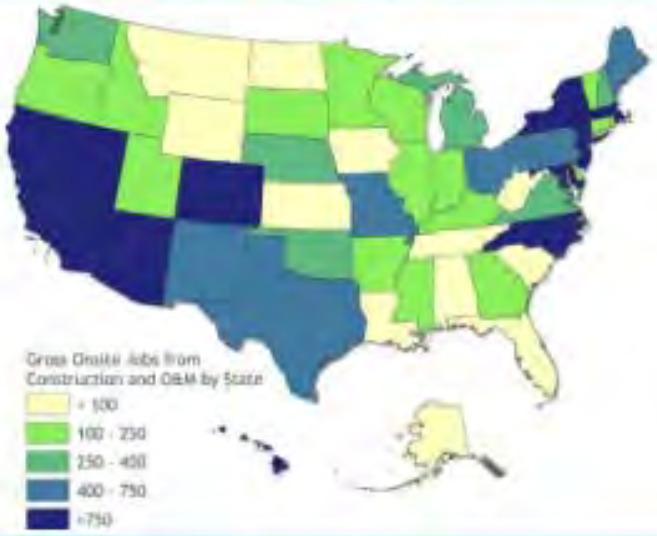
Supported nearly 200,000 gross domestic jobs in 2013, each earning an average annual salary of $60,000, with RE expenditures driving over $20 billion in gross GDP

Location of onsite jobs greatly impacted by new build in 2013-2014 (dominated by PV in California, but including a number of other prominent states noted in map below)

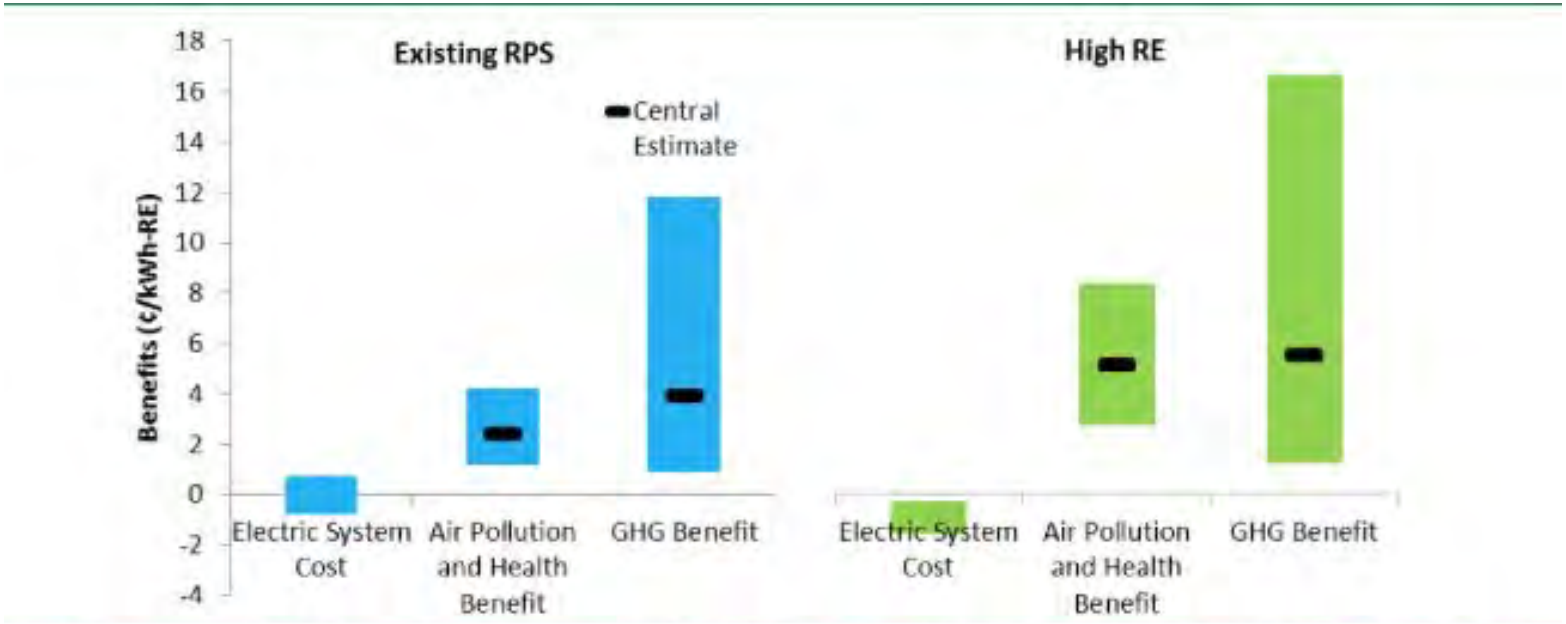
Gross Total Jobs



Gross Onsite Jobs



LNBL Benefit-Cost Analysis of RPS



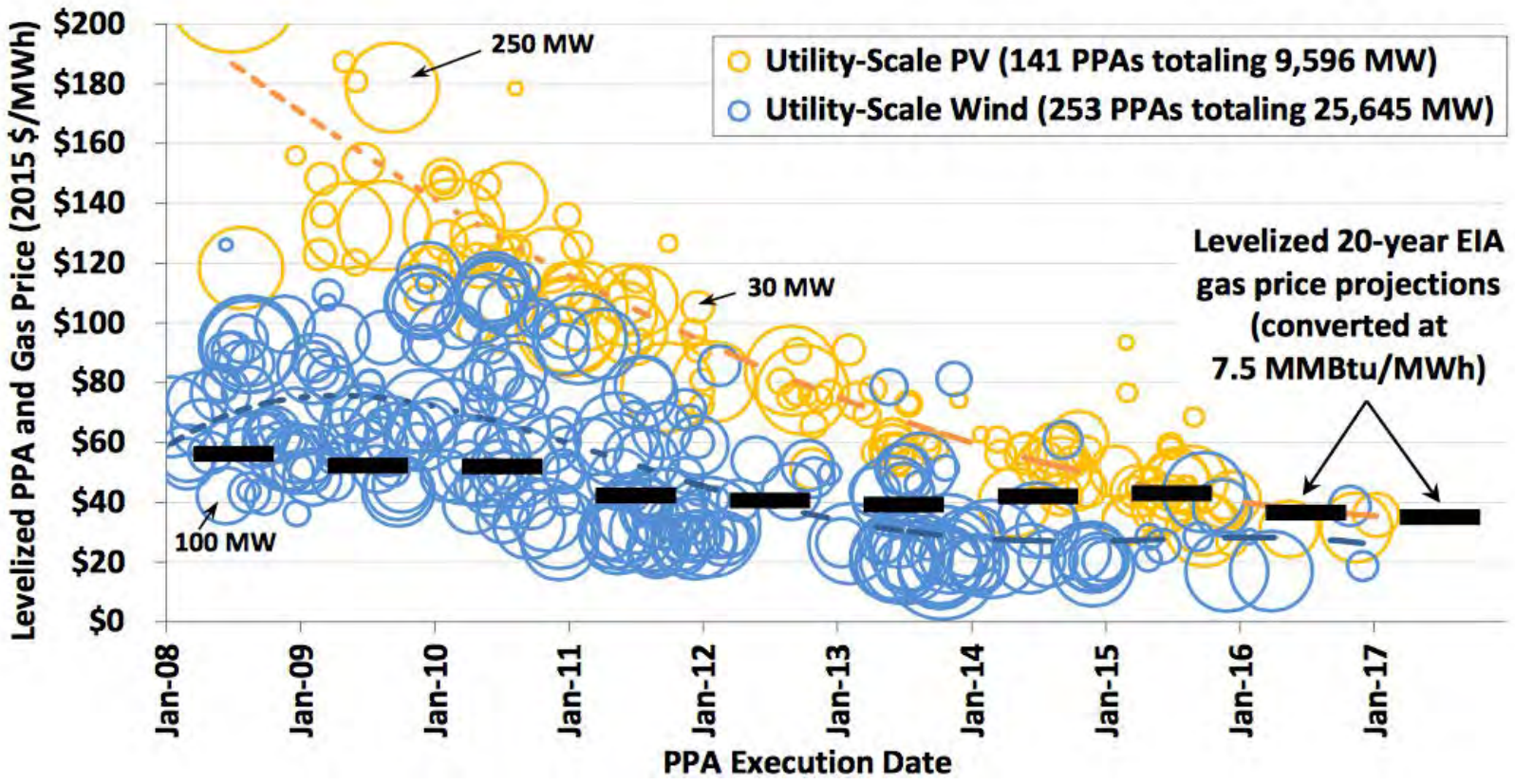
When comparing the costs and monetized benefits, we find that the benefits exceed the costs, even when considering the highest cost and lowest benefit outcomes

- Existing RPS: Costs are <0.75 cents/kWh-RE vs. >1.2 cents/kWh-RE air pollution and >0.9 cents/kWh-RE GHG benefits
- High RE: Costs are <1.5 cents/kWh RE vs. >2.7 cents/kWh-RE air pollution and >1.2 cents/kWh-RE GHG benefits

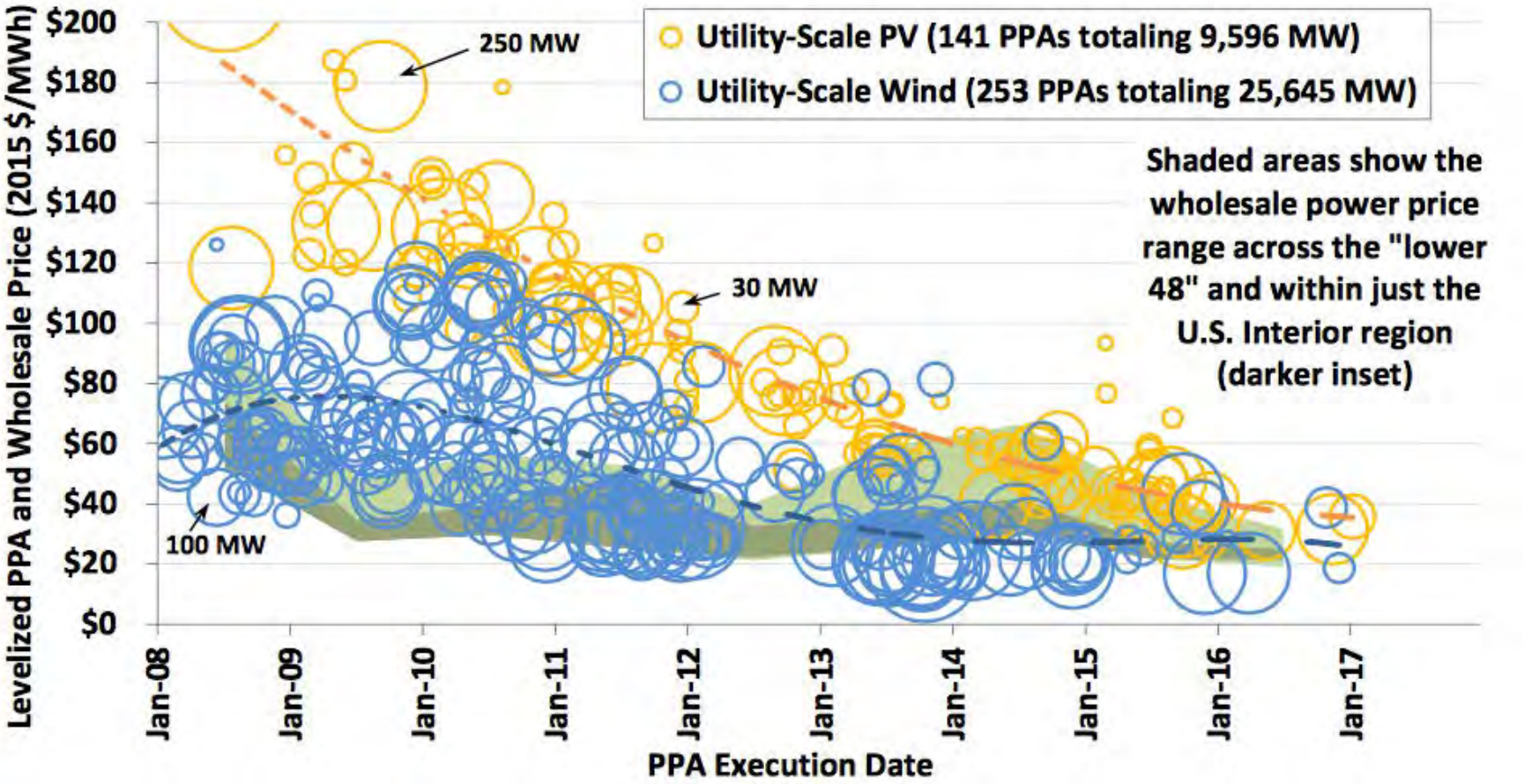
Additional benefits occur from water savings, which could not be readily monetized; other impacts associated with gross RE workforce needs and natural gas consumers are also quantified

Important to recognize that RPS policies may not be the least-cost means of achieving these benefits; see "limitations" noted earlier and described in full report

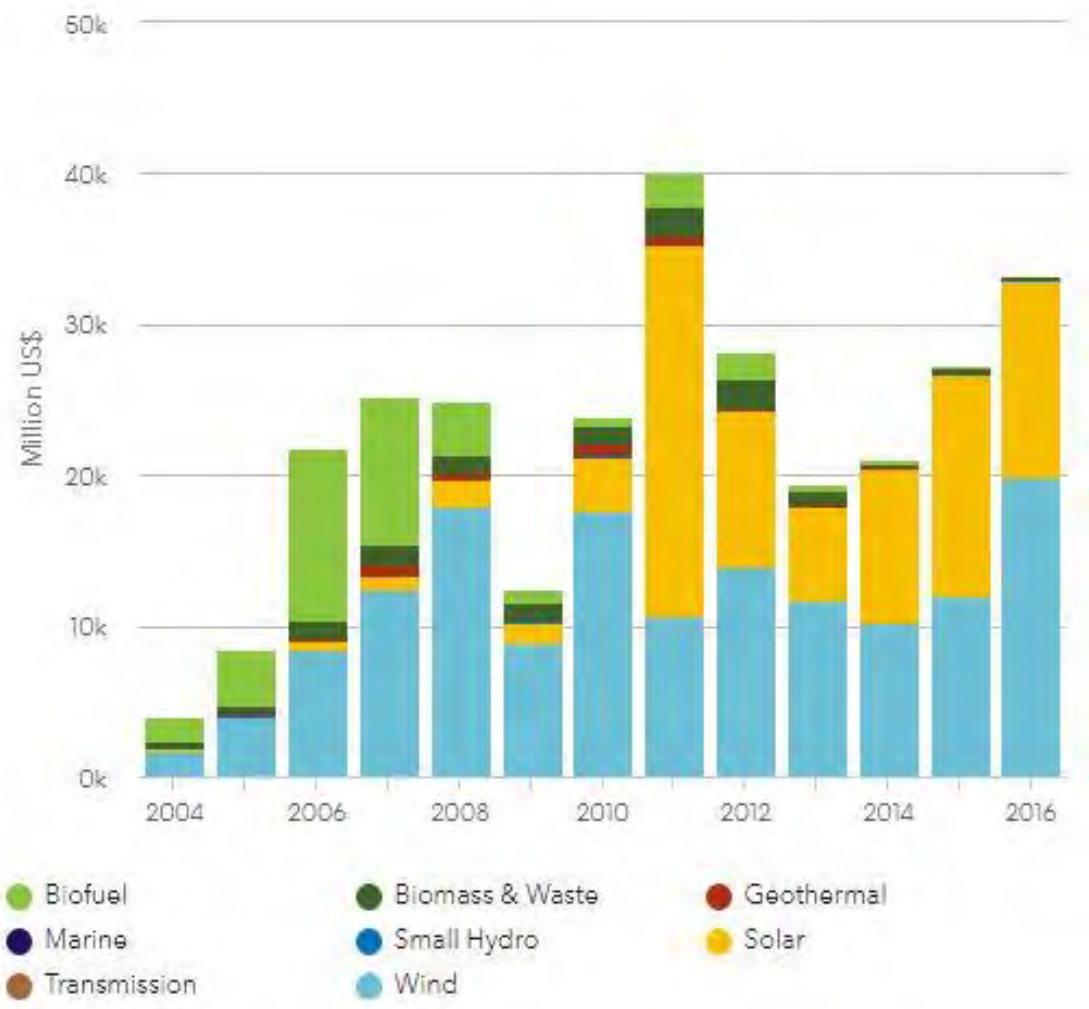
Most Recent PPA Prices



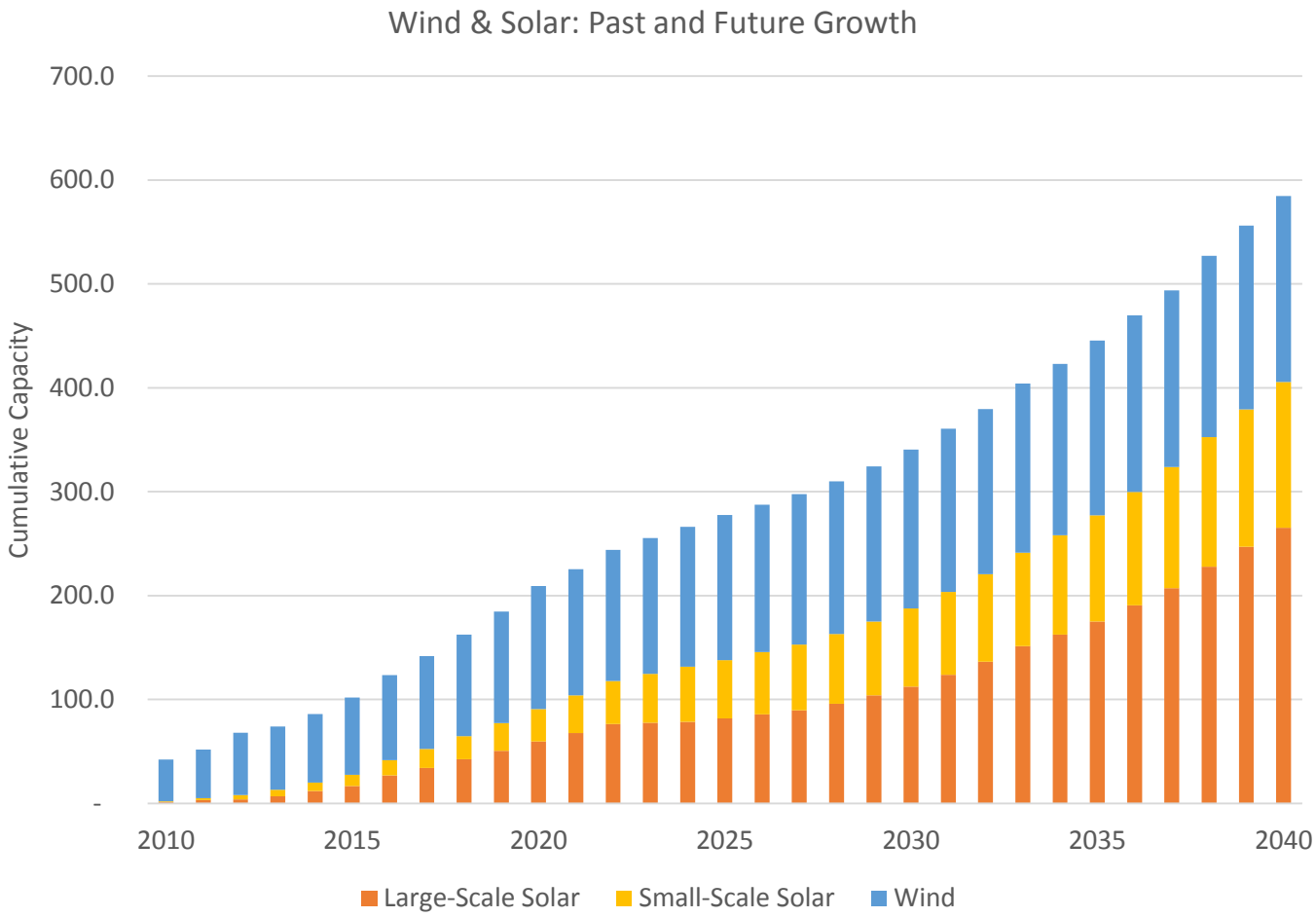
Most Recent PPA Prices



Annual U.S. Investments in Clean Energy



Expected, Economic Renewable Growth



Overview Of The Illinois Power Agency And Changes To The Illinois Renewable Portfolio Standard

Anthony Star
Director

Nevada Committee on Energy Choice
Technical Working Group on Innovation, Technology and Renewable Energy Industries
October 10, 2017

Background on IPA and Procurement Approach

- The Illinois Power Agency (IPA) is a state agency created in 2007 as part of resolution of debate on how to procure power for customers who did not switch to alternative suppliers (eligible retail customers)
- Entrusted by legislation to conduct procurement activities with transparency, objectivity, and in an ethical manner
- In 2011 became independent Agency under the oversight of the Illinois Executive Ethics Commission
- Funded through fees charged to utilities (for planning), suppliers (to run procurement events), and investment income from a Trust Fund

- Key responsibilities include:
  - Developing annual procurement plan, subject to Illinois Commerce Commission (ICC) approval
  - Running procurements and programs via third-party administrators. Procurment results subject to ICC approval

Power Procurement Approach

- Procurement of energy to meet the load requirements of "eligible retail customers"
- Criteria in the Illinois Power Agency Act:

  "Develop electricity procurement plans to ensure adequate, reliable, affordable, efficient, and environmentally sustainable electric service at the lowest total cost over time, taking into account any benefits of price stability."
- Approach has been to procure each year standard energy blocks to meet 100% of expected load in the current delivery year, 50% in the following year, and 25% in the next year.
  - This allows for a multi-year laddered approach to managing supply risks
- Current serving approximately 50% of ComEd's potentially eligible load, 40% of Ameren's potentially eligible load, and 15% of MidAmerican's load
  - Municipal Aggregation main driver of customer switching

Prior IPA Renewables Responsibilities (2008-2016)

- Utilities have annual RPS percentage requirements for eligible retail customers
  - Increases each year to 25% by 2025
  - Through 2016 the IPA included in its annual procurement plan proposed procurements to meet those targets

- Alternative Suppliers also had a separate RPS responsibility (same percentage goals)
  - Payment of Alternative Compliance Payments for at least 50% of their load
    - Payment level designed to mirror the rate that eligible retail customers were paying for RPS compliance
  - Purchase of additional RECs (or self-supply) for the balance of RPS obligations

- IPA administers the Renewable Energy Resources Fund to purchase additional renewable~~s~~ resources (funds collected from alternative suppliers as a portion of their RPS compliance)

- In reality Illinois had multiple RPSs

The Challenges of the Original RPS

- Retail choice meant that customers could switch back and forth between utility service and alternative suppliers leading to budget and target uncertainties
  - Large wave of municipal aggregation starting in 2011 led to the majority of eligible retail customer load leaving utility service
  - Curtailment of ComEd long-term contracts in 2013 and 2014
- The Renewable Energy Resources Fund encountered challenges as funds were redirected to other purposes, and the wording of the law constrained its use

Changes Ahead!

- Public Act 99-0906 fundamentally alters the Illinois RPS
  - Move to single RPS rather than separate mechanisms for customer taking service from alternative suppliers
  - Creation of programs as well as procurements
- Existing procurement approach (utility-scale) is well tested and might not need significant modification for future procurements (although the size and scope of renewable resources to be procured will increase significantly)
- New programs will necessitate development of new approaches for distributed solar and community solar
- Other changes in law will require consideration of new policy issues

Long-term Renewable Resources Procurement Plan

- Published for comment on September 29th
  - See: www.illinois.gov/sites/ipa/Pages/Renewable_Resources.aspx
- 45 days for stakeholder comment
- 21 days to file with Commission for approval
- 120 day proceeding before Commission

What's In the Plan?

- Percentage-based targets – 25% by 2025 of retail sales
- Quantitative targets for new build
  - New utility-scale wind projects
  - New solar projects (utility-scale, brownfield, distributed)
- Procurements to meet percentage targets
- Adjustable Block Program
  - Community Solar
  - Distributed Photovoltaic Generation
- Illinois Solar for All Program (low-income customers)
- Use of existing contracts to help meet targets

Adjustable Block Programs

- Three programs
  - Distributed Generation below 10 kW, upfront payment
  - Distributed Generation between 10 kW and 2 MW, 20% payment when energized, remainder over four years
  - Community Solar, 20% payment when energized, remainder over four years
- Contracts to purchase 15 years of RECs
- Plan includes proposed approach for the determination of prices, block size/schedule, application process/criteria, ongoing credit/performance requirements, etc.
- Agency will be issuing an RFP to hire a third-party program administrator to run day-to-day operations

Illinois Solar for All Program

"The objectives of the Illinois Solar for All Program are to bring photovoltaics to low-income communities in this State in a manner that maximizes the development of new photovoltaic generating facilities, to create a long-term, low-income solar marketplace throughout this State, to integrate, through interaction with stakeholders, with existing energy efficiency initiatives, and to minimize administrative costs."

- Four specific programs
  - Low-income Distributed Generation Incentive
  - Low-income Community Solar Project Initiative
  - Initiatives for Non-profits and Public Facilities
  - Low-Income Community Solar Pilot Projects

- "Ensure tangible economic benefits flow directly to program participants"
- Targeting of funds for environmental justice communities

What's not in the Plan

- Net metering (handled by the utilities)
- Smart Inverter rebates (handled by the utilities)
- Energy sales from renewable resources (Plan focuses on RECs)

NV Energy

Energy Efficiency, Renewable Energy & Public Policy Customer Programs

Pat Egan

SVP, Renewables & Smart Infrastructure

Governor's Committee on Energy Choice
Technical Working Group on Innovation, Technology, and Renewable Industries
October 10, 2017

NVEnergy

NV Energy Overview

- NVE SPPC Electric Service Territory
- NVE NPC Electric Service Territory
- NV Energy Gas Service Territory
- Coal Plants
- Natural Gas Plants
- Energy Recovery Plant
- Solar Energy Plant

- Headquartered in Las Vegas, Nevada, with territory throughout Nevada
- 2,436 employees
- 1.26 million electric and 164,000 gas customers
- Service to 90% of Nevada population, along with tourist population in excess of 45 million
- 6,011 megawatts of owned power generation

NVEnergy

Nevada Power Company	Sierra Pacific Power Company
• Provides electric services to Las Vegas and surrounding areas • 917,000 electric customers • 4,639 megawatts of owned power generation capacity(1)	• Provides electric and gas services to Reno and northern Nevada • 342,000 electric customers and 164,000 gas customers • 1,372 megawatts of owned power generation capacity(1)

(1) Net summer peak megawatts owned in operation as of March 1, 2017

Agenda

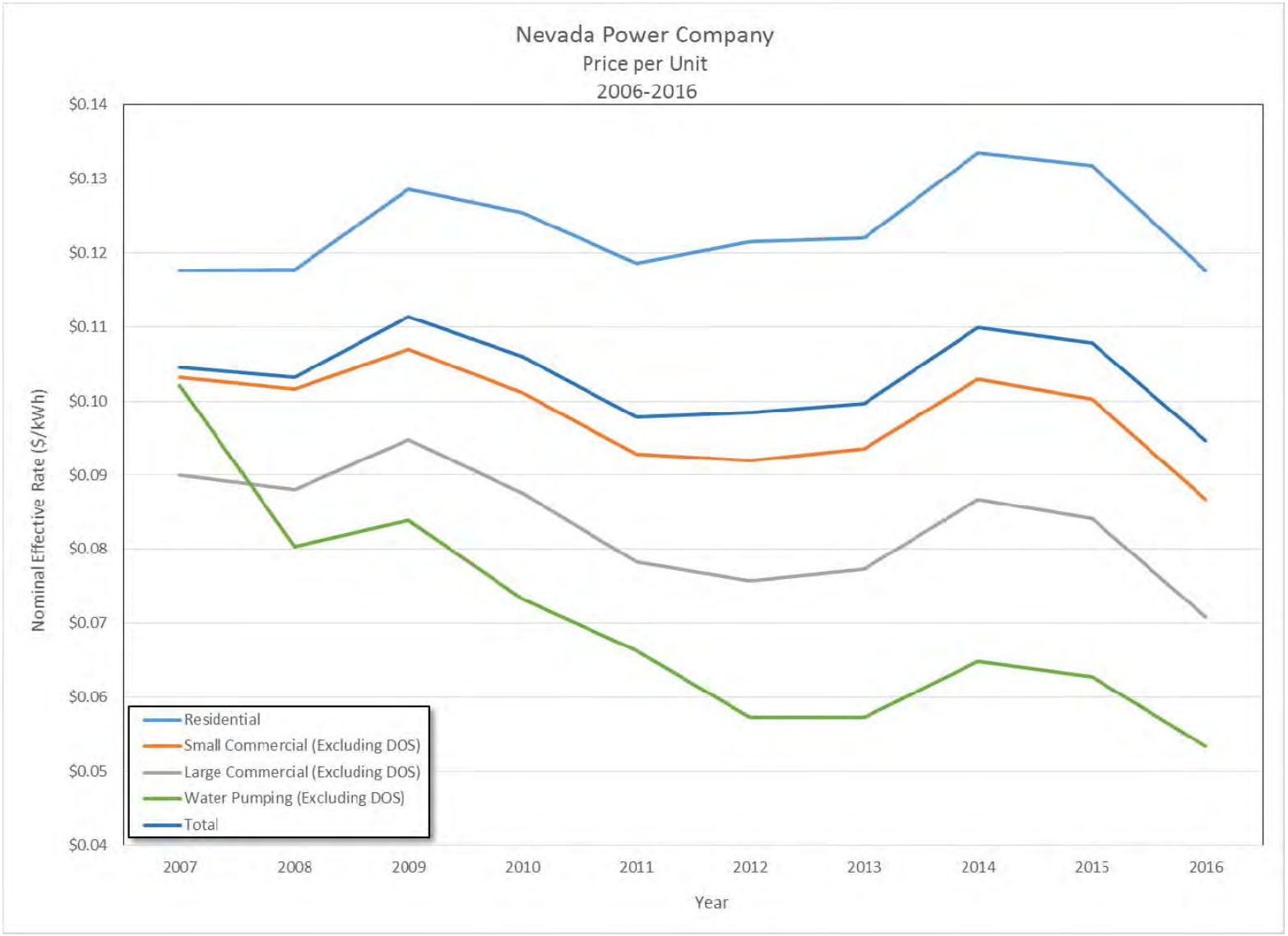
- NV Energy Customer Engagement
- Energy Efficiency and Usage Management
- Incentives and Policy Programs
  - RenewableGenerations Program
  - Electric Vehicles
  - Policy Direction
  - Distributed Energy Resources
- NV GreenEnergy Rider and Renewable Portfolio Standard

Customer Services

NVEnergy

Cost and Impact on Customers

Cost and Impact on Customers



Public Policy Costs in Customer Bill

3000111111122222223 JANE DOE 5000 HAMPTON ST 02-17-2017

PAGE 1 OF 2

NVEnergy

E A19 B19

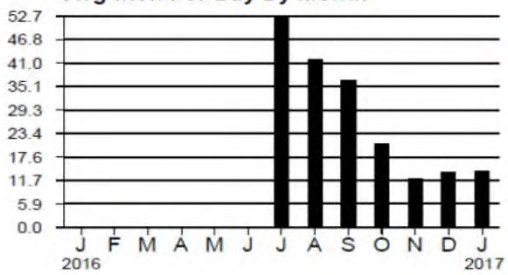
JANE DOE
Service Address: 5000 HAMPTON AVE
LAS VEGAS, NV 80000

Electric Historical Usage Data

Usage History	No. Days	kWh	Avg kWh Per Day
This Month	32	1000	31.25
Last Month	32	442	13.8

Avg Cost Per Day This Month: $2.06

Avg kWh Per Day By Month



Electric: Residential Service

Meter Number	Service Type	Service Period From	Service Period To	Bill Days	Meter Readings Previous	Meter Readings Current	Meter Mult.	Usage
CC000000000	kWh	Jan 17, 2017	Feb 17, 2017	32	28,991	29,999	1	1000

Electric Consumption	1000.000	kWh	x	0.10898	108.98
Temp. Green Power Financing	1000.000	kWh	x	0.00064	0.64
Renewable Energy Program	1000.000	kWh	x	0.00101	1.01
Energy Efficiency Charge	1000.000	kWh	x	0.00118	1.18
Basic Service Charge					12.75
Local Government Fee				5%	6.23
Universal Energy Charge	1000.000	kWh	x	0.00039	0.39

Total Electric Service Amount **$131.18**

DATE DUE:	**Mar 10, 2017**
AMOUNT DUE:	**$131.18**
Account:	**3000111111122222223**
Customer Number:	**1111111**
Premises Number:	**2222222**
Billing Date:	Jan 17, 2017
Next Read Date:	Mar 17, 2017

Account Summary

Previous Account Balance	57.26
Payment - Jan 4, 2017	57.26 CR
Electric Charges	131.18
Current Amount Due	$131.18

Thank you for maintaining an excellent payment record. We look forward to serving you in the future.

[1]Highlighted charges include average monthly residential totals of $2.83 (2.2%) in public policy costs and $6.62 (5.0%) in local and state government fee collection for a Nevada Power Company average residential bill.

Cost and Impact on Customers

Cost of Living Index*

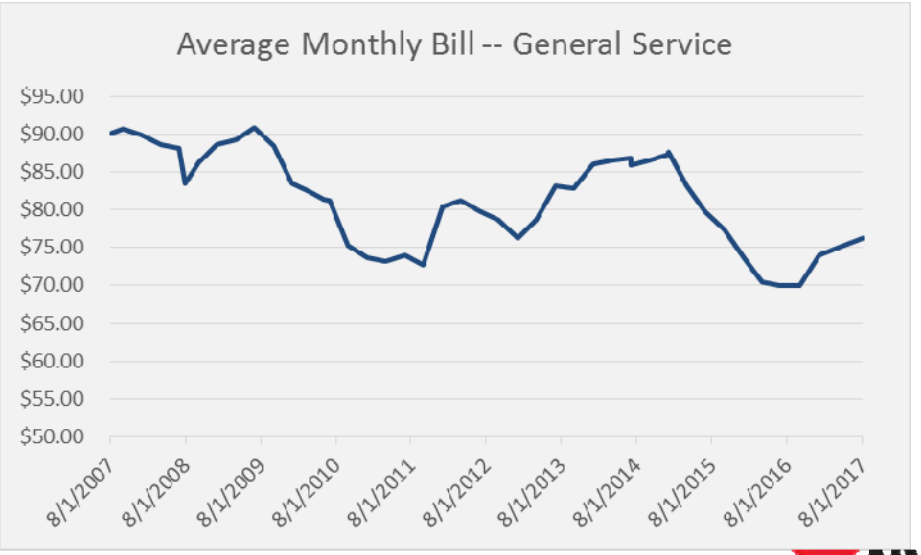
	Las Vegas MSA	Reno-Sparks MSA	U.S. Average
Grocery Items	101.7%	95.3%	100.0%
Housing	108.8%	105.0%	100.0%
Utilities	86.4%	85.2%	100.0%
Transportation	105.9%	110.0%	100.0%
Healthcare	102.7%	108.0%	100.0%
Misc. Goods & Svcs.	95.6%	106.5%	100.0%
Composite Index	100.4%	102.8%	100.0%

Source: Council for Community and Economic Research. This index measures relative price levels for consumer goods and services in 302 Metropolitan Statistical Areas (MSAs). It does not measure tax burden. The average of costs in each MSA is read as a percentage of the average of all participating places. For example, a score of 103.6% indicates that costs in that MSA are 3.6% higher than the national average.
** Q1 - 2017*

Selected Prices from Cost of Living Index

	Las Vegas MSA	Reno-Sparks MSA	U.S. Average
Apartment Rent (per month)	$1,009	$1,130	$1,032
Home Price	$370,769	$335,058	$332,959
Home P+I (per month)	$1,380	$1,255	$1,217
Energy Costs (per month)	$158.99	$117.18	$165.78
Gasoline (per gallon)	$2.42	$2.61	$2.26
Doctor Visit	$108.00	$135.67	$107.63
Prescription Drugs (Annual)	$425.43	$376.50	$426.42

Source: Council for Community and Economic Research (see above). Q1-2017



- ✓ Cost of living in Nevada cities slightly higher than average, with utilities (energy costs) below average and transportation higher
- ✓ Nevada remains one of the top states in which to do business
- ✓ According to the Sep 2017 issue of *Nevada Business Magazine*, Nevada ranks first among states on the "Small Business Policy Index" with energy costs as major advantage

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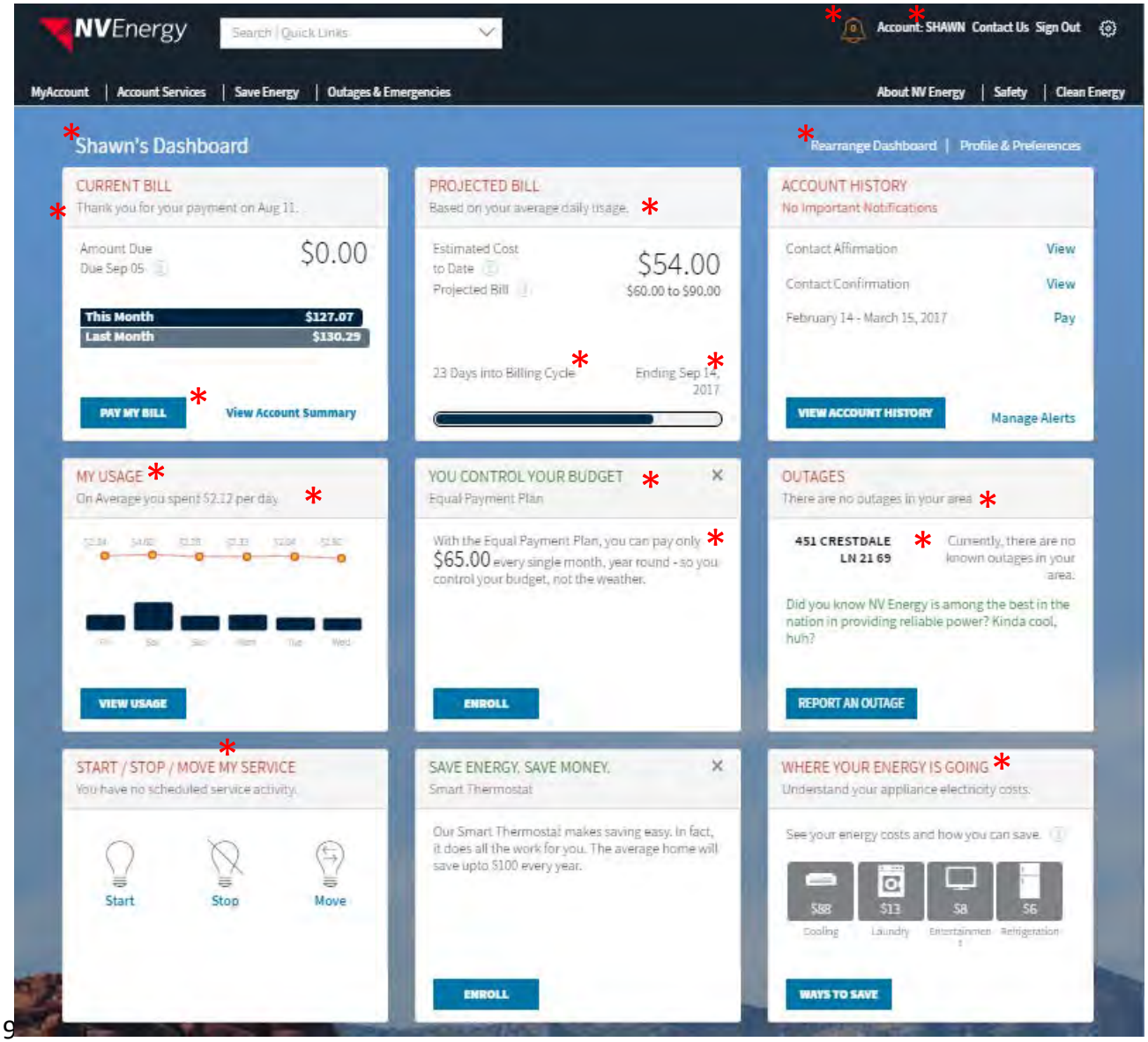
A Personalized Experience



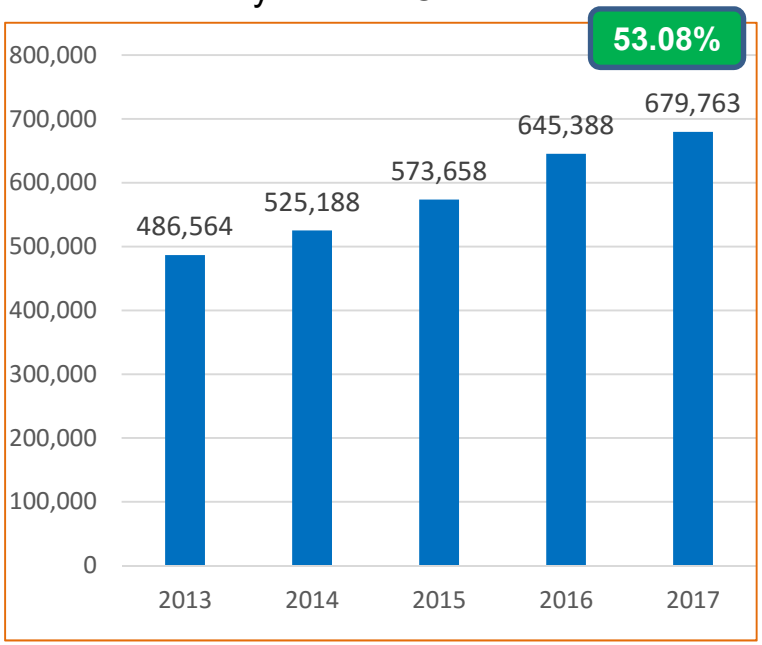
Simple, intuitive design lets customers find items easily and quickly

- ✓ Numerous personalization efforts * designed to bring the "segment of one" concept to all customers
- ✓ A personalized and customizable dashboard that provides the customer the information they want, where they want it, and when they want it

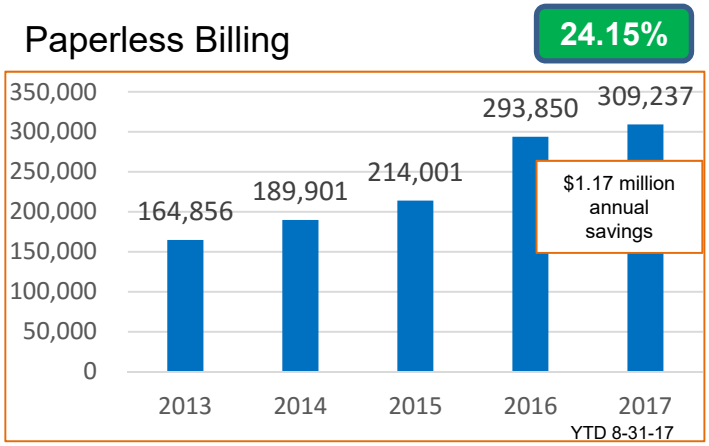
Electronic Transaction Trends

MyAccount Transactions

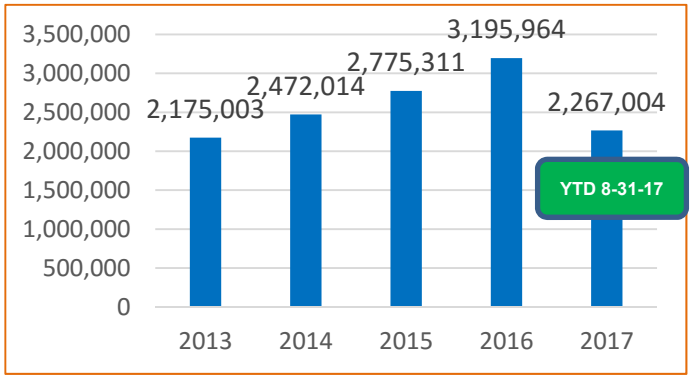
MyAccount Customers



Paperless Billing



Online Payments



10

Demand Side Management

Energy Efficiency Services
Demand Response

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NV Energy Demand Side Management Services to Nevada Customers

Commercial	• Advanced assessments and incentives for commercial new construction or retrofit projects • Non-profit agency grants
Schools	• Public school and higher education energy efficiency and demand response projects
Residential AC	• Early replacement or air conditioning retrofit units • HVAC tune ups
Residential Demand Response	• Smart Thermostats • Legacy CoolShare and two-way switches
Commercial Demand Response	• Energy efficiency and demand response controls through smart thermostats, demand limiting devices and universal gateways
Energy Assessments	• Online and home energy assessments to aid customers in identifying energy saving opportunities including direct install measures (LEDs, photo sensors, air filters and coil wraps)
Energy Reports	• Home and business reports providing energy information about usage along with energy saving advice
Energy Education	• Activities that provide energy information through participation in community events, trade associations, custom trainings and work with teachers/students

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Customer Engagement

The Right Tools to Save You Energy and Money

powershift by NVEnergy

- **Awareness**—Strategies include a combination of media (earned, paid, social), direct response customer outreach, and web/mobile/email offerings
- **Recruitment**—Strategies include utilizing pathways through existing customer contact, onboarding support of new customers, referral opportunities and energy education and outreach local community events
- **Retention**—Strategies include utilizing regular communications for continuous engagement and feedback to the Company

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DSM Approval Process

Deferred Energy Accounting Adjustment

- Filed Annually March 1
- Prudency review of costs spent prior year
- Set new public purpose surcharges (EEIR, EEPR)

•NRS 704.110(11)(c), NRS 704.187(3), NRS 704.785 - NAC 703.535, NAC 704.9494, NAC 704.9523, NAC 704.95225

Portfolio Standard Annual Report

- Filed Annually March 30
- Prudency of renewable energy credits from DSM programs

•NAC 704.8877 and NAC 704.8879

Integrated Resource Plan

- Filed Every Third Year June 1
- Approval of three-year demand side action plan
- Approval of prior year measurement and verification reports

•NAC 704.9156

Annual Update Report

- Filed Annually June 30
- Approval of remaining years of action plan
- Approval of prior year measurement and verification reports

•NAC 703.535, NAC 704.934 (8), NAC 704.9522,

Historic Budgets, Portfolio Programs, Energy and Demand Savings

NV Energy	2012	2013	2014	2015	2016
Energy Savings (MWh)	182,472	177,199	231,199	245,903	225,601
Energy Efficiency Programs Peak Reduction (MW)	30	27	36	35	33
Demand Response Peak Reduction (MW)	154.1	178.9	192.3	214.8	228.4
Expenditures ($000)	$38,669	$39,391	$48,875	$45,505	$48,911
DSM Energy Savings as % of Sales	0.62%	0.60%	0.79%	0.82%	0.75%

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DSM Funding Example

- An average residential customer pays approximately $16.00 per year to fund Demand Side Management programs

- That same customer can reduce their energy use by installing a single smart thermostat in their home and decrease their bill by approximately $56.00 per year at Nevada Power and $20.00 per year at Sierra

- By installing a single smart thermostat a NV Energy customer not only recoups the cost to pay for DSM programs but also continues to save additional dollars on his/her bill

Company	Energy Efficiency Charge	Average Monthly Usage Residential	Monthly Energy Efficiency Cost	Annual Energy Efficiency Cost	Standard Electric Rate	Annual Energy Savings to Break Even (kWh)	Annual Electric Savings for one Residential Thermostat (kWh)	Annual Standard Electric Rate Savings
NPC	$ 0.00118	1,110	$ 1.31	$ 15.72	$ 0.11154	140.91	504	$56.22
SPPC	$ 0.00181	743	$ 1.34	$ 16.14	$ 0.08822	182.93	230	$20.29

- The PowerShift by NV Energy smart thermostat program continues to save the customer energy money throughout the life of the thermostat, which is currently 10 years

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Customer Engagement in DSM

PowerShift by NV Energy products and services helps customers conserve energy, lower their energy costs and reduce emissions

- In 2016, PowerShift customers saved nearly 225,000 megawatt-hours of electricity, enough to power more than 110,000 homes
- In 2016, PowerShift provided services to over 159,000 residential customers and 2,357 commercial customers; over 3,000 of these residential customers received in-home energy assessments
- In 2016, PowerShift provided energy education to over 80,000 residential, commercial, and building industry support customers
- In 2017 to date, PowerShift customers included 256,708 residential customer participants, 2,478 commercial customer participants; over 5,000 of these residential customers received in-home energy assessments and energy education has been provided to over 68,000 customers
- For the past ten years the average annual energy savings is 0.94% of total sales, and the cumulative annual energy savings for the past ten years is 2,745 gigawatt-hours

Demand-Side Response
One Example

- 88,361 Customers enrolled
- 253 Megawatts enrolled
- 66 events in 2017
- 164 Megawatts of avoided capacity
- Avoid purchases of expensive peak market energy—substantial savings for customers
- Direct savings for participating customer
- Benefit-remote thermostat and A/C analysis

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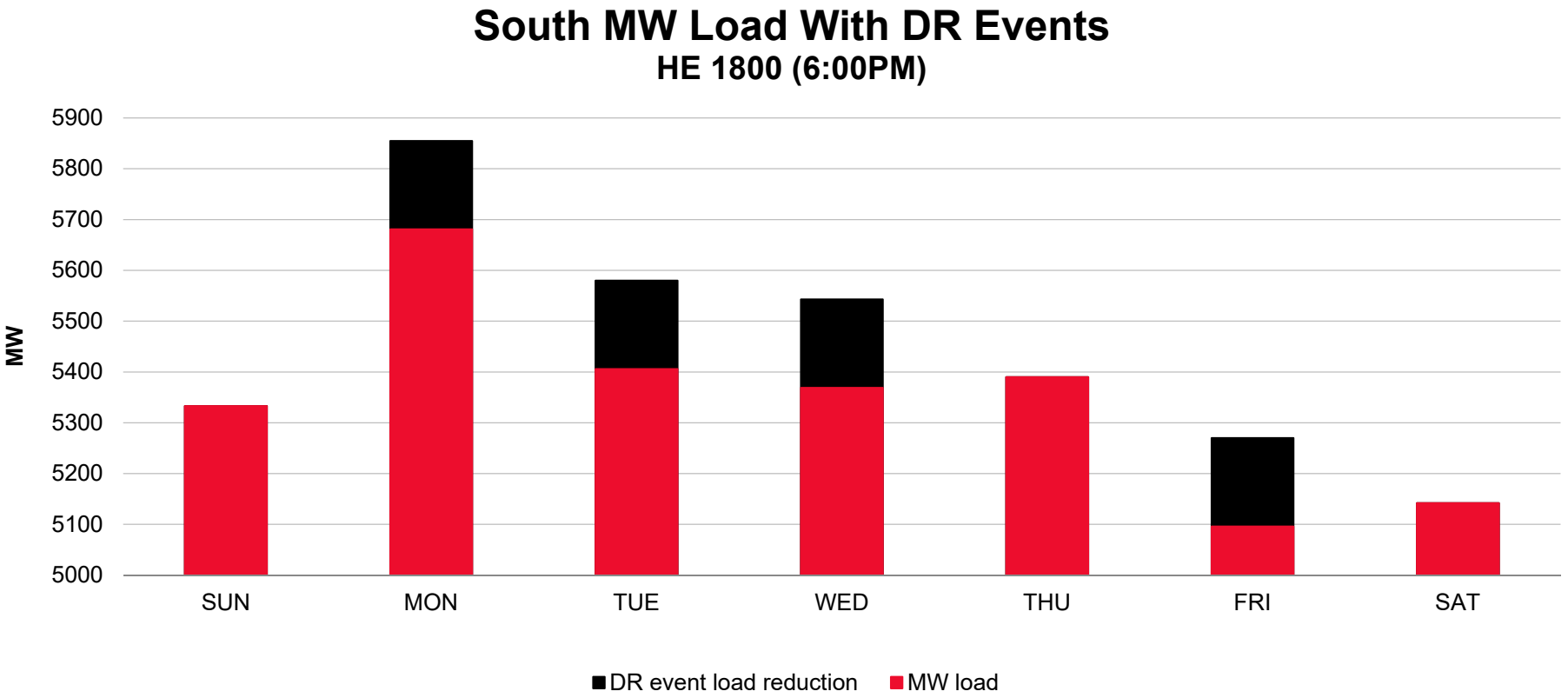
Southern Nevada Demand Response

example June 19 - 25, 2016



2017 Nevada Legislation

- AB 223 – Transition from stand-alone program approval to portfolio approval; allocation of 5% of DSM budget to low income customers
    - NV Energy will need to adjust or modify how it evaluates energy efficiency programs based on a set of programs as opposed to individual programs.
    - This change will now allow programs that historically were not cost effective individually to now be incorporated, thus expanding the types of energy efficiency programs that can be offered.
    - NV Energy will now need to allocate at least 5% of is DSM budget to low income customers.

- SB 150 – Commission establishes energy efficiency targets and cost effectiveness tests
    - The Commission is required to establish by regulation goals for energy efficiency to be included in the company's integrated resource plan.
    - NV Energy required to submit in its' integrated resource plan an energy efficiency plan that meets the goals established by the Commission.
    - NV Energy agreed to conduct a study to evaluate all potential energy efficiency programs by end of 2018.

RenewableGenerations Programs

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RenewableGenerations Programs

- Incentive program created by Legislature in 2003 (NRS 701B) to assist customers with installing private solar, wind, and hydro systems.
- 2013 Legislature set a spending limit of $255.2 million for 250,000 kW[1] of solar and $40 million[2] for wind and hydro combined (no capacity goal).
- 2017 Legislature combined spending limits into one pool of funding, expanded eligible technologies into electric vehicle infrastructure and energy storage.
- 20,439 customers have taken advantage of program.
- Solar is the only program currently receiving active applications from interested customers.
- 78% of all customers taking service under net metering provisions have done so through these programs. Since 2015, the percentage has increased to 85% of all customers.

	Since Program Inception		Applied Toward Legislative Goals	
Program Metrics[3]	Capacity Installed (kW)	Spend ($mil)	Capacity Installed (kW)	Spend
Solar	176,607	$230,105,540	172,817	$212,839,918
Wind	10,360	$26,246,208	9,735	$26,163,708
Water	595	$1,447,500	595	$1,447,500
Total	**187,562**	**$257,799,248**	**183,147**	**$240,451,126**

1. Applies to systems installed on or after July 1, 2010
2. Applies to systems installed after July 1, 2009
3. As of August 31, 2017. Does not include reserved payments on systems with active reservations.

SolarGenerations Total Spending By Category

- Since the program's inception, spending has been tracked by sector
- Schools and Public Institutions received a majority of funding, and the highest average incentive for capacity installed
- Residential customers have generated the largest number of projects

Sector	Total Incentives Paid[1]	Capacity installed (kW)	Completed Projects	Average Incentive ($/ Watt)
Residential/ Small Commercial	$41,652,309	118,536	19,523	$0.35
Large Commercial/ Industrial	$933,784	9,898	28	$0.09
Low Income/ Non Profit	$4,326,902	2,228	52	$1.94
Schools	$110,129,889	27,067	304	$4.07
Public Entity / Public and Other	$73,062,656	18,879	360	$3.87
Total	**$230,105,540**	**176,607**	**20,267**	**$1.30**

1. As of August 31, 2017. Does not include expected future payments for performance based incentives

How Do the Programs Work?

- Program funding is provided by NV Energy's customers through the Renewable Energy Program Rates paid on their monthly bill. The rate is paid on a volume consumption basis.
- The programs are open on a continuous basis until funding is exhausted.
- Plans are proposed annually to the PUCN, reviewed by interested stakeholders, and approved by the Commission.
- Systems with a total capacity of up to 500 kW are eligible.
- Incentives are paid up front at the completion of construction for small systems, or over time for larger systems based on actual performance.
- The renewable energy credits generated by program incentivized systems are assigned to the utility to apply toward the renewable portfolio standard (11.3% of all renewable credits applied by the utility for compliance in 2016).

Steps to complete a Solar System

1. Partner with an installer to complete a design
2. Submit an application online, receive reservation
3. Construct system
4. Submit completion package
5. Interconnect system
6. Begin receiving incentive payments

Current Solar Incentive Levels (Beginning 7/1/2017)

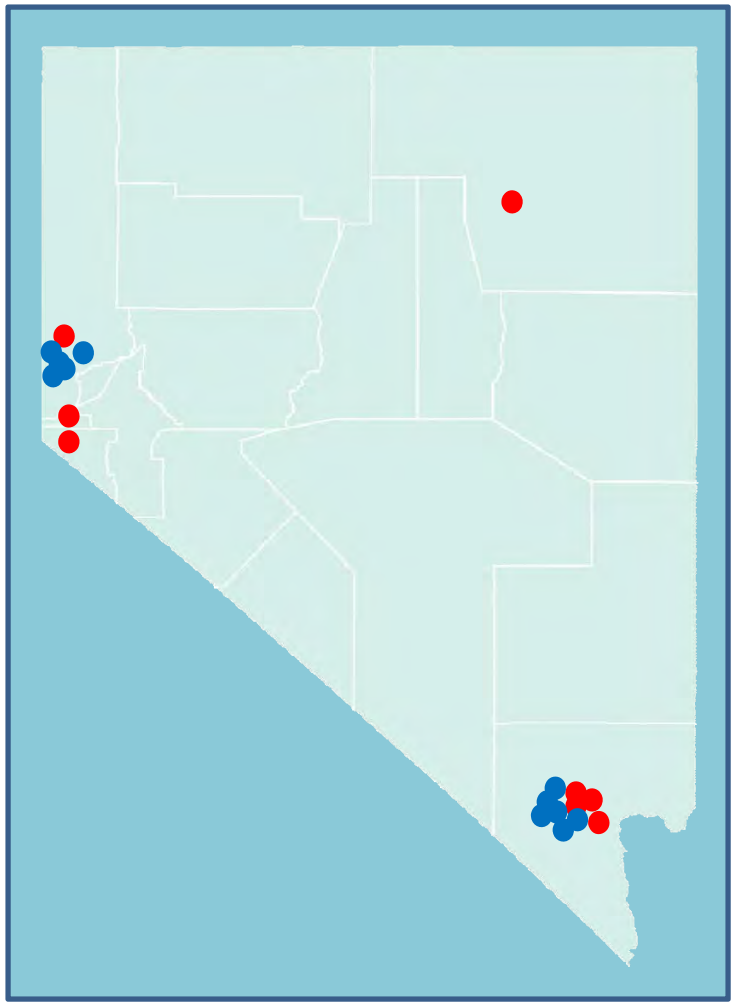
Incentives – Residential/Commercial	
Less than 25 kW	$0.245 / Watt
25 kW to 500 kW	$0.0264 / kWh

Incentives – Public/Non Profit	
Less than 25 kW	$0.49 / Watt
25 kW to 500 kW	$0.0527 / kWh

NVEnergy

Lower Income Solar Energy Pilot Program (LISEPP)

- Created by the 2013 Legislature to build 2,000 kW of solar capacity to benefit low income customers, paid for 100% from the SolarGenerations program.
- Recipients are required to utilize bill savings towards programs serving low income populations.



PHASE I: 1,000 kW, $3.0 million

- Installed at 8 Title I schools throughout the state.
- Completed in Spring of 2016.
- Utility bill savings must flow directly to benefit student populations at host school.

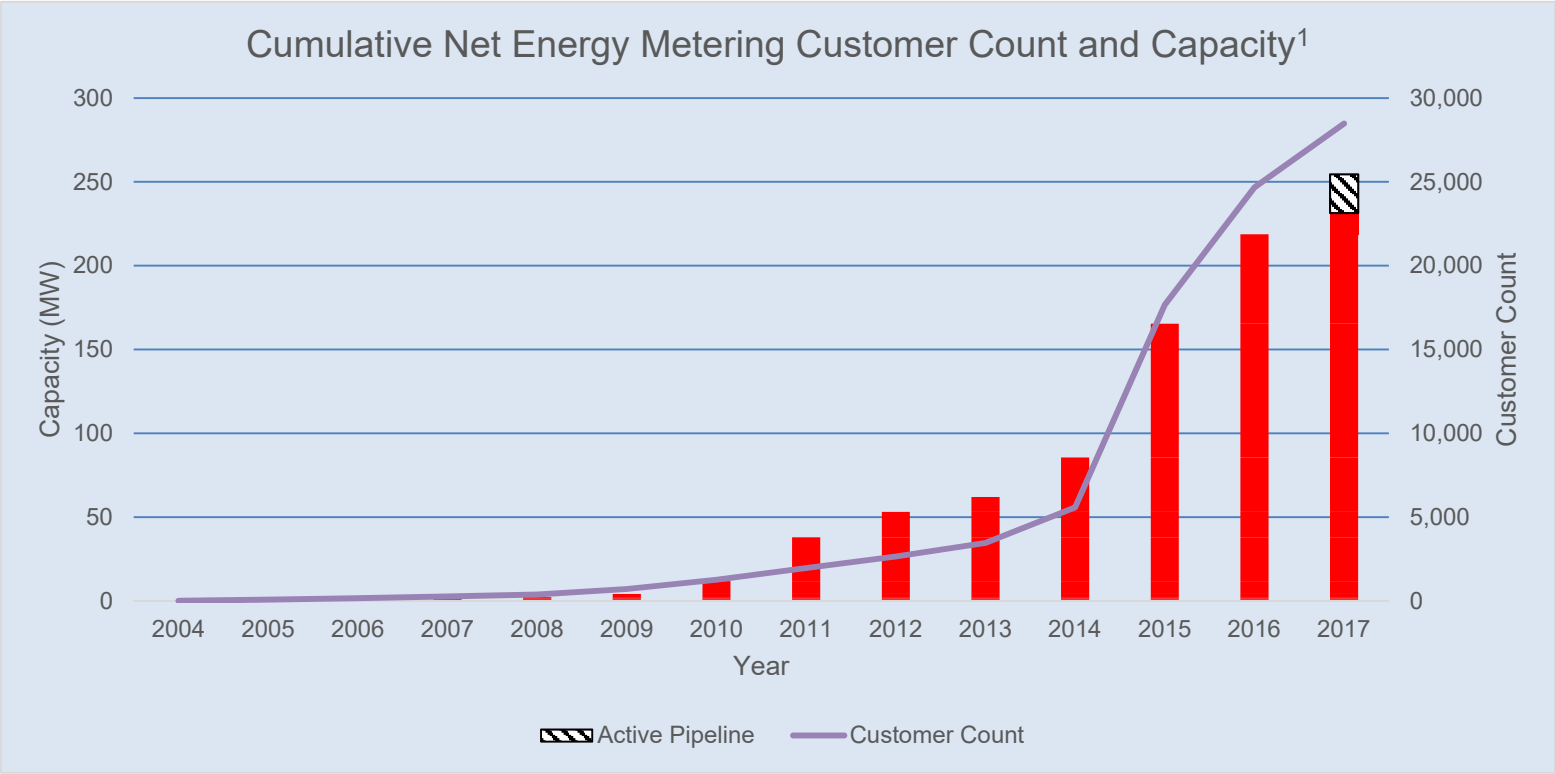
PHASE II: 1,000 kW, $4.1 million

- Installed at 15 non-profit facilities statewide.
- Completed spring of 2017.
- Utility bill savings must flow directly to benefit the low income and disadvantaged populations they serve.
- Partnered with Governor's Office of Energy who provided $350k toward project.

NVEnergy

NV Energy Historical Net Metering Information

- 26,273 net metering systems interconnected for 231.4 MW.
- Additional 2,210 systems are currently in the pipeline for 23.1 MW.
- NVE handles the netting function and purchases excess energy.



1. As of August 31, 2017

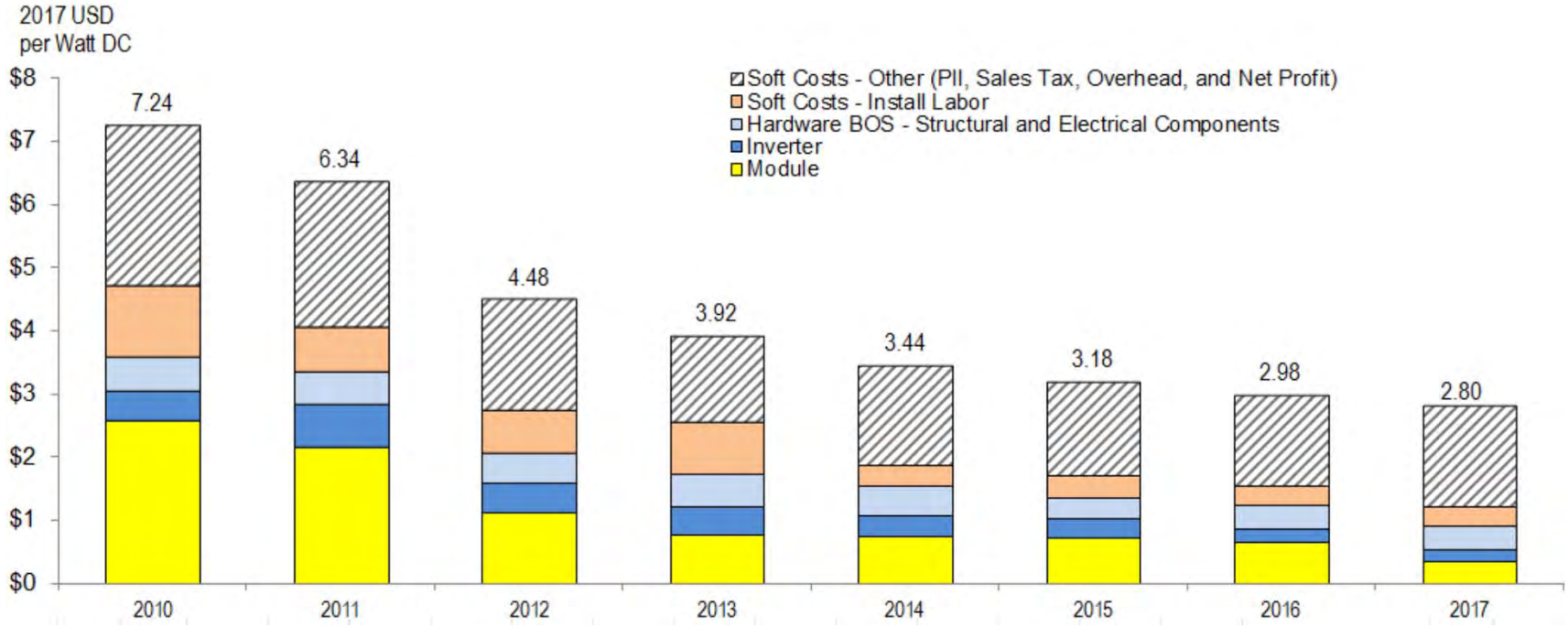
Assembly Bill 405 Changes to Net Metering

- Requires that net metering customers are in the same rate class as similarly situated non-net metering customers.
- Creates four tranches of capacity (for systems 25 kW or less).
  - Tranche 1 –80 MW priced at 95% of price of electricity.
  - Tranche 2 –80 MW priced at 88% of price of electricity.
  - Tranche 3 –80 MW priced at 81% of price of electricity.
  - Tranche 4 –uncapped priced at 75% of price of electricity.
- On September 1, 2017, the Public Utilities Commission of Nevada issued an order implementing Assembly Bill 405.
  - Excluded public policy costs (energy efficiency, low income assistance, renewable energy) from excess energy compensation.
  - Established a queue based on application submitted date to ensure that that 80 MW is installed in each tranche (no more and no less).
  - Created a regulatory asset to track and recover costs associated with implementing AB 405.
  - Implements monthly netting of electricity before determining excess energy compensation.

Residential Private Solar Installation Costs

- Average residential solar installation costs have declined by 61% since the beginning of this decade.
- From 2016 to 2017, costs declined 6%, driven primarily by module cost declines, offset partially by increases in ancillary soft costs.

NREL residential PV system cost benchmark summary Q4 2009-Q1 2017



Source: Fu, Ran, et al.; *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017;* Technical Report NREL/TP-6A20-68925; National Renewable Energy Laboratory; U.S. Department of Energy; September 2017; Pg. 23.

Net Metering Customer Outreach

- Outreach has been an important part of the SolarGenerations program since the inception of the program.
- NV Energy's website contains useful information on net metering billing, tips for customers looking to go solar, and explanations of the interconnection process.
- NV Energy regularly attends community events and has a demonstration trailer to educate customers on technology.
- NV Energy provides presentations to customer groups, including trade groups, homeowners associations, and community organizations.

Senate Bill 145 Enhancements to Program

- Combined individual funding limits into one combined pool of $295.2 million.
- Remaining funding of $54.8 million[1] can be applied toward solar, wind, water, electric vehicle infrastructure, or storage projects.
- $10 million explicitly allocated through the bill toward energy storage.
- Provides for a successor program to LISEPP, allocating up to $1 million per year specifically for low income projects.
- At current incentive levels, funding is adequate to achieve solar 250 MW capacity goal, spend entire allocation toward energy storage, and allow significant investment in electric vehicle infrastructure.
- Retains sunset provisions of NRS 701B to conclude any new projects by December 31, 2021.

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1. As of August 31, 2017. Excludes projects with active reservations that have not yet interconnected.

NV Energy Vehicle Electrification

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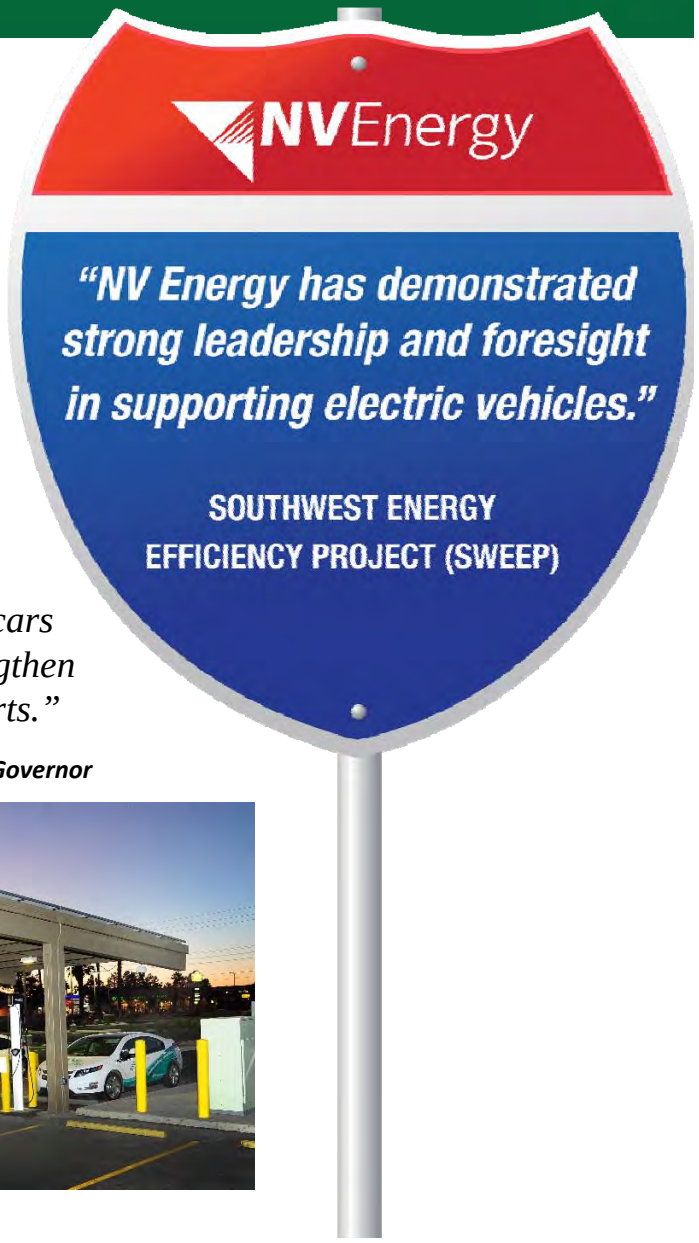
Electric Vehicles
Good For Nevada… Good For Customers

NV Energy Electric Vehicle Program

- Electric Vehicle Time of Use Rates since 2009
  - Residential, Commercial, Multi-Family
- NV Energy Workplace & Public Charging
- Electrification of the NV Energy Fleet
- Charging Station Shared Investment Program
- Nevada Electric Highway Partnership

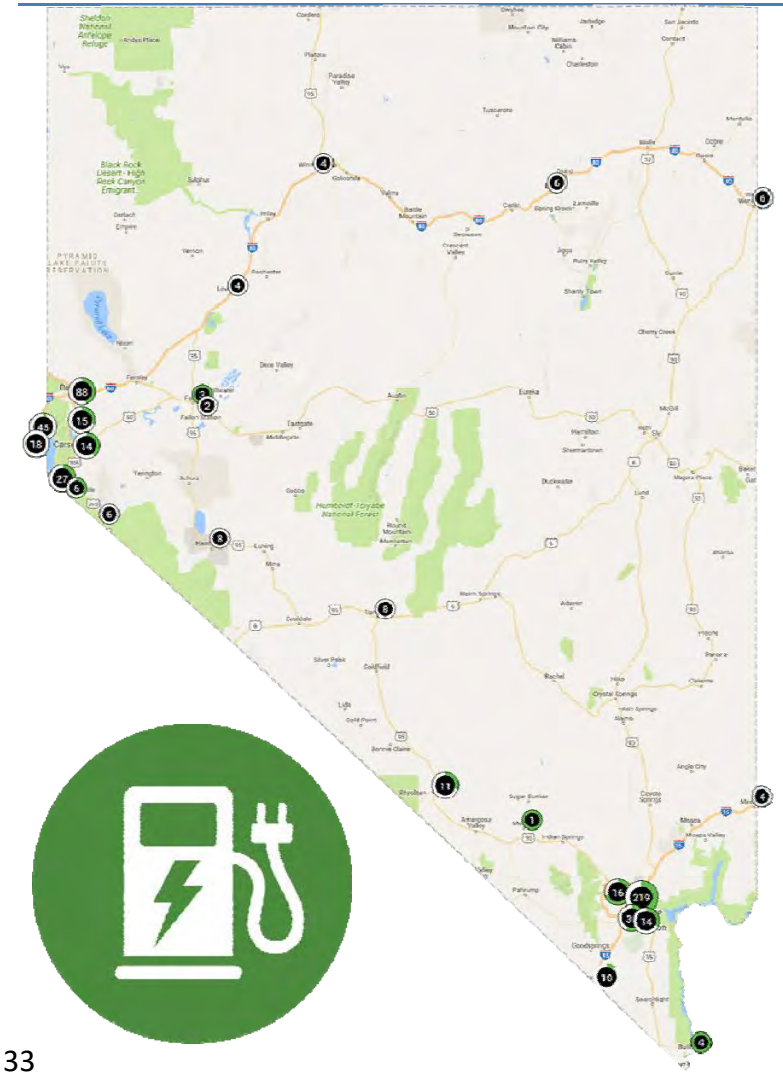
"This Electric Highway will allow electric vehicle drivers to power their cars by tapping into Nevada's own renewable energy resources. This will strengthen our state's energy independence while reducing Nevada's petroleum imports."

-- Brian Sandoval, Nevada Governor



NV Energy Charging Station Shared Investment Program

Partnerships Driving Sustainability



NV Energy partnered with ~50 Nevada companies in 2013 **and doubled** the electric vehicle charging infrastructure in Nevada

- ✓ Airports
- ✓ Universities
- ✓ Shopping Centers
- ✓ Casinos
- ✓ Government Buildings
- ✓ Small Businesses

"NV Energy's innovative and proactive market approach lets it keep pace with Nevada's quickly evolving electric transportation landscape, which Clean Energy Project believes will be central to our state's economic future and the new Nevada."

— Clean Energy Project

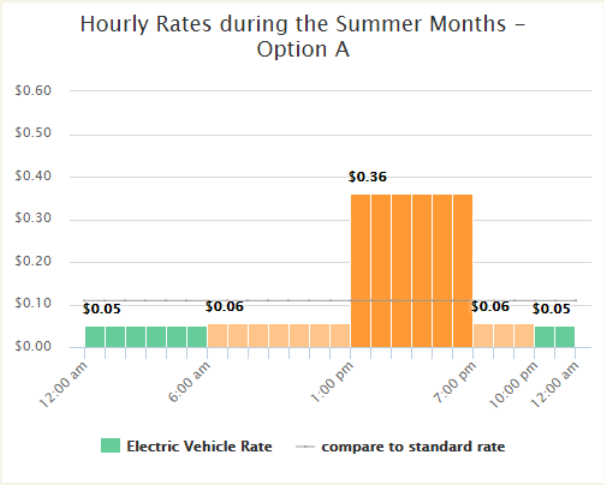
NVEnergy

Shifting Electric Vehicle Load via Price Signals

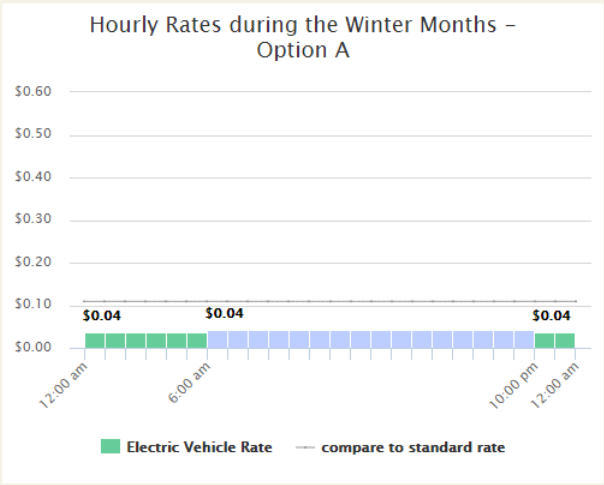
Residential Electric Vehicle Time-of-Use Rates

- **96%** of Nevada Power Customers experience lower bills on their EV TOU than other rate classes.
  - Attrition rate is 1%
  - Participation Rate 36%

- Rate applies to entire home, not just the electric vehicle load
  - **Pro**: successful customers shifted the load of their entire home and save money.
  - **Pro**: participation in rate self-identifies electric vehicles on the grid by premise.
  - **Issue:** not all electric-vehicle owners participate. No current solution to incentivize off-peak behavior of just the electric vehicle load and not the entire home.



Summer Months: Jun Jul Aug Sep



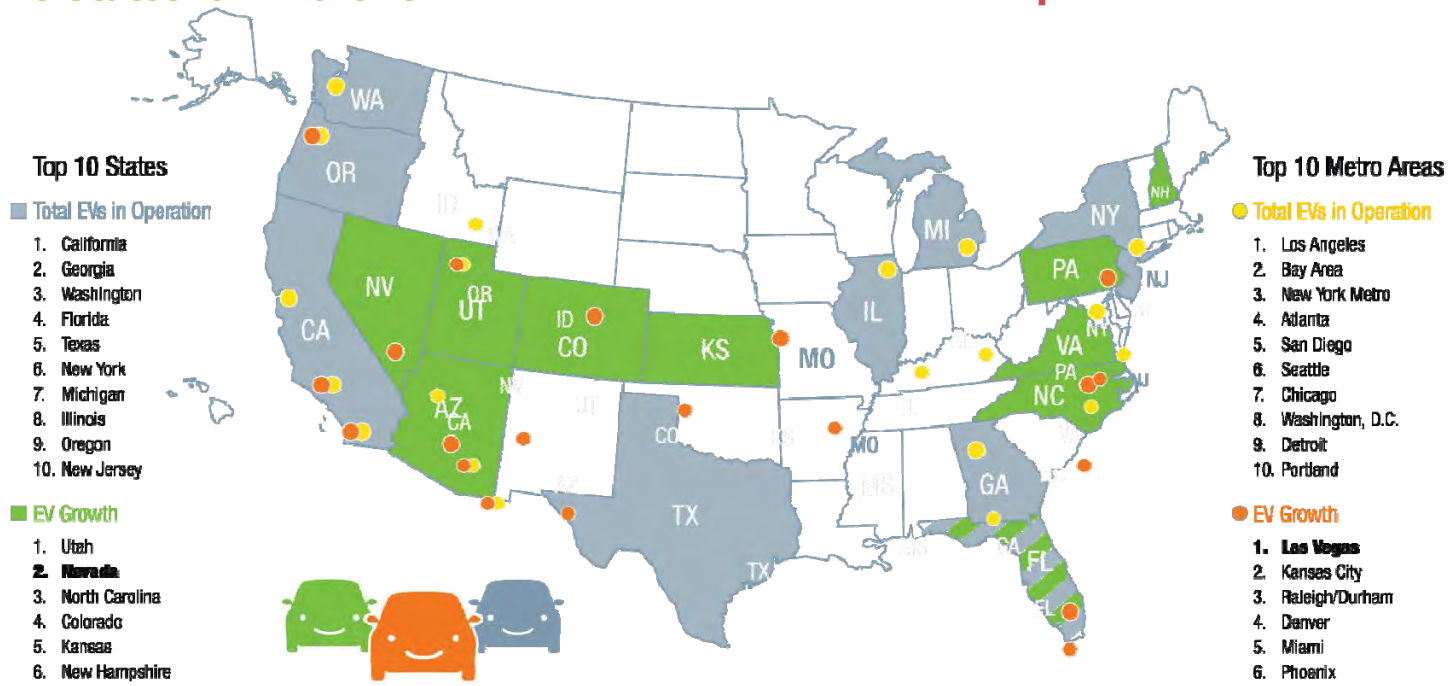
Winter Months: Jan Feb Mar Apr May Oct Nov Dec

Nevada is Primed for Electric Vehicle Growth

With the implementation of the Electric Vehicle Infrastructure Demonstration Program, as part of Senate Bill 145, the Company is poised to support and accelerate the realization of electric vehicle growth in Nevada.

Nevada listed #2
In Top 10 States for EV Growth

Las Vegas listed #1
In Top 10 Metro Areas for EV Growth



Source : ChargePoint

NVEnergy

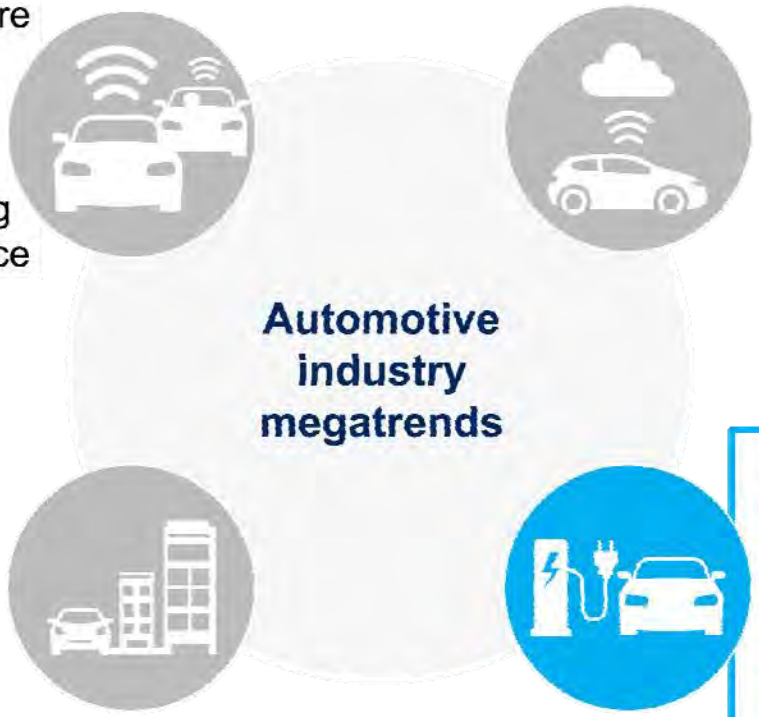
Automotive Industry Megatrends. Electrified. Happening in Nevada

Autonomous

- EV vehicle architecture has a central control unit to facilitate autonomy
- Autonomous charging could add convenience

Connected

- **A connected EV ecosystem could increase the convenience of charging**
- **Connected car grid solutions could enable cost-effective load balancing**



Shared

- **Greater annual driving distances can offer a decisive TCO edge for EVs**
- **Some consumers may prefer access to multiple vehicle types over ownership (including EVs)**

Electrified

- Tightening emissions efficiency rules make EVs necessary to meet standards
- Lower battery costs improve EV economics

SOURCE: McKinsey Sustainable Mobility Initiative

Innovation in Transportation Already in Motion; Autonomous, Connected & Electric ("ACE") Initiatives

Las Vegas launches 1st electric autonomous shuttle on U.S. public roads

*Source; techcrunch.com

Las Vegas is a top 10 market for autonomous vehicle roll-out

*Source; INRIX Autonomous Vehicle Study

Proterra Starts Industry's First Autonomous Bus Program in Nevada

RTC of Washoe County : 4th Street Station, Reno

Fleet Electrification

- As Nevada embarks on transforming the transportation sector, the Company is in a strategic position to provide technical advisory services and charging infrastructure programs to accelerate fleet electrification and thus the environmental and economic goals of the State in an expeditious manner.

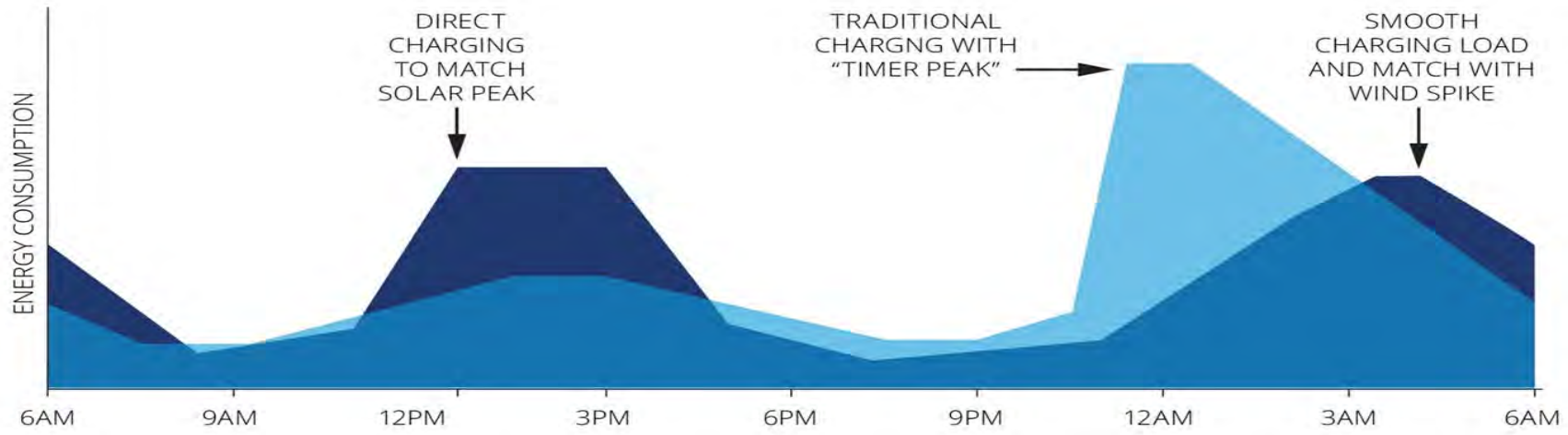
Green Fleet Sustainability All Stars*

- NV Energy has been expanding its hybrid fleet since the first hybrid bucket trucks were available in 2009 and is growing every year.
- Today, 11% of our fleet has electrification technology.
  - 45 hybrid bucket and line trucks
  - 41 hybrid ePTO bucket or line trucks
  - 18 passenger vehicles including the arrival this year of plug-in hybrid pick-up trucks

* Green Fleet Magazine

Electric Vehicles as Distributed Energy Resources

If utilities anticipate the load of charging EVs and plan for it proactively, they can not only accommodate the load at low cost, but also reap numerous benefits to the entire system.*



Source: BMW of North America, 2016 with edits from Smart Electric Power Alliance 2017

- NV Energy has been proactive in our electric vehicle program to acknowledge that electric vehicle load may occur at peak and have thus designed levers and incentives in our programs to grow electric vehicle load off-peak wherever possible.
  - Electric vehicle time of use rates for residential, commercial, and multi-family customers.
  - Demand response clause to shed load if necessary for all electric vehicle charging stations encompassed in the NV Energy Charging Station Shared Investment Program.

*Rocky Mountain Institute Electricity Innovation Lab;

NVEnergy

NV GreenEnergy Rider and Renewable Portfolio Standard

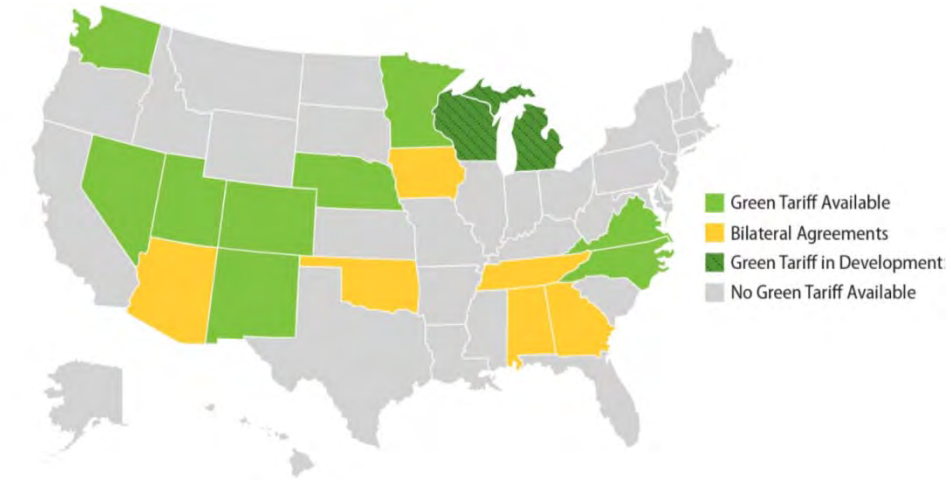
NVEnergy

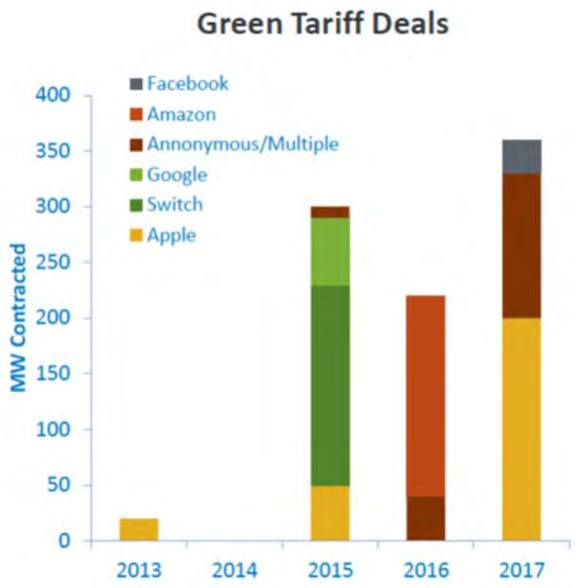
NV GreenEnergy Rider
Policy and Background

- Nevada Revised Statute 704.738 – Program of optional pricing for electricity generated from renewable energy: Authorization of Public Utilities Commission of Nevada (“PUCN”) required; Commission may authorize higher rates.
- Schedule No. NGR tariff , approved by the PUCN, also details applicability, rates, terms, and special conditions.
- The NV GreenEnergy Rider (“NGR”) program provides a means for customers to have all or some portion of load supported by renewable energy generation.
- Through the NGR, NV Energy and the customer may enter into a special contract (i.e., Renewable Energy Agreement, “REA”) under which the customer agrees to assume all of the costs of the renewable energy resource up to a specified amount, not to exceed the customer’s total energy consumption.
- The PUCN approves such a special contract upon, a satisfactory showing that NV Energy’s other customers do not subsidize the NGR transaction.

Existing NV GreenEnergy Rider Transactions

- Attractive, low-cost option for customers beyond the RPS
- Provides opportunity to improve equipment and installation costs for new solar
- The cost for the renewable attribute is among the best nationally, and customers are able to identify the source
- Customers pay the otherwise-applicable rate for energy
- NV Energy receives the energy and credits customers with the renewable attributes
- Nevada currently has nearly 50% of the commercial “green tariff” total capacity nationwide
- Among the announced green tariff transactions (900 MW total), 448.5 MW have been in Nevada.





Source: Heeter J., Charting the Emergence of Corporate Procurement of Utility-Scale PV, September 2017, NREL/PR-6A20-70003

Green Tariff Transactions Status

- Nevada has the largest percentage of commercial and industrial load under a green tariff.
- 2017 National Renewable Energy Lab report indicates that in 17 states, utilities have offered large customers the option to procure renewables through green tariffs or bi-lateral contracts.
- These partnerships offer customers access to off-site universal scale, low cost renewables.
- Most states have no green tariffs or associated transactions, so customers primarily just purchase RECs.
- Benefits include, but not limited to, long-term renewable energy at fixed price, no additional administration costs or energy expertise required for customers, and utilities can aggregate customer load to get economies of scale.

Source: Heeter J., Charting the Emergence of Corporate Procurement of Utility-Scale PV, September 2017, NREL/PR-6A20-70003

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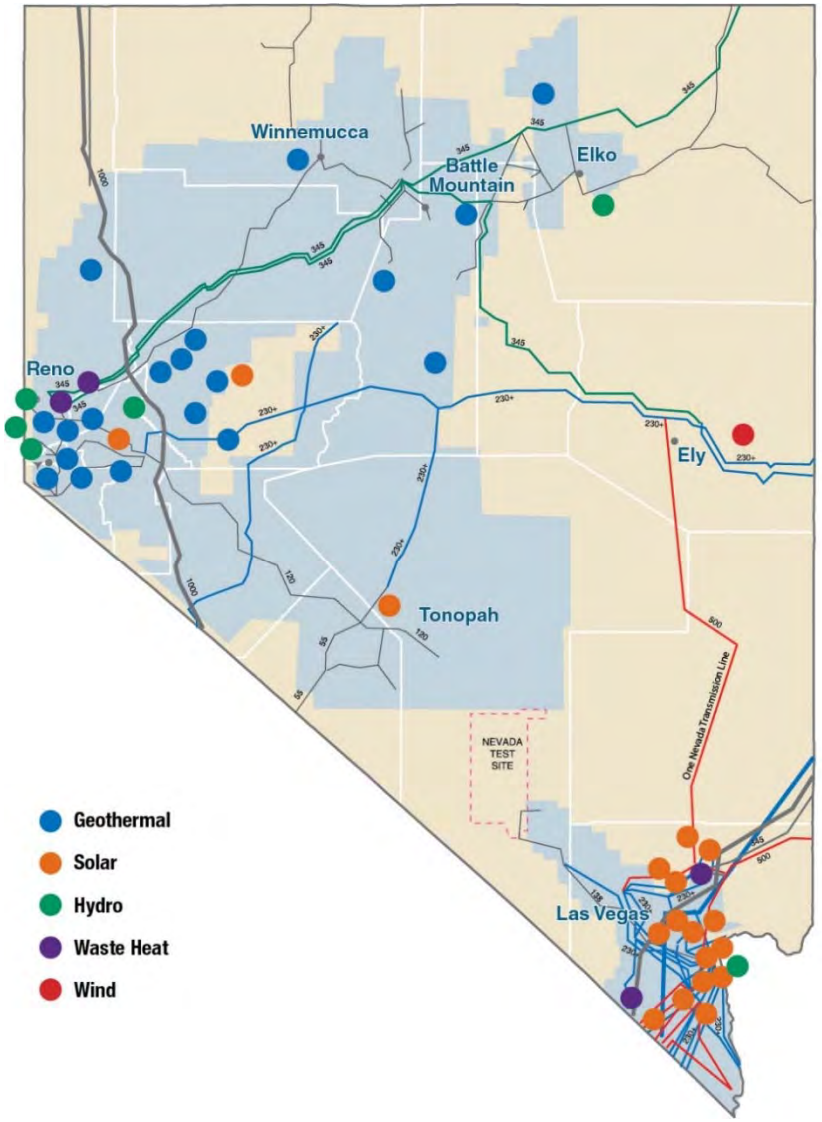
Renewable Portfolio Standard Policy and Background

- Renewable Portfolio Standard (RPS) - Energy policy that promotes the use of clean energy to meet the retail energy needs of the consumers in the state.
  - Renewable energy credit (REC) = 1 kWh
    - Credits are generated from utility scale solar, geothermal, wind, biomass, small hydro projects, and private generation
  - RPS began in the late 1980's when the Public Utilities Commission of Nevada (PUCN) required Sierra Pacific to procure 85 MW of renewables - namely geothermal

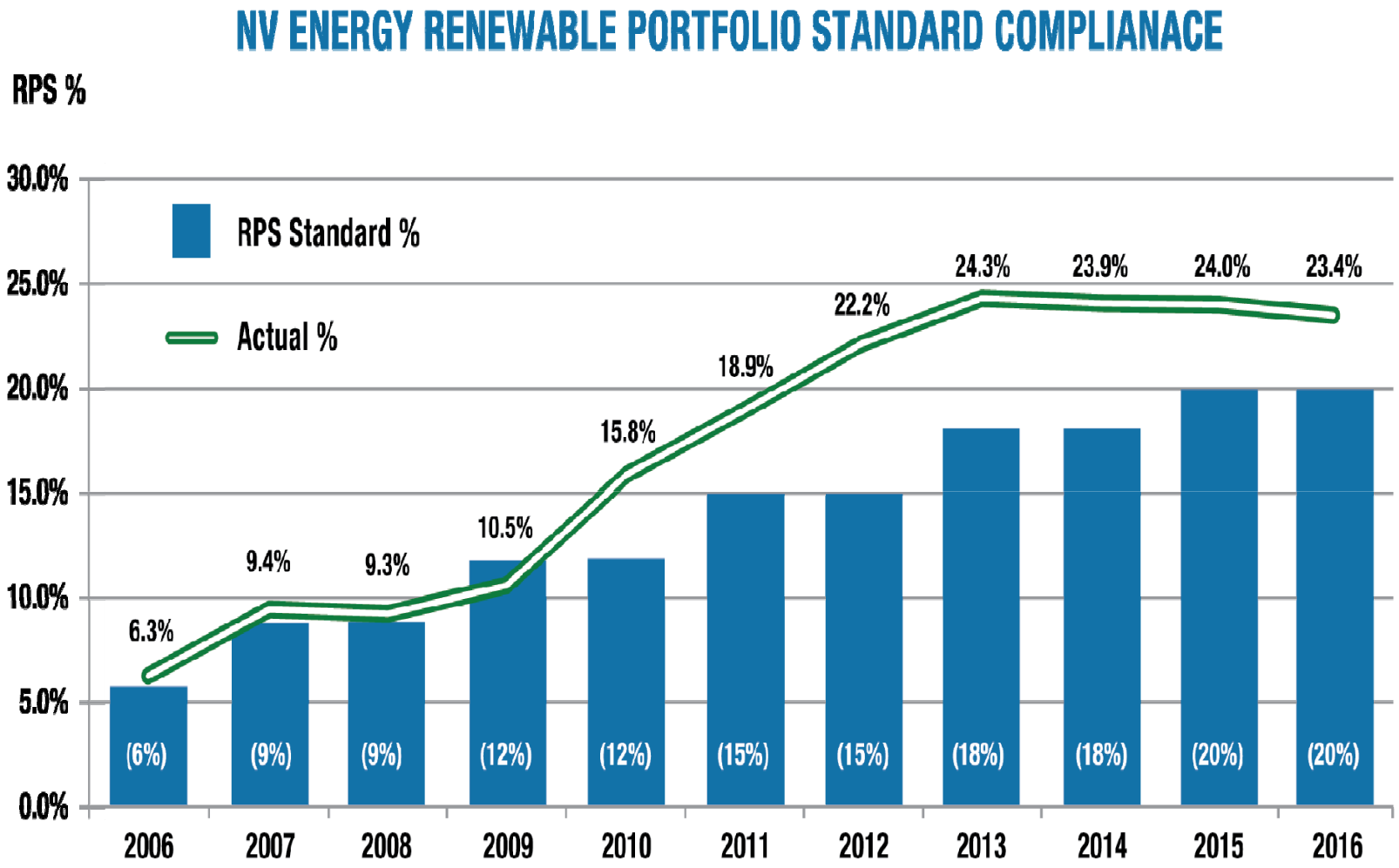
- Energy efficiency is being phased out as a tool to meet the RPS
  - Put in place as a trade-off to increase the RPS
  - Currently 20% of energy efficiency is permitted
  - Decreasing to 10% effective 2020
  - By 2025 energy efficiency will no longer be used in calculations

NV Energy Renewable Energy Projects

- NV Energy customers benefit from a very diverse set of renewable energy resources:
  - 19 Geothermal projects
  - 15 solar projects
  - 5 biomass/methane/waste heat
  - 5 small hydro
  - 1 wind farm



NV Energy RPS Compliance



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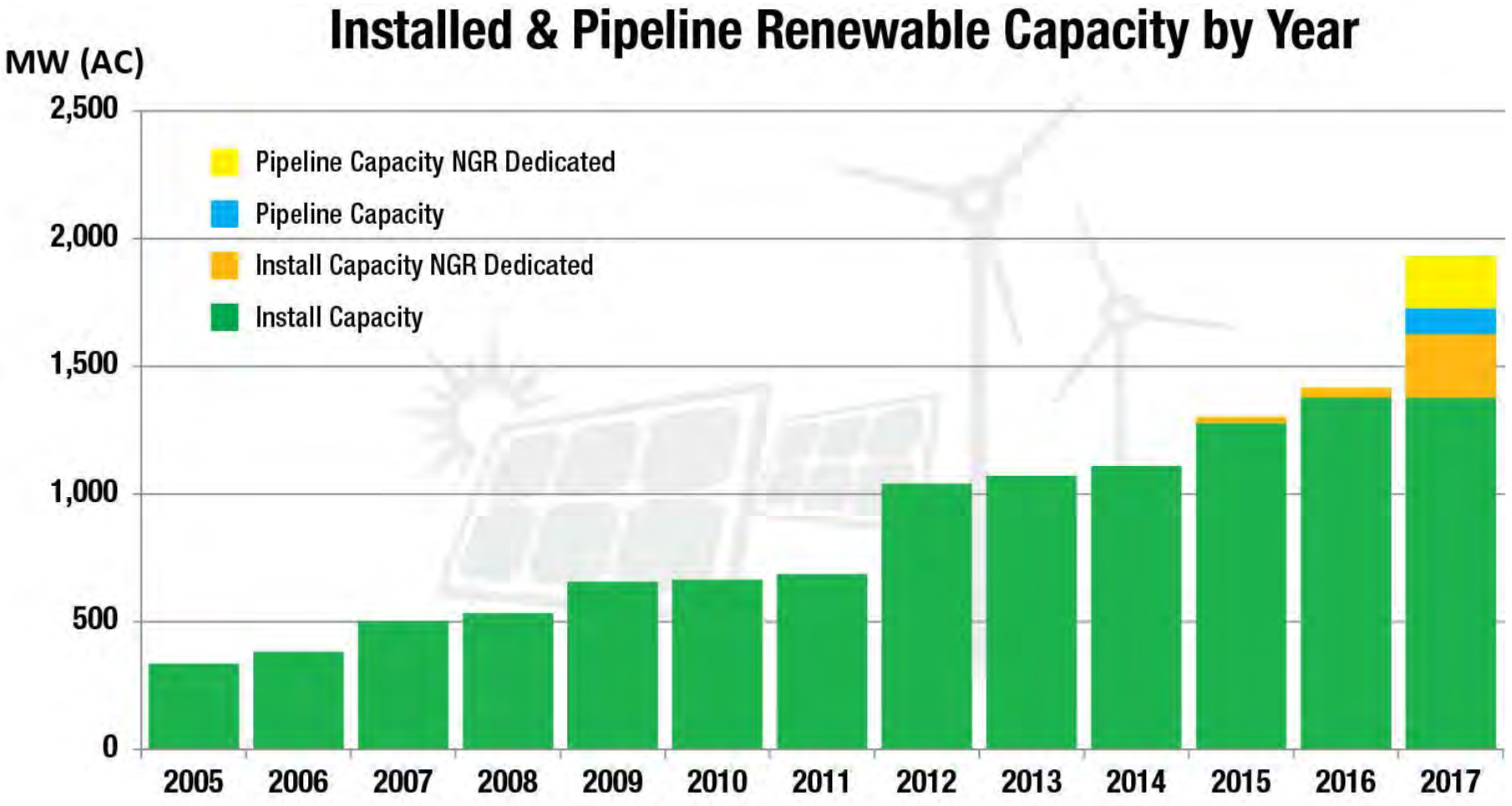
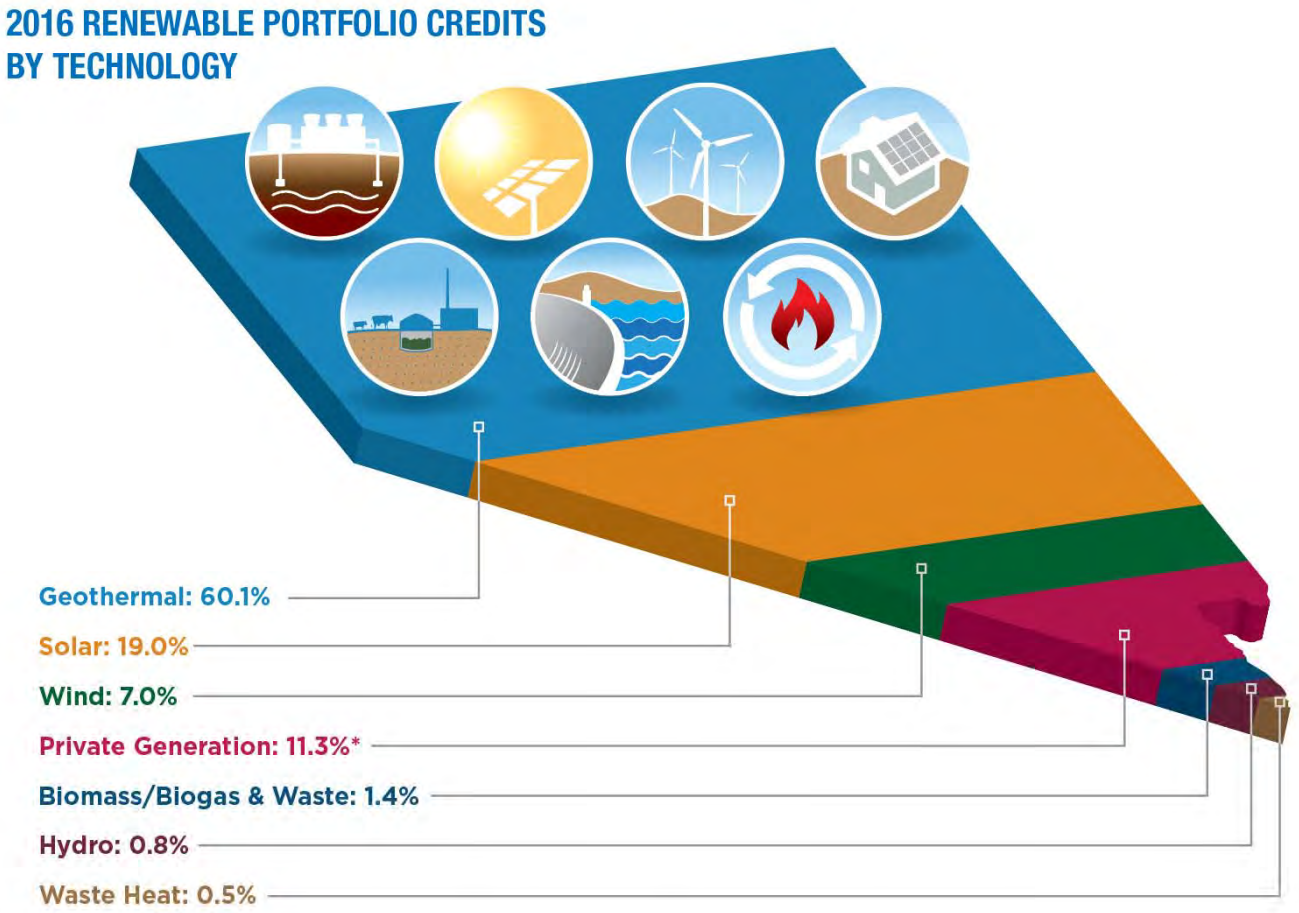
NV Energy Renewable Energy Capacity Growing Steadily



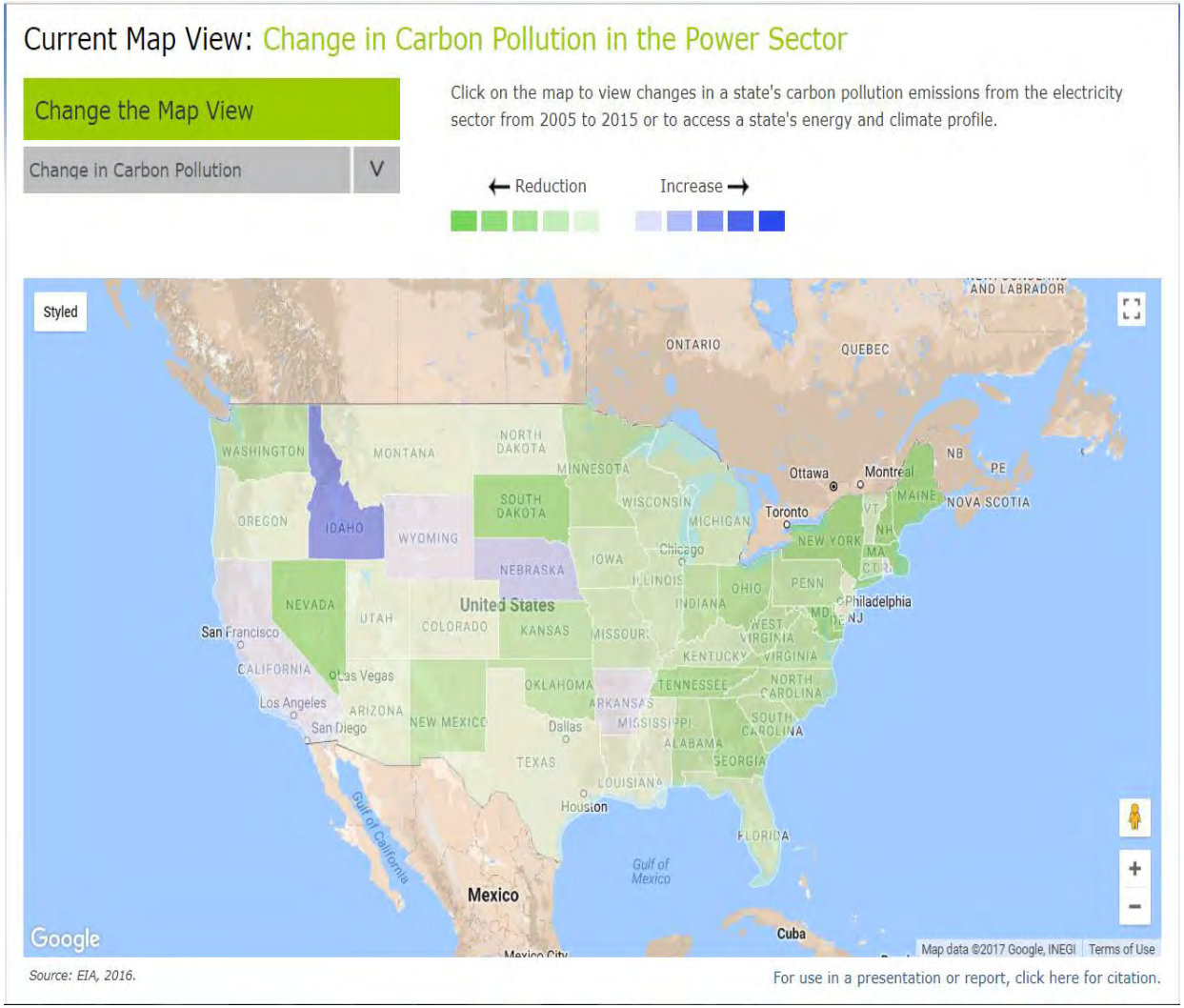
NV Energy Customers Benefit from a Diverse Renewable Energy Portfolio



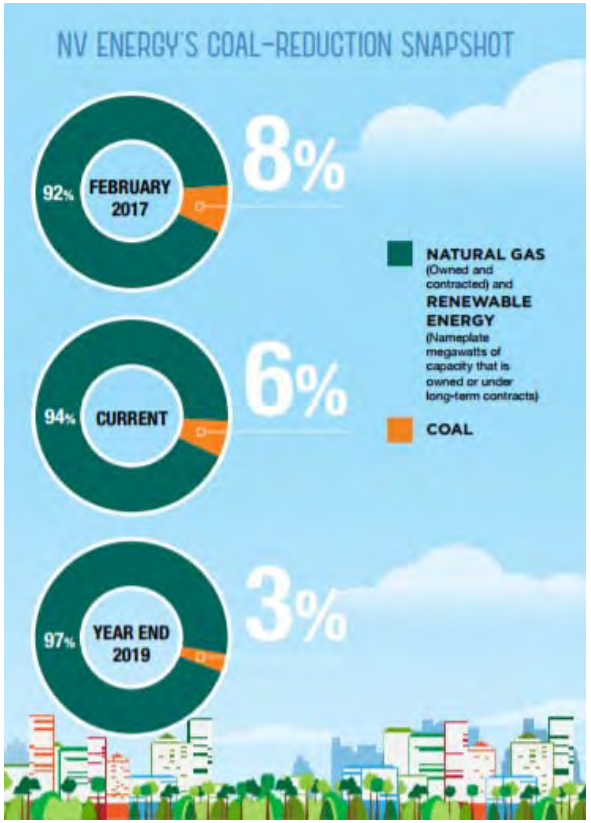
*Private Generation includes solar, wind, and hydro systems installed at a customer locations.

Nevada Carbon Reduction

- NV Energy is a leader in carbon reduction, collaborating with policymakers and transitioning while also reducing rates for customers



- ✓ Nevada reduced carbon emissions by 44% between 2005 and 2015
- ✓ NV Energy will be “out of coal” before California



Nevada is a Leader in Provision of Low-cost Renewable Resources

- Moving forward to provide renewable energy solutions to serve existing and new load, while complying the RPS goals
- NV Energy has seen long-term PPA pricing for utility-scale solar resources between $35 and $40 per megawatt-hour (“MWh”) - levelized cost over life of contract
- Since 2015, brought 474 MW of solar capacity online and contracted for another 300 MW
- Renewable energy growth through the utility promotes more rapid Nevada de-carbonization and large new projects (jobs, taxes, leadership)
- Supports improving equipment and installation costs for new solar

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Thank you.

Questions?

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Appendix

NVEnergy

Core Principles

Berkshire Hathaway ownership, combined with our core principles, strengthens the company and provides for long-term sustainability

VISION

To be the **best** energy company in serving our customers, while delivering sustainable energy solutions

CULTURE

Personal responsibility to our customers

1	Deliver exceptional customer service across all parts of the organization, resulting in an improved customer experience, as measured by customers.
2	Create a safer environment, on a daily basis, for customers, the general public and fellow employees by delivering an industry-leading occupational safety and health incident rate. Grow team of employees to be the best in the industry, while preparing them for industry challenges and newly created opportunities.
3	Reduce the impact that activities and assets have on the environment by reducing the CO_2 intensity of emissions, decreasing methane emissions and developing renewable resources to deliver a more sustainable environment in the communities where NV Energy operates and the world at large.
4	Actively engage external stakeholders, listening to their needs to properly develop value propositions that eliminate or reduce the need for rate increases and allow the business to achieve the allowed return on equity.
5	Operate assets in an efficient, cost-effective manner that reduces risk for the long-term benefit of customers, with gas pipeline assets experiencing zero unplanned interruptions, electric assets performing in the top quartile of reliability, and generating assets maintaining top decile industry performance; while ensuring no cyber or physical security events occur that impact operations.
6	Deliver strong financial performance, which allows for proper reinvestment in assets.

Community Commitment

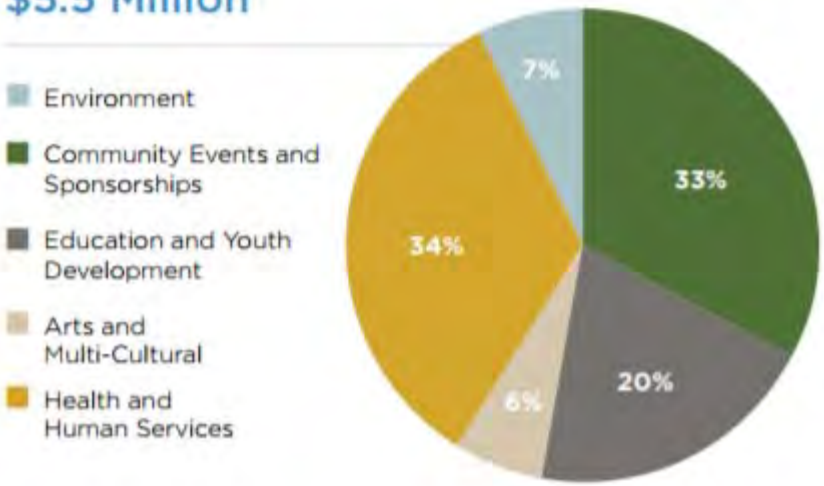
❑ We care about the communities that we serve

- In 2016, NV Energy employees volunteered more than 37,500 hours to causes statewide

NV Energy employees served on 115 nonprofit boards of directors statewide.

2016 Charitable Giving & Community Sponsorships

$5.5 Million



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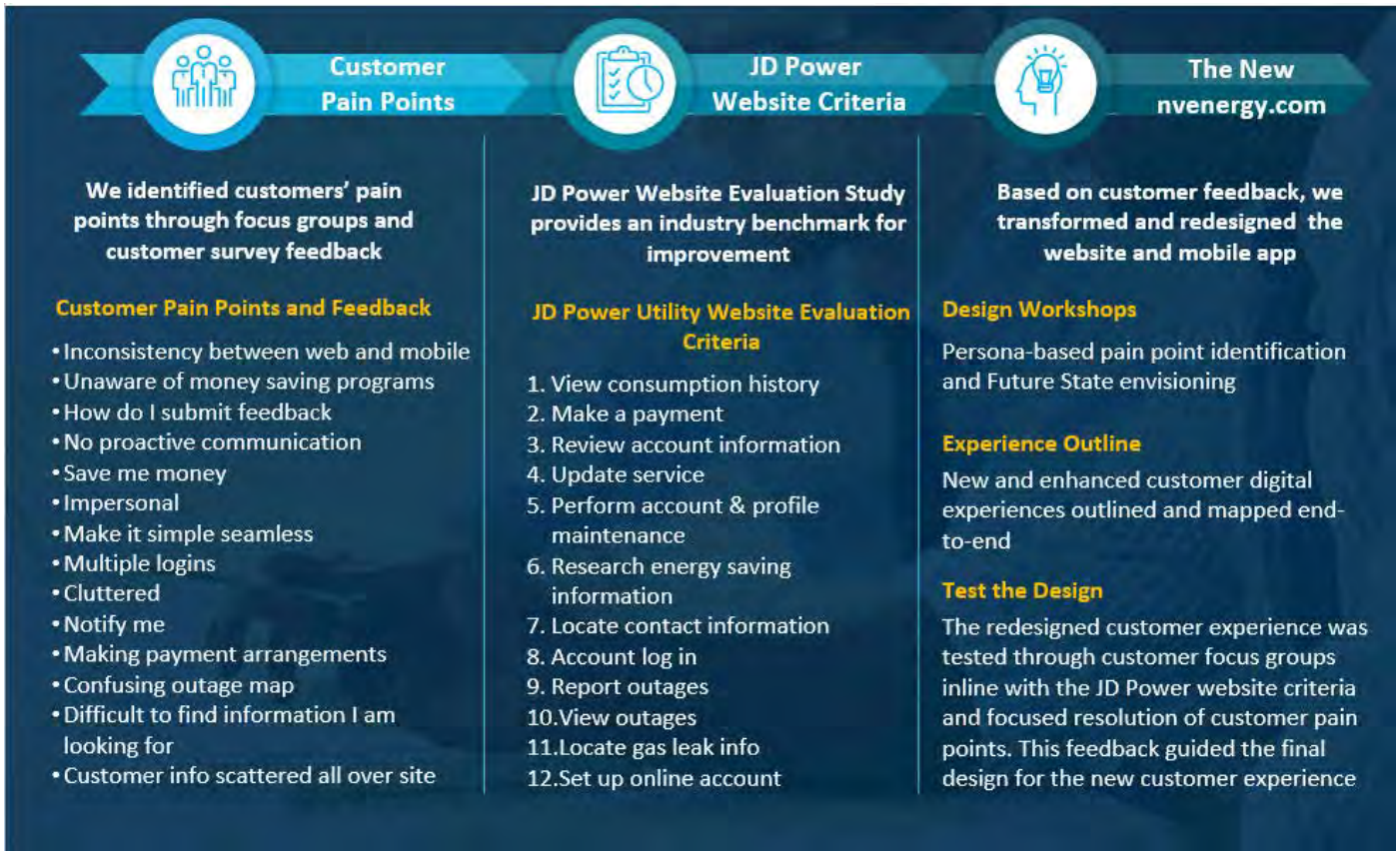
Designed to Meet and Exceed Customer Expectations

- The end product resulted from the application of the plan, execute, measure and correct philosophy



- ✓ Plan – Gathered customer feedback and applied objective assessment criteria
- ✓ Execute – Designed website
- ✓ Measure – Reviewed test website with focus groups
- ✓ Correct – Revised design to eliminate 34 additional pain points

NVEnergy

New Signature Services

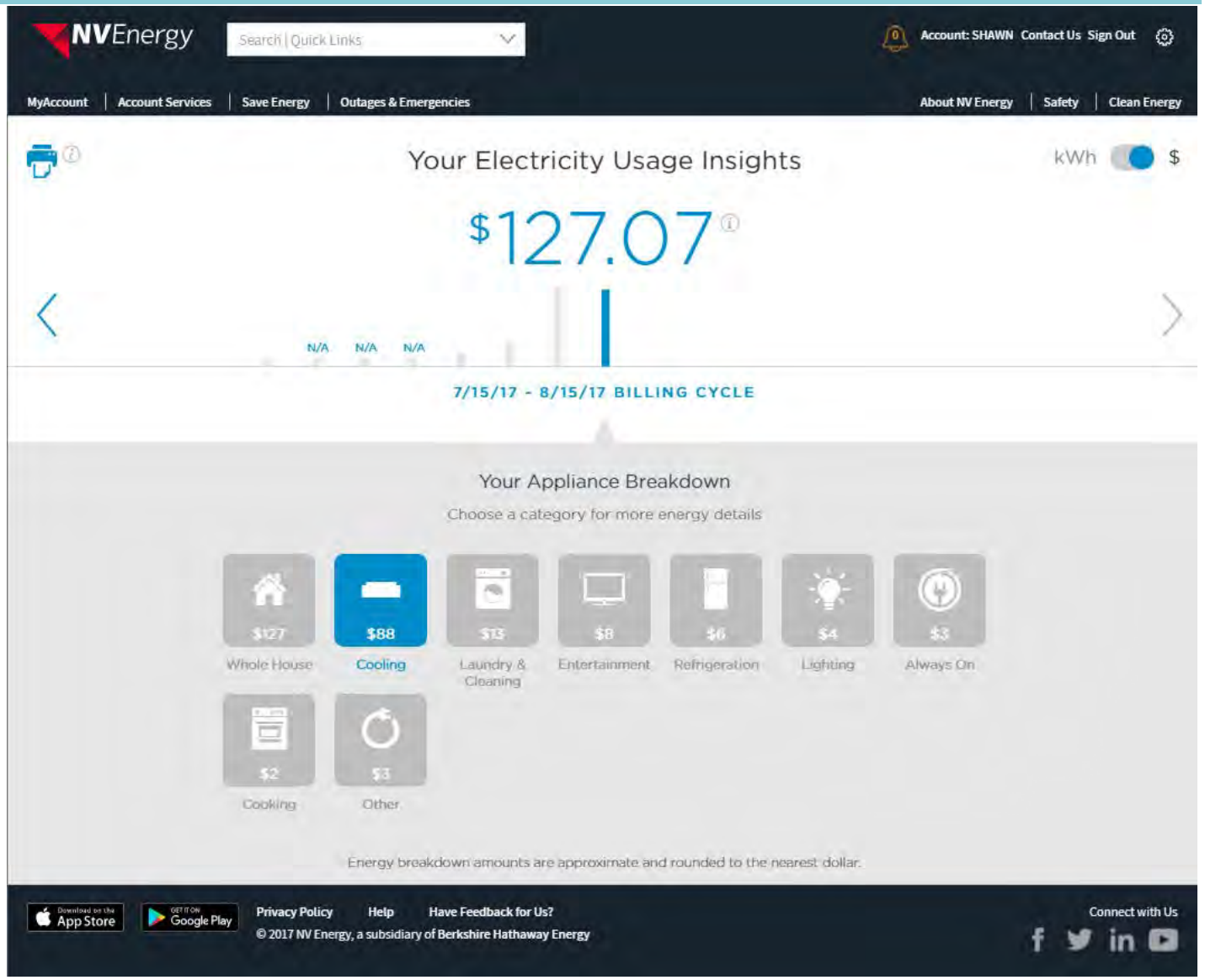
Customers able to view energy consumption by appliances (disaggregation)

- ✓ New disaggregation service that leverages the smart grid

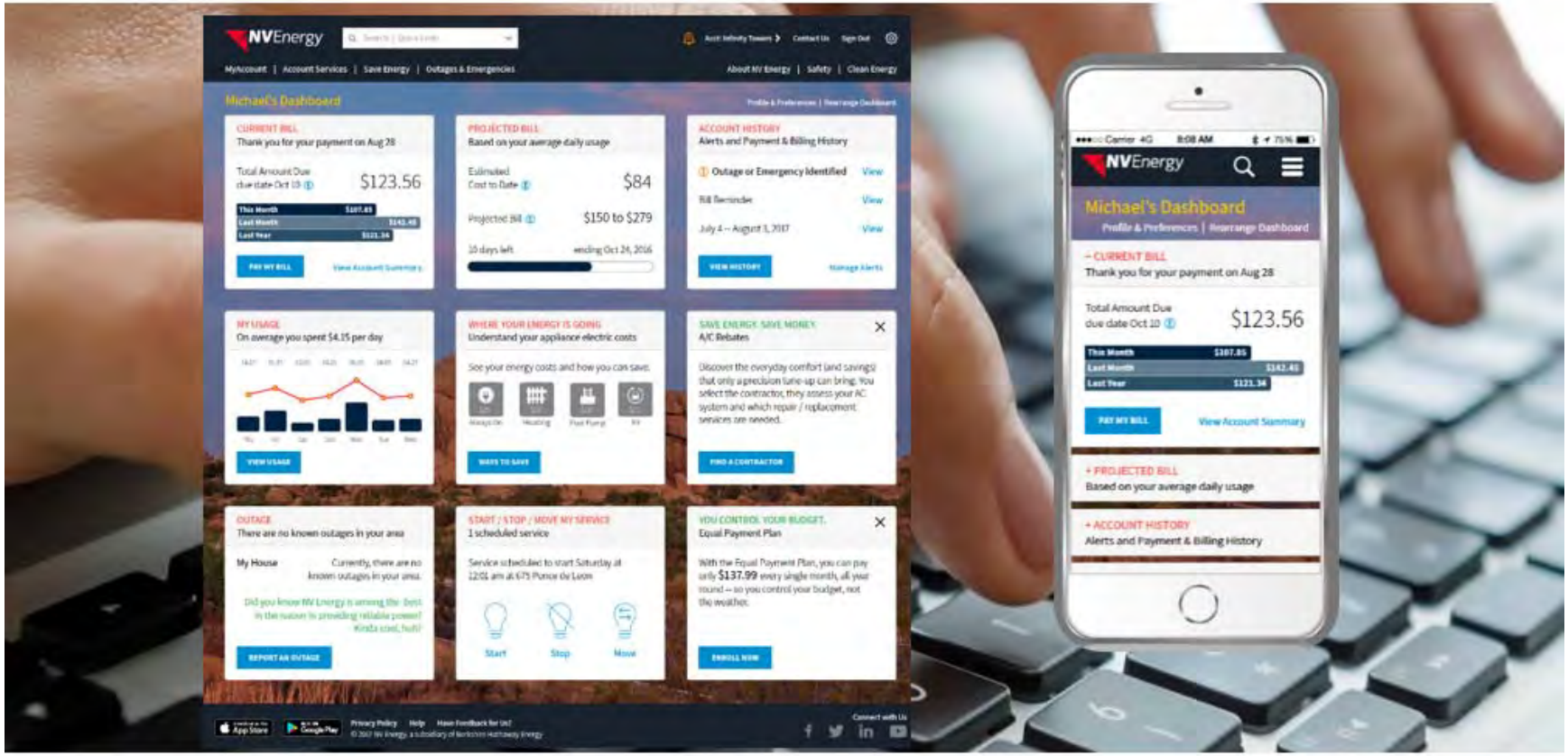
Next BestActions: personalized customer recommendations

- ✓ Enhanced personalization opportunities

Data-driven content such as real-life customer savings examples, advertisement of mobile app, online feedback, etc.



Unified Technology Stack Enhances Flexibility



- ✓ Single, unified technology stack allows customer to transition seamlessly and intuitively from desktop to mobile to application
- ✓ Single, unified technology stack improves "speed to market" by facilitating one build across all channels

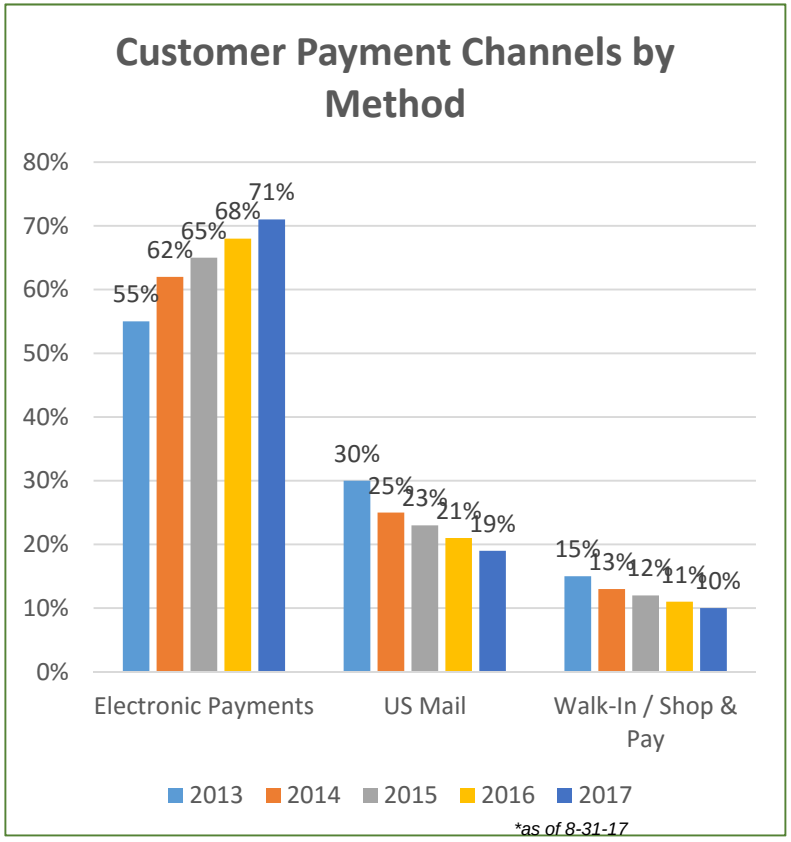
NVEnergy

Customer Payment Trends

- Billing and credit operations is forecasted to create and manage over 13.2 million customer bills in 2017
- Over 200 locations throughout the state of Nevada accept walk-in payments over the counter as well as through self-service payment kiosks
- NV Energy has collected and processed over 9.5 million payments in 2017 through August 31, 2017

Payment Method	# of Payments
Electronic	6,908,036
US Mail	1,896,526
Walk-in	0
Shop N' Pay	806,838
Kiosk	139,851
Total	**9,751,251**

*as of 8-31-17



Business Services

- Business Solutions Center
  - Premium contact handling
  - Energy-saving advice and program information
  - In-depth knowledge of commercial customer service
  - NV Energy Business Toolkit
  - https://www.nvenergy.com/account-services/business-solutions-center/toolkit.html

Northern Nevada

(775) 473-6998

Toll-free: (877) 377-6387

BusinessSolutionsNorth@nvenergy.com

Southern Nevada

(702) 402-1000

Toll-free: (866) 791-0345

BusinessServices@nvenergy.com

- MyAccount
- Customer Digital Experience

powershift by NVEnergy

- ✓ Free Energy Assessment
- ✓ Free Classes and Seminars
- ✓ Incentivized Energy Audits
- ✓ Small Business Savings
- ✓ Rebates for Installation of Qualifying Efficient Equipment

NVEnergy

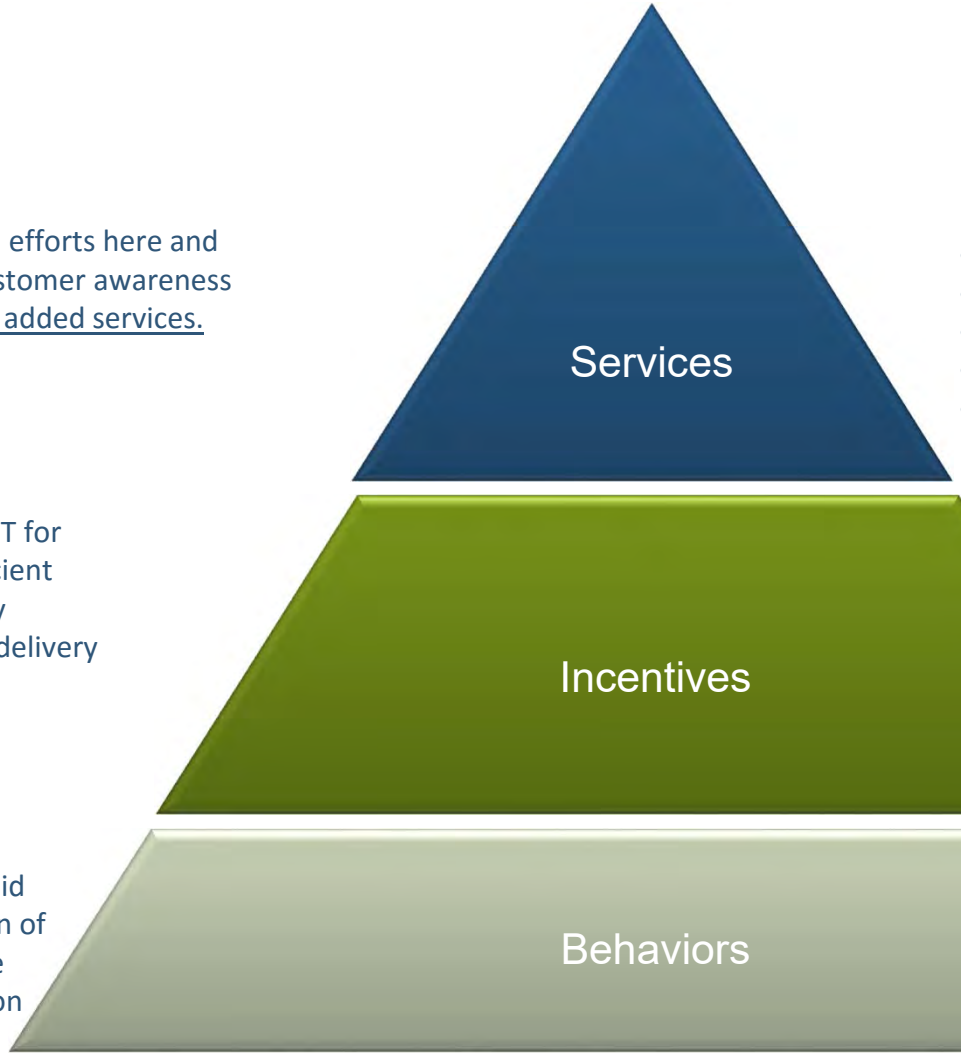
DSM Funding

- Three-year action plan is approved in the Integrated Resource Plan
- The action plan is reviewed in non Integrated Resource Plan years, and the budget and savings are reviewed and remaining years of the action plan are approved again
- The associated costs and carrying charges are collected in a regulatory asset balancing account
- During the annual Deferred Energy Accounting Adjustment (DEAA) filing, DSM costs are approved for prudency, and the Energy Efficiency Charge (rate on bill) is reset and goes into effect on October 1 of that year
- The current Energy Efficiency Charge is $0.00118 at Nevada Power and $0.00181 at Sierra. The average residential customer pays approximately $1.31/mo. at Nevada Power and $1.34/mo. at Sierra

Customer Centric Energy Management

NV Energy DSM efforts are focused on delivering higher levels of energy savings and customer satisfaction by increasing the focus on direct delivery of Energy Services that support a more efficient electric grid

Ramp up efforts here and focus customer awareness on value added services.



PowerShift by NV Energy

- Residential Smart Thermostat Service
- Commercial Energy Optimization Service
- Remote/Online Assessment
- In-Premise Assessment
- Direct Install Services

Leverage IT for more efficient and timely incentive delivery

Rebate Programs

- Residential Rebates
  - High Eff A/C
  - ~~Pool Pumps~~
  - ~~Lighting~~
  - ~~Refrigerators~~
- Commercial Rebates
  - Sure Bet

Ensure solid foundation of actionable information

Information & Tips

- Energy Tips
- Home Energy Reports
- MyAccount Reporting

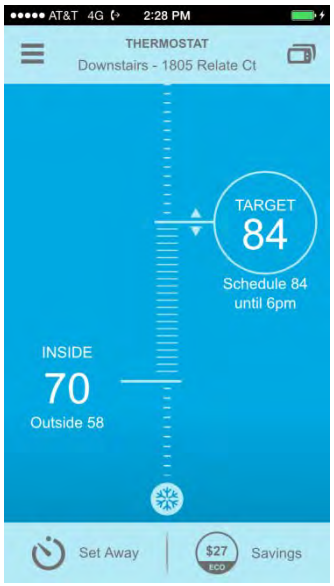
Residential Demand Response
250 Megawatts and Growing…

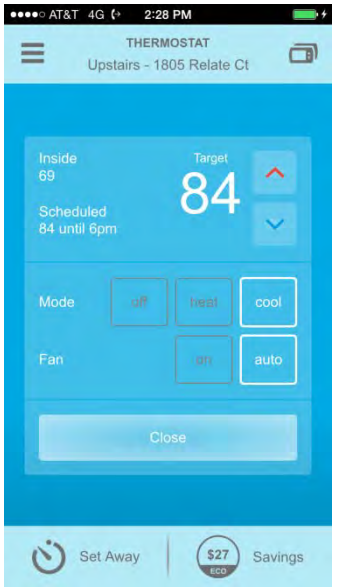
Energy Efficiency Optimization Service

HVAC Fault Detection Service

Remote Control

Enhanced data analysis identifies new savings opportunities





NV GreenEnergy Rider Process

- The REA between NV Energy and the qualified customer sets forth a price (i.e., renewable resource rate) that the customer pays for the renewable energy attributes supplied by NV Energy. This rate must be set in a manner that satisfies the PUCN that NV Energy's other customers are not potentially subsidizing the NGR transaction.
- Historically, this rate has been set by calculating the levelized difference between NV Energy's costs in acquiring the renewable energy resource and NV Energy's current long term avoided costs ("LTAC"), as the LTAC is periodically calculated and filed with the PUCN.
- This rate paid by the NGR customer does not benefit NV Energy; instead it is a credit to offset higher fuel and purchased power expenses that would otherwise be borne by non-participating NV Energy customers.
- A power purchase agreement ("PPA") is also entered between NV Energy and the renewable energy supplier to support the REA with the customer.
- Both the PPA and REA are subject to the PUCN approval.
- The existing pricing methodology has been approved by the PUCN at least seven times and, therefore, has a minimum level of regulatory risk.

Renewable Resource Rate Background

- Renewable resource rate structured such that it captures the resource cost in excess of NV Energy's applicable long-term avoided cost of energy.
- This was the approach proposed to the PUCN and approved six times.
- The full renewable resource rate amount attributable to the transaction above the long-term avoided cost of energy that NV Energy's customers would otherwise pay for energy. In effect, the renewable resource rate captures the "green renewable resource rate" that the participating customer would pay to avoid any adverse impacts to NV Energy's non-participating customers.
- To ensure NV Energy captures all costs on behalf of its non-participating customers, the special contract's term will be for the life of the array, and the output of the renewable resource is not restricted in any way by the participating customer's load.

Renewable Resource Rate Background (cont.)

- The calculation in detail.
  1. Take the present value of the [25] year annual projected revenue required with respect to the renewable energy resource.
  2. Take the present value of NV Energy's [25] year weighted average annual projected avoided cost of energy.
  3. The difference between 1. and 2. is then converted into an annuity using a term of 25 years and a discount rate equal to NV Energy's PUCN-approved rate of return.
  4. That annuity is then divided by the levelized annual production (in kilowatt-hours) of the renewable energy resource to come up with the renewable resource rate for [25] years.
- In calculating the avoided cost for this analysis, NV Energy would utilize the weighted average monthly marginal cost of energy by year using the PROMOD hourly marginal energy costs, as set forth in the most recently approved PUCN filing.

NV GreenEnergy Rider Details

- Utilizing the NGR rate methodology approved by the PUCN for supporting a large generator service ("LGS") customer's new incremental load, NV Energy has been able to secure uniquely low NGR rates for LGS customers in southern Nevada.
  - This is due in large part to the abundant solar resource in southern Nevada and the present ability of solar developers to monetize the 30% federal investment tax credit ("ITC") available under Section 48 of the Internal Revenue Code.
  - As of December 2015, the 30% ITC has been extended for another five years. The developer can monetize the full 30% if construction starts before 2020, 26% if before 2021, 22% before 2022, or 10% for construction starting in 2022 or later.
- Over the past year in southern Nevada, NV Energy has seen long-term PPA pricing for utility-scale solar PV resources between $35 and $40 per megawatt-hour ("MWh") - levelized cost over life of contract.

Key Opportunities with NGR Program's Improvement

- Customers are interested in renewable energy options for load growth and sustainability goals
- Nevada is strategically located with industrial land attractive to new large-load customers
- The NV GreenEnergy Rider ("NGR") provides a competitive advantage to NV Energy, particularly with new technology customers—pairing low base rates with low cost renewables
- Customer demand for additional renewable energy will drive development of NGR deals
- System integration costs will be assessed for renewables penetration, and existing tariffs will need to be revised or new tariffs may be needed for creating maximum customer value
- NV Energy is being asked to pursue new transaction structures for large commercial customers that provide price certainty and the ability to match load with renewable energy

Opportunities

- Multiple large industrial parcels, shovel-ready lands and low costs: Tahoe-Reno Industrial Center, Apex Industrial Complex, West Henderson, and Crossroads Commerce Center
- NV Energy is key contributor to aggressive Nevada economic development team, pursuing multiple data center, distribution center and industrial process companies
- Nevada represents substantial additional solar development opportunities
- The NGR option has been successful with the PUCN
- NV Energy will present an option to the PUCN to offer customers long-term renewable energy purchase

Success Plan

- Pursue large-load economic development and support development efforts and improve NGR solution
- Leverage state, local and energy company economic development resources
- Provide creative/comprehensive renewable energy and efficiency strategies for industrial prospects
- Formalize NGR option and gain PUCN support
- Identify customer(s) to utilize option and identify renewable resource to pursue
- Partner with major developers and suppliers for transacting with customers

Nevada Committee on Energy Choice

Technical Working Group on Innovation, Technology and Renewable Energy Industries

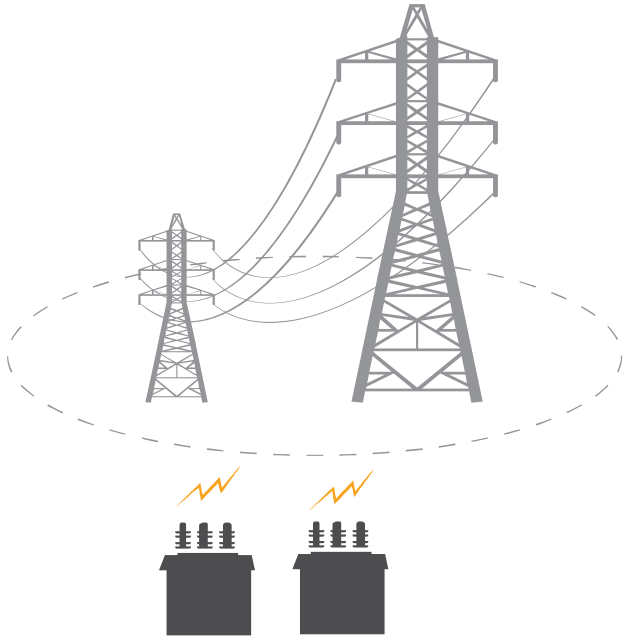
Grid Infrastructure and Distributed Energy Resources

Phil Pettingill, Director, Regional Integration

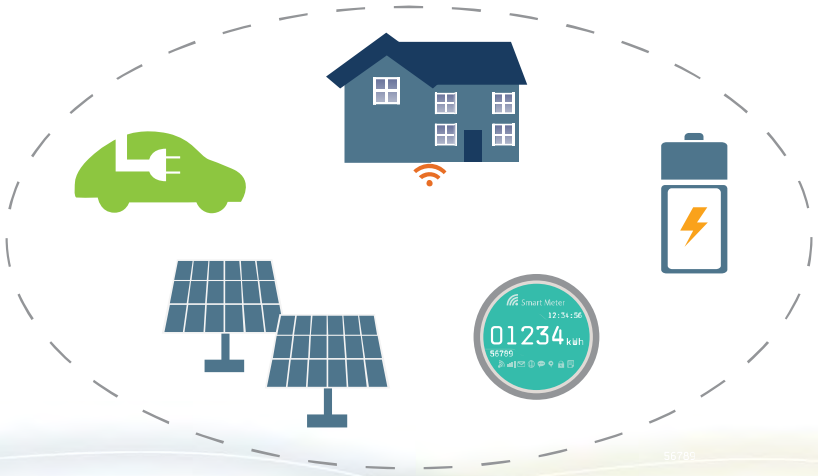
October 10, 2017

DERs are located on the distribution side of the bulk electric system.

- The ISO operates resources on the transmission grid.



- Distribution operators are responsible for DERs below the T-D interface.



What is a Distributed Energy Resource?

- Distributed energy resources (DERs), are any resources connected on the distribution level, customer side or utility side of the customer meter.

- Some technology types of DERs can include:
  - Rooftop solar, energy storage, plug-in electric vehicles, and demand response.

Distribution connected resources are becoming an increasingly important part of the CAISO energy resource mix

- The increasing number of DERs are due to…
  - DER technology becoming more cost effective for residential customers
  - A shift to renewable energy resources and away from convention fossil-fuel generation at all scales of the electric industry

The ISO established the DER provider as a new type of market participant in 2015

- The DER provider owns or operates DERs that are able to fully participate in the ISO market.

- DERs can also participate in the ISO market through two models.
  - Demand response resource
  - Non-generator resource (NGR)

DER providers can aggregate a variety of distribution connected resources to the ISO market.

- DERs in an aggregation can be connected…
  - In front of the end-use customer meter, or
  - Behind the end-use customer meter, with an additional meter on the DER

- These options open a pathway for DERs to aggregate and meet the ISO's .5 MW minimum participation requirement

DERs participate in the ISO market as a demand response or non-generator resource

- Demand response is the direct participation of load reduction as a supply resource in the market
  - Can participate under two models:
    - Proxy Demand Response (PDR)
    - Reliability Demand Response Resource (RDRR)

- Non-Generator Resource (NGR) allows for the participation of energy storage resources
  - e.g. flywheel, lithium ion battery, electric vehicles, pumped hydro, and etc.

Facilitating DERs - Some examples for the local Public Utility Commission

- Broadened consumer protection rules
- Universal regulatory obligations on all LSEs
  - state policies, rate policies (NEM), provider of last resort
- Establish short and long-term adequacy obligations on all LSEs in alignment with reliability needs and state policy goals
- New interconnection rules and procedures, including DER
  - wholesale distribution access tariffs
- Access to customer information with confidentiality
  - enable DER providers to assess investments that make sense

Appendix

- Additional Details to follow

NGRs have the capability to serve as both generation and load.

- NGRs are able to operate similar to any generating resource in the ISO market
  - offer all market services
  - bid in both the day-ahead and real-time market

- Key benefits of NGR model:
  - Seamless bid from load to generation and back
  - Management of the state of charge (SOC) by either the ISO or the resource owner

PDRs are resources that offers economic bids for load reduction but is recognized like any other generator

- Can economically bid into both the day-ahead and real-time market

- Can provide the following market services:
  - Energy
  - AS non-spinning/ spinning
  - Residual Unit Commitment (RUC)

RDRRs are emergency response reliability resources.

- RDRRs can only economically bid in to the day-ahead market.
  - Offer uncommitted capacity and respond to a reliability event for the delivery of “reliability energy” in real-time.

- Unlike PDR, RDRR cannot economically bid in the real-time market and offer any other service such as A/S.

Energy Storage:
Considerations for Nevada

Jason Burwen
Energy Storage Association

December 5, 2017

Energy Storage Association

www.energystorage.org

What's in this presentation

1. Storage overview and trends
2. Flexibility of storage
3. Barriers to storage & public policies
4. Discussion!

About the Energy Storage Association

ESA's mission is the promotion, development and commercialization of competitive and reliable energy storage delivery systems for use by electricity suppliers and their customers across the United States.

- Established 27 years ago
- Diverse membership—vendors, developers, independent generators, utilities & other power sector stakeholders
- Federal, regional, & state policy engagement

Energy Storage Association

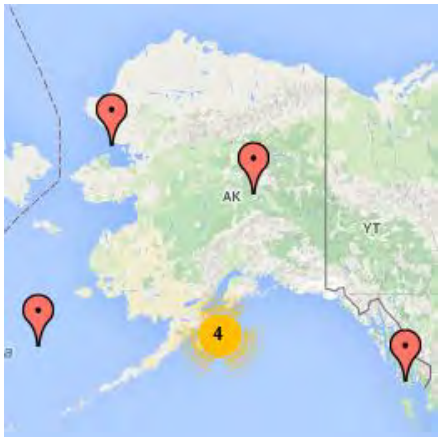
ESA Energy Storage Association

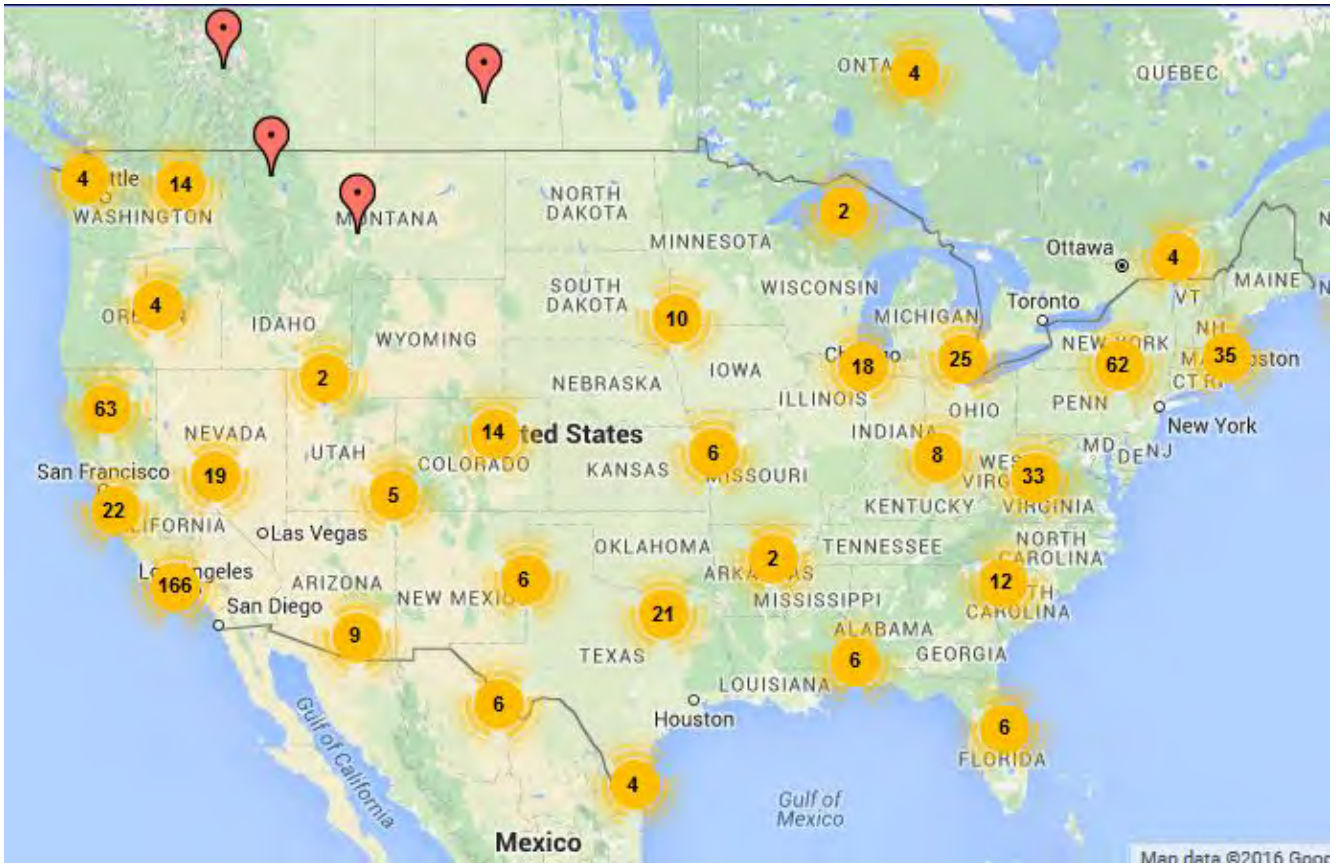
What is energy storage?

It moves energy over time

to when it is most needed

Projects operating across the U.S.





As of 2017: 800+ MW batteries; 22 GW pump hydro; 3 GW thermal

Source: DOE

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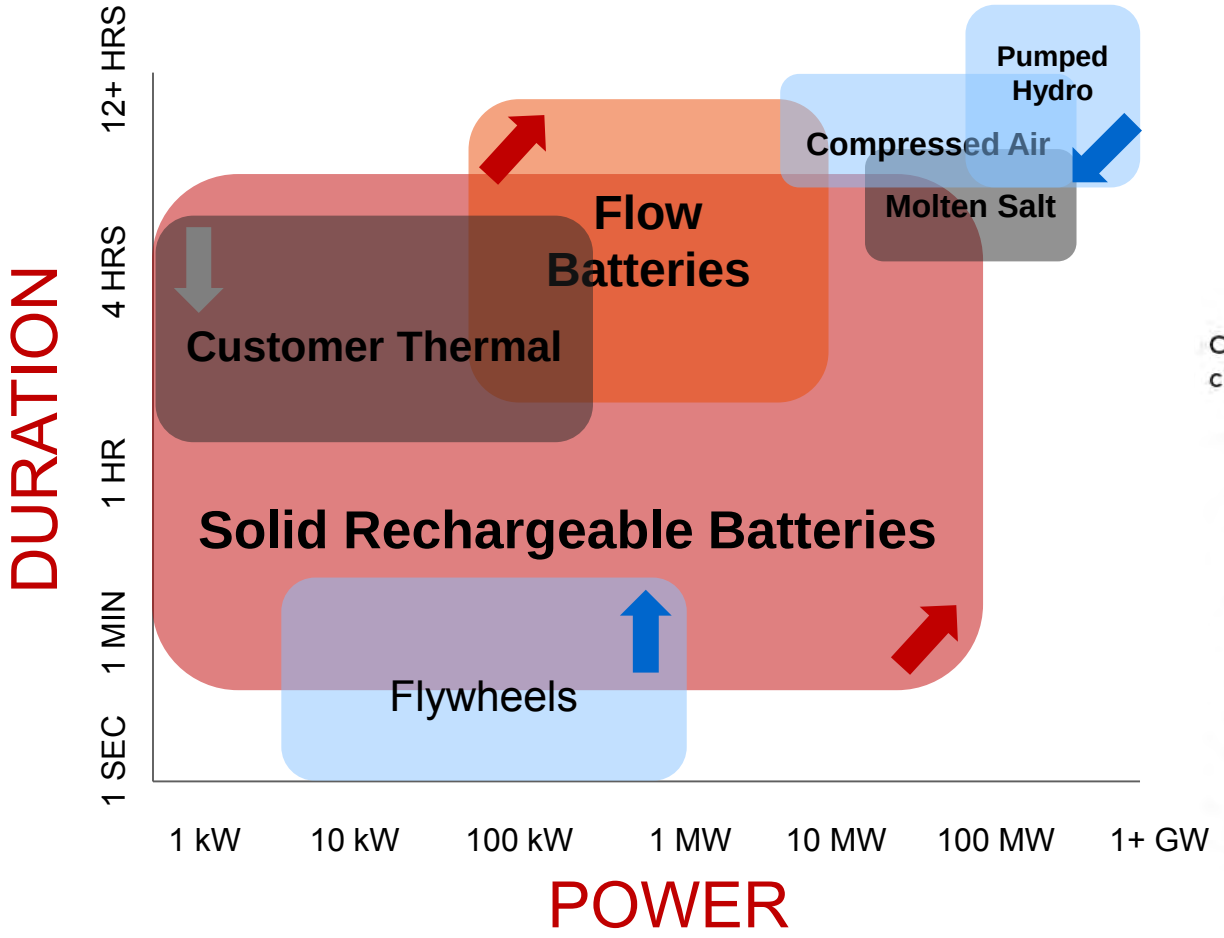
Older Storage

Newer Storage

Storage performance characteristics



Arrows indicate trajectories of future capabilities

Other relevant energy storage performance characteristics include:

- round-trip efficiency (a measure of the amount of energy lost in a "round-trip" between the time the energy storage system is charged and then discharged);
- construction time;
- operational costs;
- space requirements;
- cycle life (the number of complete charge-discharge cycles a battery can perform before its nominal capacity falls below 80% of its initial rated capacity);
- the depth of discharge the battery can reach while still retaining its rated cycle life; and
- level of technology maturity.

SOURCE: IREC, *Charging Ahead*, 2017 (based on DOE/EPRI Handbook) + new data

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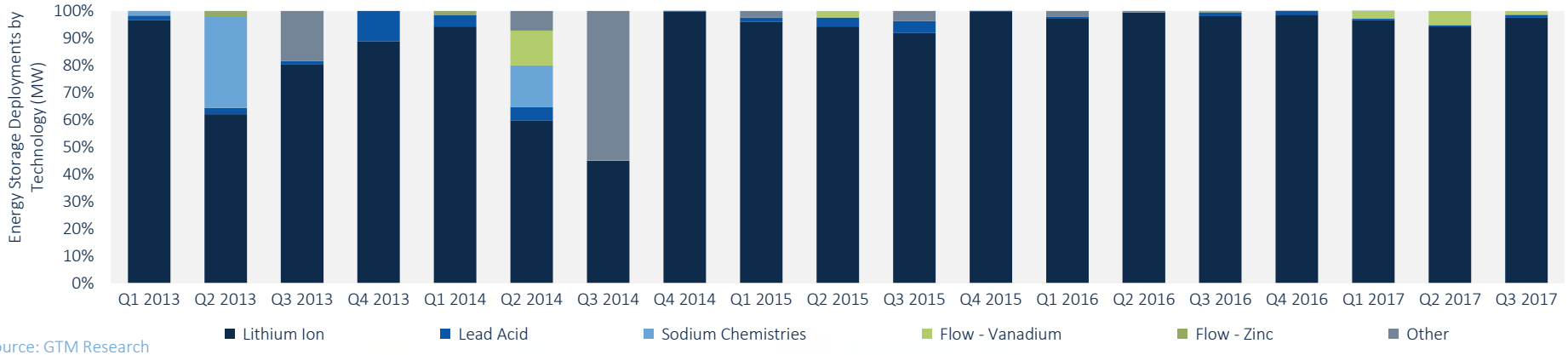
Storage characteristics

	Electrochemical Storage				*Mechanical Storage*		
	LEAD ACID	LITHIUM-ION	SODIUM-SULFUR	FLOW BATTERIES	FLYWHEELS	COMPRESSED AIR	PUMPED HYDRO
Round-trip efficiency	70-85%	85-95%	70-80%	60-75%	60-80%	50-65%	70-80%
Typical duration	2-6 hr	0.25-4 hr	6-8 hr	4-12 hr	0.25-4 hr	4-10 hr	6-20 hr
Time to build	6-12 mo	6-12 mo	6-18 mo	6-12 mo	1-2 yr	3-10 yr	5-15 yr
Operating cost	High	Low	Moderate	Moderate	Low	Moderate	Low
Space required	Large	Small	Moderate	Moderate	Small	Moderate	Large
Cycle life	500-2,000	2,000-6,000+	3,000-5,000	5,000-8,000+	100,000	10,000+	10,000+
Technology maturity	Mature	Commercial	Commercial	Early-moderate	Early-mod-erate	Moderate	Mature

SOURCE: Massachusetts Dept. of Energy Resources, *State of Charge*, 2016

Quarterly Energy Storage Deployment Share by Technology (MW %)



Source: GTM Research

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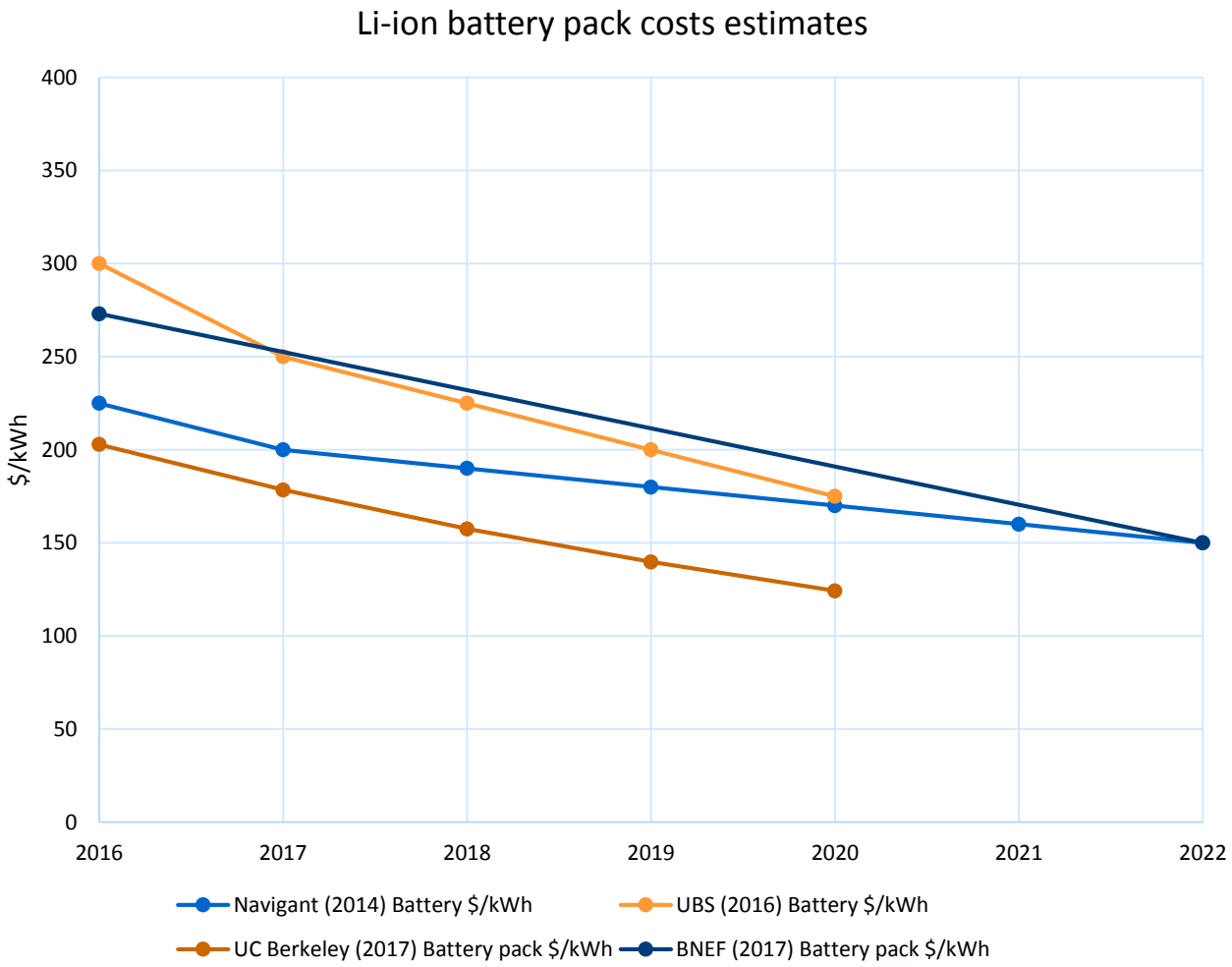
Why all the buzz on battery storage

- Fastest growing storage type
- Costs declining rapidly
- Located on all part of the grid at any size
  - Utilities, customers, and third-parties all operating
  - Systems from 5 kW to 100,000 kW in use
- Can provide multiple services interchangeably
  - Grid balancing, backup, system capacity, network capacity, curtailment avoidance, energy arbitrage
- Uniquely flexible & expanding performance capabilities
  - Instant response and ramp, bi-directional (charge/discharge)
- Quick to deploy
  - Aliso Canyon deployments <6 months from contract
- Can't be stranded – portable, modular units

Battery costs to continue rapid decline



Recent reference points

- Chevy Bolt (2017): ~$200/kWh battery pack
- Tesla (2016): $190/kWh battery pack

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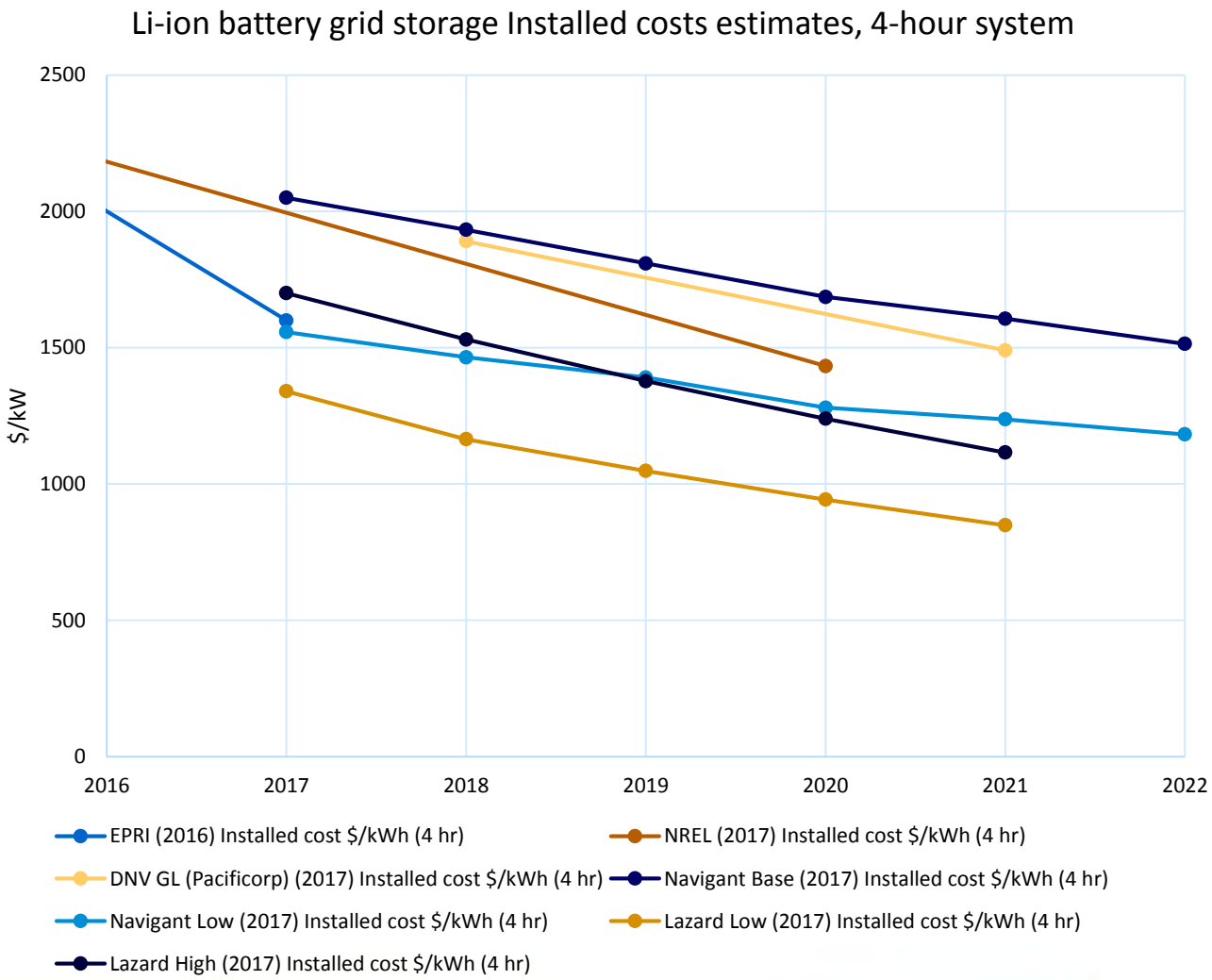
Installed cost declines follow



Recent reference points

- TEP (**AZ**): 30 MW, 4-hr storage + 100 MW solar = $0.045/kWh
- KIUC (**HI**): 20 MW, 5-hr storage + 28 MW solar = $0.11/kWh

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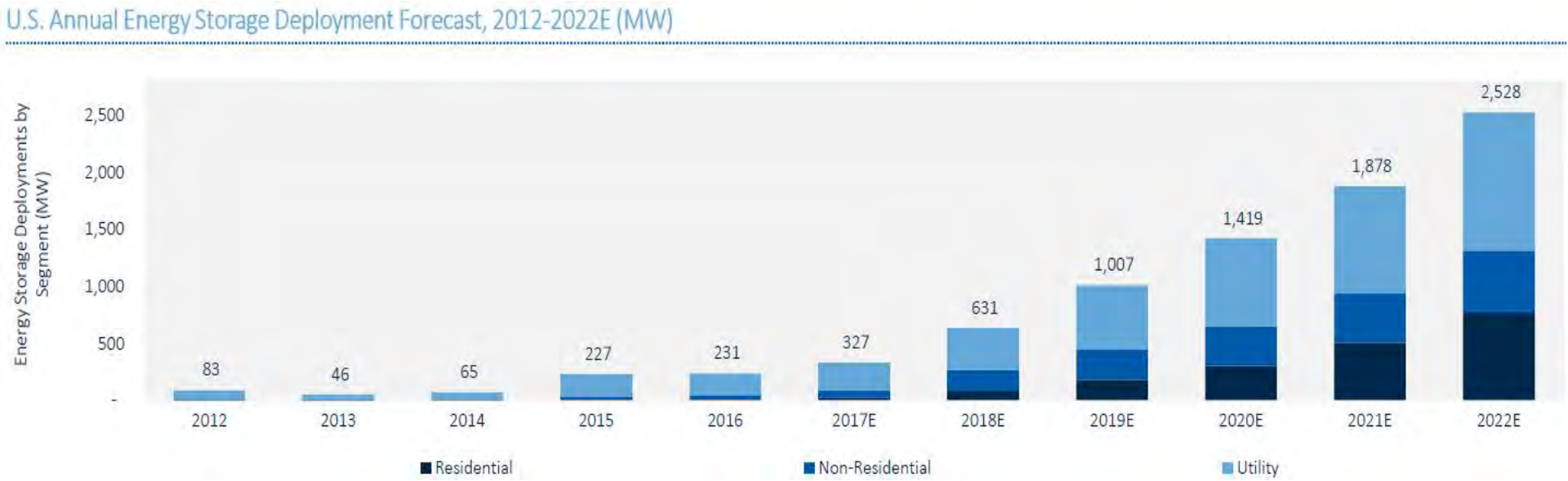
Battery installations growing…

IN THE U.S. annual installation in 2020 expected to be 1400 MW—

7x annual installation in 2016



Customer-sited storage to rise from 19% of annual capacity

to 50+% of capacity **by 2022**

Source: ESA/GTM

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Energy Storage = Flexibility

Use electricity exactly when (and where) it is most needed, regardless of when it was generated

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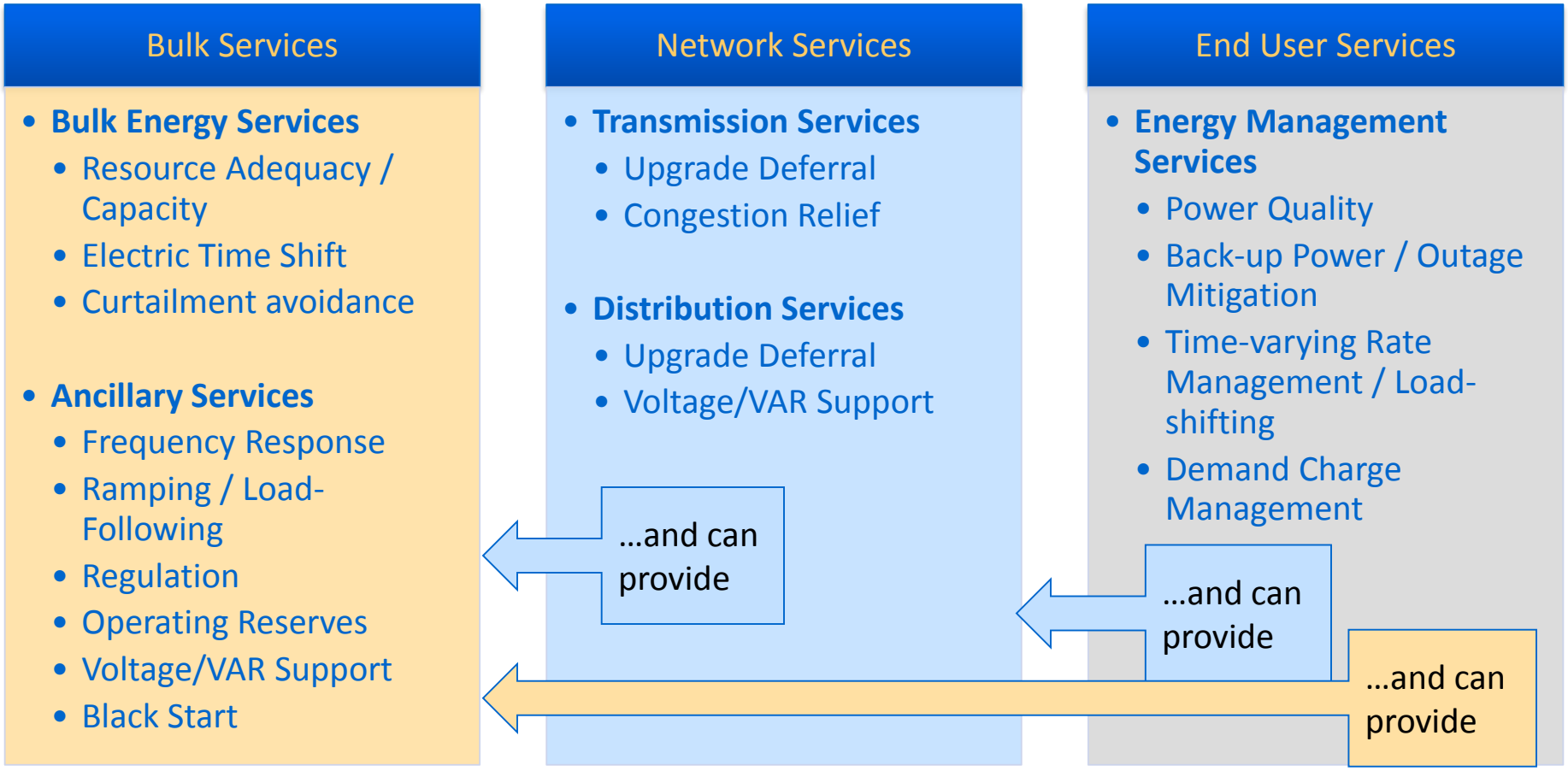
Why is storage important?

Storage optimizes use of the grid & enables system transformation

- **Saves households & businesses money** – reduce spending on excess capacity to meet peak system & local demands, optimize use of grid assets → lower rates
- **Makes the grid more reliable & resilient** – balancing supply & demand fluctuations; mitigating supply disruptions and outages; managing planning uncertainty
- **Integrates more clean & distributed energy** – compensating natural variability of renewables and making them "dispatchable;" increasing DER hosting capacity

Storage offers many applications



…and can provide these services <u>interchangeably</u> over time, depending on location

Source: EPRI/Sandia National Laboratory

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Batteries for resource adequacy

SECTIONS HOME SEARCH The New York Times

ENERGY & ENVIRONMENT

A Big Test for Big Batteries

By DIANE CARDWELL and CLIFFORD KRAUSS JAN. 14, 2017

SDG&E/AES 30 MW, **4-hr**

SCE/Tesla 20 MW, **4-hr**

"I was stunned at the ability of batteries and the battery industry's ability to meet our needs…This was something I didn't expect to see until 2020. Here it is in 2017, and it's already in the ground."

--California PUC Chair Michael Picker

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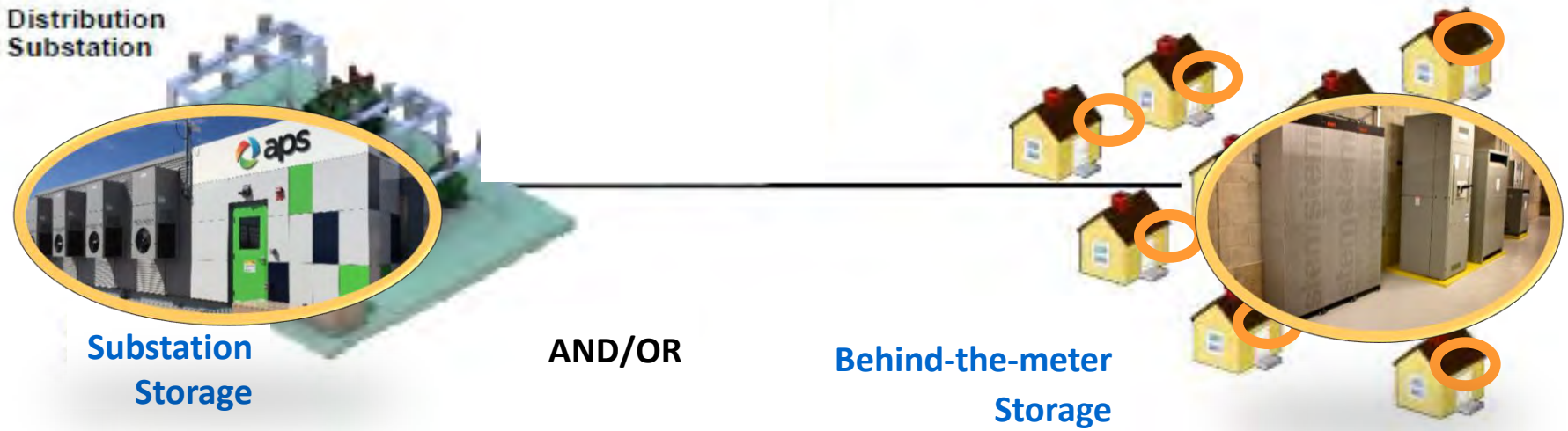
Storage in network capacity

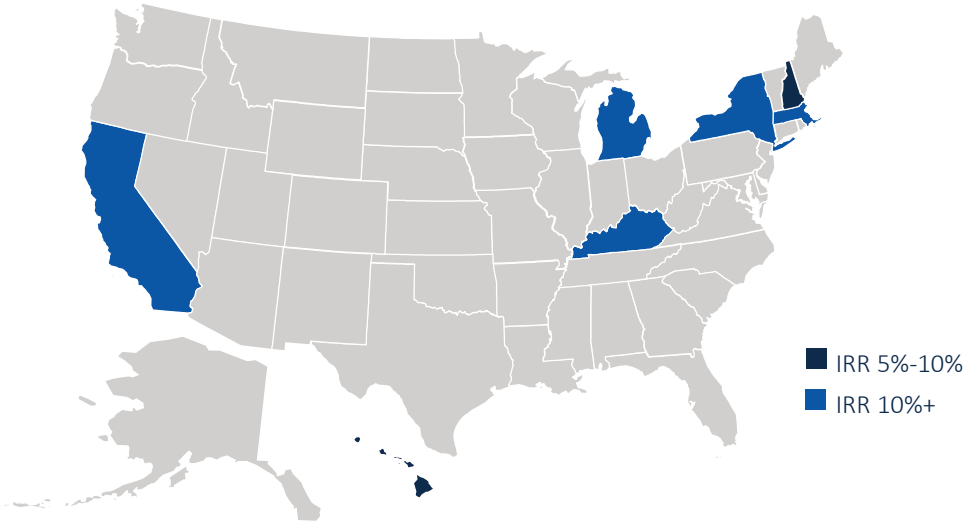


- Reduces local peak demand & increases circuit power quality → defers or avoids substation and circuit upgrades
- Backup
  - System blackstart capable
  - Onsite backup at municipal facilities & critical infrastructure
- Containerized storage can be re-located over time → reconfigurable grid + effective risk management (not strandable)

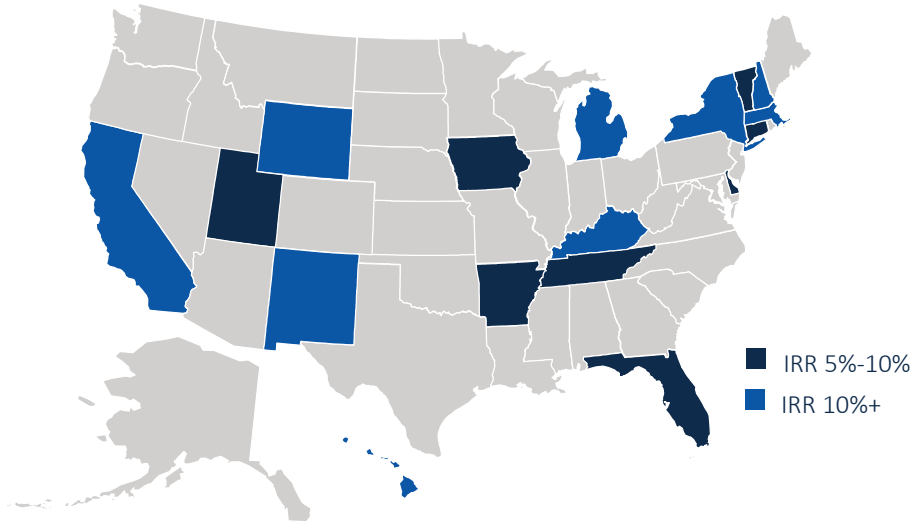
Rates as a driver of customer storage

Medium C&I Energy Storage Returns from Demand Charge Management Alone

2016



2022



Source: GTM Research The Economics of Commercial Energy Storage in the U.S.: The Outlook for Demand Charge Management, 2016

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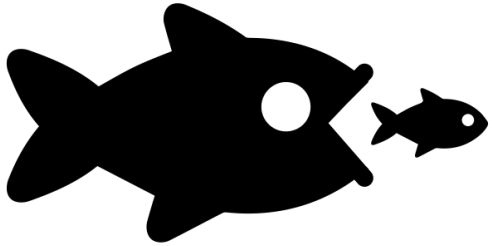
Removing barriers to storage

Capture the full VALUE of energy storage

Ensure accurate market signals that monetize economic value, operational efficiency, and societal benefits



Enable COMPETITION in all grid planning and procurements

Storage can be a cost-saving and higher-performing resource at the meter, distribution, and transmission levels

Ensure fair and equal ACCESS for storage to the grid and markets

Reduce market and grid barriers that limit the ability for energy storage systems to interconnect

Policy Tools in the Toolbox

ACCESS

- DISTRIBUTION INTERCONNECTION
- TRANSMISSION INTERCONNECTION
- DISTRIBUTION TRANSPARENCY
- OWNERSHIP OPTIONS
- DER QUEUE MANAGEMENT
- MULTI-SERVICE CAPABILITY

COMPETITION

- NEW PROCUREMENT PROCESSES
- IRPs
- DISTRIBUTION PLANNING & GRID MOD
- RPS
- RESILIENCE PLANNING
- PROGRAMS NWA, EE, DR
- RESOURCE ADEQUACY QUALIFICATION
- RFPs
- RFIs

VALUE

- INCENTIVE
- TARGET
- FINANCING
- RATE DESIGN LOAD, DER
- PROGRAMS NWA, EE, DR
- COST-BENEFIT STUDY

CHARGING AHEAD

An **Energy Storage** Guide for Policymakers

- INVESTIGATE
- CLARIFY
- PLAN
- ENERGIZE

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Storage Policies in Other States

Value	Competition	Access

• **Procurement Target**
  • California
  • Oregon
  • Massachusetts
  • New York
 	
• **Incentive**
  • California
  • Massachusetts
  • New Jersey
  • Maryland
 	
• **Programs/Updated Rate Design**
  • California
  • Massachusetts
  • Arizona
  • Hawaii
	• **Updated Integrated Resource Planning**
	  • Washington
	  • New Mexico
	  • California
	  • Arizona
	  • Hawaii
	
	• **Distribution Planning**
	  • New York
	  • California
		• **Updated Interconnection**
		  • California
		  • Hawaii
		  • Nevada
		
		• **Multiple-use Framework (in conjunction with ISO)**
		  • California
		  • New York

Removing barriers in wholesale markets

Modernize tariff, operating, and planning structures appropriately to reflect the capabilities of advanced technologies → batteries will compete on its own merits

- Physical access (interconnection)
- Market access (generator services & Tx services)
- Multiple-use enabled (Tx/Gen & wholesale/retail)
- Price signals for flexibility (fast response/ramp, etc)
- Included in planning processes
- Memorialized in tariffs & BPMs explicitly

RTO Market designs

RTO Market Designs

- PJM Performance Regulation: fast resources paid multiple of slower resources, reduces overall reserve
- CAISO ESDER: framework for distribution storage to provide wholesale services
- CAISO FRACMOO: product for providing ramping services as renewables share increases

Relevant FERC Activities

- PL17-2 on multiple-use storage
  - Opens door to dual-use of storage for transmission services & wholesale generator services
- RM16-23 on market participation of energy storage and DER aggregations
  - Would create explicit participation model for storage in wholesale markets, including new bidding parameters & smaller project size eligibility
  - Would also create same for DER aggregations
- RM17-8 on generator interconnection
  - Would establish rules to enable faster transmission interconnection of storage

Thank you

Jason Burwen
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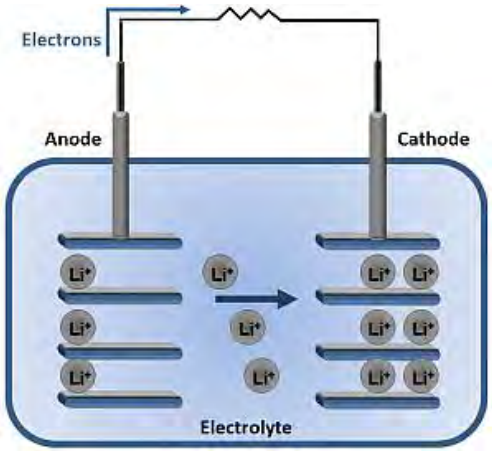
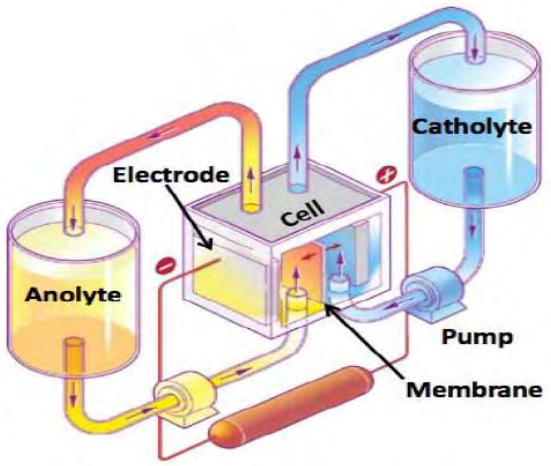
www.energystorage.org

Parking lot

Electrochemical storage (batteries)





Solid electrode (battery)

- Scales by number of units in array
- Common chemistries
  - Lithium-ion
  - Sodium-sulfur
  - Advanced lead-acid
  - Zinc-air
- Key benefit = fast & flexible

Liquid electrode (flow battery)

- Scales by volume of tanks on single unit
- Common chemistries
  - Vanadium redox
  - Zinc-bromine
  - Aqueous sodium
- Key benefit = long-duration & long-lived

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What about mechanical storage?

- Pumped hydroelectric
  - Installed originally to absorb excess central generating power, especially nuclear
    - Innovations to come include fast-response variable-speed turbines
  - Most of storage capacity in U.S., geographically constrained
    - Availability constrained by drought, affected by changing climate
  - Environmental concerns of hydro power
    - Siting impacts, power vs. ecological use
- Compressed air
  - Few large-scale installations; capital intensive
  - Innovations to come
    - Compressed liquid
    - Underwater compressed air
- Key benefit = bulk supply & long duration
- Flywheel
  - Inherently short-term = niche applications

What about thermal storage?

- Most thermal storage is demand response
  - Sited behind the customer meter
  - Examples
    - Chilled water/ice → displace cooling demand
    - Water heaters → time-shift heating demand
    - Air conditioners → time-shift cooling demand
  - Does not inject electrons—different measurement and verification for grid operations
  - Provides many similar applications to electrochemical/mechanical storage
    - And batteries can act like demand response…
  - Key benefit = low cost
- Front-of-meter thermal storage still maturing
  - Solar thermal power with molten salt storage

What about chemical storage?

- Most chemical storage today involves hydrocarbon fuels
  - Hydrogen from natural gas reforming
  - (Fossil) Power-to-gas
- Forthcoming technologies may become relevant for clean energy
  - Hydrogen from (clean energy-powered) electrolysis
  - Hydrogen from renewable biogas reforming
- Key benefit = seasonal storage (e.g., days/weeks duration)

State Policies to Fully Charge Advanced Energy Storage:

The Menu of Options

July 2017

Value. Competition. Access.

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Why Focus on Value?

- Current market structures and policies lack clear mechanisms to identify and capture full value of energy storage systems
- Ensure net system benefits and cost savings to ratepayers by setting accurate market compensation for energy storage systems

Value

- Setting a cost-effective, "no regrets" procurement target for storage jump-starts market creation, drives learning-by-doing, and orchestrates development of regulatory framework
- Incentives in the form of rebates, grants, or various tax incentives, can provide a bridge to scalable deployment for storage
  - Incentives should be designed to decline as storage values become more readily monetized
- Dynamic and time-varying rates can signal to customers the value of leveraging storage while better aligning customer costs with system costs

States with Procurement Targets

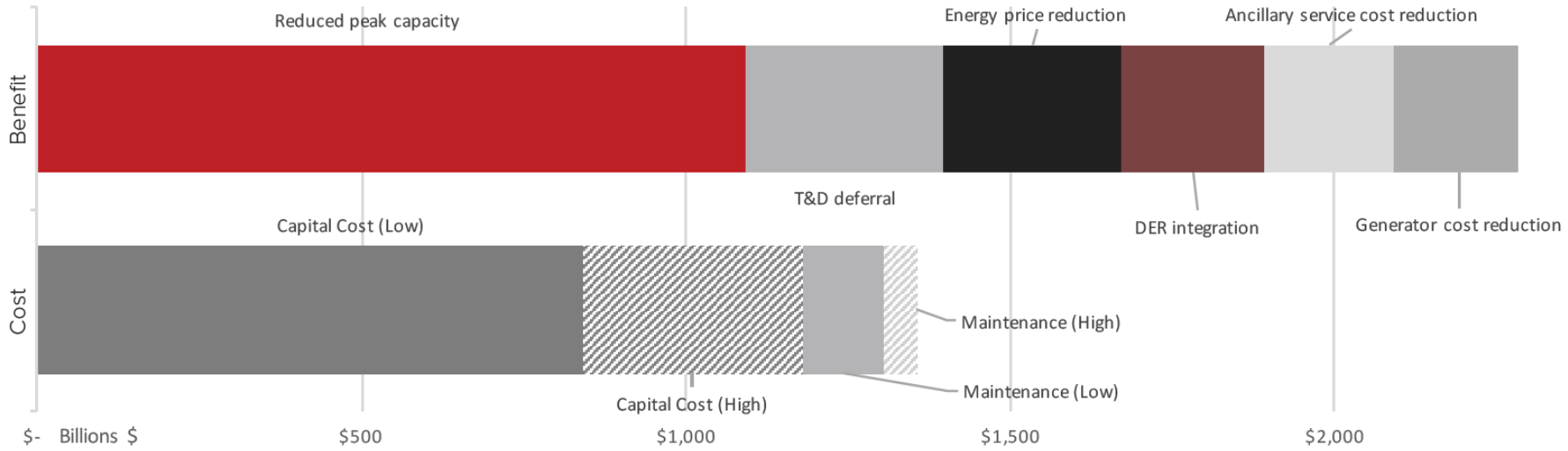
- *California*: First-in-the-nation 1.325 GW procurement target for storage by 2020; later increased by 500 MWs
- *Oregon*: Legislature passed HB 2193 in 2015 calling on the Commission to set 2020 procurement targets up to 1% of peak load; currently being implemented
- *Massachusetts*: State legislature considering 2030 targets and DOER just released target for 200 MWh by Jan 1, 2020
- *New York*: Regulator ordered initial procurements (2 projects per utility) and legislature passed SB 5190 / A 6571 to create 2030 procurement targets
- *Nevada*: Legislature passed SB 204 calling on a study to inform biennial increasing procurement targets in 2017

States with Storage Incentives

- *California*: SGIP program modified in 2016 to focus on storage, and more incentives under consideration this legislative session
- *Maryland*: Legislature passed first-of-its-kind tax incentive bill (SB 758) in 2017 session
- *Massachusetts*: SMART incentive program includes adder for systems with storage
- *Nevada*: Legislature passed AB 145 for storage in the solar incentive program (SESIP)
- *New Jersey:* Renewable Energy Storage Incentive Program for customer-sited storage at critical faciltiies

Cost-Benefit Analysis

Massachusetts' State of Charge Report an excellent example of storage cost-benefit analysis



Source: MA DOER State of Charge Report, 2016. Note: Graph recreated from original "State of Charge" report.

Other states investigating storage include Nevada, Oregon, and North Carolina.

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Why Focus on Competition?

- Storage often not on the menu of options in planning and procurement.
- When storage is included, it is often with outdated assumptions.
- Legacy metrics such as LCOE do not reflect the operational parameters or value proposition of energy storage.
- The benefits storage can offer may not be captured in metric by which value is defined.

Competition

- Including storage in **IRPs** and **distribution planning** is critical to least-cost planning
- Utilities in some states are pioneering reverse auctions for peak load reduction as **non-wires alternatives**
- States are revisiting **RPS programs** and **resource adequacy qualifications** to consider how storage can help meet system needs

Examples of Policy Support for Competition

- *Washington:* Draft policy statement from regulator requires consideration of storage in resource planning
- *New Mexico*: Consideration of storage required in resource planning
- *Massachusetts*: DOER inserting storage in existing programs as part of 200 MWh target
- *New York*: Utilities issuing all-source RFPs for grid needs as non-wires alternatives
- *California*: Distribution Resource Planning reform to include non-wires alternatives

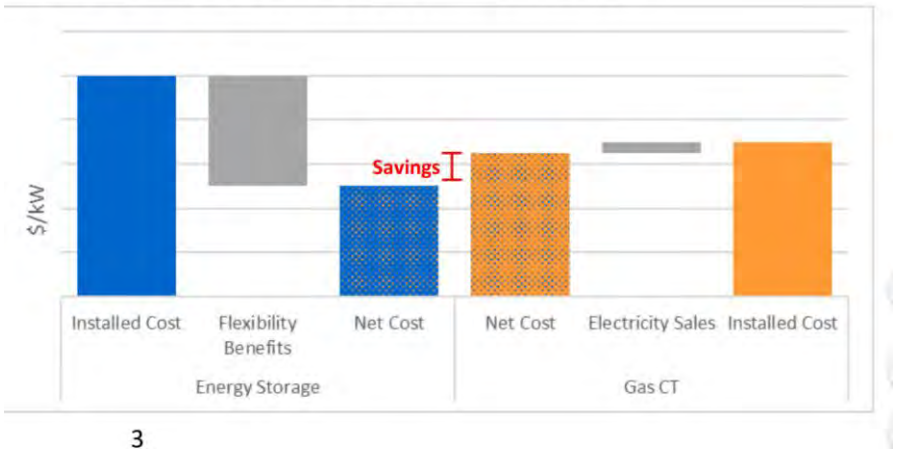
IRPs and Storage

- IRPs are used in ~25 states
- Utilities planning to invest billions of dollars in new and replacement capacity over the next several years
- Planning models not granular enough to capture operations of advanced storage
- Models use inaccurate and out-of-date cost information

How Can Storage Be Included in IRPs?

- Should take proactive approach to include storage in resource planning
- ESA recommendations:
  - Ensure storage is included as eligible technology
  - Use latest cost/performance data
  - Match resource need with resource selection
  - Use sub hourly modeling
  - Ensure net cost of capacity (stacked benefits) are considered
  - Incorporate load-sited storage options as a potential resource

Figure 1 Example Net Cost of Capacity Calculation



Net cost of capacity = Total installed cost − Operational benefits (flexibility operations & avoided costs)

Why Focus on Access?

- The market wasn't designed to include storage
- Inadvertent roadblocks prohibit storage from interconnecting and participating in the market
  - ✓ Arcane rules require 100 MW wind farm with 20 MW battery to interconnect at 120 MW, resulting in unnecessary and costly upgrades – *PROJECT NOT BUILT*
  - ✓ Behind the meter storage simply used to shift load may be treated as an injecting resource requiring unnecessary interconnecting processes and costs – *PROJECT NOT BUILT*

Access

- Updating interconnection rules and standards is key to ensuring fair, streamlined and cost effective access for storage
- In wholesale markets, reform rules on metering, telemetry and accounting to allow customer-sited storage to provide both retail and wholesale services

States Advancing Storage Access

States updating their interconnection procedures to include storage:

- *California* – Rule 21
- *Hawaii* – Rule 14H and Rule 22 (CSS)
- *Nevada* – Rule 15 update
- *Maryland* – PC 44 interconnection working group

- NC, MN, AZ, and others considering revisiting

Takeaways for Regulators

- Incorporating energy storage into planning processes ensures ratepayers will receive cost savings and grid flexibility
- Updating interconnection procedures and developing time-varying rates is critical for success
- Grid modernization requires particular considerations for storage

Takeaways for Legislators

- If regulator is being proactive, only provide legislation if it is determined that further authority is needed
- If no regulatory action on grid modernization, interconnection processes, or procurement targets, then legislation is best way to trigger activity

Conclusions

- It all comes down to Value, Competition and Access
- Investigative studies are useful, but only if they have an end goal of developing a procurement target
- Procurement targets are good tool to encourage learning by doing and jumpstarts process to include storage in utility processes
- Procurement targets and incentives not enough – need effective interconnection and rate design to make sure resources show up
- Many states are already designing policies for a robust storage market. Now is the time to act!

Governor's Committee on Energy Choice: Technical Working Group on Innovation, Technology, & Renewable Energy

Marta Tomic
Community Solar, Program Director

December 5, 2017

VOTE SOLAR

Agenda

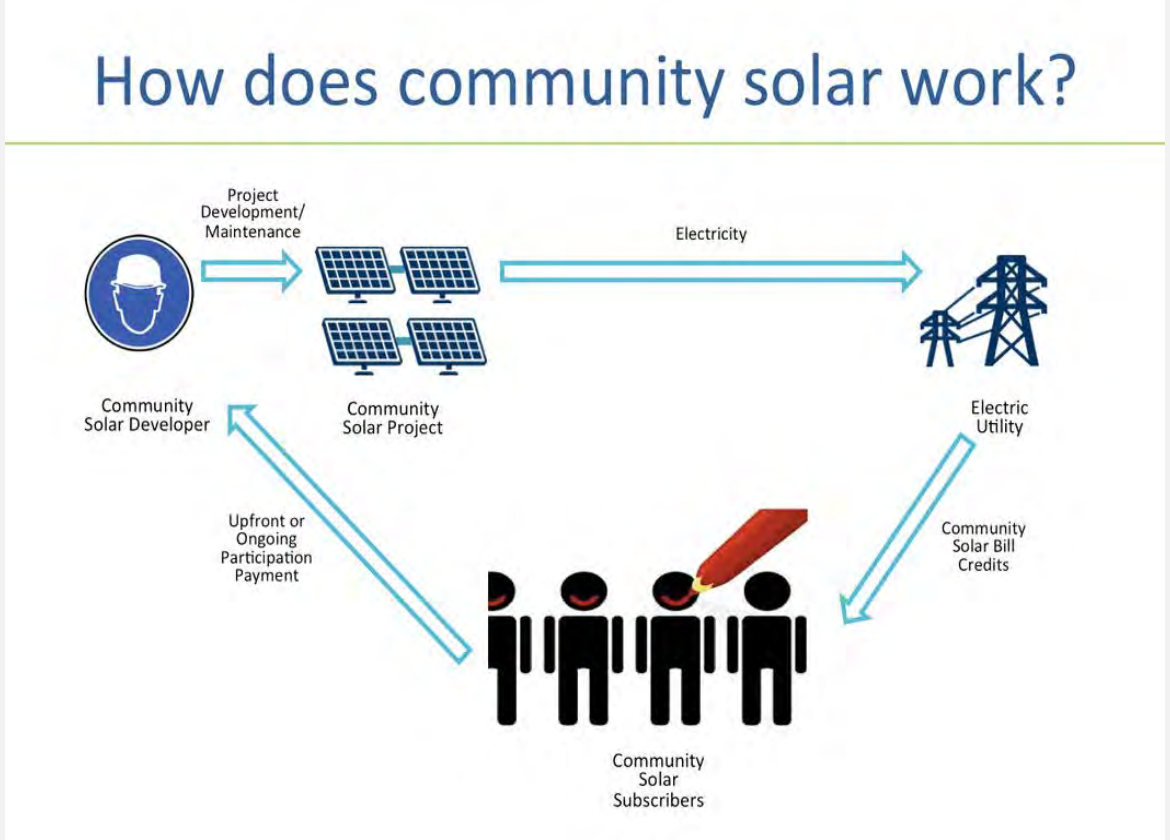
VOTE SOLAR

1. Community solar and a comparison to other solar energy offerings
2. Benefits of community solar
3. Community solar in restructured markets
4. Key recommendations

What is Community Solar?

VOTE SOLAR

- **Community solar refers to local solar facilities shared by multiple community members who receive credits on their electricity bills for their share of the energy produced.**
- Community solar differs from other customer-focused offerings such as community choice aggregation and green tariff programs (e.g.: “subscription solar”)

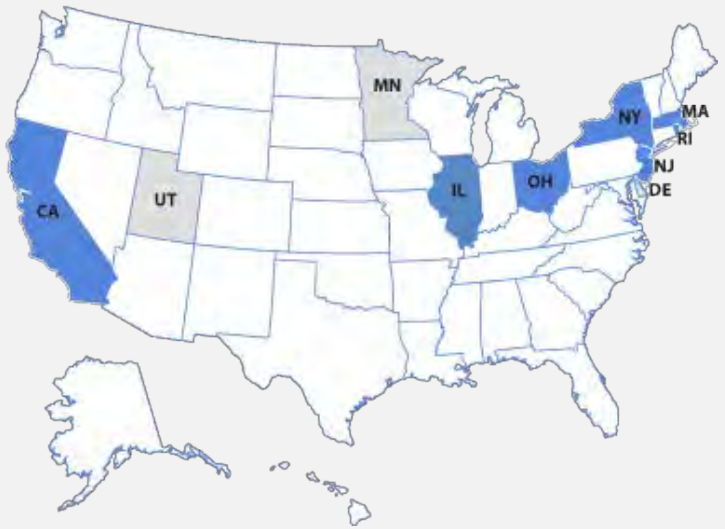


Community Choice Aggregation (CCA)

VOTE SOLAR

- **A program that allows cities and counties to buy and/or generate electricity for residents, businesses and government electricity users within its jurisdiction.**
  - Aggregated buying power
  - CCAs enter contracts with alternative suppliers or large generators connected to the transmission system
  - Utility retains ownership and management of transmission and distribution.

Community Choice Aggregation must be legislatively enabled.



Legal in 7 States: CA, IL, MA, NJ, OH, RI and NY

Under consideration in: UT, DE, MN

Image source: http://www.leanenergyus.org/cca-by-state/

Green Tariff Programs (e.g. “subscription solar”)

VOTE SOLAR

- **Involve the sale of Renewable Energy Credits (RECs) from a renewable energy facility to individual subscribers.**

- **Pros**
  - Flexible contract terms
  - Allows subscribers to meet individual and corporate sustainability goals
  - Allows utilities to maintain the customer relationship

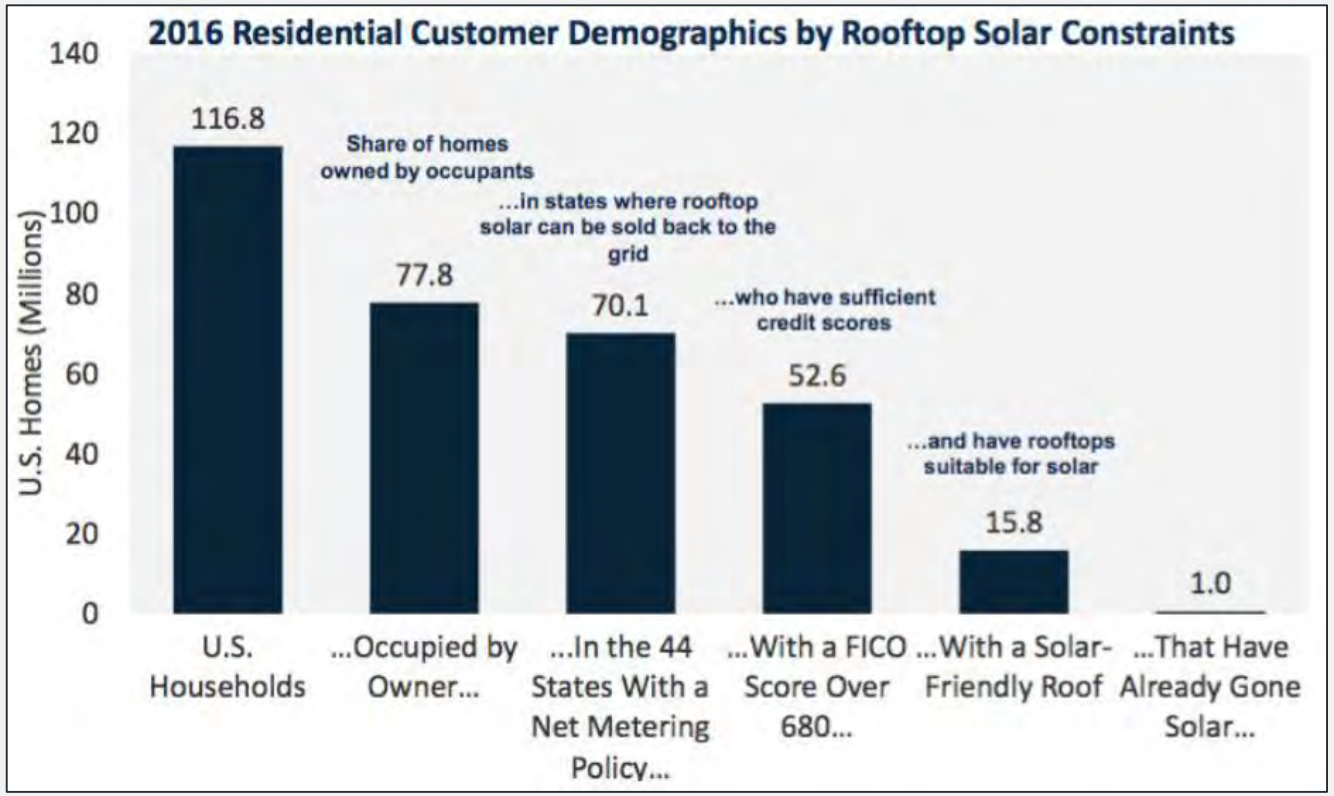
- **Cons**
  - Subscribers pay a premium
  - Renewable energy generating facilities are typically not sited locally
  - Do not provide the energy from the generating facility on subscriber bills
  - Do not offer the opportunity to reduce energy expenditures

Utility-Scale Solar and Large-Scale Commercial Solar

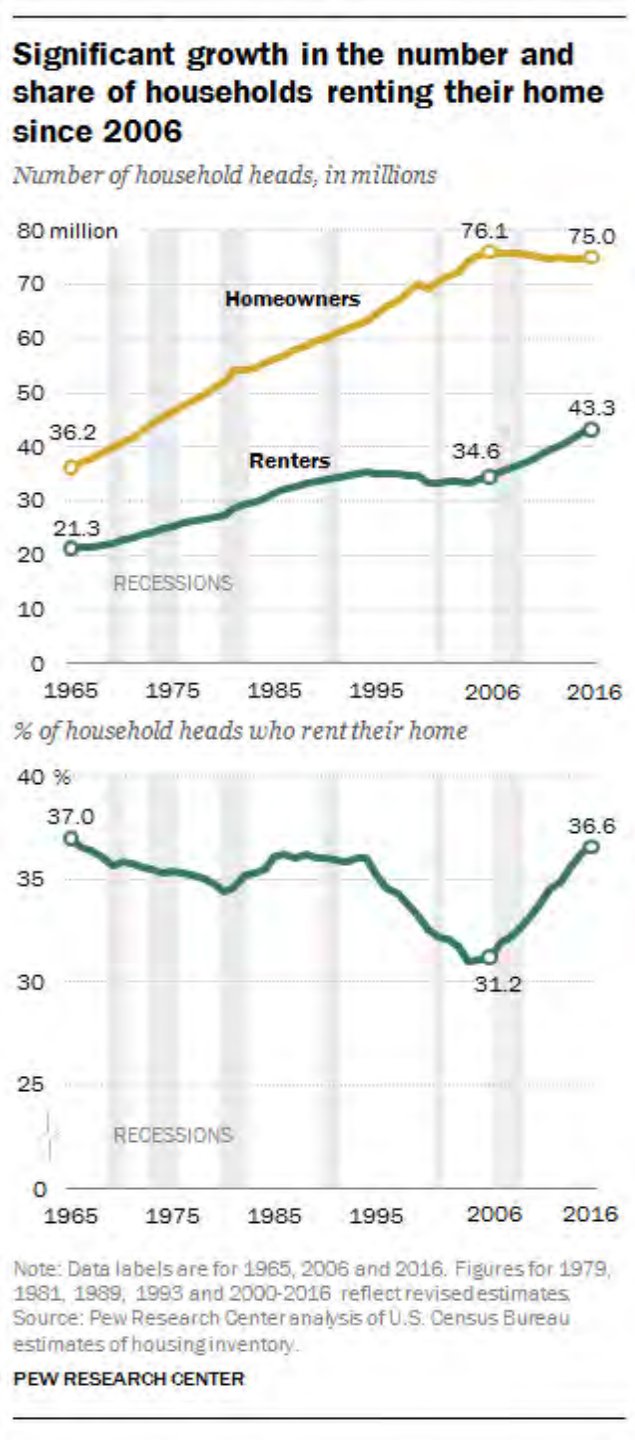
VOTE SOLAR

- Designed for a single off-taker.
  - In contrast, community solar allows individuals including renters, condominium owners, and businesses the opportunity to directly participate in and receive the benefits of solar.
- Typically sell power directly to utilities, who receive the benefits of solar power.
  - In contrast, community solar provides individuals and commercial entities the opportunity to directly participate in a generating facility and receive the benefits from their subscription.
- Utility-scale and large-scale are typically connected at the transmission level.
  - In contrast, community solar facilities are connected to the local distribution system.

Community solar solves the physical and homeownership barriers of solar



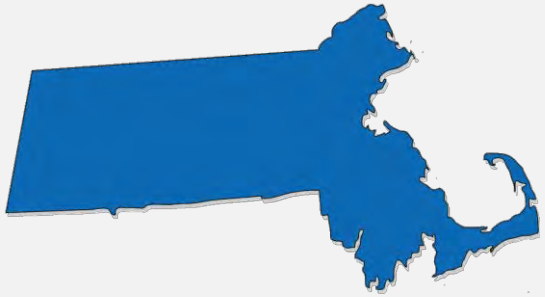
Source: Greentech Media U.S. Community Solar Market Outlook, Oct 2016



Benefits of Community Solar

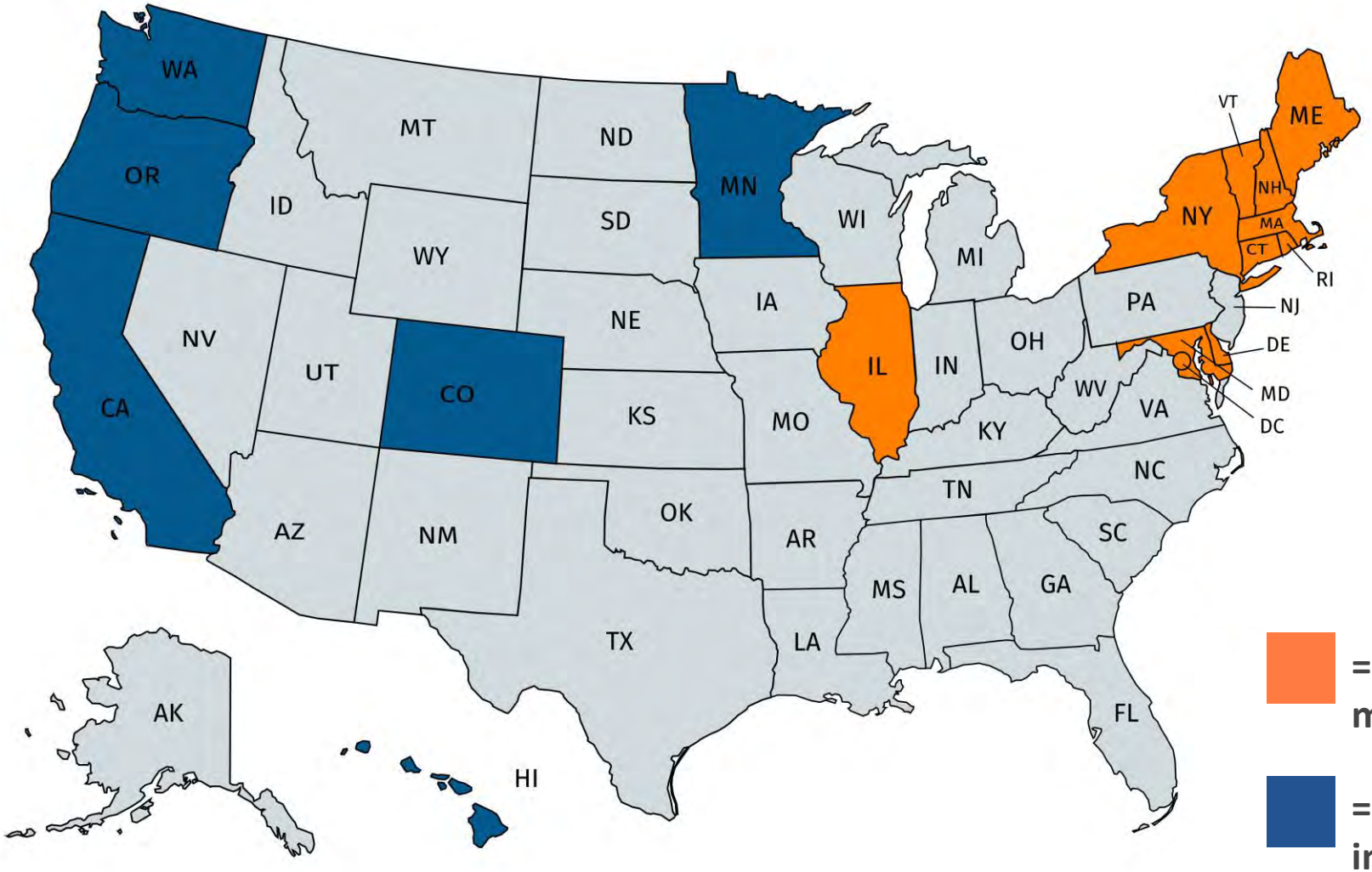
VOTE SOLAR

- Promotes competition to create low-cost customer focused offerings.
- Expands access to local renewable energy for entities that cannot install rooftop solar (e.g., homeowners, small businesses, businesses that lease space, commercial and industrial facilities, renters, apartment complexes, local governments).
- Allows subscribers to directly benefit from offsite community solar installations.
- Provides opportunity for customer savings and re-investment in the local economy.
- Drives economic development and private investment.

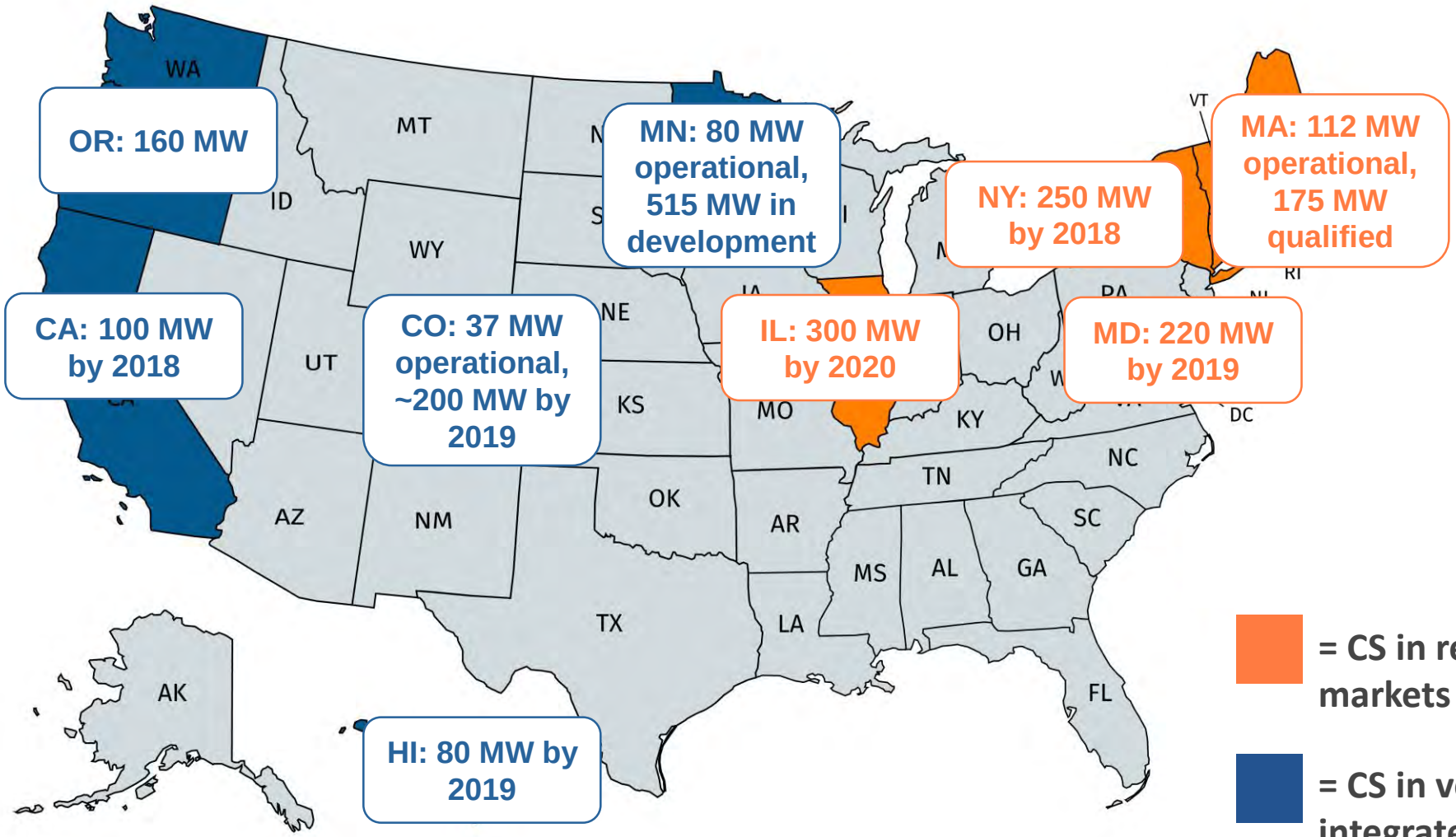


Massachusetts: In 2016, 63 MW of community solar resulted in over $154,000,000 in the Commonwealth.

Community solar is legislatively enabled in 16 states and the District of Columbia.



Community solar is legislatively enabled in 16 states and the District of Columbia.



Community Solar in Restructured Markets

VOTE SOLAR

- Community solar fits in all market types.
  - 6 vertically integrated markets: CO, MN, HI, WA, OR, CA
  - 11 restructured markets: MA, NY, MD, IL, RI, VT, NH, ME, CT, DE and DC
- Maryland Register, Proposed Action on Regulations, published 4/29/2016:

> E(1). Developers of solar facilities will benefit from the ability to construct and manage community solar energy generation systems. Retail suppliers of electricity will be unaffected by these regulations because a member of a Subscriber organization may continue as a retail customer.

Community Solar in Restructured Markets

VOTE SOLAR

- Community solar ownership:
  - A Subscriber Organization shall be any for-profit or not-for-profit entity permitted by state law that:
    - (A) owns or operates one or more community solar facility(ies) for the benefit of subscribers, or
    - (B) contracts with a third-party entity to build, own or operate one or more community solar facilities.
  - In restructured markets, this includes third party providers, customer owned facilities, and retail suppliers.
- Electric distribution utility responsible for administering the credits.
- Community solar credit rates are consistent for all end-users, regardless of the competitive retail supplier.

Community Solar in Restructured Markets

VOTE SOLAR

- Interconnection
  - Community solar facilities are interconnected at the local distribution system.
  - Community solar system owners are responsible for all maintenance up to the point of interconnection.
  - Project interconnection is governed by a set of safety standards and regulations that apply to all distributed solar energy projects.
  - Clear rules and regulations for project interconnection and queue management.

Community Solar: 5 Guiding Principles

VOTE SOLAR

- Expand consumer access
- Provide tangible economic benefits
- Put consumers first
- Promote fair market competition
- Complement existing programs

IREC, *Model Rules for Shared Renewable Energy Programs* (2017), http://www.irecusa.org/publications/guiding-principles-for-shared-renewable-energy-programs/

Key Recommendations

VOTE SOLAR

- Create a statewide community solar program to provide all customer types the opportunity to access solar energy through off-site solar installations.
- Allow for multiple subscribers to directly benefit from a single off-site solar installation.
- Enable subscribers to receive a bill credit for their share of production from an off-site facility.
- Encourage competition to create low-cost community solar offerings and expand access to all customer types.

Thank you!

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VOTE SOLAR

Resources

VOTE SOLAR

- Interstate Renewable Energy Council Guiding Principles:
  - http://www.irecusa.org/publications/guiding-principles-for-shared-renewable-energy-programs/
- Coalition for Community Solar Access Policy decision matrix:
  - http://www.communitysolaraccess.org/wp-content/uploads/2016/03/CCSA-Policy-Decision-Matrix-Final-11-15-2016.pdf
- Links to authorizing legislation and/or regulations
  - Massachusetts: Virtual Net Metering, Chapter 169, https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter169
  - New York: PSC Order Establishing a Community DG Program, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={76520435-25ED-4B84-847
  - Maryland:
    - Chapter 347, http://mgaleg.maryland.gov/2015RS/Chapters_noln/CH_347_hb1087e.pdf
    - Title 20 Public Service Commission, Subtitle 62 Community Solar Energy Generating Systems, http://www.dsd.state.md.us/COMAR/subtitle_chapters/20_Chapters.aspx#Subtitle62 (MD Public Utilities Code Ann. Section 7-306.2)
  - Illinois: Public Act 099-0906, http://www.ilga.gov/legislation/publicacts/99/PDF/099-0906.pdf
  - Rhode Island: Article 18, http://webserver.rilin.state.ri.us/billtext16/housetext16/article-018-sub-a.htm

Retail Choice and Net Metering: Issues and Considerations

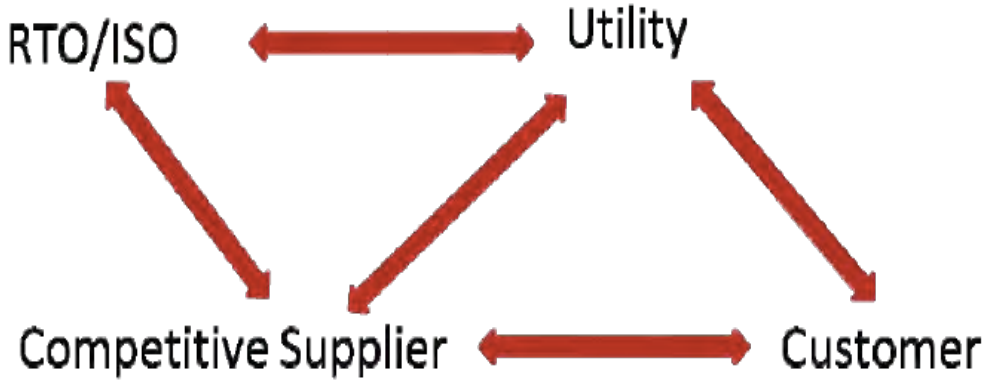
January 23, 2018

Justin Barnes – EQ Research, LLC

NV Governor's Electric Competition Task Force Meeting

Discussion Summary

- Retail Choice & NEM Basics
  - Supply Choice
  - Billing Options
- Overarching Themes
  - Symmetry
  - Clarity
  - Simplicity
- Transactional Issues
  - NEM Billing for Customers
  - Wholesale Side/Supplier Compensation
- AB 405 Nuances



Retail Choice : Supply Choice

- Customer Options
  - Standard offer or default service
    - Details subject to overall state market design
  - Choice of competitive offers from suppliers
    - Likely numerous rate options (e.g., fixed rate, variable, % discount, and more).
    - Offers vary based on market segment
- Distribution utility continues to perform distribution functions (e.g., interconnection, possibly meter reading)

Retail Choice Basics: Billing

- Billing Options
  - Utility consolidated billing
  - Retail supplier consolidated billing
  - Separate billing
- All require the transmission of data between suppliers and utilities.
- Choice of which occurs driven by law, supplier's preference, and/or consumer preference.

Symmetry

- NEM rules apply equally to utilities & suppliers
  - Net monthly charges, non-discrimination.
- Accounting reflects the service being provided (i.e., supplier “funds” energy credits)
- WHY SYMMETRY?
  - Level playing field
  - Less complicated for customers
  - Rules should not impede switching
- Supplier Obligation is a policy question
  - Arguably required by AB 405 (“fair credit for

Supplier Obligation: States

- New Jersey
  - NEM clearly required for all suppliers
- Pennsylvania
  - Supplier option
  - Ambiguous rules formerly gave rise to different utility practices
- Ohio
  - Supplier option
  - Utility obligation to net distribution charges for shopping customers now in question

Clarity

- Important to clearly define all obligations to avoid confusion and billing mistakes.
  - Suppliers understand meaning of billing data they receive (e.g., how is negative usage reflected) via EDI transactions.
  - Wholesale settlements (i.e., cost to suppliers) aligned with costs/benefits.
  - What happens when a customer switches suppliers? Credit cash out?

Simplicity

- NEM system already works in Nevada
  - Existing NEM customers know what to expect
  - DG providers & utilities know how to educate customers on what to expect
  - Utilities have systems to accomplish the requisite transactions
  - Aligning dozens of retail suppliers on rules could be challenging

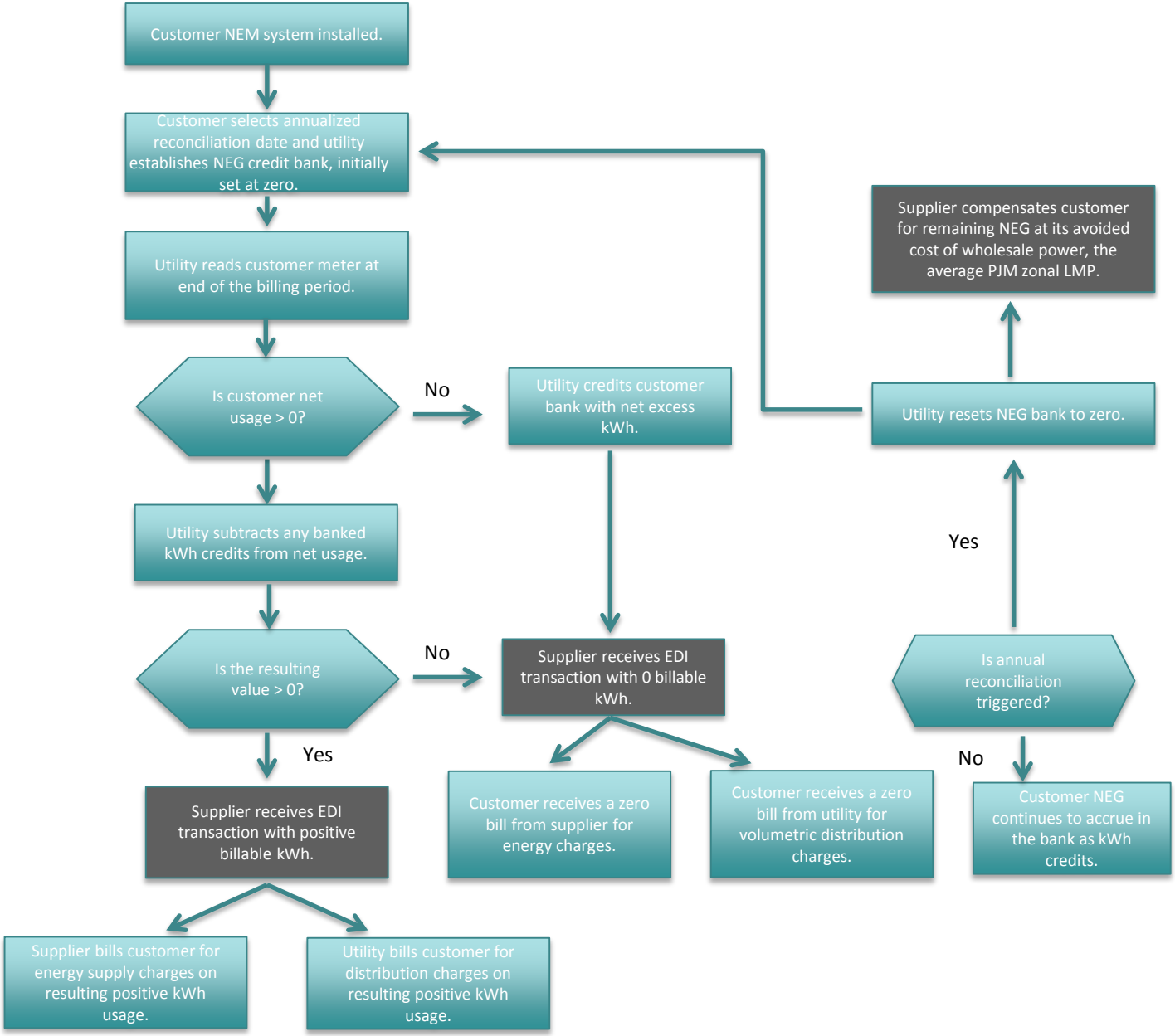
No need to reinvent the wheel. Retain as much of the current protocols as possible.

Transactions: Retail

- Clear and consistent standards help avoid billing mistakes
  - Billing (and other) data exchanged via EDI transactions (e.g., metered usage via EDI 867 loop)
  - EDI identifiers must be set up to clearly indicate “negative” usage
  - Must indicate net vs. gross values (e.g., separate imports and exports, single net value)
- Recommendations
  - EDI Manual expressly addresses DG customers (e.g., examples in OH, NJ)
  - Utilities use same practices

Retail NEM Transaction Options

- Utility-Side Netting (NJ, MD, NY)
  - Utility operates the “credit bank”
  - Credits for prior months applied *before* data supplier receives billing data
  - Simplest method, consistent with what utilities already do.
- Split Netting (IL, D.C.)
  - Each entity processes separately and maintains a separate credit bank
  - Each entity receives full metered data to process bank balance
- Supplier-Side Netting (TX)
  - Reverse of utility-side netting
  - In TX, no netting of distribution charges


Customer NEM system installed.
Customer selects annualized reconciliation date and utility establishes NEG credit bank, initially set at zero.
Utility reads customer meter at end of the billing period.
Is customer net usage > 0?
No
Utility credits customer bank with net excess kWh.
Utility subtracts any banked kWh credits from net usage.
Is the resulting value > 0?
No
Supplier receives EDI transaction with 0 billable kWh.
Yes
Supplier receives EDI transaction with positive billable kWh.
Supplier bills customer for energy supply charges on resulting positive kWh usage.
Utility bills customer for distribution charges on resulting positive kWh usage.
Customer receives a zero bill from supplier for energy charges.
Customer receives a zero bill from utility for volumetric distribution charges.
Utility resets NEG bank to zero.
Supplier compensates customer for remaining NEG at its avoided cost of wholesale power, the average PJM zonal LMP.
Yes
Is annual reconciliation triggered?
No
Customer NEG continues to accrue in the bank as kWh credits.

Retail NEM Transactions

- Utility side is simple and effectively already in place
  - Separate credit banks at least double the chance of errors
  - Many suppliers = many individual billing systems = many more opportunities for error
- Opposing view
  - Suppliers may want “untouched” meter data
  - Does utility-side accommodate unique or advanced rate options or specialized agreements?

Retail NEM: Issues

- Billing miscommunications (NJ)
- Netting distribution charges for shopping customers (PA, CA)
- Utilities “net” usage data even though no supplier obligation exists (PA)
- Billing oddities (MA)
  - Separate supplier billing creates possibility of “stranded” credits.

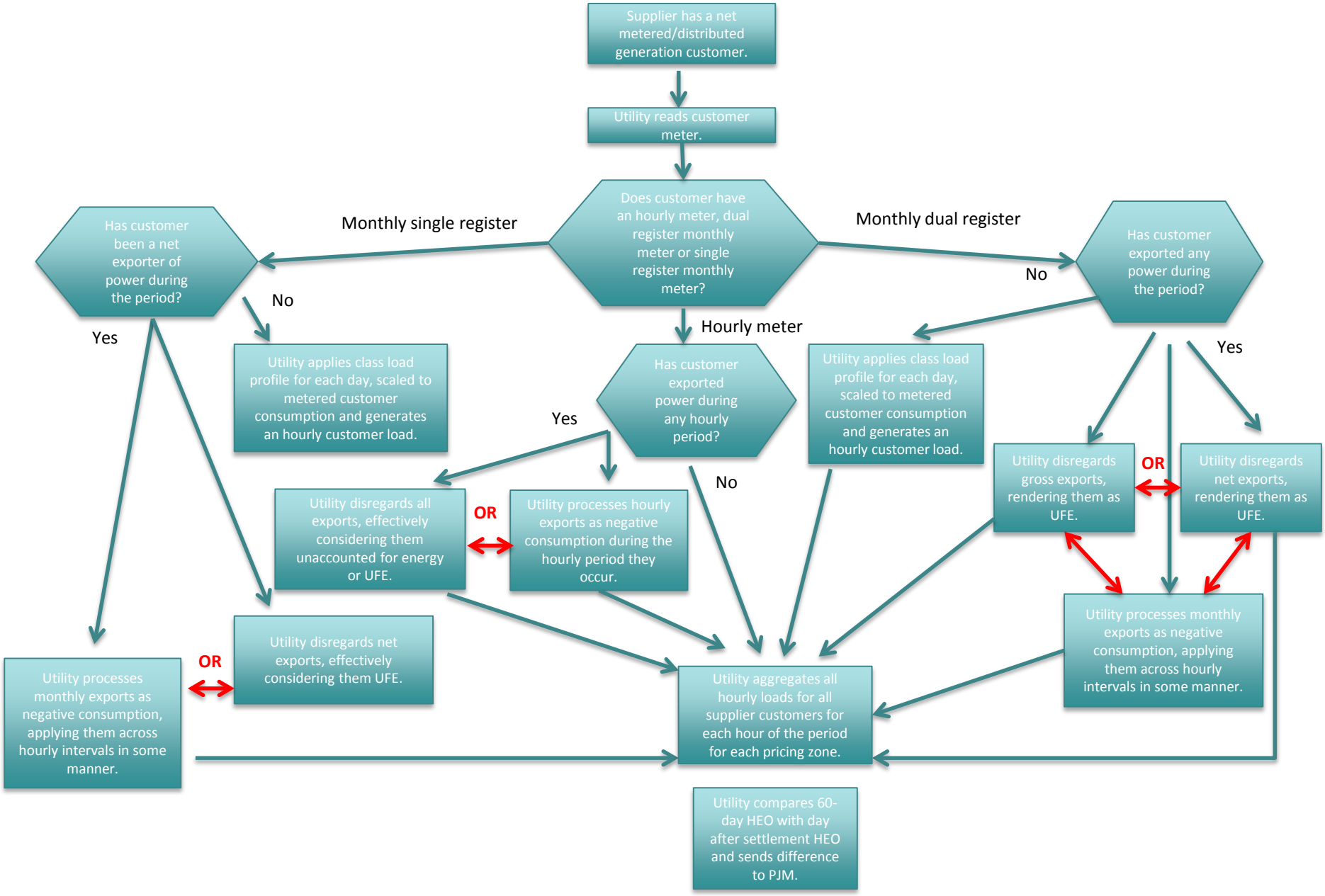
Wholesale Transactions

- Determines a supplier's cost to serve a net metering customer
  - Lower cost energy to serve load not provided by solar (e.g., less on-peak energy)
  - Lower generation capacity needs based on customer contribution to coincident system peaks
  - Credit for excess customer generation (i.e., excess is "owned" by the retail supplier)
- Critical point for suppliers
  - No regulated cost recovery mechanism
  - Suppliers "eat" NEM costs *unless* they can realize benefits of NEM customers through lower costs

Wholesale Transaction Nuances

- How are capacity obligations determined?
  - Profiled vs. hourly metered customers? Negative values possible?
- How are hourly energy obligations determined?
  - Solar load profile? (ERCOT)
- How is hourly or monthly excess reflected?
  - Subtracted from hourly positive obligation? To which hours for non-hourly metered customers?

Needs to be aligned with otherwise applicable market rules


Supplier has a net metered/distributed generation customer.
Utility reads customer meter.
Does customer have an hourly meter, dual register monthly meter or single register monthly meter?
Monthly single register
Monthly dual register
Hourly meter
Has customer been a net exporter of power during the period?
Yes
No
Has customer exported any power during the period?
Yes
No
Has customer exported power during any hourly period?
Yes
No
Utility applies class load profile for each day, scaled to metered customer consumption and generates an hourly customer load.
Utility applies class load profile for each day, scaled to metered customer consumption and generates an hourly customer load.
Utility disregards all exports, effectively considering them unaccounted for energy or UFE.
OR
Utility processes hourly exports as negative consumption during the hourly period they occur.
Utility disregards gross exports, rendering them as UFE.
OR
Utility disregards net exports, rendering them as UFE.
Utility processes monthly exports as negative consumption, applying them across hourly intervals in some manner.
OR
Utility disregards net exports, effectively considering them UFE.
Utility processes monthly exports as negative consumption, applying them across hourly intervals in some manner.
Utility aggregates all hourly loads for all supplier customers for each hour of the period for each pricing zone.
Utility compares 60-day HEO with day after settlement HEO and sends difference to PJM.

AB 405 Nuances: Credit Rate

- How should the declining % of retail rate for monthly credit be addressed?
  - Option #1: Excess kWh reduced by the applicable % before rates are applied.
    - Results in a symmetrical framework
  - Option #2: Reduction applied only to distribution portion of the rate
    - More reflective of cost causation? Consistent with AB 405?
  - Option #3: Reduction applied only to energy portion
    - Reduces supplier risk of net NEM costs through reduced compensation

AB 405 Nuances

- **Disclosures - Section 11 (l)(4) and equivalents**
  - Disclosure must state whether credits for excess electricity are available.

Not possible if retail suppliers are not required to offer NEM.

- Crediting protocol upon switch of supplier
  - Not addressed in current rules or tariffs
- Supplier/Utility Obligations
  - References only to “utility”
  - Might be changed to “supplier” or equivalent.

Align obligations with entity providing service

Questions??

Contact Information

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919-825-3342

Useful Links

New Jersey EDI Manual – provides express guidance on DG billing

First Energy Supplier Manuals – clearly explain how wholesale settlement occurs for energy, and how customer's capacity tag is determined

ERCOT Load Profiles – Solar load profiles (designated as "PV") may be downloaded from here.

NEVADA RURAL ELECTRIC ASSOCIATION

Representing Nevada's Rural Electric Cooperatives, Power Districts, and Municipal Utilities.

Prepared for the Governor's Committee on Energy Choice Workgroups

Generation, Transmission & Delivery

Energy Consumer & Investor Impacts

January 23, 2018

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Rural Electrics:
Governance

- Each NREA member is an individual association of people with a common purpose to procure and distribute aggregated energy load solely for the members of their Association.

- Local, democratically elected boards are at the center of each member's electric distribution system with a common mission to distribute:
  - safe, reliable, and low-cost electric service for their owner-member/consumers

- PUCN oversight is limited as prescribed in various NRS enabling statutes relative to the Association's entities:

Electric Cooperatives --- Power Districts --- Municipalities.
NRS Chapter 81 NRS Chapter 318 NRS Chapter 268

Fundamental Characteristics of
NEVADA'S RURAL ELECTRIC DISTRIBUTION SYSTEMS

- NREA Members currently offer **meaningful choice** to their member/consumers…
  - In their power supply options, their rates, and in the make-up of their Boards'.
  - All owner-members have one vote regardless of the amount of energy purchased.
- Each Cooperative, Power District, and Municipality aggregates member-owners' energy requirements and procures the best available resource at the best available price.
- In accordance with each NREA members' Board policies related to safety and reliability, individual members have the right and potential ability to seek and procure energy generation resources for themselves, with other owner-members, or, outside of the Board approved resource mix.

Fundamental Characteristics of
NEVADA'S RURAL ELECTRIC DISTRIBUTION SYSTEMS

- **NREA Distribution Systems Are Not Vertically Integrated**
  - Procure energy from providers of choice
  - Net metering for individual consumer-owned Distributed Generation
- Each Association's Board establishes standards for the expansion of the distribution system through a line extension policy. This policy ensures all members will benefit from the expansion of the system and who pays the costs. All members share in the operating and maintenance of the system, but also enjoy the low costs of the system.
- NREA utility members have **no excess margin component** when setting rates**.**
  - Rate components = Energy + Demand + Cost of managing Association business

Rural Electrics:
Operations

- NREA owner-member/consumers own and operate their Association's electric transmission and distribution systems.
- Each member in an NREA member Association owns a portion of the Association's physical assets.
- These systems are solely used to serve their own requirements and meet high reliability standards. These systems directly benefit the owner-member because the system is operated at cost.

Rural Electrics:
Operations

Through their elected representatives, member-owners choose:

- Their source of electricity
  - One member, one vote.
  - Or, terminate membership as an owner.
- Structure conservation and energy efficiency programs to fit local conditions
- Aid fellow consumers in need
  - Low-income and energy assistance programs
- Enable individual member and Community Renewable Resource generation
  - Net-metering
  - Individual and/or Community-based DG projects
- Employ local community resources
- Strengthen their communities by supporting schools and community-based service.

NEVADA RURAL ELECTRIC ASSOCIATION

Representing Nevada's Rural Electric Cooperatives, Power Districts, and Municipal Utilities.

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Capturing Nevada's Efficiency Potential in a Competitive Retail Electricity Market

By: Chris Neme

February 6, 2018

Energy Futures Group Consulting

EE/RE Areas of Expertise

- Policy
- Market Analysis
- Program Design
- Evaluation

Range of Clients

- Regulators
- Government Agencies
- Advocates
- Utilities

Clients in more than 25 states, 5 Canadian provinces, Europe & China.

Presentation Overview

1. Value of Efficiency as a Resource
2. Size of Cost-Effective Efficiency Resource
3. Need for Efficiency Programs
   - Why consumers don't invest in all cost-effective efficiency
   - Why competitive electric market won't change that reality
4. Options for Assigning Efficiency Program Obligations under Competitive Retail Electric Market

Value of Efficiency Resource

Multiple Benefits of Efficiency

Utility System Benefits

- Energy
- Generating Capacity
- T&D infrastructure
- Line losses
- Environmental Compliance
- RPS compliance
- Credit & Collection Costs
- Price Suppression
- Lower risk

Other Consumer/Societal

- Consumer Non-Energy Bens:
  - Comfort
  - Health & safety
  - Building durability
  - Water
  - O&M
  - Business productivity
  - Etc.
- Jobs/Economic Devt
- Environment
- Public Health
- Energy Security

Efficiency as a Resource - Energy

Illinois Example (ComEd)

- Savings targets imposed on distribution utilities
- Spend ~4% of electric revenue on EE programs
- To meet 20% of electric energy needs in 13 years

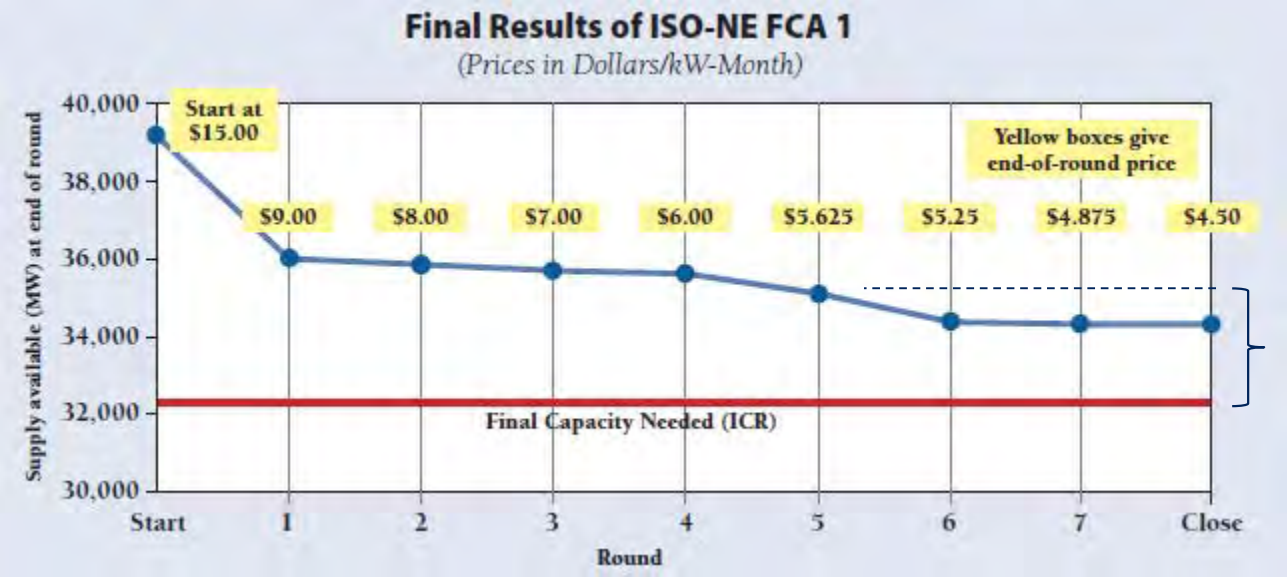
Massachusetts Example

- Mandate to acquire "all cost-effective" efficiency
  - Imposed on distribution utilities
- Spend ~6% of electric revenue on EE programs
- Will meet >20% of electric energy needs in 10 yrs

Efficiency as a Resource - Capacity

New England ISO Capacity Market Example

- Demand resources (DRs), including EE, compete w/supply
- 11 annual auctions to date
- DRs and EE have lowered market clearing prices



~2300 MWh of DRs cleared; without them market clears at ~$1/kW-month higher price

Efficiency as a Resource - Transmission

New England Example

- ISO began integrating forecast EE into T planning in 2012
- Cut >$400 million in planned T projects for just VT/NH
  - Context: VT/NH population, GDP, electric sales all less than NV

Source: Chris Neme & Jim Grevatt (Energy Futures Group), *"Energy Efficiency as a T&D Resource"*, published by Northeast Energy Efficiency Partnerships, January 2015.

Efficiency as a Resource - Distribution

Con Ed (New York) Example

Passive Deferrals

- Substation level forecasts of impacts
- >$1 billion reduction in 10-yr forecast

Active Deferrals

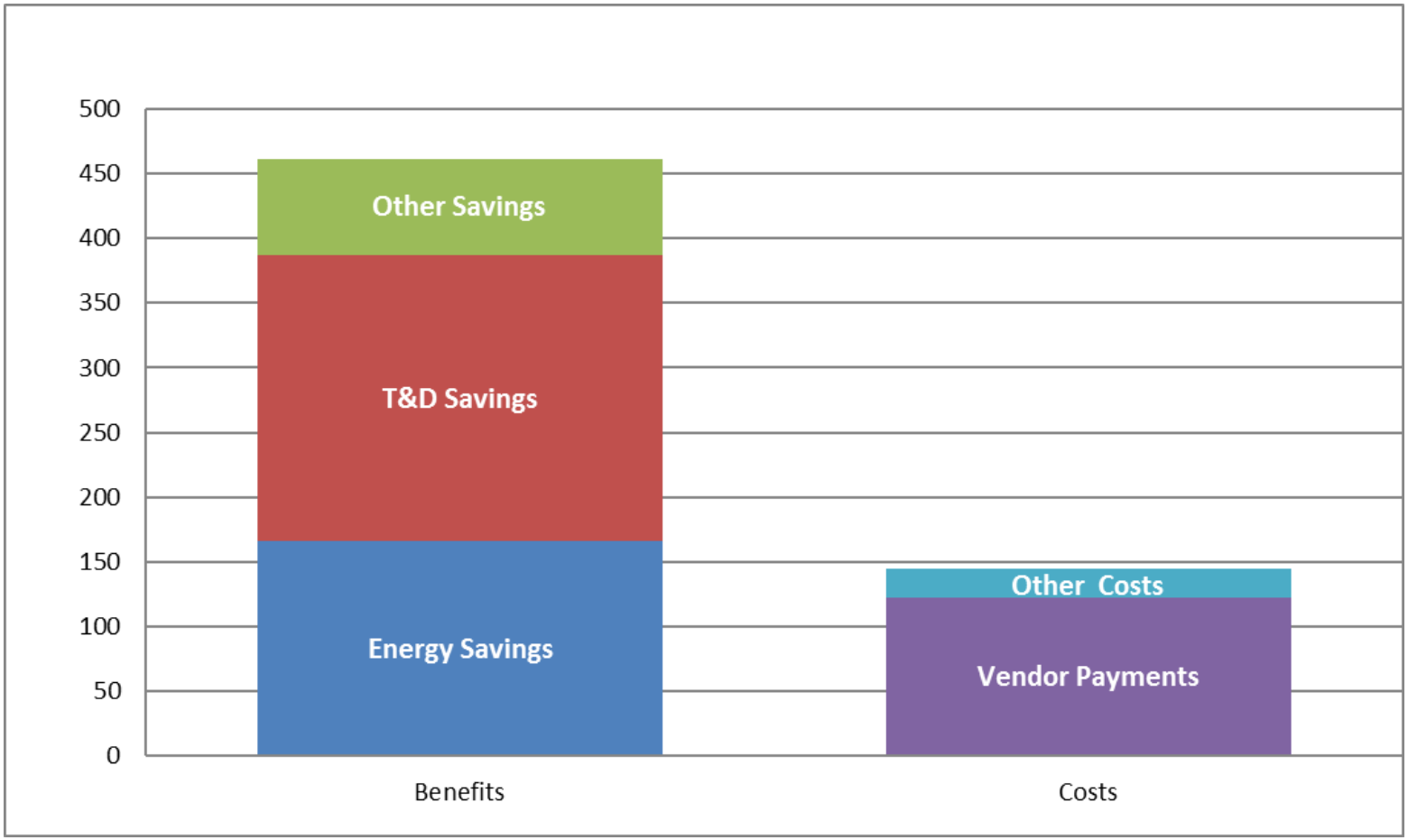
- >30 projects since 2003
- RFPs for DERs, but mostly EE won
- Many successful deferrals
- Also hedge vs. forecast uncertainty – some projects never needed

Source: Chris Neme & Jim Grevatt (Energy Futures Group), *"Energy Efficiency as a T&D Resource"*, published by Northeast Energy Efficiency Partnerships, January 2015.

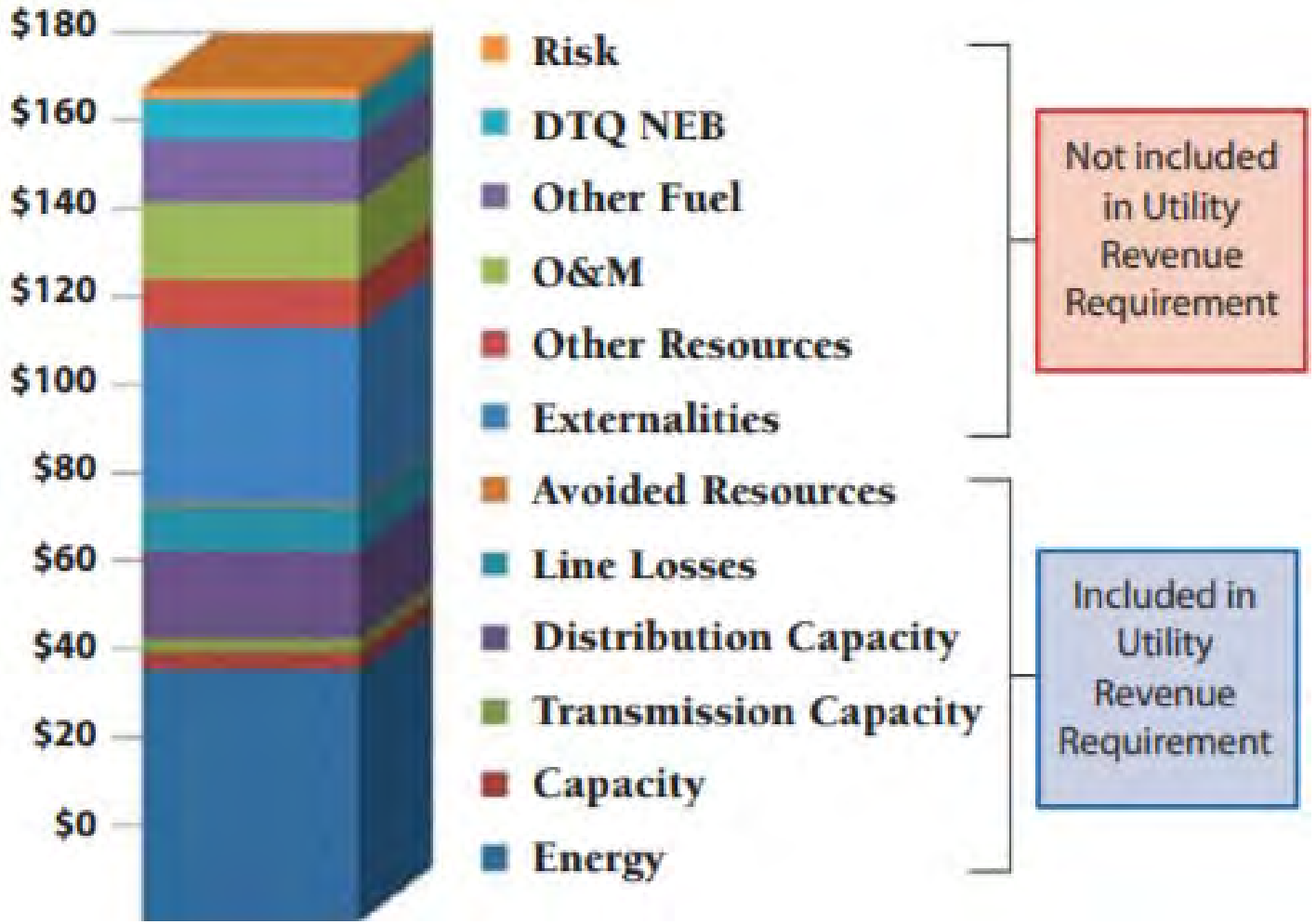
Con Ed Active Deferral Cost-Effectiveness

NPV of Net Benefits of Con Ed's 2003-2010 Non-Wires Projects

(millions $)



Vermont's 2013 Estimated Value of Efficiency
($/MWh)



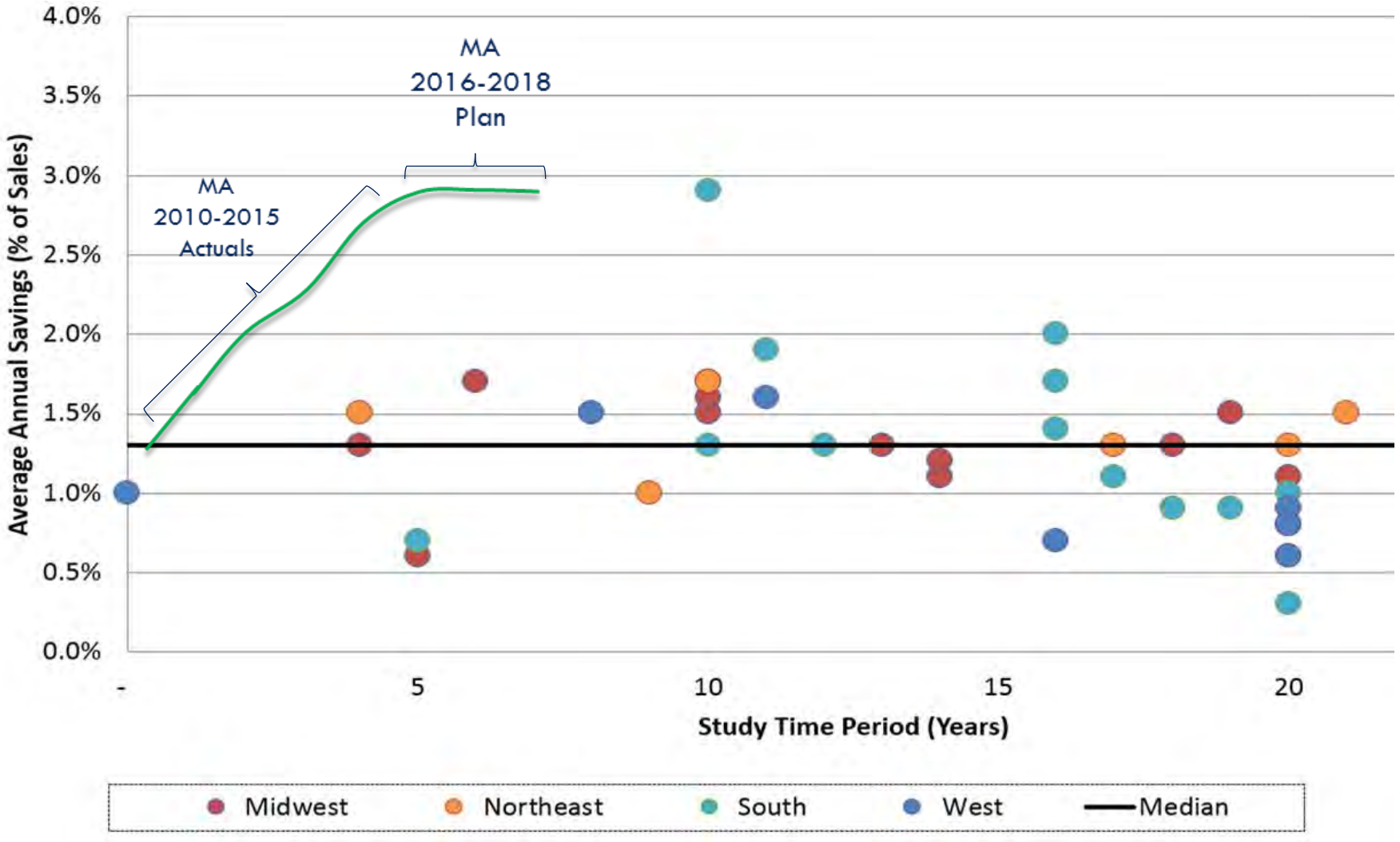
Source: Jim Lazar & Ken Colburn, *"Recognizing the Full Value of Energy Efficiency",* Regulatory Assistance Project, Sept. 2013

Size of Efficiency Resource

Large, Untapped Potential

- Studies typically estimate ~10-20% of energy use
- But such estimates are inherently very conservative
  - Don't address all efficiency measures
  - Don't account for new technology
  - Ignore transformational effects on markets
  - Often assume artificial budget/policy constraints
  - Etc.
- 30% likely possible in many/most jurisdictions

Estimates of Max Achievable Well Below Leading Jurisdictions' Actual Achievements



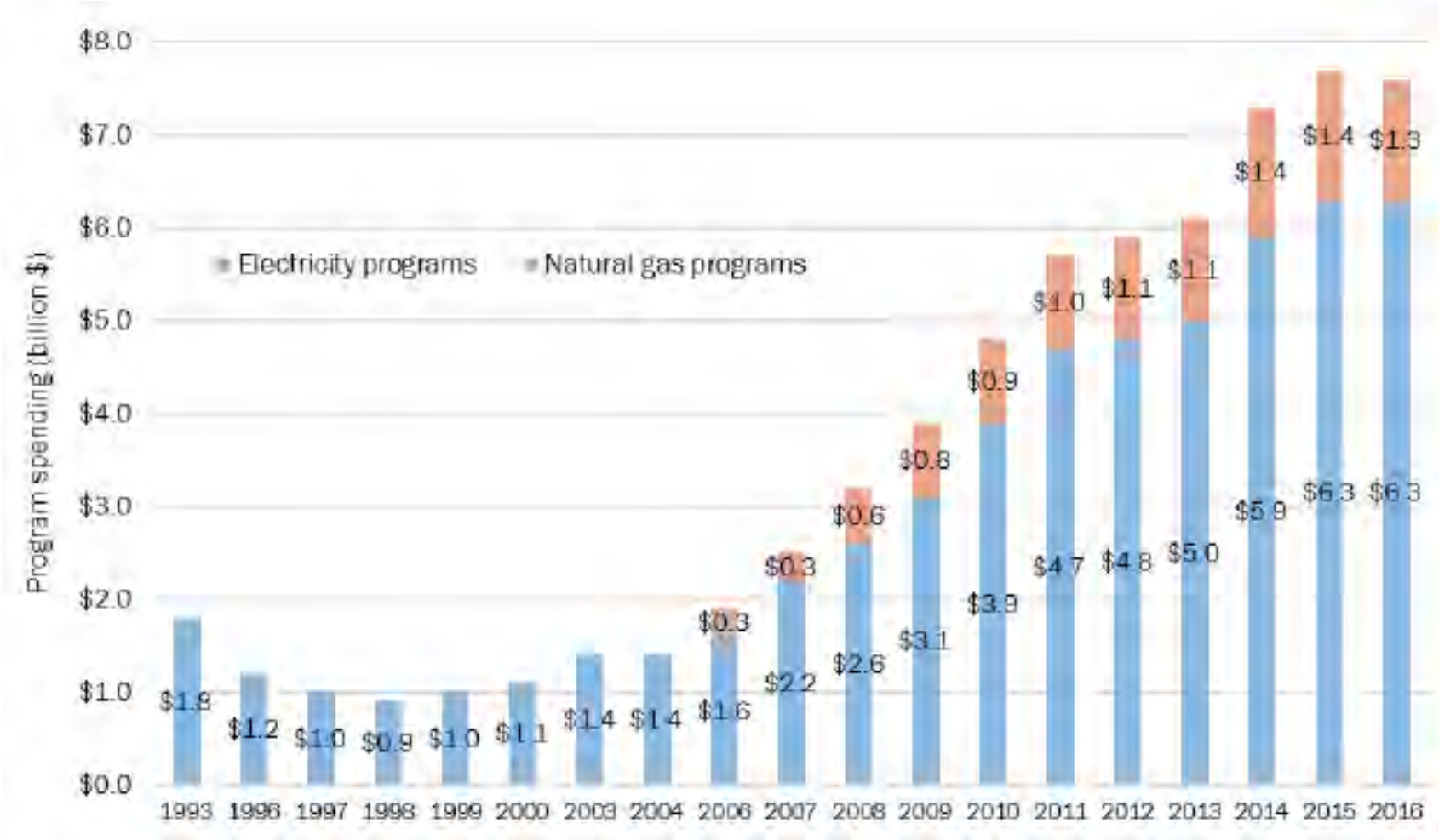
The Bar Keeps Getting Raised
*(annual **electric** savings as % of sales)*

2006	2016
≥2.5%: 0 states	≥2.5%: 3 states
≥1.5%: 0 states	≥1.5%: 6 states (incl. CA, WA)
≥1.0%: 3 states	≥1.0%: 16 states (incl. AZ, ID)
≥0.5%: 12 states	≥0.5%: 28 states (NV: 0.6%)

6 states have EERS ≥2.0% savings in the future (incl. AZ)

Sources: ACEEE 2008 and 2017 State Energy Efficiency Scorecards

Increasing National Expenditures



Source: ACEEE 2017 State Energy Efficiency Scorecard

Low Costs of Savings (1)

- Typical program cost ~2-3 cents per kWh saved
- Most aggressive states ~3-5 cents per kWh saved

Need for Efficiency "Programs"

Numerous Market Barriers

- Awareness/info
  - Consumers
  - Builders, vendors, suppliers, contractors, etc.
- Split incentives
  - Builders vs. future occupants
  - Owners vs. tenants
- Risk/Uncertainty regarding efficiency performance
  - Individual customer choice vs. portfolio of EE measures/participants
- Transaction costs
- Different planning horizons for demand than for supply
- Lack of access to capital
- Energy prices don't align with costs

Will Retail Choice Change Barriers?

- Won't directly change them
- Only indirectly if efficiency offers used to attract customers
  - No evidence to suggest this will be the case
  - And only even possible for some efficiency measures
    - Only retrofit measures
    - No effect on time of purchase, new construction measures

In UK, residential insulation market collapsed once requirements for retail energy suppliers to acquire energy savings was eliminated (i.e. once it was made optional).

Need to Obligate an Entity to Acquire EE

- Significant cost-effective efficiency will be "left on the table" without a mandate
- That's true regardless of market structure
  - Vertically-integrated utility or
  - Retail choice
- "Someone" needs to be obligated to acquire EE

Options for Efficiency Obligations under Retail Choice

3 Primary Options

- Distribution Utility
  - IL, MA, OH, CA, etc.
- Independent 3rd Party
  - NJ, OR
- Retail Energy Suppliers
  - UK, France

Distribution Utility

Pros

- Serves all customers
  - Full range EE programs
  - Market clarity
- Customer relationships
- Customer data access
- Regulated investments
  EE helps address

Cons

- Not "core business"
- Monopoly has less incentive for innovation

Independent 3rd Party

Pros

- Serves all customers
  - Full range EE programs
  - Market clarity
- Singular focus
- Competition can drive innovation

Cons

- No customer relationships
- No customer data

Note: Assumes competitive selection process, but there are other variations.

Retail Energy Suppliers

Pros

- Some customer data
- Some relationships
- EE can be marketing tool
- Pressure to minimize costs

Cons

- Only some customers
  - Limits EE program options
  - Creates EE mkt confusion
  - Puts upward pressure on EE program costs
- Not "core business"

Mix

- Some customer data, but not all
- Some customer relationships, not all

Doesn't Competition Lower Cost?

Yes, but for whom?

- Increased competition for customers, savings…
  - results in increased offers (e.g. rebates) to customers
- Lowers net cost to participating customers…
  - but increases program costs for ratepayers as a whole

Can "Cons" Be Addressed?

Distribution Utility Model

- Not core business
- Monopoly disincentive to innovate

→ Shareholder incentives, tied to performance; Decoupling (NV already)

Independent 3rd Party

- No customer data → Can make available
- No existing customer relationships → No short-term solution; goes away over long-term

Retail Energy Suppliers

- Serve only some customers
  - Limited program options
  - Market confusion
  - Increased EE program costs
- Not core business

→ No obvious solution

Recommendations (1)

- Establish an Energy Efficiency Resource Standard
  - Statutorily set targets or require PUC to set them
    - i.e. moved out of current context of resource planning
    - but still driven by concept of EE as a resource alternative
  - Targets should be:
    - Approximately = max that is cost-effective (as under SB 150)
    - Multi-year
    - Expressed in ways that reward longer-lived savings
  - Need to obligate entity to meet standards

Recommendations (2)

- EE Obligation on Distribution Utility or 3rd Party
  - *Do not* impose on retail energy suppliers
  - They can still supplement DU/3rd party if they choose
- Create *performance* incentives
  - Most important for DU, but helpful for 3rd Party too
  - Many different ways to do this
- Independent evaluation
  - Particularly important w/performance incentives

Recommendations (3)

- Decoupling
  - NV already has
- IRP/least cost approaches for D Investments
  - Additional geo-targeting of EE, on top of system-wide
  - Several jurisdictions now do this…
  - …including NV starting in 2020

Q&A

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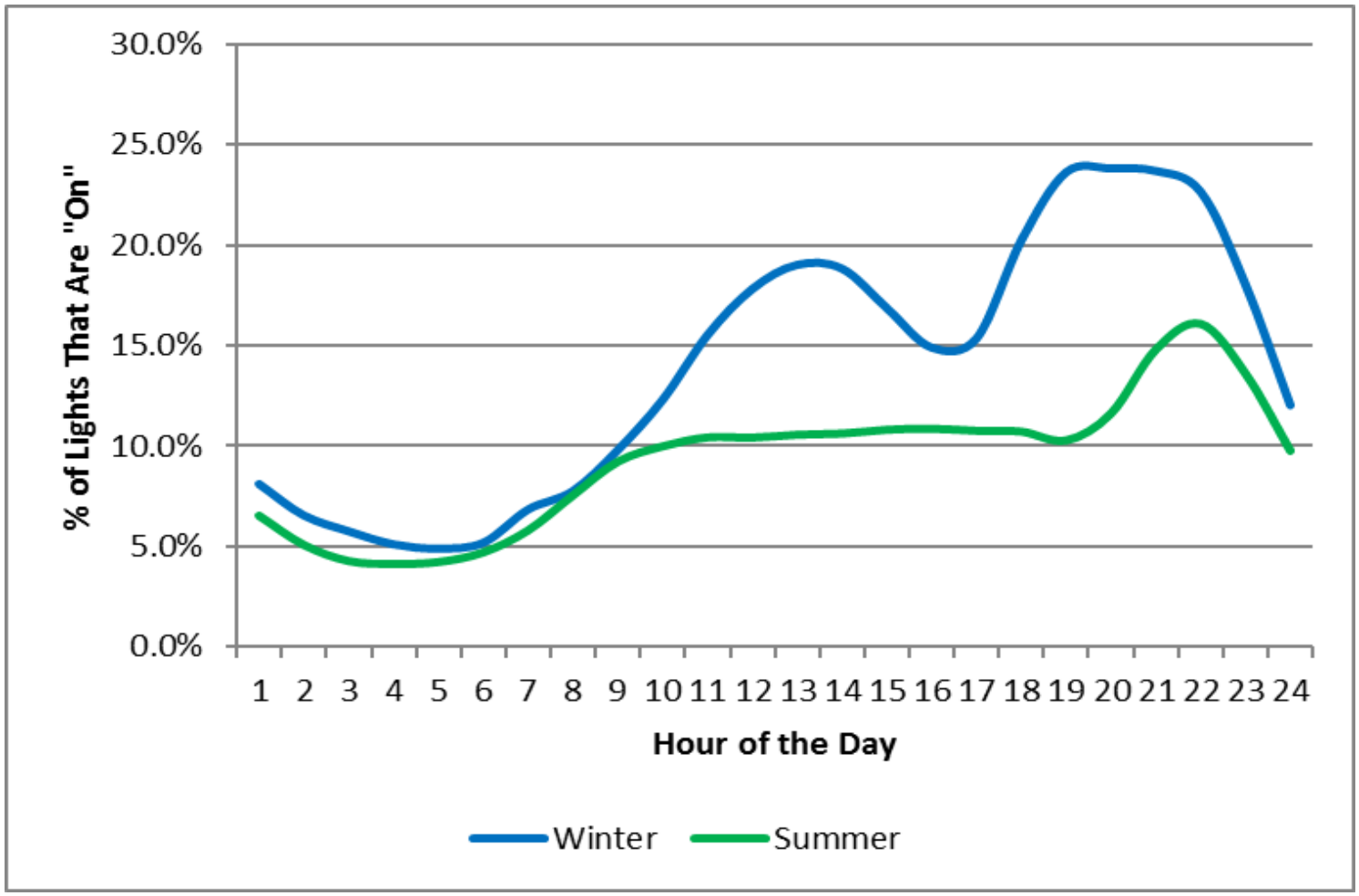
Extras for Reference (if needed)

Most EE Programs Provide Some Savings at All Hours of Potential Interest



Comparative Reliability of EE Capacity

(Current ISO New England Data/Assumptions)

Demand Resources

- Efficiency: 100%
- Demand Response: 90%
- **Total System: 98%**

Generators

- Combined Cycle: 96.1%
- Fossil: 80.7%
- CT: 89.6%
- Nuclear 98.1%
- Hydro 96.5%
- Diesel 90.7%
- Misc. 90.7%
- **Total System 92.7%**

Efficiency as a Resource – T&D

Passive Deferrals

- Indirect, long-term impacts system-wide programs

Active Deferrals

- Geographically-targeted programs intentionally designed to defer specific T&D projects

Depth of Savings Matters

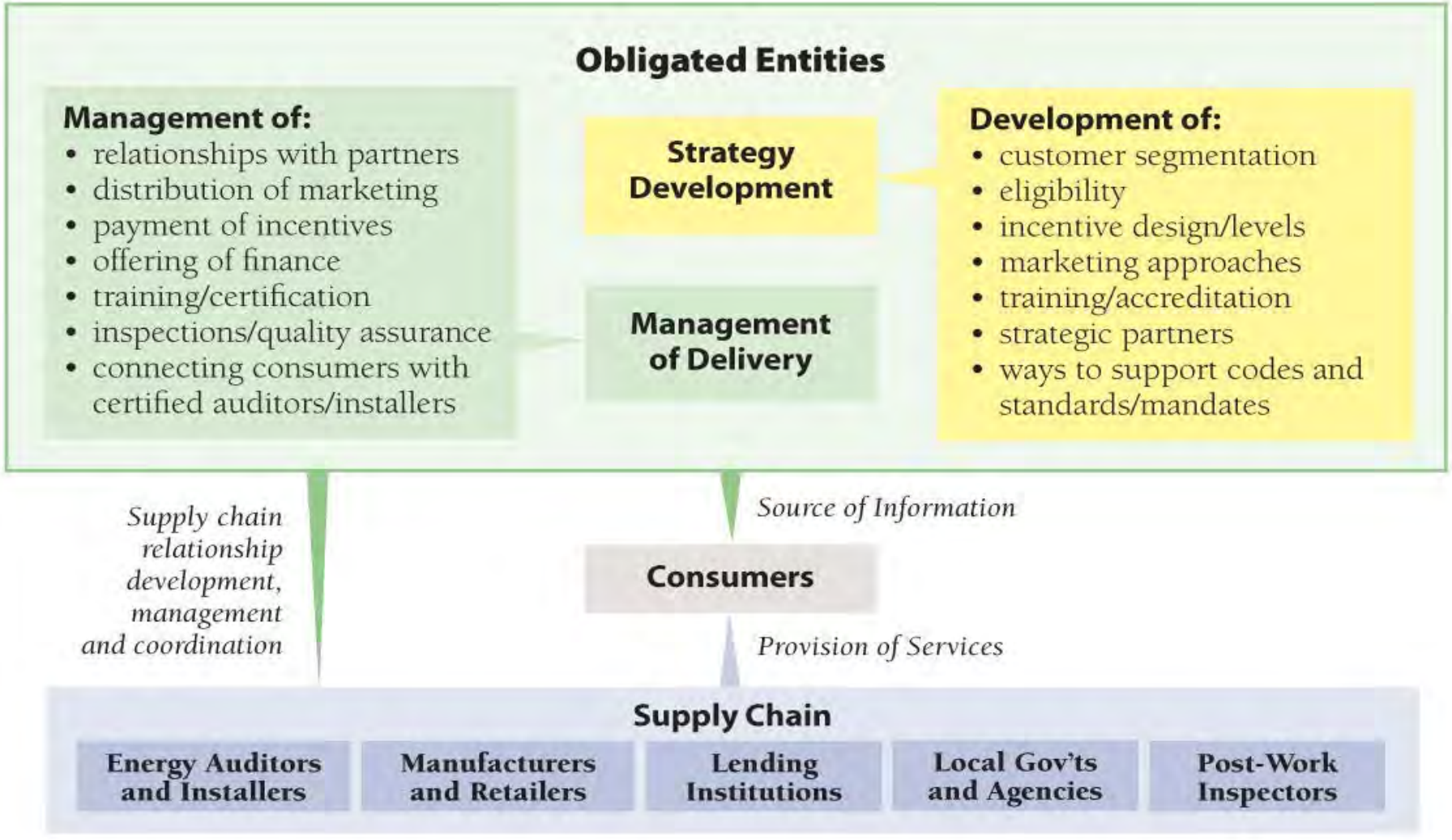
Hypothetical Distribution Substation w/100 MW Capacity

Level of Savings	Net Growth Rate	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
No EE programs	3.0%	90	93	95	98	101	104	107	111	114	117	121	125	128
0.5% savings/year	2.5%	90	92	95	97	99	102	104	107	110	112	115	118	121
1.0% savings/year	2.0%	90	92	94	96	97	99	101	103	105	108	110	112	114
1.5% savings/year	1.5%	90	91	93	94	96	97	98	100	101	103	104	106	108
2.0% savings/year	1.0%	90	91	92	93	94	95	96	96	97	98	99	100	101

Season & Hour of T&D Peak Matter

Substation	Customer Mix	Peak Season	Peak Hour	Annual Peak MW Savings by Program			
				Residential CFLs	Residential A/C	Commercial Lighting Retrofits	Total
A	Primarily Business	Summer	3:00 PM	0.4	0.9	0.7	2.0
B	Primarily Residential	Summer	7:00 PM	0.4	1.4	0.3	2.1
C	Primarily Residential w/Electric Heat	Winter	7:00 PM	1.0	0.0	0.4	1.4

Concept of "Obligation"



Institutionalizing Non-Wires Alternatives

2015 Screening Criteria for Triggering Detailed Assessments of NWAs

	Must Be Load Related	Minimum Years Before Need	Maximum Load Reduction Required	Minimum T&D Project Cost	Source
Transmission					
Vermont	Yes	1 to 3 4 to 5 6 to 10	15% 20% 25%	$2.5 Million	Regulatory policy
Maine	Yes			>69 kV or >$20 Million	Legislative standard
Rhode Island	Yes	3	20%	$ 1 Million	Regulatory policy
Pacific Northwest (BPA)	Yes	5		$3 Million	Internal planning criteria
Distribution					
PG&E (California)	Yes	3	2 MW		Internal planning criteria
Rhode Island	Yes	3	20%	$ 1 Million	Regulatory policy
Vermont	Yes		25%	$0.3 Million	Regulatory policy

ANALYSIS GROUP
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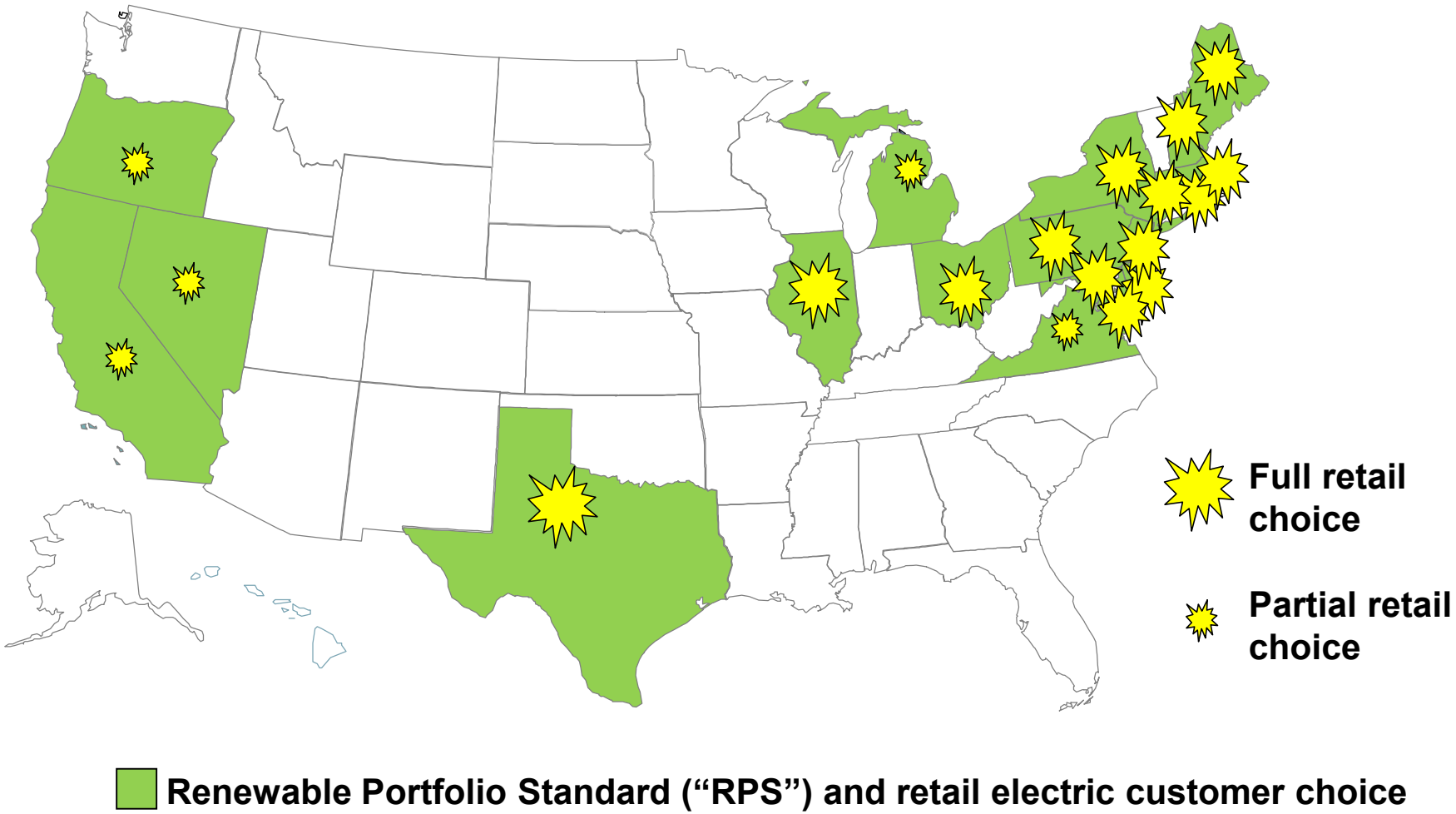
Electric customer choice & renewable energy: Insights from other states

Susan Tierney

Presentation to the Nevada Committee on Energy Choice
November 7, 2017

States with Full/Partial Retail Customer Choice and RPS



Core concepts in retail choice states with RPS

- What's the role of the utility in the electric system and market for renewables ("RE")?
- Who holds the RPS obligation?
- Who purchases/procures RE and renewable energy credits ("RECs") to comply with RPS requirements?
- What are different methods for procuring RE/RECs in these states?
- Are there examples where RPS requirements changed after choice was initiated?
- What other policies (beyond RPS) have these states adopted to support development of renewable resources?

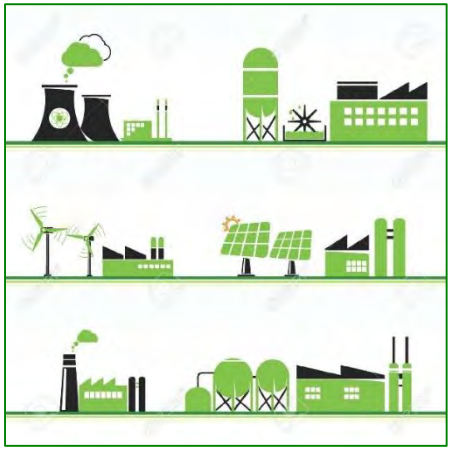
Common elements of these approaches

The utility

- Provides wires service
- Provides basic service for customers that don't choose another supplier (except in TX)
- May or may not own any power plants

Customers choose power supplier

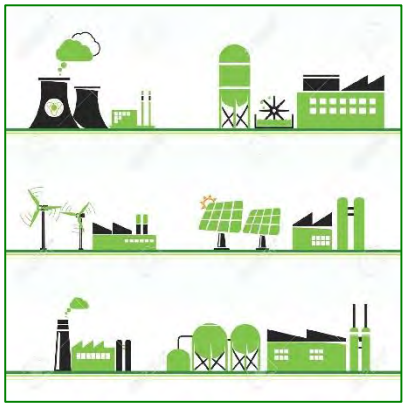
- All customers (or customers eligible to choose)
- Suppliers are registered by state



Common elements of these approaches

Load-serving entities (LSEs)

- Utilities provide basic service for customers that don't choose another supplier (except in TX)
- Competitive power suppliers for customers that have exercised choice



LSEs are typically responsible for compliance with RPS

* Note: some states do not assign RPS requirements to publicly owned utilities

Three core approaches to RE/REC procurement

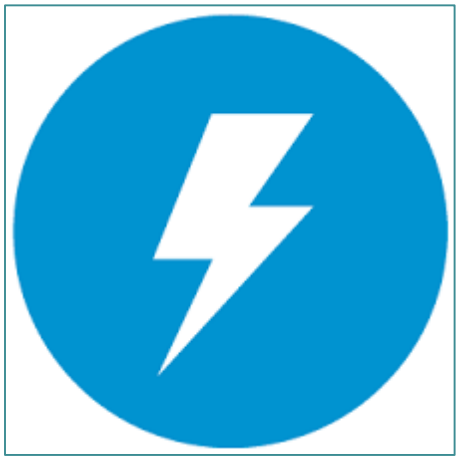
Each LSE arranges its own RE/RECs

"Decentralized"

Utility also has major role in contracting for RE/RECs

"Hybrid"

Power agency has major role in contracting for RE/RECs



"Centralized"

"Decentralized" approaches to RE/REC procurement

Every LSE arranges its own RE/RECs

"Decentralized"

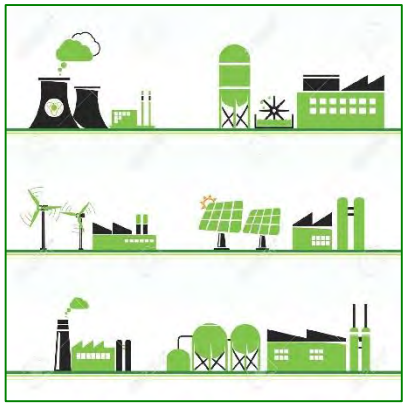
Structure:

States with partial or full customer choice, where LSEs hold RPS obligation and without special utility role in procuring renewables or low-carbon supply:

- DC
- DE
- MD
- ME
- NH
- NJ
- NV
- OH
- PA
- RI
- TX

"Decentralized" approaches to RE/REC procurement

Every LSE arranges its own RE/RECs



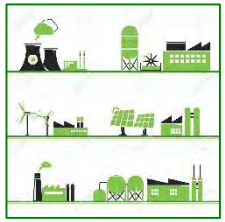
"Decentralized"

RE/REC Procurement methodologies:

- **Competitive suppliers arrange for RE/RECs through contracts, ownership, spot purchases**
- **Utility providing basic retail service requires suppliers to include RECs as part of supply offers/obligations**

"Hybrid" approaches to RE/REC procurement

Utility alsohas major role in contracting for RE/RECs



"Hybrid"

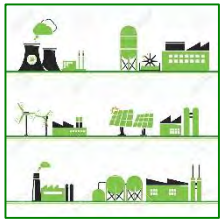
Structure:

States with partial or full customer choice; LSEs hold RPS obligation; and the investor-owned utilities also play a key role in contracting for RE/RECs

- **CA**
- **CT**
- **MA**

"Hybrid" approaches to RE/REC procurement

Utility also has major role in contracting for RE/RECs



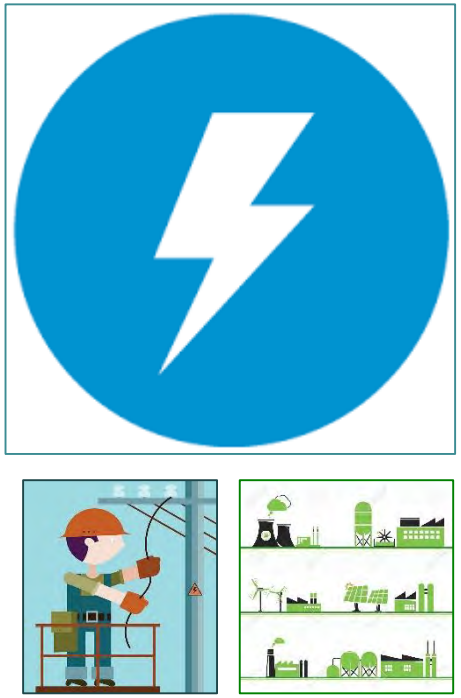
"Hybrid"

Procurement methodologies

- RFPs and competitive solicitations for renewables, with the opportunity to sign short-term and long-term power purchase agreements
- Solicitations for different types of RE and zero-carbon resources (short-term, medium-term, and long-term contracts)

Centralized approaches to RE/REC procurement

Power agency has major role in contracting for RE/RECs



"Centralized"

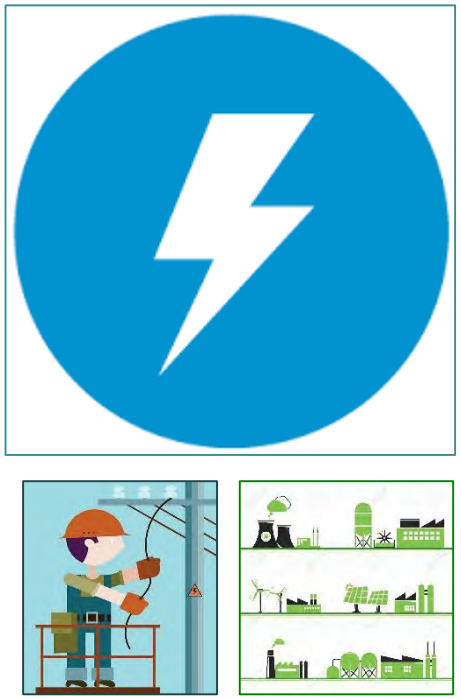
Structure:

States with full customer choice – where LSEs hold RPS obligation and where there is a centralized responsibility for procuring RE/RECs assigned to a state power agency

- **NY**
- **IL**

Centralized approaches to RE/REC procurement

Power agency has major role in contracting for RE/RECs



"Centralized"

Procurement approaches:

- **NY: ("Clean Energy Standard")**
  - **Multiple "Tiers" or types of resources**
  - **Budget approved by NY PSC**
  - **NYSERDA issues periodic RFPs and enters into long-term contracts**
  - **Paid through non-bypassable charge**
- **IL (Illinois Power Authority & RPS)**
  - **IPA issues periodic RFPs and enters into long-term contracts for IOUs**
  - **Paid through energy charges to basic service customers**

Other policies in advancing RE in states with retail competition

- Green tariffs
- Net energy metering
- Green banks
- Compensation for the value of solar (and distributed energy resources)
- Long-term contracting
- Regional power markets
- Transmission investment for RE development

Trends and impacts of RPS on RE development

New retrospective study from Lawrence Berkeley Nat'l Lab (7-2017)[1]

- Most states (including those with choice) have revised RPS policies over time (e.g., increased targets, solar carve-outs)
- States with competition/choice and RPS have tended to see RE development matched with RPS targets (except Texas has much more)
- Most states with choice meet their RPS targets with RE (not alternative compliance payments)

1. Galen Barbose, ***U.S. Renewables Portfolio Stndards: 2017 Annual Status Report***, 2017. LBNL-2001031.

Trends and impacts of RPS on RE development

Prospective study of RPS performance from LBNL (2016)[2]

- RPS drives deeper development of RE (relative to no RPS scenario)
- Non-monetized benefits include reduced air pollution, lower water withdrawals, increased jobs, lower natural gas prices
- ~1% impact on electricity prices

2. Mai, Trieu, Ryan H Wiser, Galen L Barbose, Lori Bird, Jenny Heeter, David Keyser, Venkat Krishnan, Jordan Macknick, and Dev Millstein. ***A Prospective Analysis of the Costs, Benefits, and Impacts of U.S. Renewable Portfolio Standards***. 2016. LBNL-1006962.

Thanks, and good luck!

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