



NARUC

Winter Committee Meetings

Committee On Energy Resources & the Environment



Energy Technologies Area

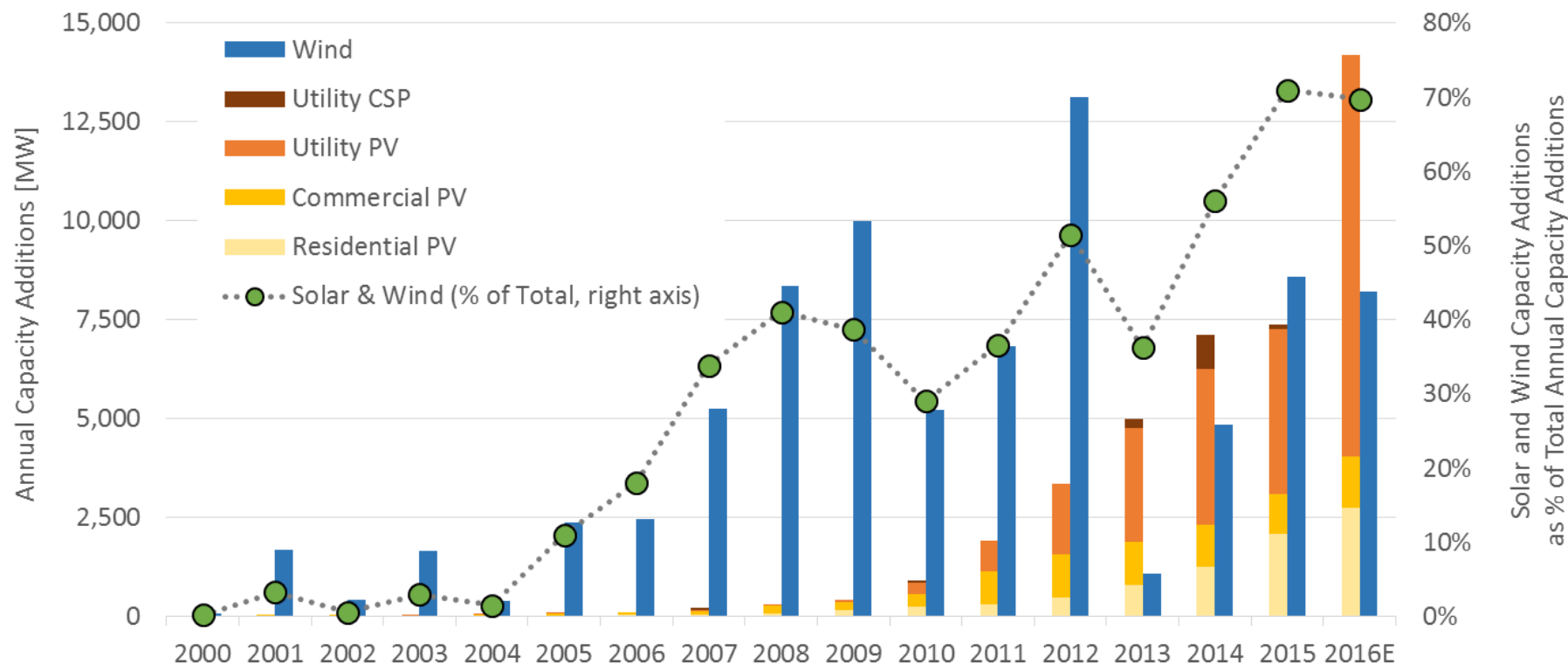
Lawrence Berkeley National Laboratory

Drivers for Renewable Energy Growth: Historical and Emerging Roles for Regulators

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NARUC Winter Meetings
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Sustained Wind Growth since 2007; Rapid Recent Growth in PV, Especially Utility & Residential; Low National Energy Penetrations



PV Capacity is given in MWdc, CSP and Wind Capacity is given in MWac

Sources: Wind: LBNL, AWEA; Solar: LBNL, GTM/SEIA

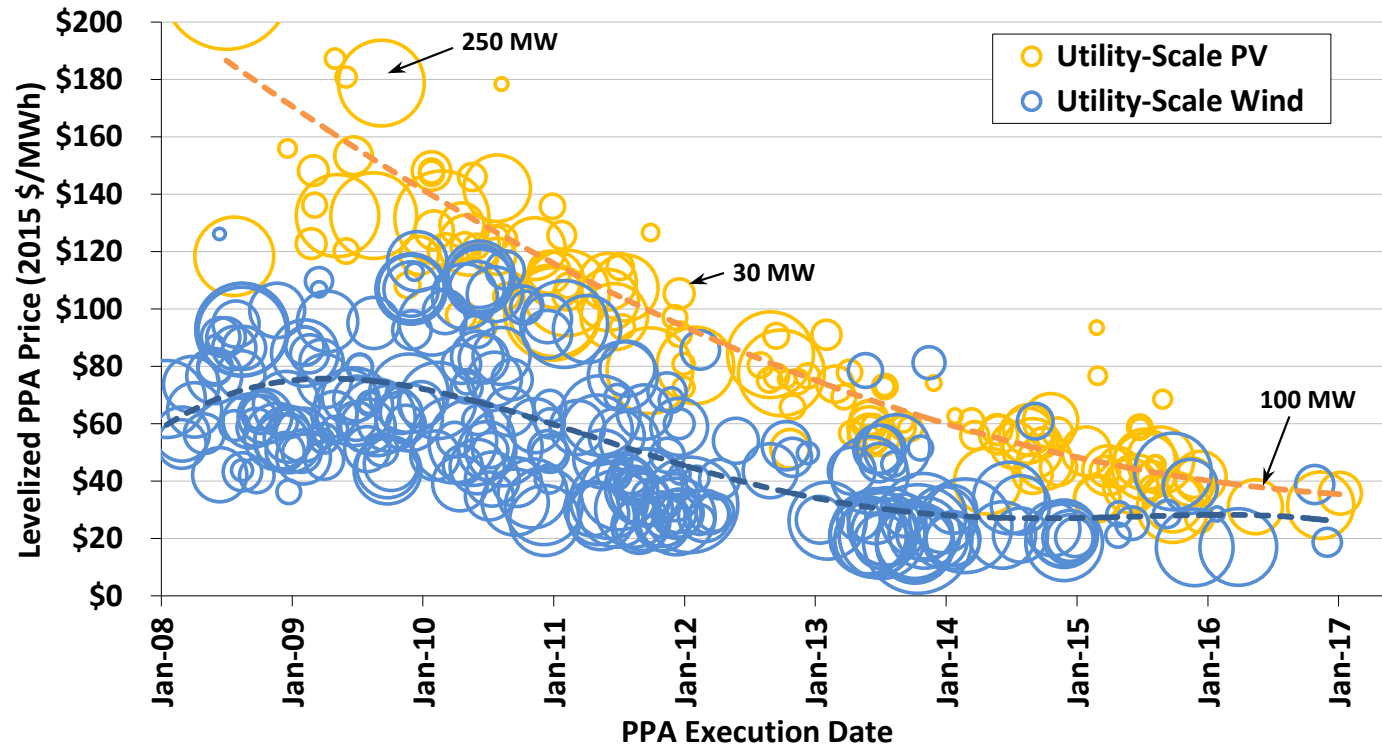
CAPACITY

- Wind: ~82 GW
- Solar: ~40 GW

PRODUCTION

- Wind: 5.5%
- Solar: 1.3%

Favorable Power Purchase Prices for Electric Utilities, Driven by Underlying Cost Reductions and by Federal Tax Incentives



Production Tax Credit

- 10 yr, 2.3 ¢/kWh; declining for projects that commence construction after 2016

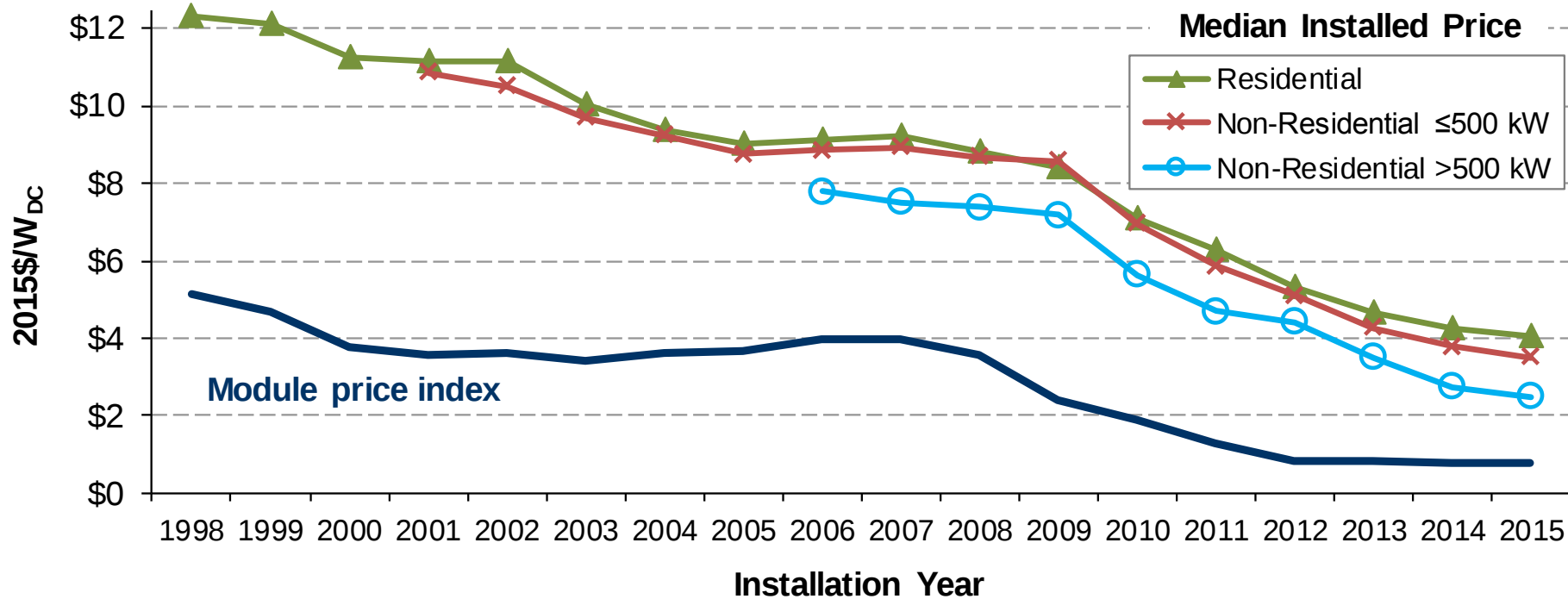
Investment Tax Credit

- 30%; declining for projects that commence construction after 2019

Accel. Tax Depreciation

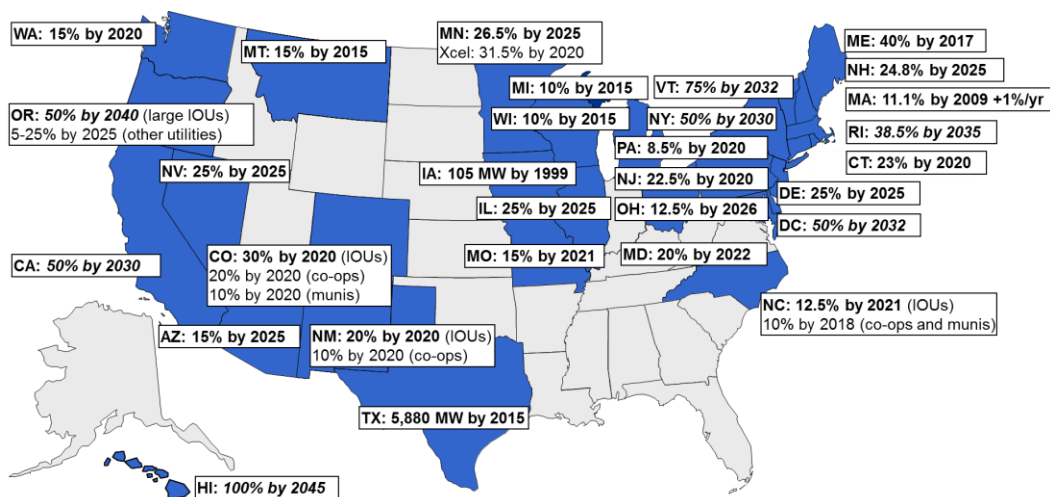
- 5-yr MACRS

Installed Prices for Distributed Solar Have Fallen Precipitously and Continue to Decline

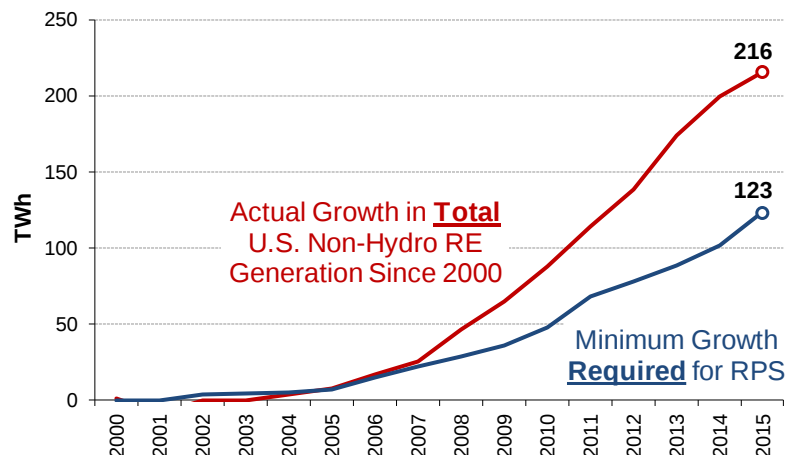


Median installed price series is based on data from 451,693 systems, assembled by Berkeley Lab. Module price index is from SPV Market Research.

RPS' Exist in 29 States & DC, w/ Multiple States Increasing Targets; Have Been and Will Likely Continue to be Sizable Driver for RE



Growth in Non-Hydro RE, 2000-2015: > 50% required by RPS policies



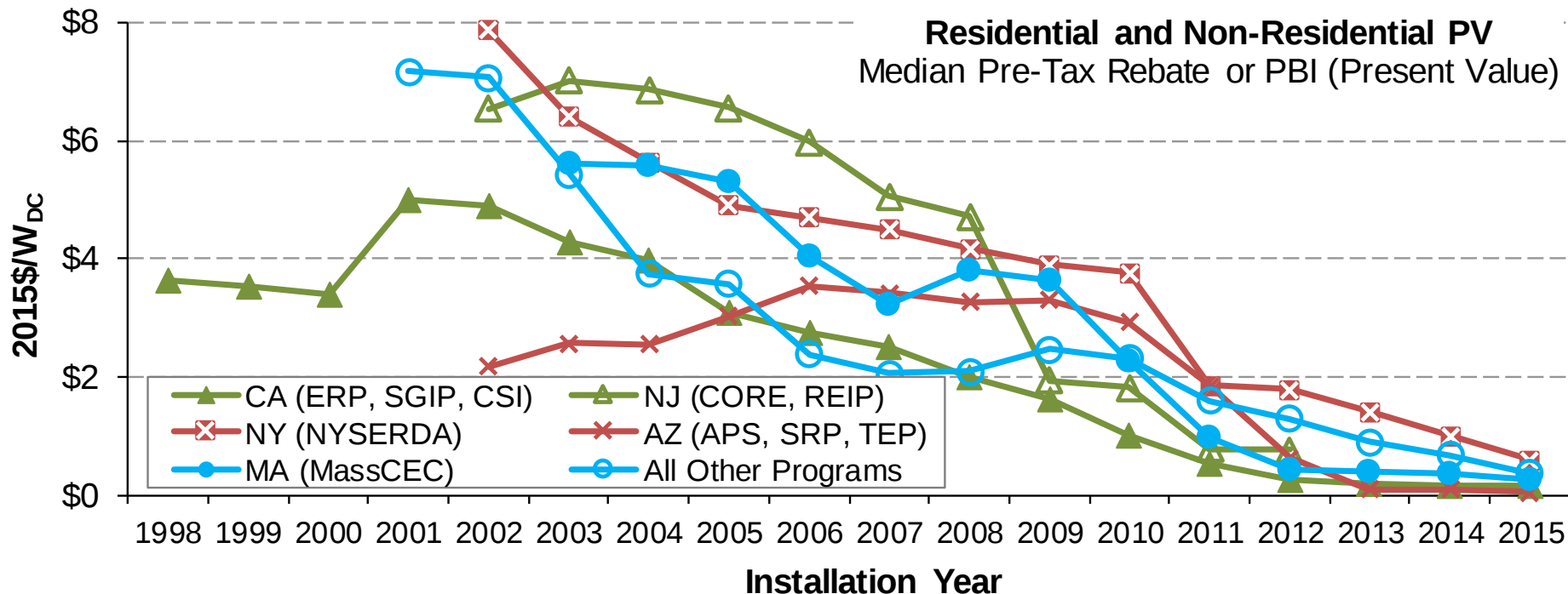
Wind is 68% of all RPS builds to-date, but solar was 62% of 2015 adds (including main tier and set-asides)

Substantial Growth in RPS Demand Remains:
Total U.S. RPS demand roughly doubles by 2030

But, as costs decline, economic drivers have emerged

State and Utility Financial and Tax Incentives Generally Declining with Time, but Are Still Common and Impactful in Many Markets

Reductions in rebates and performance based incentives

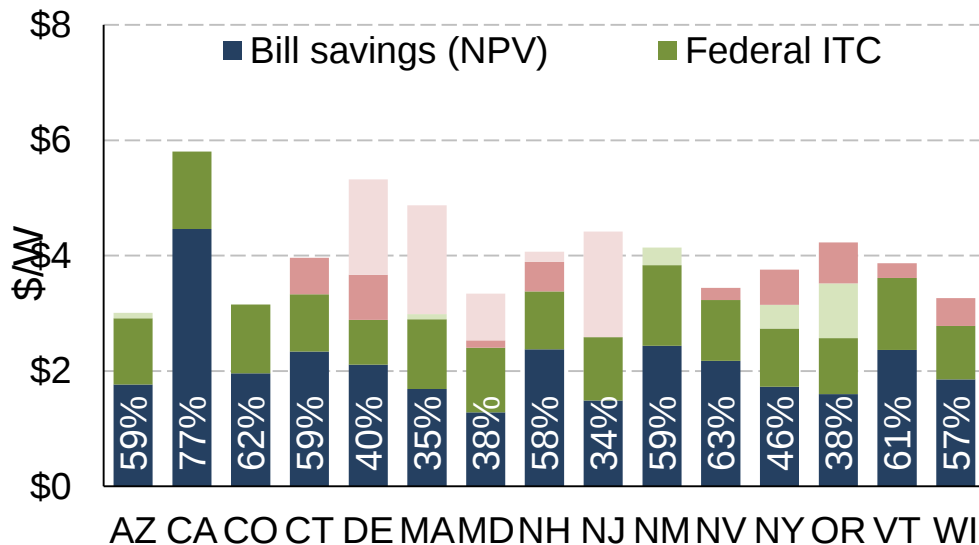


Notes: The figure depicts the pre-tax value of rebates and PBI payments (calculated on a present-value basis) provided through state/utility PV incentive programs, among only those systems that received such incentives. Although not shown in the figure, a growing portion of the sample received no direct cash incentive.

OTHER INCENTIVES: SRECs (via RPS); tax incentives; FiTs / VoS
tariffs: loans

Rate Design/Net Metering Has Been Pivotal to DG-PV Economics, and Becoming More So with the Decline of other Incentives...

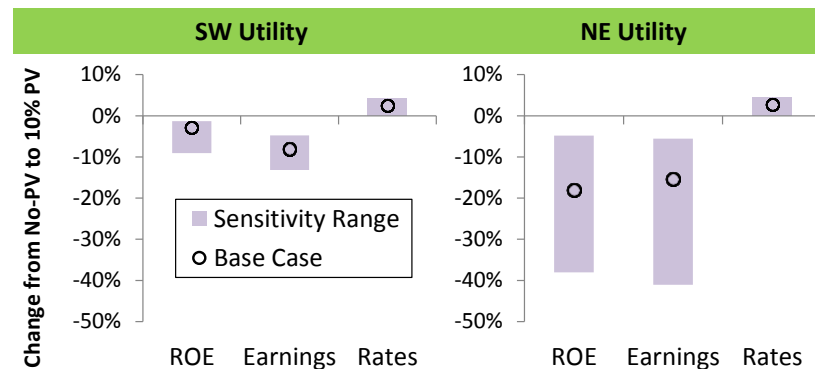
NPV of Benefit Streams for Residential PV



Notes: Based on project level data collected for Berkeley Lab's annual "Tracking the Sun" report. Bill savings calculated from EIA data for average retail electricity price by utility, with adjustments for usage tiers and other rate design details.

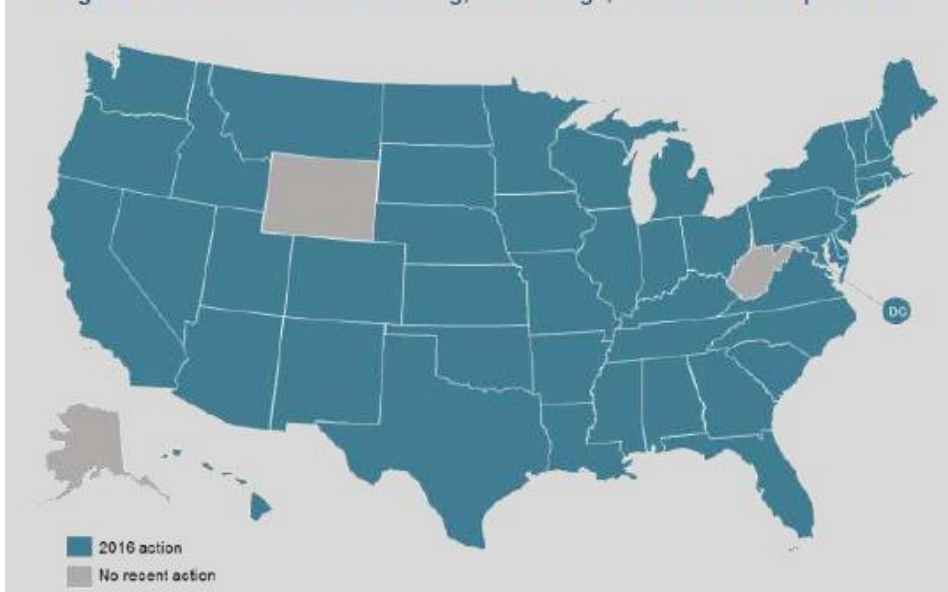
...but is also Increasingly a Source of Concern

Modeled Impact of 10% DG-PV Penetration on Utility Financial Metrics



Net Metering and Rate Reforms Have Proliferated in Varying Forms

Figure 1. 2016 Action on Net Metering, Rate Design, & Solar Ownership Policies



Source: NC Clean Energy Technology Center and Meister Consultants, 2016. "50 States of Solar: Q4 2016 Quarterly Report and Annual Review"

Rate reforms impacting distributed solar

1. Increased customer charges
2. Increased standby charges, interconnection charges
3. Minimum bills
4. Mandatory demand charges
5. Reduced compensation for grid exports
6. Two-way rates (feed-in tariff, value-of-solar tariff)
7. REC ownership transferred via NEM
8. Unbundled attribute pricing
9. Time-varying pricing
10. Locational pricing
11. Compression of inclining block rates

Other Existing Regulatory Tools Have Played a More-Modest Role; Some Likely to Decline in Importance over Time and Others Grow

PURPA QF Contracts

- Still kicking in some locations, albeit often with utility pushback to reduce attractiveness of pricing or terms of contracts
- Operating & contracted PV in early 2016: NC (~2700 MW), UT (~700 MW), ID (~500 MW), OR (~200 MW,) SC (~200 MW)

Utility Resource Planning for Utility-Scale Renewables

- ...and, increasingly, DG renewables as well

Utility Ownership of Utility-Scale Renewable Energy

- Utility-Scale Solar: Florida Power & Light, Georgia Power, Dominion, Duke, PNM, etc.
- Wind: MidAmerican, PacifiCorp, ALLETE, Puget Sound Energy, Portland General, Xcel, etc.

Transmission Investment to Enable Remote Resources

- Planning, approval, and cost allocation for new transmission infrastructure
- Examples: CREZ in ERCOT; Tehachapi, Sunrise and RETI in CA; Clean Line projects; Cap-X; MISO Multi-Value; SPP, etc.

Distribution Infrastructure and Retail Ratemaking

- Interconnection rules, procedures, technical requirements
- Decoupling utility revenue from sales, and rate-making practices (frequency, lag, multi-year, etc.)

Carbon Cap-and-Trade or Other GHG Policy

- Carbon prices low, but provide signaling mechanism at a minimum: RGGI, California
- Utility integrated resource planning treatment of carbon regulatory risk

Emerging Regulatory Tools Becoming More Salient as Renewable Energy Penetrations Rise and “Issues” Arise

Expand the Market for Renewable Energy

- **Low-income solar programs:** e.g., CA, CT, DC, IL, NY, OR, MA, more and growing
- **Community & shared solar:** MN, CO, and many more
- **Green pricing / direct access;** expanding to include utility facilitation of **corporate synthetic PPAs** and other RE purchase structures
- **Comm. Choice Aggregation:** CA, IL, MA, NJ, NY, OH, RI

Address Integration Concerns

- **Market design & operations:** bulk power and (increasingly) DER, every ISO, many utilities
- **Storage (behind & in-front of the meter) and EV policy:** e.g., CA, MA, OR
- **Demand response:** re-envisioning DR for high RE penetrations, e.g. CA)

Aligning Utility Interests w/ DER

- **Utility dist. system planning, non-wires alternatives:** e.g., HI, NY, CA, MA, RI, VT
- **Hosting capacity/net benefits analysis:** e.g., MN, CA, NY
- **Utility ownership of DG solar assets:** e.g., AZ
- **Utility shareholder PBR / incentives to encourage DER:** e.g., consideration in NY, CA
- **Utilities as DER operating platforms:** e.g., NY

Thank you!

Contact information

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More information from LBNL's Electricity Markets & Policy Group

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