



Energy Technologies Area

Lawrence Berkeley National Laboratory

Renewables Portfolio Standards

Supporting U.S. renewable energy growth

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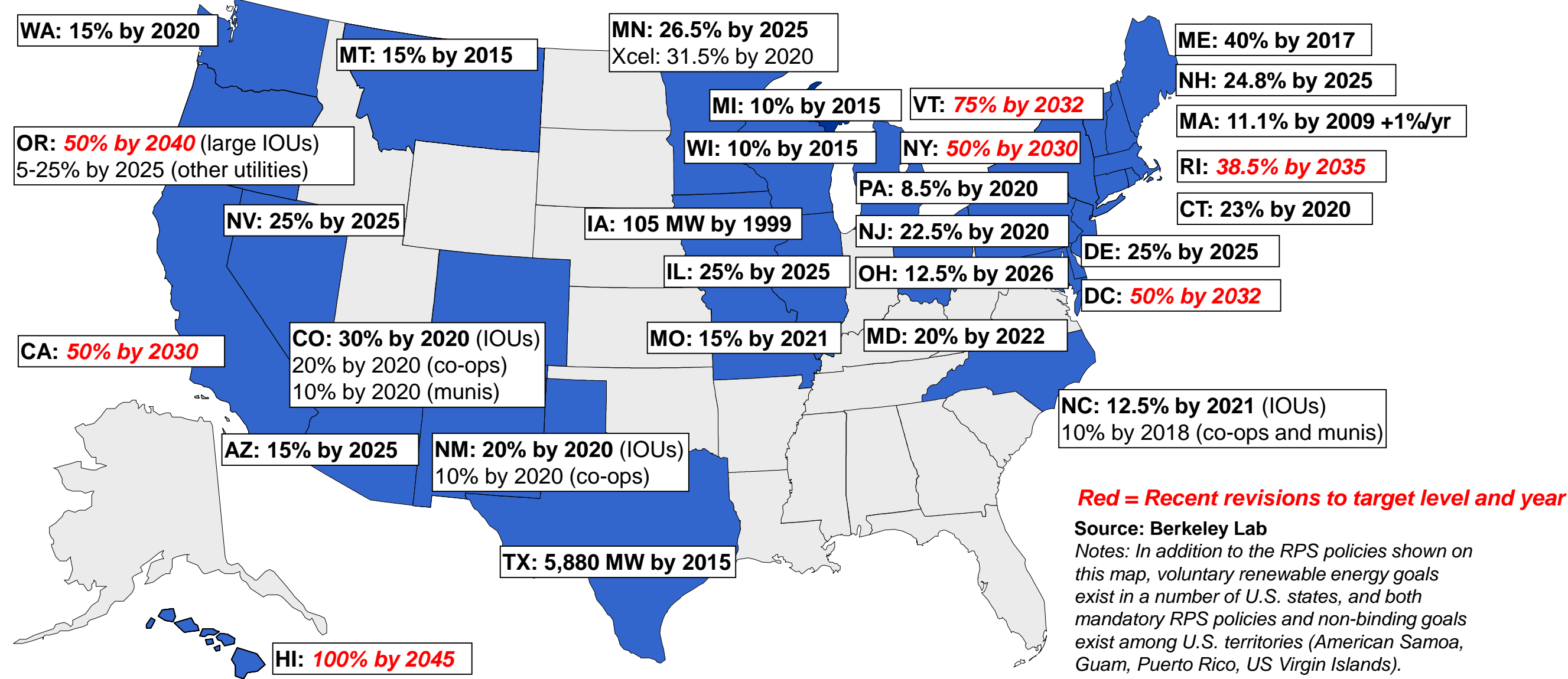
Renewable Energy Markets 2016

San Francisco, CA

October 18, 2016

RPS Policies Exist in 29 States and DC

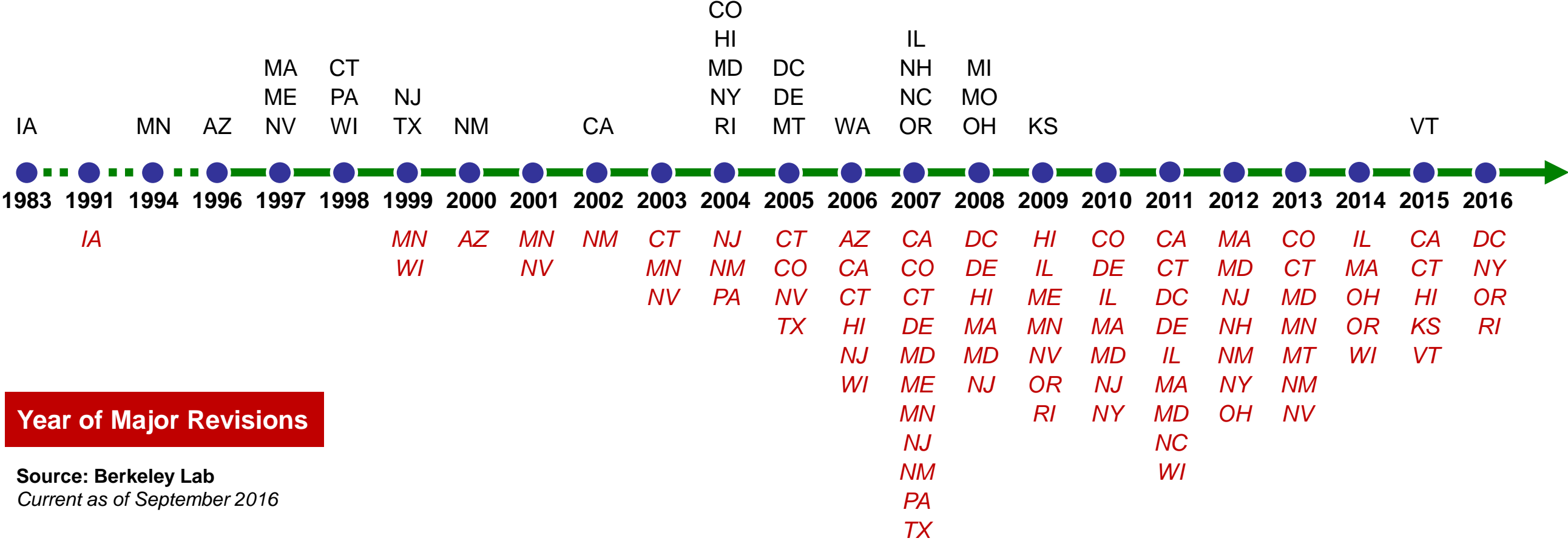
Apply to 56% of Total U.S. Retail Electricity Sales



Most RPS Policies Have Been in Place for at Least 10 Years

States continue to make regular and significant revisions

Year of RPS Enactment



Year of Major Revisions

Source: Berkeley Lab
Current as of September 2016

RPS Legislation and Other Revisions in 2016

Most proposals sought to strengthen existing RPS' or make small technical changes

RPS-Related Bills Introduced and Enacted in 2016

	Strengthen	Weaken	Neutral	Total
Introduced	37	9	32	78
Enacted	3	0	2	5

Data Source: EQ Research

Notes: Includes legislation from 2016 sessions and from 2015-2016 sessions active in 2016, as well as pre-filed legislation for 2017. Companion bills in both chambers are counted as a single bill.

Contrasts to previous years with more prevalent efforts to repeal or weaken RPS requirements

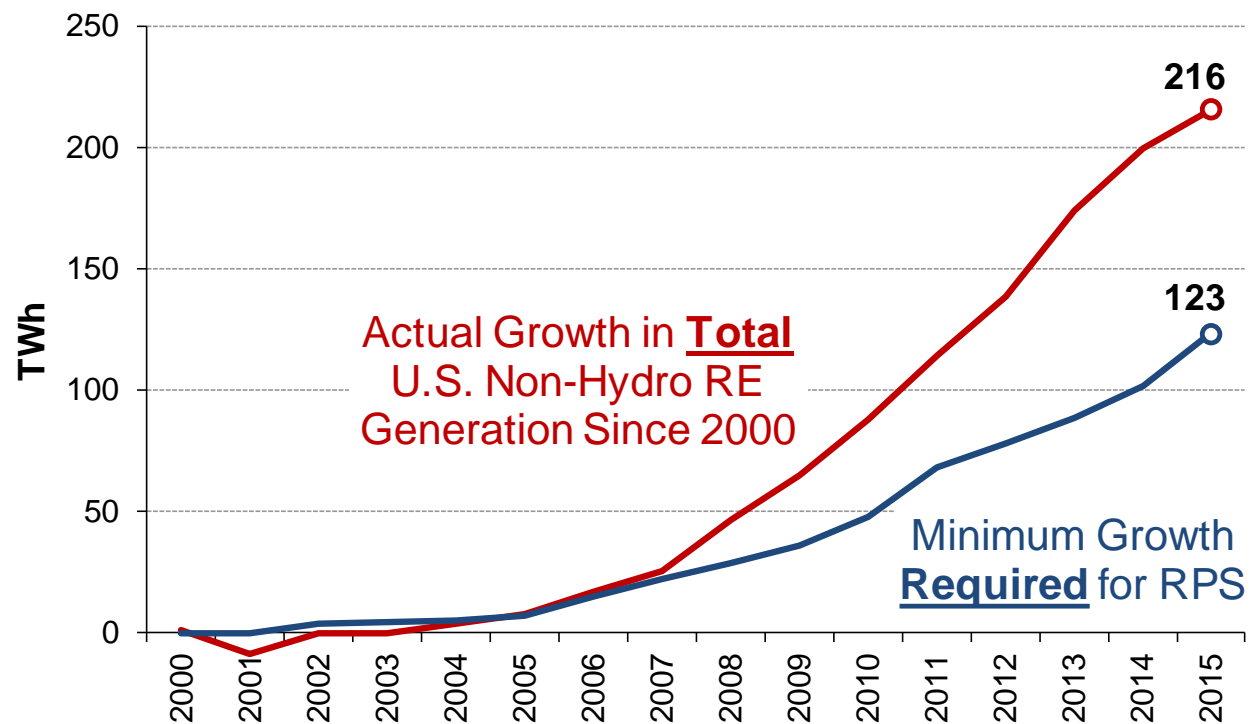
Significant RPS revisions in 2016 (legislative and administrative):

- **DC:** Increased and extended RPS to 50% by 2032
- **NY:** Increased and extended RPS to 50% by 2030, and expanded coverage statewide
- **OR:** Increased and extended RPS to 50% by 2040 for large IOUs
- **RI:** Increased and extended RPS to 38.5% by 2035

RPS Policies a Key Driver for RE Generation Growth

>50% of total growth in U.S. RE generation required by RPS

Growth in U.S. Non-Hydro Renewable Generation: 2000-2015



Notes: Minimum Growth Required for RPS excludes contributions to RPS compliance from pre-2000 vintage facilities, and from hydro, municipal solid waste, and non-RE technologies. This comparison focuses on non-hydro RE, because RPS rules typically allow only limited forms hydro for compliance.

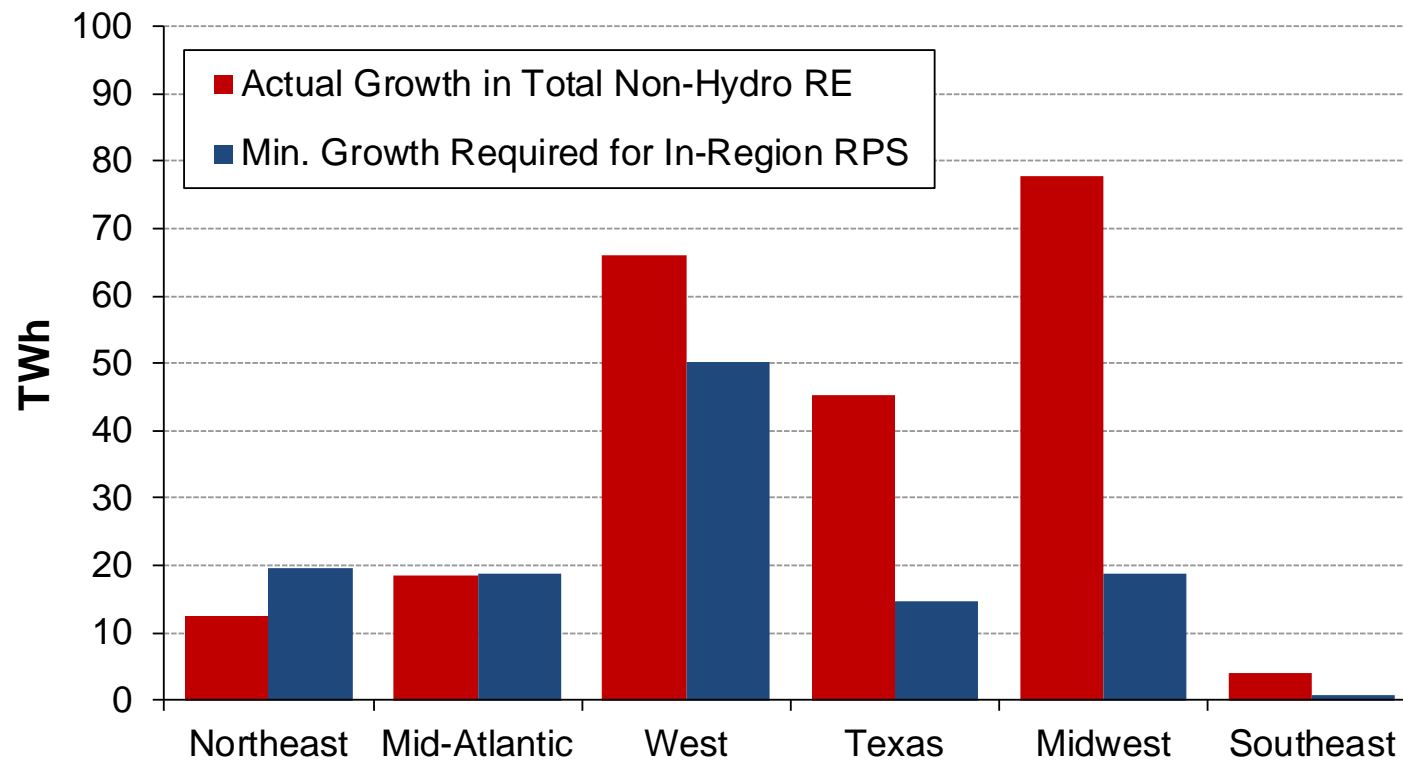
Many factors have contributed to RE growth, but RPS provides a floor

- Total non-hydro RE generation in the U.S. grew by 216 TWh from 2000-2015
- RPS policies required 123 TWh increase over that period (57% of total growth)
 - Not strict attribution: some of that would have occurred without RPS
- Additional RE growth associated with:
 - Voluntary green power markets
 - Economic purchases
 - Accelerated RPS procurement

Role of RPS in Driving RE Growth Varies Regionally

Seemingly most critical in the Northeast, Mid-Atlantic, West

Growth in Non-Hydro Renewable Generation: 2000-2015

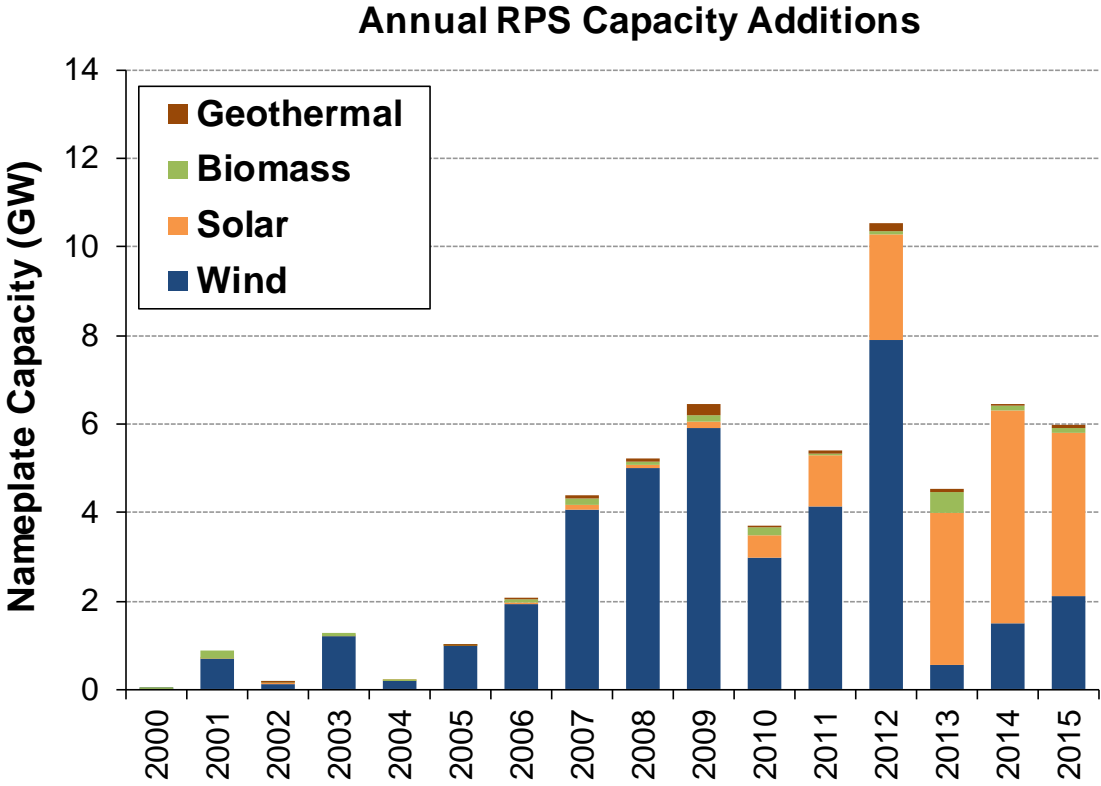


Notes: Northeast consists of New England states plus New York. Actual growth shown for that region is estimated based on new RE capacity that meets the vintage requirements for RPS eligibility. Mid-Atlantic consists of states that are primarily within PJM (in terms of load served).

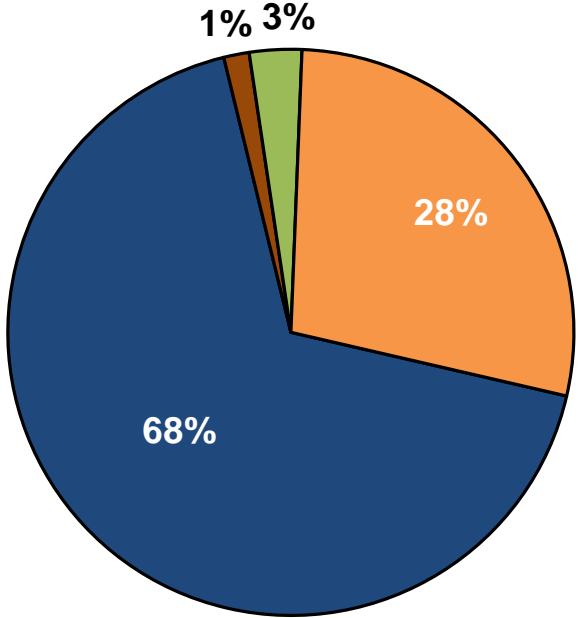
- In the Northeast, Mid-Atlantic, West:
 - Actual RE growth closely matches RPS needs
 - Northeast and Mid-Atlantic rely, to some degree, on RECs from neighboring regions to meet compliance obligations
- In Texas and the Midwest:
 - Actual RE growth far outpaced RPS needs, given favorable wind energy capacity factors/economics in those regions
- Southeast
 - Minimal RE growth or RPS demand, with just a single RPS state (North Carolina)

Wind Was Historically the Dominant New-Build for RPS, But Solar Has Come to the Fore

RPS Capacity Additions by Technology Type



Cumulative RPS Capacity Additions



Wind is 68% of all RPS builds to-date, but solar was 62% of 2015 adds

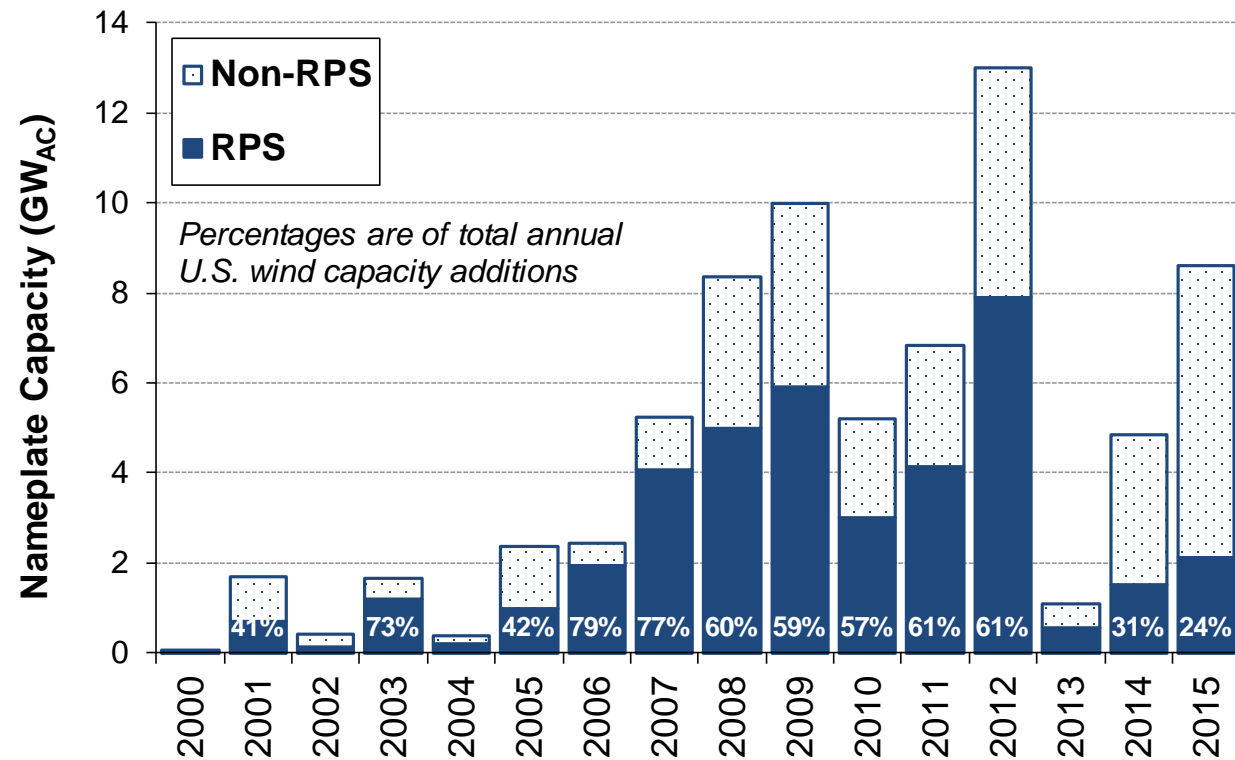
- Growing role of solar for RPS reflects:
 - Ramping up of solar carve-out requirements
 - Increasing cost-competitiveness of utility-scale solar vis-à-vis wind
- Wind capacity growth still strong, but recent additions primarily not for RPS

Notes: "RPS Capacity Additions" represent RE capacity contracted to entities subject to an RPS or sold on a merchant basis into regional RPS markets (see Supplementary Notes). On an energy (as opposed to capacity) basis, wind represents approximately 75%, solar 16%, biomass 5%, and geothermal 4% of RPS-related renewable energy growth.

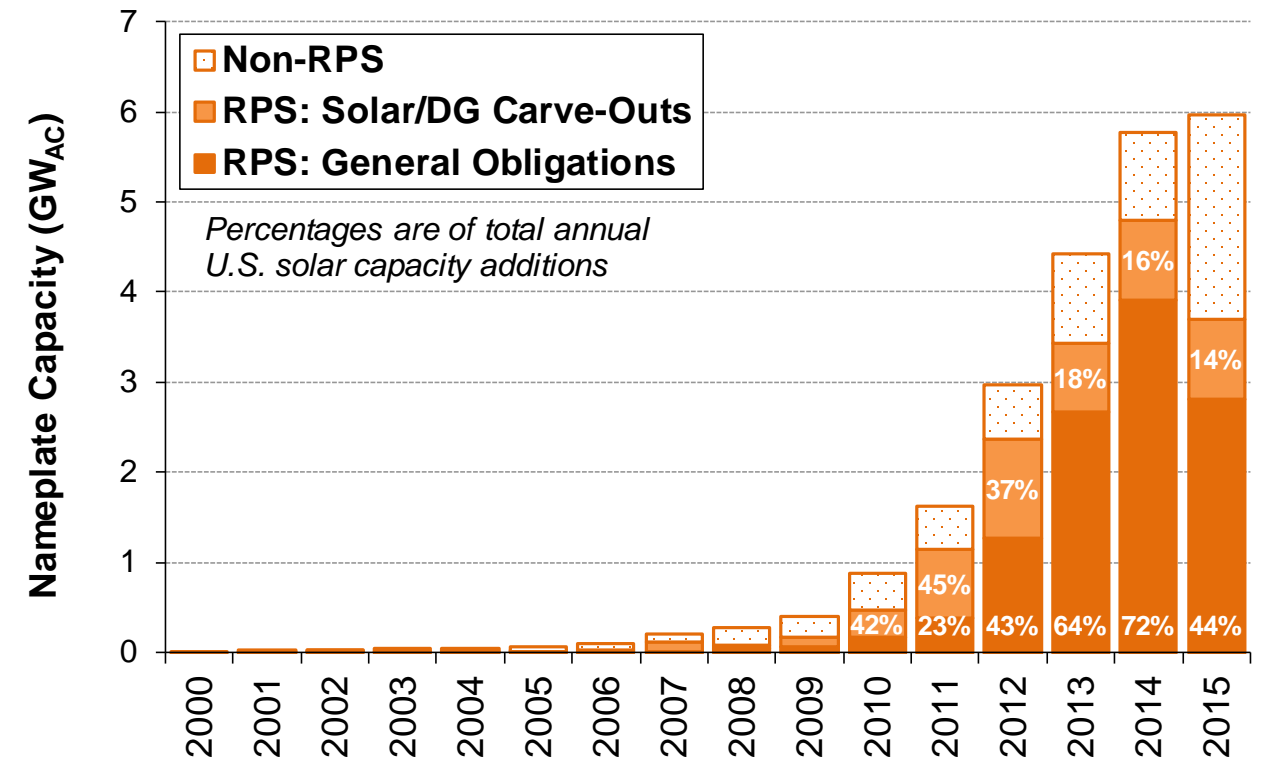
Wind Additions Built Primarily Outside of RPS Requirements, While Solar is More-Concentrated in RPS States

In 2015, **24%** of all wind additions were dedicated to RPS demand, compared to **58%** for solar (44% for general RPS obligations + 14% for carve-outs)

Wind Capacity Additions



Solar Capacity Additions



States Are Starting to Approach Final Target Years

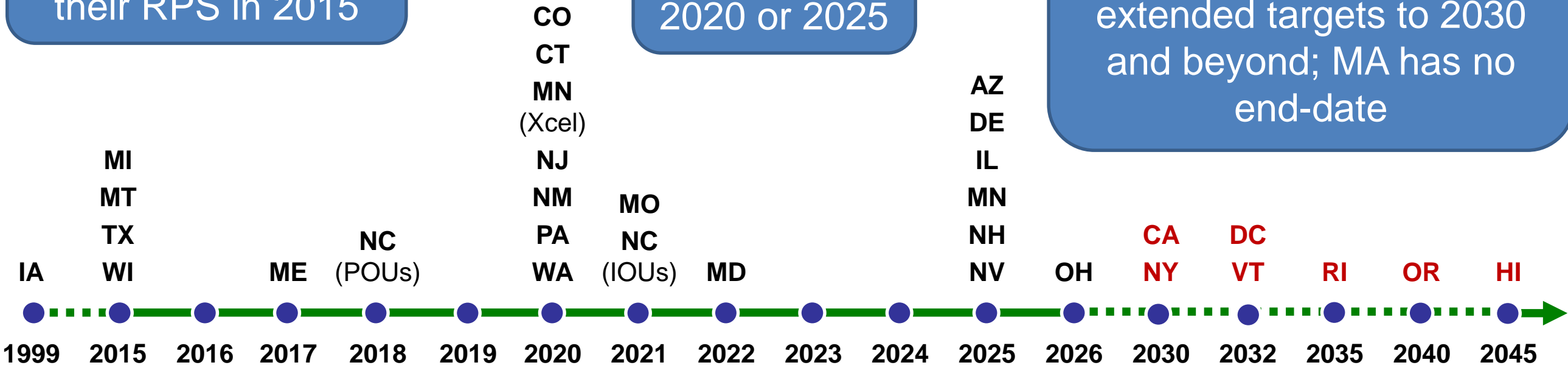
Though most still have 5-10 years

Year of Final RPS Target

Four states reached the terminal year of their RPS in 2015

Most others will do so in 2020 or 2025

Recent revisions in CA, DC, HI, NY, OR, RI, VT extended targets to 2030 and beyond; MA has no end-date



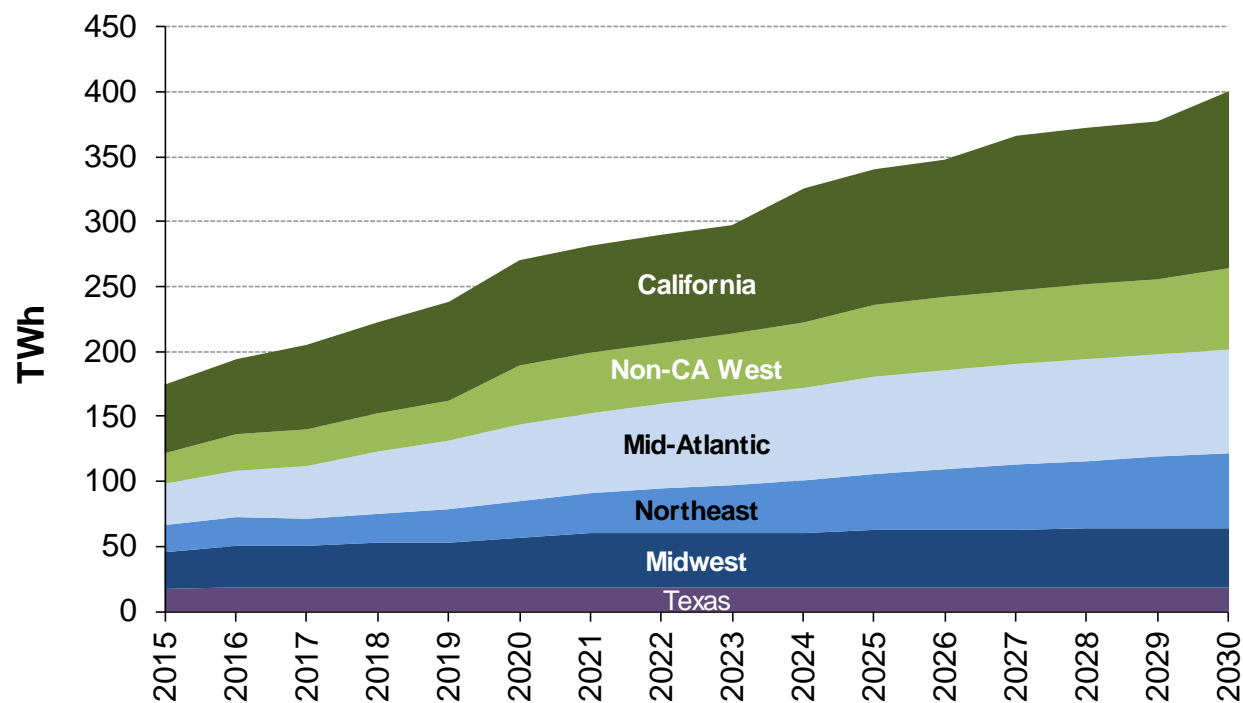
RPS needs will continue to grow after final targets, due to load growth and RE retirements

Substantial Growth in RPS Demand Remains

Total U.S. RPS demand roughly doubles by 2030

Projected RPS Demand (TWh)

Excluding hydro, MSW, and non-RE



Notes: Projected RPS demand is estimated based on current targets, accounting for exempt load, likely use of credit multipliers, offsets, and other state-specific provisions. Likely contributions by hydro, municipal solid waste (MSW), and non-RE technologies are deducted from the totals for consistency across states. Underlying retail electricity sales forecasts are based on regional growth rates from the most-recent EIA Annual Energy Outlook reference case.

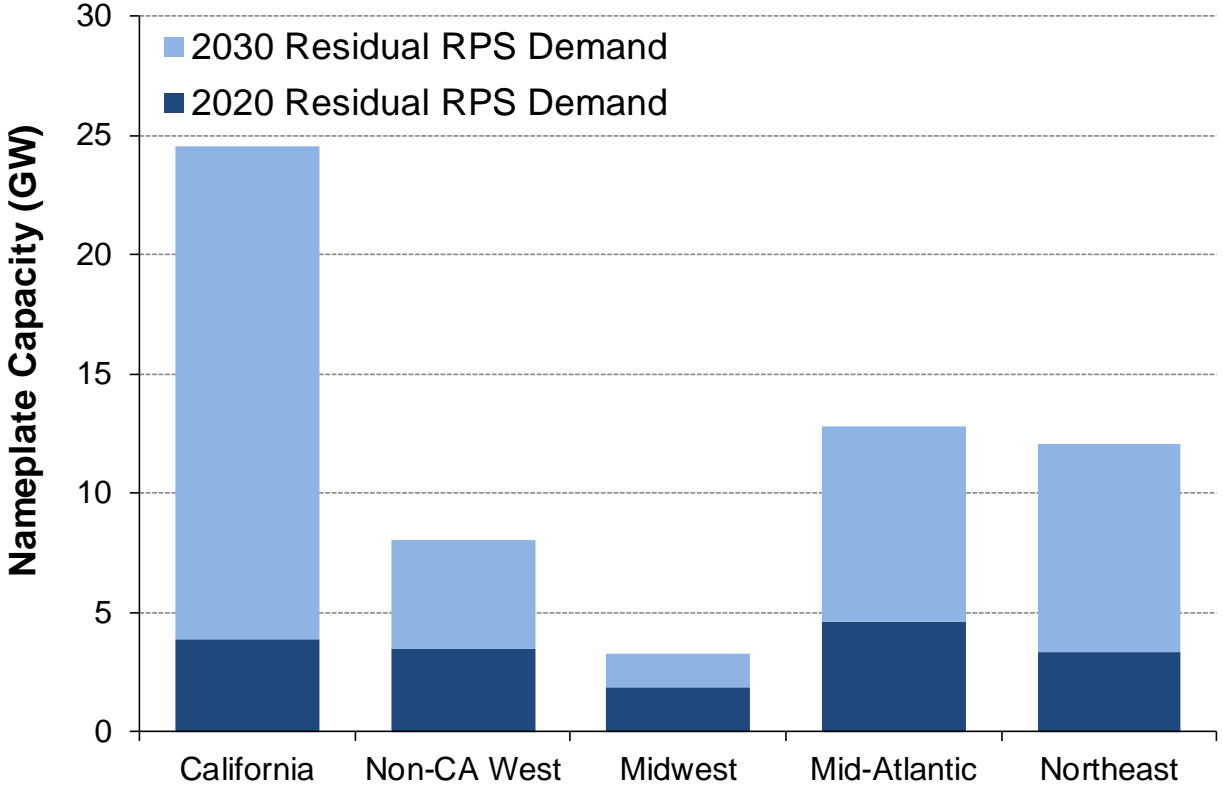
- Under current targets, total RPS demand increases from 200 TWh in 2016 to 400 TWh in 2030
 - Latest RPS revisions in CA and NY added >70 TWh in 2030
- However, increased demand does not equate to required increase in supply:
 - Some utilities and regions are ahead of schedule, while others are behind
 - Full compliance may or may not be achieved

State-level RPS demand projections available for download at: rps.lbl.gov

RE Capacity Needed for RPS Demand Growth

61 GW of additional RE capacity needed by 2030, 17 GW by 2020

Residual RPS Demand Relative to “Available RPS Supply”



Notes: Residual RPS demand is computed on a regional basis for NEPOOL and PJM states, but otherwise estimated for each state individually, and then aggregated to the regions shown here. No residual RPS demand for Texas or the Southeast.

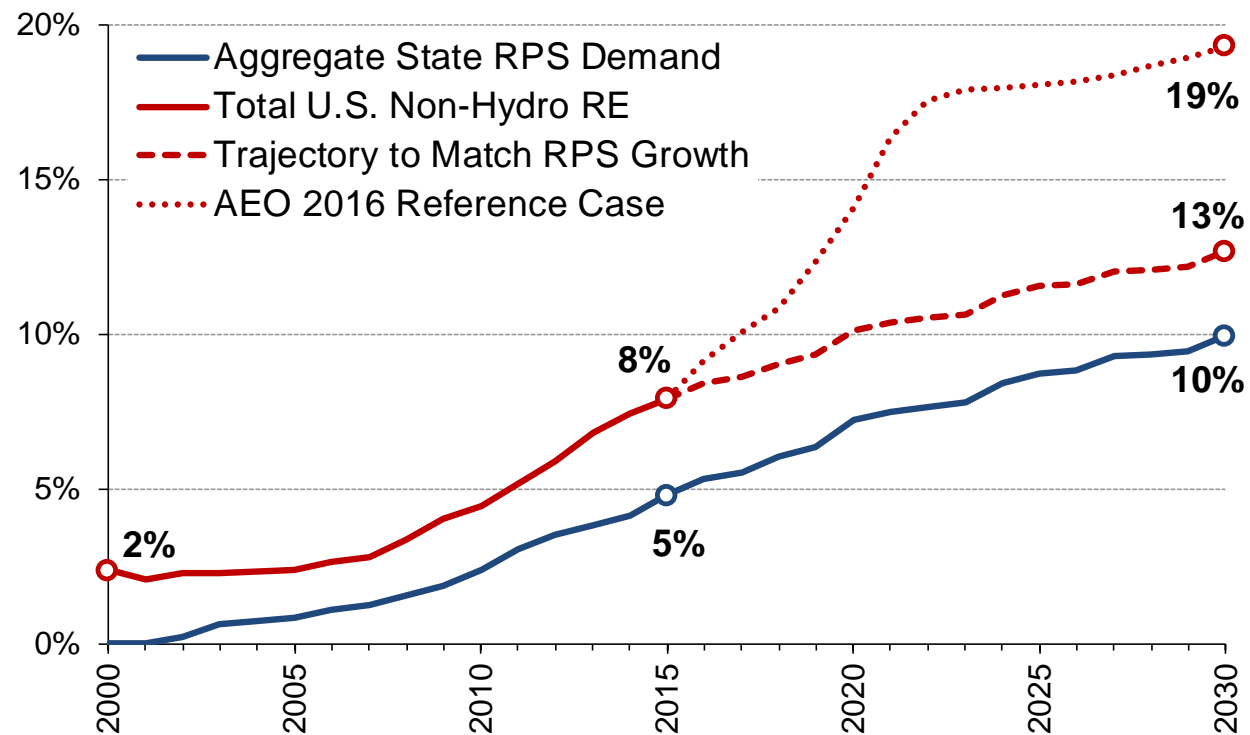
- Represents roughly a doubling of total RPS-builds through 2015 (58 GW)
- Some of the near-term residual need may be met with RE capacity under development
- Near-term needs distributed somewhat evenly across regions; long-term concentrated in California
- Residual demand in Mid-Atlantic and Northeast could be lower, depending on availability of imports from Midwest/Canada

“Available RPS supply”: For most regions, based on projects under contract to retail suppliers with RPS obligations or sold on merchant basis into RTO markets. For Mid-Atlantic, derived from tracking system data on REC generation and eligibility.

U.S. RE Generation Likely to Increase Well Beyond RPS Needs

Would reach 19% of retail sales by 2030 under latest EIA reference case

Projected RPS Demand vs. RE Supply (% of Retail Electricity Sales)



Notes: State RPS demand is based on current targets, accounting for exempt load, likely use of credit multipliers, offsets, and other state-specific provisions. Likely contributions by hydro, MSW, and non-RE technologies are deducted from the totals for consistency across states. Underlying retail electricity sales are based on the EIA Annual Energy Outlook reference case growth rates for each region.

- Total RPS demand rises to 10% of U.S. retail electricity sales in 2030
- To keep pace with RPS demand growth, U.S. RE supply would need to reach 13% of retail sales
- Much greater RE growth is projected
 - AEO 2016 projects 19% RE by 2030
 - Rapid growth prior to expiration of ITC/PTC
 - RPS and CPP sustain growth afterwards
- RPS policies provide a floor, equal to roughly half of all projected growth

The Future Role of State RPS Programs in Supporting RE Growth Will Depend On...

Internal Factors

- ➔ Whether more states extend RPS targets as they approach final year
- ➔ RPS compliance costs and ACPs/cost caps
- ➔ Legislative and legal challenges to state RPS programs
- ➔ Ongoing RPS refinements—e.g., eligibility rules, long-term contracting, carve-outs

External Factors

- ➔ Clean Power Plan legal challenges, compliance plans, implementation
- ➔ The many related issues affecting RE deployment (integration, siting, net metering, etc.)

For Further Information

RPS reports, presentations, data files, resources

rps.lbl.gov



All renewable energy publications

emp.lbl.gov/reports/re

Follow the Electricity Markets & Policy Group on Twitter @BerkeleyLabEMP

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