Environmental Energy Technologies Division Lawrence Berkeley National Laboratory

Renewables Portfolio Standards in the United States: A Status Update

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State-Federal RPS Collaborative
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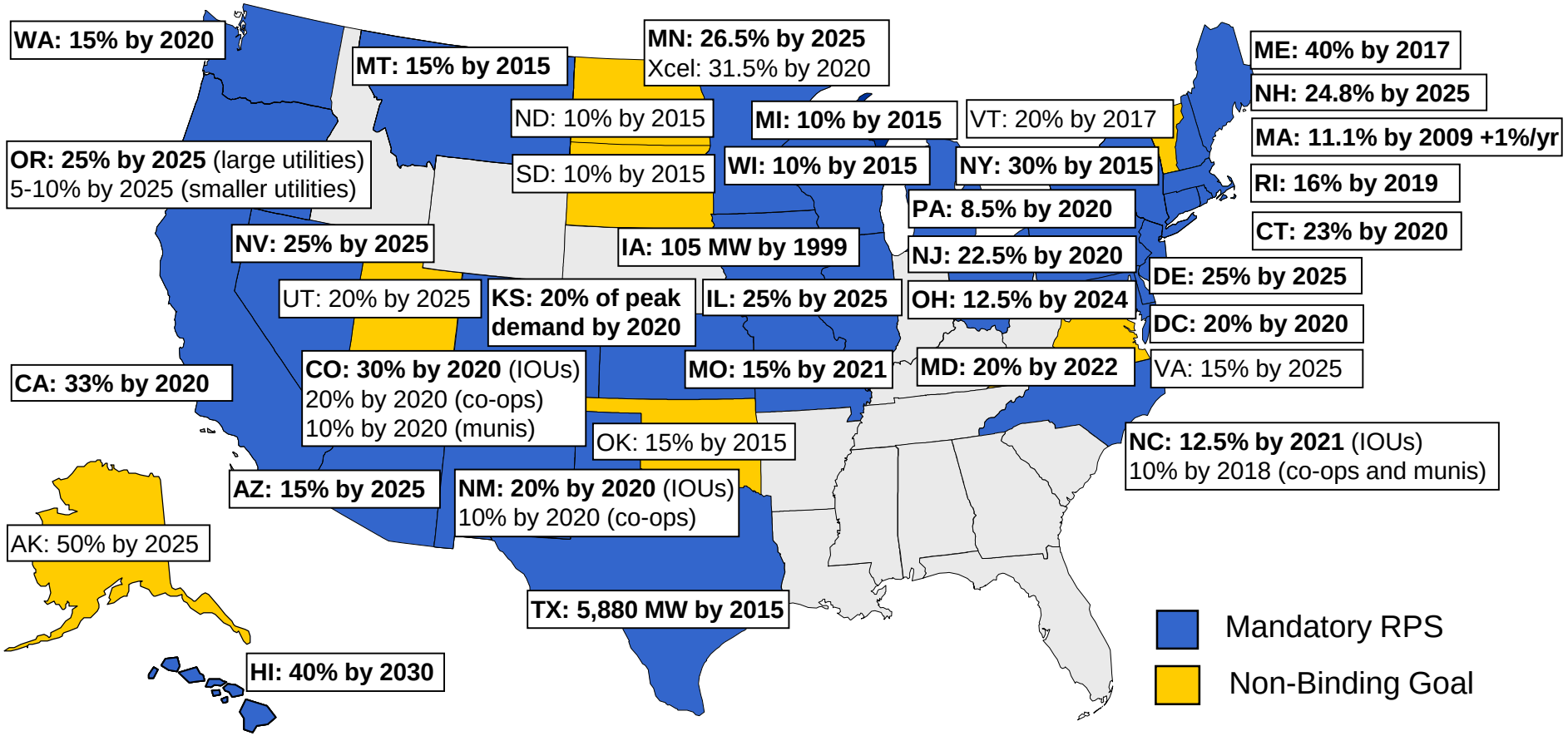
Outline

- **RPS policy landscape**
- Impacts on RE development
- Future RPS demand
- Compliance
- Costs
- A note on two upcoming RPS projects

RPS Policies Exist in 29 States and DC

7 More States Have Non-Binding Goals

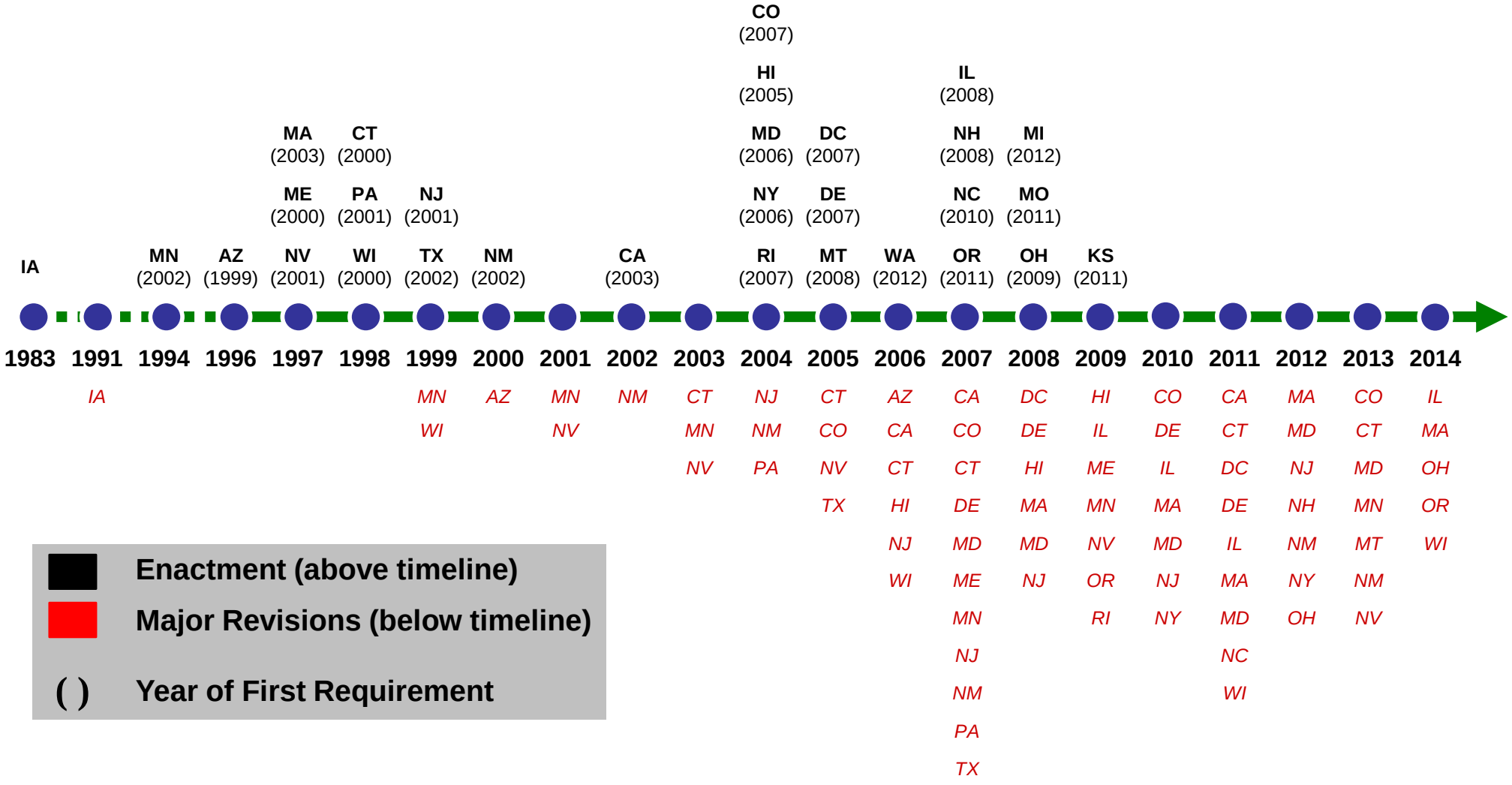
Existing State RPS Policies Apply to 56% of Total U.S. Retail Electricity Sales in 2013



Source: Berkeley Lab

Notes: Compliance years are designated by the calendar year in which they begin. Mandatory standards or non-binding goals also exist in US territories (American Samoa, Guam, Puerto Rico, US Virgin Islands)

Enactment of New RPS Policies Has Waned, but States Continue to Hone Existing Policies



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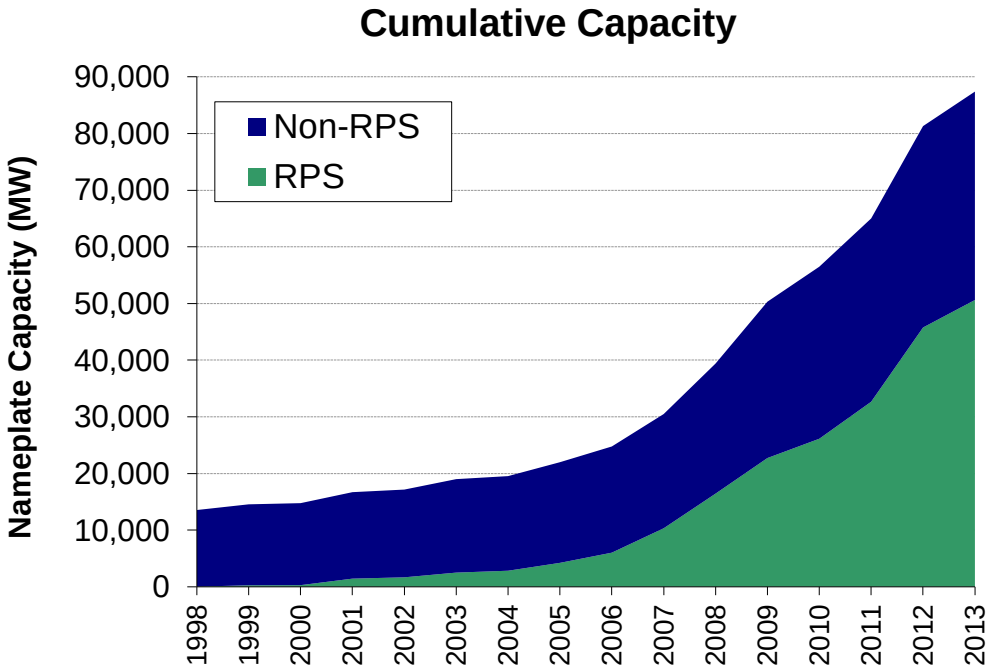
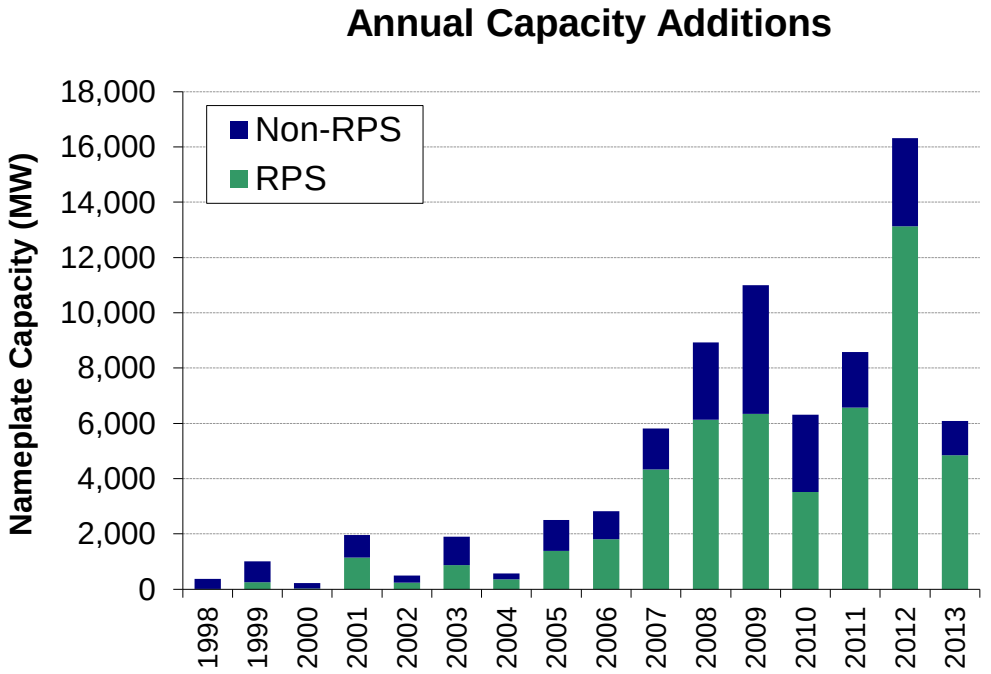
State RPS Policies Appear to Have Motivated Substantial Renewable Capacity Development

Cumulative and Annual Non-Hydro Renewable Energy Capacity in RPS and Non-RPS States, Nationally





Though not an ideal metric for RPS-impact, **68%** (**51 GW**) of all non-hydro renewable capacity additions from 1998-2013 occurred in states with active/impending RPS compliance obligations

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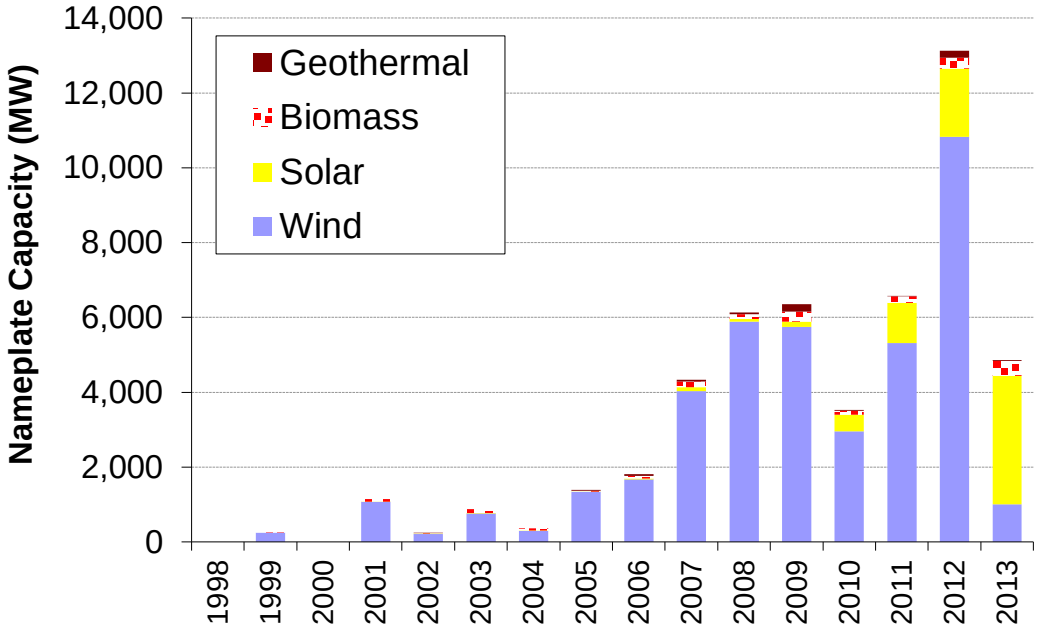
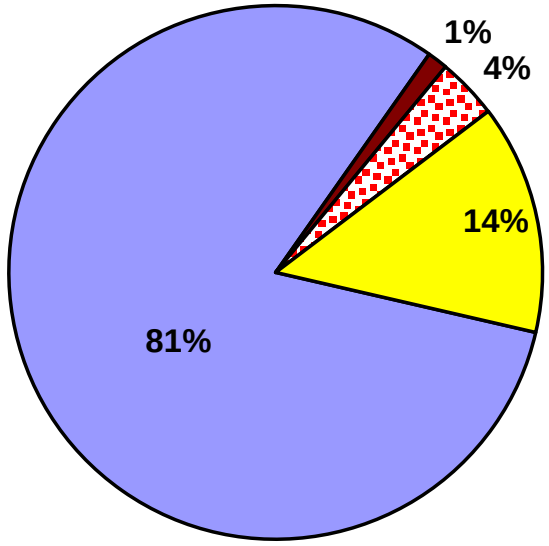
State RPS' Have Largely Supported Wind, Though Solar Has Become More Prominent

RPS-Related* Renewable Energy Capacity Additions from 1998-2013, by Technology Type

Annual RPS Capacity Additions



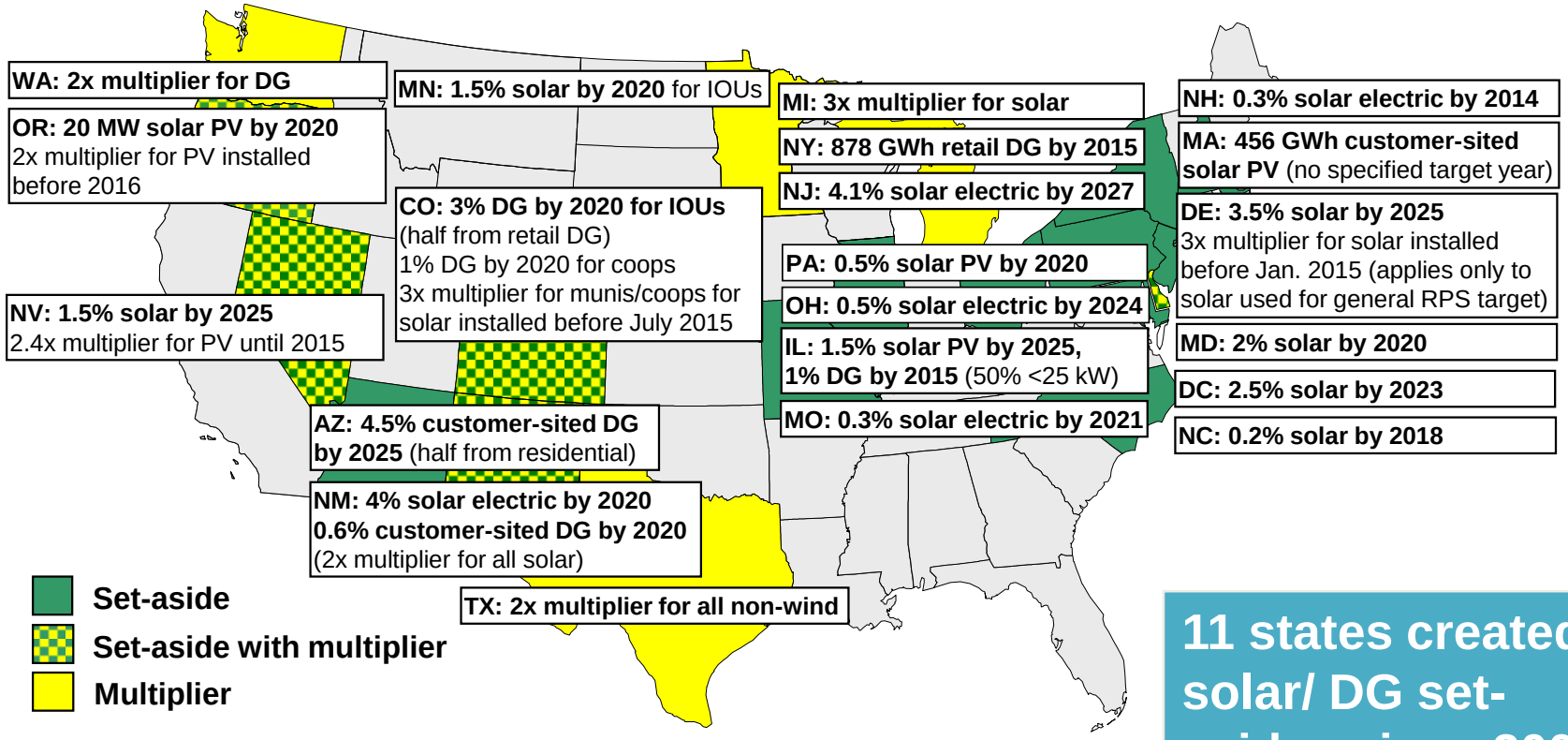
Cumulative RPS Capacity Additions (1998-2013)



** Renewable additions are counted as "RPS-related" if and only if they are located in a state with an RPS policy and commercial operation began no more than one year before the first year of RPS compliance obligations in that state. On an energy (as opposed to capacity) basis, wind energy represents approximately 80%, biomass 9%, solar 7%, and geothermal 3% of cumulative RPS-motivated renewable energy additions from 1998-2013, if estimated based on assumed capacity factors.*

Solar and DG Set-Asides Have Proliferated

17 states + D.C. have solar or DG set-asides, sometimes combined with credit multipliers; 3 other states only have credit multipliers



Source: Berkeley Lab

Note: Compliance years are designated by the calendar year in which they begin

Differential support for solar/DG also provided via long-term contracting programs (CT, DE, NJ, RI) and via up-front incentives/SREC payments

11 states created solar/ DG set-asides since 2007:
DE, IL, MA, MD, MO, MN, NC, NH, NM, OH, OR

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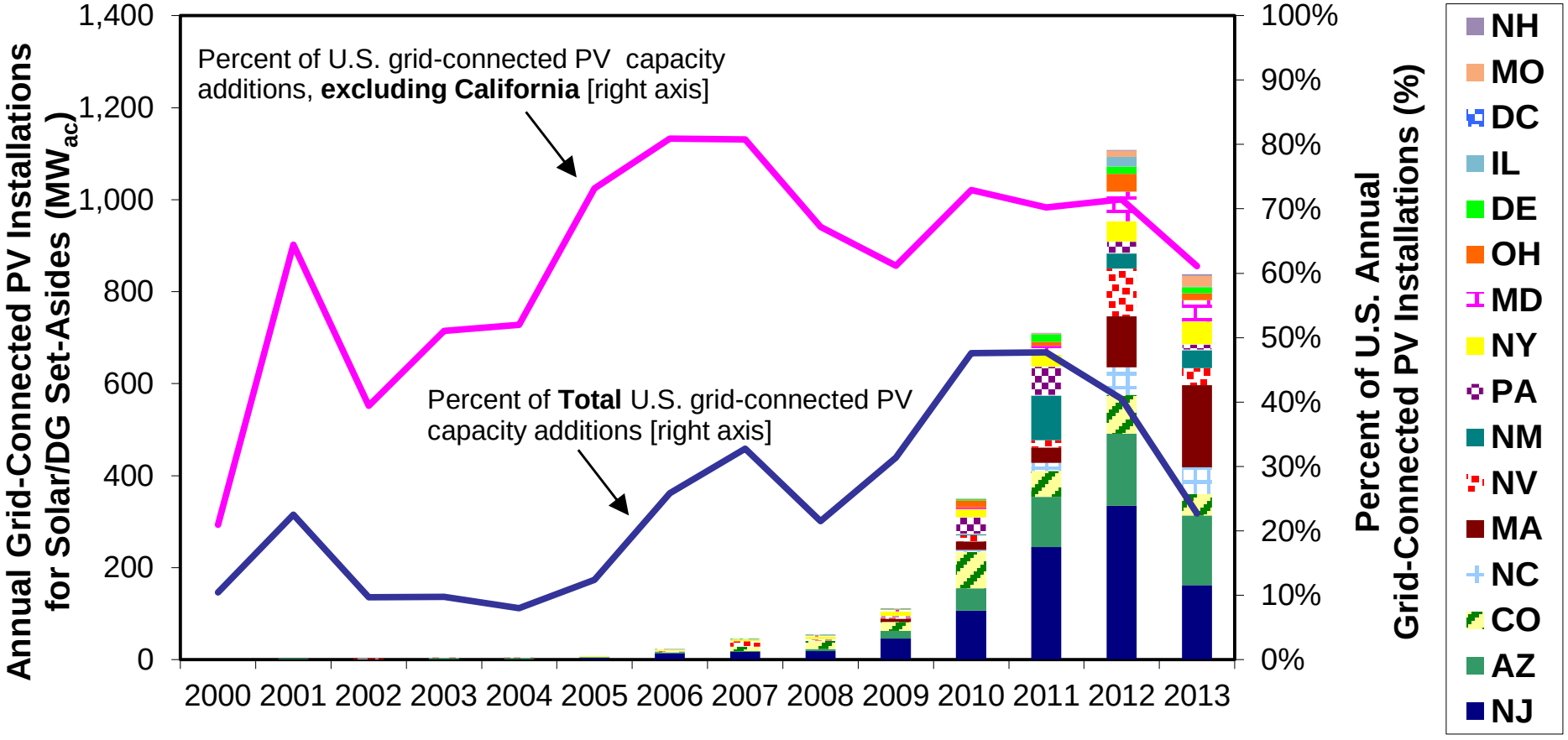
Impact of Solar/DG Set-Asides is Substantial:
60-80% of Non-CA PV Additions Since 2005

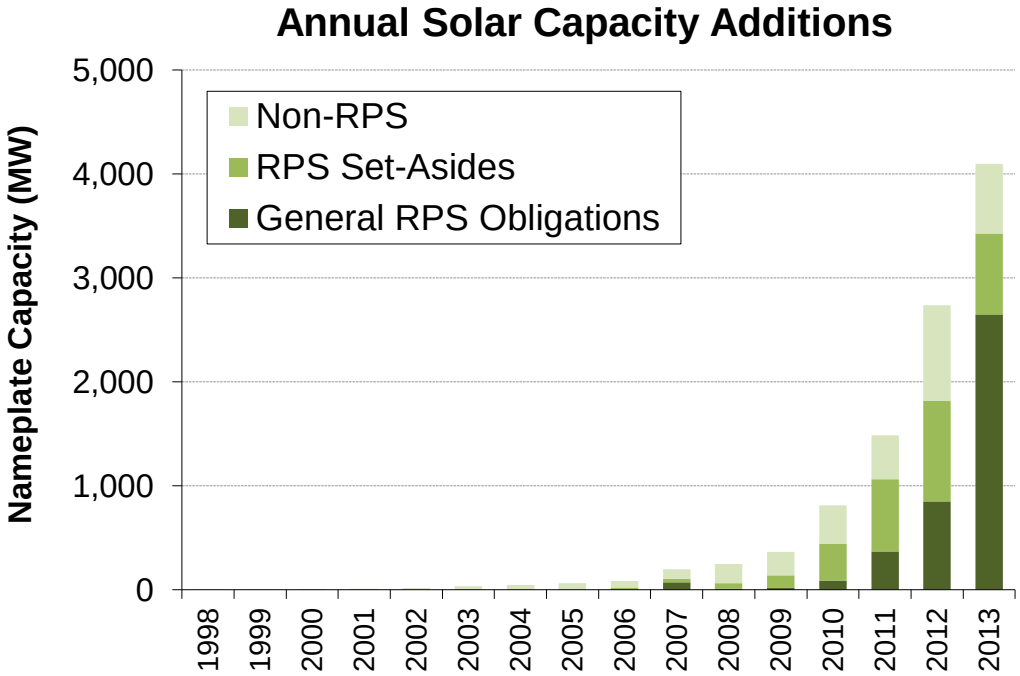
Dip in set-aside capacity additions in 2013 reflects depressed SREC pricing and reduced or eliminated incentives in a number of states

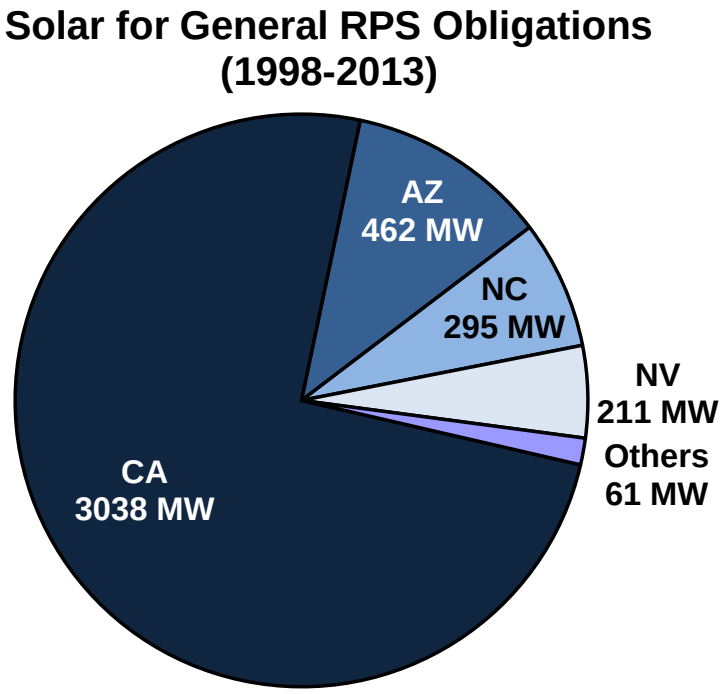


**PV capacity additions are attributed to the solar/DG set-aside only if installation occurred no more than one year before commencement of set-aside compliance obligations in the host state and if eligible for the set-aside and not attributed general RPS obligations.*

General RPS Obligations Also Driving Significant Solar Additions in California and Elsewhere

Sizable number of large solar projects (9 PV + 2 CSP, 100-300 MW each) added to meet general RPS obligations in CA & AZ in 2013





Substantial solar capacity in excess of set-aside requirements also built and applied towards general obligations in NC and NV

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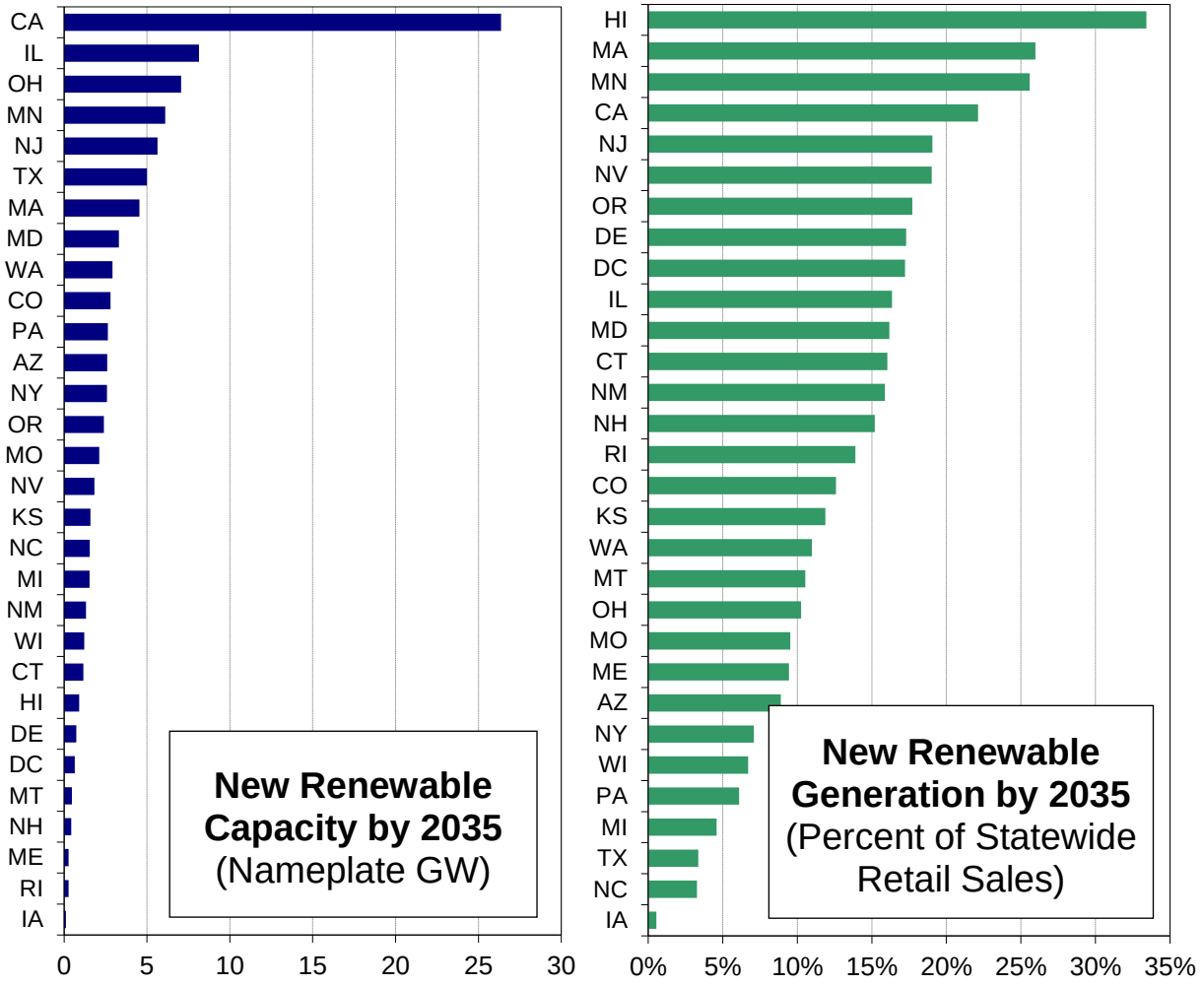
Future RPS Requirements are Sizable, But Well Within Recent RE Growth Rates

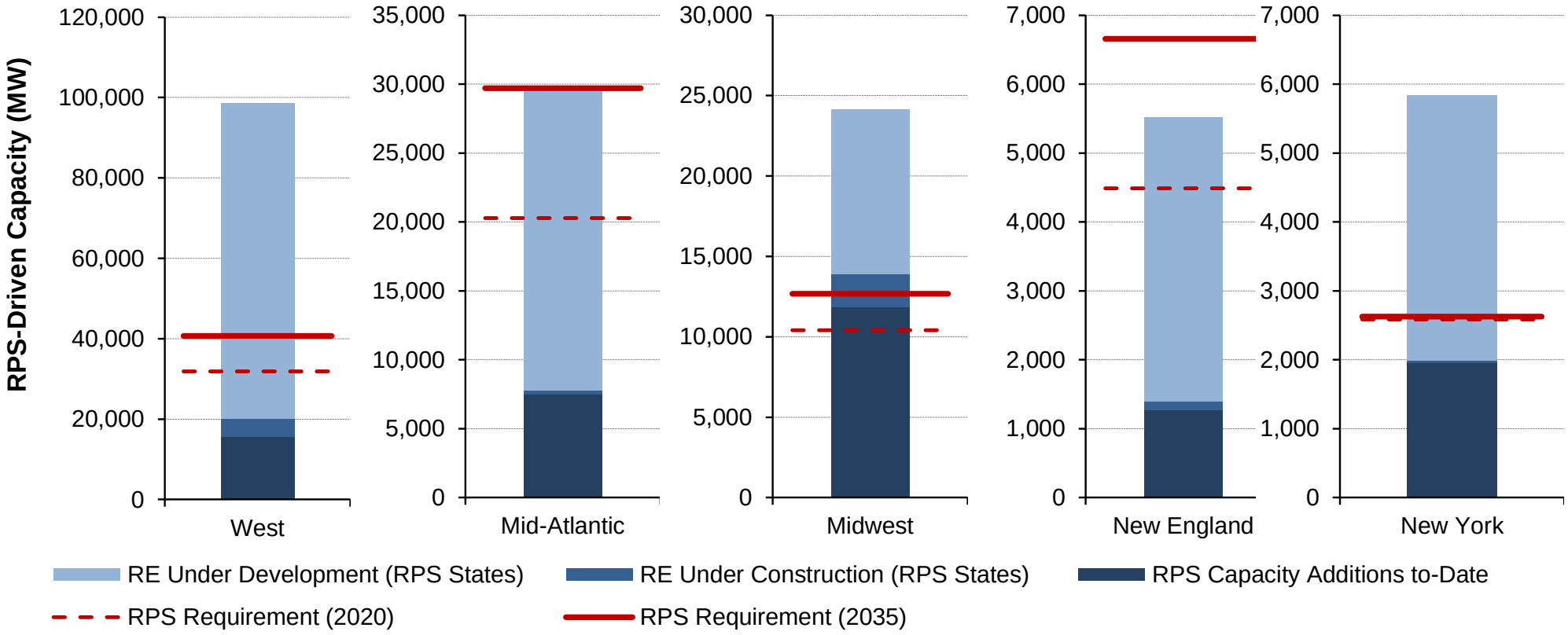
- **75 GW** of "New RE" required by 2020, **98 GW** by 2035 (including 51 GW already built) to achieve full compliance
- Equates to roughly **3-5 GW/yr** through 2020, 2-3 GW through 2035
- By comparison, RE additions have averaged ~**10 GW/yr** since 2008 (7 GW/yr in RPS states)



Note: "New RE" refers to capacity built after the year in which the RPS was enacted, or is based on state-specific definition of "new" vs. "existing" RE. This definition is intended to allow for rough comparison of the stringency of each state's target. It does not represent new or incremental renewables relative to current supply.

RE Currently Under Development May Be Enough to Meet Future RPS Demand in Most Regions

Future RPS Requirements Compared to Current RPS Supply plus New RE Capacity Under Construction and Under Development



Notes: RE under development and under construction refer only to RPS states within each region and therefore do not include additional new RE from other states in the region or from outside the region. RPS requirements in MW terms reflect regionally specific assumptions about RPS resource mix and capacity factors. Data source for RE Under Construction and Under Development: SNL Energy.

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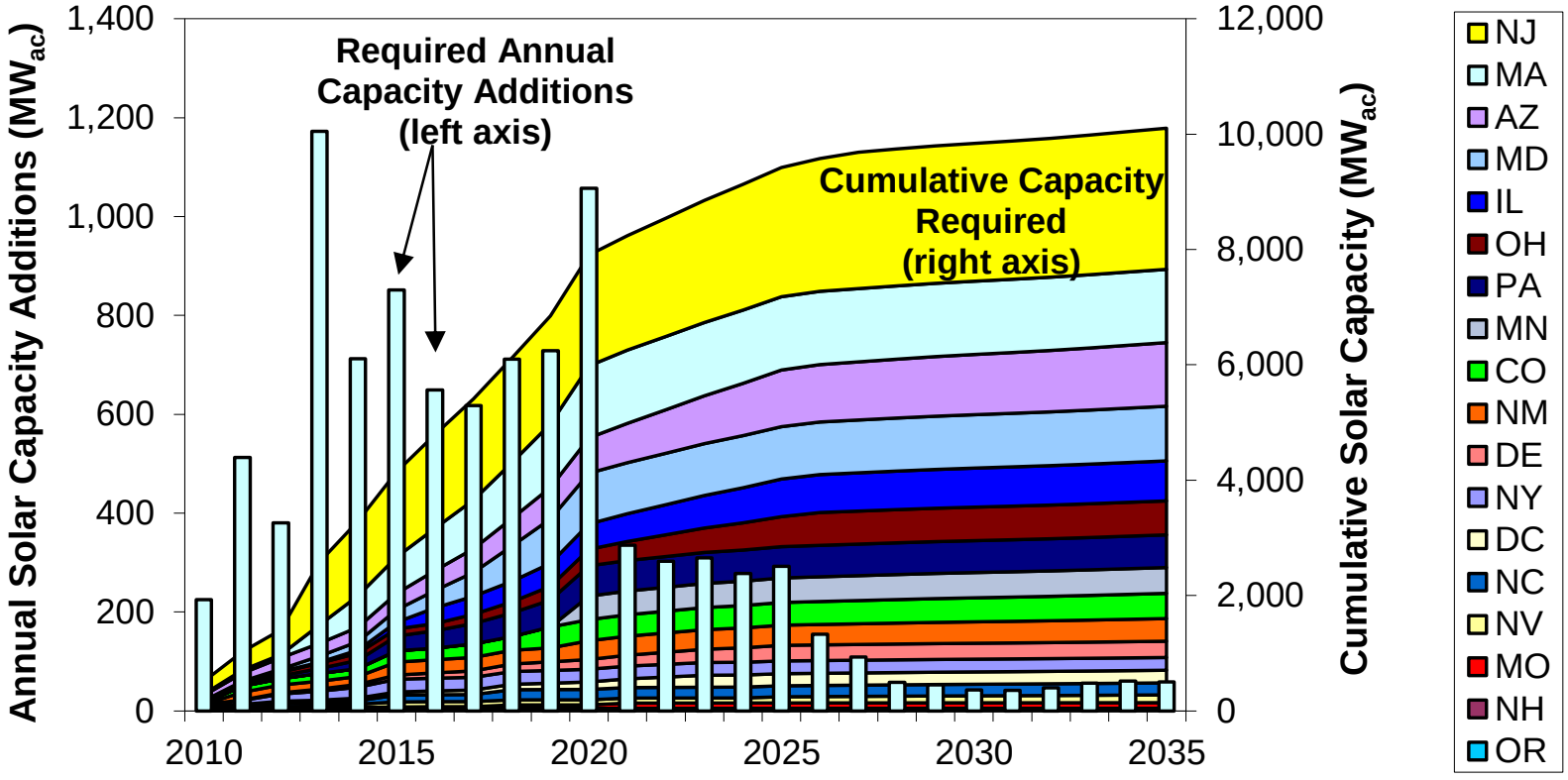
Solar Market Growth is on Pace to Meet Future Solar/DG Set-Aside Requirements

- Requirement grows to **8,000 MW by 2020** and 10,000 MW by 2035
- Required average annual solar capacity additions of **750 MW/yr through 2020**, tapering off thereafter
- By comparison, PV additions for set-asides averaged 800 MW/yr in 2011-2013



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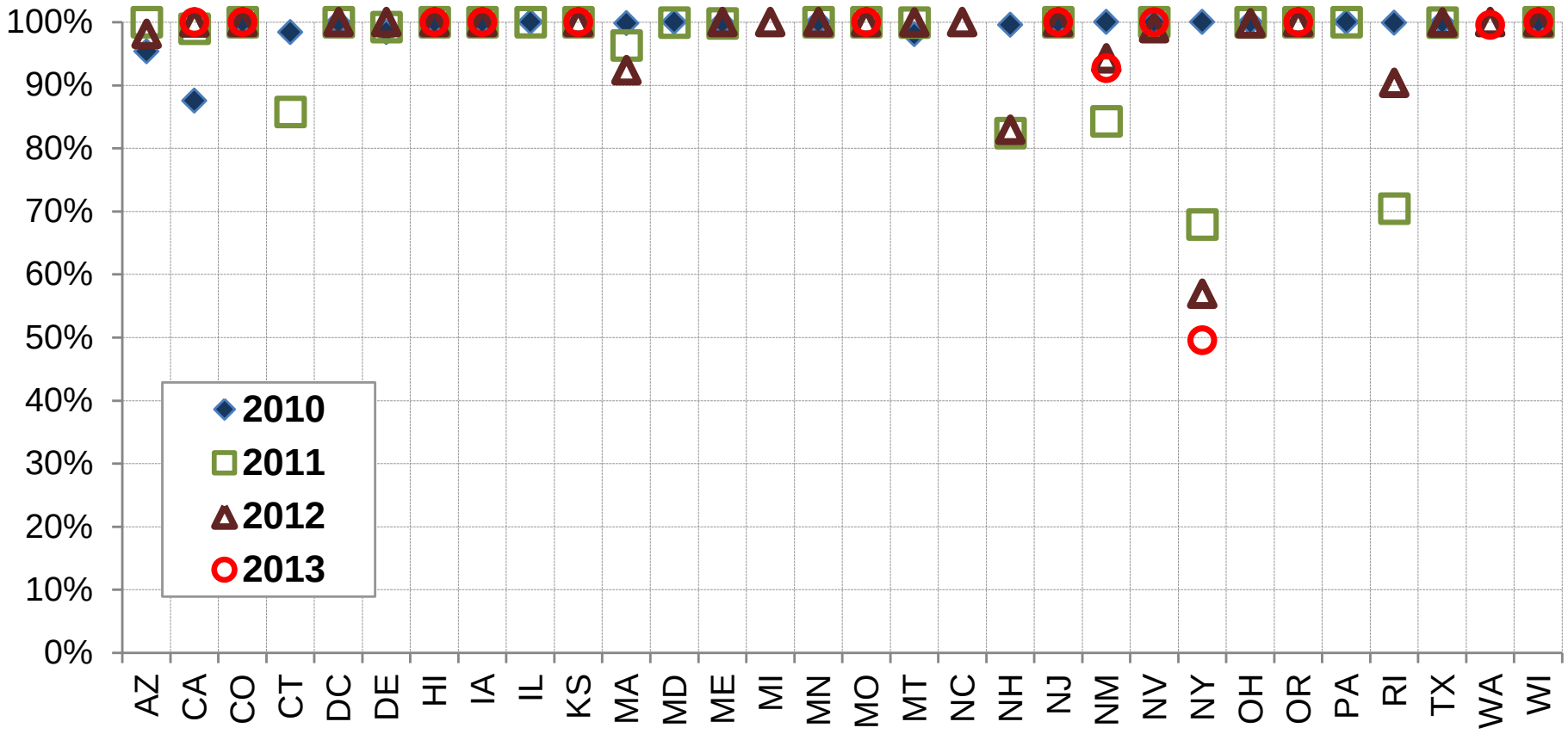
Main Tier RPS Targets Largely Achieved

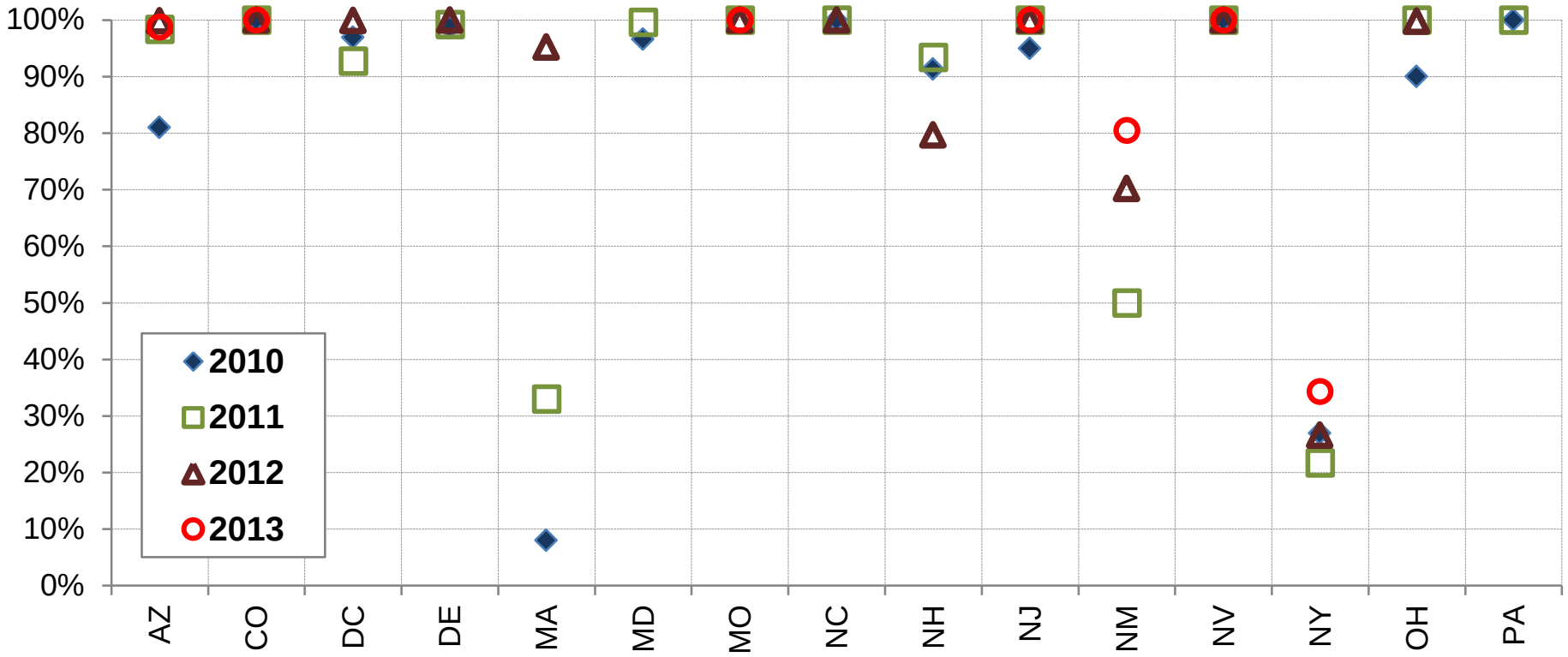
Percent of Main Tier RPS Target Met with Renewable Electricity or RECs
(including available credit multipliers and banking, but excluding ACPs)



Note: Percentages less than 100% do not necessarily indicate that "full compliance" was not technically achieved, because of ACP compliance options, funding limits, or force majeure events.

Achievement of Solar/DG Set-Aside Targets Has Also Generally Been High or Increasing

Percent of Solar/DG Set-Aside Target Met with Solar/DG Electricity or SRECs
(including available credit multipliers and banking, but excluding ACPs)



Note: "Percent of Solar/DG Target Met with Solar/DG Electricity or RECs" excludes ACPs but includes applicable credit multipliers. In cases where this figure is below 100%, suppliers may not have been technically out of compliance due to solar ACP compliance options, funding limits, and force majeure provisions.

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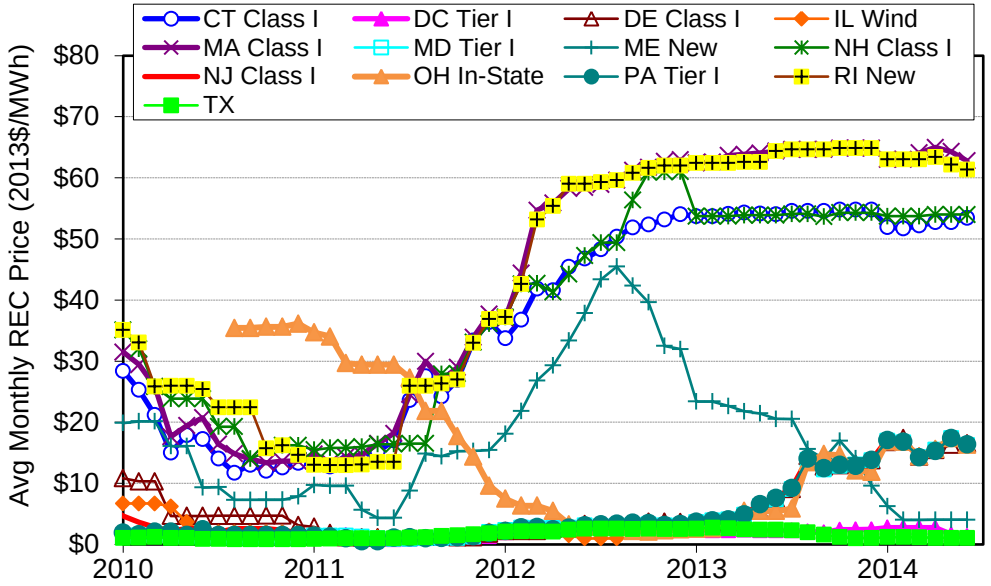
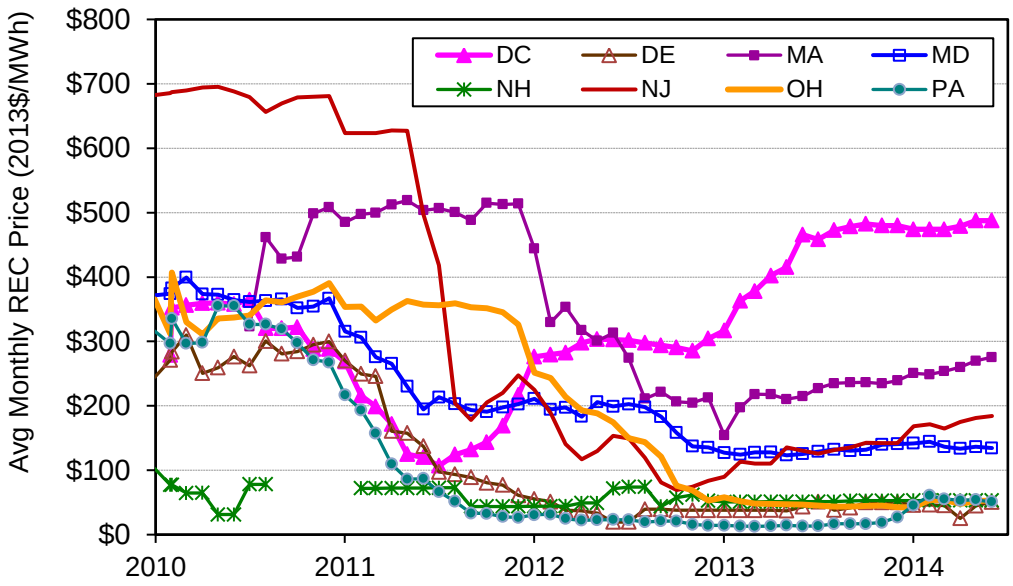
RPS Costs in Restructured States Are Partly a Function of REC Prices

- Rising Class I REC prices in Northeastern states reflect tightening supply, while pricing in Mid-Atlantic states and TX remain low
- Depressed SREC prices in most states show enduring over-supply of solar, muting the cost impacts of rising set-aside targets

Main Tier/Class I RECs



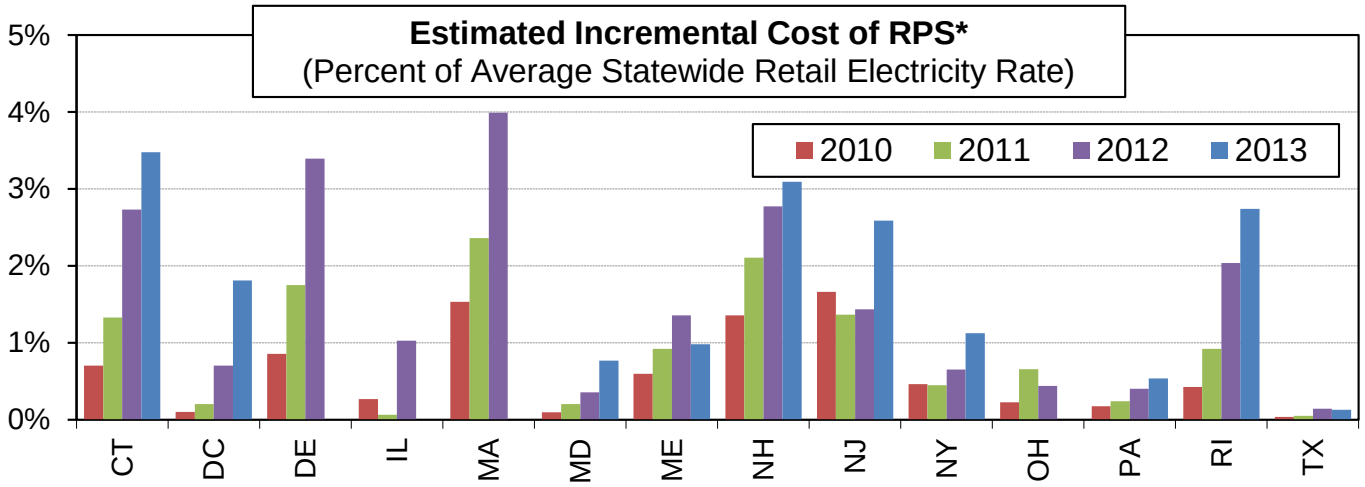
SRECs



Sources: Spectron, SRECTrade, Flett Exchange, PJM-GATS, and NJ Clean Energy Program. Depending on the source used, plotted values are either the mid-point of monthly average bid and offer prices, the average monthly closing price, or the weighted average price of all RECs transacted in the month, and generally refer to REC prices for the current or nearest future compliance year traded in each month.

Restructured States: REC + ACP Costs Typically <3% of Average Rates, But Are Rising

RPS compliance costs in restructured states can be approximated by REC + ACP costs and expressed as a fraction of average retail electricity rates



** Incremental costs are estimated from REC and ACP prices and volumes for each compliance year, which may differ from calendar years. If available, REC prices are based on average prices reported by the PUC (DC, IL, MD, ME, OH, NJ, PA); they are otherwise based on published spot market prices, supplemented with data on long-term contract prices where available. Incremental costs for NY are based on NYSERDA's annual RPS expenditures and estimated REC deliveries.*

Simplified approach: Ignores some ratepayer costs (e.g., integration) and benefits (e.g., wholesale electricity and natural gas price suppression); may overstate costs to ratepayers in states where ACP costs are not passed through

Differences across states and years reflect:

- RPS target levels
- Underlying REC and ACP prices
- Mix of resource tiers

Rising costs in some states due to:

- Increasing targets
- Elevated REC prices (esp. in Northeast)

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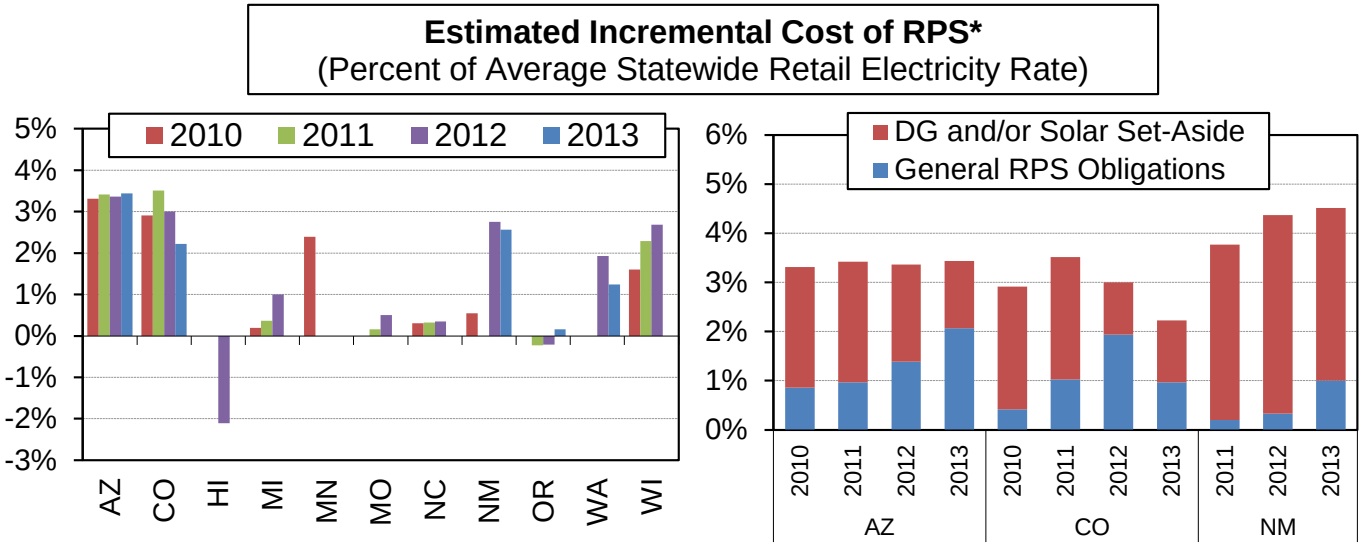
Regulated States: Varying Methods Generally Show Estimated Costs <3% of Average Retail Rates

Utility and PUC cost estimates rely on varying methods but can nevertheless be compared



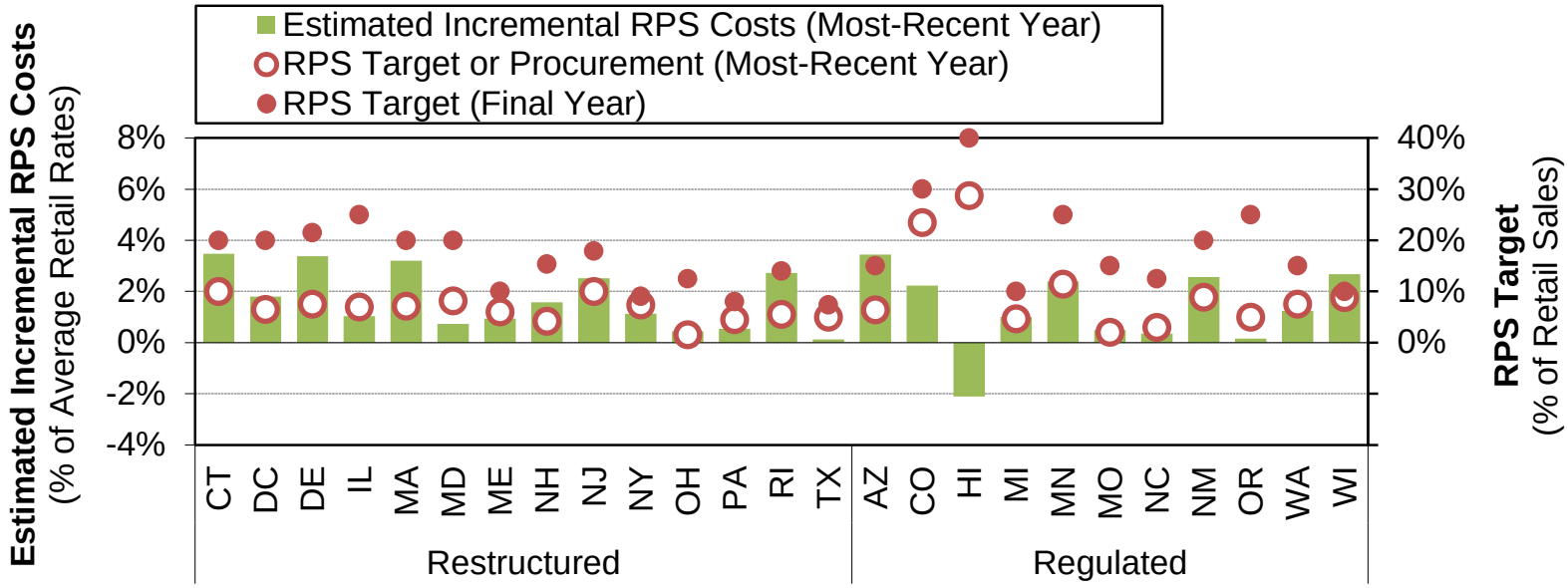
** Incremental costs are based on utility- or PUC-reported estimates and are based on either RPS resources procured or RPS resources applied to the target in each year. Data for AZ include administrative costs, which are grouped in "General RPS Obligations" in the right-hand figure. Data for CO are for Xcel only. Data for NM in the left-hand figure include SPS and PNM in all years shown, but data in right-hand figure include only SPS. States omitted if data on RPS incremental costs are unavailable (CA, IA, KS, MT, NV).*

Utility/PUC estimates of incremental RPS costs typically based on comparisons of RE procurement costs to proxy non-RE generators or to wholesale prices, or via system modeling

- Relatively high costs in AZ, CO, and NM due partly to solar/DG set-aside costs, where costs are front-loaded
- Low costs in states with low RPS targets during analysis period and/or where targets met primarily with pre-existing renewables
- Net savings estimated in HI, OR

Rising RPS Targets Could Put Upward Pressure on Future Compliance Costs

The figure shows RPS costs for the most-recent year along with recent and final RPS targets

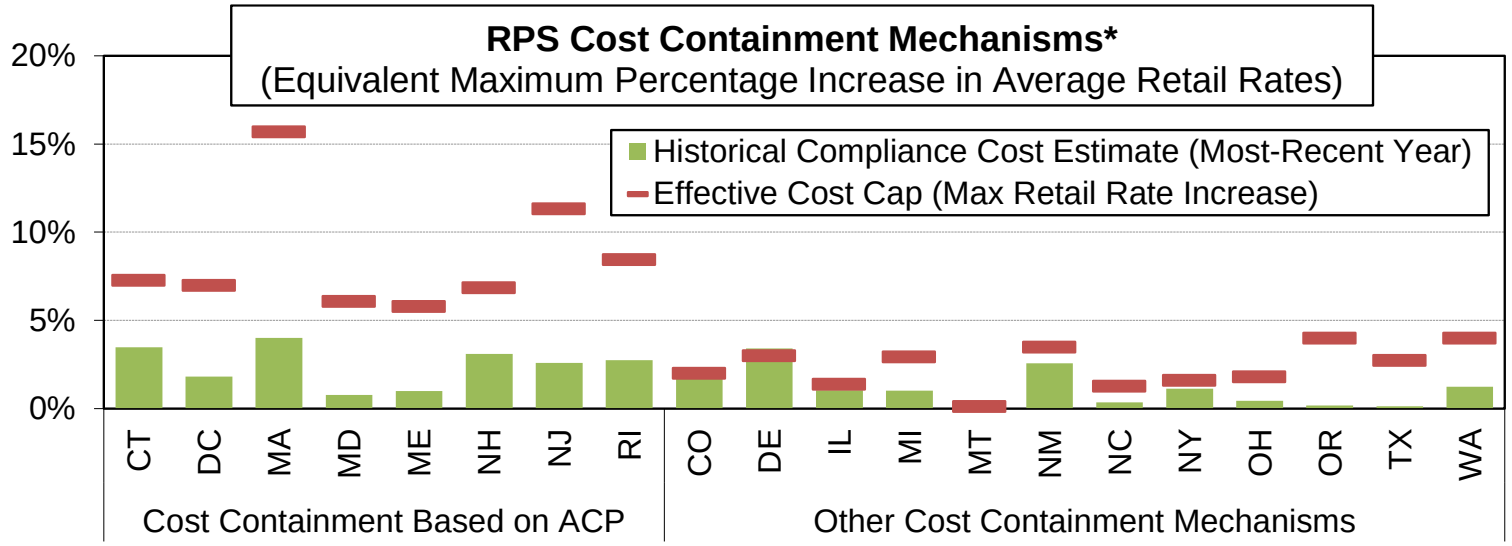


** For most states shown, the most-recent year RPS cost and target data are for 2012 or 2013. MA does not have single terminal year for its RPS; the final-year target shown is based on 2020. Excluded from the chart are those states without available data on historical incremental RPS costs (CA, KS, HI, IA, MT, NV). The values shown for RPS targets and costs exclude any secondary RPS tiers (e.g., for pre-existing resources). For most regulated states, data for the most-recent historical year reflect actual RPS procurement percentages in those years .*

- Final-year RPS targets (closed circles) constitute, on average, roughly a three-fold increase in RPS obligations compared to most-recent year targets (open circles)
- Future RPS costs will depends on many factors: RE technology costs, natural gas prices, federal tax incentives, environmental regulations, and RPS cost caps

Most States Have Capped Rate Impacts Below 10% and Many Below 5%

The figure compares each state's "effective" cost cap with actual costs for the most-recent year



** For states with multiple cost containment mechanisms, the cap shown here is based on the most-binding mechanism. MA does not have a single terminal year for its RPS; the calculated cost cap shown is based on RPS targets and ACP rates for 2020. "Other cost containment mechanisms" include: rate impact/revenue requirement caps (DE, KS, IL, NM, OH, OR, WA), surcharge caps (CO, MI, NC), renewable energy contract price cap (MT), renewable energy fund cap (NY), and financial penalty (TX). Excluded from the chart are those states currently without any mechanism to cap total incremental RPS costs (AZ, CA, IA, HI, KS, MN, MO, NV, PA, WI), though some of those states may have other kinds of mechanisms or regulatory processes to limit RPS costs.*

- ACPs generally cap costs at 6-9% of average retail rates
- Among states with some other form of cost containment, effective cost caps are more restrictive (1-4%), and have already become binding in several states

Summary of State RPS Experience-to-Date

- State RPS policies have been a significant driver for renewable energy growth in the United States
- Significant growth in RE capacity required to meet future RPS targets, but well in-line with pace of additions in recent years and with pipeline currently under development
- Generally high levels of compliance achieved
- Compliance costs thus far relatively modest, and future increases will be limited by cost caps in most states

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Project 1: RPS Cost and Benefit Analysis

A multi-year, joint LBNL-NREL project that expands and improves upon the Labs' FY14 work to more-comprehensively assess RPS cost and benefits

- FY15: Retrospective benefits
  - Suite of analyses to quantify (in monetary terms where possible) RPS benefits and impacts, leveraging tools applied in Wind Vision Study: life-cycle carbon, criteria air emissions, water use, risk and hedging, electricity and gas price suppression, local economic development
  - Convene webinar or other forum around January 2015 to solicit input on project scope/methods; will be specifically seeking input from RPS Collaborative participants
- FY16: Prospective costs and benefits
  - Both current targets & possible increases (e.g., to regional benchmarks, driven by 111d)
  - ReEDS modeling to assess displacement of conventional generation and similar set of benefits analyses as in FY15 project
- FY17: Retrospective costs
  - Standardized approach leveraging FERC EQR data for PPA costs in regulated states and REC pricing data for restructured markets

Project 2: Implications of Scheduled ITC Reversion for State RPS Programs

- Joint LBNL-NREL project to analyze implications of the scheduled ITC reversion for RPS-driven solar deployment and costs
- Exact scope and methods still to be refined, but may include:
  1) Estimate incremental solar set-aside demand at the time of the scheduled ITC reversion → For which states might the ITC reversion be most significant?
  2) Assess adequacy of current incentives and SREC pricing for achieving set-aside targets, post-ITC reversion (using NREL's SAM model, as appropriate)
  3) Estimate magnitude of increase in incentives/SREC prices required to compensate for scheduled reduction in ITC (or otherwise ensure achievement of set-aside targets); identify possible rate impacts relative to RPS cost caps
  4) For general RPS obligations (perhaps focusing on the SW), examine relative economics and RPS-driven deployment of wind vs. solar under scheduled ITC reversion and other federal tax incentive scenarios (potentially using ReEDS)
- Final report expected Fall 2015

Thank You!

For further information:

LBNL RPS publications and resources:
rps.lbl.gov

LBNL renewable energy publications:
emp.lbl.gov/reports/re

Contact information:
Galen Barbose, *glbarbose@lbl.gov*, 510-495-2593

The Future Role and Impact of State RPS Programs Will Depend On…

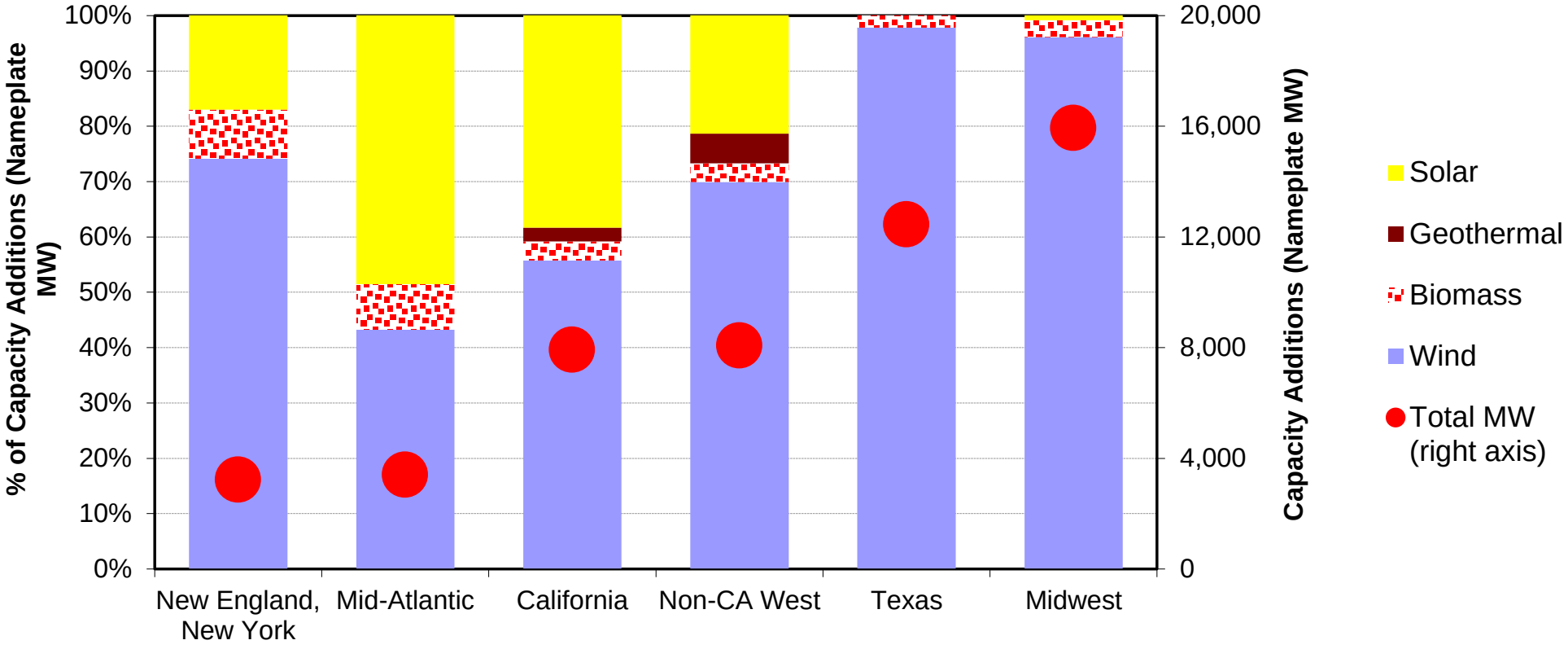
- The outcome of ongoing and future legislative and legal challenges
- Outcome of EPA carbon emissions regulations (potential legal battles and eventual state implementation)
- Whether cost caps become binding (which in turn depends on RE costs, gas prices, PTC/ITC, etc.)
- How other related issues and barriers affecting RE deployment are addressed (transmission, integration, siting, net metering, etc.)
- How policymakers re-tune RPS' in response to all of the above and to changing market conditions more generally

RPS Program Design Developments in 2014

- **IL:** Authorized IPA to procure PV with $30M existing ACP funds
- **MA:** Issued final rules for SREC II program; added renewable fuels to alternative energy standard
- **OH:** Froze RPS (and EERS) for two years, eliminates requirement for 50% in-state resources, other changes (e.g., cost disclosure)
- **OR:** Increased allowed usage of unbundled RECs by large public utilities (up to 75% of final RPS target)
- **WI:** Froze RPS for several individual utilities
- **Continuing refinement of eligibility rules:** WA, WI, others

Solar Share is Notably Greater in Regions with Set-Asides or Strong Solar Resource Potential

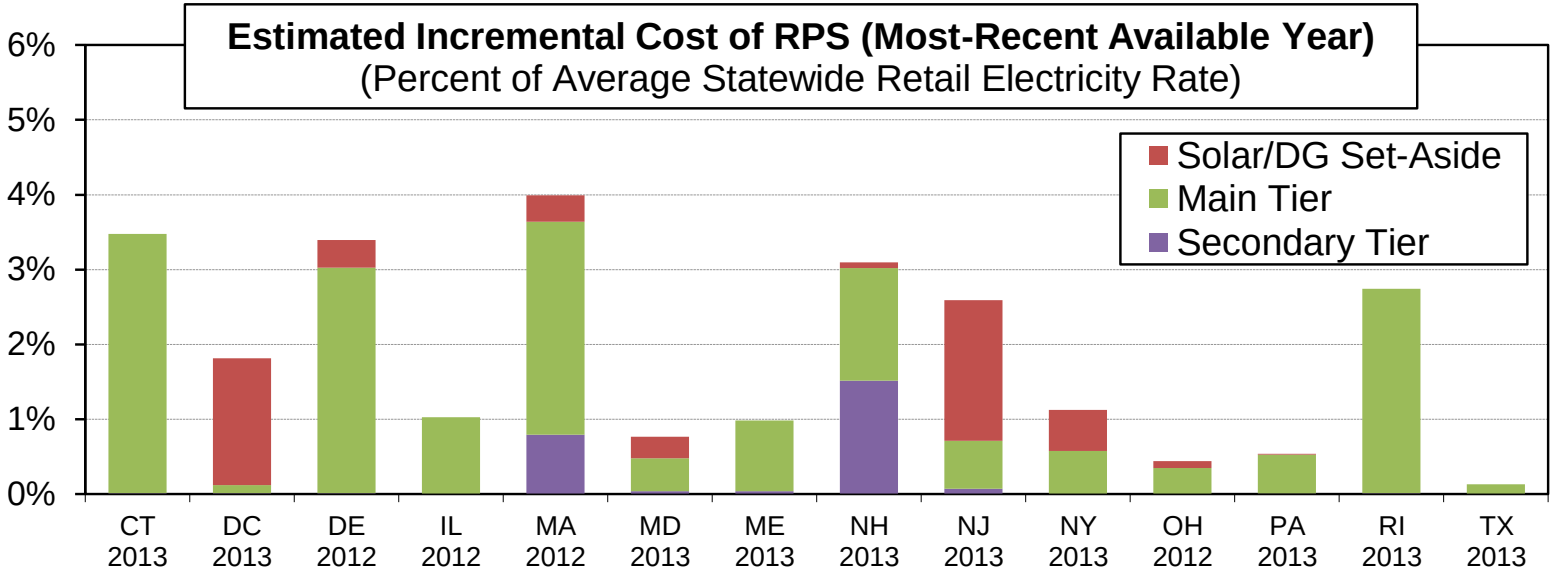
RPS-Motivated* Renewable Energy Capacity Additions from 1998-2013, by Region and Technology Type



**Renewable additions are counted as "RPS-motivated" if and only if they are located in a state with an RPS policy and commercial operation began no more than one year before the first calendar year of RPS compliance obligations in the host state.*

Main Tiers Represented the Bulk of Compliance Costs in Most Restructured States

RPS costs disaggregated into resource tiers



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- Relatively high solar set-aside costs in DC and NJ, which have high solar requirements and/or high SREC prices
- Significant secondary tier costs in MA and NH, which are undersupplied (though rule changes in MA may ameliorate shortage)