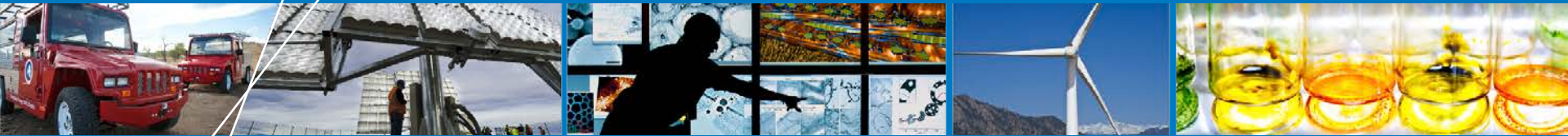


Quantifying the Level of Cross-State Renewable Energy Transactions



Project Team: Jenny Heeter, Philipp Beiter, Francisco Flores-Espino, David Hurlbut, Chang Liu

Clean Energy States Alliance webinar

February 2015

Purpose of Analysis

- Provide first-ever assessment of the extent to which renewable energy is crossing state borders to be used to meet renewable portfolio standard (RPS) requirements.

Two Primary Methods for Data Collection

1. Renewable Energy Certificate (REC) Tracking

Collect data from **regional REC tracking systems, state agencies, and utility compliance reports** to understand how cross-state transactions have been used to meet RPS compliance.

2. Power Flow Estimates

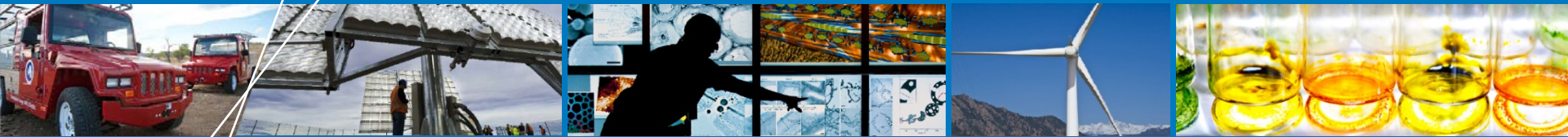
Estimate regional renewable energy flow using **generator-specific information primarily sourced from EIA, SNL Energy, and FERC Form 1 filings**. The renewable energy examined through this method may or may not have actually been used to meet RPS compliance.

These Approaches are Complementary

- The two approaches are complementary but do not yield identical results:
 - What is **GENERATED** (power flow analysis) in a given year is NOT necessarily **USED FOR COMPLIANCE** (REC transactions) in that same year.
 - Generation may be contracted through a power purchase agreement (PPA) to a counterparty in State X, but the RECs from that generation may be sold to state Y.
- Here we provide an analysis “snapshot” for 2012; we provide 2013 compliance data, where available, in the associated data file provided here:
http://www.nrel.gov/analysis/policy_state_local.html

Limitations

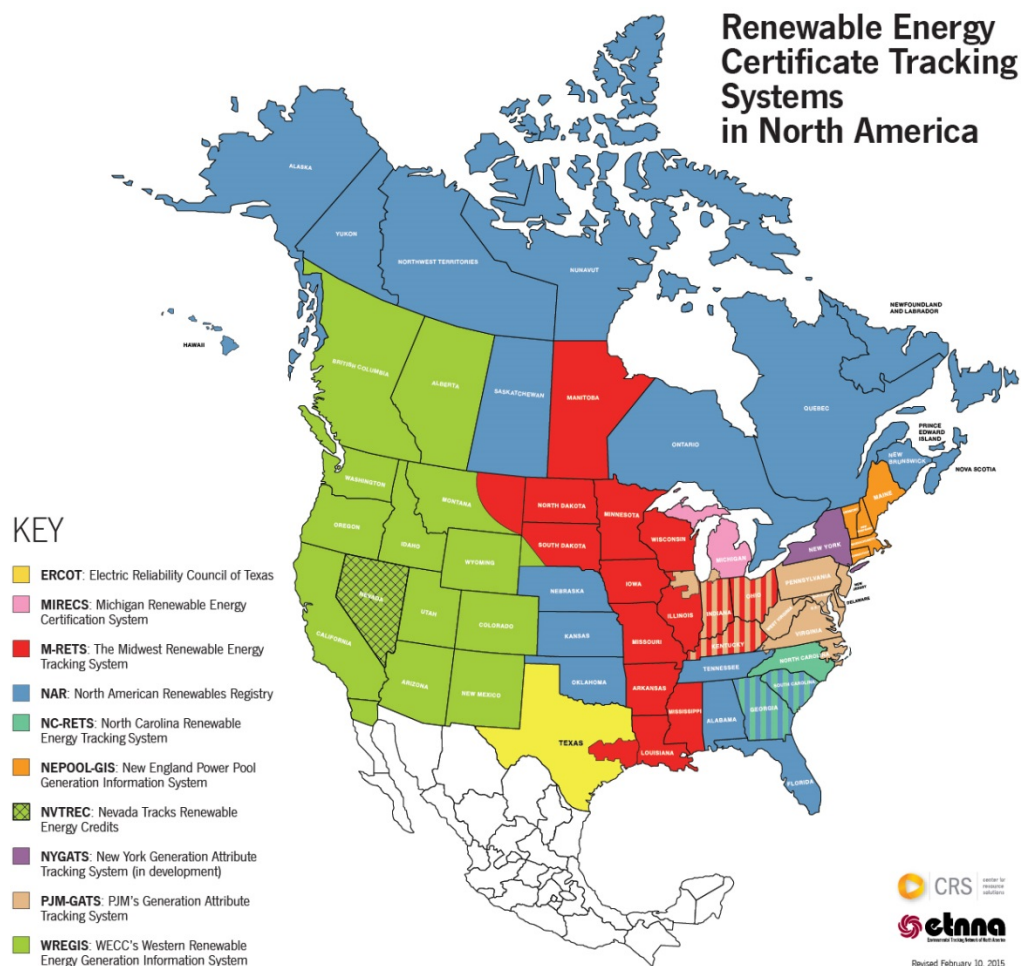
- Data on REC tracking include actual MWh used to meet RPS compliance; power flow data are estimates.
- Data on power purchase agreements (PPAs) is incomplete, as a result, only 43% of the total net generation from those agreements is reflected in the power flow estimate.
- Power flows were restricted to NERC region boundaries, which resulted in an additional 5% of the total net generation being excluded from the analysis.
- Estimates do not fully capture contributions from small generators.



1. REC Tracking & Compliance Data

Background: REC Tracking Systems

- Electronic REC tracking systems ensure that RECs are “retired” (used to meet compliance or substantiate a voluntary claim) only once by assigning a unique serial number to each MWh of renewable energy generation.
- In the United States, there are ten different tracking systems (New York’s system is under development). REC tracking systems generally follow the same boundaries as regional transmission organizations or independent system operators.



Methodology: REC Tracking

- **Data are RECs retired to meet 2012 compliance.**
 - In some cases, states allow older vintage RECs to be used
 - In some cases, states allow REC retirements for 2012 compliance to occur post-2012 (e.g. in the first quarter of 2013).
- **Data include all RPS Tiers/Classes.**
- **Data do not include multipliers (e.g., Michigan's Incentive RECs, in-state generation multipliers).**
- **Data sources:**
 - Tracking systems: M-RETS, PJM-EIS, NEPOOL, NC-RETS
 - RPS administrators, through use of tracking system or other mechanism: MI, MO, CA, NM
 - RPS Compliance Reports: WA, OR, CO, KS, NY, TX
 - Data incomplete and not readily available: AZ, NV.
- **This presentation is focused on 2012 compliance; we also gathered 2013 where possible and provide it in the associated data file available here:**
http://www.nrel.gov/analysis/policy_state_local.html

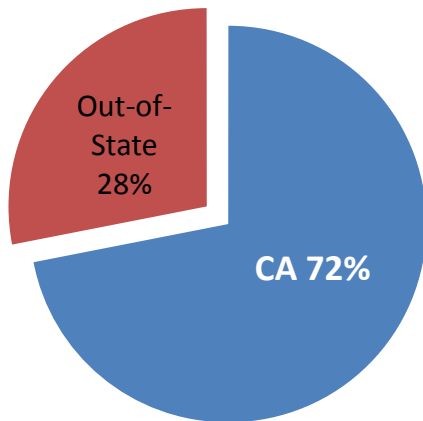
2012 RPS Compliance Data by State

- States are presented by region.
- Each pie chart represents the source of RECs retired to comply with the state's RPS in 2012 (unless noted).
- State data representing less than 0.01% of 2012 compliance are not shown.
- For states marked with *, see Notes on REC Transaction Data for more information.

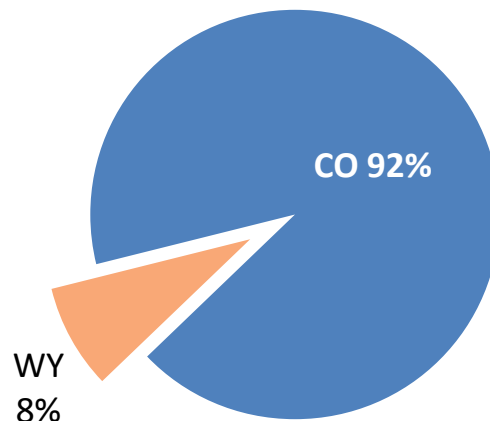
Western U.S.: 2012 RPS Compliance

- States in the western U.S. used primarily in-state RECs (57%-100%) for compliance; out-of-state RECs were typically drawn from adjacent western states.
- Arizona and Nevada are not included due to incomplete or not readily available data.

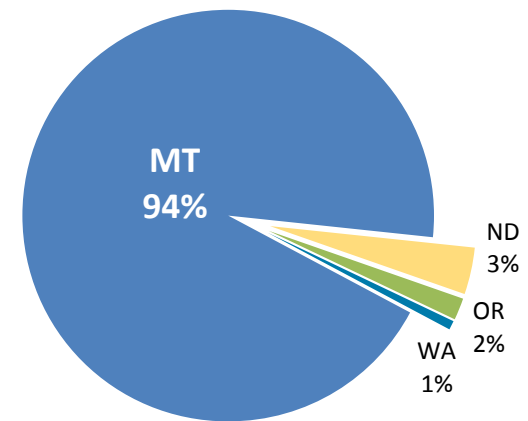
CA* 54,057,767 MWh



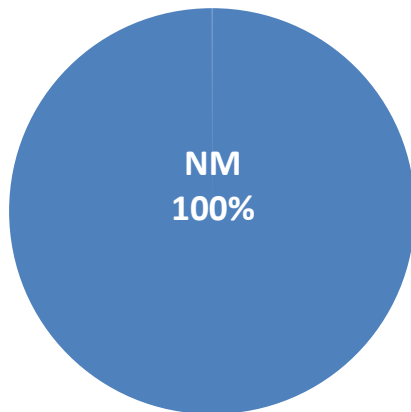
CO* 3,306,732 MWh



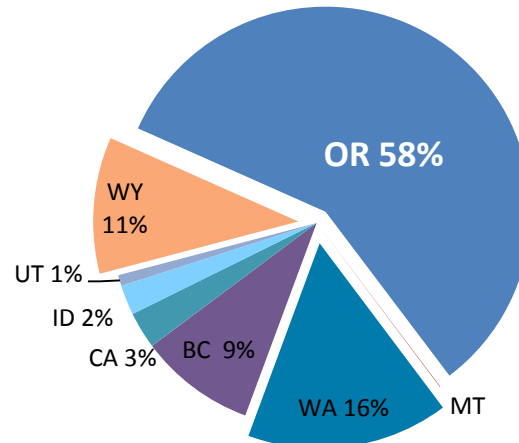
MT 717,347 MWh



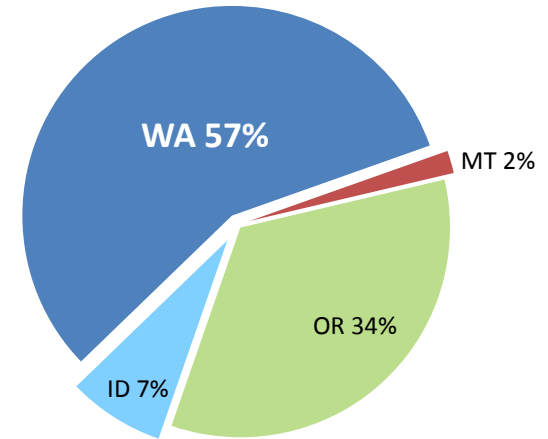
NM 1,352,815 MWh



OR 1,537,731 MWh



WA 2,800,917 MWh

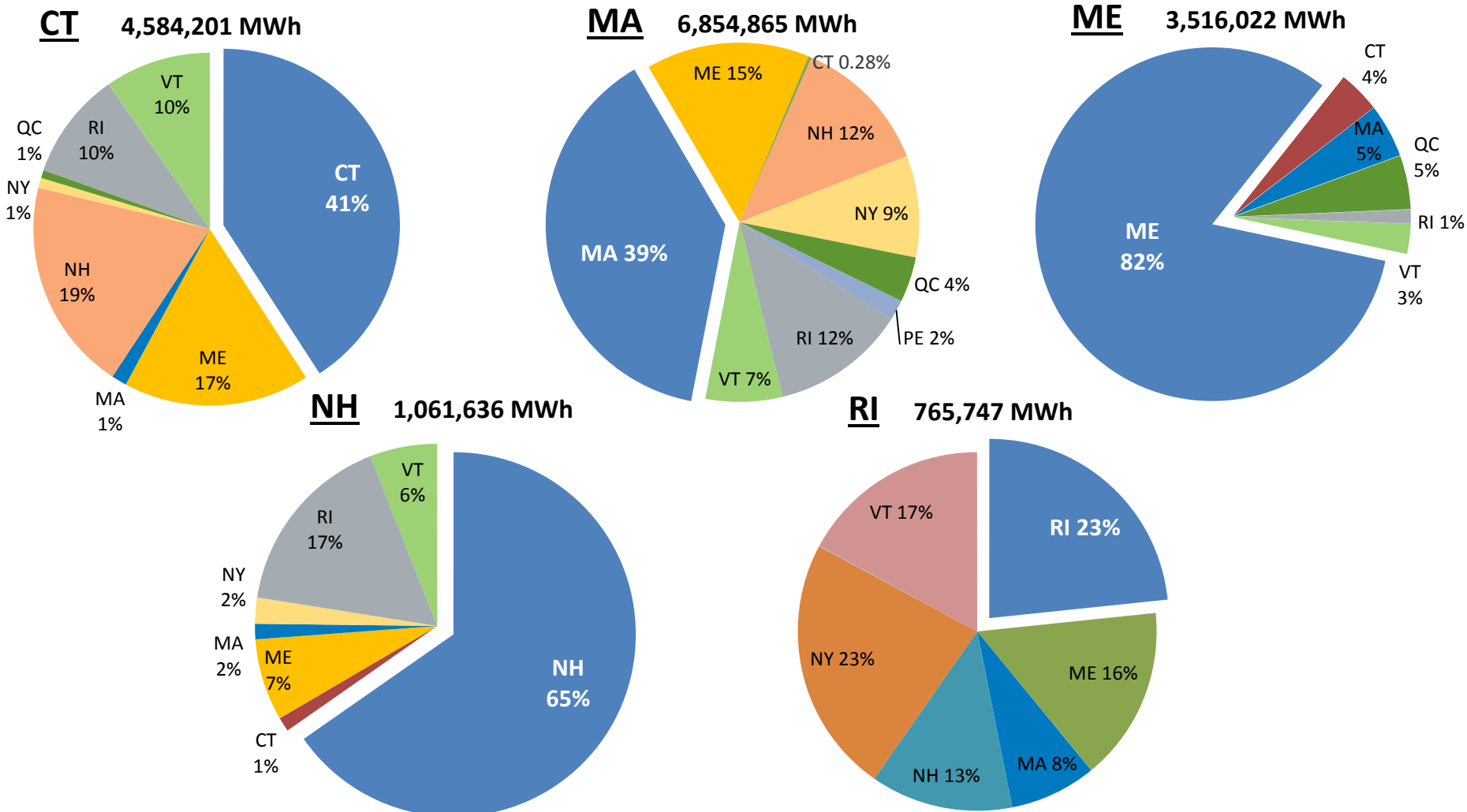


* See Notes Slide

NOTES: State data representing less than 0.01% of 2012 compliance are not shown here. See Notes and Reference slides for more information on data sources.

New England: 2012 RPS Compliance

- New England states used 23%-65% in-state RECs; they relied on a mix of out-of-state RECs, primarily from New England, but also from New York state and Canadian provinces.

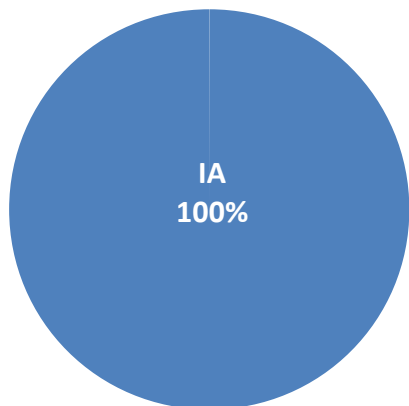


NOTES: State data representing less than 0.01% of 2012 compliance are not shown here. See Notes and Reference slides for more information on data sources.

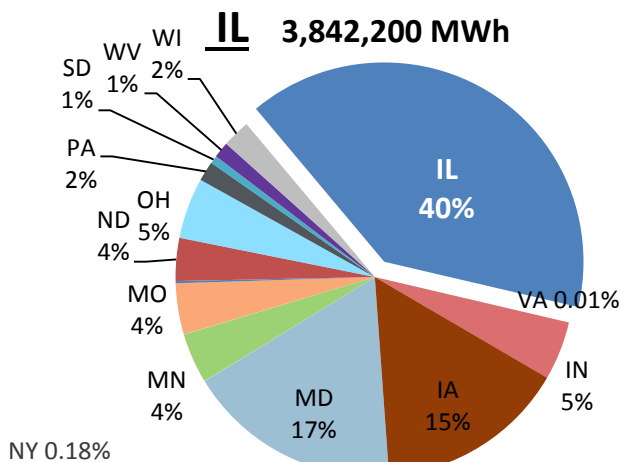
Midwest: 2012 RPS Compliance

- Midwestern states compliance approach varied, ranging from Iowa's use of 100% in-state RECs to Missouri's use of 6% in-state RECs.

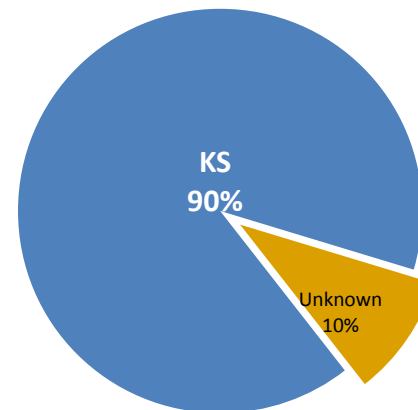
IA 294,575 MWh



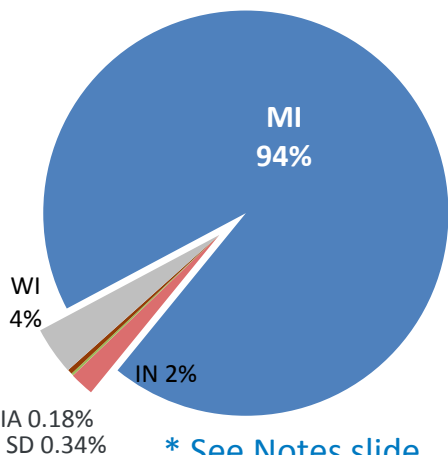
IL 3,842,200 MWh



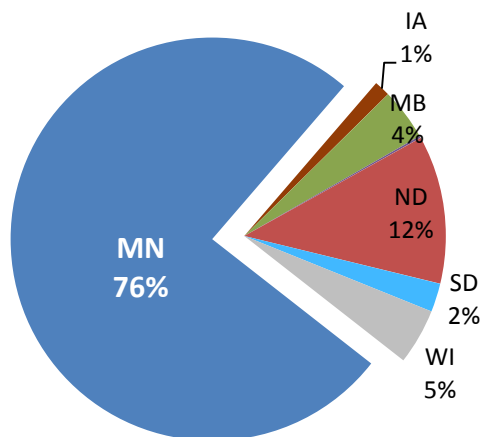
KS* 1,168 MW



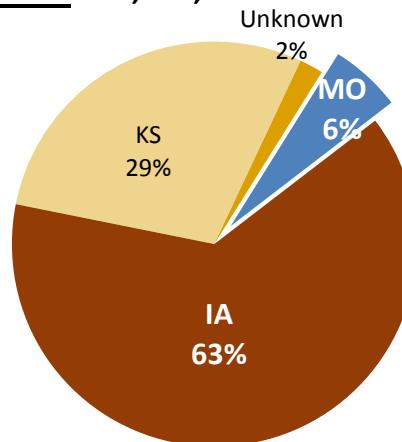
MI 3,423,994 MWh



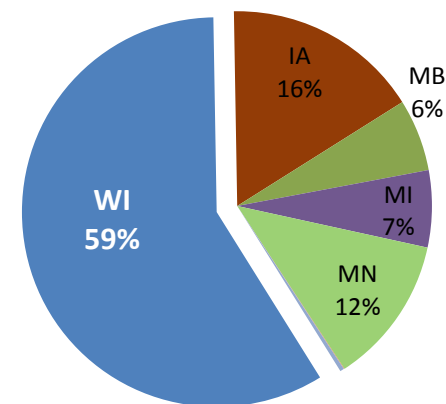
MN 9,638,920 MWh



MO 1,132,519 MWh



WI 3,294,576 MWh

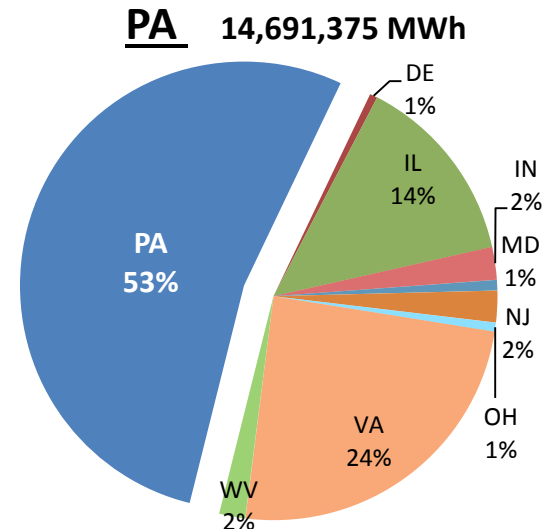
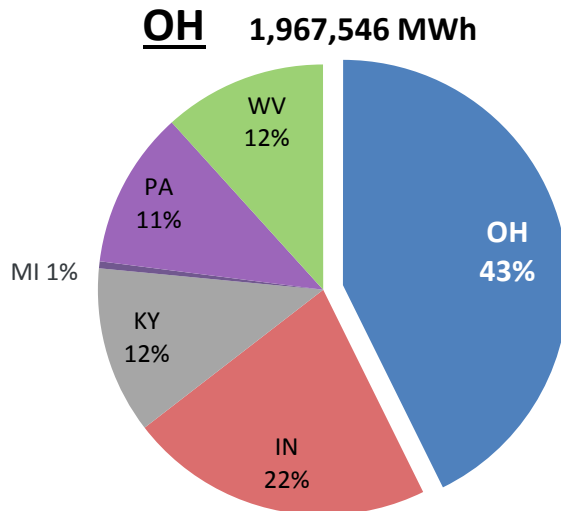
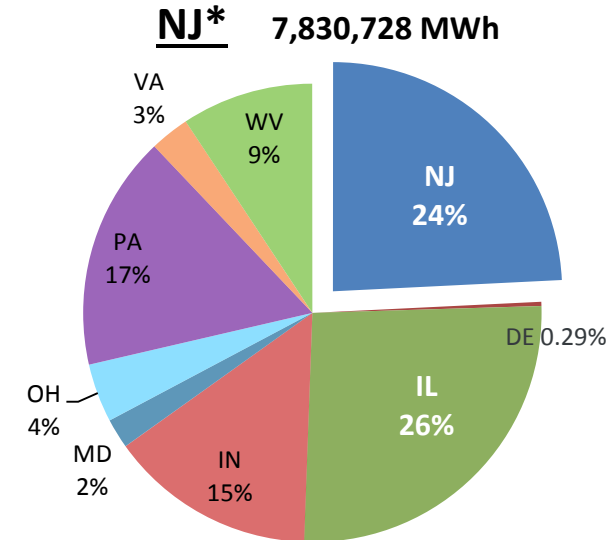
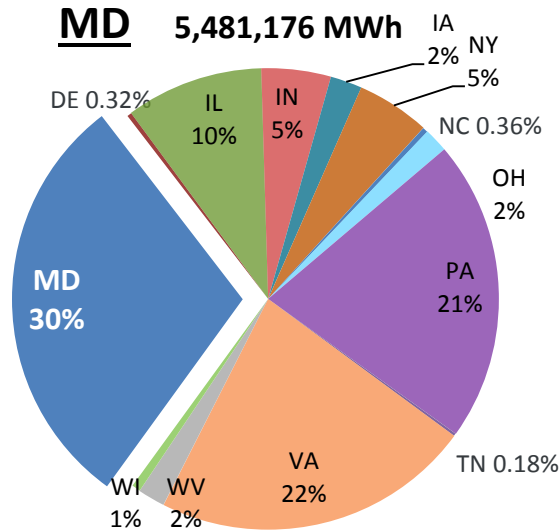
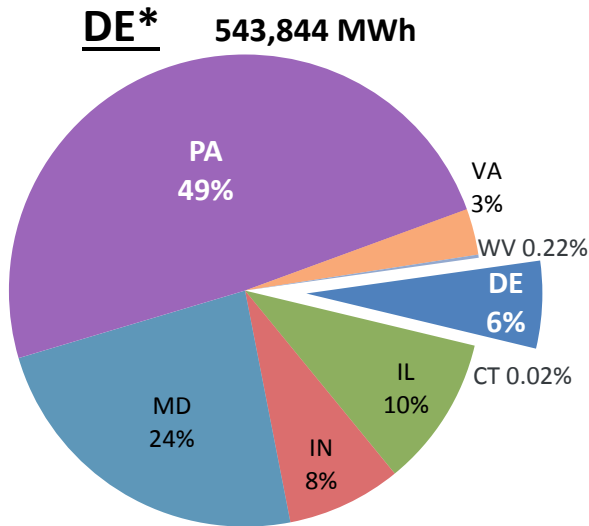


* See Notes slide

NOTES: State data representing less than 0.01% of 2012 compliance are not shown here. See Notes and Reference slides for more information on data sources.

Mid-Atlantic: 2012 RPS Compliance

- Mid-Atlantic states used 6% to 53% in-state RECs and sourced out-of-state RECs mostly from the Mid-Atlantic and Midwest.

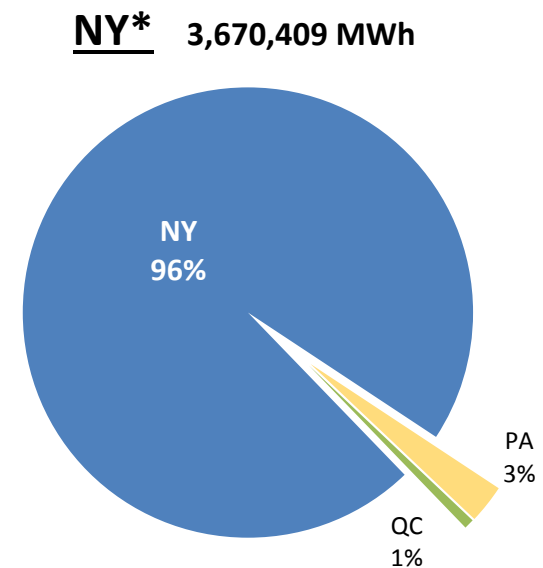
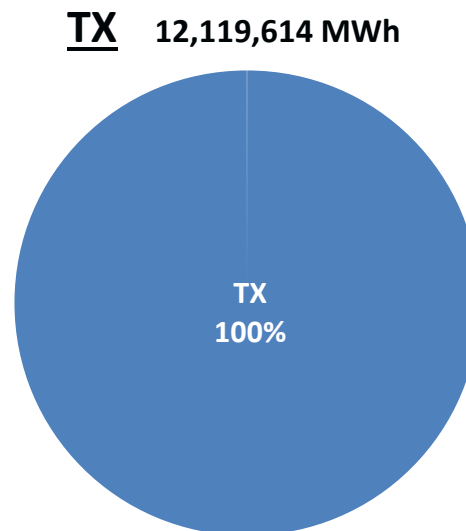
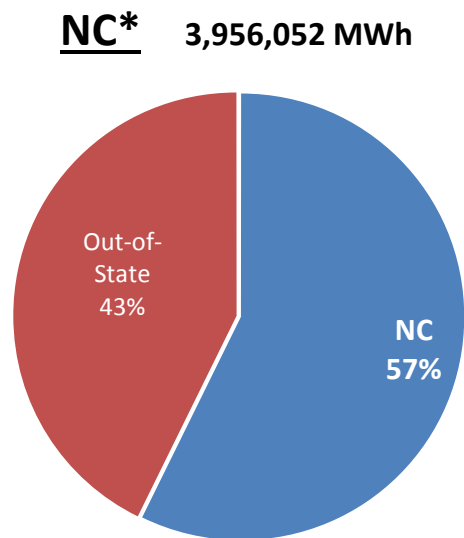


* See Notes slide

NOTES: State data representing less than 0.01% of 2012 compliance are not shown here. See Notes and Reference slides for more information on data sources.

Other States: 2012 RPS Compliance

- New York and Texas used almost entirely in-state RECs.
- North Carolina used a mix of in-state and out-of-state resources. RECs listed by the state as "in-state (delivered to NC)" in NC-RETS are classified as out-of-state renewables in this analysis; as a consequence, the percentage of out-of-state renewables is calculated as higher than the state's 25% limit for unbundled RECs from out-of-state facilities.



* See Notes slide

Registration by Small Generators Varies

A small data gap exists in the REC tracking analysis because not all small generators are registered in tracking systems. Typically, small generation is counted toward RPS compliance in the state where it is sourced. In the table below, we present tracking system data on “small generators.” Because there is not a single definition of “small generator,” we present three sets of data: renewable generators ≤ 1 MW, renewable generators ≤ 10 MW, and solar PV generators.

Whether a small generator registers depends on a variety of factors, including:

- State requirements (for example, in order to receive incentive payments)
- Level of incentive payment
- Cost to register
- Cost of metering requirements, if any.

Tracking System	# of Renewable Generators ≤ 1 MW	# of Renewable Generators ≤ 10 MW	Total Capacity of Renewable Generators ≤ 1 MW (in MW)	Total Capacity of Renewable Generators ≤ 10 MW (in MW)	# of Solar PV Generators	Total Capacity of Solar PV Generators (in MW)	# Solar PV Certificates Issued and Year of Issue
WREGIS	*	*	696	3,767	2,143	7,062	9,221,379 (2014)
M-RETS	240	446	69	69	101	77	41,377 (2014)
MI-RECS	73	142	34	300	41	17	not available
NC-RETS	400	646	90	1,048	363	548	387,546 (2013)
NAR	50	118	31	302	47	72	not available
ERCOT	not available	not available	not available	not available	22	175	178,325 (2013)
PJM-EIS	53,060	53,346	1,152	1842	53,357	2,028	1,946,597 (2014)
NEPOOL	not available	not available	not available	not available	6,626	not available	386,031 (2013)

* WREGIS has 2,149 registrants ≤ 1 MW and 2,895 ≤ 10 MW, but each may contain several hundred “aggregated” units that bundle even smaller units.

Summary: 2012 RPS Compliance

- States on average sourced 61% of 2012 RPS requirements from in-state resources (65% on weighted average basis).
- States in **New England** and **PJM** used **greater** percentages of out-of-state RECs than states in the **Midwest** and **West**.
- States that used out-of-state RECs sourced them according to their RPS requirements, which typically restrict eligible RECs to the state's region (e.g., ISO or neighboring states).
- Utilities may have sourced RECs from out-of-state to reduce the cost of compliance, to source RECs from specific generation types, or for other reasons.
- **California's** RPS limits the use of out-of-state RECs, but the limitation only applies to contracts executed after June 1, 2010.

Notes on REC Transaction Data

AZ: Compliance data by state or fuel are not available.

CA: Source states for out-of-state generation are not available. Data are only available for the 2011-2013 compliance period; we divide the period value by three to estimate 2012 retirements. Data have not been verified by the California Energy Commission.

CO: Data for cooperative utilities not purchasing through Tri-State are not available. Tri-State data are from 2013. Fort Collins and Colorado Springs data are estimates.

DE: Compliance period used: June 2012 - May 2013.

IL: Compliance period used: June 2012 - May 2013.

KS: RPS compliance is reported on a capacity basis (MW). Source states for out-of-state generation are not available.

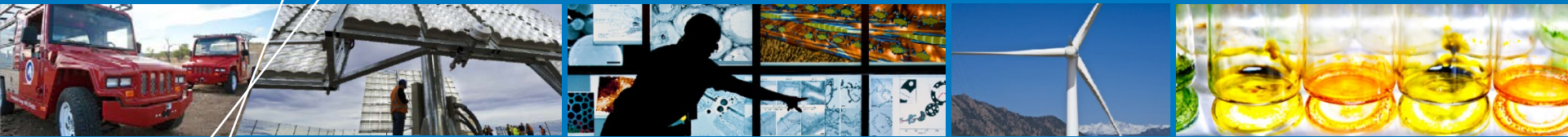
NV: Compliance data by state or fuel are not available.

NJ: Compliance period used: June 2012 - May 2013.

NY: Data are sourced from NYSERDA's "Maximum Annual Contract Quantity" reported in "The New York State Renewable Portfolio Standard Performance Report: Through December 31, 2012" and do not necessarily reflect actual REC retirements.

NC: Source states for out-of-state generation are not available. RECs listed by the state as "in-state (delivered to NC)" are classified as out-of-state renewables in this analysis; as a consequence, the percentage of out-of-state renewables is calculated as higher than the state's 25% limit for unbundled RECs from out-of-state facilities.

PA: Compliance period used: June 2012 - May 2013.



2. Power Flow Estimates

Power Flow Estimates

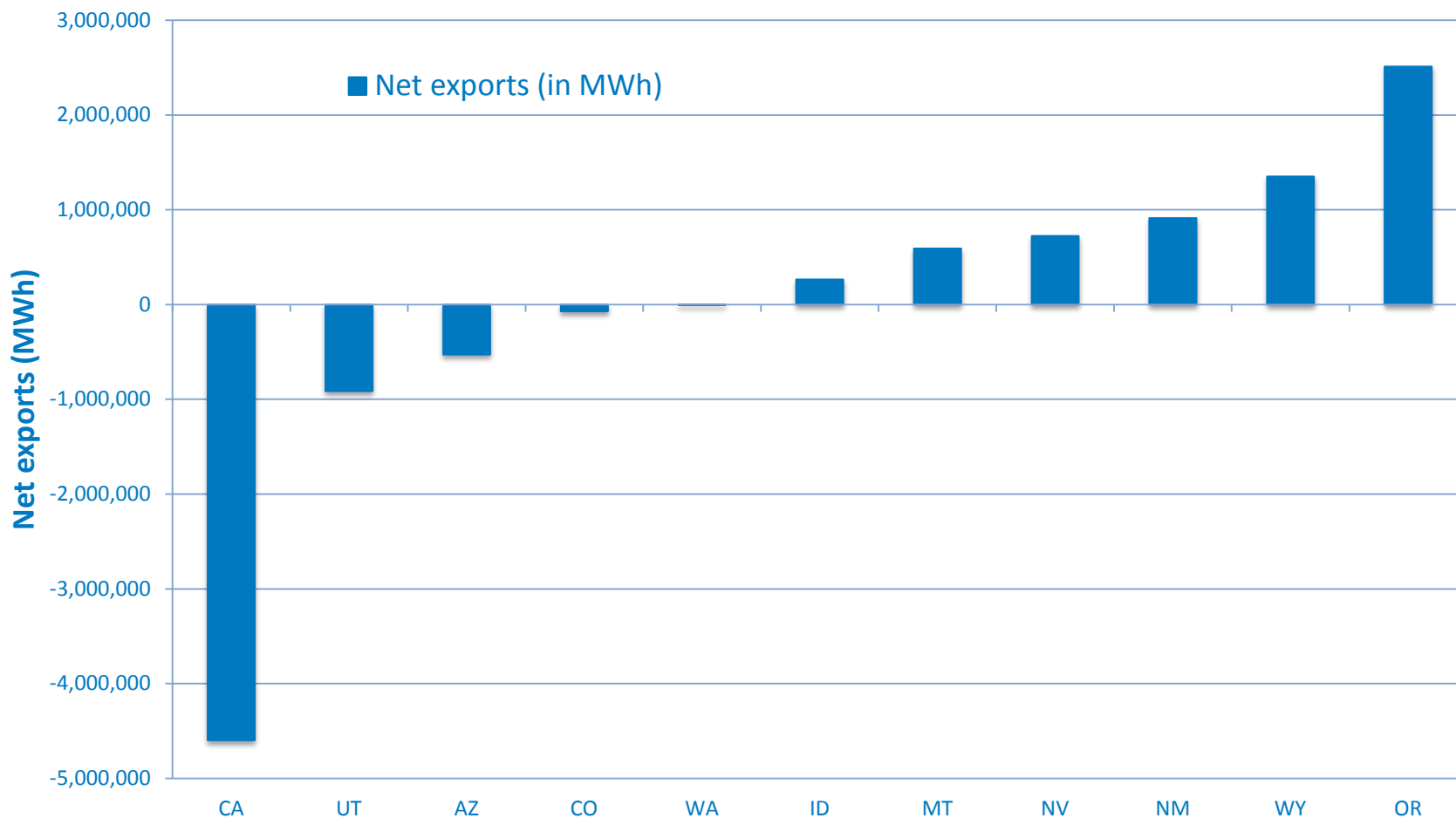
- We analyzed power purchase agreements (PPAs) to estimate cross-state renewable transactions. PPA agreements do **NOT** necessarily correlate with REC purchases and also are not necessarily used to meet RPS compliance.
- The following renewable resource types were included in this analysis: small hydropower (generator capacity <30 MW), solar, wind, geothermal, and biomass. These resource types are generally consistent with eligible RPS resources, given that each state has its own eligibility definition.
- We used data from SNL Energy, EIA, FERC, and other sources to allocate renewable generation from the generation plant to contracted parties.

Allocating Generation to Power Purchasers

We assigned generation from power plants to power purchasers using two different methodologies, depending on whether a PPA was in place for the generation.

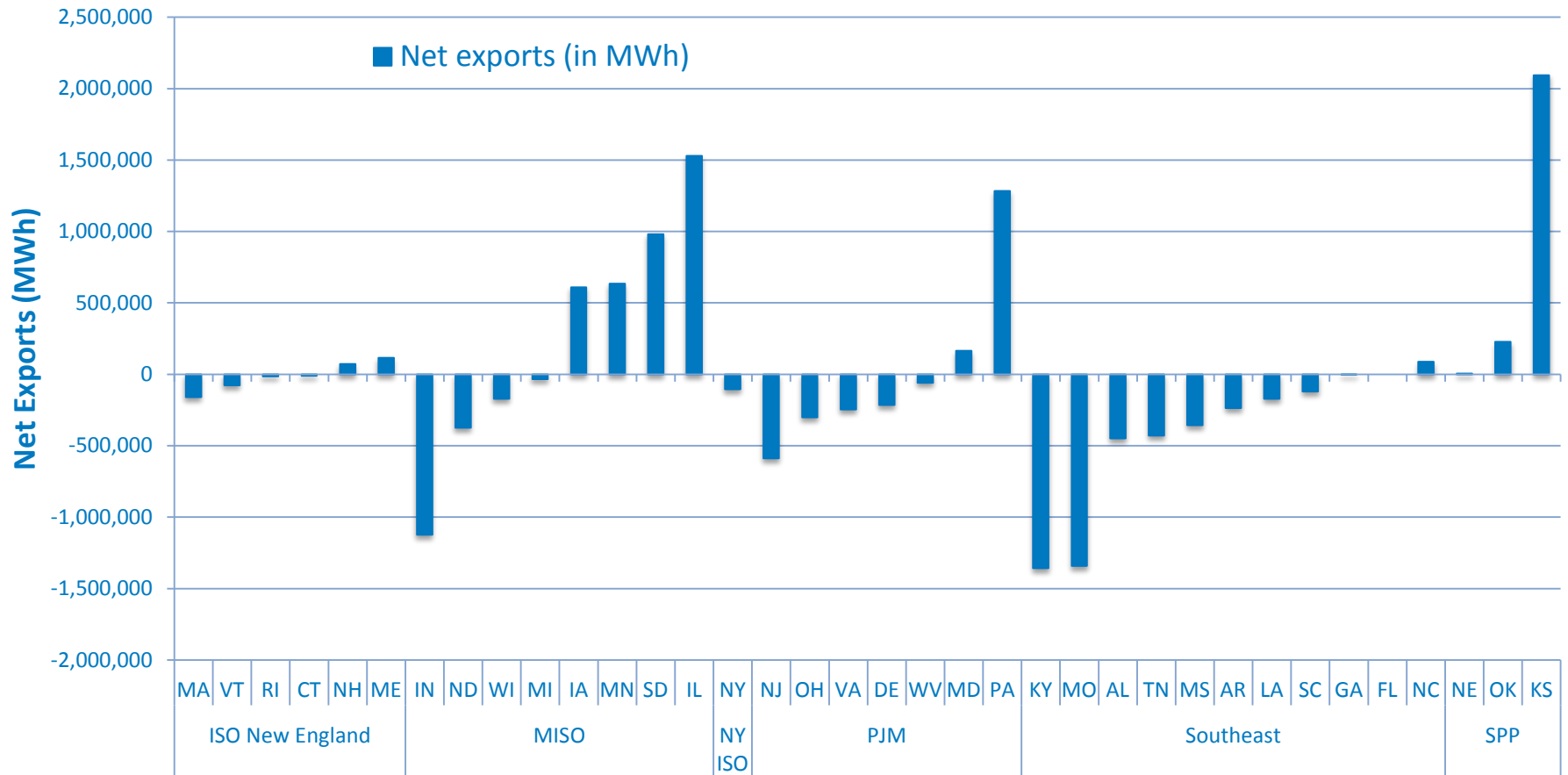
- Where a PPA was in place, power flows were allocated in a two-step procedure: First, we allocated flows to the largest PPA counterparty of a power plant. In a second step, we proportionally allocated this energy flow to those states in which the largest PPA counterparty has a customer base in.
 - Due to data limitations, only a subset of PPA counterparties could be matched with power plants; as a consequence, **only 43% of the total net generation from power plants with a PPA in place are reflected in the analysis.**
- We restricted flows for a PPA to occur within only the encompassing NERC region. For instance, recorded flows from Texas to New Mexico refer only to the part of Texas falling within the SPP NERC region. As a consequence of this assumption, HI and AK do not show flows to other states. We did not reallocate flows that were restricted by NERC region boundaries, which resulted in an additional 5% of the total net generation being excluded from the analysis.
 - This restriction is a simplifying assumption for modeling purposes, **but may not reflect how energy actually flowed in 2012.**
- Where no PPA was in place, we allocated the 2012 net generation of a plant to the RTO in which the plant was geographically located. While this method is less precise than the method for allocating generation where a PPA was in place, the level of precision is consistent with the data available.

Renewable Generation from Power Plants with PPAs: 2012 Net Exports in the Western Interconnection, By State



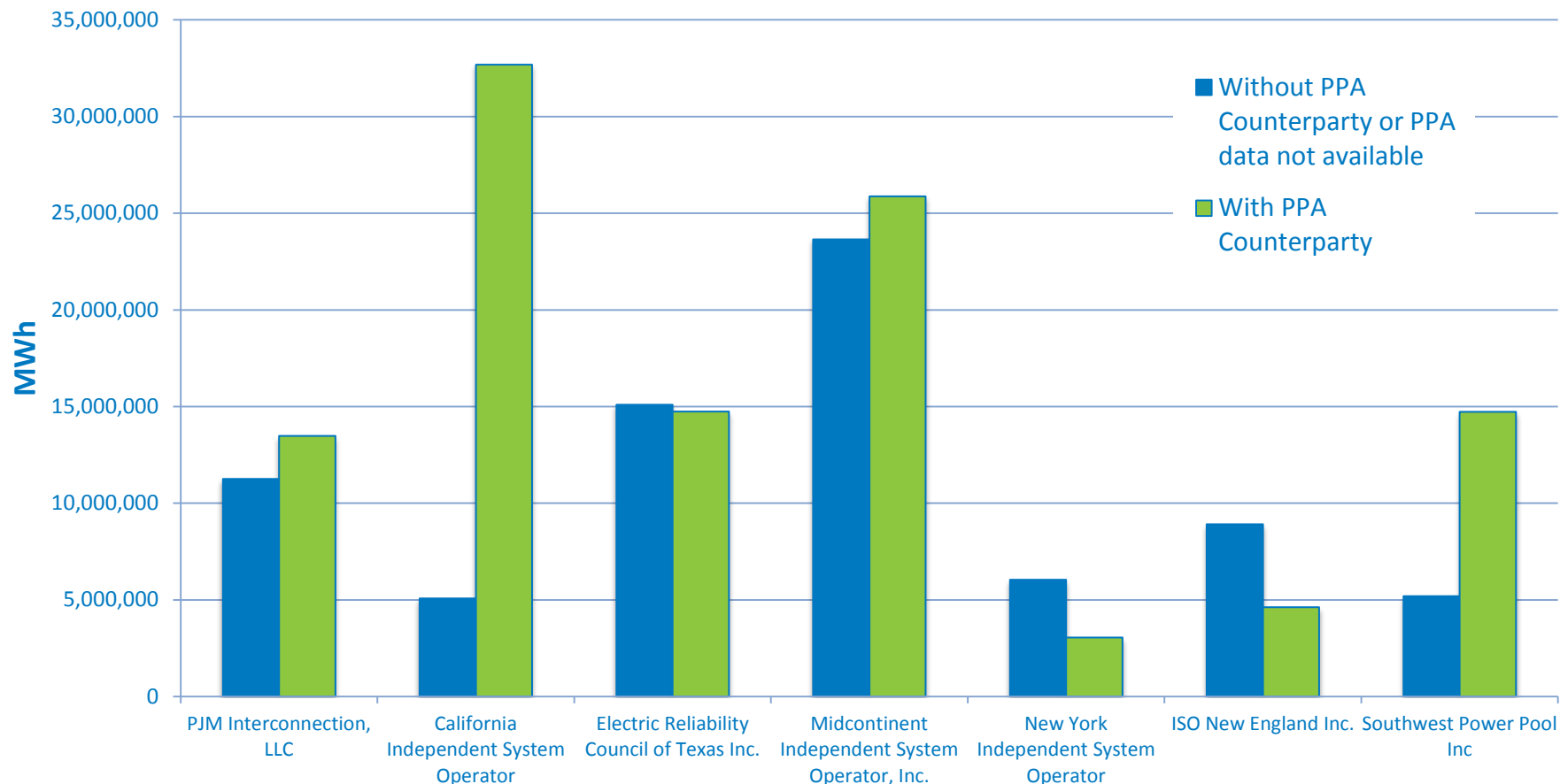
- California, Utah, and Arizona were net importers of PPA-based renewable generation; several-other Western states were net exporters on a total generation basis.

Renewable Generation from Power Plants with PPAs: 2012 Net Exports in the Eastern Interconnection, By RTO and State



- States rich in wind resources (e.g. Kansas, Illinois, South Dakota, Minnesota) were large net exporters of renewable generation, on a total generation basis.

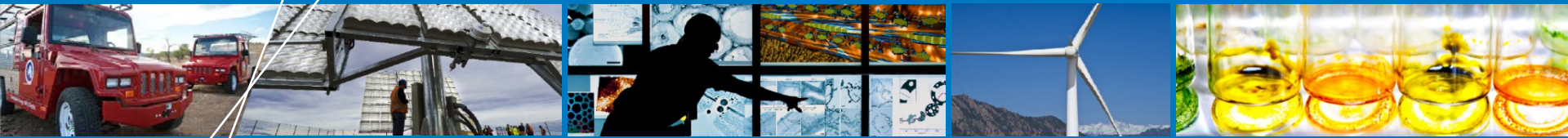
2012 Renewable Generation from Power Plants: Plants Without v. With a PPA Counterparty by RTO



- The amount of PPA-based renewable generation identified in this analysis varied by region: In California, most renewable generation was associated with PPAs, while in New England and New York, the majority of renewable generation was not.
- We allocate renewable generation without an associated PPA by RTO; the greatest amount of renewable generation without a PPA was located in MISO.

Summary: 2012 Power Flow Estimates

- Understanding how power is contracted can provide insight into how power may flow across states or regions.
- However, these estimates do not provide a complete picture of how generation may have been used to meet RPS compliance requirements.
- In the Western U.S., California, Utah, Arizona, and, to a lesser degree, Colorado and Washington, were net importers of renewable generation in 2012, while other states were net exporters.
- Eastern states rich in wind resources were typically net exporters of renewable generation in 2012.



Observations and Further Research

Observations

- 2012 REC tracking data showed that RPS compliance used a significant amount of cross-state transactions.
 - States on average sourced 61% of 2012 RPS requirements from in-state resources (65% on weighted average basis).
- The amount of generation associated with these transactions varied by state and region.
- 2012 power flow estimates of cross-state transactions at the level of individual plants demonstrate similar conditions.
- Not all generation from small renewable generators is captured in REC tracking systems or in the power flow estimates.

Questions for Further Research

The data presented here could be further examined to help answer the following RPS-related questions:

- To what extent are RECs from older generators used to meet RPS compliance requirements?
- To what extent are RECs generated in an earlier year used to meet future year RPS compliance requirements?
- Which states have large banks of existing RECs that could be used for future year compliance?
- In the Eastern Interconnection, to what extent do cross-state renewable energy PPA flows stay within NERC or RTO regions?
- What additional data sources could be developed to inform and strengthen future analyses?

Answers to these questions could improve our understanding of the impacts of RPS policies.

Acknowledgments

- The authors would like to thank the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy's Strategic Programs Office for funding this analysis. In particular, the authors are grateful to Stephen Capanna and Ookie Ma for their support of this project.
- The authors would also like to thank the following individuals for providing data for and/or review of this work: Lori Bird, Jaquelin Cochran, Jeffrey Logan, Gian Porro, Robin Newmark and David Mooney of the U.S. Department of Energy's National Renewable Energy Laboratory; Galen Barbose, Lawrence Berkeley National Laboratory; Matt Clouse, U.S. Environmental Protection Agency; Andrea Coon, WREGIS; Glenn Blackmon, Washington Department of Commerce – State Energy Office; Claire Eubanks, Missouri Public Service Commission; Angela Gould, California Energy Commission; Kelly Knutsen and Kara Podkaminer, DOE; Ed Hold, Ed Holt & Associates; Warren Leon, Clean Energy States Alliance; Julie Peacock, Oregon Department of Energy; Heidi Pitts, New Mexico Public Regulation Commission; Ankit Saraf, ICF; Margo Shurman, Montana Public Service Commission; Katherine Trachsel, Michigan Public Service Commission; and James Webb, APX, Inc.

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