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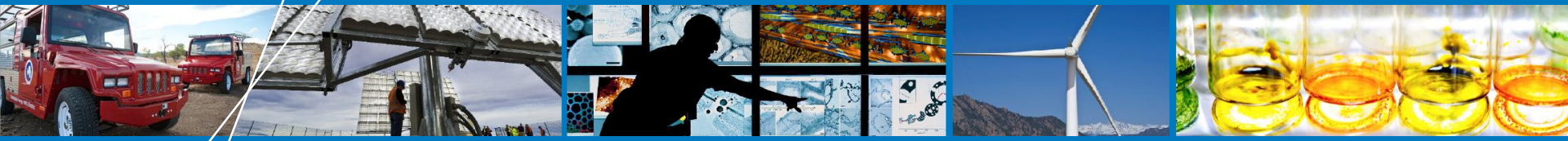
Renewable Portfolio Standards: Costs and Benefits



Lori Bird, NREL
Renewable Energy Markets
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[2] Lawrence Berkeley National Laboratory (LBNL)

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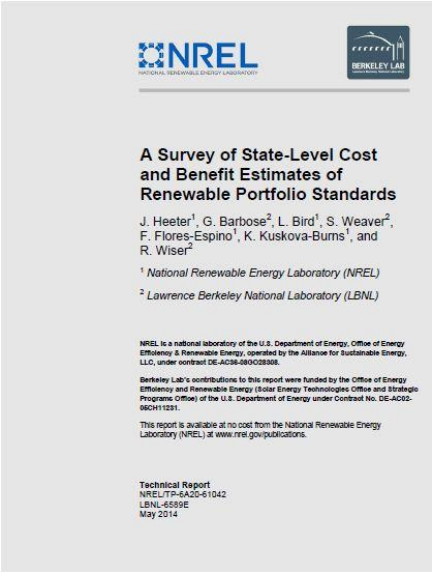
Overview

- Cost methods
- RPS compliance costs
- Benefits of RPS
- Conclusion and future work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A Survey of State-Level Cost and Benefit Estimates of Renewable Portfolio Standards

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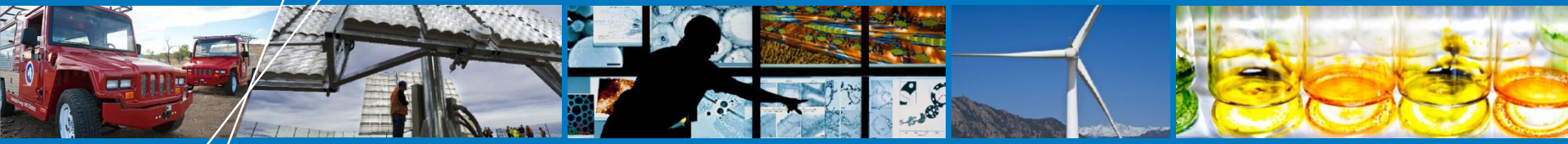


Cost Methods and Historical Cost Data

Approach: Analysis of Historical Costs

Summarize available data on incremental compliance costs – i.e., utility procurement costs net of avoided costs – over the 2010-2012 period

Basic Methodology

- **Restructured Markets:** Calculate costs based on REC and alternative compliance penalty (ACP) prices and volumes for each resource tier
- **Regulated States:** Synthesize cost estimates published by utilities and PUCs, based on the varying methods and conventions used

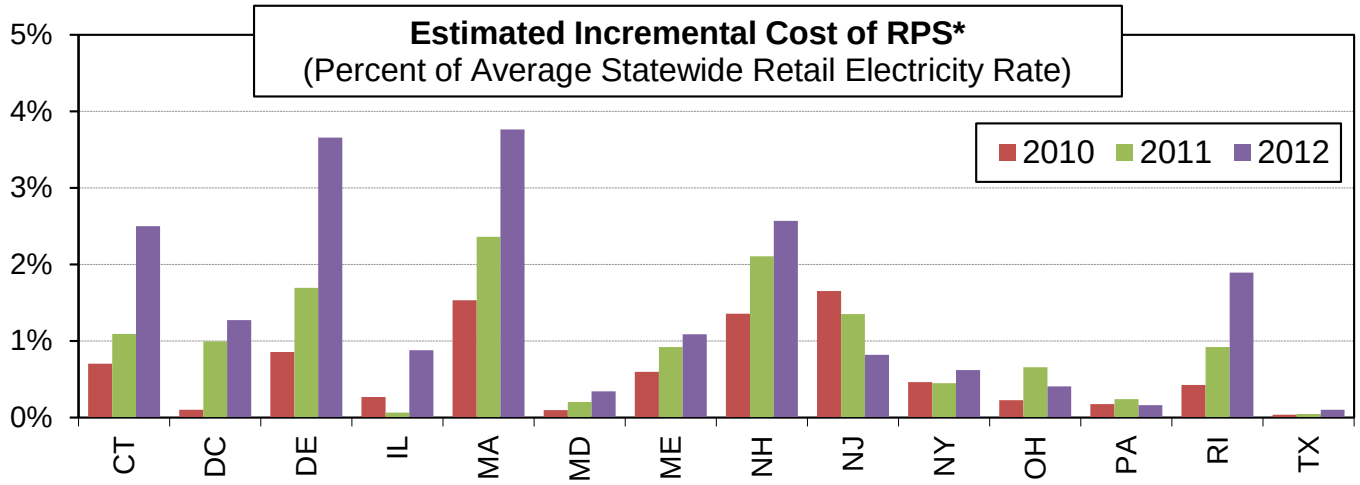
Two Metrics

- $/MWh of renewable energy procured
- % of average retail rates

Important to understand what these data do and don't represent:

- Net cost to utility, not to society nor even to ratepayers (e.g., because of regulatory lag, prohibition on pass-through of ACPs, etc.)
- Synthesis of available data, not an application of uniform methodology or set of assumptions

Restructured Markets: % of Retail Rates



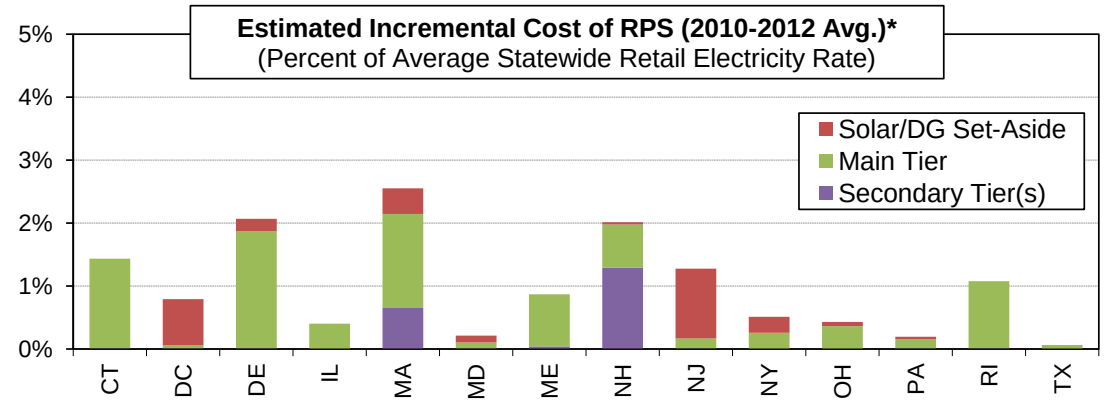
** Incremental costs are estimated from REC and ACP prices and volumes for each compliance year, which may differ from calendar years. If available, REC prices are based on average prices reported by the PUC (DC, IL, MD, ME, OH, NJ, PA); they are otherwise based on published spot market prices, supplemented 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.*

Data represent the rate impact if utility costs were fully and immediately passed through

- **Costs were generally <2% of retail rates** (10 out of 14 states in 2012), with an average of **1.4% in 2012**, but also varied significantly among states
- **Trends reflect the same drivers discussed previously:** REC pricing and mix of resource tiers
- **Also reflect differences in RPS target level** → hence costs rose over time in most states as RPS targets rose

Restructured Markets: Costs Breakdowns

RPS costs disaggregated into resource tiers (top) and RECs vs. ACPs (bottom)



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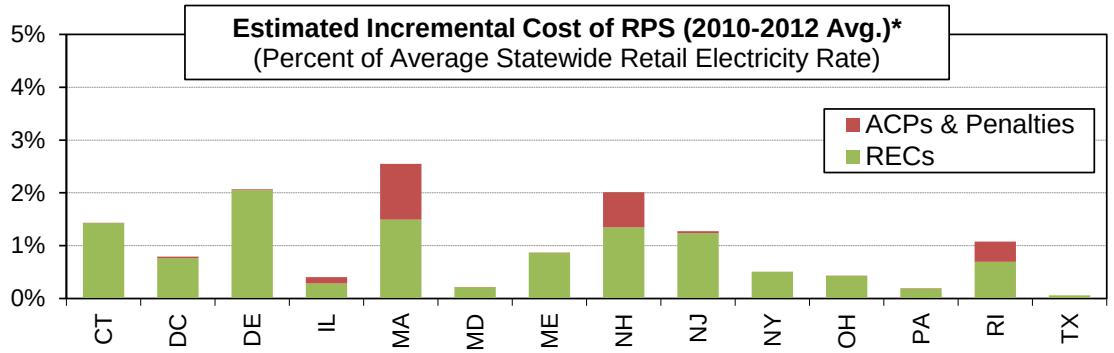
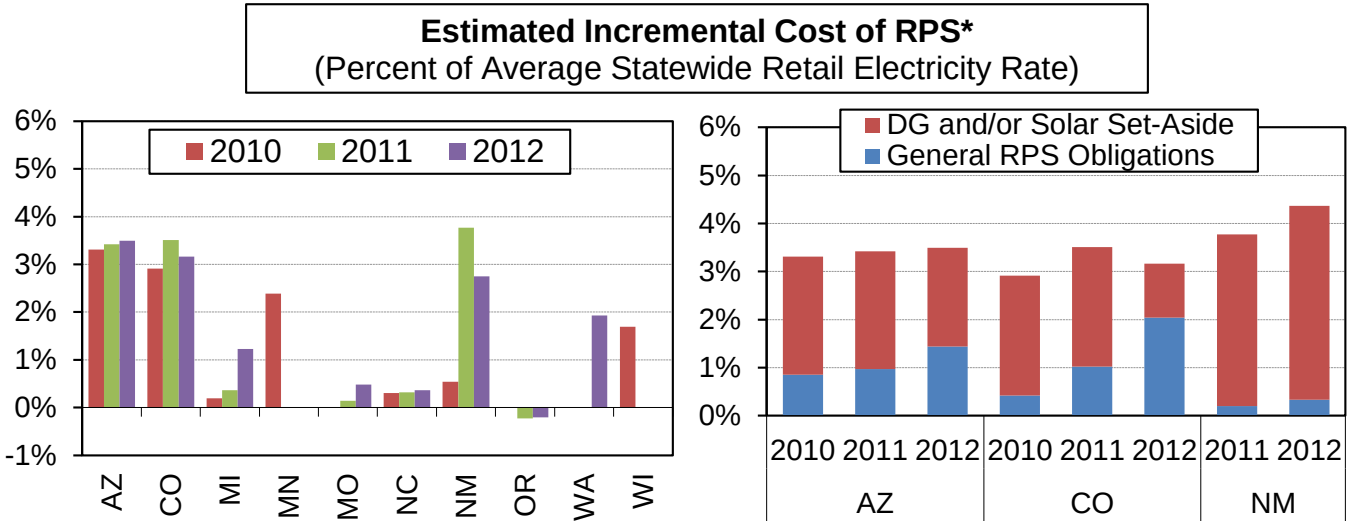


** Incremental costs are estimated from REC and ACP prices and volumes, averaged over the 2010-2012 compliance years, based on those years for which data are available. Only 2010 data available for CT and DC. If available, REC prices are based on average prices reported by the PUC (DC, IL, MD, ME, OH, NJ, PA); they are otherwise based on published spot market prices, supplemented with data on long-term contract prices where available. For IL, ACP costs reflect the requirement that competitive suppliers must meet at least 50% of RPS target with ACPs. NY does not have ACPs or penalties; all costs are therefore associated with REC procurement and program administration.*

- **Main tier requirements represented the bulk of RPS compliance costs in most states**
- **Exceptions in DC and NJ** (high solar requirements and SREC prices) **and MA and NH** (high secondary tier REC prices)
- **ACP costs generally minimal** (reflecting adequate REC supply)
- **Exceptions in MA, NH, and RI**, where shortages led to significant reliance on ACPs in some years

Regulated States: % of Retail Rates



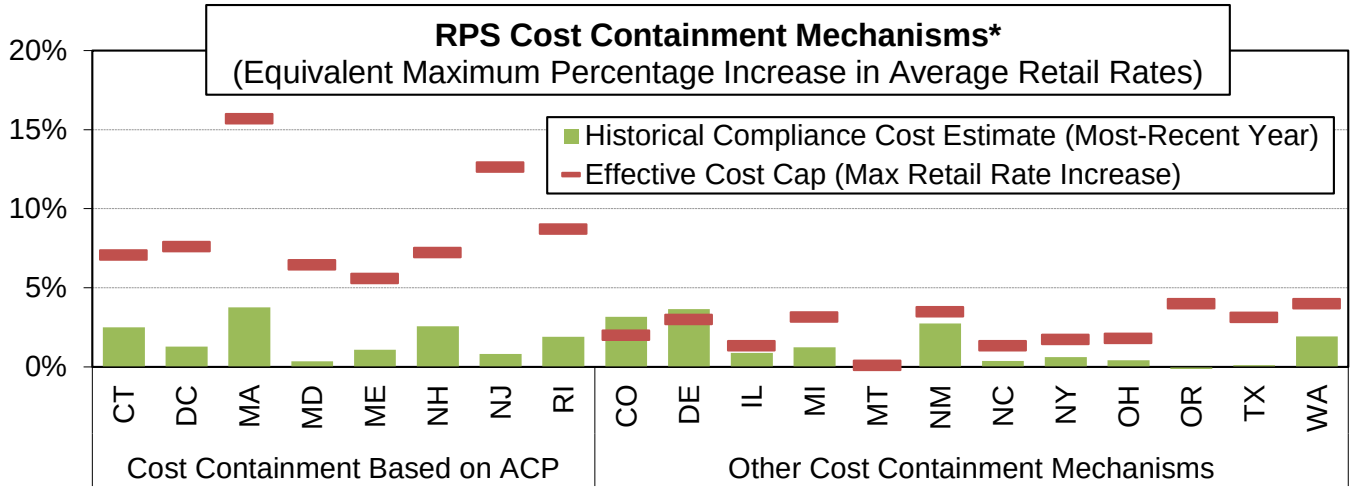
These figures include DG/solar set-aside costs along with general RPS obligations

** 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 (2010-2012) and PNM (2010 and 2012), but include only SPS in the right-hand figure. States omitted if data on RPS incremental costs are unavailable (HI, IA, KS, MT, NV).*

- **RPS costs at or below 2% of average rates in 6 of 10 states** (left-hand chart)
- **Higher costs in AZ, CO, and NM due partly to solar/DG set-aside costs** (right-hand chart) **with front-loaded costs associated with rebates and PBIs**
- **Relatively low costs in a number of states (MI, MO, NC) with low RPS targets during the analysis period and/or where targets were met primarily with pre-existing renewables**

Impact of Cost Containment Mechanisms

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; plenty of head-room currently, but may diminish as targets rise**
- **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**

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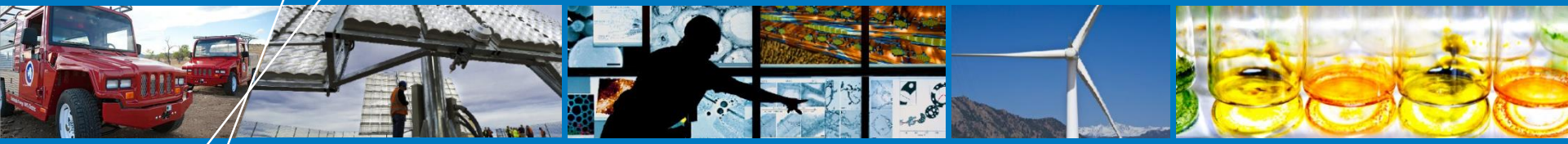

RPS Benefits Estimates

RPS Benefits Overview

- **Potential societal benefits of RPS policies include:**
  - Reduced air emissions, health benefits, fuel diversity, electricity price stability, energy security, and economic development.
  - Avoided costs of conventional generation included in cost estimates.

- **We reviewed literature on benefits estimates conducted for state RPS policies.**
  - We did not include broader renewable energy benefits literature.
  - Most studies examined were prepared for state legislatures.

- **A variety of methods were used to assess impacts; the level of analytical rigor varies as well.**

Range of Benefits Studies Identified

State	Emissions and Health	Economic Development Impacts	Wholesale Market Impacts	Study required?	Study
CT	✔			As part of IRP	The Brattle Group et al. 2010
		✔			CEEEP and R/ECON 2011
DE	✔			As part of IRP	DPL 2012
IL	✔	✔	✔	✔	IPA 2013
ME	✔	✔	✔	✔	LEI 2012
MA			✔	✔	EOHED and EOEEA 2011
MI		✔	✔	✔	MPSC 2013
NY	✔	✔	✔	✔	NYSERDA 2013b; 2013c
OH	✔			✔	PUCO 2013a
			✔	✔	PUCO 2013b
OR		✔		✔	ODOE 2011

Source: RPS Cost and Benefit report http://www.nrel.gov/docs/fy14osti/61042.pdf

Emissions Benefits

- **Two main estimation methods:**
  - Electric sector modeling (CT, OH, DE, IL, NY)
  - Displaced marginal generator emission rate (ME)
- **Valuation based on:**
  - Value of avoided emissions
  - Human health benefits from improved air quality
- **Challenges in comparing benefits to incremental costs:**
  - Allowance prices may already be captured in wholesale electricity prices and estimated RE incremental cost.
  - Emissions benefits are often forward looking, in contrast to historical costs, and may occur over lifetime of RE project.
- **Benefits range from $10s-100s of million dollars annually; $4-$23/MWh of renewable generation**
  - Often, the value of CO_2 assumed drives the estimates, because of the magnitude of CO_2 emission reductions

State	Estimated Monetary Impact (millions)	Benefits $/MWh of RE	Period
CT	N/A	N/A	2020
OH	N/A	N/A	2014
ME	$13	$7	Annual
DE	$980 - $2,200	N/A	2013 – 2022
IL	$75	$11	2011
NY	N/A	N/A	2002-2006
	$312 - $2,196	$3–$22	2002 – 2037
	$48	$0.5	2002 – 2037

Economic Development Impacts

State	Estimated Monetary Impact (million)	Benefit $/MWh of RE	Period
CT	Negative to positive GSP impact	N/A	Through 2020
IL	$3003	$14	Construction
	$140	$16	Annual, during project lifespan
ME	$1,147	$24	Construction
	$7.3	$4	Annual, during project lifespan
MI	$159.8	N/A	Construction
NY	$1,252	$13	Project lifespan
	$921	$9	Project lifespan
OR	Not estimated	N/A	Project lifespan

- **Economic impacts of RPS include:**
  - Jobs, direct investment from construction and operation of facilities, tax revenues, and indirect and induced spending
  - Changes in electricity prices can have economic impacts
- **Approaches to assessing economic impacts:**
  - Input-output models or case studies (IL, ME, MI, OR)
  - Economic modeling (CT, NY)
- **Net or gross impacts is a key issue**
  - Net impacts consider shifts in employment
  - Typically assessed over project lifetime
- **One-time construction benefits on order of $100s of millions; annual ongoing benefits over project lifetime in $10s to $100s millions**
- **Benefit equivalent to $22-$30/MWh of renewable generation**

Wholesale Market Price Suppression

- **Renewable energy can depress wholesale market prices by displacing more expensive generators from the dispatch stack**
- **Typically assessed through dispatch modeling**
  - Scenarios with and without RE
- **Effect may be temporary**
- **Effects may be captured in incremental cost estimates**
  - Embedded in wholesale prices
- **Market price suppression $0.05-1.3/MWh (total market effect)**
- **Benefit equivalent to $2-$50/MWh of renewable generation**

State	Estimated Monetary Impact	Benefit $/MWh of RE	Period
ME	$4.5 million ($0.375/MWh reduction in wholesale prices)	$2	2010
MA	$328 million	~$50	2012
IL	$177 million ($1.3/MWh reduction in wholesale prices)	$26	2011
MI	2% decline in wholesale prices from wind, net imports, and decrease in load.	N/A	2011
NY	$455 million	$5	Project lifespan
OH	($0.05-0.17/MWh reduction in wholesale prices)	N/A	2014

Conclusions and Future Work

- **Comparisons of incremental RPS cost data across states are limited by different methods employed; cost estimates rely on available data.**
- **Over the 2010-2012 period, average estimated incremental RPS compliance costs were about 1% of retail electricity rates**
  - Restructured markets incremental cost estimates range from well below $10/MWh to upwards of $60/MWh
  - Regulated markets incremental costs were typically near or below $20/MWh
- **In most states, future incremental RPS compliance costs are limited by cost containment mechanisms**.
- **States have most commonly estimated RPS benefits associated with avoided emissions ($4-23/MWh of renewable generation), economic development ($22-30/MWh), and/or wholesale electricity price suppression ($2-50/MWh).**
- **Comparison of benefits to costs is challenging because of differences in methods and analytical rigor, variation in the timeframe of analysis, the limited benefits analyzed, and because incremental costs may be capturing some benefits.**
- **Future work could be done to comprehensively assess costs and benefits, using similar methodologies and level of rigor.**
- **Ongoing RPS cost assessment and standardization efforts in some states might also be useful to other states (CA, DE, MN, OR, WA).**