

# State RPS Fulfillment

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# RPS and Carbon

- **RPS are State requirements to use renewable energy**
- **Renewable energy sources form or replenish naturally in a short period of time and consist of solar, geothermal, wind, biomass from plants and hydropower from flowing water. Nonrenewable energy sources do not form or replenish in a short period of time and consist of crude oil, natural gas, coal and uranium (nuclear energy).**
- **Renewable energy means carbon free or carbon neutral**



# Cross state subsidies through RPS

- **State RPS requirements may allow RECs purchased from other states**
- **REC producers may factor price into offers**
- **It is impossible to prevent leakage**



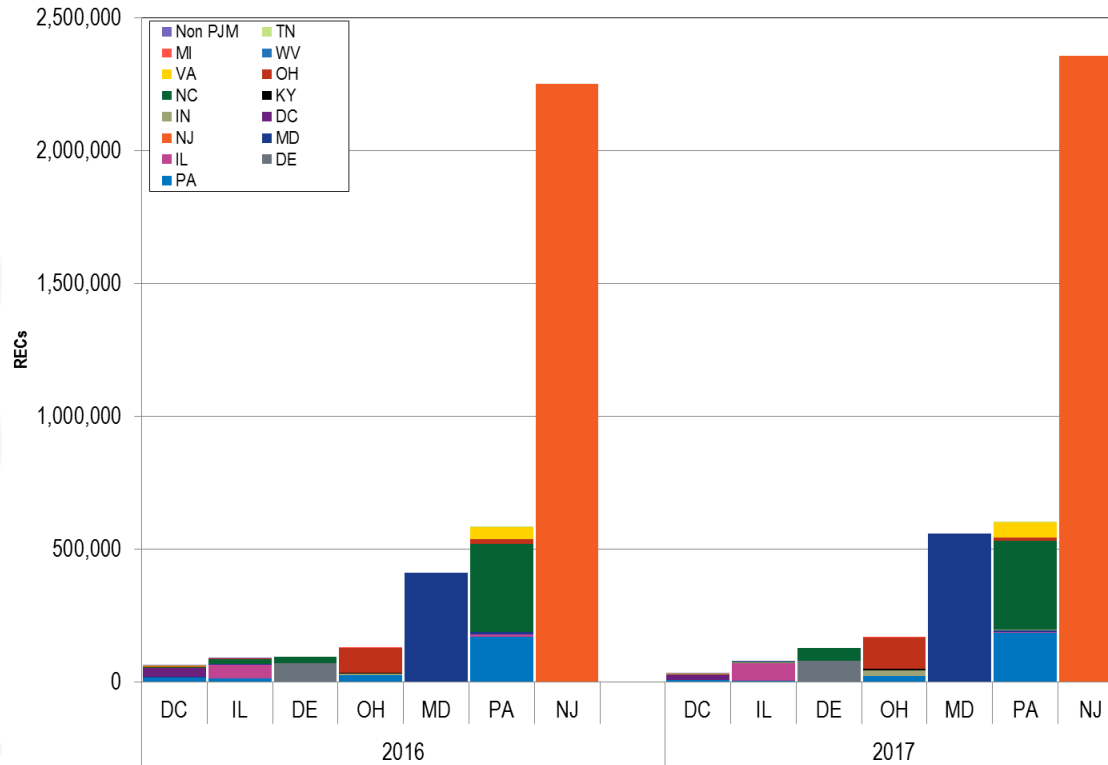
# Geographic restrictions on REC purchases for RPS for PJM States

State with RPS	RPS Contains In-state Provision	Geographical Requirements for RPS Compliance
Delaware	No	RECs must be purchased from resources located either within PJM or from resources outside of PJM that are directly deliverable into Delaware.
Illinois	Yes	All RECs be purchased from resources located within Illinois or from resources located in adjacent states that meet certain public interest criteria.
Maryland	No	RECs must come from within PJM, 10-30 miles offshore the coast of Maryland or from a control area adjacent to PJM that is capable of delivering power into PJM.
Michigan	Yes	RECs must either come from resources located within Michigan or anywhere in the service territory of retail electric provider in Michigan that is not an alternative electric supplier. There are many exceptions to these requirements (see Michigan S.B. 213).
New Jersey	No	RECs must either be purchased from resources located within PJM or from resources located outside of PJM for which the energy associated with the REC is delivered to PJM via dynamic scheduling.
North Carolina	Yes	Dominion, the only utility located in both the state of North Carolina and PJM, may purchase RECs from anywhere. Other utilities in North Carolina not located in PJM are subject to different REC requirements (see G.S. 62-113.8).
Ohio	Yes	All RECs must be generated from resources that are located in the state of Ohio or have the capability to deliver power directly into Ohio. Any renewable facility located in a state contiguous to Ohio has been deemed deliverable into the state of Ohio. For renewable resources in noncontiguous states, deliverability must be demonstrated to the Public Utilities Commission of Ohio.
Pennsylvania	Yes	RECs must be purchased from resources located within PJM. All SRECs used for compliance with the Solar PV standard must source from solar PV resources within the state of Pennsylvania.
Washington, D.C.	No	RECs must be purchased from either a PJM state or a state adjacent with PJM. A PJM state is defined as any state with a portion of their geographical boundary within the footprint of PJM. An adjacent state is defined as a state that lies next to a PJM state, i.e. SC, GA, AL, AR, IA, NY, MO, MS, and WI.
State with Voluntary Standard		
Indiana	Yes	At least 50 percent of RECs must be purchased from resources located within Indiana.
Virginia	No	RECs must be purchased from the RTO or control area in which the participating utility is a member.

# Solar RPS

- **State RPS requirement only fulfilled by solar generation**
- **States may allow purchase of RECs across state lines**

# State fulfillment of Solar RPS



# State fulfillment of Solar RPS

	State SREC	Import SREC
2016 DC Solar	49.8%	50.2%
IL Solar Renewable	56.5%	43.5%
DE Solar Eligible	76.5%	23.5%
OH Solar Renewable Energy Source	73.3%	26.7%
MD Solar	100.0%	0.0%
PA Solar	29.1%	70.9%
NJ Solar	100.0%	0.0%
2017 DC Solar	17.2%	82.8%
IL Solar Renewable	87.6%	12.4%
DE Solar Eligible	61.9%	38.1%
OH Solar Renewable Energy Source	69.0%	31.0%
MD Solar	100.0%	0.0%
PA Solar	30.6%	69.4%
NJ Solar	100.0%	0.0%

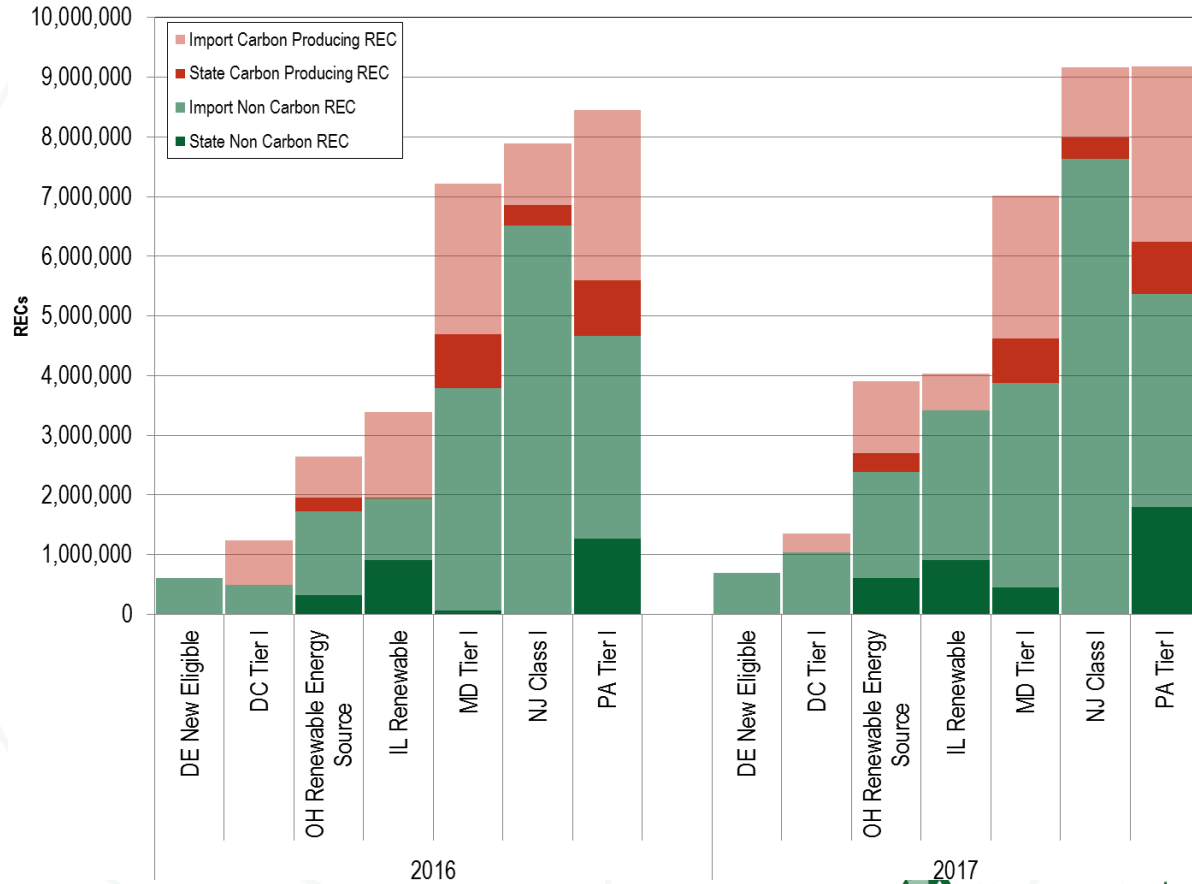
# Tier I equivalent RPS

- **Tier I does not mean renewable**
- **Depending on the state, the RPS requirement can be fulfilled by wind, solar, hydro (“Non Carbon REC”) or with landfill gas, captured methane, wood, black liquor, etc. (“Carbon Producing REC”)**
- **States generally allow purchase of RECs across state lines**





# State fulfillment of Tier I equivalent RPS



# State fulfillment of Tier I equivalent RPS

Year	REC Type	State Non Carbon REC	Import Non Carbon REC	State Carbon Producing REC	Import Carbon Producing REC
2016	DE New Eligible	1.0%	99.0%	0.0%	0.0%
	DC Tier I	0.0%	40.5%	0.0%	59.5%
	OH Renewable Energy Source	12.3%	52.8%	8.7%	26.2%
	IL Renewable	27.1%	30.3%	0.1%	42.5%
	MD Tier I	0.8%	51.7%	12.5%	35.0%
	NJ Class I	0.0%	82.5%	4.5%	13.0%
	PA Tier I	15.1%	40.2%	11.1%	33.7%
2017	DE New Eligible	0.7%	99.3%	0.0%	0.0%
	DC Tier I	0.0%	77.2%	0.0%	22.8%
	OH Renewable Energy Source	15.6%	45.8%	8.1%	30.6%
	IL Renewable	22.5%	62.3%	0.0%	15.2%
	MD Tier I	6.5%	48.9%	10.7%	34.0%
	NJ Class I	0.1%	83.2%	3.9%	12.8%
	PA Tier I	19.6%	38.9%	9.4%	32.0%

# Carbon Allowance Contribution to 2018 PJM Load Weighted LMP by Zone

Zone	LMP (\$/MWh)	Carbon Allowance Contribution	
		\$/MWh	Percent
AECO	\$37.06	\$0.09	0.3%
AEP	\$37.79	\$0.15	0.4%
APS	\$39.78	\$0.17	0.4%
ATSI	\$40.19	\$0.17	0.4%
BGE	\$44.03	\$0.19	0.4%
ComEd	\$30.05	\$0.06	0.2%
DAY	\$38.96	\$0.22	0.6%
DEOK	\$39.16	\$0.21	0.5%
DLCO	\$39.98	\$0.17	0.4%
DPL	\$43.76	\$0.30	0.7%
Dominion	\$43.16	\$0.17	0.4%
EKPC	\$36.20	\$0.13	0.4%
JCPL	\$37.08	\$0.14	0.4%
Met-Ed	\$37.06	\$0.17	0.5%
PECO	\$36.36	\$0.21	0.6%
PENELEC	\$37.90	\$0.14	0.4%
PPL	\$35.95	\$0.15	0.4%
PSEG	\$36.68	\$0.17	0.5%
Pepco	\$42.60	\$0.19	0.5%
RECO	\$37.40	\$0.15	0.4%
PJM	\$38.24	\$0.16	0.4%

# Scenario Analysis

- **All fossil units in PJM incur carbon emission costs. In 2018, only generation units in Maryland and Delaware incurred carbon emission costs as part of their participation in RGGI.**
- **Carbon priced at \$5, \$10 and \$15 per metric ton**
- **Marginal unit offer price includes carbon adder**
- **Carbon Adder = {Carbon emission rate\*} x {incremental heat rate at the dispatch Point} x {Carbon price}**
- **All other parameters are assumed to be equal**

\* Carbon emission rates for generation outside RGGI are obtained from EIA, Table A03

[https://www.eia.gov/electricity/annual/html/epa\\_a\\_03.html](https://www.eia.gov/electricity/annual/html/epa_a_03.html)



# Scenario Analysis

- **Calculate the LMP for every node for every five minute interval using the recalculated marginal unit offers and generation unit participation factors**
- **Aggregate to obtain the load weighted average LMP**
- **The scenario analysis is not based on a counterfactual redispatch of the system. It is possible that the actual LMPs could be lower than the calculated LMPs in the scenario analysis if there were inframarginal units with a lower price than the marginal unit with carbon adder.**

# Scenario Analysis

	2018 LMP (\$ per MWh)	Carbon Price (\$ per metric ton)	2018 LMP with Carbon Pricing		Percent
			LMP (\$ per MWh)	Change (\$ per MWh)	
Scenario 1	\$38.24	\$5.00	\$39.94	\$1.69	4.4%
Scenario 2	\$38.24	\$10.00	\$41.80	\$3.56	9.3%
Scenario 3	\$38.24	\$15.00	\$43.66	\$5.42	14.2%



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