

# 2017 Inventory of Renewable Energy Generators Eligible for the Maryland RPS

---

KEVIN PORTER AND STACY SHERWOOD, EXETER ASSOCIATES INC.

MARYLAND RPS WORKING GROUP WEBINAR

APRIL 26, 2018

# Overview

---

- History of the Inventory Report
- RPS Requirements and changes
- Renewable Energy Market in Maryland
- Report Methodology
- Report Sources
- Overall Results
- Non-carve-out Tier 1 results and projected capacity
- Solar carve-out Tier 1 results and projected capacity
- Alternative Scenarios
- Summary

# History

---

2006

- First Inventory Report
- Report concluded that Tier 1 and Tier 2 resources would be sufficient through 2011 and 2012, respectively.
- Projected that PJM-wide renewables would experience increased competition in 2011 and 2012.

2011

- Second Inventory Report
- Report concluded that meeting solar generation requirements through 2022 would be difficult.
- Projected that additional Tier 1 investment was needed to meet the non-carve-out Tier 1 requirement in PJM.

2017

- Third and current Inventory Report (Draft)
- The Report concluded that there will likely be a shortfall of Tier 1 resources within PJM to satisfy all of RPS policies in states throughout PJM, including voluntary RPS policies.
- Projected there is sufficient resources within Maryland to satisfy the Maryland solar carve-out; as well as sufficient solar in PJM states with a solar carve-out.

# Maryland RPS Requirements by Year

RPS updates since 2011 Inventory Report:

- Tier 1 requirement increased to 25% by 2020
- RPS Solar carve-out increased to 2.5% by 2020
- Offshore wind carve-out of Tier 1 up to 2.5% of the Tier 1 requirement.
- Solar water-heating, thermal energy associated with biomass systems, and geothermal heating and cooling systems were added at Tier 1 resources.

**Maryland RPS – Percentage of Renewable Energy Required**

Year	Tier 1 Total	Solar (subset Tier 1) <sup>[a]</sup>	Offshore Wind (subset Tier 1) <sup>[b]</sup>	Tier 2 Total <sup>[c]</sup>
2006	1%	0%	0%	2.5%
2007	1	0	0	2.5
2008	2.005	0.005	0	2.5
2009	2.01	0.01	0	2.5
2010	3.025	0.025	0	2.5
2011	5	0.05	0	2.5
2012	6.5	0.1	0	2.5
2013	8.2	0.25	0	2.5
2014	10.3	0.35	0	2.5
2015	10.5	0.5	0	2.5
2016	12.7	0.7	0	2.5
2017	13.1	1.15	0	2.5
2018	15.8	1.5	0	2.5
2019	20.4	1.95	0	--
2020	25	2.5	0	--
2021 <sup>[d]</sup>	25	2.5	~1.33	--
2022	25	2.5	~1.33	--
2023+	25	2.5	~2.0	--

<sup>[a]</sup> Solar requirement began in compliance year 2008.

<sup>[b]</sup> The offshore wind carve-out by law could be a maximum of 2.5 percent beginning in 2017; however, only the approved ORECs have been included here. Other states in PJM do not have an equivalent category.

<sup>[c]</sup> Tier 2 requirement sunsets at the end of compliance year 2018.

<sup>[d]</sup> According to Maryland PSC Order No. 88192, Table 2, "Offshore Wind Component of the RPS Obligation for Purchasers of ORECs." (The percentage fluctuates annually because the ORECs are based on MWh and energy sales every year.)

# Major Changes to the Renewable Energy Market in Maryland Since the Last Report

---

- Federal incentives (Production Tax Credit and Investment Tax Credit) were implemented and extended until 2022, although actual levels of both tax credits decline each year until their expiration.
- The Maryland PSC authorized the provision of offshore renewable energy credits (ORECs) to two Maryland offshore wind projects slated to come online in 2021 and 2022.
- The costs of solar PV decreased by about 75 percent since 2010.
- Renewable energy credit (REC) and Solar REC (SREC) prices have declined.
- A three-year Community Solar Pilot for 194 MW launched in 2017.

# Report Methodology

---

- Reviewed potential to satisfy Maryland's RPS requirements from 2018 through 2030 as the requirements are held constant after the year 2020.
- Analyzed current RPS requirements in PJM, encompassing eight PJM states and DC with mandatory RPS requirements, as well as two PJM states with voluntary RPS targets.
- Aligned PJM states' RPS resources to match with Maryland's Tiers to evaluate competition for resources.
- Applicable generation was limited to resources categorized as Maryland-certified in PJM Generator Attributes Tracking System (GATS).
- Considered number of projects in the PJM Interconnection Queue against historical estimated in-service rates.
- Reviewed the capacity and number of certified renewable energy generating facilities located within PJM's footprint only. *(While this report only considered facilities within PJM to satisfy the RPS requirements, generation outside of PJM may be used to fulfill non-carve-out Tier 1 requirements, such as wind facilities in the Midwest or hydro facilities in New York.)*



# Report Sources

---

- Primary data source – PJM GATS, specifically nameplate capacity for each facility.
- Complementary data source – U.S. Energy Information Agency (EIA) Form EIA-860M.
- Capacity factors assigned to each technology based on a variety of sources.
- Current and past generation were based on the historical GATS capacity data using the designated capacity factors.
- Retail sales projections for Maryland were based on the PSC Ten-Year Plan and utility-specific growth rates in the PJM 2017 Load Forecast. The retail sale projections were lowered by 1.9 percent to account for the exemption of industrial process load.
- For the remaining states and the District of Columbia (DC), EIA-826 and MISO and PJM Load Forecasts were used.
- RPS percentages were then applied to determine future requirements for RPS-eligible resources.

# Results of the 2017 Renewable Inventory Report

---

- There is sufficient generation in PJM to satisfy Maryland's non-carve-out Tier 1 generation requirements; however, when compared with other PJM states' non-carve-out Tier 1 generation RPS requirements and voluntary goals, there is insufficient generation.
- Competition for non-carve-out Tier 1 resources within PJM is expected to increase as a result of the projected deficit.
- There is sufficient in-state solar resources to exceed the State's solar carve-out requirement annually from 2018 through the end of the study period (2030). The projected solar generation within PJM is expected to satisfy all PJM states' solar carve-outs.
- In Maryland, Tier 2 expires at the conclusion of 2018. There is more than sufficient generation available in Maryland and in PJM for Tier 2 compliance.

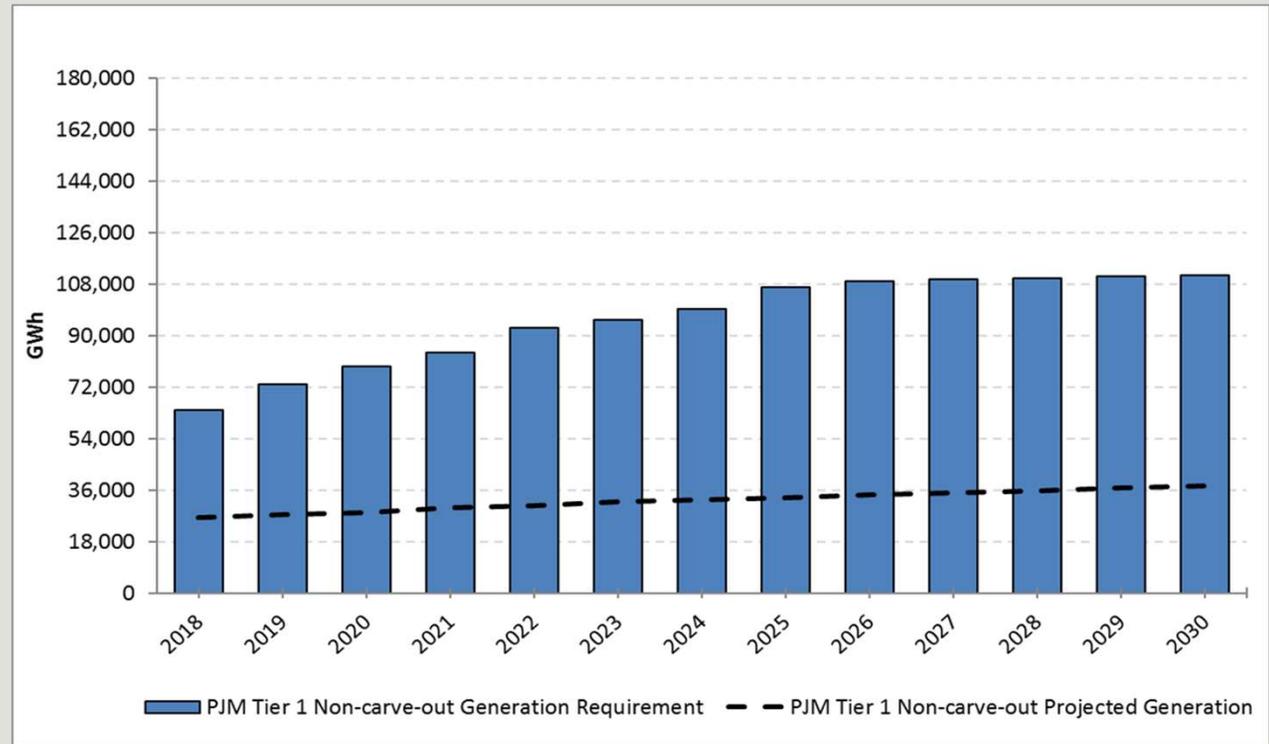
# 2017 Report Projections

Maryland		2017 GWh	2020 GWh (Projection)
Energy/RPS Requirements	Total Electric	60,788	60,702
	Tier 1 Solar Carve-out	699	1,518
	Tier 1 Non-carve-out	8,784	13,658
Estimated Generation		Annual Growth Rate Required to Meet RPS with In-State Resources	
	Tier 1 Solar Carve-out	1,367	4%
	Tier 1 Non-carve-out	1,473	N/A
PJM Region			
Energy/RPS Requirements	Total Electric	786,962	797,014
	Tier 1 Solar Carve-out	4,694	6,621
	Tier 1 Non-carve-out	56,644	79,325
Estimated Generation		Annual Growth Rate Required to Meet Current RPS	
	Tier 1 Solar Carve-out	7,182	N/A
	Tier 1 Non-carve-out	25,625	46%

# Non-carve-out Tier 1 RPS Requirements in PJM

- To meet the RPS requirements in PJM, renewable energy generation in PJM would need an annual growth rate of 46% from 2017 to 2020.
- The non-carve out Tier 1 projected annual growth rate in PJM is currently 3%.
- The projected shortfall can be partially met by solar generation used for Tier 1 and offshore wind, both in Maryland and in other PJM states.

**PJM Non-carve-out Tier 1 Generation Requirement Compared to Projected Non-carve-out Tier 1 Generation (2018-2030) (GWh)**



# Non-Carve-Out Tier 1 Projected Projects in PJM by Technology 2018-2030

## Estimated Capacity (MW)

Year	Wind	Offshore Wind	Hydro	Biomass	Other <sup>[a]</sup>	TOTAL
2018	7,264	--	265	151	1,517	9,196
2019	7,340	--	281	228	1,517	9,366
2020	7,417	--	297	304	1,517	9,536
2021	7,494	248	313	381	1,517	9,953
2022	7,571	248	328	458	1,517	10,123
2023	7,648	368	344	535	1,517	10,412
2024	7,725	368	360	612	1,517	10,582
2025	7,802	368	376	689	1,517	10,751
2026	7,879	368	392	766	1,517	10,921
2027	7,955	368	407	843	1,517	11,091
2028	8,032	368	423	920	1,517	11,260
2029	8,109	368	439	997	1,517	11,430
2030	8,186	368	455	1,073	1,517	11,599
Average Annual Growth Rates						
2018-2024	1.03%	--	5.24%	26.27%	0.00%	2.37%
2024-2030	0.97%	0.00%	3.98%	9.81%	0.00%	1.54%
2018-2030	--	--	4.61%	17.75%	0.00%	1.95%
<sup>[a]</sup> Includes black liquor, geothermal, methane, and waste-to-energy, which are based on PJM GATS and not expected to experience market growth.						

## Estimated Generation (GWh)

Energy Source	Wind	Offshore Wind	Hydro	Biomass	Other <sup>[a]</sup>	TOTAL
2018	16,543	--	1,045	1,108	7,840	26,538
2019	16,718	--	1,108	1,674	7,840	27,341
2020	16,894	--	1,170	2,240	7,840	28,144
2021	17,069	914	1,232	2,806	7,840	29,861
2022	17,244	914	1,295	3,372	7,840	30,664
2023	17,419	1,369	1,357	3,938	7,840	31,923
2024	17,594	1,369	1,419	4,503	7,840	32,726
2025	17,769	1,369	1,481	5,069	7,840	33,529
2026	17,944	1,369	1,544	5,635	7,840	34,333
2027	18,119	1,369	1,606	6,201	7,840	35,136
2028	18,294	1,369	1,668	6,767	7,840	35,939
2029	18,469	1,369	1,731	7,333	7,840	36,742
2030	18,644	1,369	1,793	7,899	7,840	37,546
Average Annual Growth Rates						
2018-2024	1.03%	--	5.24%	26.27%	0.00%	3.55%
2024-2030	0.97%	0.00%	3.98%	9.81%	0.00%	2.32%
2018-2030	--	--	4.61%	17.75%	0.00%	2.93%
<sup>[a]</sup> Includes black liquor, geothermal, methane, and waste-to-energy, which are based on PJM GATS and not expected to experience market growth.						

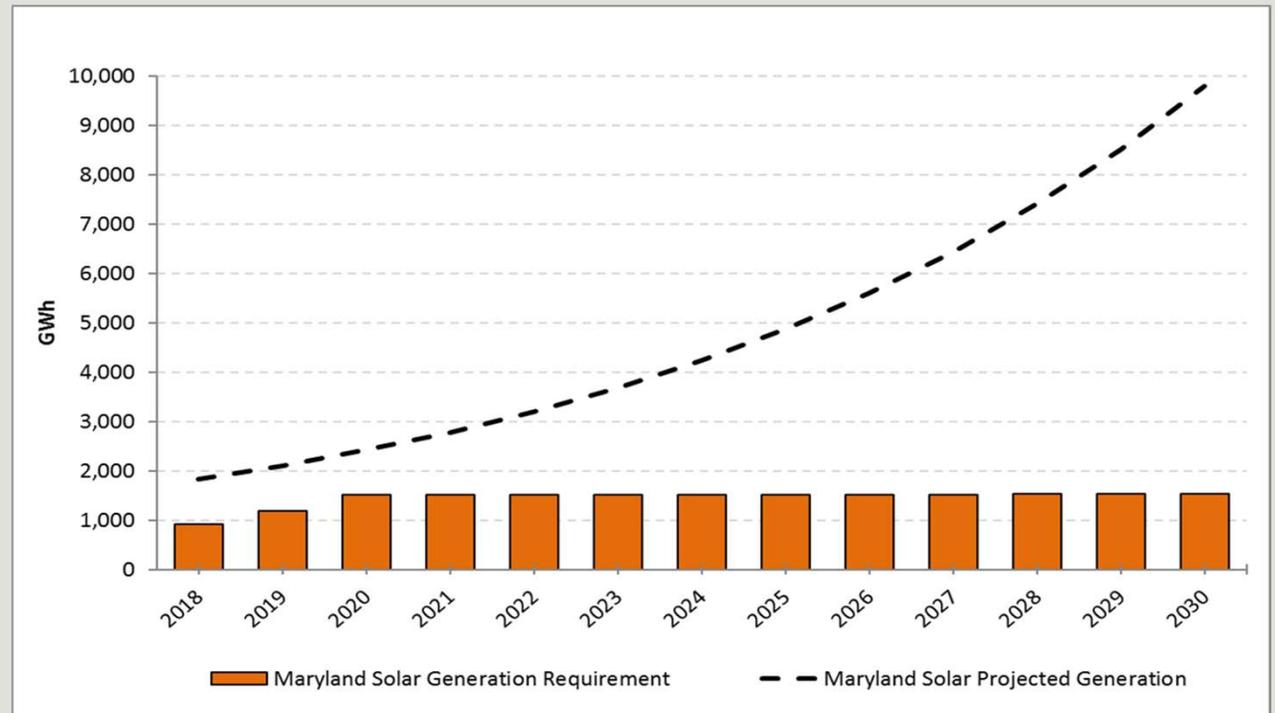
Non-carve-out Tier 1 RPS Requirements in PJM Compared to Projected PJM Renewable Energy Generation (2018-2030) (GWh)

Year	Generation Requirement	Projected Generation	Difference
2018	64,072	26,538	(37,535)
2019	73,019	27,341	(45,678)
2020	79,325	28,144	(51,181)
2021	83,998	29,861	(54,137)
2022	92,820	30,664	(62,155)
2023	95,559	31,923	(63,636)
2024	99,215	32,726	(66,489)
2025	106,964	33,529	(73,434)
2026	109,098	34,333	(74,765)
2027	109,592	35,136	(74,456)
2028	110,214	35,939	(74,275)
2029	110,641	36,742	(73,899)
2030	111,183	37,546	(73,637)
Average Annual Growth Rates			
2018-2024	7.56%	3.55%	--
2024-2030	1.92%	2.93%	--
2018-2030	4.70%	2.32%	--

# Maryland Solar Carve-out

- Maryland is expected to significantly exceed the solar generation requirements.
- Maryland is projected to be in excess of its solar carve-out requirement by 12,330 GWh by 2020 and by 68,087 GWh by 2030.

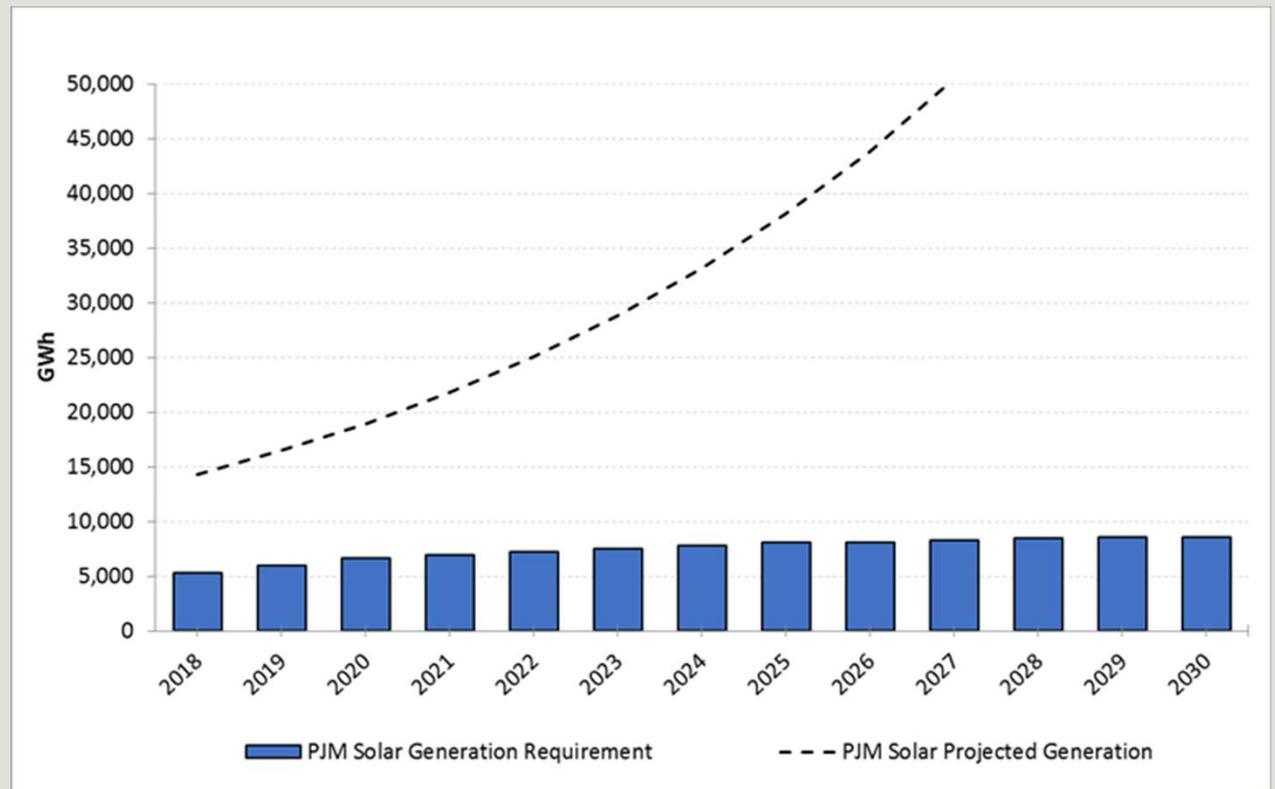
**PJM Solar Carve-out Generation Requirement Compared to Projected Solar Carve-out Generation (2018-2030) (GWh)**



# PJM Solar Carve-out

- All of the PJM states with solar carve-outs are expected to exceed their respective solar generation requirements as well.

### PJM Solar Carve-out Generation Requirement Compared to Projected Solar Carve-out Generation (2018-2030) (GWh)



# Potential Solar Generation to Meet Deficit of Non-carve-out Tier 1 Generation Requirements in PJM (2018-2030) (GWh)

Year	Deficit	Excess PJM Solar	Remaining Deficit
2018	(37,535)	9,006	(28,528)
2019	(45,678)	10,538	(35,140)
2020	(51,181)	12,330	(38,852)
2021	(54,137)	14,819	(39,319)
2022	(62,155)	17,803	(44,353)
2023	(63,636)	21,275	(42,361)
2024	(66,489)	25,329	(41,160)
2025	(73,434)	30,024	(43,411)
2026	(74,765)	35,751	(39,014)
2027	(74,456)	42,158	(32,298)
2028	(74,275)	49,544	(24,732)
2029	(73,899)	58,135	(15,764)
2030	(73,637)	68,087	(5,550)

# Alternative Scenario – What if Black Liquor is Disqualified?

---

- All else equal, the elimination of black liquor from the Maryland RPS would have adverse impacts on PJM states and D.C. for the following reasons:
  - In 2016, black liquor generation was used to satisfy 23% of the non-carve-out Tier 1 compliance in Maryland.
  - Since other PJM states with an RPS do not categorize black liquor as a Tier 1 resource, the “pool” of eligible Tier 1 generation in PJM would decrease by the projected amount of black liquor that would have been used to meet the Maryland RPS, which is approximately 4,240 GWh.
  - Consequently, the decrease in the “pool” of eligible resources would increase the demand for Tier 1 RECs. PJM states with an RPS would need to, in aggregate, increase imports into PJM to meet their collective non-carve-out Tier 1 requirements.
- Elimination of any other eligible Tier 1 resource would not have a significant impact because there would be no reduction to the overall generation “pool.”
  - For example, if small hydro was no longer eligible in Maryland, another state where small hydro is eligible could purchase the RECs from small hydro generation that Maryland formerly utilized to satisfy its RPS. Maryland could then purchase RECs from another eligible technology that the other state no longer need.

## Alternative Scenario – 50% Maryland RPS by 2030

- An increase in the Maryland RPS requirement will put upward pressure on Maryland REC prices, making it more economic to apply RECs from other states to Maryland.
- An increase in Maryland REC prices will in turn increase REC prices in other PJM states with an RPS. With an overall increase, renewable energy projects that may have been unprofitable at lower REC prices may become profitable, resulting in an increase in the amount of RECs in the market.

**Scenario for 50 Percent Maryland RPS Requirements by 2030, by Percentages**

Year	Tier 1 Solar	ORECs	Non-carve-out Tier 1	TOTAL
2018	1.77%	0.00%	16.51%	18.28%
2019	2.04	0.00	18.72	20.76
2020	2.31	1.33	20.93	24.57
2021	2.58	1.33	23.14	27.04
2022	2.85	1.33	25.35	29.52
2023	3.12	1.98	27.56	32.65
2024	3.38	1.98	29.76	35.13
2025	3.65	1.98	31.97	37.61
2026	3.92	1.98	34.18	40.09
2027	4.19	1.98	36.39	42.56
2028	4.46	1.98	38.60	45.04
2029	4.73	1.98	40.81	47.52
2030	5.00	1.98	43.02	50.00

## Alternative Scenario – 50% Maryland RPS by 2030 Impact on Non-carve-out Tier 1

- When evaluated only for Maryland, there is sufficient resources within PJM to comply with Maryland’s non-carve-out Tier 1 requirement.
- When considering all PJM RPS requirements, there would be insufficient resources within PJM to satisfy non-carve out Tier 1 requirements which would result in substational competition for those resources.

**Tier 1 Non-carve-out RPS Requirements in PJM Compared to Maryland Current and 50% RPS Requirements by 2030 (GWh)**

Year	Difference in Maryland Tier 1 Non-carve-out Current RPS and 50% RPS Requirement	PJM Tier 1 Non-carve-out Generation Requirement	PJM Tier 1 Non-carve-out Projected Generation	Difference Between PJM Generation Requirement and PJM Projected Generation
2018	(177)	64,072	26,538	(37,358)
2019	(1,356)	73,019	27,341	(44,322)
2020	(954)	79,325	28,144	(50,227)
2021	1,192	83,998	29,861	(55,329)
2022	2,531	92,820	30,664	(64,686)
2023	4,263	95,559	31,923	(67,899)
2024	5,614	99,215	32,726	(72,103)
2025	6,953	106,964	33,529	(80,388)
2026	8,305	109,098	34,333	(83,070)
2027	9,660	109,592	35,136	(84,116)
2028	11,034	110,214	35,939	(85,310)
2029	12,389	110,641	36,742	(86,288)
2030	13,747	111,183	37,546	(87,384)

## Alternative Scenario – 50% Maryland RPS by 2030 with 5% Solar Carve-out

- Maryland in-state solar energy generation is projected to exceed a 5% solar generation requirement.
- Increasing the solar requirement would reduce the available solar generation that could be used to meet the non-carve-out Tier 1 deficit projected through 2030.

### 5% Maryland RPS Requirements for Solar Compared to Projected Maryland Solar Energy Generation (2018-2030) (GWh)

Year	5% Solar Carve-out Generation Requirement	Projected Maryland Solar Generation	Difference
2018	1,076	1,830	753
2019	1,239	2,104	865
2020	1,401	2,420	1,019
2021	1,562	2,782	1,221
2022	1,725	3,200	1,475
2023	1,888	3,680	1,792
2024	2,055	4,232	2,177
2025	2,218	4,867	2,648
2026	2,385	5,597	3,212
2027	2,552	6,436	3,884
2028	2,723	7,401	4,679
2029	2,888	8,512	5,623
2030	3,055	9,788	6,733
<b>Average Annual Growth Rates</b>			
2018-2024	11.39%	15.00%	--
2024-2030	6.83%	15.00%	--
2018-2030	9.09%	15.00%	--

# Summary

---

- There are sufficient renewable resources, current and projected, to meet the Tier 2 and Tier 1 solar carve-out requirements in the Maryland RPS.
- In contrast, there is a projected shortfall of Tier 1 RECs to meet future Maryland RPS requirements.
- That projected shortfall will put upward pressure on Tier 1 REC prices in Maryland and in other PJM states.
- Higher Tier 1 REC prices will encourage more renewable energy projects, changes in REC sales among states based on differentials in REC prices, and increased imports of RECs into PJM.
- Market dynamics, therefore, can be anticipated to address much, if not all, of the projected shortfalls in non-carve-out Tier 1 resources.

# Extra Slides

---

# Maryland Tier 1 and Tier 2 Eligible Resources

## Tier 1 Eligible Facilities

Solar PV and solar thermal systems (located within Maryland for the carve-out) that produce electric power, and solar water-heating systems constructed after June 1, 2011

Land-based and offshore wind

Qualifying biomass<sup>[a]</sup>

Methane from the anaerobic decomposition of organic materials in a landfill or a wastewater treatment plant

Geothermal including energy generated through geothermal exchange from or thermal energy avoided by groundwater or a shallow ground source

Ocean including energy from waves, tides, currents, and thermal differences

Fuel cells powered by methane or biomass

Hydroelectric plants under 30 MW licensed by FERC or exempt from licensing

Poultry litter-to-energy within Maryland

Waste-to-energy (including blast furnace gas and refuse-derived fuels) within Maryland

## Tier 2 Eligible Facilities

Hydroelectric plants other than pumped storage hydropower

Renewable Energy  
Generating  
Facilities in PJM  
Certified as Eligible  
for Maryland RPS  
Compliance (as of  
EOY 2017)

State	Tier 1		Tier 2 No. of Facilities
	No. of Solar Carve-out Facilities	No. of Non-carve- out Facilities	
Maryland	54,973	101	1
Delaware	4,511	4	--
District of Columbia	3,352	--	--
Illinois	832	38	--
Indiana	49	11	--
Kentucky	122	6	--
Michigan	7	6	--
New Jersey	80,002	6	--
North Carolina	86	3	2
Ohio	2,343	22	1
Pennsylvania	16,275	39	3
Tennessee	4	1	--
Virginia	2,198	36	1
West Virginia	405	9	3
<b>TOTAL:</b>	<b>165,159</b>	<b>282</b>	<b>11</b>

[a] There is no column for the offshore wind carve-out, as there are no operational facilities as of December 31, 2017. The facilities in other states are categorized by Maryland Tier 1 and Tier 2 eligibility, as further explained in Section III.

Existing Generation Capacity and Number of Installed Units in PJM Certified as Tier 1 Under the Maryland RPS (as of EOY 2017)

State	MW/ No. of Units	Tier 1 Facility Category								TOTAL
		Solar	Wind	Hydro- electric <sup>[a]</sup>	Methane <sup>[b]</sup>	Qualifyin g Biomass	Waste- to- Energy	Black Liquor	Geo- thermal	
Maryland	MW	975	180	20	23	4	258	30	2	1,492
	No.	54,973	7	2	10	2	4	1	75	55,074
Delaware	MW	97	--	--	9	--	--	--	--	106
	No.	4,511	--	--	4	--	--	--	--	4,515
District of Columbia	MW	45	--	--	--	--	--	--	--	45
	No.	3,352	--	--	--	--	--	--	--	3,352
Illinois	MW	55	2,719	20	129	--	--	--	--	2,924
	No.	832	17	3	18	--	--	--	--	870
Indiana	MW	11	1,701	8	--	--	--	--	--	1,721
	No.	49	9	2	--	--	--	--	--	60
Kentucky	MW	12	--	--	16	5	--	--	--	33
	No.	122	--	--	5	1	--	--	--	128
Michigan	MW	5	--	15	3	--	--	--	--	23
	No.	7	--	5	1	--	--	--	--	13
New Jersey	MW	2,211	8	11	50	--	--	--	--	2,280
	No.	80,002	1	1	4	--	--	--	--	80,008
North Carolina	MW	784	208	--	--	--	--	124	--	1,116
	No.	86	1	--	--	--	--	2	--	89
Ohio	MW	172	418	--	71	--	--	51	--	713
	No.	2,343	6	--	15	--	--	1	--	2,365
Pennsylvania	MW	321	997	95	144	--	--	83	--	1,640
	No.	16,275	13	7	17	--	--	2	--	16,314
Tennessee	MW	0	--	--	--	--	--	49	--	49
	No.	4	--	--	--	--	--	1	--	5
Virginia	MW	431	--	29	111	140	124	239	--	1,074
	No.	2,198	--	13	16	2	1	4	--	2,234
West Virginia	MW	4	652	58	--	--	--	--	--	714
	No.	405	5	4	--	--	--	--	--	414
TOTAL:	MW	5,124	6,884	257	557	149	382	576	2	13,930
	No.	165,159	59	37	90	5	5	11	75	165,441

Note: Totals may not equal sum of components due to independent rounding.

Existing Generation Capacity and Number of Installed Units in PJM Certified as Tier 2 Under the Maryland RPS (as of EOY 2017)

	MW/ No. of Units	Tier 2 Facility Category Hydroelectric <sup>[a]</sup>	TOTAL
Maryland	MW	531	531
	No.	1	1
North Carolina	MW	278	278
	No.	2	2
Ohio	MW	47	47
	No.	1	1
Pennsylvania	MW	501	501
	No.	3	3
Virginia	MW	8	8
	No.	1	1
West Virginia	MW	159	159
	No.	3	3
TOTAL:	MW	1,525	1,525
	No.	11	11

Note: PJM states with no Tier 2 eligible facilities certified in Maryland under Tier 2 include: Delaware, Illinois, Indiana, Kentucky, Michigan, New Jersey, and Tennessee; the District of Columbia also has no Tier 2 eligible facilities.

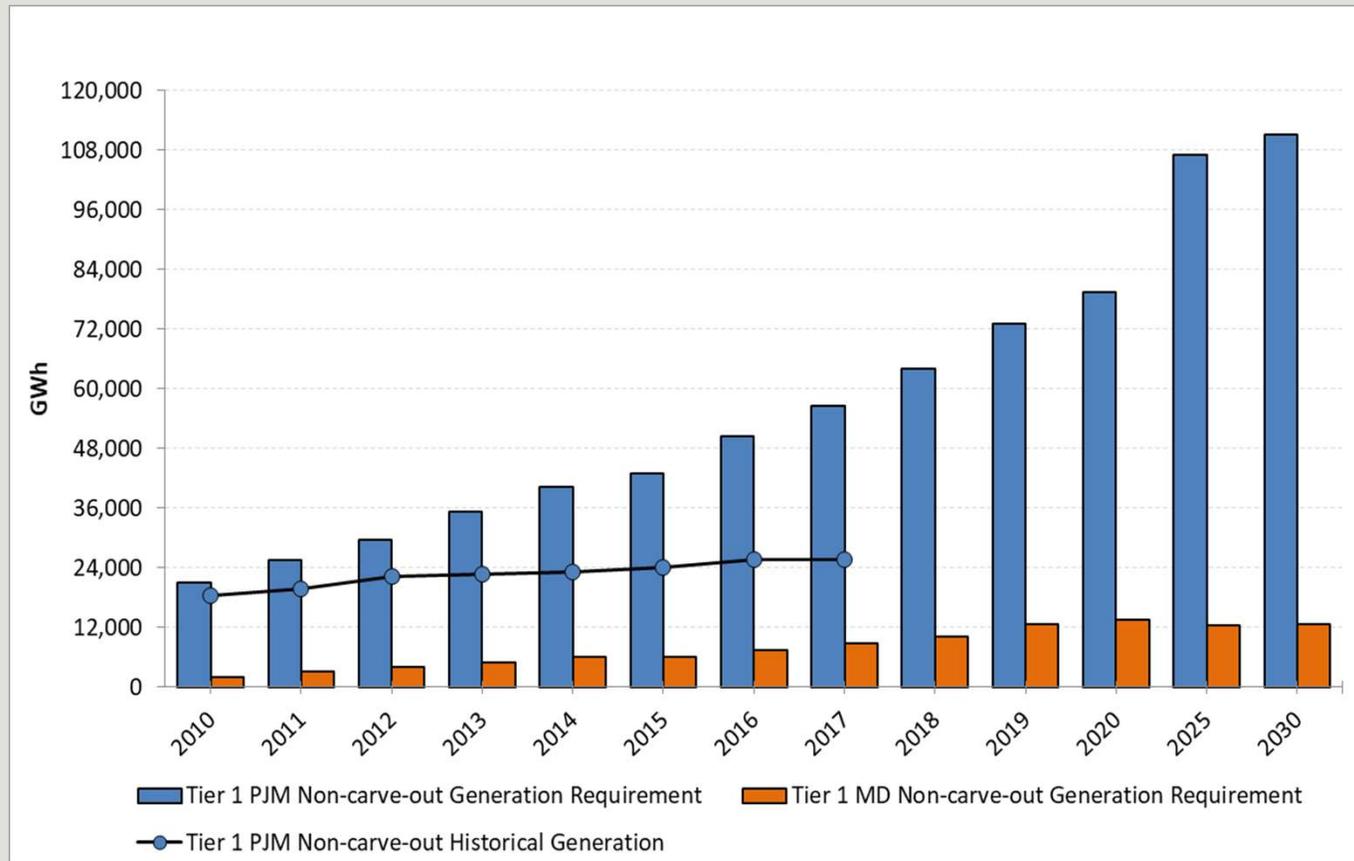
<sup>[a]</sup> Hydroelectric for Tier 2 includes all hydroelectric facilities (other than those less than 30 MW) that were constructed at a dam that was in operation prior to 2004.

## Electric Generating Capacity Factors Estimated for PJM

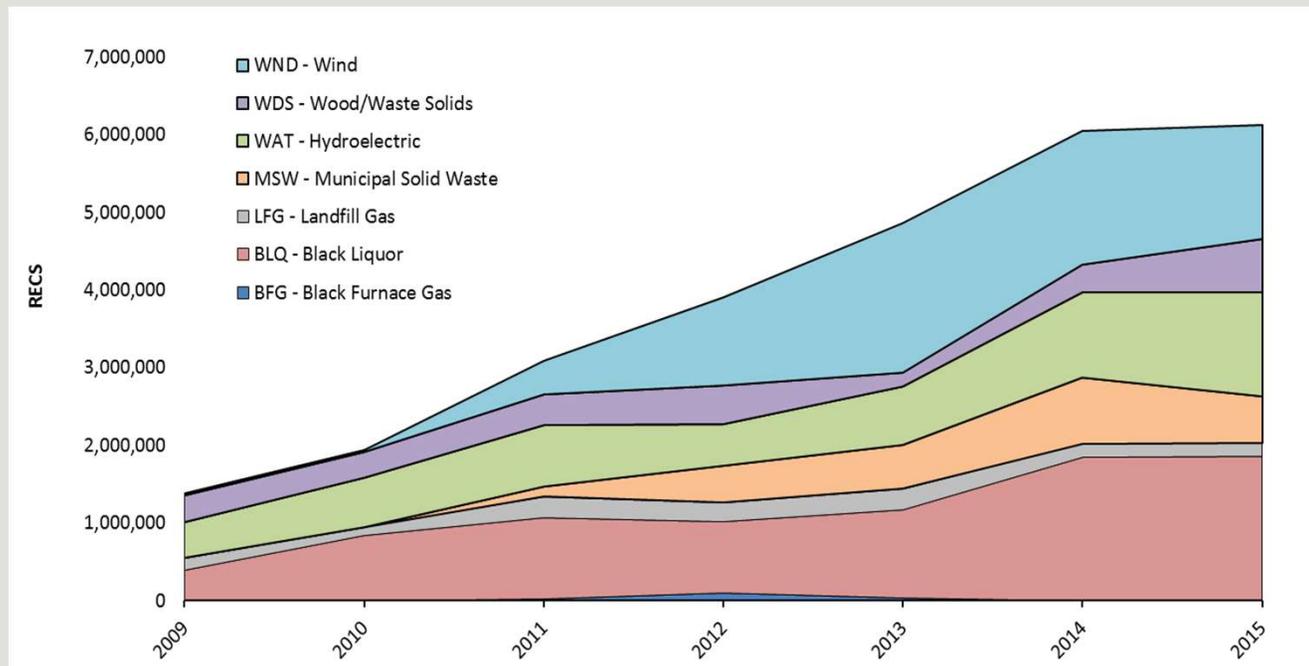
Generator Type	PJM Capacity Factor
<b>Biomass</b>	<b>84%</b>
<b>Black Liquor</b>	<b>84</b>
<b>Geothermal</b>	<b>80</b>
<b>Hydroelectric<sup>[a]</sup></b>	<b>45</b>
<b>Methane (mixed fuel)</b>	<b>55</b>
<b>Solar PV</b>	<b>16</b>
<b>Solar Thermal</b>	<b>25</b>
<b>Waste-to-Energy</b>	<b>27</b>
<b>Wind – Land-based</b>	<b>26</b>
<b>Wind – Offshore<sup>[b]</sup></b>	<b>39</b>

<sup>[a]</sup> Tier 1 Hydroelectric (i.e., <30 MW).  
<sup>[b]</sup> This was not used for the two Maryland-specific projects; those projections were based directly (read hard-entered) on Maryland PSC Order No. 88192.

# Non-carve-out Tier 1 Generation Required by the RPS in Maryland and PJM

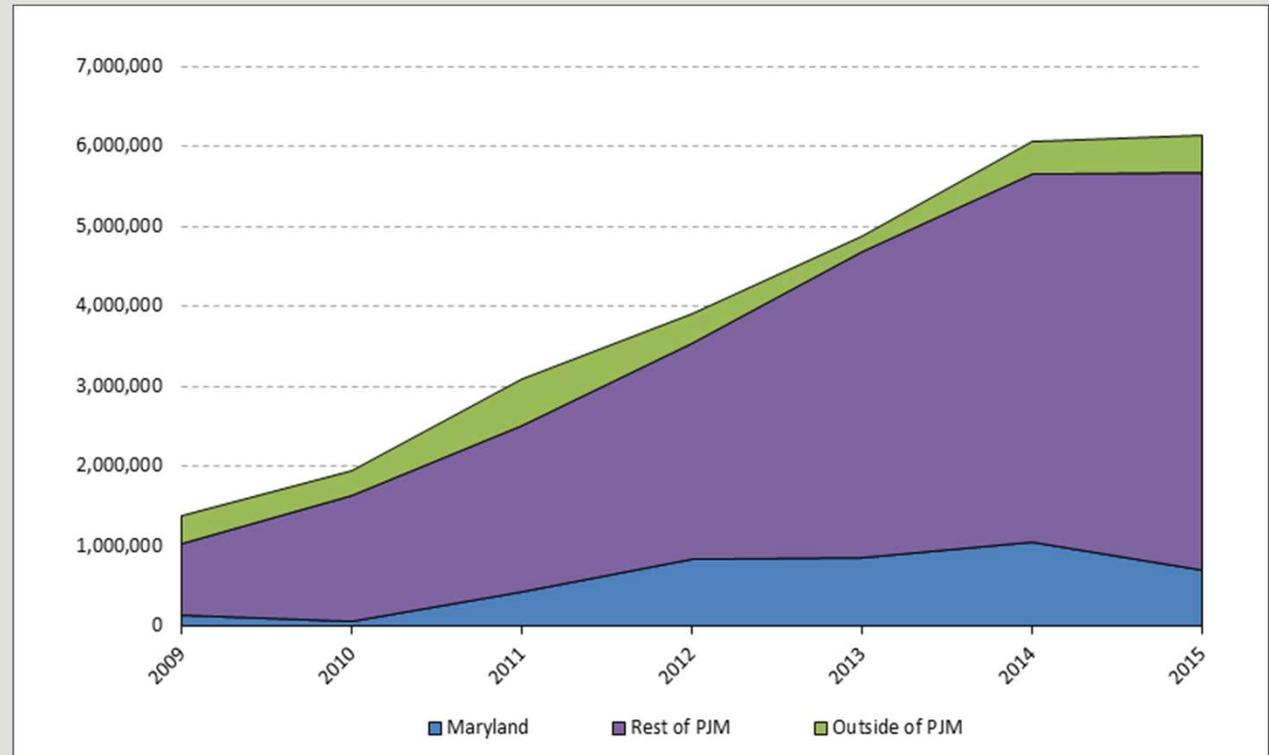


# RECs Retired for Non-carve-out Tier 1 RPS Compliance by Resource in Maryland (2009-2015)



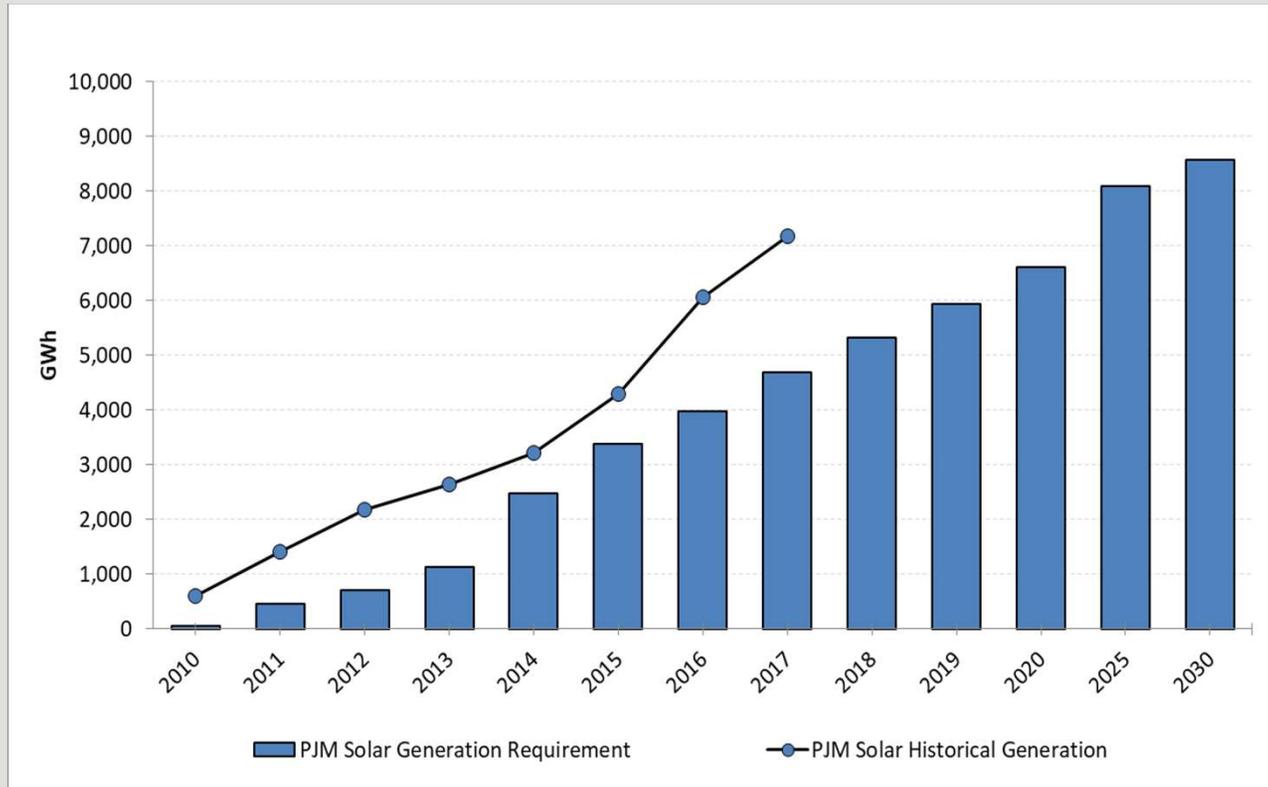
Source: Maryland Public Service Commission

# RECs Retired for Non-carve-out Tier 1 RPS Compliance in Maryland by Location (2009-2015)

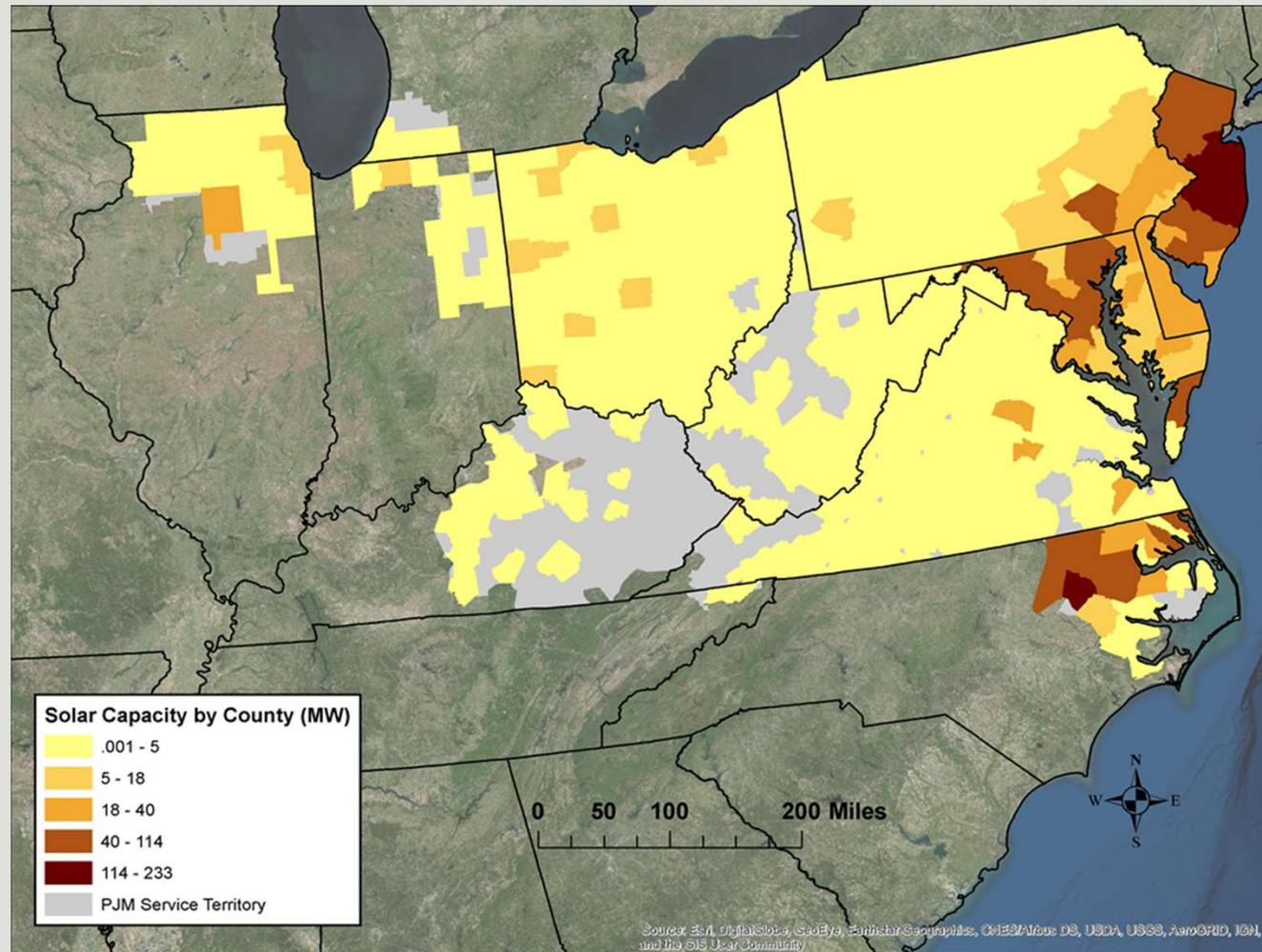


Source: Maryland Public Service Commission

# Solar Carve-out Requirement in PJM Compared to PJM Solar Historical Generation



# Solar Capacity in PJM (2017)



## Estimated Capacity and Generation of Total Solar Projects in Maryland (2018-2030)

Year	Utility-scale Solar Capacity (MW)	Utility-scale Solar Generation (GWh)
2018	1,305	1,830
2019	1,501	2,104
2020	1,726	2,420
2021	1,985	2,782
2022	2,283	3,200
2023	2,625	3,680
2024	3,019	4,232
2025	3,472	4,867
2026	3,993	5,597
2027	4,592	6,436
2028	5,281	7,401
2029	6,073	8,512
2030	6,984	9,788