

# Distributed Solar Resources in the Long Term Load Forecast

Molly Mooney

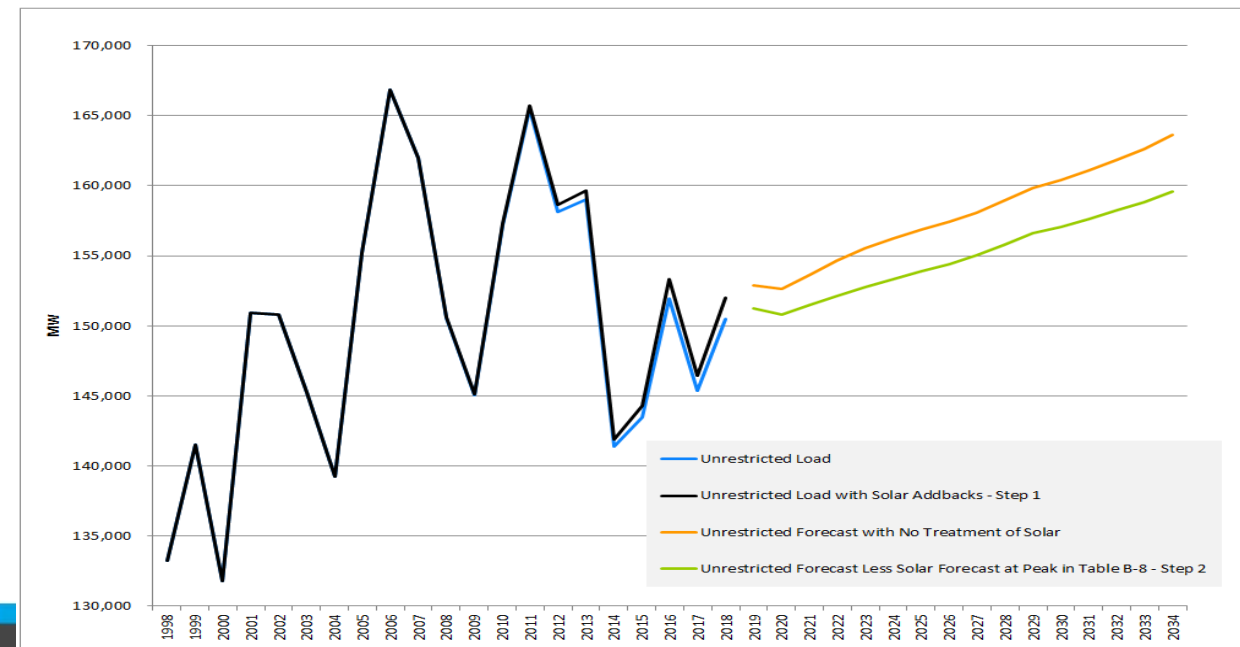
Resource Adequacy Planning Department

Intermittent Resources Subcommittee

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PJM uses a two-step approach to address distributed solar generation in the load forecast.

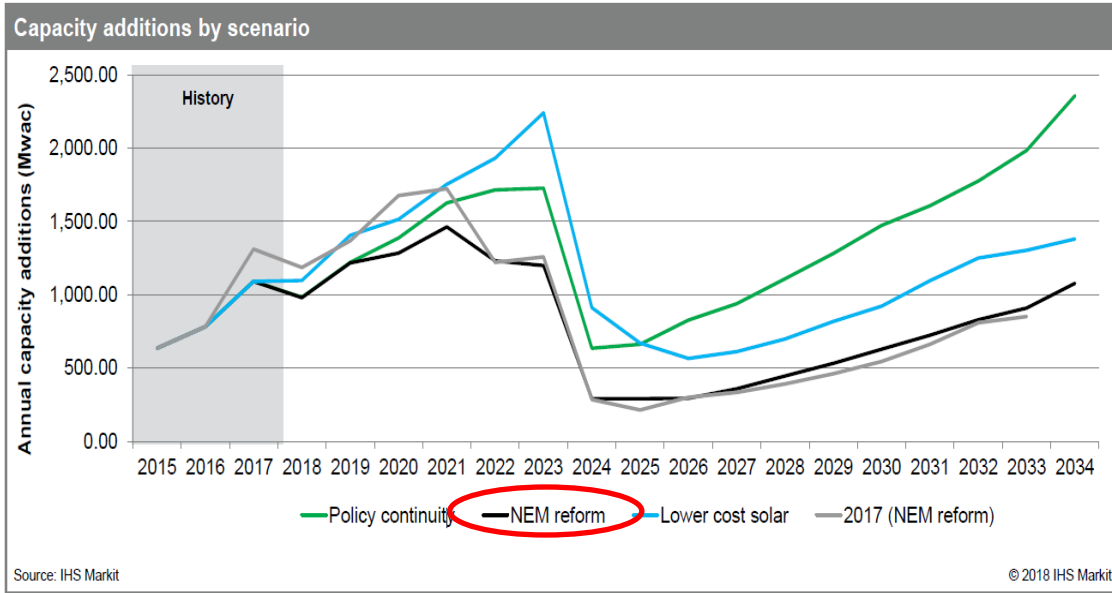
- **Step 1:**  
To account for the historical impacts of distributed solar generation, AWS Truepower back-casts hourly values by zone. These estimates are then added to the unrestricted load used in PJM load models.
- **Step 2:**  
For forecasted values of distributed solar capacity, PJM contracts with IHS Energy to develop a distributed solar generation forecast specific to the PJM region. PJM then uses the state-level forecast to derive a zonal capacity at peak. Those values are then subtracted from the forecast created with solar addbacks.



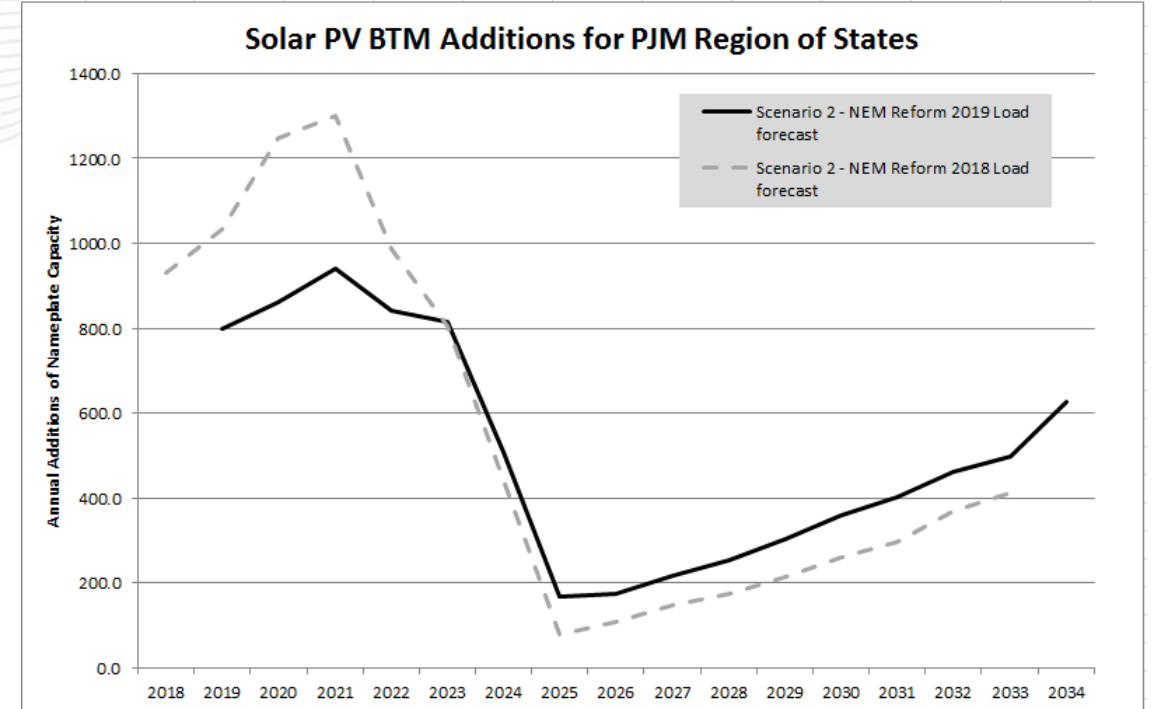
- AWS Truepower is providing the historical estimates used to add back to unrestricted loads in the first step of the process.
  - Impacts:
    - Higher historical estimates compared to PJM estimates will increase forecast output from step one.
    - The resulting higher capacity factors will decrease the forecast when applied in step two (subtracting a larger number)
    - These changes impact the 2022 Summer PJM RTO forecast results by -0.4%

IHS produces three scenarios; PJM will use Scenario 2 – NEM Reform in the 2019 Load Forecast

## Distribution/BTM capacity additions by scenario



- Calendar year additions
- Entire PJM States
- Distribution/BTM solar Capacity additions



- Q3 to Q3 additions
- PJM Region of states
- Only BTM solar Capacity additions with degradation

**Distributed Solar Generation Forecast by State**  
**IHS Scenario 2 – NEM Reform**  
 PJM Region Only  
 Annual Additions of Nameplate Capacity

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
DC	18.5	21.1	21.2	23.6	20.2	14.7	12.2	4.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
DE	26.8	42.5	46.0	47.5	35.3	13.8	5.3	4.6	4.6	4.6	8.0	9.5	10.8	15.0	14.9	14.8
IL	23.6	33.5	47.6	45.2	40.3	31.0	17.9	13.7	13.0	15.4	24.3	38.2	40.1	37.3	43.2	76.2
IN	6.7	8.4	11.6	11.4	11.6	14.7	5.0	3.9	3.4	5.5	7.3	7.3	6.5	7.2	7.1	7.1
KY	1.8	2.2	2.8	3.8	2.0	9.6	1.1	1.9	3.4	5.1	6.0	6.0	6.0	6.0	5.9	5.9
MD	103.8	92.2	116.4	98.8	105.0	49.6	17.0	16.8	16.7	16.6	14.2	27.0	31.1	30.0	29.8	49.5
MI	0.8	0.7	0.7	0.7	0.6	1.3	1.2	1.1	2.4	2.0	3.1	4.0	4.2	4.3	7.8	7.9
NC	88.1	103.0	112.3	94.0	74.3	43.4	4.2	3.8	3.9	6.9	10.0	14.4	25.5	43.0	43.6	44.4
NJ	264.4	288.4	313.5	215.9	178.5	80.2	55.8	72.7	101.7	114.3	137.4	148.3	167.1	175.1	177.1	179.7
OH	40.2	58.3	78.1	85.1	100.4	35.7	1.7	3.1	11.8	20.4	22.6	22.5	29.1	28.5	28.3	63.9
PA	114.9	85.6	63.9	85.7	103.3	57.5	30.7	27.8	28.4	33.7	37.3	49.6	42.4	59.2	60.0	84.6
TN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VA	107.9	122.4	123.8	123.1	140.2	136.7	10.8	17.7	25.8	25.9	25.9	25.8	33.9	51.2	69.0	81.7
WV	1.9	1.8	1.6	5.3	4.6	20.2	3.4	2.7	2.0	1.3	5.3	5.7	5.7	4.9	11.0	11.8
<b>Total</b>	<b>799.3</b>	<b>860.1</b>	<b>939.5</b>	<b>840.0</b>	<b>816.4</b>	<b>508.3</b>	<b>166.4</b>	<b>174.0</b>	<b>217.8</b>	<b>252.3</b>	<b>301.9</b>	<b>359.0</b>	<b>403.1</b>	<b>462.2</b>	<b>498.3</b>	<b>628.2</b>

## Distributed Solar Generation Forecast of Additions by State Comparison of 2018 and 2019 Forecast

	2019 Forecast (Scenario 2 NEM Reform)				2018 Forecast (Scenario 2 NEM Reform)				Percent Change			
	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
DC	18.5	21.1	21.2	23.6	15.1	18.0	14.7	12.4	23%	17%	44%	91%
DE	26.8	42.5	46.0	47.5	6.4	10.8	12.8	12.6	319%	295%	260%	276%
IL	23.6	33.5	47.6	45.2	21.3	37.0	60.8	59.3	11%	-9%	-22%	-24%
IN	6.7	8.4	11.6	11.4	7.5	9.4	10.8	19.3	-10%	-11%	7%	-41%
KY	1.8	2.2	2.8	3.8	3.5	5.5	5.9	7.3	-48%	-60%	-53%	-48%
MD	103.8	92.2	116.4	98.8	313.8	360.9	271.4	191.7	-67%	-74%	-57%	-48%
MI	0.8	0.7	0.7	0.7	1.3	1.6	2.7	5.3	-40%	-58%	-75%	-88%
NC	88.1	103.0	112.3	94.0	50.9	57.5	52.3	28.2	73%	79%	115%	233%
NJ	264.4	288.4	313.5	215.9	333.7	347.5	247.0	153.6	-21%	-17%	27%	41%
OH	40.2	58.3	78.1	85.1	60.9	133.6	273.5	162.5	-34%	-56%	-71%	-48%
PA	114.9	85.6	63.9	85.7	98.4	118.0	136.9	110.0	17%	-27%	-53%	-22%
TN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%	0%	0%	0%
VA	107.9	122.4	123.8	123.1	117.7	144.9	206.1	219.0	-8%	-16%	-40%	-44%
WV	1.9	1.8	1.6	5.3	1.9	1.6	5.6	4.8	2%	15%	-72%	11%
<b>Total</b>	<b>799.3</b>	<b>860.1</b>	<b>939.5</b>	<b>840.0</b>	<b>1,032.4</b>	<b>1,246.3</b>	<b>1,300.5</b>	<b>986.1</b>	<b>-23%</b>	<b>-31%</b>	<b>-28%</b>	<b>-15%</b>



# Historical and IHS Nameplate Capacity

## Distributed Solar Generation Forecast by Zone

### Cumulative Nameplate Capacity

Includes Historical Degraded Values and IHS Forecast

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
AE	412.8	446.6	483.5	507.9	527.6	534.8	539.0	545.2	555.2	566.7	581.1	596.9	614.9	634.0	653.2	672.8
AEP	104.9	154.5	214.7	279.7	352.0	415.7	426.0	436.4	452.1	472.8	499.8	528.0	559.2	592.9	636.3	695.1
APS	158.1	187.5	217.4	249.7	285.9	314.3	322.0	329.3	336.7	344.6	354.4	367.9	381.2	397.3	416.8	443.5
ATSI	112.4	136.7	167.6	201.9	242.5	257.3	258.4	259.9	264.7	272.9	282.0	291.5	303.2	315.3	327.3	353.4
BGE	364.4	406.2	459.4	504.0	551.6	572.7	578.4	584.0	589.5	595.0	599.3	609.7	622.0	633.8	645.5	666.3
COMED	71.3	104.4	151.6	196.4	236.3	266.9	284.5	297.8	310.5	325.5	349.5	387.3	427.1	464.0	506.8	582.6
DAYTON	25.7	31.8	39.9	48.8	59.3	62.9	62.9	63.1	64.2	66.1	68.3	70.5	73.4	76.2	78.9	85.4
DPL	235.7	283.9	337.3	391.0	433.1	449.9	454.9	459.3	463.7	468.2	475.8	485.9	497.7	513.7	529.9	547.4
DQE	28.6	36.1	41.8	49.3	58.5	63.5	66.1	68.4	70.8	73.7	76.9	81.2	84.8	89.9	95.1	102.5
DUKE	21.6	30.8	43.3	56.9	72.9	79.2	79.5	80.0	82.0	85.6	89.6	93.6	98.6	103.6	108.6	119.3
EKPC	12.0	13.3	14.8	17.0	18.1	23.7	24.3	25.4	27.3	30.2	33.7	37.1	40.6	44.0	47.4	50.8
JCPL	638.9	716.5	801.3	858.3	904.7	923.2	934.8	951.2	976.0	1,004.4	1,039.5	1,077.8	1,121.5	1,167.6	1,214.3	1,261.8
METED	63.6	71.5	77.4	85.4	95.2	100.4	103.0	105.4	107.8	110.8	114.1	118.7	122.5	128.1	133.8	141.9
PECO	111.3	132.8	148.6	170.1	196.1	210.3	217.6	224.2	230.9	239.0	248.1	260.3	270.7	285.4	300.4	321.7
PENLC	20.1	29.6	36.6	46.0	57.3	63.5	66.9	69.8	72.9	76.5	80.4	85.7	90.2	96.5	102.9	111.8
PEPCO	342.9	391.5	448.1	501.4	553.2	581.7	597.2	604.6	608.5	612.3	615.4	622.7	631.3	639.6	647.9	662.6
PL	154.2	174.8	190.0	210.7	235.8	249.4	256.2	262.2	268.5	276.1	284.6	296.2	306.0	320.0	334.3	354.8
PS	1,001.8	1,158.8	1,330.2	1,446.4	1,541.3	1,580.3	1,605.5	1,640.5	1,691.9	1,750.6	1,822.5	1,900.6	1,989.6	2,083.2	2,177.9	2,274.2
RECO	19.8	25.3	31.3	35.4	38.8	40.2	41.2	42.5	44.4	46.5	49.0	51.8	54.9	58.2	61.5	64.8
UGI	1.2	1.7	2.1	2.6	3.2	3.6	3.8	3.9	4.1	4.3	4.5	4.8	5.1	5.4	5.8	6.2
VEPCO	848.9	1,044.1	1,249.9	1,436.8	1,617.8	1,765.1	1,772.7	1,785.6	1,805.0	1,827.6	1,853.3	1,883.5	1,931.3	2,010.5	2,104.7	2,210.0
<b>PJM RTO</b>	<b>4,750.0</b>	<b>5,578.5</b>	<b>6,486.7</b>	<b>7,295.6</b>	<b>8,081.2</b>	<b>8,558.8</b>	<b>8,694.9</b>	<b>8,838.8</b>	<b>9,026.7</b>	<b>9,249.4</b>	<b>9,521.9</b>	<b>9,851.7</b>	<b>10,225.8</b>	<b>10,659.3</b>	<b>11,129.1</b>	<b>11,729.0</b>

- Note the change to using AWS Truepower historical estimates have impacted capacity factors compared to last year.
- Capacity Factors are calculated using the hourly back-casted values divided by the value of the GATS installations
- The average capacity factor over Hour Ending 17 for the months of June, July, and August will be applied to the Zonal level Nameplate Capacity for a value at peak

	Hour Ending 17; June, July, and August (AWS Truepower Estimates)	Hour Ending 17; June, July, and August (PJM Estimates)
AE	34%	28%
AEP	37%	32%
APS	34%	28%
ATSI	37%	29%
BGE	35%	26%
COMED	41%	32%
DAYTON	39%	32%
DPL	35%	30%
DQE	34%	25%
DUKE	38%	27%
EKPC	41%	32%
JCPL	32%	26%
METED	33%	29%
PECO	32%	28%
PENLC	32%	30%
PEPCO	34%	25%
PL	33%	28%
PS	31%	27%
RECO	31%	26%
UGI	32%	26%
VEPCO	35%	27%

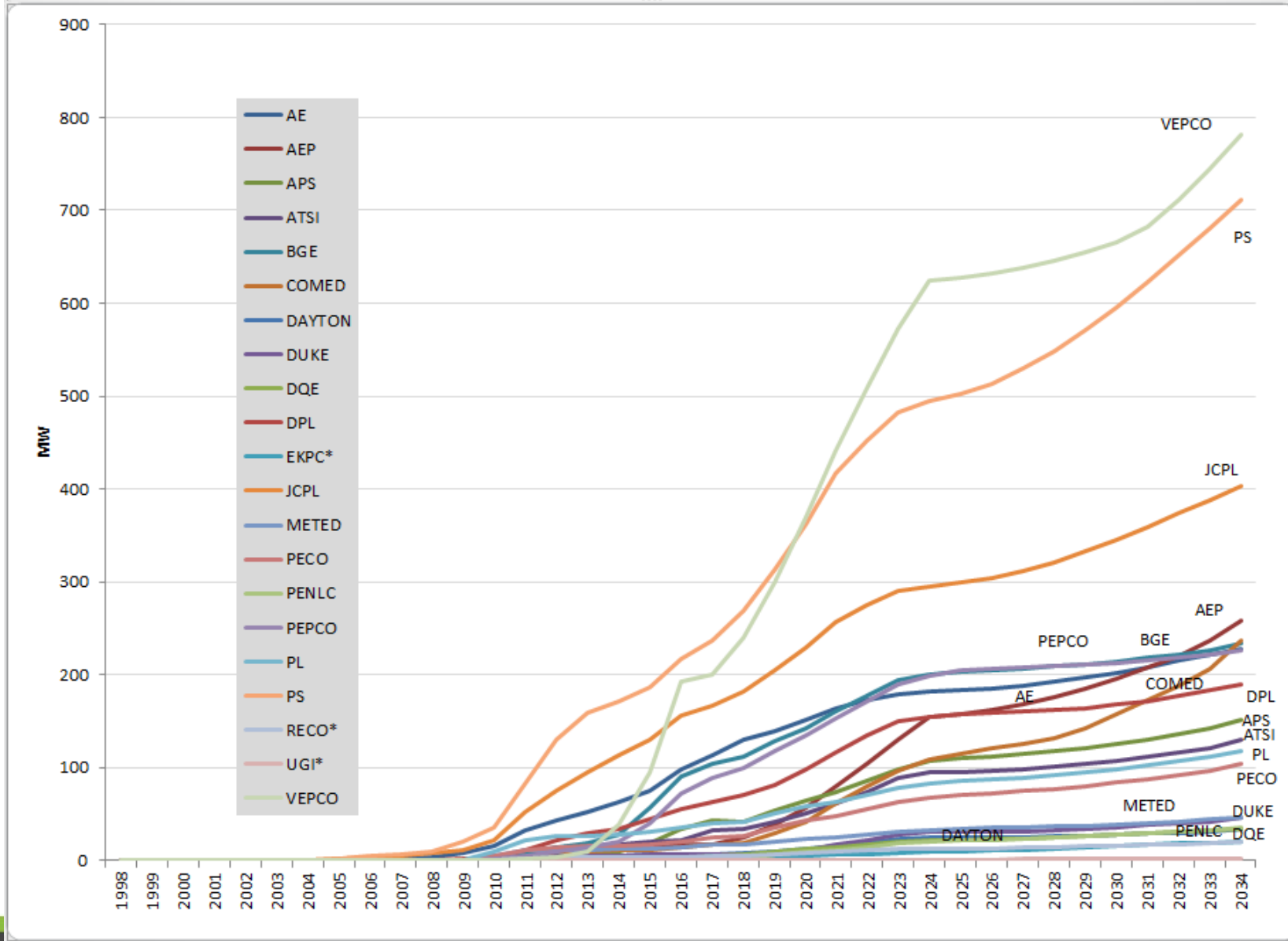


## Distributed Solar Generation Forecast by Zone Annual Capacity at Peak 2019-2034

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
AE	140.0	151.5	164.0	172.3	179.0	181.4	182.8	184.9	188.3	192.2	197.1	202.4	208.6	215.0	221.6	228.2
AEP	39.0	57.4	79.8	103.9	130.8	154.5	158.3	162.2	168.0	175.7	185.7	196.2	207.8	220.3	236.5	258.3
APS	54.0	64.0	74.2	85.2	97.6	107.3	109.9	112.4	115.0	117.7	121.0	125.6	130.2	135.7	142.3	151.4
ATSI	41.4	50.4	61.8	74.4	89.4	94.9	95.3	95.8	97.6	100.6	104.0	107.5	111.8	116.2	120.7	130.3
BGE	127.9	142.5	161.2	176.9	193.6	201.0	203.0	204.9	206.9	208.8	210.3	214.0	218.3	222.4	226.5	233.8
COMED	28.9	42.4	61.5	79.7	95.9	108.3	115.5	120.9	126.0	132.1	141.9	157.2	173.3	188.3	205.7	236.5
DAYTON	10.1	12.5	15.8	19.3	23.4	24.8	24.8	24.9	25.3	26.1	26.9	27.8	28.9	30.0	31.1	33.7
DPL	81.3	98.0	116.4	134.9	149.5	155.3	157.0	158.5	160.0	161.6	164.2	167.7	171.8	177.3	182.9	188.9
DQE	9.7	12.3	14.2	16.7	19.8	21.5	22.4	23.2	24.0	25.0	26.1	27.6	28.8	30.5	32.3	34.8
DUKE	8.3	11.8	16.6	21.9	28.0	30.4	30.5	30.7	31.5	32.9	34.4	35.9	37.9	39.8	41.7	45.8
EKPC	5.0	5.5	6.1	7.0	7.4	9.8	10.0	10.4	11.2	12.5	13.9	15.3	16.7	18.1	19.5	20.9
JCPL	204.5	229.3	256.5	274.7	289.6	295.5	299.2	304.5	312.4	321.5	332.7	345.0	359.0	373.7	388.7	403.9
METED	21.0	23.7	25.6	28.3	31.5	33.2	34.1	34.9	35.7	36.7	37.8	39.3	40.6	42.4	44.3	47.0
PECO	36.1	43.0	48.2	55.1	63.6	68.2	70.5	72.7	74.9	77.5	80.4	84.4	87.7	92.5	97.4	104.3
PENLC	6.5	9.5	11.8	14.8	18.4	20.4	21.5	22.4	23.4	24.6	25.8	27.5	29.0	31.0	33.0	35.9
PEPCO	117.4	134.0	153.4	171.6	189.4	199.1	204.4	207.0	208.3	209.6	210.7	213.2	216.1	219.0	221.8	226.8
PL	51.4	58.3	63.3	70.2	78.6	83.1	85.4	87.4	89.5	92.0	94.9	98.7	102.0	106.7	111.5	118.3
PS	313.5	362.6	416.2	452.6	482.3	494.5	502.4	513.3	529.4	547.8	570.3	594.7	622.6	651.8	681.5	711.6
RECO	6.1	7.8	9.7	10.9	12.0	12.4	12.7	13.1	13.7	14.4	15.1	16.0	16.9	18.0	19.0	20.0
UGI	0.4	0.5	0.7	0.8	1.0	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.7	1.8	2.0
VEPCO	300.2	369.3	442.0	508.1	572.1	624.2	626.9	631.5	638.3	646.3	655.4	666.1	683.0	711.0	744.3	781.5
<b>PJM RTO</b>	<b>1,602.7</b>	<b>1,886.4</b>	<b>2,198.9</b>	<b>2,479.5</b>	<b>2,752.9</b>	<b>2,921.1</b>	<b>2,968.0</b>	<b>3,017.0</b>	<b>3,080.8</b>	<b>3,156.8</b>	<b>3,250.1</b>	<b>3,363.6</b>	<b>3,492.5</b>	<b>3,641.6</b>	<b>3,803.9</b>	<b>4,014.0</b>



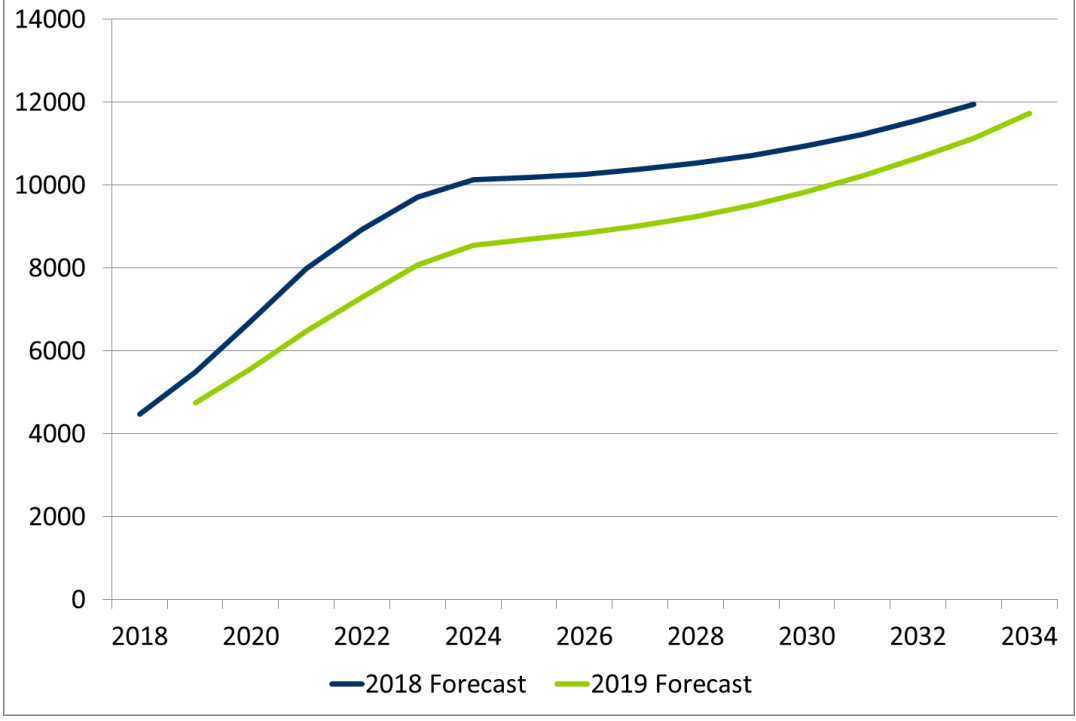
# Distributed Solar Generation 2019 Forecast by Zone Annual Capacity at Peak



\* Cumulative zonal impact is less than 20 MW at summer peak

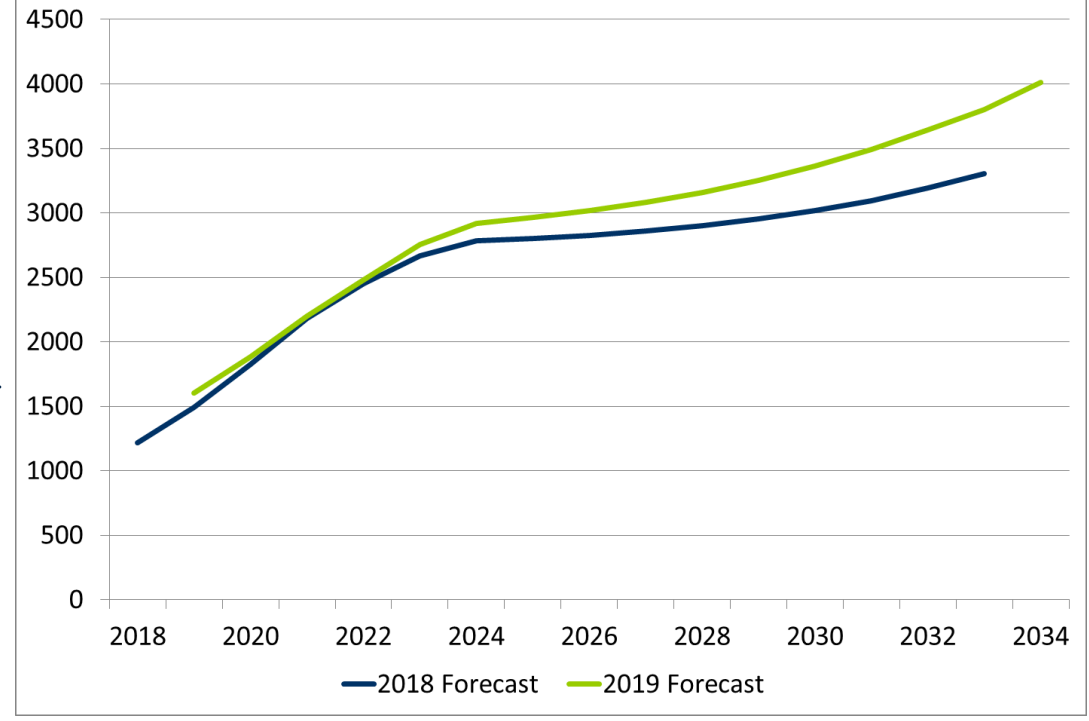
# Comparison of 2018 and 2019 Forecasts

**BtM Solar Nameplate Capacity (MW)**



**Higher Capacity Factor**

**BtM Solar Generation at Summer Peak (MW)**





# Comparison of 2018 and 2019 Forecasts

## Distributed Solar Generation Forecast by Zone Capacity at Peak

	2019 Forecast				2018 Forecast				Percent Change			
	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
AE	140.0	151.5	164.0	172.3	116.0	127.6	135.6	140.3	21%	19%	21%	23%
AEP	39.0	57.4	79.8	103.9	42.2	68.8	116.2	154.9	-8%	-17%	-31%	-33%
APS	54.0	64.0	74.2	85.2	63.8	83.0	101.0	115.2	-15%	-23%	-27%	-26%
ATSI	41.4	50.4	61.8	74.4	37.7	53.1	83.5	101.8	10%	-5%	-26%	-27%
BGE	127.9	142.5	161.2	176.9	154.0	198.6	232.0	255.4	-17%	-28%	-31%	-31%
COMED	28.9	42.4	61.5	79.7	24.5	36.2	55.4	74.1	18%	17%	11%	8%
DAYTON	10.1	12.5	15.8	19.3	8.7	13.2	22.4	27.9	16%	-5%	-30%	-31%
DPL	81.3	98.0	116.4	134.9	70.7	81.2	90.5	98.3	15%	21%	29%	37%
DQE	9.7	12.3	14.2	16.7	7.7	10.4	13.4	15.9	25%	18%	5%	5%
DUKE	8.3	11.8	16.6	21.9	8.2	13.9	25.6	32.6	1%	-15%	-35%	-33%
EKPC	5.0	5.5	6.1	7.0	1.2	2.2	3.3	4.7	320%	147%	84%	49%
JCPL	204.5	229.3	256.5	274.7	184.4	209.6	227.2	237.7	11%	9%	13%	16%
METED	21.0	23.7	25.6	28.3	20.2	23.6	27.4	30.5	4%	1%	-7%	-7%
PECO	36.1	43.0	48.2	55.1	35.6	44.2	54.1	62.0	1%	-3%	-11%	-11%
PENLC	6.5	9.5	11.8	14.8	8.6	12.5	17.1	20.7	-25%	-24%	-31%	-29%
PEPCO	117.4	134.0	153.4	171.6	120.6	154.0	179.3	197.5	-3%	-13%	-14%	-13%
PL	51.4	58.3	63.3	70.2	47.8	55.9	65.4	72.9	8%	4%	-3%	-4%
PS	313.5	362.6	416.2	452.6	300.8	351.9	387.8	409.5	4%	3%	7%	11%
RECO	6.1	7.8	9.7	10.9	7.1	8.8	10.0	10.7	-14%	-11%	-3%	2%
UGI	0.4	0.5	0.7	0.8	0.5	0.7	0.9	1.1	-18%	-17%	-25%	-22%
VEPCO	300.2	369.3	442.0	508.1	230.6	275.9	332.9	386.2	30%	34%	33%	32%
<b>PJM RTO</b>	<b>1,602.7</b>	<b>1,886.4</b>	<b>2,198.9</b>	<b>2,479.5</b>	<b>1,491.1</b>	<b>1,825.1</b>	<b>2,180.9</b>	<b>2,449.9</b>	<b>7%</b>	<b>3%</b>	<b>1%</b>	<b>1%</b>

- Load Analysis Subcommittee
  - <https://www.pjm.com/committees-and-groups/subcommittees/las.aspx>
  - November 27, 2018 meeting
    - IHS forecast slides with assumptions
    - PJM solar forecast slides
    - Excel file with solar back-cast data and IHS scenario results