Attachment to Testimony of Joseph Bowring
Ohio Energy Mandates Study Committee
April 16, 2015

Monitoring Analytics

Figure 1-1 PJM's footprint and its 20 control zones

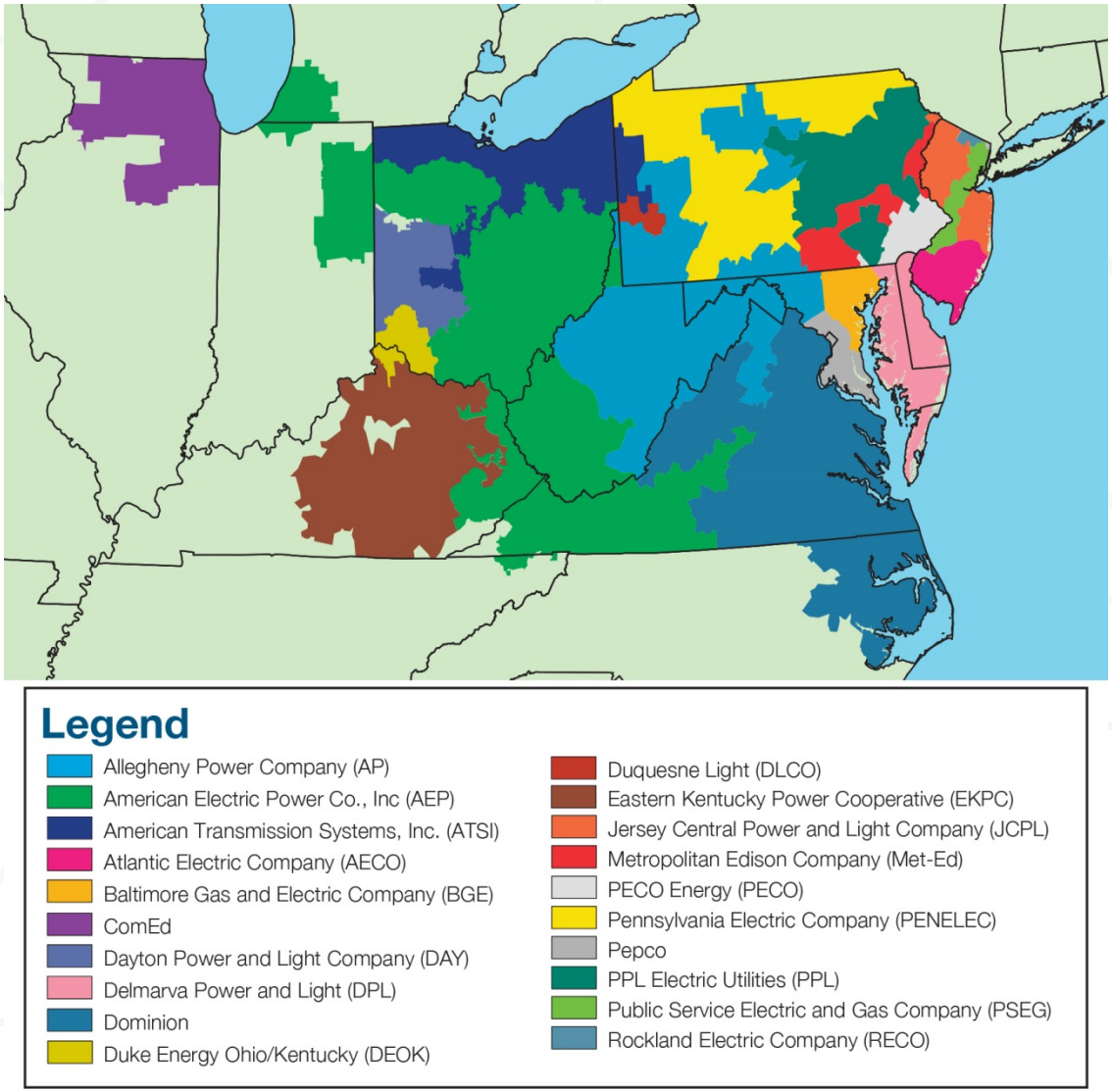
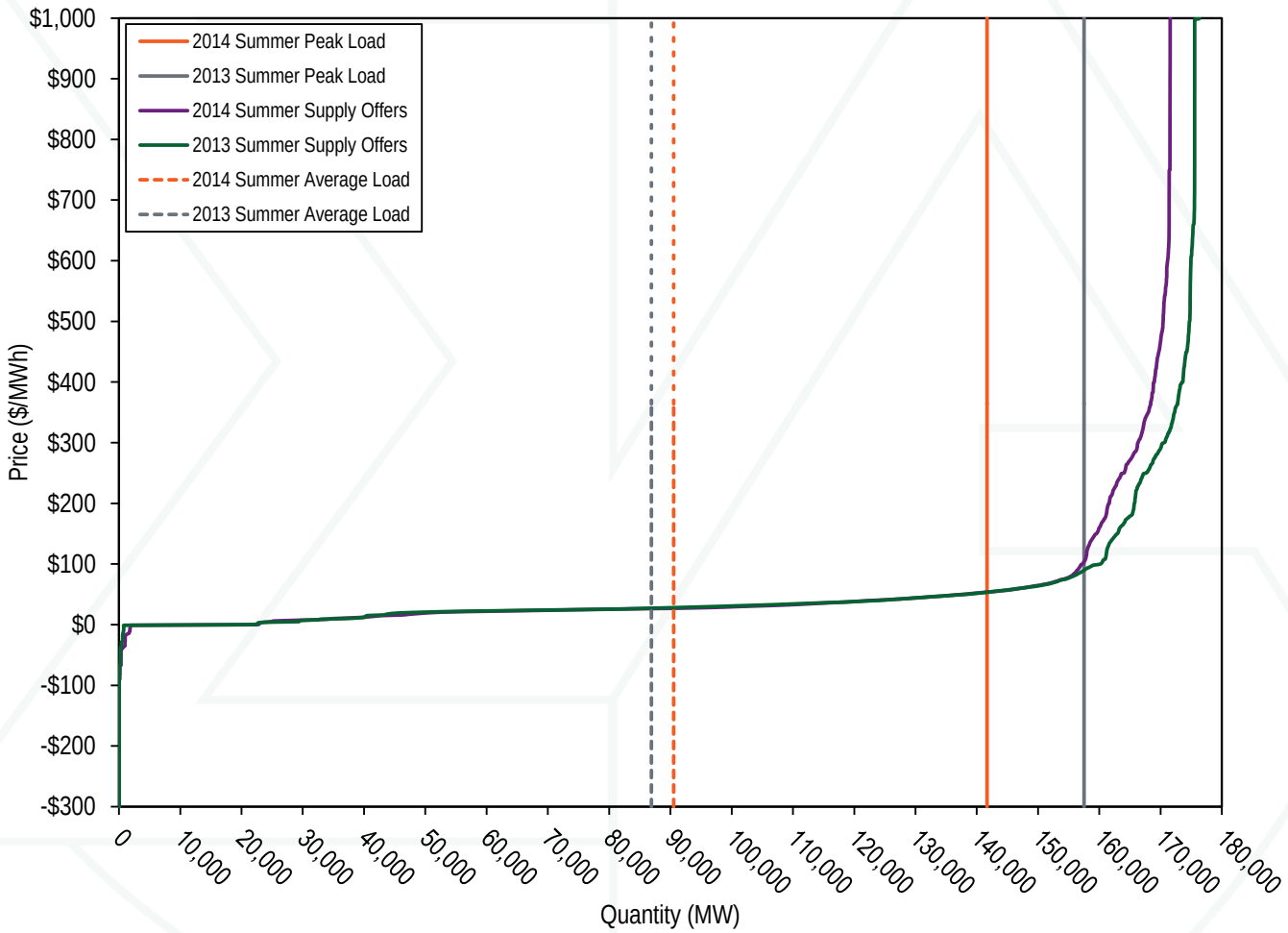
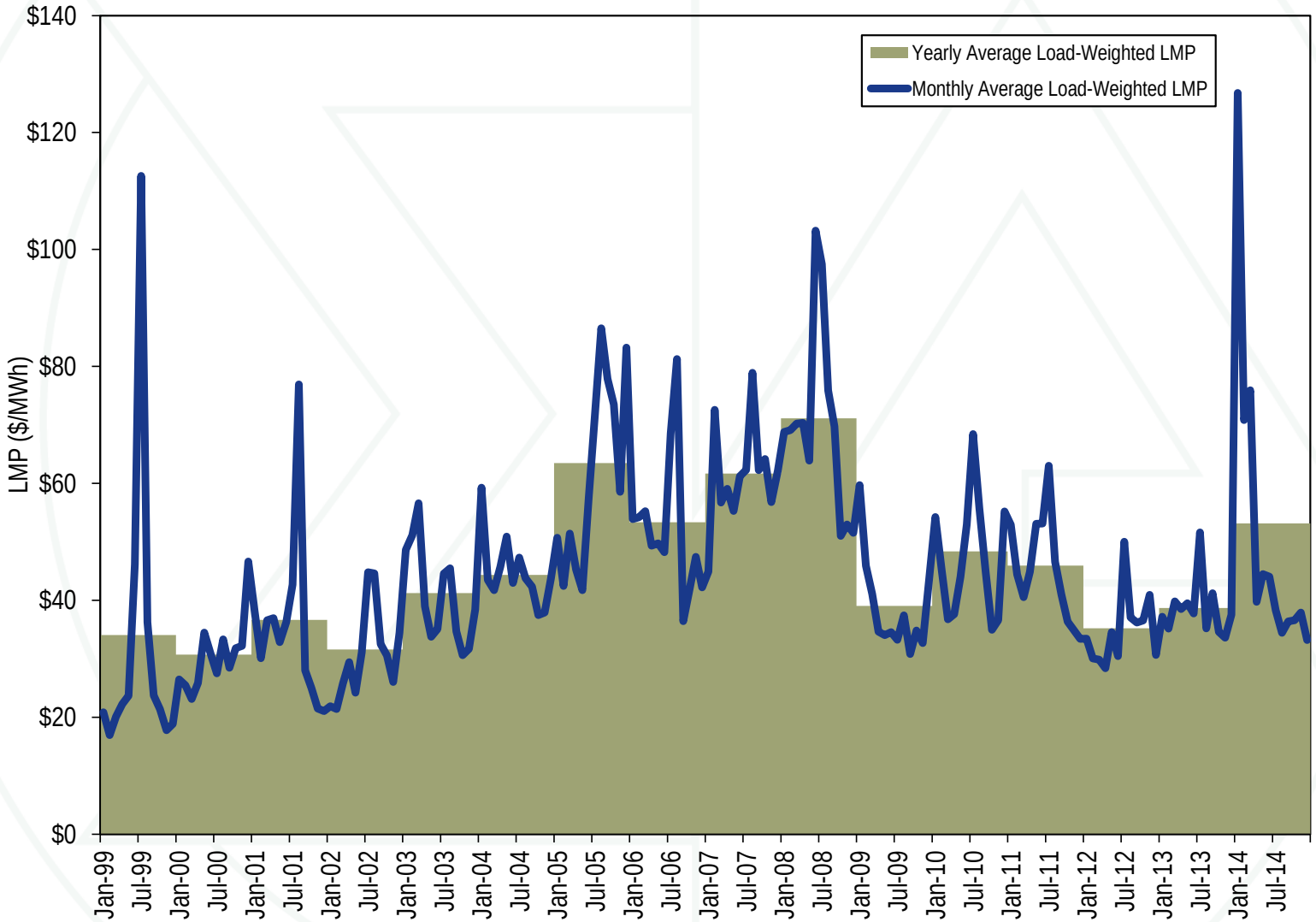


Figure 3-4 Average PJM aggregate real-time generation supply curves by offer price: Summer of 2013 and 2014



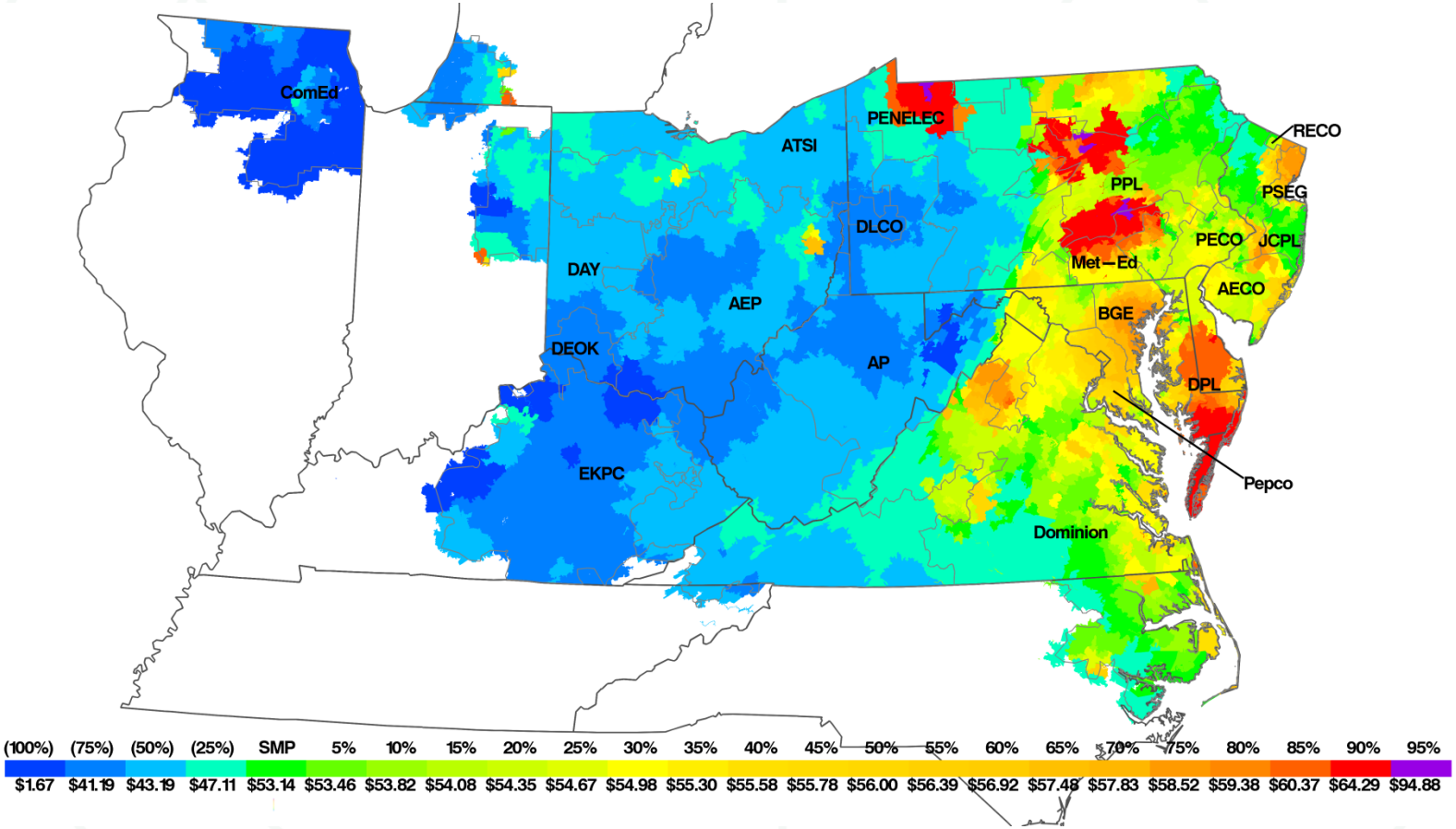
Monitoring Analytics

Figure 3-30 PJM real-time, monthly and annual, load-weighted, average LMP: 1999 through 2014



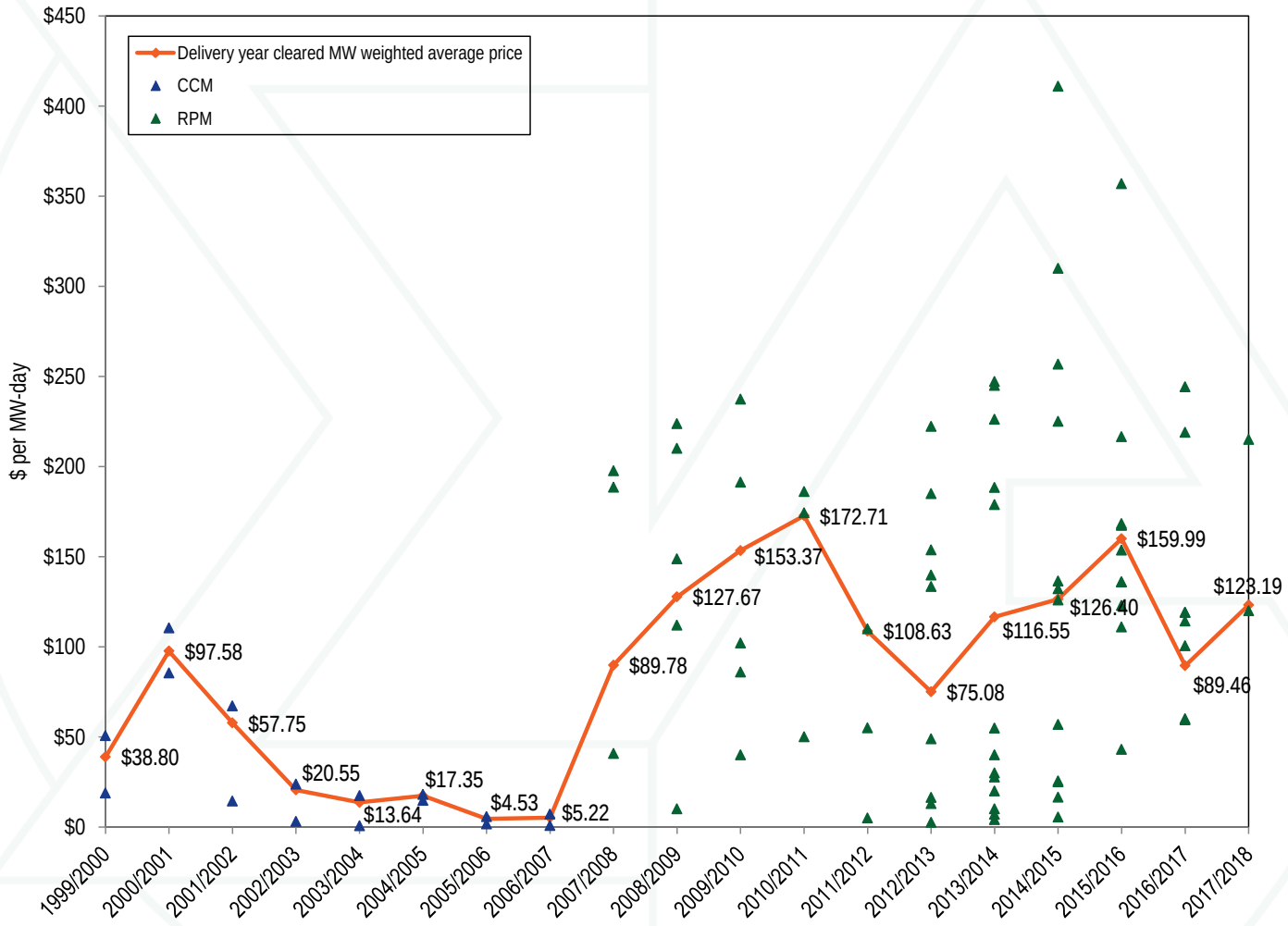
Monitoring Analytics

Figure 3-29 PJM real-time, load-weighted, average LMP: 2014



Monitoring Analytics

Figure 5-4 History of PJM capacity prices: 1999/2000 through 2017/2018



Monitoring Analytics

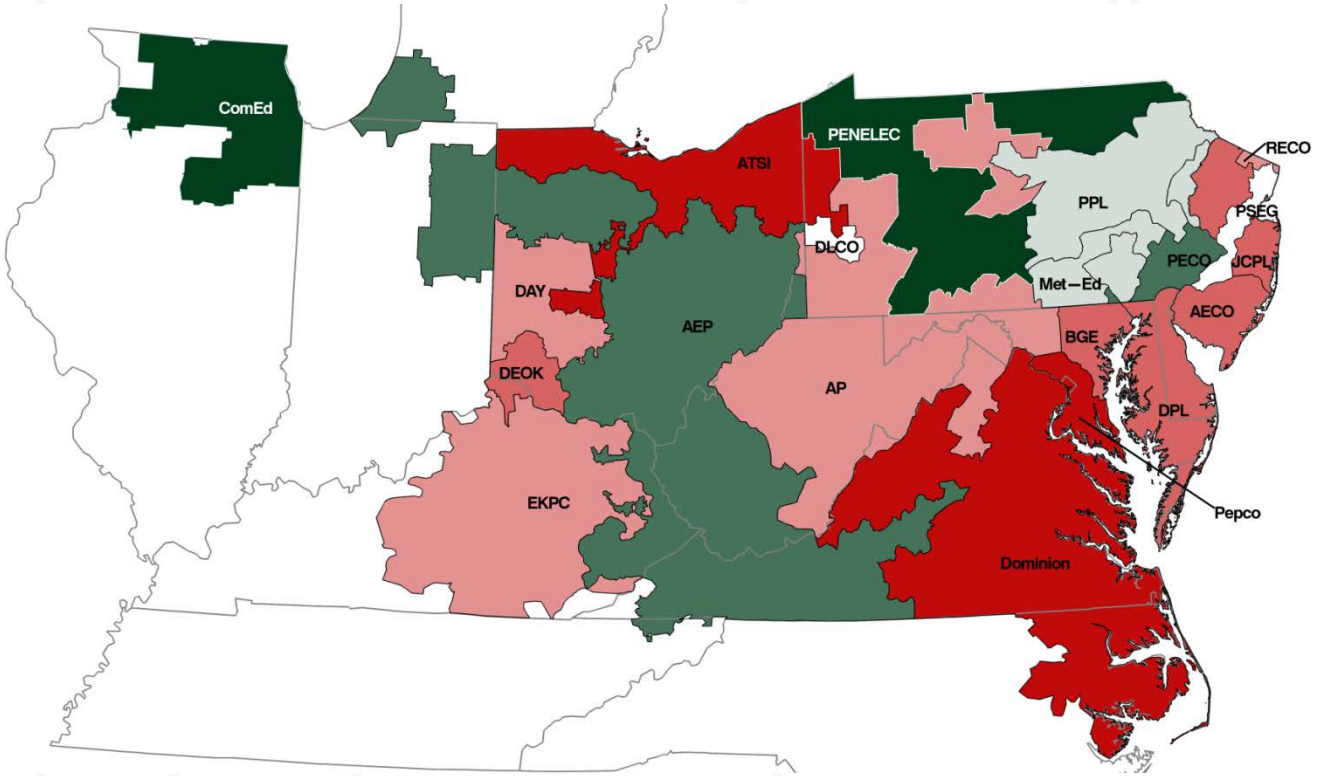
Table 5-3 PJM installed capacity (By fuel source): January 1, May 31, June 1, and December 31, 2014

	1-Jan-14		31-May-14		1-Jun-14		31-Dec-14	
	MW	Percent	MW	Percent	MW	Percent	MW	Percent
Coal	75,544.6	41.3%	75,253.0	41.1%	74,785.5	40.6%	73,015.3	39.7%
Gas	53,395.0	29.2%	53,841.6	29.4%	55,041.7	29.9%	56,364.5	30.7%
Hydroelectric	8,106.7	4.4%	8,135.7	4.4%	8,463.8	4.6%	8,765.3	4.8%
Nuclear	33,076.7	18.1%	33,073.7	18.0%	32,891.0	17.9%	32,947.1	17.9%
Oil	11,314.2	6.2%	11,290.4	6.2%	11,155.7	6.1%	10,931.7	6.0%
Solar	84.2	0.0%	84.2	0.0%	94.7	0.1%	97.5	0.1%
Solid waste	701.4	0.4%	701.4	0.4%	780.0	0.4%	780.0	0.4%
Wind	872.4	0.5%	872.4	0.5%	796.7	0.4%	822.7	0.4%
Total	183,095.2	100.0%	183,252.4	100.0%	184,009.1	100.0%	183,724.1	100.0%

Table 3-8 PJM generation (By fuel source (GWh)): 2013 and 2014

	2013		2014		
	Gwh	Percent	GWh	Percent	Change in Output
Coal	356,018.0	44.5%	351,456.5	43.5%	(1.3%)
Standard Coal	346,188.8	43.3%	341,538.6	42.3%	(1.3%)
Waste Coal	9,829.2	1.2%	9,918.0	1.2%	0.9%
Nuclear	277,277.8	34.7%	277,635.6	34.3%	0.1%
Gas	130,230.9	16.3%	140,076.4	17.3%	7.6%
Natural Gas	127,855.5	16.0%	137,503.6	17.0%	7.5%
Landfill Gas	2,321.0	0.3%	2,369.4	0.3%	2.1%
Biomass Gas	54.5	0.0%	203.5	0.0%	273.3%
Hydroelectric	14,116.4	1.8%	14,394.3	1.8%	2.0%
Pumped Storage	6,690.4	0.8%	7,138.7	0.9%	6.7%
Run of River	7,426.0	0.9%	7,255.5	0.9%	(2.3%)
Wind	14,854.1	1.9%	15,540.5	1.9%	4.6%
Waste	5,040.1	0.6%	5,472.4	0.7%	8.6%
Solid Waste	4,185.0	0.5%	4,566.5	0.6%	9.1%
Miscellaneous	855.1	0.1%	905.9	0.1%	5.9%
Oil	1,948.5	0.2%	3,299.9	0.4%	69.4%
Heavy Oil	1,730.7	0.2%	2,742.1	0.3%	58.4%
Light Oil	187.2	0.0%	480.0	0.1%	156.5%
Diesel	14.8	0.0%	52.5	0.0%	253.6%
Kerosene	15.7	0.0%	25.3	0.0%	61.3%
Jet Oil	0.1	0.0%	0.1	0.0%	(38.6%)
Solar, Net Energy Metering	355.0	0.0%	404.6	0.0%	13.7%
Battery	0.7	0.0%	6.5	0.0%	807.7%
Total	799,841.7	100.0%	808,286.8	100.0%	1.1%

Figure 3-11 Map of PJM real-time generation less real-time load by zone: 2014



Zone	Net Gen Minus Load (GWh)	Zone	Net Gen Minus Load (GWh)	Zone	Net Gen Minus Load (GWh)	Zone	Net Gen Minus Load (GWh)
AECO	(6,957)	ComEd	28,592	DPL	(10,865)	PENELEC	27,531
AEP	19,292	DAY	(2,668)	EKPC	(2,419)	Pepco	(18,671)
AP	(2,266)	DEOK	(7,196)	JCPL	(9,782)	PPL	8,250
ATSI	(14,277)	DLCO	3,324	Met-Ed	6,543	PSEG	2,013
BGE	(10,598)	Dominion	(12,862)	PECO	20,234	RECO	(1,493)

Monitoring Analytics

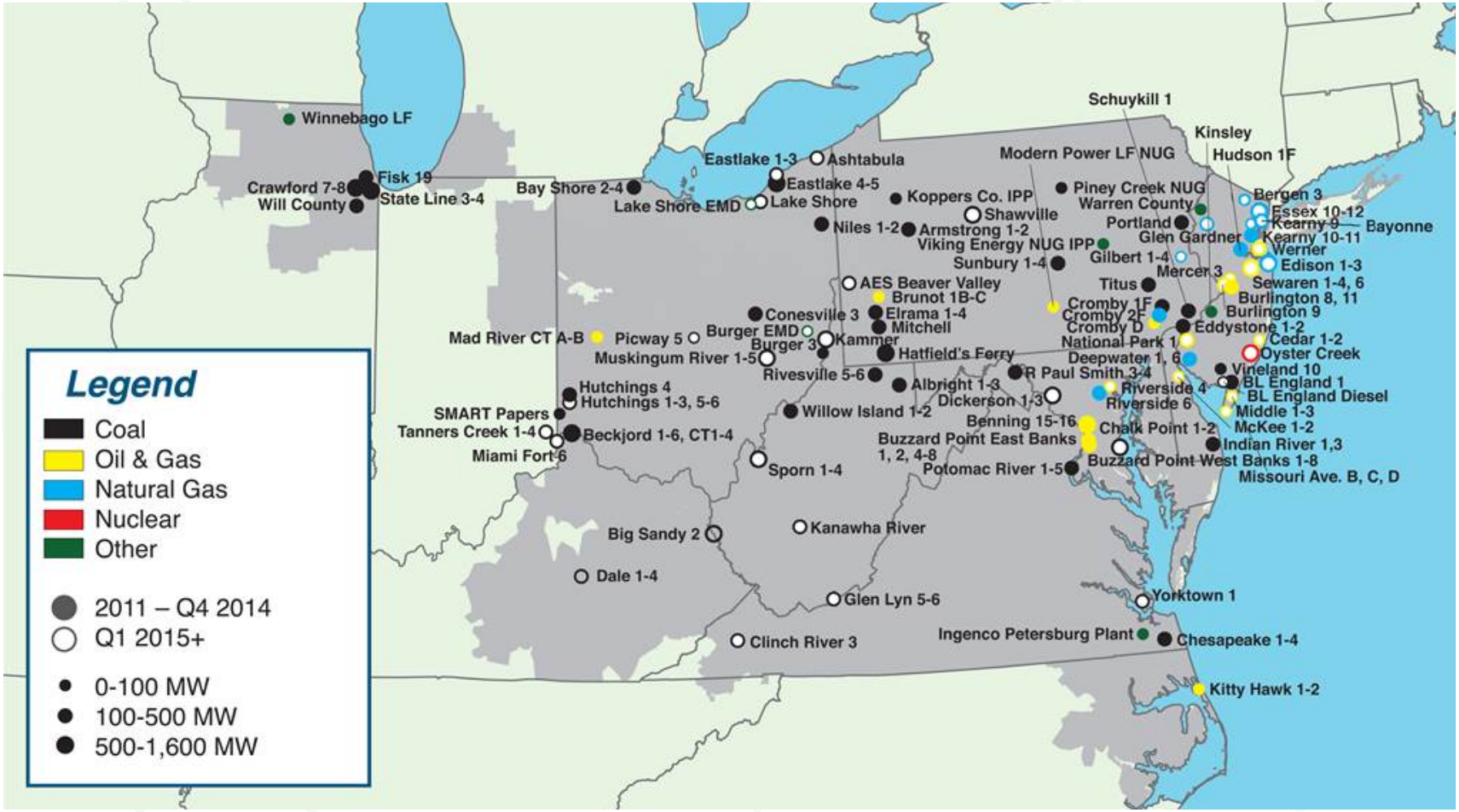
Table 8-4 Renewable standards of PJM jurisdictions to 2024

Jurisdiction	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Delaware	10.00%	11.50%	13.00%	14.50%	16.00%	17.50%	19.00%	20.00%	21.00%	22.00%	23.00%
Illinois	8.00%	9.00%	10.00%	11.50%	13.00%	14.50%	16.00%	17.50%	19.00%	20.50%	22.00%
Indiana	4.00%	4.00%	4.00%	4.00%	4.00%	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%
Kentucky	No Standard										
Maryland	12.80%	13.00%	15.20%	15.60%	18.30%	17.40%	18.00%	18.70%	20.00%	20.00%	20.00%
Michigan	6.75%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
New Jersey	12.53%	13.76%	14.90%	15.99%	18.03%	19.97%	21.91%	23.85%	23.94%	24.03%	24.12%
North Carolina	3.00%	6.00%	6.00%	6.00%	10.00%	10.00%	10.00%	12.50%	12.50%	12.50%	12.50%
Ohio	2.50%	2.50%	2.50%	3.50%	4.50%	5.50%	6.50%	7.50%	8.50%	9.50%	10.50%
Pennsylvania	10.72%	11.22%	13.72%	14.22%	14.72%	15.22%	15.72%	18.02%	18.02%	18.02%	18.02%
Tennessee	No Standard										
Virginia	4.00%	4.00%	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%	12.00%	12.00%	12.00%
Washington, D.C.	10.50%	12.00%	13.50%	15.00%	16.50%	18.00%	20.00%	20.00%	20.00%	20.00%	20.00%
West Virginia	No Standard										

Table 8-6 Solar renewable standards of PJM jurisdictions 2014 to 2024

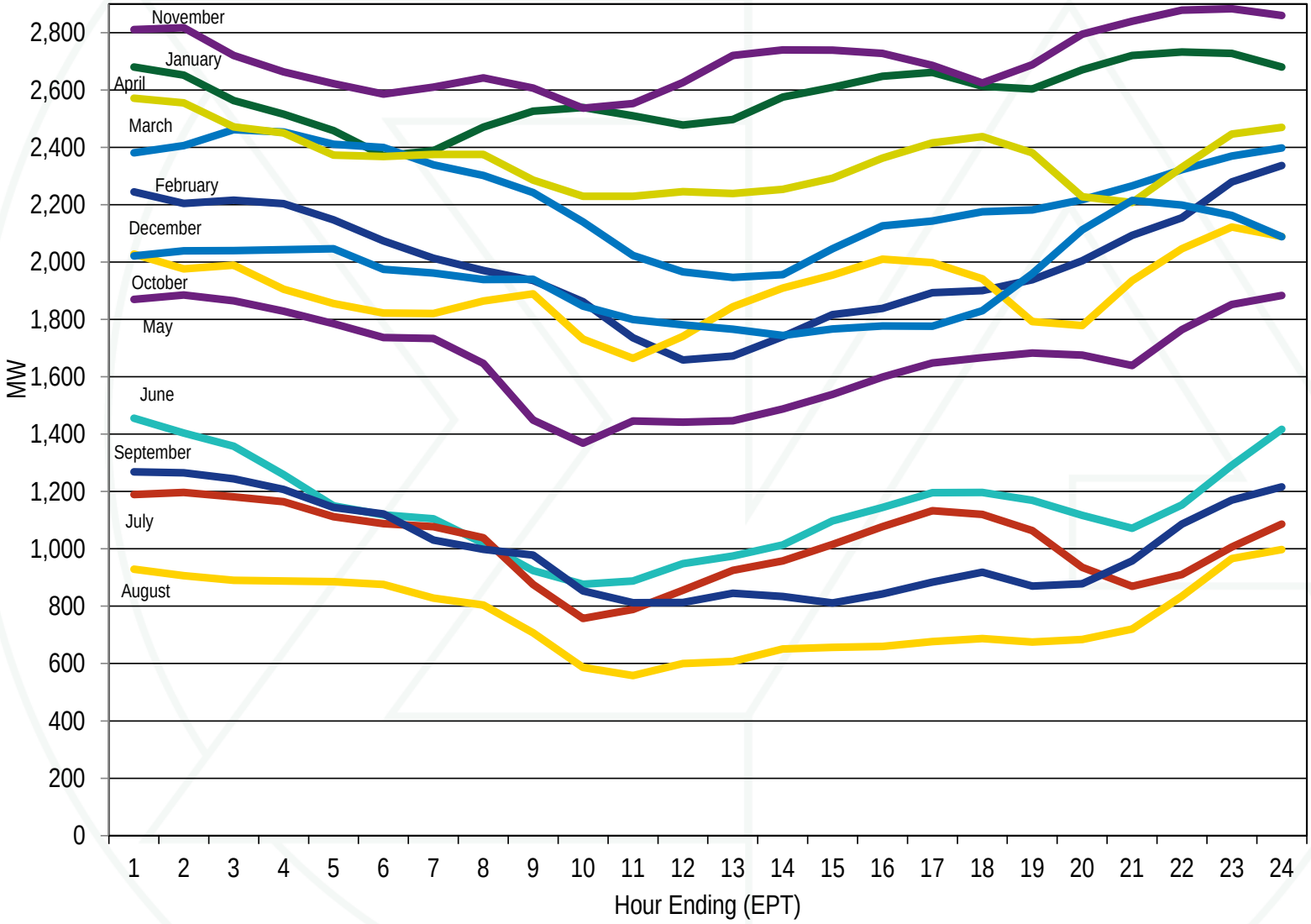
Jurisdiction	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Delaware	0.80%	1.00%	1.25%	1.50%	1.75%	2.00%	2.25%	2.50%	2.75%	3.00%	3.25%
Illinois	0.12%	0.27%	0.60%	0.69%	0.78%	0.87%	0.96%	1.05%	1.14%	1.23%	1.32%
Indiana	No Solar Standard										
Kentucky	No Standard										
Maryland	0.35%	0.50%	0.70%	0.95%	1.40%	1.75%	2.00%	2.00%	2.00%	2.00%	2.00%
Michigan	No Solar Standard										
New Jersey	2.05%	2.45%	2.75%	3.00%	3.20%	3.29%	3.38%	3.47%	3.56%	3.65%	3.74%
North Carolina	0.07%	0.14%	0.14%	0.14%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%
Ohio	0.12%	0.12%	0.12%	0.15%	0.18%	0.22%	0.26%	0.30%	0.34%	0.38%	0.42%
Pennsylvania	0.08%	0.14%	0.25%	0.29%	0.34%	0.39%	0.44%	0.50%	0.50%	0.50%	0.50%
Tennessee	No Standard										
Virginia	No Solar Standard										
Washington, D.C.	0.60%	0.70%	0.83%	0.98%	1.15%	1.35%	1.58%	1.85%	2.18%	2.50%	2.50%
West Virginia	No Solar Standard										

Figure 12-1 Map of PJM unit retirements: 2011 through 2019



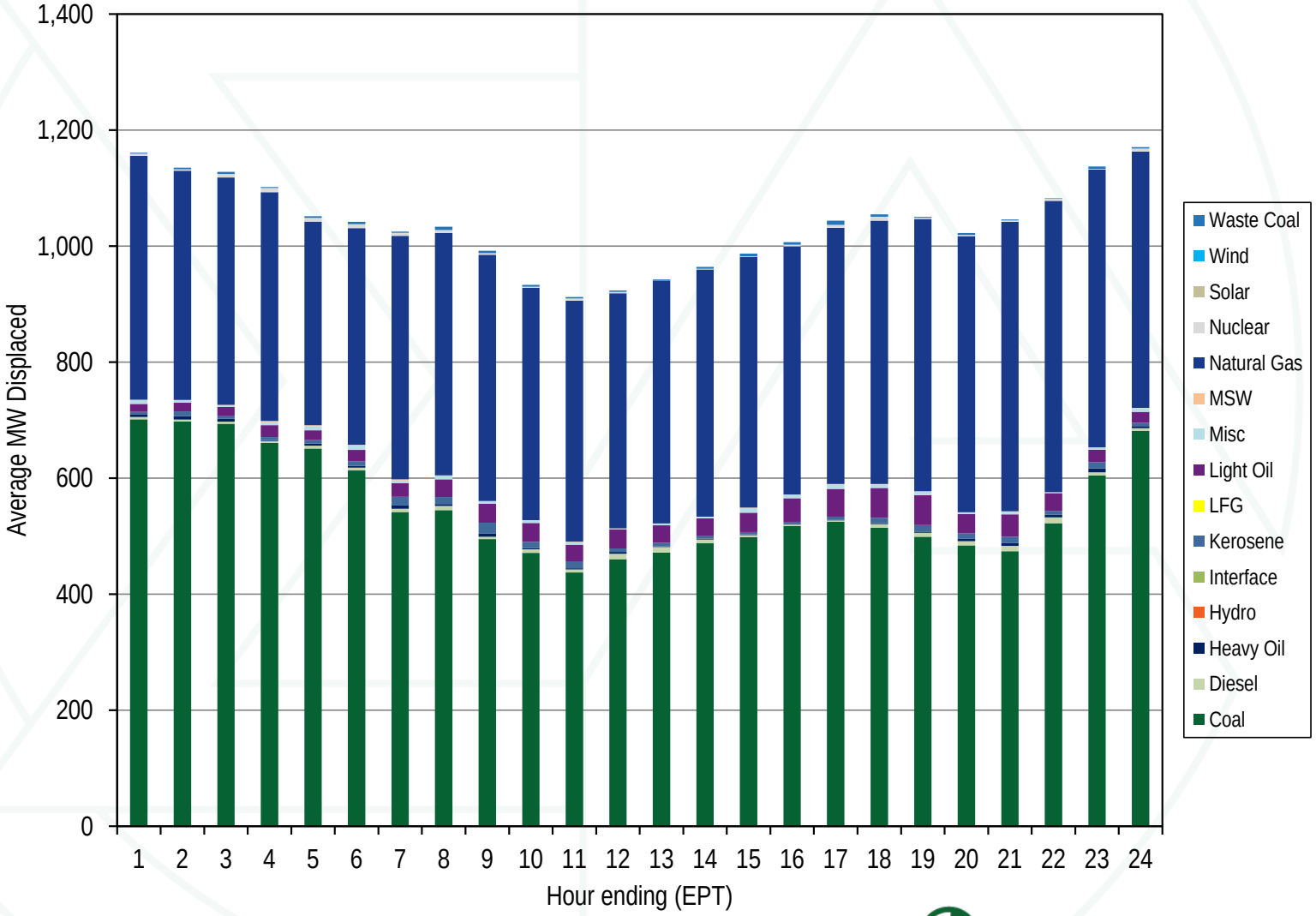
Monitoring Analytics

Figure 8-2 Average hourly real-time generation of wind units in PJM: 2014



Monitoring Analytics

Figure 8-4 Marginal fuel at time of wind generation in PJM: 2014



Monitoring Analytics

Table 8-16 Capacity factor of wind units in PJM: 2014

Type of Resource	Capacity Factor	Installed Capacity (MW)
Energy-Only Resource	18.2%	804
Capacity Resource	28.8%	5,798
All Units	27.8%	6,602

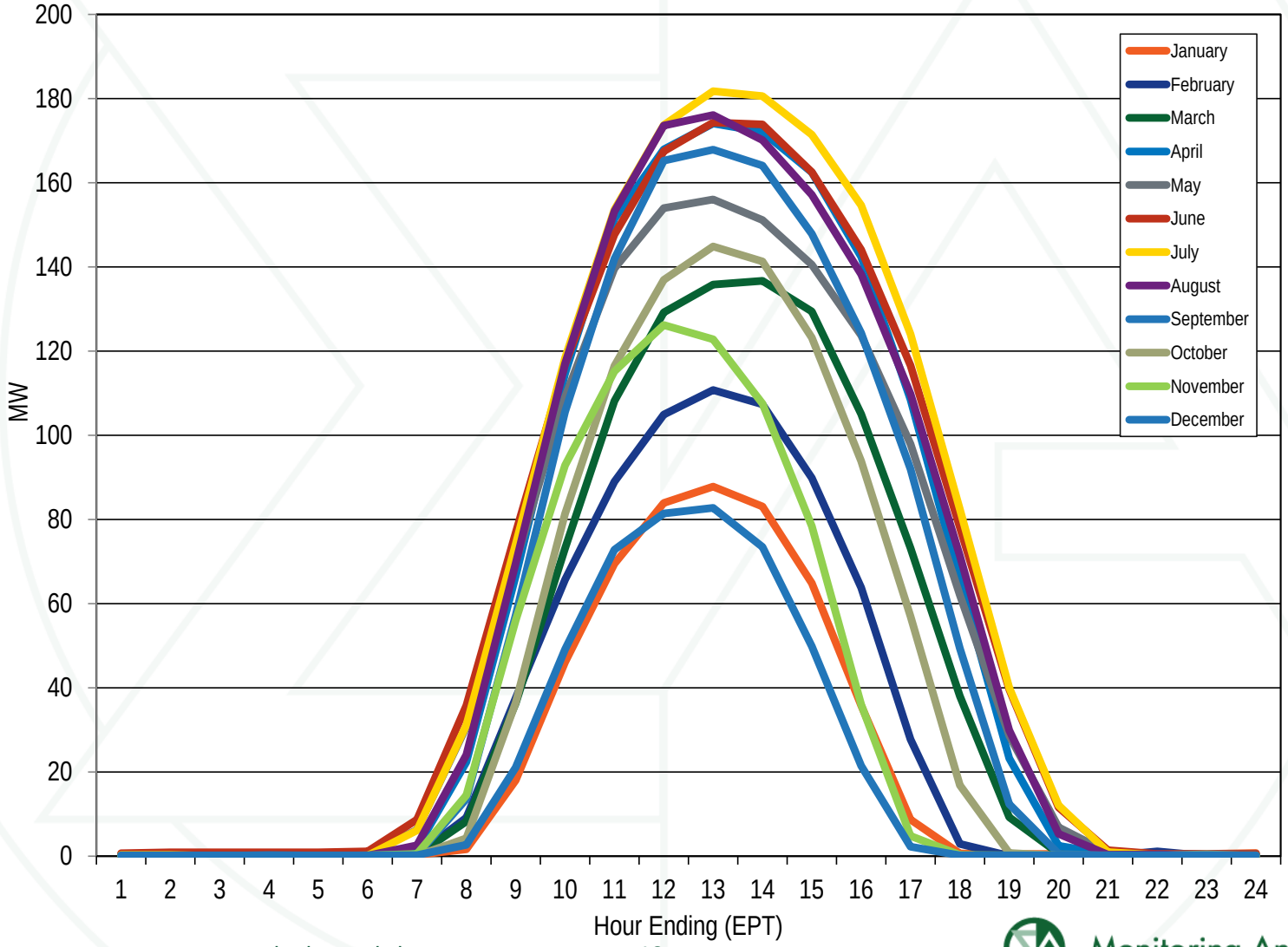
Table 8-17 Capacity factor of wind units in PJM by month, 2013 and 2014

Month	Generation (MWh)	Capacity Factor	Generation (MWh)	Capacity Factor
January	1,784,359.3	40.3%	1,918,441.4	40.7%
February	1,397,468.3	35.4%	1,342,055.5	31.5%
March	1,606,248.3	36.5%	1,661,382.1	35.3%
April	1,639,590.9	37.8%	1,697,703.3	37.2%
May	1,271,272.4	28.5%	1,238,061.3	26.2%
June	862,532.2	19.8%	820,312.2	18.0%
July	588,174.8	13.4%	757,166.8	16.0%
August	510,448.5	12.0%	566,425.3	12.0%
September	719,196.4	16.7%	721,411.2	15.8%
October	1,070,829.4	23.5%	1,416,878.2	30.0%
November	1,833,051.6	41.2%	1,949,112.9	41.5%
December	1,543,685.2	34.2%	1,451,542.0	29.7%
Annual	14,826,857.3	28.3%	15,540,492.0	27.8%

Wind Percent Recovery of Levelized Costs

Zone	2012	2013	2014
ComEd	67%	77%	93%
PENELEC	64%	79%	99%

Figure 8-5 Average hourly real-time generation of solar units in PJM: 2014



Monitoring Analytics

Solar Percent Recovery of Levelized Costs

Zone	2012	2013	2014
PSEG	100%	166%	190%

Table 1 Summary of sensitivity results: 2017/2018 RPM Base Residual Auction

Scenario	Scenario Description	RPM Revenue ($ per Delivery Year)	Difference from Actual Results	
			RPM Revenue ($ per Delivery Year)	Percentage
0	Actual Results	$7,512,229,630	NA	NA
1	Annual Resources Only	$9,738,222,922	$2,225,993,292	29.6%
2	No Offers for DR or EE (Generation Resources Only)	$16,859,658,203	$9,347,428,573	124.4%
3	No Short-Term Resource Procurement Target Reduction from VRR Curve	$9,947,329,539	$2,435,099,909	32.4%
3A	No Short-Term Resource Procurement Target Reduction	$9,967,834,187	$2,455,604,557	32.7%
4	No Short-Term Resource Procurement Target Reduction and Annual Resources Only	$10,932,522,889	$3,420,293,259	45.5%
5	No Short-Term Resource Procurement Target Reduction and No Offers for DR or EE (Generation Resources Only)	$23,870,404,571	$16,358,174,941	217.8%

Monitoring Analytics, LLC
2621 Van Buren Avenue
Suite 160
Eagleville, PA
19403

(610) 271-8050

MA@monitoringanalytics.com

www.MonitoringAnalytics.com