

# 2017 Year in Review

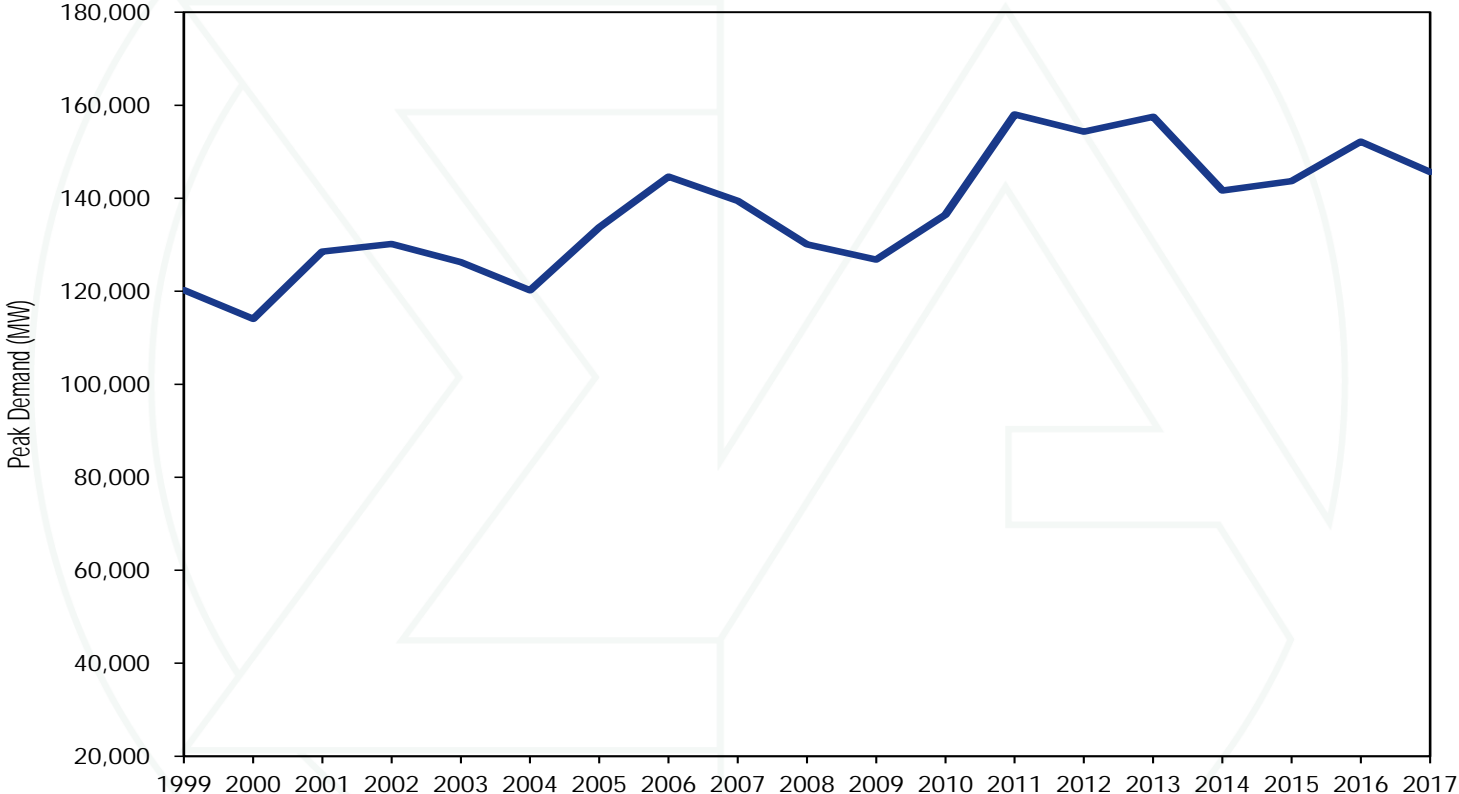
PJM Annual Meeting  
May 16, 2018

Joe Bowring

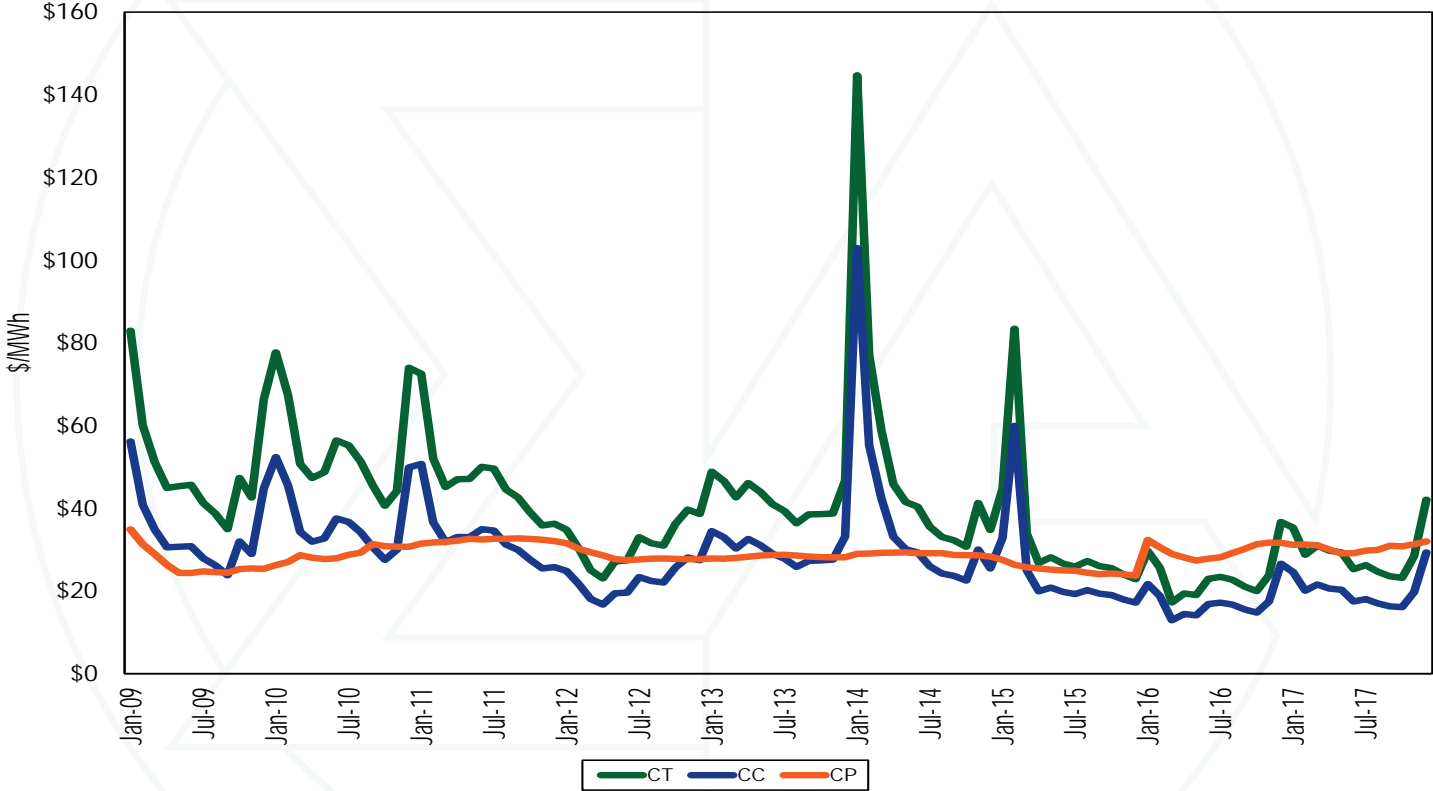


Monitoring Analytics

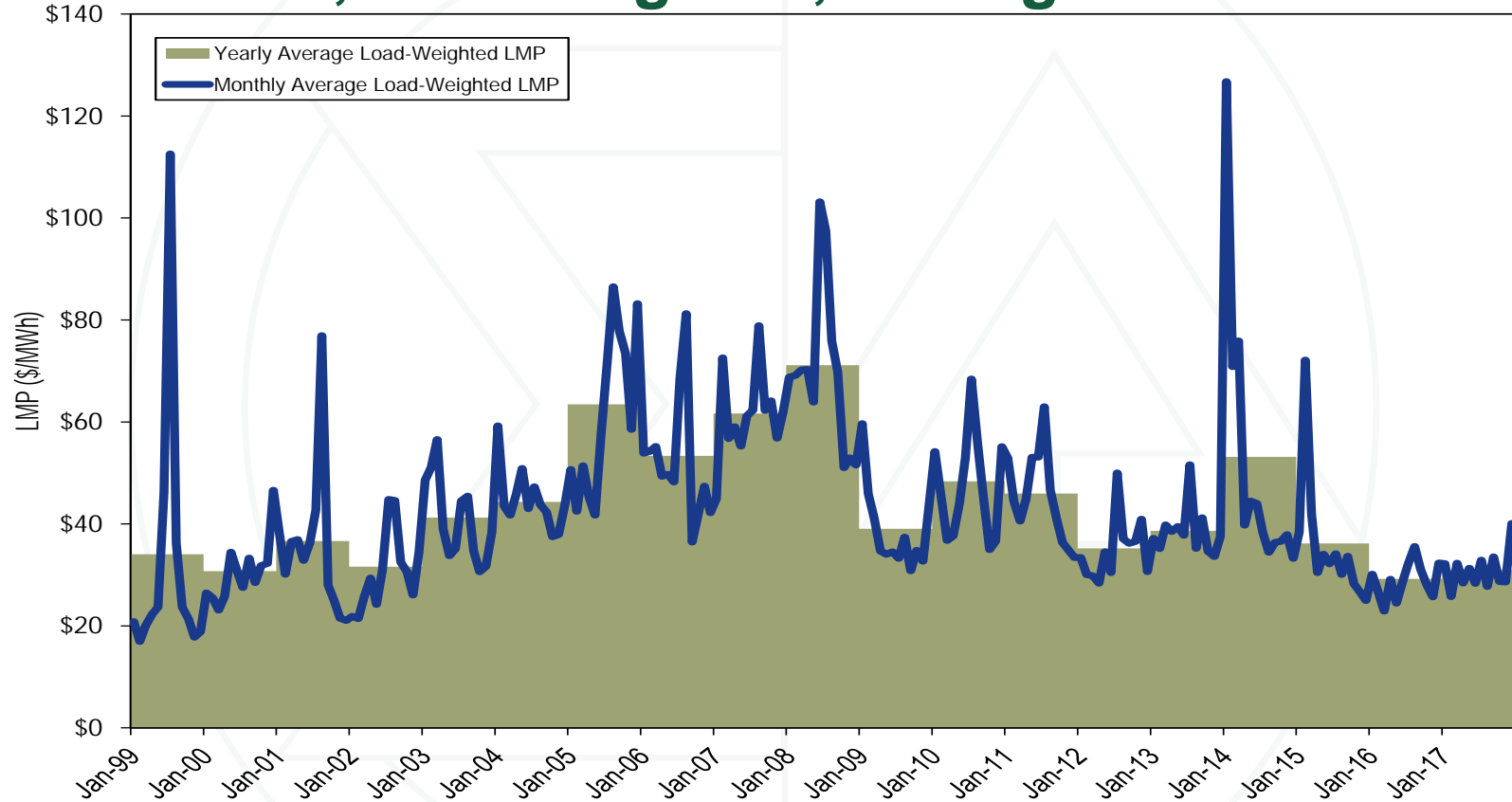
# Peak load: 1999 to 2017



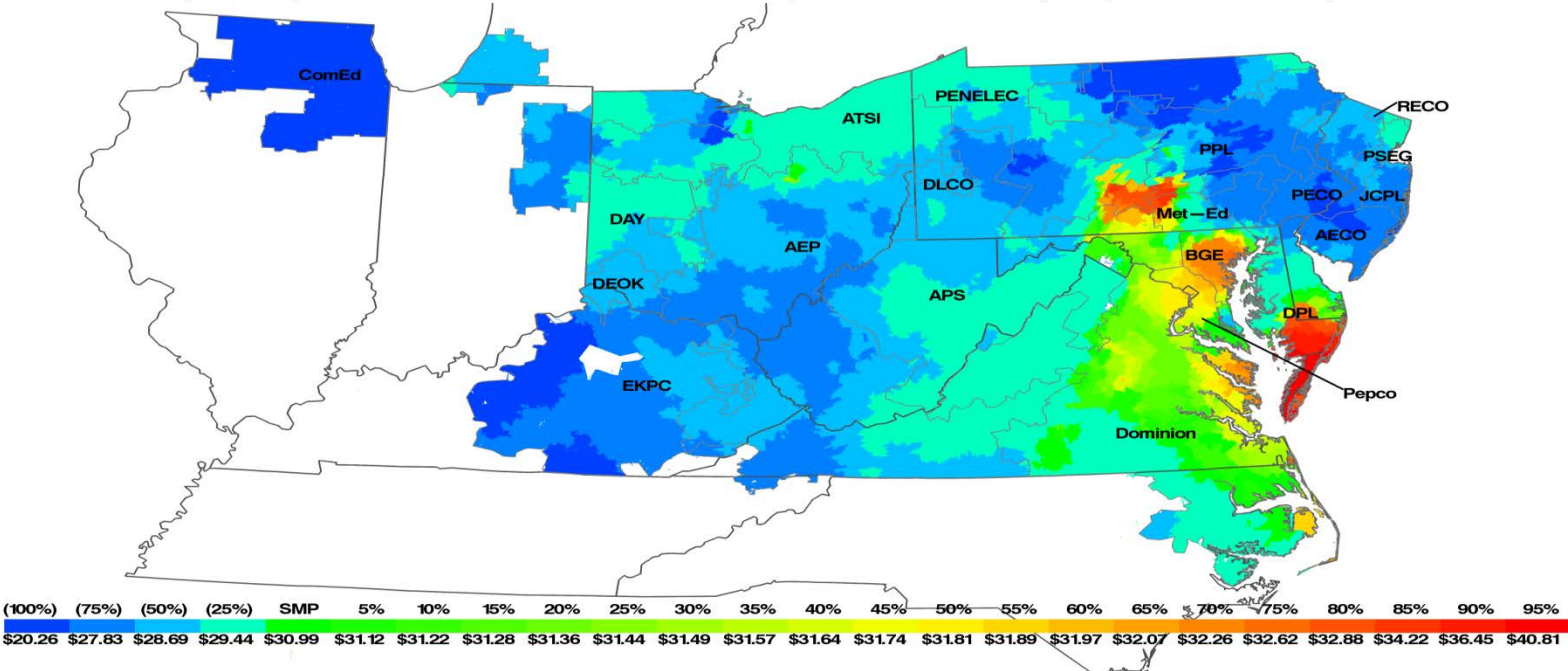
# Average short run marginal costs



# Real-time, load-weighted, average LMP



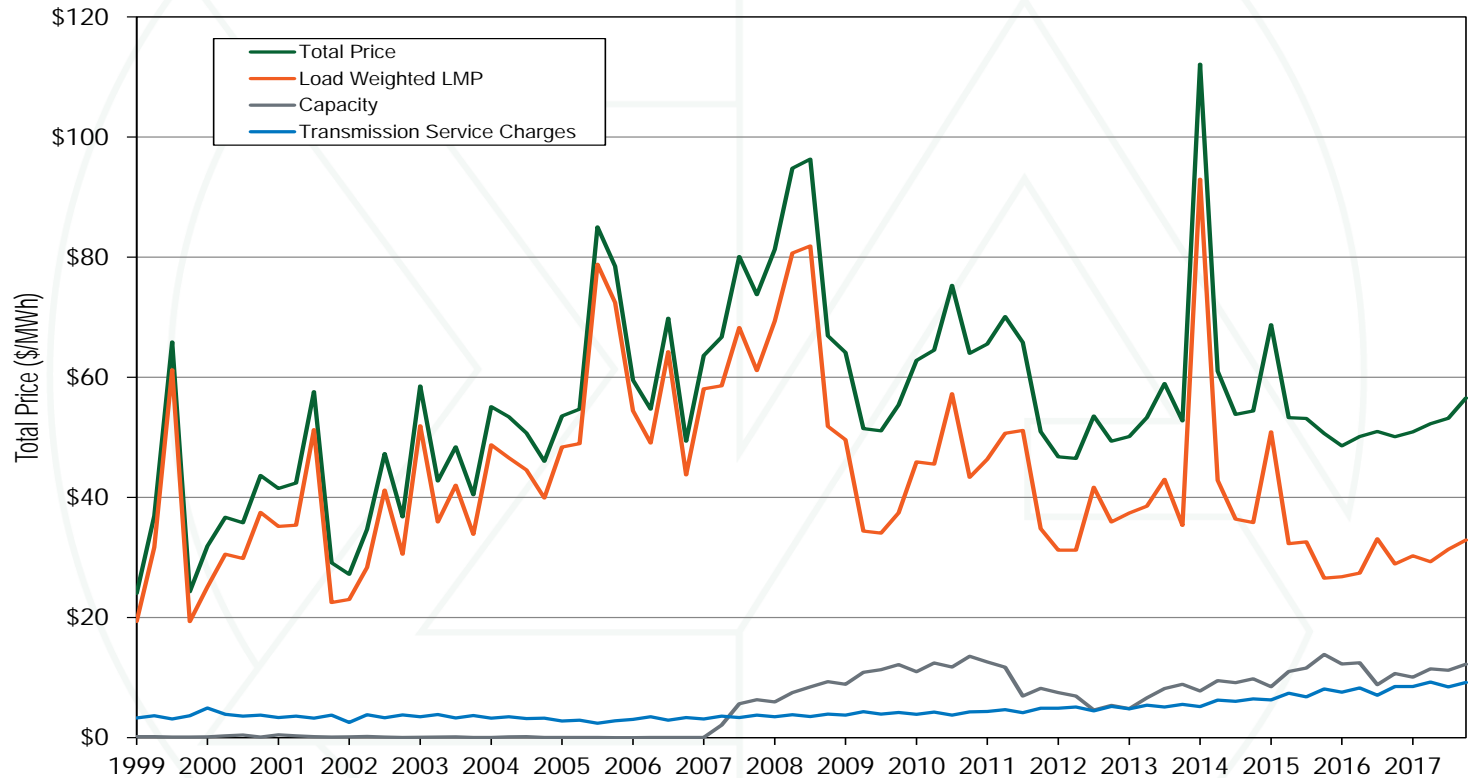
# Real-time, load-weighted, average LMP



# Components of PJM real-time LMP

Element	2016		2017		Change
	Contribution to LMP	Percent	Contribution to LMP	Percent	Percent
Gas	\$7.76	26.5%	\$12.15	39.2%	12.7%
Coal	\$13.44	46.0%	\$8.97	28.9%	(17.0%)
Markup	\$0.27	0.9%	\$2.55	8.2%	7.3%
Ten Percent Adder	\$2.43	8.3%	\$2.39	7.7%	(0.6%)
VOM	\$2.04	7.0%	\$1.70	5.5%	(1.5%)
NA	\$1.48	5.1%	\$0.81	2.6%	(2.5%)
LPA Rounding Difference	\$0.15	0.5%	\$0.78	2.5%	2.0%
Oil	\$0.24	0.8%	\$0.44	1.4%	0.6%
NO <sub>x</sub> Cost	\$0.42	1.4%	\$0.41	1.3%	(0.1%)
Increase Generation Adder	\$0.41	1.4%	\$0.39	1.2%	(0.2%)
Ancillary Service Redispatch Cost	\$0.32	1.1%	\$0.25	0.8%	(0.3%)
CO <sub>2</sub> Cost	\$0.09	0.3%	\$0.09	0.3%	(0.0%)
SO <sub>2</sub> Cost	\$0.07	0.3%	\$0.06	0.2%	(0.1%)
Other	\$0.15	0.5%	\$0.06	0.2%	(0.3%)
Scarcity Adder	\$0.00	0.0%	\$0.05	0.2%	0.2%
Municipal Waste	\$0.04	0.1%	\$0.05	0.2%	0.0%
Opportunity Cost Adder	\$0.00	0.0%	\$0.04	0.1%	0.1%
Market-to-Market Adder	\$0.01	0.0%	\$0.00	0.0%	(0.0%)
Uranium	\$0.00	0.0%	\$0.00	0.0%	(0.0%)
Constraint Violation Adder	\$0.00	0.0%	\$0.00	0.0%	0.0%
LPA-SCED Differential	(\$0.01)	(0.0%)	(\$0.01)	(0.0%)	0.0%
Decrease Generation Adder	(\$0.03)	(0.1%)	(\$0.07)	(0.2%)	(0.1%)
Wind	(\$0.05)	(0.2%)	(\$0.11)	(0.4%)	(0.2%)
Total	\$29.23	100.0%	\$30.99	100.0%	0.0%

# Top three components of total wholesale price

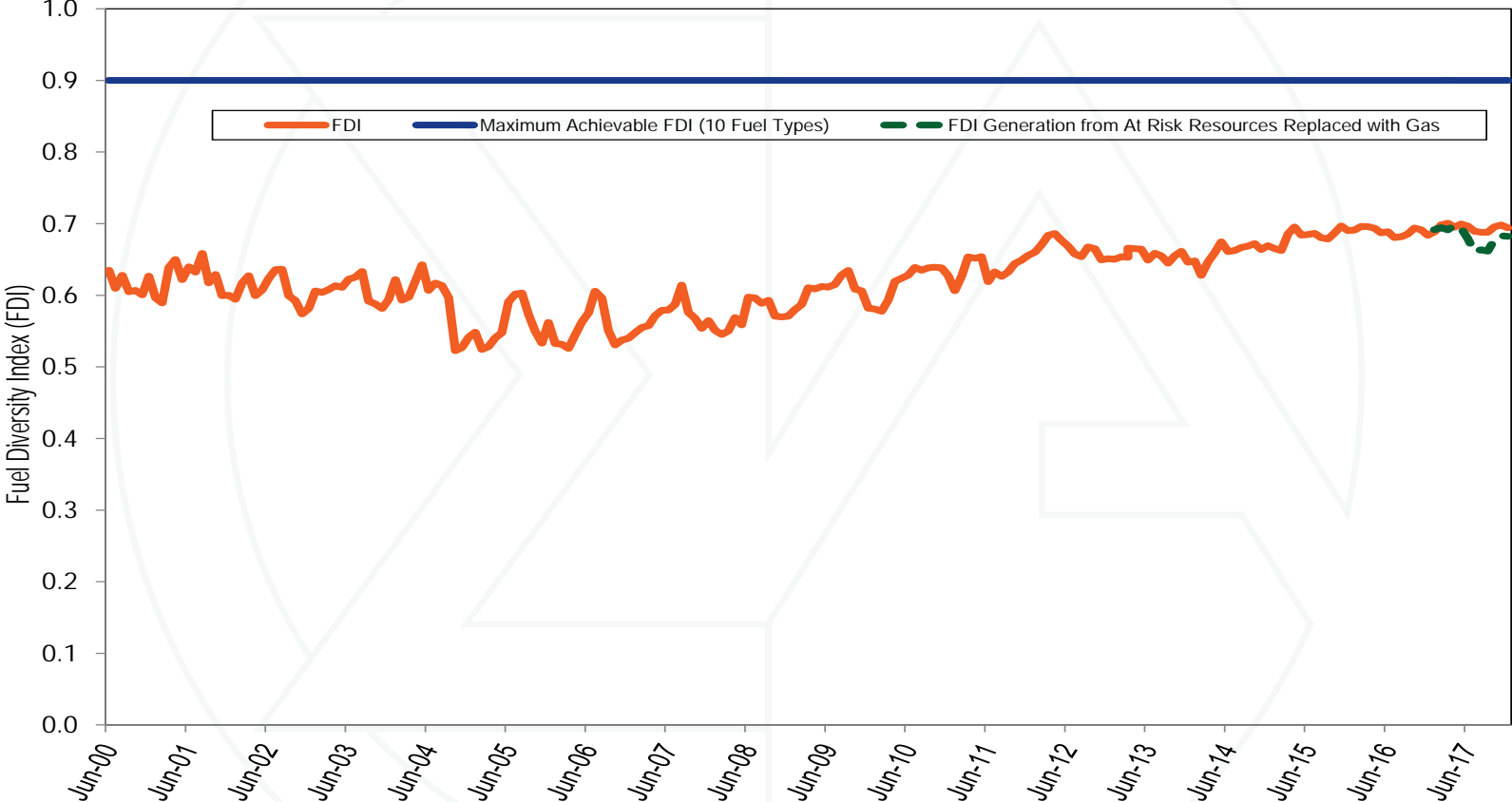


# PJM generation by fuel source

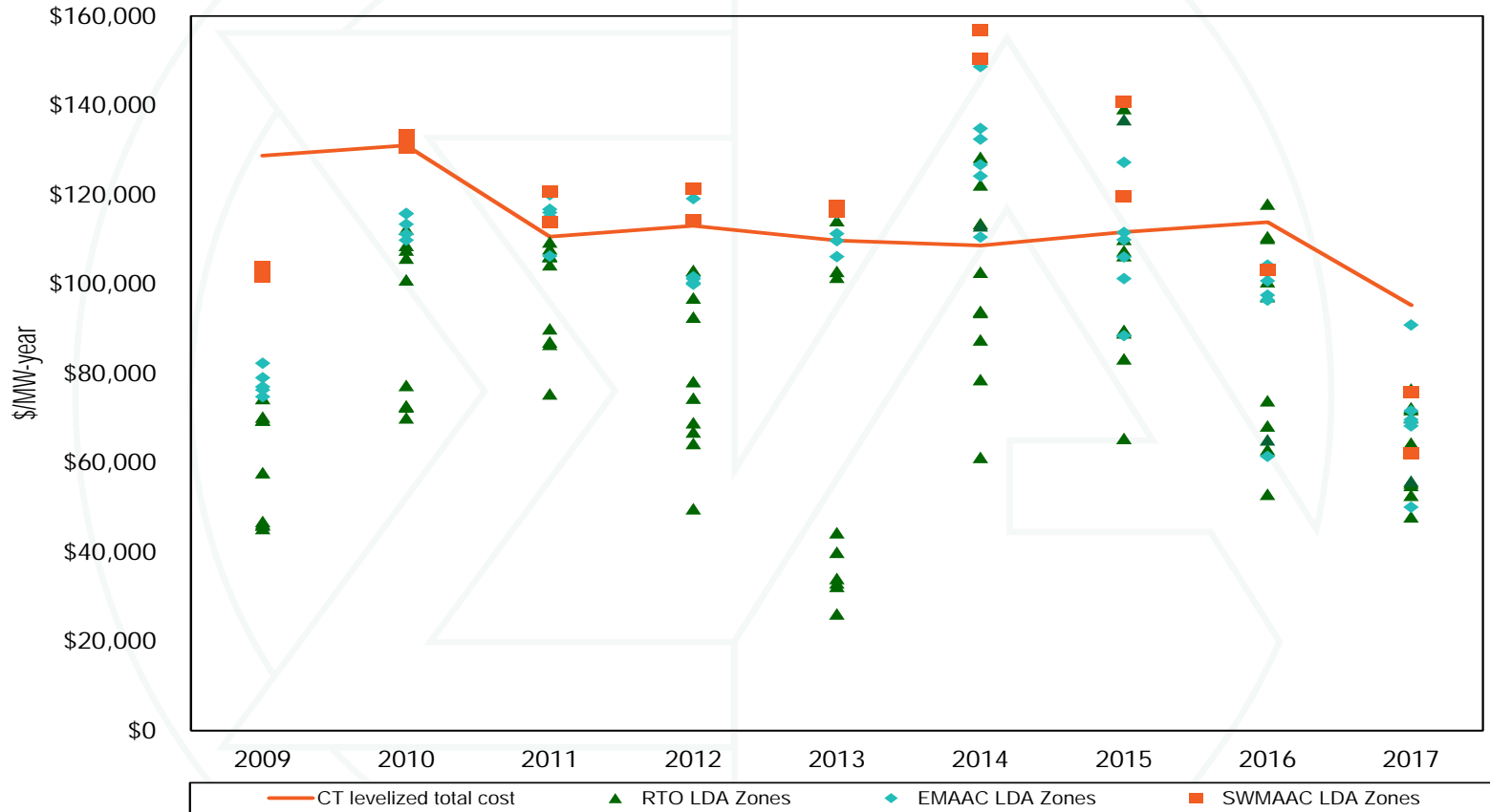
	2016		2017		Change in Output
	GWh	Percent	GWh	Percent	
Coal	275,289.4	33.9%	256,613.8	31.8%	(6.8%)
Bituminous	241,050.2	29.7%	220,789.4	27.3%	(8.4%)
Sub Bituminous	28,949.8	3.6%	28,016.0	3.5%	(3.2%)
Other Coal	5,289.5	0.7%	7,808.4	1.0%	47.6%
Nuclear	279,546.4	34.4%	287,575.8	35.6%	2.9%
Gas	217,199.0	26.7%	219,205.1	27.1%	0.9%
Natural Gas	215,021.4	26.5%	216,758.6	26.8%	0.8%
Landfill Gas	2,177.6	0.3%	2,433.1	0.3%	11.7%
Other Gas	0.0	0.0%	13.4	0.0%	NA
Hydroelectric	13,686.8	1.7%	14,868.4	1.8%	8.6%
Pumped Storage	4,840.2	0.6%	5,132.6	0.6%	6.0%
Run of River	7,332.8	0.9%	8,119.8	1.0%	10.7%
Other Hydro	1,513.8	0.2%	1,616.0	0.2%	6.8%
Wind	17,716.0	2.2%	20,714.1	2.6%	16.9%
Waste	4,358.9	0.5%	3,984.1	0.5%	(8.6%)
Solid Waste	4,139.8	0.5%	3,740.7	0.5%	(9.6%)
Miscellaneous	219.2	0.0%	243.4	0.0%	11.1%
Oil	2,163.2	0.3%	2,301.7	0.3%	6.4%
Heavy Oil	270.7	0.0%	174.4	0.0%	(35.6%)
Light Oil	340.7	0.0%	340.3	0.0%	(0.1%)
Diesel	59.4	0.0%	81.7	0.0%	37.5%
Gasoline	0.0	0.0%	0.0	0.0%	NA
Kerosene	74.8	0.0%	15.2	0.0%	(79.6%)
Jet Oil	0.0	0.0%	3.1	0.0%	NA
Other Oil	1,417.7	0.2%	1,687.0	0.2%	19.0%
Solar, Net Energy Metering	1,019.4	0.1%	1,468.7	0.2%	44.1%
Energy Storage	15.7	0.0%	25.1	0.0%	59.6%
Battery	15.7	0.0%	25.1	0.0%	59.6%
Compressed Air	0.0	0.0%	0.0	0.0%	NA
Biofuel	1,541.5	0.2%	1,473.0	0.2%	(4.4%)
Geothermal	0.0	0.0%	0.0	0.0%	NA
Other Fuel Type	0.0	0.0%	0.0	0.0%	NA
<b>Total</b>	<b>812,536.3</b>	<b>100.0%</b>	<b>808,229.7</b>	<b>100.0%</b>	<b>(0.5%)</b>



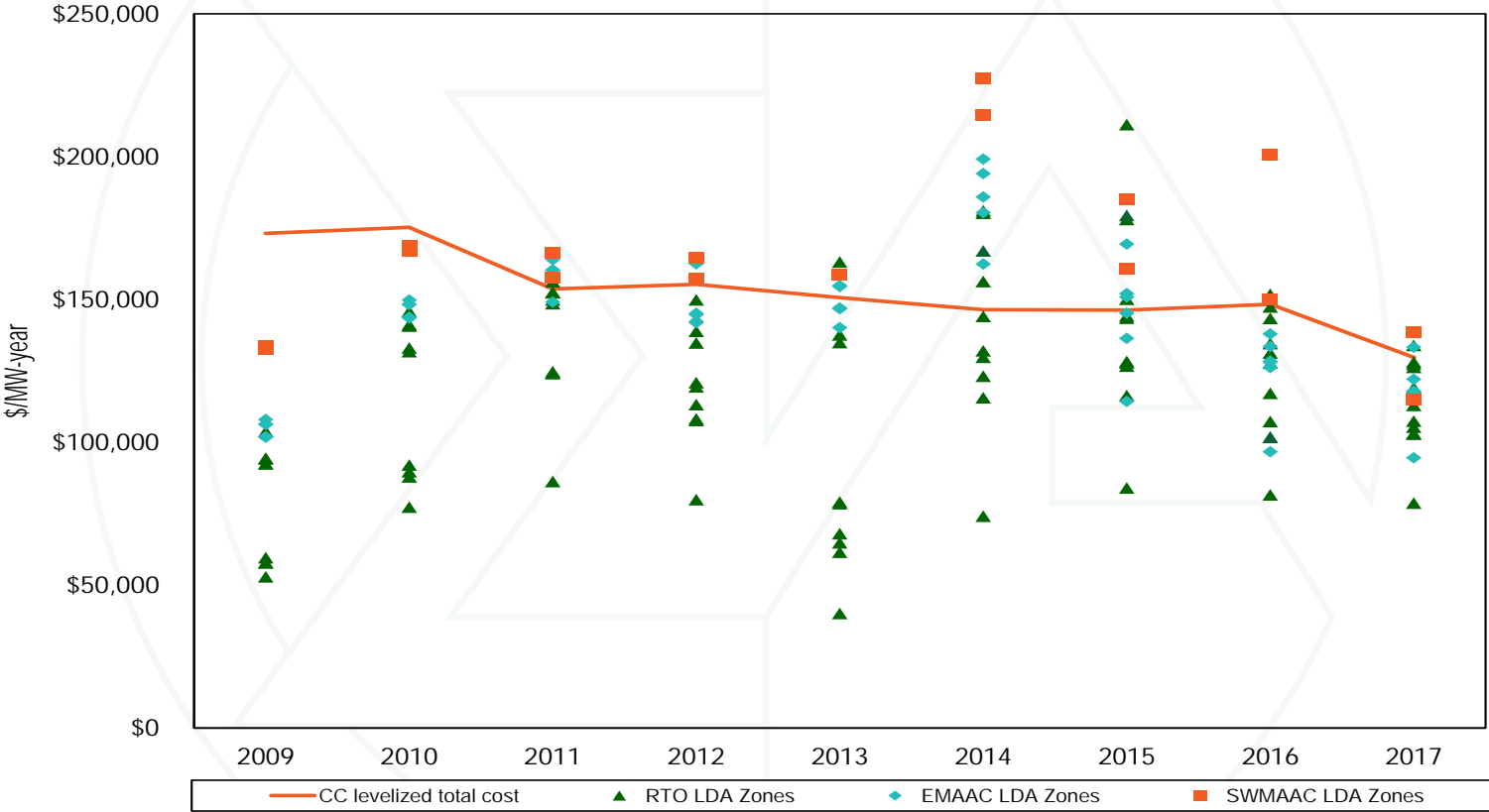
# Generation fuel diversity index



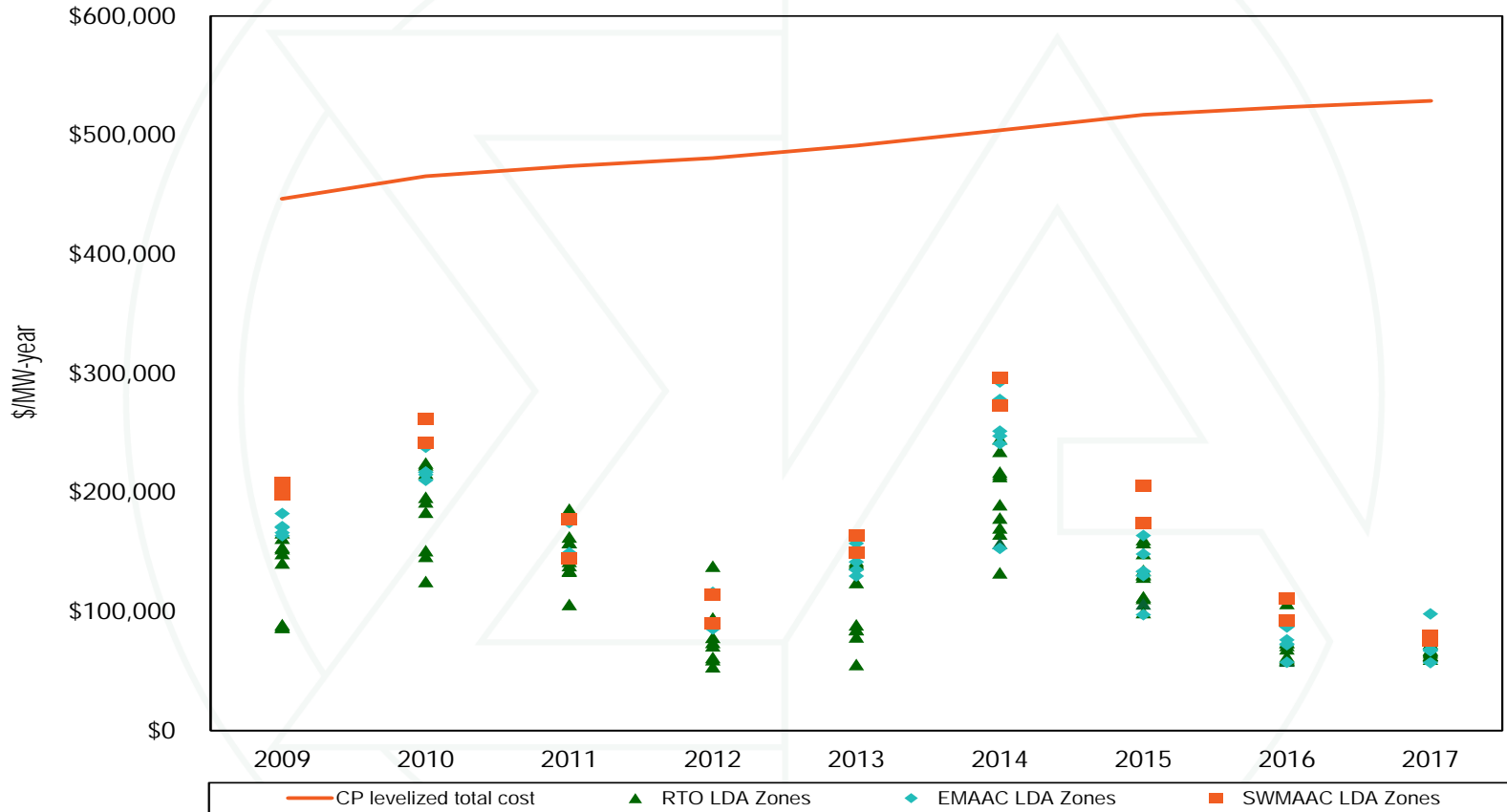
# New entrant CT net revenue and total cost



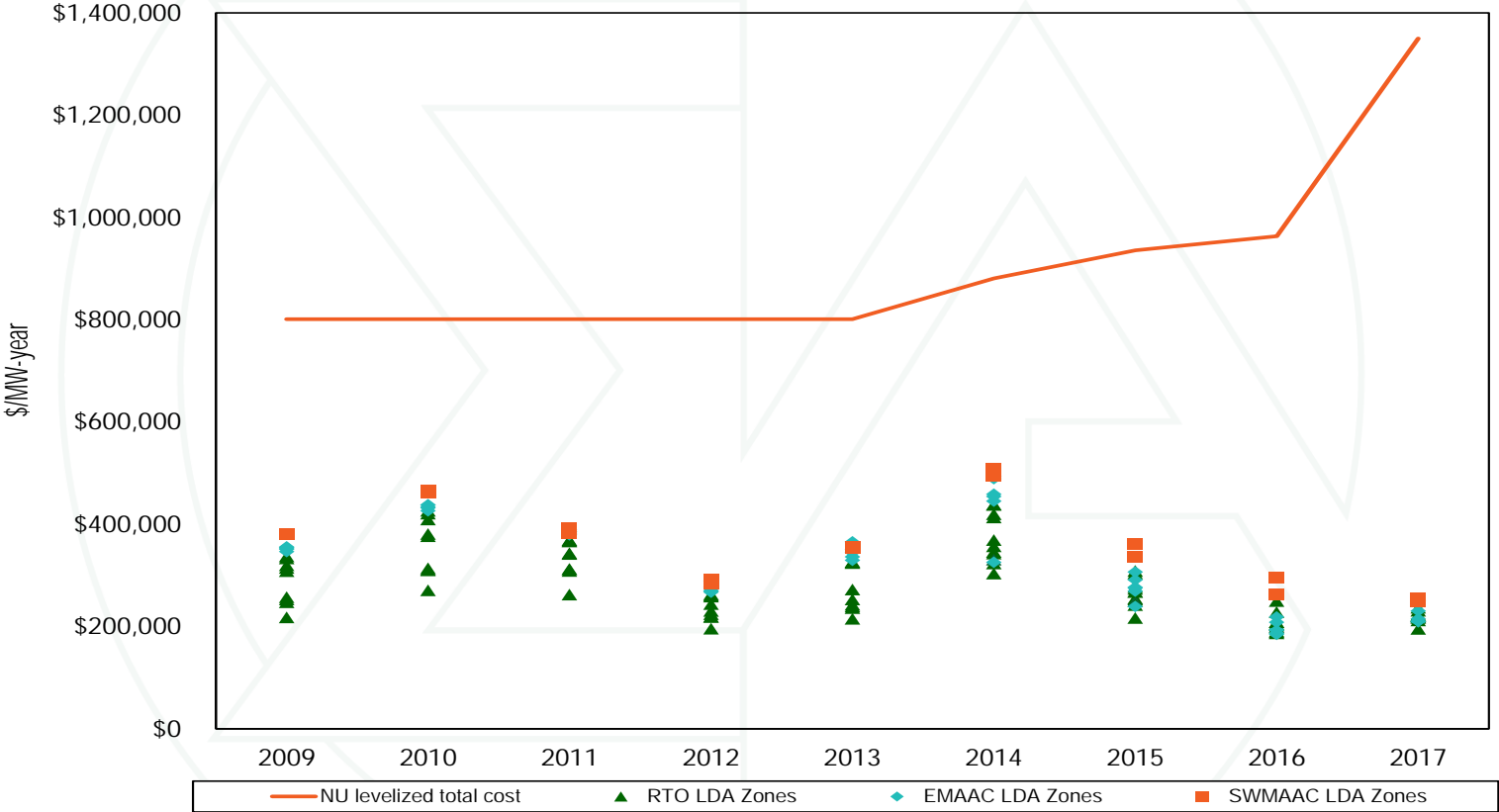
# New entrant CC net revenue and total cost



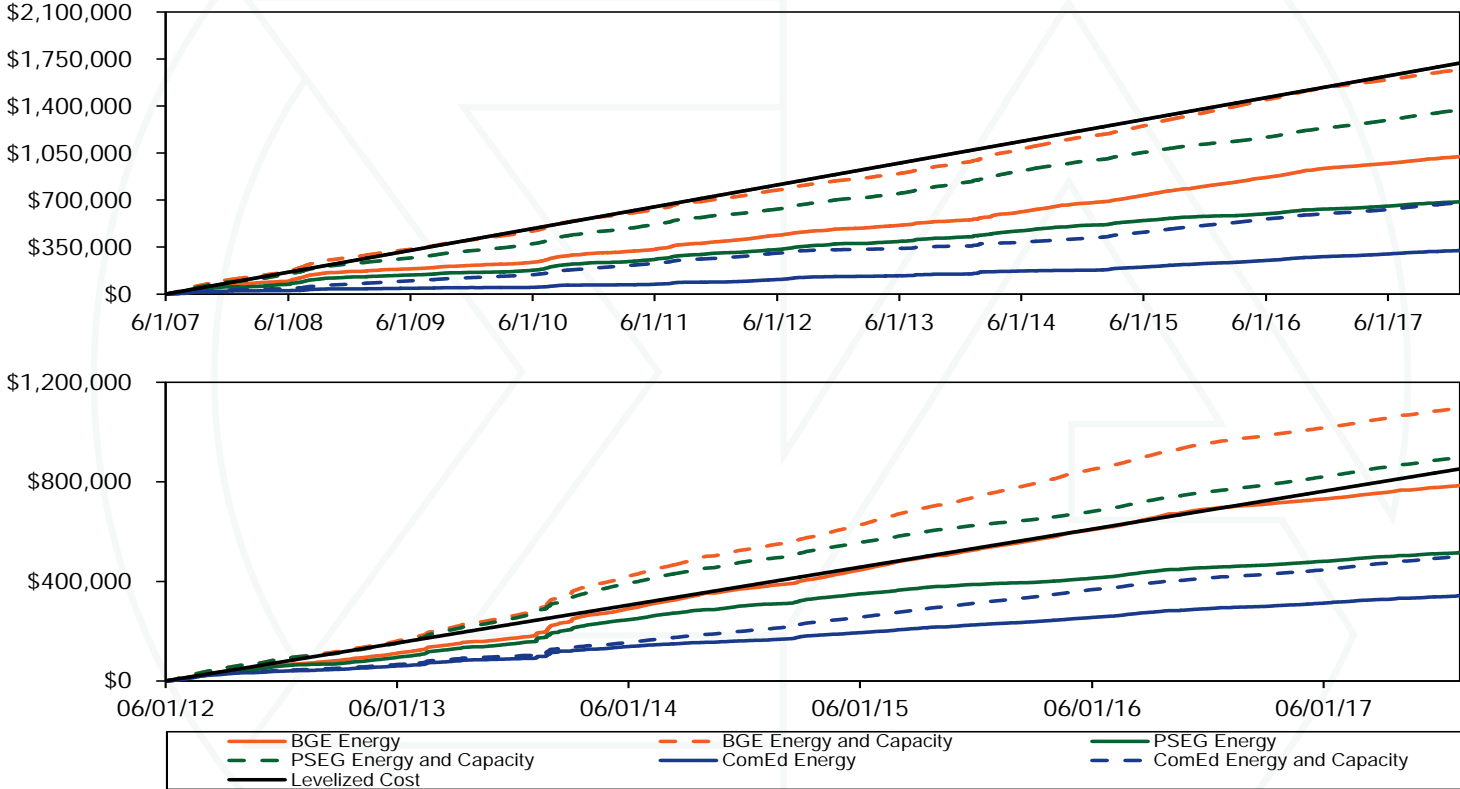
# New entrant coal net revenue and total cost



# New entrant nuclear net revenue and total cost



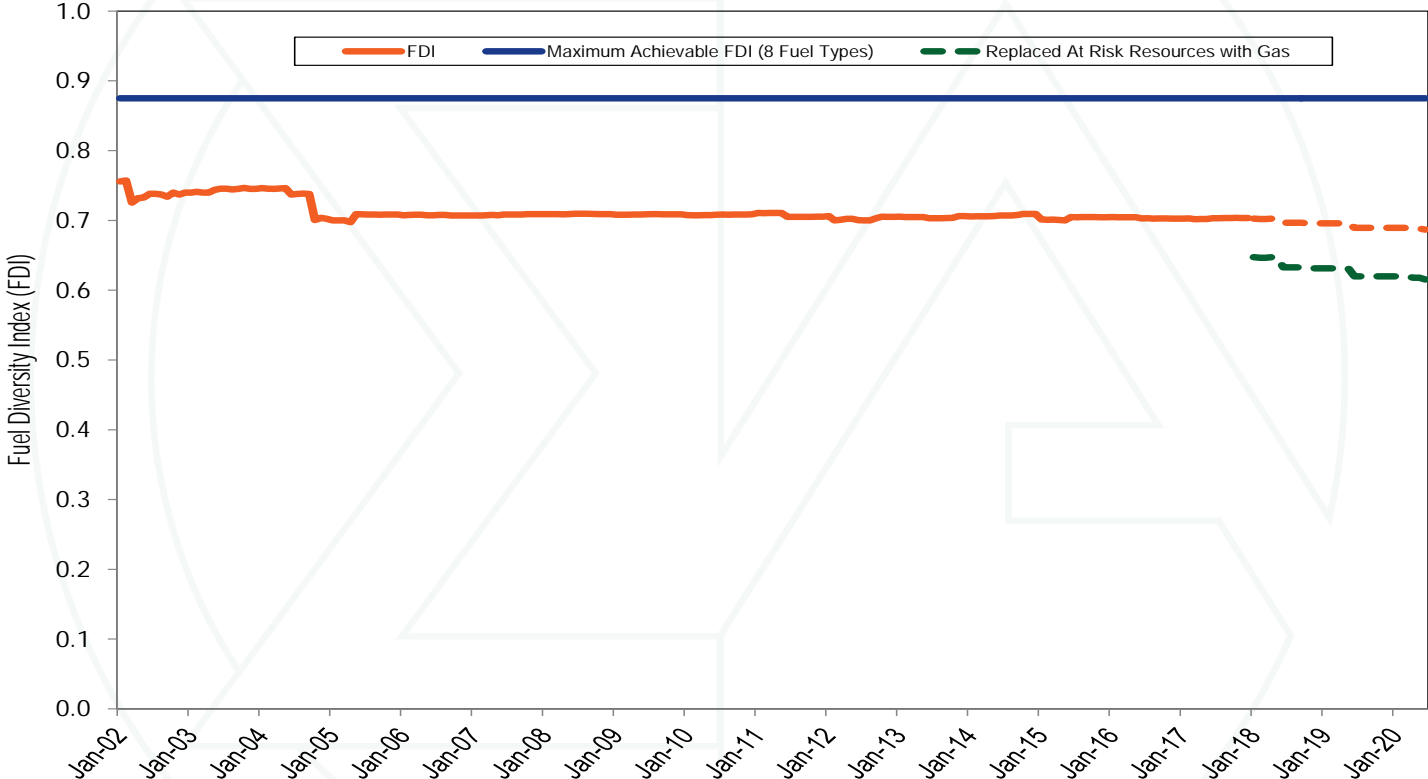
# Historical new entrant CC revenue adequacy



# PJM installed capacity (by fuel source)

	1-Jan-17		31-May-17		1-Jun-17		31-Dec-17	
	MW	Percent	MW	Percent	MW	Percent	MW	Percent
Coal	66,622.2	36.5%	66,941.3	36.5%	65,688.0	35.9%	65,144.0	35.4%
Gas	65,110.3	35.7%	65,787.1	35.9%	66,397.6	36.3%	67,726.4	36.8%
Hydroelectric	8,850.4	4.9%	8,850.4	4.8%	8,870.2	4.8%	8,856.2	4.8%
Nuclear	33,043.4	18.1%	33,103.7	18.0%	33,163.5	18.1%	33,163.5	18.0%
Oil	6,733.6	3.7%	6,687.0	3.6%	6,684.4	3.7%	6,672.2	3.6%
Solar	262.3	0.1%	268.0	0.1%	366.8	0.2%	373.2	0.2%
Solid waste	769.4	0.4%	769.4	0.4%	814.4	0.4%	809.4	0.4%
Wind	1,019.1	0.6%	1,079.1	0.6%	1,114.3	0.6%	1,136.7	0.6%
Total	182,410.7	100.0%	183,486.0	100.0%	183,099.2	100.0%	183,881.6	100.0%

# Installed capacity fuel diversity index





# Avoidable cost recovery: 2011 through 2017

Technology	Units with full recovery from energy and ancillary net revenue							Units with full recovery from all markets						
	2011	2012	2013	2014	2015	2016	2017	2011	2012	2013	2014	2015	2016	2017
CC - Combined Cycle	55%	46%	50%	72%	59%	63%	62%	85%	79%	79%	95%	88%	93%	86%
CT - Aero Derivative	15%	6%	6%	53%	15%	8%	23%	100%	96%	76%	98%	100%	99%	99%
CT - Industrial Frame	26%	23%	17%	38%	13%	8%	18%	99%	98%	83%	100%	100%	100%	99%
Coal Fired	-	-	25%	78%	18%	19%	19%	-	-	54%	83%	69%	40%	52%
Diesel	48%	42%	37%	69%	56%	33%	46%	100%	100%	77%	100%	100%	100%	100%
Hydro	74%	61%	95%	97%	81%	79%	95%	81%	77%	97%	98%	100%	100%	97%
Nuclear	-	-	79%	100%	53%	16%	21%	-	-	95%	100%	89%	58%	68%
Oil or Gas Steam	8%	6%	11%	15%	3%	0%	9%	92%	78%	86%	85%	91%	88%	88%
Pumped Storage	100%	100%	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

# Nuclear unit historic annual surplus (shortfall)

	ICAP (MW)	Surplus (Shortfall) (\$/MWh)														
		100% of NEI Capital Costs					2/3 of NEI Capital Costs					1/3 of NEI Capital Costs				
		2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Beaver Valley	1,777	\$3.6	\$13.8	\$4.2	(\$0.8)	\$1.4	\$5.6	\$15.8	\$6.3	\$1.3	\$3.5	\$7.7	\$17.9	\$8.3	\$3.3	\$5.5
Braidwood	2,330	(\$0.4)	\$9.3	(\$0.2)	(\$3.5)	(\$2.7)	\$1.6	\$11.3	\$1.9	(\$1.5)	(\$0.6)	\$3.7	\$13.4	\$3.9	\$0.6	\$1.4
Byron	2,300	(\$1.5)	\$7.0	(\$5.1)	(\$9.9)	(\$3.9)	\$0.6	\$9.0	(\$3.1)	(\$7.8)	(\$1.8)	\$2.6	\$11.1	(\$1.0)	(\$5.8)	\$0.2
Calvert Cliffs	1,716	\$16.4	\$33.5	\$15.1	\$6.8	\$4.9	\$18.5	\$35.5	\$17.2	\$8.9	\$7.0	\$20.5	\$37.6	\$19.2	\$10.9	\$9.0
Cook	2,071	\$3.5	\$12.4	\$3.8	(\$0.9)	\$0.3	\$5.5	\$14.5	\$5.8	\$1.2	\$2.4	\$7.6	\$16.5	\$7.9	\$3.2	\$4.4
Davis Besse	894	(\$4.3)	\$9.4	\$1.4	(\$4.6)	(\$7.6)	(\$1.4)	\$12.2	\$4.3	(\$1.7)	(\$4.8)	\$1.5	\$15.1	\$7.2	\$1.2	(\$1.9)
Dresden	1,787	\$1.2	\$11.1	\$1.3	(\$1.9)	(\$1.3)	\$3.2	\$13.2	\$3.4	\$0.1	\$0.7	\$5.3	\$15.2	\$5.4	\$2.2	\$2.8
Hope Creek	1,161	\$14.2	\$27.9	\$7.2	(\$2.6)	\$0.1	\$16.2	\$30.0	\$9.3	(\$0.6)	\$2.2	\$18.3	\$32.0	\$11.3	\$1.5	\$4.2
LaSalle	2,238	\$0.3	\$9.8	\$0.1	(\$3.9)	(\$3.0)	\$2.3	\$11.8	\$2.2	(\$1.8)	(\$0.9)	\$4.4	\$13.9	\$4.2	\$0.2	\$1.1
Limerick	2,296	\$14.0	\$27.7	\$7.5	(\$2.5)	\$0.3	\$16.1	\$29.7	\$9.5	(\$0.4)	\$2.4	\$18.1	\$31.8	\$11.6	\$1.6	\$4.4
North Anna	1,891	\$7.9	\$25.3	\$11.9	\$2.7	\$3.6	\$9.9	\$27.3	\$14.0	\$4.7	\$5.6	\$12.0	\$29.4	\$16.0	\$6.8	\$7.7
Oyster Creek	615	\$5.6	\$19.0	(\$1.9)	(\$11.8)	(\$8.9)	\$8.5	\$21.9	\$1.0	(\$8.9)	(\$6.0)	\$11.4	\$24.8	\$3.9	(\$6.0)	(\$3.1)
Quad Cities	1,819	(\$4.7)	\$2.6	(\$6.7)	(\$9.8)	(\$4.6)	(\$2.7)	\$4.7	(\$4.6)	(\$7.7)	(\$2.5)	(\$0.6)	\$6.7	(\$2.6)	(\$5.7)	(\$0.5)
Peach Bottom	2,251	\$14.1	\$27.5	\$6.8	(\$2.8)	\$0.1	\$16.2	\$29.5	\$8.8	(\$0.7)	\$2.2	\$18.2	\$31.6	\$10.9	\$1.3	\$4.2
Perry	1,240	(\$3.7)	\$8.3	\$2.2	(\$4.6)	(\$6.6)	(\$0.8)	\$11.2	\$5.1	(\$1.7)	(\$3.7)	\$2.0	\$14.1	\$8.0	\$1.2	(\$0.8)
Salem	2,332	\$14.1	\$27.9	\$7.2	(\$2.6)	\$0.1	\$16.2	\$29.9	\$9.2	(\$0.6)	\$2.2	\$18.2	\$32.0	\$11.3	\$1.5	\$4.2
Surry	1,690	\$7.3	\$23.7	\$11.8	\$2.3	\$3.4	\$9.4	\$25.7	\$13.8	\$4.3	\$5.5	\$11.4	\$27.8	\$15.9	\$6.4	\$7.5
Susquehanna	2,520	\$12.9	\$26.5	\$7.3	(\$2.2)	\$0.5	\$15.0	\$28.6	\$9.3	(\$0.1)	\$2.5	\$17.0	\$30.6	\$11.4	\$1.9	\$4.6
Three Mile Island	805	\$3.3	\$16.3	(\$4.0)	(\$12.6)	(\$9.3)	\$6.1	\$19.2	(\$1.1)	(\$9.7)	(\$6.4)	\$9.0	\$22.1	\$1.8	(\$6.8)	(\$3.5)

# Nuclear unit forward annual surplus (shortfall)

	Surplus (Shortfall) (\$/MWh)								
	100% of NEI Capital Costs			2/3 of NEI Capital Costs			1/3 of NEI Capital Costs		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Beaver Valley	\$6.77	\$3.99	\$2.11	\$8.82	\$6.04	\$4.16	\$10.87	\$8.09	\$6.21
Braidwood	\$0.11	\$2.63	\$1.93	\$2.16	\$4.68	\$3.98	\$4.21	\$6.73	\$6.03
Byron	\$1.31	\$2.42	\$1.72	\$3.36	\$4.47	\$3.77	\$5.41	\$6.52	\$5.82
Calvert Cliffs	\$10.18	\$5.79	\$4.14	\$12.23	\$7.84	\$6.19	\$14.28	\$9.89	\$8.24
Cook	\$3.96	\$3.37	\$1.50	\$6.01	\$5.42	\$3.55	\$8.06	\$7.47	\$5.60
Davis Besse	(\$3.73)	(\$5.57)	(\$7.44)	(\$0.84)	(\$2.68)	(\$4.55)	\$2.05	\$0.21	(\$1.66)
Dresden	\$2.78	\$4.95	\$4.25	\$4.83	\$7.00	\$6.30	\$6.88	\$9.05	\$8.35
Hope Creek	\$7.35	\$3.32	\$2.96	\$9.40	\$5.37	\$5.01	\$11.45	\$7.42	\$7.06
LaSalle	\$0.26	\$2.68	\$1.98	\$2.31	\$4.73	\$4.03	\$4.36	\$6.78	\$6.08
Limerick	\$7.67	\$3.74	\$3.39	\$9.72	\$5.79	\$5.44	\$11.77	\$7.84	\$7.49
North Anna	\$10.01	\$5.48	\$3.58	\$12.06	\$7.53	\$5.63	\$14.11	\$9.58	\$7.68
Oyster Creek	(\$1.80)	(\$5.70)	(\$6.05)	\$1.09	(\$2.81)	(\$3.16)	\$3.98	\$0.08	(\$0.27)
Quad Cities	\$0.75	\$2.11	\$1.40	\$2.80	\$4.16	\$3.45	\$4.85	\$6.21	\$5.50
Peach Bottom	\$7.11	\$3.35	\$3.00	\$9.16	\$5.40	\$5.05	\$11.21	\$7.45	\$7.10
Perry	(\$2.01)	(\$4.91)	(\$6.79)	\$0.88	(\$2.02)	(\$3.90)	\$3.77	\$0.87	(\$1.01)
Salem	\$7.33	\$3.30	\$2.94	\$9.38	\$5.35	\$4.99	\$11.43	\$7.40	\$7.04
Surry	\$9.74	\$5.08	\$3.18	\$11.79	\$7.13	\$5.23	\$13.84	\$9.18	\$7.28
Susquehanna	\$5.83	\$1.97	\$0.34	\$7.88	\$4.02	\$2.39	\$9.93	\$6.07	\$4.44
Three Mile Island	(\$4.61)	(\$8.04)	(\$9.66)	(\$1.72)	(\$5.15)	(\$6.77)	\$1.17	(\$2.26)	(\$3.88)

# Profile of units at risk of retirement

Technology	No. Units	ICAP (MW)	Avg. 2017 Run Hrs	Avg. Unit Age (Yrs)	Avg. Heat Rate (Btu/MWh)
CC - Combined Cycle	5	590	497	33	11,302
CT - Aero Derivative	10	254	137	41	13,724
CT - Industrial Frame	40	955	94	41	14,434
Coal Fired (high)	46	21,039	3,346	46	10,428
Coal Fired (low) (90% ACR recovery)	38	17,302	3,304	46	10,390
Diesel or Oil or Gas Steam	12	889	968	36	11,701
Nuclear (high)	5	7,058	-	38	-
Nuclear (low) (forward looking)	3	2,939	-	38	-
Total (high)	118	30,785	1,560	42	12,312
Total (low)	108	22,929	1,404	42	12,441

# Reserve margin: June 1, 2016 to June 1, 2020

	Generation and DR RPM Committed Less Deficiency UCAP (MW)	Forecast Peak Load	FRR Peak Load	PRD	RPM Peak Load	IRM	Pool Wide Average EFORd	Generation and DR RPM Committed Less Deficiency ICAP (MW)	Reserve Margin	Reserve Margin in Excess of IRM Percent	Reserve Margin in Excess of IRM ICAP (MW)
01-Jun-16	160,883.3	152,356.6	12,511.6	0.0	139,845.0	16.4%	5.91%	170,988.7	22.3%	5.9%	8,209.2
01-Jun-17	163,872.0	153,230.1	12,837.5	0.0	140,392.6	16.6%	5.94%	174,220.7	24.1%	7.5%	10,522.9
01-Jun-18	166,747.4	152,407.9	12,732.9	0.0	139,675.0	16.1%	6.07%	177,523.0	27.1%	11.0%	15,360.4
01-Jun-19	166,715.0	154,510.0	12,559.0	0.0	141,951.0	16.6%	6.59%	178,476.6	25.7%	9.1%	12,961.7
01-Jun-20	163,399.0	153,915.0	12,200.6	558.0	141,156.4	16.6%	6.59%	174,926.7	23.9%	7.3%	10,338.3



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