

# Potential Changes in Grid Operation Resulting from New USEPA Regulations

MADRI Working Group  
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Monitoring Analytics

# Overview

- **Factors affecting retirement decisions**
  - **Net revenues**
  - **Costs**
- **Net revenues**
  - **LMP minus marginal costs**
  - **RPM prices**
- **Costs**
  - **Going forward costs**
  - **Fixed costs**
  - **Compliance with EPA regulations**



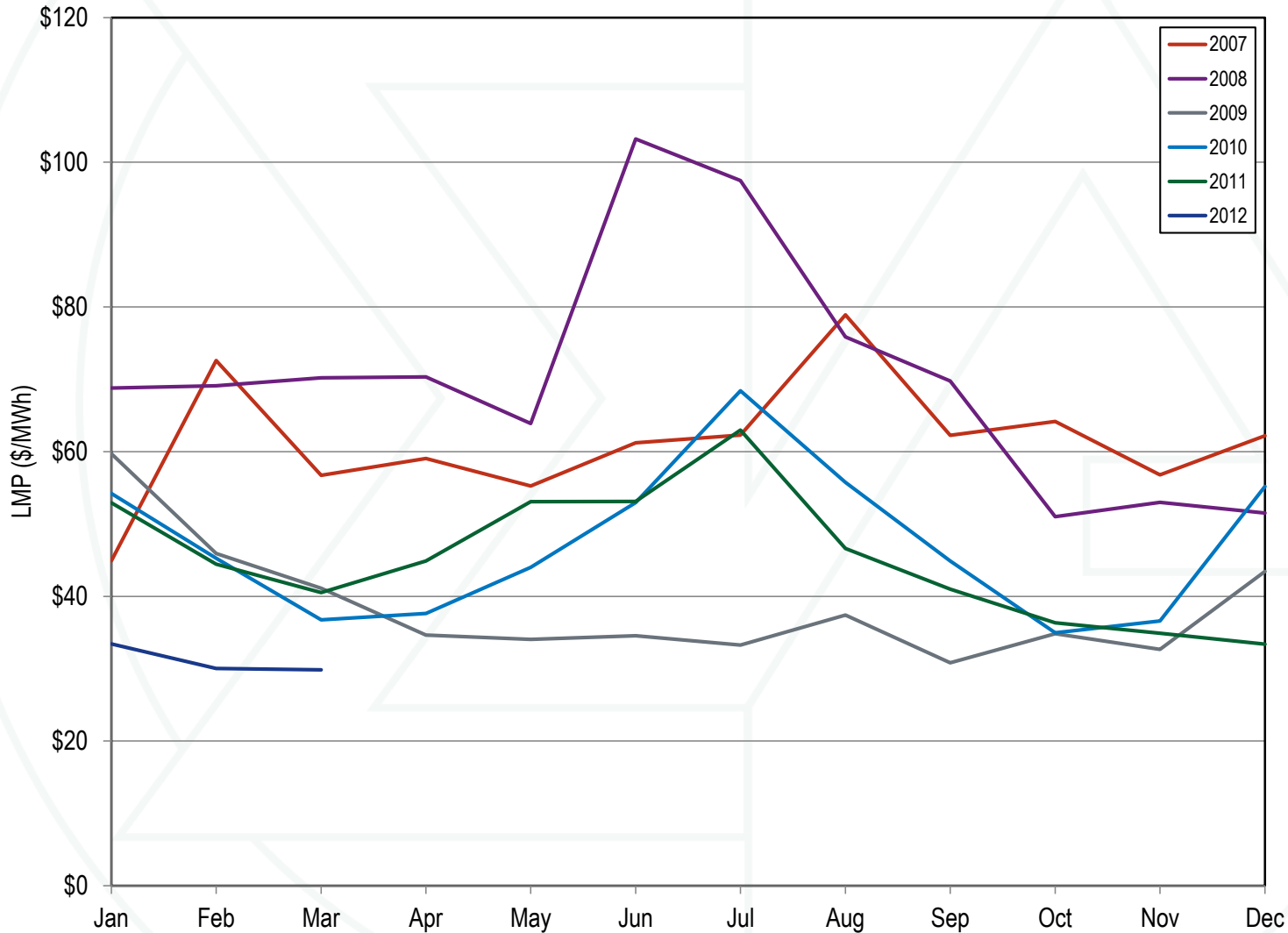
**Table 1-7 Total price per MWh by category and total revenues by category: January through March 2011 and 2012 (See 2011 SOM, Table 1-7)**

Category	Jan-Mar 2011 \$/MWh	Jan-Mar 2012 \$/MWh	Percent Change Totals	Jan-Mar 2011 Percent of Total	Jan-Mar 2012 Percent of Total
Energy	\$46.35	\$31.21	(32.7%)	70.7%	68.6%
Capacity	\$12.60	\$7.51	(40.4%)	19.2%	16.5%
Transmission Service Charges	\$4.32	\$4.80	11.1%	6.6%	10.6%
Operating Reserves (Uplift)	\$0.72	\$0.49	(31.6%)	1.1%	1.1%
Reactive	\$0.39	\$0.48	23.8%	0.6%	1.1%
PJM Administrative Fees	\$0.33	\$0.36	10.4%	0.5%	0.8%
Transmission Enhancement Cost Recovery	\$0.30	\$0.28	(7.3%)	0.5%	0.6%
Regulation	\$0.27	\$0.17	(36.6%)	0.4%	0.4%
Transmssion Owner (Schedule 1A)	\$0.09	\$0.08	(13.6%)	0.1%	0.2%
Synchronized Reserves	\$0.12	\$0.03	(75.6%)	0.2%	0.1%
Black Start	\$0.02	\$0.02	28.8%	0.0%	0.0%
NERC/RFC	\$0.02	\$0.02	8.9%	0.0%	0.0%
RTO Startup and Expansion	\$0.01	\$0.01	(10.9%)	0.0%	0.0%
Load Response	\$0.01	\$0.01	18.5%	0.0%	0.0%
Transmission Facility Charges	\$0.00	\$0.00	(3.2%)	0.0%	0.0%
Day Ahead Scheduling Reserve (DASR)	\$0.00	\$0.00	(97.6%)	0.0%	0.0%
<b>Total</b>	<b>\$65.56</b>	<b>\$45.48</b>	<b>(30.6%)</b>	<b>100.0%</b>	<b>100.0%</b>

**Table 4-3 PJM installed capacity (By fuel source): January 1, January 31, February 29, and March 31, 2012 (See the 2011 SOM, Table 4-3)**

	1-Jan-12		31-Jan-12		29-Feb-12		31-Mar-12	
	MW	Percent	MW	Percent	MW	Percent	MW	Percent
Coal	75,190.4	42.0%	80,212.1	43.3%	79,749.1	43.1%	79,749.1	43.1%
Gas	50,529.3	28.3%	51,788.5	27.9%	51,774.8	28.0%	51,774.8	28.0%
Hydroelectric	8,047.0	4.5%	8,047.0	4.3%	8,047.0	4.4%	8,047.0	4.4%
Nuclear	32,492.6	18.2%	32,492.6	17.5%	32,492.6	17.6%	32,534.6	17.6%
Oil	11,217.3	6.3%	11,495.2	6.2%	11,494.7	6.2%	11,494.7	6.2%
Solar	15.3	0.0%	15.3	0.0%	15.3	0.0%	15.3	0.0%
Solid waste	705.1	0.4%	705.1	0.4%	705.1	0.4%	705.1	0.4%
Wind	657.1	0.4%	660.1	0.4%	660.1	0.4%	660.1	0.4%
Total	178,854.1	100.0%	185,415.9	100.0%	184,938.7	100.0%	184,980.7	100.0%

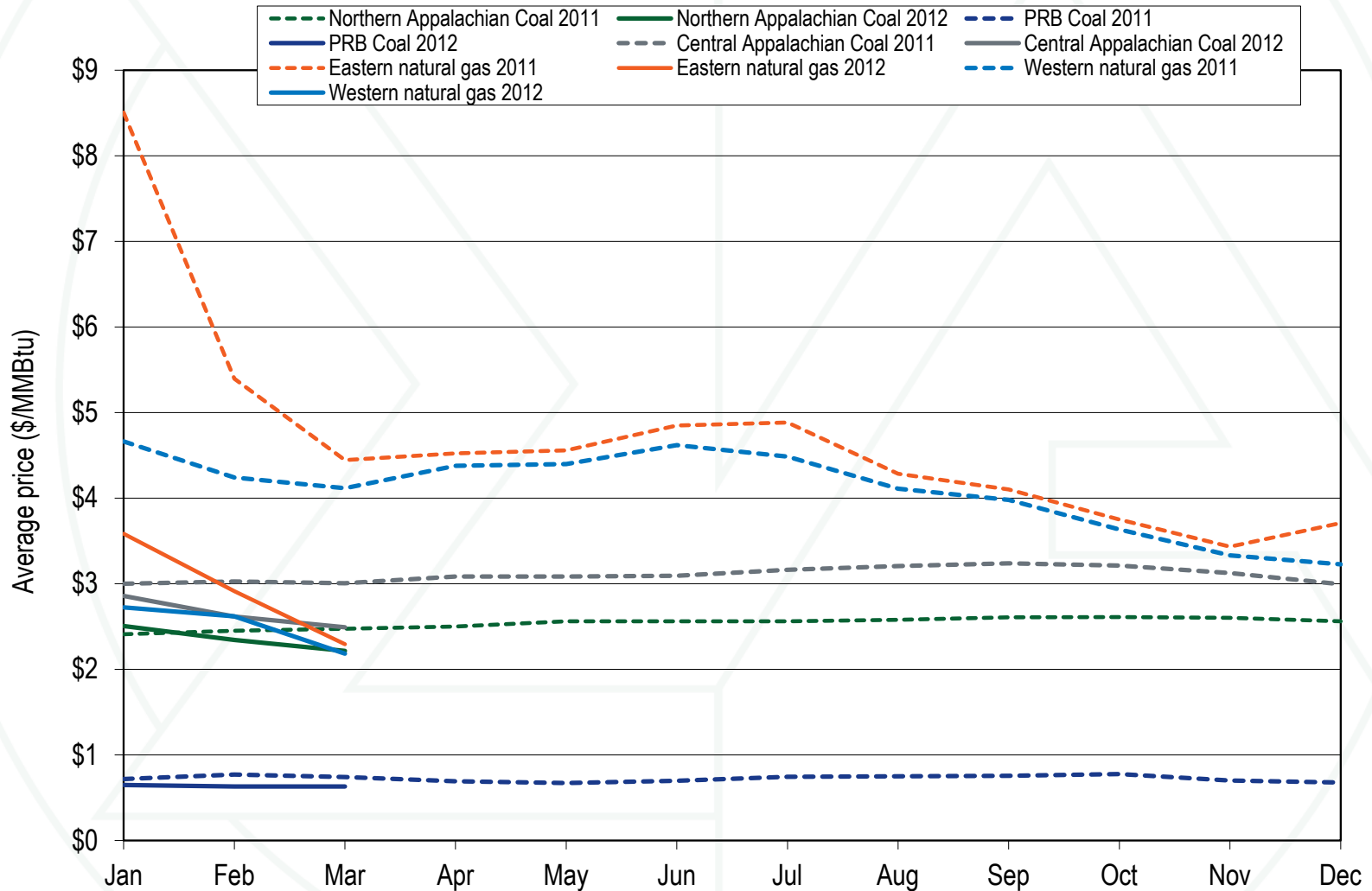
**Figure 2-16 PJM real-time, monthly, load-weighted, average LMP: 2007 through March of 2012 (See 2011 SOM, Figure 2-16)**



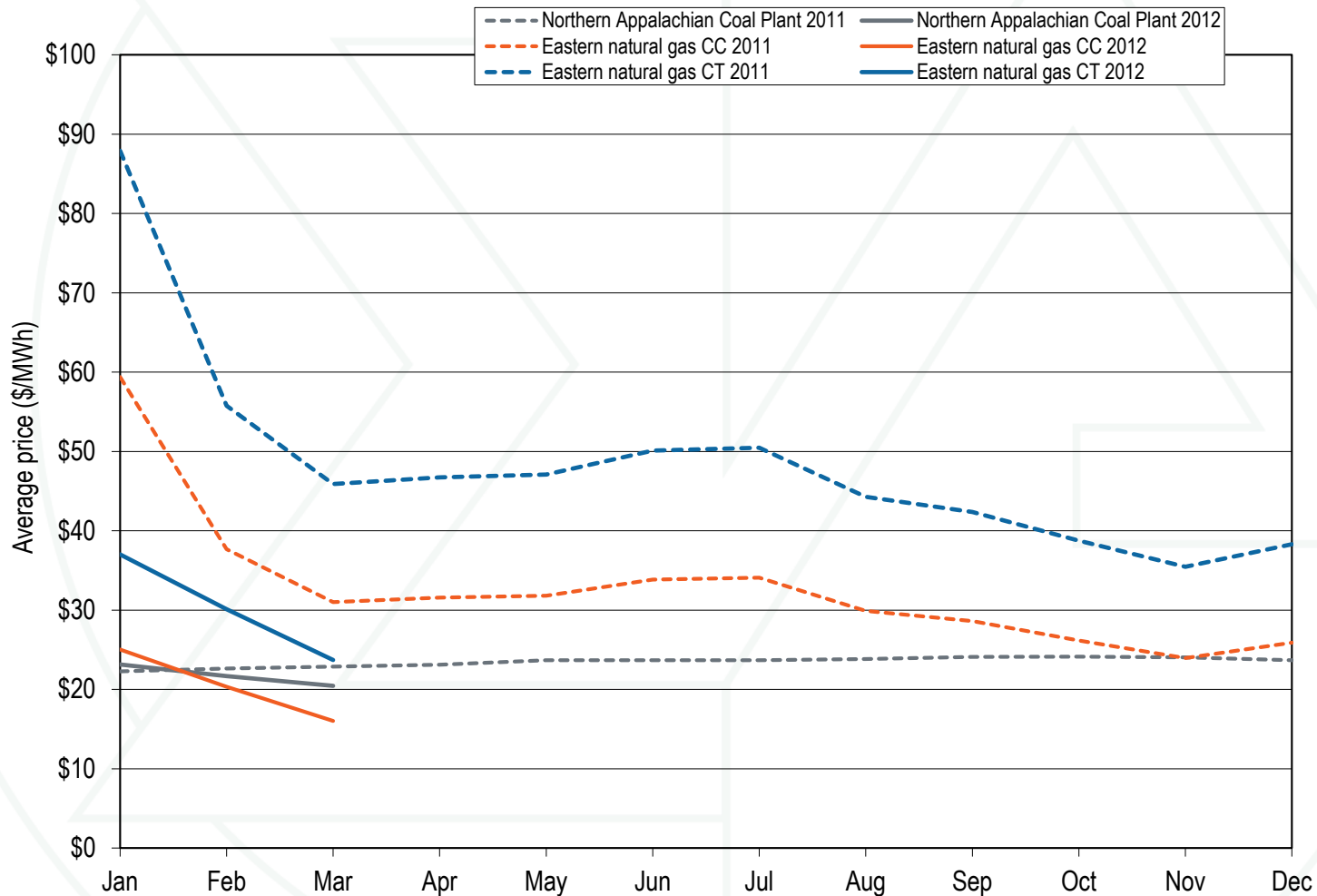
**Table 2-23 PJM real-time, load-weighted, average LMP (Dollars per MWh): January through March, 1998 through 2012 (See 2011 SOM, Table 2-37)**

(Jan-Mar)	Real-Time, Load-Weighted, Average LMP			Year-to-Year Change		
	Average	Median	Standard Deviation	Average	Median	Standard Deviation
1998	\$18.13	\$15.80	\$8.14	NA	NA	NA
1999	\$19.38	\$16.90	\$7.66	6.9%	7.0%	(5.9%)
2000	\$25.10	\$18.25	\$17.22	29.5%	8.0%	124.9%
2001	\$35.16	\$27.38	\$21.52	40.1%	50.0%	25.0%
2002	\$23.01	\$19.89	\$9.93	(34.6%)	(27.4%)	(53.8%)
2003	\$51.93	\$46.12	\$30.99	125.6%	131.9%	211.9%
2004	\$48.77	\$43.22	\$24.62	(6.1%)	(6.3%)	(20.6%)
2005	\$48.37	\$42.20	\$22.62	(0.8%)	(2.4%)	(8.1%)
2006	\$54.43	\$47.62	\$23.69	12.5%	12.9%	4.7%
2007	\$58.07	\$50.60	\$34.44	6.7%	6.3%	45.4%
2008	\$69.35	\$60.11	\$36.56	19.4%	18.8%	6.2%
2009	\$49.60	\$42.23	\$23.38	(28.5%)	(29.8%)	(36.1%)
2010	\$45.92	\$39.01	\$22.99	(7.4%)	(7.6%)	(1.7%)
2011	\$46.35	\$39.11	\$24.26	0.9%	0.3%	5.5%
2012	\$31.21	\$29.25	\$12.02	(32.7%)	(25.2%)	(50.5%)

# Figure 2-17 Spot average fuel price comparison: 2011 and January through March 2012 (See 2011 SOM, Figure 2-17)



# Figure 2-18 Spot average cost of generation comparison of CP, CT, and CC: 2011 and January through March 2012





**Table 2-2 PJM generation (By fuel source (GWh)): January through March 2011 and 2012 (See 2011 SOM, Table 2-2)**

	Jan-Mar 2011		Jan-Mar 2012		Change in Output
	GWh	Percent	GWh	Percent	
Coal	87,871.5	47.7%	77,677.8	39.9%	(11.6%)
Standard Coal	84,742.7	46.0%	75,121.6	38.6%	(10.9%)
Waste Coal	3,128.7	1.7%	2,556.2	1.3%	(0.7%)
Nuclear	65,194.7	35.4%	70,637.4	36.3%	8.3%
Gas	22,383.0	12.2%	37,024.4	19.0%	65.4%
Natural Gas	21,945.7	11.9%	36,430.7	18.7%	66.0%
Landfill Gas	437.3	0.2%	593.6	0.3%	35.7%
Biomass Gas	0.1	0.0%	0.1	0.0%	123.5%
Hydroelectric	3,647.6	2.0%	3,357.9	1.7%	(7.9%)
Wind	3,363.8	1.8%	4,261.3	2.2%	26.7%
Waste	1,359.1	0.7%	1,249.0	0.6%	(8.1%)
Solid Waste	1,034.0	0.6%	979.3	0.5%	(5.3%)
Miscellaneous	325.1	0.2%	269.7	0.1%	(17.1%)
Oil	229.3	0.1%	353.7	0.2%	54.2%
Heavy Oil	190.1	0.1%	315.3	0.2%	65.9%
Light Oil	35.4	0.0%	37.2	0.0%	5.2%
Diesel	2.4	0.0%	1.1	0.0%	(52.7%)
Kerosene	1.5	0.0%	0.2	0.0%	(88.4%)
Jet Oil	0.0	0.0%	0.0	0.0%	(26.4%)
Solar	7.0	0.0%	43.9	0.0%	526.8%
Battery	0.1	0.0%	0.1	0.0%	(40.5%)
Total	184,056.2	100.0%	194,605.6	100.0%	5.7%

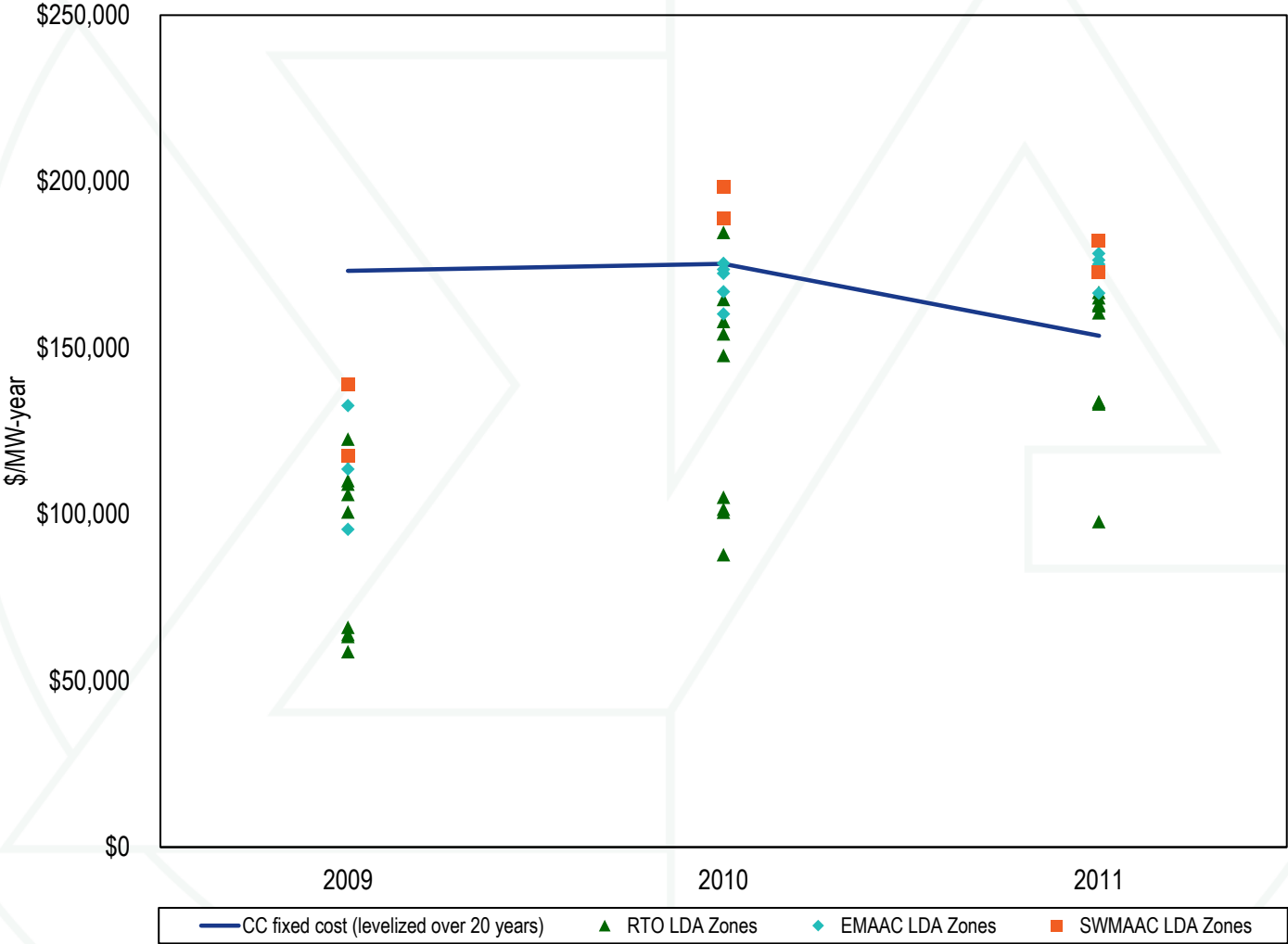
**Table 2-3 PJM Generation (By fuel source (GWh)) excluding ATSI and DEOK zones: January through March 2011 and 2012 (See 2011 SOM, Table 2-2)**

	Jan-Mar 2011		Jan-Mar 2012		Change in Output
	GWh	Percent	GWh	Percent	
Coal	87,871.5	47.7%	65,895.1	37.2%	(25.0%)
Standard Coal	84,742.7	46.0%	63,338.9	35.8%	(24.4%)
Waste Coal	3,128.7	1.7%	2,556.2	1.4%	(0.7%)
Nuclear	65,194.7	35.4%	66,012.3	37.3%	1.3%
Gas	22,383.0	12.2%	35,983.9	20.3%	60.8%
Natural Gas	21,945.7	11.9%	35,431.8	20.0%	61.5%
Landfill Gas	437.3	0.2%	552.0	0.3%	26.2%
Biomass Gas	0.1	0.0%	0.1	0.0%	123.5%
Hydroelectric	3,647.6	2.0%	3,357.9	1.9%	(7.9%)
Wind	3,363.8	1.8%	4,261.3	2.4%	26.7%
Waste	1,359.1	0.7%	1,249.0	0.7%	(8.1%)
Solid Waste	1,034.0	0.6%	979.3	0.6%	(5.3%)
Miscellaneous	325.1	0.2%	269.7	0.2%	(17.1%)
Oil	229.3	0.1%	352.9	0.2%	53.9%
Heavy Oil	190.1	0.1%	315.3	0.2%	65.9%
Light Oil	35.4	0.0%	37.1	0.0%	4.8%
Diesel	2.4	0.0%	0.4	0.0%	(82.8%)
Kerosene	1.5	0.0%	0.2	0.0%	(88.4%)
Jet Oil	0.0	0.0%	0.0	0.0%	(26.4%)
Solar	7.0	0.0%	43.9	0.0%	526.8%
Battery	0.1	0.0%	0.1	0.0%	(40.5%)
Total	184,056.2	100.0%	177,156.5	100.0%	(3.7%)

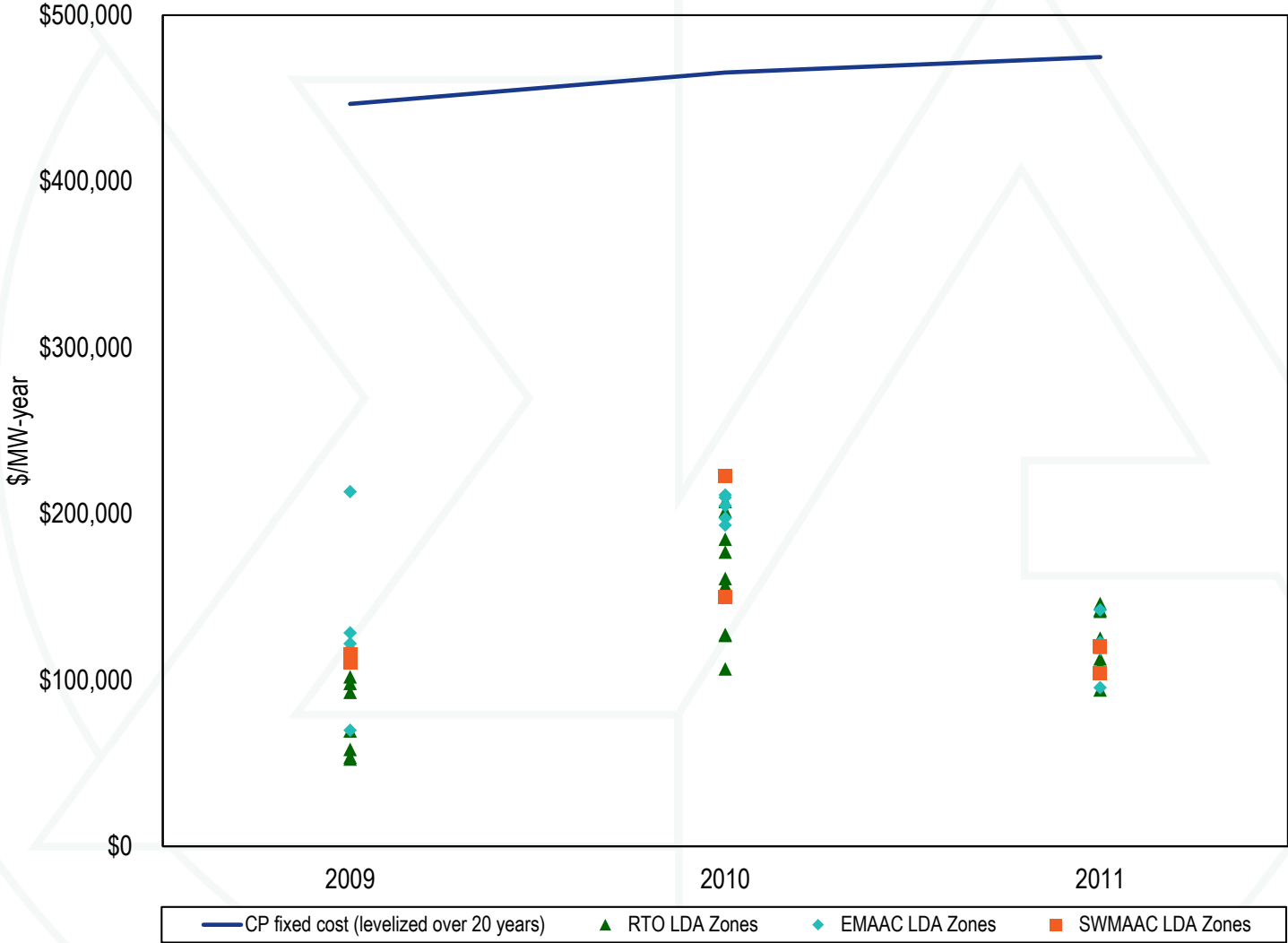
**Table 4-13 PJM capacity factor (By unit type (GWh)); January through March 2011 and 2012 (See the 2011 SOM, Table 4-24)**

Unit Type	Jan-Mar 2011		Jan-Mar 2012	
	Generation (GWh)	Capacity Factor	Generation (GWh)	Capacity Factor
Battery	0.1	5.1%	0.1	0.1%
Combined Cycle	21,045.3	41.1%	35,691.6	63.0%
Combustion Turbine	500.5	0.8%	557.1	0.8%
Diesel	183.4	17.6%	214.5	19.1%
Diesel (Landfill gas)	168.7	40.2%	277.7	52.6%
Nuclear	65,194.7	95.9%	70,637.4	96.3%
Pumped Storage Hydro	1,652.5	13.9%	1,227.8	10.2%
Run of River Hydro	1,995.2	39.4%	2,130.1	40.4%
Solar	7.0	9.2%	43.9	13.8%
Steam	89,295.8	51.8%	79,543.8	39.8%
Wind	3,363.8	36.0%	4,261.3	37.3%
<b>Total</b>	<b>183,407.0</b>	<b>48.6%</b>	<b>194,585.3</b>	<b>45.6%</b>

# Figure 6-4 New entrant CC net revenue and 20-year levelized fixed cost by LDA (Dollars per installed MW-year)



# Figure 6-6 New entrant CP net revenue and 20-year levelized fixed cost by LDA (Dollars per installed MW-year)



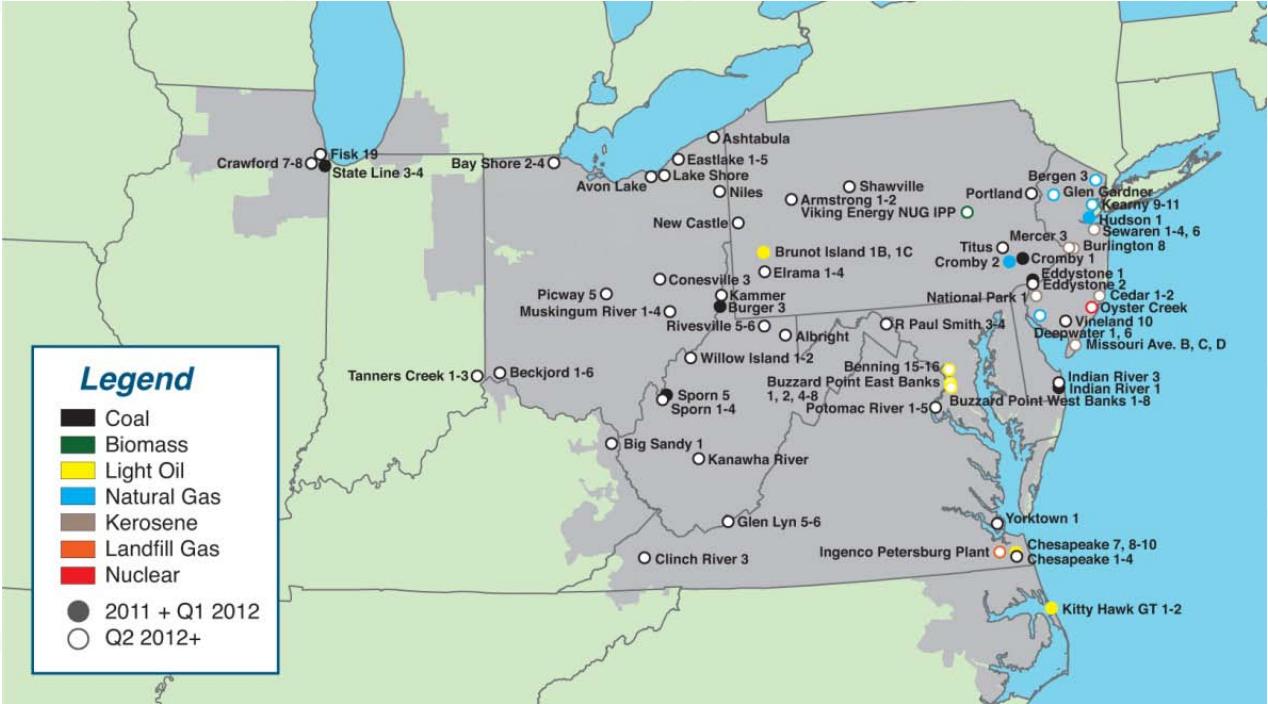
**Table 11-8 PJM capacity (MW) by age: at April 1, 2012 (See 2011 SOM Table 11-9)**

Age (years)	Combined Cycle	Combustion Turbine	Diesel	Hydroelectric	Nuclear	Solar	Steam	Storage	Wind	Total
Less than 11	19,000	8,820	400	11	0	154	2,495	28	5,505	36,413
11 to 20	6,047	13,019	113	48	0	0	3,261	0	34	22,522
21 to 30	1,584	1,700	55	3,448	15,359	0	8,475	0	0	30,622
31 to 40	244	3,123	43	105	16,344	0	29,514	0	0	49,373
41 to 50	198	4,911	135	2,915	2,349	0	30,493	0	0	41,001
51 to 60	0	0	15	379	0	0	16,963	0	0	17,357
61 to 70	0	0	0	0	0	0	2,939	0	0	2,939
71 to 80	0	0	0	284	0	0	95	0	0	379
81 to 90	0	0	0	549	0	0	79	0	0	628
91 to 100	0	0	0	151	0	0	0	0	0	151
101 and over	0	0	0	84	0	0	0	0	0	84
<b>Total</b>	<b>27,073</b>	<b>31,573</b>	<b>761</b>	<b>7,975</b>	<b>34,051</b>	<b>154</b>	<b>94,315</b>	<b>28</b>	<b>5,539</b>	<b>201,469</b>

**Table 11-10 Summary of PJM unit retirements (MW): Calendar year 2011 through 2019 (See 2011 SOM, Table 11-11)**

	<b>MW</b>
Retirements 2011	1,322.3
Retirements 2012	955.0
Planned Retirements 2012	6,012.0
Planned Retirements Post-2012	10,535.4
<b>Total</b>	<b>18,824.7</b>

# Figure 11-1 Unit retirements in PJM Calendar year 2011 through 2019 (See 2011 SOM, Figure 11-1)





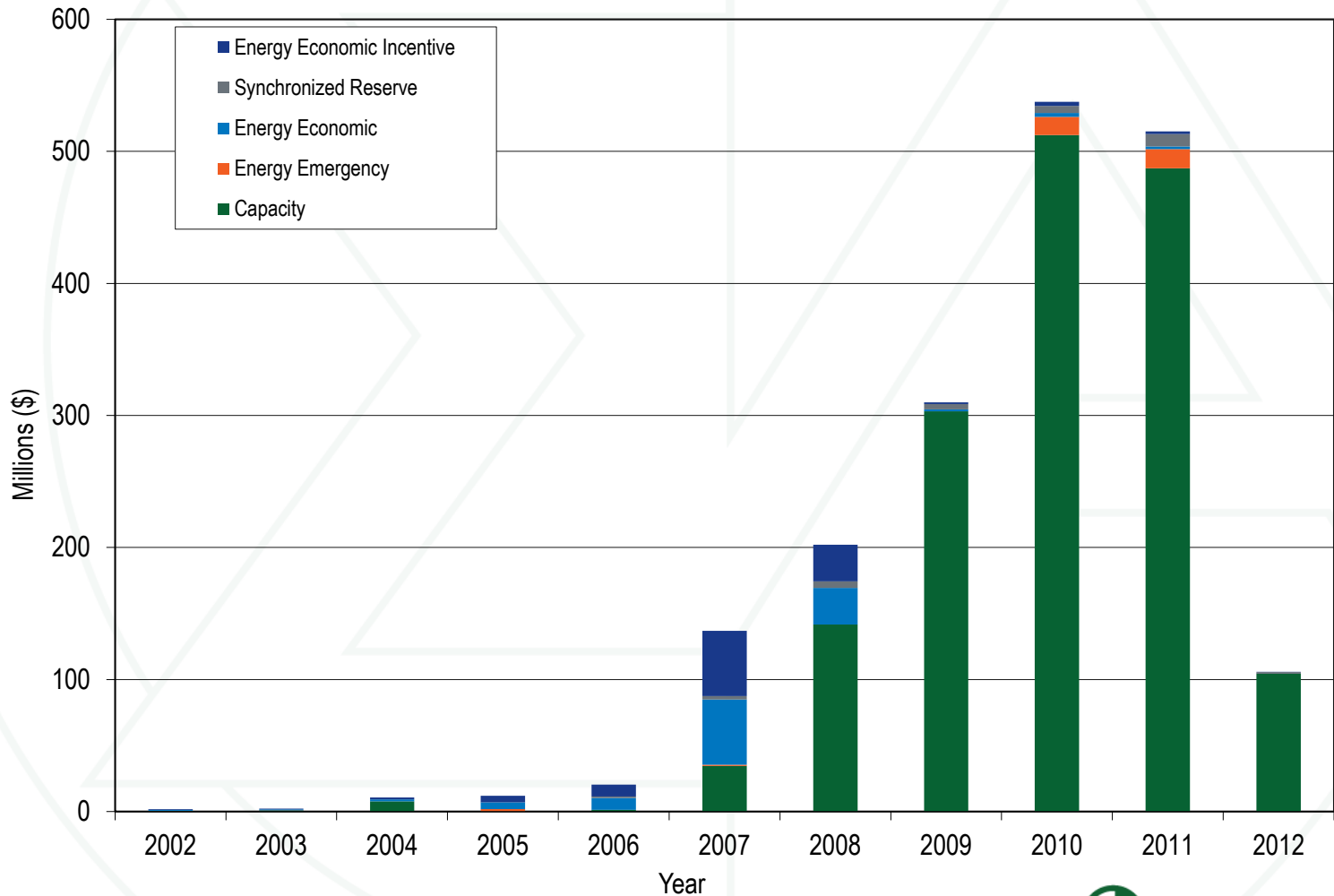
**Table 11-6 Capacity additions in active or under-construction queues by LDA (MW): At March 31, 2012 (See 2011 SOM, Table 11-7)**

	CC	CT	Diesel	Hydro	Nuclear	Solar	Steam	Storage	Wind	Total
EMAAC	11,422	1,906	60	0	540	2,228	142	35	1,774	18,106
SWMAAC	6,146	256	35	0	1,640	12	132	0	0	8,221
WMAAC	6,941	31	46	3	139	225	180	0	1,855	9,420
Non-MAAC	13,668	1,246	226	315	2,397	641	3,586	20	25,789	47,887
Total	38,177	3,439	367	318	4,716	3,106	4,040	55	29,418	83,635

## Table 18 Impact of DR product types: 2014/2015 RPM Base Residual Auction

LDA	Product Type	Actual Auction Results		Annual Resources Only	
		Clearing Prices (\$ per MW-day)	Cleared UCAP (MW)	Clearing Prices (\$ per MW-day)	Cleared UCAP (MW)
RTO	Limited	\$125.47	12,165.9		
	Extended Summer	\$125.99	1,441.0		
	Annual	\$125.99	136,367.8	\$154.87	149,420.6
MAAC	Limited	\$125.47	5,920.7		
	Extended Summer	\$136.50	1,076.8		
	Annual	\$136.50	60,178.5	\$202.80	65,957.5
PSEG North	Limited	\$213.97	340.7		
	Extended Summer	\$225.00	97.1		
	Annual	\$225.00	3,379.7	\$225.00	3,807.9

**Figure 5-1 Demand Response revenue by market: Calendar years 2002 through 2011 and the first three months of 2012 (See the 2011 SOM, Figure 5-1)**



## Table 20 Impact of EPA MACT emissions standards: 2014/2015 RPM Base Residual Auction

LDA	Product Type	Actual Auction Results		Remove APIR associated with pending EPA MACT emission standards	
		Clearing Prices (\$ per MW-day)	Cleared UCAP (MW)	Clearing Prices (\$ per MW-day)	Cleared UCAP (MW)
RTO	Limited	\$125.47	12,165.9	\$94.26	12,133.9
	Extended Summer	\$125.99	1,441.0	\$94.26	812.2
	Annual	\$125.99	136,367.8	\$94.26	137,618.1
MAAC	Limited	\$125.47	5,920.7	\$102.50	6,000.5
	Extended Summer	\$136.50	1,076.8	\$105.00	799.3
	Annual	\$136.50	60,178.5	\$105.00	60,456.0
EMAAC	Limited	\$125.47	2,322.2	\$128.35	2,497.0
	Extended Summer	\$136.50	442.8	\$133.41	321.8
	Annual	\$136.50	29,789.0	\$133.41	29,348.9
PSEG North	Limited	\$213.97	340.7	\$222.50	398.6
	Extended Summer	\$225.00	97.1	\$225.00	64.5
	Annual	\$225.00	3,379.7	\$225.00	3,347.1

## Table 5-12 Comparison of Demand Response and Generation Resources, Calendar year 2011 (New Table)

	DSR (July 22, 2011 Event)	DSR (July 22, 2011 Event \$999 Strike Price)	DSR (10x6 Events)	DSR (\$999 strike price)	DSR (No Events)	CC	CT	Coal
Hours of Operation	6	6	60	60	0	7,524	2,489	4,751
E&AS	\$230,244	\$599,400	\$1,751,744	\$5,994,000	\$0	\$13,080,600	\$4,864,200	\$5,694,000
Capacity	\$4,985,779	\$4,985,779	\$4,985,779	\$4,985,779	\$4,985,779	\$4,985,779	\$4,985,779	\$4,985,779
Total	\$5,216,023	\$5,585,179	\$6,737,523	\$10,979,779	\$4,985,779	\$18,066,379	\$9,849,979	\$10,679,779
Average margin per MWh	\$384	\$999	\$292	\$999		\$17	\$20	\$12

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