



PJM Analysis of Accuracy and Stability of Economic and Load Forecasts

Load Analysis Subcommittee
November 10, 2011

Economic Driver Accuracy Analysis

- We examined Moody's and Global Insight's GDP, GMP, employment and population.
- For the purposes of this study, because, until recently, GI data was only available semi-annually we compared each December and June vintage to the most recent forecasts available, in this case, September 2011.
- All series were indexed to Q1 1998 so that series that were stated in different dollar terms (2000 base versus 2005 base) could be compared. Q1 1998 was chosen because this is the typical start of PJM's modeling estimation period.
- Straight percent differences between forecasts and actual values could understate errors due to positive and negative values cancelling out. While having a sense of the directionality of the error is important, we chose to focus the analysis simply on the magnitude of the errors.

Economic Driver Accuracy Analysis

- Actual historic GDP values are available from the BEA. Consequently, both vendors have the same historic actual values of GDP in their most recent database to compare historic forecasts to.
- GMP is not a measure that is standardized and both vendors have different “actual” historic values.
 - Each vendor’s past forecasts were compared to their “actual” history in the most recent forecast database.
 - Each vendor’s past forecasts were also compared to “actual” GMP historic values developed by the BEA and published most recently on September 30.
- Employment and population are standardized across vendors and so historic values from the September 2011 forecast vintages are comparable.
 - Historic employment values originate from the BLS and are released monthly.
 - Historic population values come from the Census Bureau and are released annually.

Indexed Series											
Vintage	2006Q2	2006Q4	2007Q2	2007Q4	2008Q2	2008Q4	2009Q2	2009Q4	2010Q2	2010Q4	2011Q2
Sum of Dec2005	1.29	1.31	1.33	1.35	1.37	1.39	1.41	1.43	1.45	1.47	1.50
Sum of Jun2006		1.31	1.32	1.34	1.37	1.39	1.41	1.43	1.45	1.47	1.50
Sum of Dec2006			1.30	1.33	1.35	1.37	1.39	1.41	1.43	1.45	1.47
Sum of Jun2007				1.32	1.34	1.36	1.38	1.40	1.42	1.44	1.46
Sum of Dec2007					1.32	1.34	1.36	1.39	1.41	1.43	1.45
Sum of Jun2008						1.33	1.34	1.37	1.39	1.42	1.44
Sum of Dec2008							1.28	1.29	1.31	1.33	1.37
Sum of Jun2009								1.26	1.27	1.30	1.33
Sum of Dec2009									1.31	1.33	1.35
Sum of Jun2010										1.34	1.37
Sum of Dec2010											1.34
Sum of Sep2011	1.28	1.29	1.30	1.32	1.32	1.28	1.25	1.27	1.29	1.31	1.31

Percent Difference											
Vintage	2006Q2	2006Q4	2007Q2	2007Q4	2008Q2	2008Q4	2009Q2	2009Q4	2010Q2	2010Q4	2011Q2
Sum of Dec2005	-0.48%	-1.45%	-1.68%	-1.87%	-3.56%	-8.14%	-11.27%	-11.41%	-11.02%	-11.20%	-12.17%
Sum of Jun2006		-1.09%	-1.43%	-1.69%	-3.45%	-8.07%	-11.21%	-11.35%	-11.00%	-11.21%	-12.20%
Sum of Dec2006			0.02%	-0.46%	-2.16%	-6.69%	-9.85%	-10.00%	-9.64%	-9.86%	-10.86%
Sum of Jun2007				0.13%	-1.45%	-5.94%	-9.05%	-9.13%	-8.75%	-9.00%	-10.03%
Sum of Dec2007					0.02%	-4.58%	-8.07%	-8.52%	-8.24%	-8.43%	-9.36%
Sum of Jun2008						-3.75%	-6.89%	-7.35%	-7.23%	-7.63%	-8.59%
Sum of Dec2008							-2.45%	-1.49%	-0.88%	-1.73%	-3.85%
Sum of Jun2009								0.44%	1.48%	1.10%	-0.93%
Sum of Dec2009									-1.22%	-1.32%	-3.00%
Sum of Jun2010										-2.18%	-4.01%
Sum of Dec2010											-2.09%
Sum of Sep2011	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Absolute Percent Difference											
Vintage	2006Q2	2006Q4	2007Q2	2007Q4	2008Q2	2008Q4	2009Q2	2009Q4	2010Q2	2010Q4	2011Q2
Sum of Dec2005	0.48%	1.45%	1.68%	1.87%	3.56%	8.14%	11.27%	11.41%	11.02%	11.20%	12.17%
Sum of Jun2006		1.09%	1.43%	1.69%	3.45%	8.07%	11.21%	11.35%	11.00%	11.21%	12.20%
Sum of Dec2006			0.02%	0.46%	2.16%	6.69%	9.85%	10.00%	9.64%	9.86%	10.86%
Sum of Jun2007				0.13%	1.45%	5.94%	9.05%	9.13%	8.75%	9.00%	10.03%
Sum of Dec2007					0.02%	4.58%	8.07%	8.52%	8.24%	8.43%	9.36%
Sum of Jun2008						3.75%	6.89%	7.35%	7.23%	7.63%	8.59%
Sum of Dec2008							2.45%	1.49%	0.88%	1.73%	3.85%
Sum of Jun2009								0.44%	1.48%	1.10%	0.93%
Sum of Dec2009									1.22%	1.32%	3.00%
Sum of Jun2010										2.18%	4.01%
Sum of Dec2010											2.09%
Sum of Sep2011	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

- Below, „6 month“ is the average of the 11 pink cells on the previous chart. „12 month“ is the average of the 10 orange cells, etc. There is only one observation for „66 month“ performance.
- For GDP, Global Insight performs slightly better than Moody’s.

Time Period	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
6 month	-1.1%	1.3%	-0.9%	1.2%
12 month	-2.2%	2.5%	-1.7%	2.0%
18 month	-3.3%	3.5%	-2.8%	3.0%
24 month	-4.9%	4.9%	-4.3%	4.3%
30 month	-7.2%	7.2%	-6.5%	6.5%
36 month	-9.2%	9.2%	-8.7%	8.7%
42 month	-10.1%	10.1%	-9.8%	9.8%
48 month	-10.6%	10.6%	-10.5%	10.5%
54 month	-11.0%	11.0%	-10.9%	10.9%
60 month	-11.7%	11.7%	-11.4%	11.4%
66 month	-12.2%	12.2%	-11.9%	11.9%

- An analysis similar to that performed on GDP was also done on zonal GMPs.

Zone	LDA	BGE										
Moody's												
Date	2006Q2	2006Q4	2007Q2	2007Q4	2008Q2	2008Q4	2009Q2	2009Q4	2010Q2	2010Q4	2011Q2	
Data	Sum of Dec2005	1.27	1.29	1.30	1.31	1.33	1.34	1.35	1.36	1.37	1.39	1.40
	Sum of Jun2006		1.29	1.30	1.32	1.33	1.35	1.37	1.38	1.40	1.41	1.43
	Sum of Dec2006			1.32	1.33	1.34	1.36	1.37	1.39	1.40	1.42	1.43
	Sum of Jun2007				1.33	1.34	1.36	1.37	1.39	1.40	1.42	1.43
	Sum of Dec2007					1.31	1.32	1.34	1.36	1.38	1.40	1.41
	Sum of Jun2008						1.30	1.32	1.34	1.36	1.39	1.41
	Sum of Dec2008							1.29	1.30	1.33	1.36	1.39
	Sum of Jun2009								1.28	1.30	1.33	1.36
	Sum of Dec2009									1.34	1.37	1.40
	Sum of Jun2010										1.39	1.44
	Sum of Dec2010											1.41
	Sum of Sep2011	1.27	1.29	1.30	1.31	1.31	1.31	1.30	1.32	1.35	1.37	1.38
Data												
Date	2006Q2	2006Q4	2007Q2	2007Q4	2008Q2	2008Q4	2009Q2	2009Q4	2010Q2	2010Q4	2011Q2	
Data	Sum of Dec2005	-0.06%	-0.31%	-0.02%	-0.38%	-1.18%	-2.12%	-3.57%	-3.26%	-1.58%	-1.53%	-1.31%
	Sum of Jun2006		-0.12%	0.09%	-0.48%	-1.62%	-2.93%	-4.73%	-4.73%	-3.31%	-3.52%	-3.47%
	Sum of Dec2006			-1.20%	-1.70%	-2.50%	-3.53%	-5.11%	-5.04%	-3.52%	-3.61%	-3.44%
	Sum of Jun2007				-1.61%	-2.55%	-3.64%	-5.22%	-5.09%	-3.56%	-3.70%	-3.56%
	Sum of Dec2007					0.40%	-0.71%	-2.84%	-3.35%	-2.20%	-2.48%	-2.33%
	Sum of Jun2008						0.45%	-1.32%	-1.72%	-0.86%	-1.81%	-2.28%
	Sum of Dec2008							1.04%	1.05%	1.99%	0.31%	-1.08%
	Sum of Jun2009								2.73%	3.87%	2.52%	1.09%
	Sum of Dec2009									1.28%	-0.18%	-1.56%
	Sum of Jun2010										2.13%	-3.96%
	Sum of Dec2010											-2.16%
	Sum of Sep2011	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Data												
Date	2006Q2	2006Q4	2007Q2	2007Q4	2008Q2	2008Q4	2009Q2	2009Q4	2010Q2	2010Q4	2011Q2	
Data	Sum of Dec2005	0.06%	0.31%	0.02%	0.38%	1.18%	2.12%	3.57%	3.26%	1.58%	1.53%	1.31%
	Sum of Jun2006		0.12%	0.09%	0.48%	1.62%	2.93%	4.73%	4.73%	3.31%	3.52%	3.47%
	Sum of Dec2006			1.20%	1.70%	2.50%	3.53%	5.11%	5.04%	3.52%	3.61%	3.44%
	Sum of Jun2007				1.61%	2.55%	3.64%	5.22%	5.09%	3.56%	3.70%	3.56%
	Sum of Dec2007					0.40%	0.71%	2.84%	3.35%	2.20%	2.48%	2.33%
	Sum of Jun2008						0.45%	1.32%	1.72%	0.86%	1.81%	2.28%
	Sum of Dec2008							1.04%	1.05%	1.99%	0.31%	1.08%
	Sum of Jun2009								2.73%	3.87%	2.52%	1.09%
	Sum of Dec2009									1.28%	0.18%	1.56%
	Sum of Jun2010										2.13%	3.96%
	Sum of Dec2010											2.16%
	Sum of Sep2011	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

- A summary was produced for each zone and LDA for both vendors.

Zone	Time Period	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
BGE	6 month	-0.1%	1.2%	0.4%	2.2%
BGE	12 month	-0.6%	1.6%	0.0%	3.1%
BGE	18 month	-0.9%	1.9%	-1.2%	3.9%
BGE	24 month	-1.7%	2.0%	-2.8%	4.6%
BGE	30 month	-2.8%	2.8%	-4.6%	5.5%
BGE	36 month	-3.4%	3.4%	-7.0%	7.0%
BGE	42 month	-3.6%	3.6%	-8.8%	8.8%
BGE	48 month	-3.4%	3.4%	-9.4%	9.4%
BGE	54 month	-2.8%	2.8%	-9.9%	9.9%
BGE	60 month	-2.5%	2.5%	-10.2%	10.2%
BGE	66 month	-1.3%	1.3%	-11.7%	11.7%

Zone	Time Period	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
RTO_ATSI_DUKE	6 month	-1.8%	2.0%	-1.8%	2.5%
RTO_ATSI_DUKE	12 month	-2.7%	3.1%	-2.6%	3.3%
RTO_ATSI_DUKE	18 month	-3.6%	4.2%	-3.8%	4.3%
RTO_ATSI_DUKE	24 month	-5.0%	5.1%	-5.4%	5.6%
RTO_ATSI_DUKE	30 month	-6.9%	6.9%	-7.6%	7.6%
RTO_ATSI_DUKE	36 month	-8.7%	8.7%	-9.9%	9.9%
RTO_ATSI_DUKE	42 month	-9.6%	9.6%	-11.2%	11.2%
RTO_ATSI_DUKE	48 month	-9.8%	9.8%	-11.9%	11.9%
RTO_ATSI_DUKE	54 month	-10.0%	10.0%	-12.5%	12.5%
RTO_ATSI_DUKE	60 month	-10.4%	10.4%	-13.1%	13.1%
RTO_ATSI_DUKE	66 month	-10.6%	10.6%	-14.0%	14.0%

- Zonal data (not including LDAs) was then summarized.
- In nearly every measure and time period, Moody's outperformed Global Insight.

Zone	Time Period	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
MIN	6 month	-4.8%	1.2%	-9.5%	1.7%
MIN	12 month	-6.8%	1.6%	-10.9%	1.6%
MIN	18 month	-8.9%	1.9%	-13.1%	1.4%
MIN	24 month	-10.8%	2.0%	-16.2%	2.1%
MIN	30 month	-13.1%	2.7%	-18.7%	2.3%
MIN	36 month	-15.5%	2.3%	-21.7%	3.3%
MIN	42 month	-16.7%	2.1%	-23.3%	3.1%
MIN	48 month	-17.1%	1.8%	-24.0%	3.7%
MIN	54 month	-17.9%	1.3%	-24.9%	4.7%
MIN	60 month	-18.4%	2.1%	-25.7%	5.6%
MIN	66 month	-16.9%	1.3%	-25.7%	6.6%
MIN	ALL	-18.4%	1.2%	-25.7%	1.4%
MAX	6 month	0.7%	4.8%	1.2%	9.6%
MAX	12 month	0.4%	6.8%	0.9%	11.0%
MAX	18 month	0.2%	8.9%	0.4%	13.1%
MAX	24 month	-0.4%	10.8%	-0.3%	16.2%
MAX	30 month	-1.6%	13.1%	-1.3%	18.7%
MAX	36 month	-2.3%	15.5%	-2.4%	21.7%
MAX	42 month	-2.1%	16.7%	-2.6%	23.3%
MAX	48 month	-1.8%	17.1%	-3.7%	24.0%
MAX	54 month	-0.2%	17.9%	-4.7%	24.9%
MAX	60 month	0.0%	18.4%	-5.6%	25.7%
MAX	66 month	2.1%	16.9%	-6.6%	25.7%
MAX	ALL	2.1%	18.4%	1.2%	25.7%

- Zonal data (not including LDAs) was then summarized – continued.

Zone	Time Period	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
AVERAGE	6 month	-2.0%	2.6%	-2.5%	3.2%
AVERAGE	12 month	-2.9%	3.7%	-3.3%	4.1%
AVERAGE	18 month	-3.8%	4.7%	-4.5%	5.1%
AVERAGE	24 month	-5.2%	5.7%	-6.1%	6.5%
AVERAGE	30 month	-7.0%	7.2%	-8.2%	8.3%
AVERAGE	36 month	-8.8%	8.8%	-10.5%	10.5%
AVERAGE	42 month	-9.7%	9.7%	-11.8%	11.8%
AVERAGE	48 month	-10.0%	10.0%	-12.6%	12.6%
AVERAGE	54 month	-10.1%	10.1%	-13.2%	13.2%
AVERAGE	60 month	-10.5%	10.6%	-13.9%	13.9%
AVERAGE	66 month	-10.6%	10.8%	-14.8%	14.8%
AVERAGE	ALL	-7.3%	7.6%	-9.2%	9.5%
MEDIAN	6 month	-1.8%	2.2%	-2.0%	2.5%
MEDIAN	12 month	-2.7%	3.4%	-2.9%	3.3%
MEDIAN	18 month	-3.6%	4.5%	-4.0%	4.4%
MEDIAN	24 month	-5.0%	5.6%	-5.6%	5.6%
MEDIAN	30 month	-7.0%	7.0%	-7.9%	7.9%
MEDIAN	36 month	-8.8%	8.8%	-10.2%	10.2%
MEDIAN	42 month	-9.7%	9.7%	-11.6%	11.6%
MEDIAN	48 month	-10.1%	10.1%	-12.2%	12.2%
MEDIAN	54 month	-10.0%	10.0%	-12.7%	12.7%
MEDIAN	60 month	-10.3%	10.3%	-13.1%	13.1%
MEDIAN	66 month	-10.6%	10.6%	-13.8%	13.8%
MEDIAN	ALL	-7.6%	7.6%	-9.4%	9.4%
STDEV	6 month	1.0%	0.9%	2.1%	1.7%
STDEV	12 month	1.3%	1.0%	2.3%	1.8%
STDEV	18 month	1.7%	1.2%	2.5%	2.0%
STDEV	24 month	2.0%	1.7%	2.9%	2.4%
STDEV	30 month	2.3%	2.2%	3.1%	2.9%
STDEV	36 month	2.7%	2.7%	3.4%	3.3%
STDEV	42 month	2.9%	2.9%	3.6%	3.6%
STDEV	48 month	3.1%	3.1%	3.7%	3.7%
STDEV	54 month	3.4%	3.4%	3.7%	3.7%
STDEV	60 month	3.8%	3.7%	3.8%	3.8%
STDEV	66 month	4.2%	3.9%	3.5%	3.5%
STDEV	ALL	4.2%	3.9%	5.3%	5.0%

- Vendor forecasts of GMP were also compared to the BEA estimates of GMP.
- Despite the fact that Moody's is not trying to tie its GMP forecasts to the BEA values, they still end up performing better than Global Insight.

Metro Area	Time Period	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
MIN	Same year	-28.01%	1.37%	-19.26%	1.25%
MIN	One year out	-28.10%	1.47%	-21.97%	1.63%
MIN	Two years out	-30.44%	1.35%	-28.79%	2.44%
MIN	Three years out	-34.90%	2.11%	-39.64%	1.37%
MIN	Four years out	-39.55%	3.05%	-44.08%	0.91%
MIN	Five years out	-36.19%	1.57%	-42.91%	2.18%
MIN	ALL	-39.55%	1.35%	-44.08%	0.91%
MAX	Same year	14.53%	28.01%	10.29%	19.26%
MAX	One year out	16.26%	28.10%	12.82%	21.97%
MAX	Two years out	16.64%	24.35%	15.82%	28.79%
MAX	Three years out	12.13%	34.90%	22.19%	39.64%
MAX	Four years out	10.61%	39.55%	20.85%	44.08%
MAX	Five years out	16.68%	36.19%	27.75%	42.91%
MAX	ALL	16.68%	39.55%	27.75%	44.08%
AVERAGE	Same year	-10.23%	12.49%	-8.16%	10.24%
AVERAGE	One year out	-11.16%	13.53%	-10.29%	12.55%
AVERAGE	Two years out	-13.10%	12.21%	-14.10%	16.23%
AVERAGE	Three years out	-16.60%	17.77%	-19.01%	21.95%
AVERAGE	Four years out	-18.56%	19.73%	-22.65%	24.52%
AVERAGE	Five years out	-18.59%	20.13%	-23.20%	25.60%
AVERAGE	ALL	-14.71%	15.98%	-16.23%	18.52%
MEDIAN	Same year	-9.96%	10.97%	-9.32%	10.15%
MEDIAN	One year out	-11.79%	12.91%	-11.85%	12.39%
MEDIAN	Two years out	-14.22%	11.70%	-15.57%	15.72%
MEDIAN	Three years out	-18.31%	18.31%	-21.56%	22.01%
MEDIAN	Four years out	-20.95%	20.95%	-24.74%	24.74%
MEDIAN	Five years out	-22.12%	22.12%	-26.69%	27.78%
MEDIAN	ALL	-16.43%	15.99%	-16.57%	17.36%
STD DEV	Same year	10.66%	7.84%	7.59%	5.03%
STD DEV	One year out	11.08%	7.95%	9.20%	6.13%
STD DEV	Two years out	11.38%	6.63%	11.14%	7.99%
STD DEV	Three years out	11.21%	9.21%	14.66%	11.23%
STD DEV	Four years out	11.71%	9.54%	14.90%	11.47%
STD DEV	Five years out	12.33%	9.54%	15.80%	11.37%
STD DEV	ALL	11.79%	9.07%	13.77%	10.89%

Non-Manufacturing Employment Accuracy

- Forecast results from the two vendors were then compared for non-manufacturing employment. However, in this analysis, there was not seen to be a significant difference in performance across the vendors.

	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
6 month	-0.54%	1.02%	-0.75%	1.14%
12 month	-1.13%	1.52%	-1.54%	1.79%
18 month	-1.99%	2.31%	-2.51%	2.67%
24 month	-3.04%	3.28%	-3.52%	3.61%
30 month	-4.42%	4.55%	-4.73%	4.78%
36 month	-5.68%	5.73%	-5.81%	5.82%
42 month	-6.45%	6.48%	-6.62%	6.62%
48 month	-6.82%	6.86%	-6.96%	6.96%
54 month	-6.99%	7.07%	-7.05%	7.06%
60 month	-6.96%	7.05%	-7.00%	7.00%
66 month	-6.68%	6.75%	-6.63%	6.63%

- Finally, forecast results from the two vendors were compared for population. Similar to the employment analysis, little difference is found in performance across the vendors.

	Moody's Average	Moody's Absolute Average	Global Insight Average	Global Insight Absolute Average
6 month	0.26%	0.96%	0.26%	0.99%
12 month	0.27%	1.03%	0.26%	1.05%
18 month	0.28%	1.11%	0.26%	1.14%
24 month	0.24%	1.16%	0.23%	1.20%
30 month	0.20%	1.25%	0.18%	1.27%
36 month	0.23%	1.37%	0.12%	1.36%
42 month	0.19%	1.50%	0.03%	1.48%
48 month	0.22%	1.67%	0.01%	1.62%
54 month	0.25%	1.92%	-0.04%	1.84%
60 month	0.31%	2.10%	-0.06%	2.04%
66 month	0.31%	2.41%	-0.11%	2.43%

Load Forecast Accuracy – WN to Forecast

- To determine accuracy, PJM obtained historic economic data series from Moody's and Global Insight and used the data to develop models as if we had possessed the data at the time. Models were run for the years 2006 – 2011.
- Models were developed using GMP, GDP, Index 1, Index 2, Index 1 with GDP and Index 2 with GDP from both vendors individually, as well as using an average of the drivers from both vendors.
- Forecasts for a particular forecast year were compared to the weather normalized value, produced by a comparable model in terms of the economic driver, for that year.
- For the purposes of this study, because, until recently, GI data was only available semi-annually;
 - economic data from December of each year was used to develop the forecasts
 - economic data from June of each year was used to develop the weather normalized peaks.
- 6 economic drivers * 3 vendors (M, GI & AVG) * 12 forecast vintages (1 per year for both forecasts and weather normalized) = 216 forecast runs.

Load Forecast Accuracy – WN to Forecast

- Straight percent differences between forecasts and weather normalized values could understate errors due to positive and negative values cancelling out. While having a sense of the directionality of the error is important, we chose to focus the analysis simply on the magnitude of the errors.

zone	forecast typ	metric	forecast vinta	2006	2007	2008	2009	2010	2011
PJM_RTO	M_GMP	Forecast	2006	135,275.94	137,499.81	140,125.28	142,666.22	145,100.84	147,459.61
PJM_RTO	M_GMP	Forecast	2007		137,306.07	139,609.04	141,941.12	144,292.63	146,494.97
PJM_RTO	M_GMP	Forecast	2008			138,177.93	141,271.10	144,460.31	146,875.95
PJM_RTO	M_GMP	Forecast	2009				134,699.83	136,150.28	140,104.35
PJM_RTO	M_GMP	Forecast	2010					135,141.62	138,875.69
PJM_RTO	M_GMP	Forecast	2011						136,573.62
PJM_RTO	M_GMP	WN	WN	134,780.43	136,953.08	137,390.22	133,156.58	135,823.10	135,376.59
PJM_RTO	M_GMP	MW_diff	2006	495.51	546.73	2,735.05	9,509.64	9,277.74	12,083.03
PJM_RTO	M_GMP	MW_diff	2007		352.99	2,218.82	8,784.54	8,469.53	11,118.39
PJM_RTO	M_GMP	MW_diff	2008			787.70	8,114.52	8,637.21	11,499.37
PJM_RTO	M_GMP	MW_diff	2009				1,543.25	327.18	4,727.76
PJM_RTO	M_GMP	MW_diff	2010					-681.48	3,499.10
PJM_RTO	M_GMP	MW_diff	2011						1,197.04
PJM_RTO	M_GMP	Pct_diff	2006	0.4%	0.4%	2.0%	7.1%	6.8%	8.9%
PJM_RTO	M_GMP	Pct_diff	2007		0.3%	1.6%	6.6%	6.2%	8.2%
PJM_RTO	M_GMP	Pct_diff	2008			0.6%	6.1%	6.4%	8.5%
PJM_RTO	M_GMP	Pct_diff	2009				1.2%	0.2%	3.5%
PJM_RTO	M_GMP	Pct_diff	2010					-0.5%	2.6%
PJM_RTO	M_GMP	Pct_diff	2011						0.9%
PJM_RTO	M_GMP	ABS_Pct_diff	2006	0.4%	0.4%	2.0%	7.1%	6.8%	8.9%
PJM_RTO	M_GMP	ABS_Pct_diff	2007		0.3%	1.6%	6.6%	6.2%	8.2%
PJM_RTO	M_GMP	ABS_Pct_diff	2008			0.6%	6.1%	6.4%	8.5%
PJM_RTO	M_GMP	ABS_Pct_diff	2009				1.2%	0.2%	3.5%
PJM_RTO	M_GMP	ABS_Pct_diff	2010					0.5%	2.6%
PJM_RTO	M_GMP	ABS_Pct_diff	2011						0.9%
				Current year	one year ahead	two years ahead	three years ahead	four years ahead	five years ahead

Load Forecast Accuracy – WN to Forecast

- Once the original “triangle” charts were developed, we were able to translate the analysis to determine how the models performed for the current year, one year, two years...five years into the future.
- Below, Current year is the average of the six pink cells on the previous chart. First year is the average of the five orange cells, etc. There is only one observation for fifth year performance.
- Within each “year”, color formatting indicates which model had the smallest average absolute error with green being smallest moving to red being the largest.

zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year
PJM_RTO	M_GMP	0.62%	2.19%	4.61%	7.29%	7.52%	8.93%
PJM_RTO	GI_GMP	1.07%	2.91%	5.66%	8.96%	9.84%	11.00%
PJM_RTO	AVG_GMP	0.85%	2.53%	5.11%	8.08%	8.65%	9.96%
PJM_RTO	M_GDP	0.90%	2.76%	5.72%	8.60%	9.67%	11.02%
PJM_RTO	GI_GDP	0.75%	2.37%	5.05%	8.30%	9.56%	10.79%
PJM_RTO	AVG_GDP	0.83%	2.57%	5.38%	8.45%	9.62%	10.91%
PJM_RTO	M_IN1	0.65%	1.91%	4.28%	6.47%	7.05%	7.33%
PJM_RTO	GI_IN1	0.76%	2.23%	4.51%	7.01%	7.90%	8.36%
PJM_RTO	AVG_IN1	0.71%	2.07%	4.40%	6.74%	7.48%	7.85%
PJM_RTO	M_IN2	0.65%	2.00%	4.41%	6.69%	7.26%	7.82%
PJM_RTO	GI_IN2	0.77%	2.28%	4.62%	7.24%	8.15%	8.74%
PJM_RTO	AVG_IN2	0.71%	2.15%	4.51%	6.97%	7.71%	8.28%
PJM_RTO	M_IN1GDP	0.70%	2.21%	4.62%	6.87%	7.61%	8.27%
PJM_RTO	GI_IN1GDP	0.64%	2.00%	4.19%	6.65%	7.50%	8.23%
PJM_RTO	AVG_IN1GDP	0.67%	2.10%	4.40%	6.76%	7.55%	8.25%
PJM_RTO	M_IN2GDP	0.71%	2.28%	4.79%	7.14%	7.95%	8.70%
PJM_RTO	GI_IN2GDP	0.66%	2.08%	4.36%	6.96%	7.90%	8.68%
PJM_RTO	AVG_IN2GDP	0.69%	2.19%	4.57%	7.05%	7.92%	8.69%

Load Forecast Accuracy – WN to Forecast

- After calculating the average error of each model X years out, models were ranked, by X years out, with the lowest ranking being associated with the smallest error.
- Rankings were then averaged across years out and per-unitized to come up with an overall rank. For the RTO, Moody's Index 1 was the best performer.
- While this is a easily digestible summary, it does not tell the whole story. It neglects:
 - By what margin does a particular model outperform others
 - Patterns that may exist within the years i.e., does one type of model perform better in the near-term while another performs better in the long-term.

zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year	Average Ranking	Adjusted Rankin
PJM_RTO	M_GMP	0.62%	2.19%	4.61%	7.29%	7.52%	8.93%	8	9
PJM_RTO	GI_GMP	1.07%	2.91%	5.66%	8.96%	9.84%	11.00%	18	18
PJM_RTO	AVG_GMP	0.85%	2.53%	5.11%	8.08%	8.65%	9.96%	15	15
PJM_RTO	M_GDP	0.90%	2.76%	5.72%	8.60%	9.67%	11.02%	17	17
PJM_RTO	GI_GDP	0.75%	2.37%	5.05%	8.30%	9.56%	10.79%	14	14
PJM_RTO	AVG_GDP	0.83%	2.57%	5.38%	8.45%	9.62%	10.91%	16	16
PJM_RTO	M_IN1	0.65%	1.91%	4.28%	6.47%	7.05%	7.33%	2	1
PJM_RTO	GI_IN1	0.76%	2.23%	4.51%	7.01%	7.90%	8.36%	10	11
PJM_RTO	AVG_IN1	0.71%	2.07%	4.40%	6.74%	7.48%	7.85%	5	4
PJM_RTO	M_IN2	0.65%	2.00%	4.41%	6.69%	7.26%	7.82%	3	3
PJM_RTO	GI_IN2	0.77%	2.28%	4.62%	7.24%	8.15%	8.74%	12	13
PJM_RTO	AVG_IN2	0.71%	2.15%	4.51%	6.97%	7.71%	8.28%	8	7
PJM_RTO	M_IN1GDP	0.70%	2.21%	4.62%	6.87%	7.61%	8.27%	8	8
PJM_RTO	GI_IN1GDP	0.64%	2.00%	4.19%	6.65%	7.50%	8.23%	3	2
PJM_RTO	AVG_IN1GDP	0.67%	2.10%	4.40%	6.76%	7.55%	8.25%	5	5
PJM_RTO	M_IN2GDP	0.71%	2.28%	4.79%	7.14%	7.95%	8.70%	11	12
PJM_RTO	GI_IN2GDP	0.66%	2.08%	4.36%	6.96%	7.90%	8.68%	6	6
PJM_RTO	AVG_IN2GDP	0.69%	2.19%	4.57%	7.05%	7.92%	8.69%	9	10

Load Forecast Accuracy – WN to Forecast

- Keeping the aforementioned limitations in mind, the above analysis was repeated for each zone.
- Within each zone, after the 18 models were ranked according to the average absolute error across all forecast horizons, if a particular model had the lowest error, it got a score of one.
- From this point, for each of the 18 models, we tallied up how often each of them was the best performer. In 8 of 20 zones, Moody's Index 1 was the best performer.

zone	NAME	Average Rankin	Adjusted Rankin
VEPCO	M_GMP	5	4
VEPCO	GI_GMP	16	16
VEPCO	AVG_GMP	8	7
VEPCO	M_GDP	18	18
VEPCO	GI_GDP	15	15
VEPCO	AVG_GDP	16	17
VEPCO	M_IN1	2	1
VEPCO	GI_IN1	8	6
VEPCO	AVG_IN1	5	3
VEPCO	M_IN2	2	2
VEPCO	GI_IN2	10	10
VEPCO	AVG_IN2	6	5
VEPCO	M_IN1GDP	10	9
VEPCO	GI_IN1GDP	9	8
VEPCO	AVG_IN1GDP	10	10
VEPCO	M_IN2GDP	10	12
VEPCO	GI_IN2GDP	10	13
VEPCO	AVG_IN2GDP	11	14

Model	Rank 1 Count
AVG_GDP	0
AVG_GMP	0
AVG_IN1	1
AVG_IN1GDP	0
AVG_IN2	0
AVG_IN2GDP	0
GI_GDP	0
GI_GMP	0
GI_IN1	0
GI_IN1GDP	5
GI_IN2	0
GI_IN2GDP	3
M_GDP	0
M_GMP	0
M_IN1	8
M_IN1GDP	0
M_IN2	3
M_IN2GDP	0
Grand Total	20

Load Forecast Accuracy – WN to Forecast

- To address the fact that certain models may perform better in shorter or longer forecast horizons, both of the above analysis were repeated, but this time breaking the data out by year.

Load Forecast Accuracy – WN to Forecast

- Here, repeating the tally analysis, it can be seen that Moody's Index 1 and GI Index 2 using GDP perform very similarly overall, however, GI is the stronger performer in the near term while Moody's is stronger in the 3 to 5 year forecast horizon.

	Frequency of being the most accurate						Total
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year	
M_GMP	-	1	3	3	3	2	12
GI_GMP	-	-	-	-	-	-	-
AVG_GMP	-	-	-	-	-	-	-
M_GDP	-	-	-	-	-	-	-
GI_GDP	3	-	-	-	-	-	3
AVG_GDP	-	-	-	-	-	-	-
M_IN1	4	6	4	7	7	8	36
GI_IN1	-	-	1	-	1	-	2
AVG_IN1	-	1	-	-	-	-	1
M_IN2	3	3	2	2	3	3	16
GI_IN2	-	-	-	-	-	1	1
AVG_IN2	-	-	-	-	-	-	-
M_IN1GDP	-	-	-	-	-	-	-
GI_IN1GDP	8	8	8	5	6	4	39
AVG_IN1GDP	-	1	-	-	1	-	2
M_IN2GDP	-	-	-	-	-	1	1
GI_IN2GDP	4	2	2	3	-	1	12
AVG_IN2GDP	-	1	-	-	-	-	1
Total	22	23	20	20	21	20	126

The total exceeds the expected 120 (6 forecast horizons * 20 zones) due to ties.

- When repeating the average ranking analysis, first, by zone, errors were ranked within each year.

zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year
PECO	M_GMP	0.53%	2.04%	3.21%	5.61%	4.93%	3.63%
PECO	GI_GMP	0.64%	1.64%	2.89%	4.93%	5.39%	5.80%
PECO	AVG_GMP	0.55%	1.83%	2.96%	5.15%	4.93%	4.53%
PECO	M_GDP	0.40%	1.91%	3.92%	5.94%	6.24%	6.82%
PECO	GI_GDP	0.29%	1.57%	3.27%	5.68%	6.16%	6.64%
PECO	AVG_GDP	0.34%	1.73%	3.60%	5.81%	6.20%	6.74%
PECO	M_IN1	0.27%	1.15%	2.32%	3.31%	3.31%	2.81%
PECO	GI_IN1	0.46%	1.33%	2.10%	3.42%	3.50%	3.25%
PECO	AVG_IN1	0.36%	1.23%	2.21%	3.37%	3.40%	3.02%
PECO	M_IN2	0.33%	1.40%	2.68%	4.26%	4.16%	3.75%
PECO	GI_IN2	0.45%	1.40%	2.44%	4.11%	4.36%	4.40%
PECO	AVG_IN2	0.39%	1.41%	2.52%	4.16%	4.23%	4.04%
PECO	M_IN1GDP	0.30%	1.41%	2.70%	4.12%	4.23%	4.33%
PECO	GI_IN1GDP	0.35%	1.19%	2.11%	3.55%	3.53%	3.49%
PECO	AVG_IN1GDP	0.28%	1.30%	2.38%	3.83%	3.88%	3.91%
PECO	M_IN2GDP	0.33%	1.58%	3.14%	4.77%	4.98%	5.29%
PECO	GI_IN2GDP	0.30%	1.31%	2.51%	4.36%	4.60%	4.80%
PECO	AVG_IN2GDP	0.31%	1.45%	2.83%	4.57%	4.80%	5.04%



zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year
PECO	M_GMP	16	18	15	15	12	5
PECO	GI_GMP	18	14	12	13	15	15
PECO	AVG_GMP	17	16	13	14	12	11
PECO	M_GDP	13	17	18	18	18	18
PECO	GI_GDP	3	12	16	16	16	16
PECO	AVG_GDP	9	15	17	17	17	17
PECO	M_IN1	1	1	4	1	1	1
PECO	GI_IN1	15	6	1	3	3	3
PECO	AVG_IN1	11	3	3	2	2	2
PECO	M_IN2	7	7	9	9	6	6
PECO	GI_IN2	14	7	6	6	9	10
PECO	AVG_IN2	12	9	8	8	7	8
PECO	M_IN1GDP	4	9	10	7	7	9
PECO	GI_IN1GDP	10	2	2	4	4	4
PECO	AVG_IN1GDP	2	4	5	5	5	7
PECO	M_IN2GDP	7	13	14	12	14	14
PECO	GI_IN2GDP	4	5	7	10	10	12
PECO	AVG_IN2GDP	6	11	11	11	11	13

- Then rankings for each model, in each year, were averaged across zones and per-unitized for an overall measure of accuracy.
- According to this measure, GI's Index 1 using GDP had the lowest score, followed by Moody's Index 1. It can also be seen that either GI Index using GDP perform well in the near term, while Moody's Index 1 performs better in the longer-term.

Average Ranking by forecast period - per unitized							Average Ranking	Adjusted Ranking
Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year			
M_GMP	16	17	12	13	11	13	14	14
GI_GMP	18	18	17	17	17	17	17	18
AVG_GMP	17	15	15	14	14	14	15	15
M_GDP	15	16	18	18	18	18	17	17
GI_GDP	9	13	14	15	15	15	14	13
AVG_GDP	12	14	16	16	16	16	15	16
M_IN1	5	4	3	2	1	1	3	2
GI_IN1	14	10	7	8	10	7	9	10
AVG_IN1	11	6	5	4	4	2	5	6
M_IN2	6	5	6	5	2	3	5	4
GI_IN2	13	11	10	11	13	12	12	12
AVG_IN2	10	8	8	7	6	5	7	7
M_IN1GDP	8	9	11	9	7	7	9	9
GI_IN1GDP	2	1	1	1	2	4	2	1
AVG_IN1GDP	3	3	4	3	5	5	4	3
M_IN2GDP	7	12	13	12	12	11	11	11
GI_IN2GDP	1	2	2	6	8	9	5	5
AVG_IN2GDP	4	7	9	10	9	10	8	8

Load Forecast Accuracy – WN to Forecast

- The previous slide was showing the rankings for the zones averaged. Below is the ranking for the RTO with ATSI and DUKE as well as for Mid-Atlantic. Moody's Index1 was the best model for both.

zone	Model	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year	Average Ranking	Adjusted Ranking
PJM_MA	M_GMP	0.70%	2.39%	4.20%	6.54%	6.81%	7.40%	12	13
PJM_MA	GI_GMP	0.95%	2.46%	4.57%	7.60%	8.41%	9.48%	16	16
PJM_MA	AVG_GMP	0.79%	2.27%	4.32%	6.97%	7.51%	8.37%	14	15
PJM_MA	M_GDP	0.79%	2.61%	5.17%	7.97%	9.03%	10.41%	18	18
PJM_MA	GI_GDP	0.59%	2.23%	4.53%	7.68%	8.91%	10.18%	14	14
PJM_MA	AVG_GDP	0.69%	2.42%	4.86%	7.83%	8.97%	10.30%	16	17
PJM_MA	M_IN1	0.54%	1.82%	3.54%	5.50%	6.11%	6.43%	2	1
PJM_MA	GI_IN1	0.62%	1.85%	3.58%	5.87%	6.63%	7.33%	7	7
PJM_MA	AVG_IN1	0.58%	1.82%	3.56%	5.69%	6.37%	6.88%	4	3
PJM_MA	M_IN2	0.53%	1.89%	3.65%	5.68%	6.25%	6.63%	4	4
PJM_MA	GI_IN2	0.62%	1.88%	3.64%	5.99%	6.79%	7.51%	9	9
PJM_MA	AVG_IN2	0.58%	1.86%	3.65%	5.84%	6.52%	7.07%	6	6
PJM_MA	M_IN1GDP	0.63%	2.00%	4.00%	6.14%	6.88%	7.69%	11	11
PJM_MA	GI_IN1GDP	0.44%	1.69%	3.42%	5.74%	6.51%	7.31%	3	2
PJM_MA	AVG_IN1GDP	0.53%	1.85%	3.71%	5.95%	6.70%	7.50%	7	8
PJM_MA	M_IN2GDP	0.61%	2.02%	4.05%	6.22%	6.99%	7.78%	12	12
PJM_MA	GI_IN2GDP	0.46%	1.75%	3.54%	5.93%	6.77%	7.60%	5	5
PJM_MA	AVG_IN2GDP	0.54%	1.88%	3.80%	6.08%	6.88%	7.69%	9	10
RTO_ATSI_DUKE	M_GMP	0.73%	2.24%	4.64%	7.35%	7.47%	8.96%	11	11
RTO_ATSI_DUKE	GI_GMP	1.03%	2.85%	5.61%	8.86%	9.75%	10.88%	18	18
RTO_ATSI_DUKE	AVG_GMP	0.88%	2.51%	5.10%	8.07%	8.58%	9.93%	15	15
RTO_ATSI_DUKE	M_GDP	0.88%	2.80%	5.68%	8.51%	9.57%	10.86%	17	17
RTO_ATSI_DUKE	GI_GDP	0.73%	2.38%	5.04%	8.22%	9.44%	10.63%	14	14
RTO_ATSI_DUKE	AVG_GDP	0.80%	2.59%	5.36%	8.36%	9.50%	10.74%	16	16
RTO_ATSI_DUKE	M_IN1	0.63%	1.93%	4.24%	6.41%	6.98%	7.32%	2	1
RTO_ATSI_DUKE	GI_IN1	0.73%	2.24%	4.47%	6.96%	7.84%	8.30%	9	10
RTO_ATSI_DUKE	AVG_IN1	0.68%	2.09%	4.36%	6.69%	7.42%	7.82%	5	5
RTO_ATSI_DUKE	M_IN2	0.64%	2.04%	4.38%	6.65%	7.22%	7.81%	4	3
RTO_ATSI_DUKE	GI_IN2	0.74%	2.30%	4.58%	7.18%	8.10%	8.73%	12	13
RTO_ATSI_DUKE	AVG_IN2	0.69%	2.17%	4.49%	6.92%	7.67%	8.28%	8	8
RTO_ATSI_DUKE	M_IN1GDP	0.66%	2.20%	4.54%	6.74%	7.47%	8.12%	7	7
RTO_ATSI_DUKE	GI_IN1GDP	0.60%	2.00%	4.11%	6.53%	7.37%	8.08%	2	2
RTO_ATSI_DUKE	AVG_IN1GDP	0.63%	2.10%	4.33%	6.64%	7.42%	8.10%	4	4
RTO_ATSI_DUKE	M_IN2GDP	0.68%	2.30%	4.74%	7.05%	7.87%	8.60%	11	12
RTO_ATSI_DUKE	GI_IN2GDP	0.62%	2.09%	4.31%	6.89%	7.82%	8.58%	6	6
RTO_ATSI_DUKE	AVG_IN2GDP	0.65%	2.19%	4.52%	6.97%	7.84%	8.59%	9	9

- Results however may have been influenced by smaller zones since all zones were treated equally. To account for this possibility, zonal contributions to the RTO's CP from 2006 to 2011 were summed and then divided by the RTO's sum of CPs over that time frame to develop weights.

AE	1.8%
AEP	15.3%
APS	5.4%
ATSI	8.4%
BGE	4.5%
COMED	13.0%
DAYTON	2.2%
DPL	2.6%
DQE	1.8%
DUKE	3.4%
JCPL	4.0%
METED	1.9%
PECO	5.5%
PENLC	1.9%
PEPCO	4.3%
PL	4.7%
PS	6.6%
RECO	0.3%
UGI	0.1%
VEPCO	12.3%

Incorporating Zonal Weighting: WN Accuracy

- Using this zonal weighting scheme, accuracy results were recalculated.
- Results are fairly similar to previous analysis with Global Insight Index 1 with GDP coming out ahead, followed by Moody's Index 1 in second.

	Weighted Average Ranking by forecast period - per unitized						Average Ranking	Adjusted Ranking
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year		
M_GMP	16	16	9	13	10	13	13	13
GI_GMP	18	18	17	18	18	17	18	18
AVG_GMP	17	15	14	14	14	14	15	15
M_GDP	15	17	18	17	17	18	17	17
GI_GDP	11	10	15	15	15	15	14	14
AVG_GDP	13	14	16	16	16	16	15	16
M_IN1	5	3	3	1	1	1	2	2
GI_IN1	14	11	7	8	8	8	9	10
AVG_IN1	9	6	5	3	3	2	5	4
M_IN2	6	4	6	5	4	5	5	5
GI_IN2	12	13	11	12	13	12	12	12
AVG_IN2	10	8	8	9	7	7	8	8
M_IN1GDP	7	9	12	6	6	6	8	7
GI_IN1GDP	1	1	1	2	2	3	2	1
AVG_IN1GDP	3	5	4	4	5	4	4	3
M_IN2GDP	8	12	13	11	12	11	11	11
GI_IN2GDP	2	2	2	7	9	9	5	6
AVG_IN2GDP	4	7	10	10	11	10	9	9

Load Forecast Accuracy – WN to Forecast

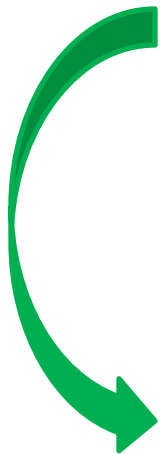
- To address the fact that none of the above metrics measure the magnitude of performance improvement, an additional metric was created to measure each model's performance relative to the model that performed the best in that zone and time period.
- This measure is attempting to determine, when a model is the best performer, is it the best by a wide margin or by just a little bit. Likewise, when a model is not the best performer, is it a lot worse, or just a little worse than the best model.

Load Forecast Accuracy – WN to Forecast

- Calculate the percentage by which each model's error exceeds that of the best performing model's error.

zone	NAME	Current year	First year	Second year	Third year	Fourth year	Fifth year
AEP	M_GMP	1.68%	2.74%	5.41%	8.24%	8.33%	9.05%
AEP	GI_GMP	1.69%	3.69%	6.45%	9.54%	10.24%	10.12%
AEP	AVG_GMP	1.66%	3.19%	5.93%	8.89%	9.26%	9.61%
AEP	M_GDP	1.70%	3.30%	6.51%	9.34%	10.07%	10.02%
AEP	GI_GDP	1.57%	3.22%	5.99%	9.12%	10.00%	9.85%
AEP	AVG_GDP	1.64%	3.26%	6.26%	9.23%	10.04%	9.93%
AEP	M_IN1	1.51%	3.25%	5.49%	7.63%	7.83%	7.01%
AEP	GI_IN1	1.62%	3.54%	5.53%	8.08%	8.39%	7.63%
AEP	AVG_IN1	1.55%	3.39%	5.47%	7.86%	8.11%	7.32%
AEP	M_IN2	1.56%	3.15%	5.49%	8.00%	8.25%	7.87%
AEP	GI_IN2	1.60%	3.48%	5.73%	8.47%	8.97%	8.41%
AEP	AVG_IN2	1.57%	3.32%	5.61%	8.24%	8.62%	8.16%
AEP	M_IN1GDP	1.52%	3.30%	5.66%	7.96%	8.32%	7.62%
AEP	GI_IN1GDP	1.46%	3.28%	5.23%	7.75%	8.14%	7.54%
AEP	AVG_IN1GDP	1.49%	3.29%	5.44%	7.86%	8.23%	7.56%
AEP	M_IN2GDP	1.57%	3.29%	5.89%	8.41%	8.90%	8.38%
AEP	GI_IN2GDP	1.48%	3.25%	5.47%	8.20%	8.77%	8.30%
AEP	AVG_IN2GDP	1.52%	3.27%	5.68%	8.31%	8.82%	8.34%

zone	NAME	Current year	First year	Second year	Third year	Fourth year	Fifth year
AEP	M_GMP	15.07%	0.00%	3.44%	7.99%	6.39%	29.10%
AEP	GI_GMP	15.75%	34.67%	23.33%	25.03%	30.78%	44.37%
AEP	AVG_GMP	13.70%	16.42%	13.38%	16.51%	18.26%	37.09%
AEP	M_GDP	16.44%	20.44%	24.47%	22.41%	28.61%	42.94%
AEP	GI_GDP	7.53%	17.52%	14.53%	19.53%	27.71%	40.51%
AEP	AVG_GDP	12.33%	18.98%	19.69%	20.97%	28.22%	41.65%
AEP	M_IN1	3.42%	18.61%	4.97%	0.00%	0.00%	0.00%
AEP	GI_IN1	10.96%	29.20%	5.74%	5.90%	7.15%	8.84%
AEP	AVG_IN1	6.16%	23.72%	4.59%	3.01%	3.58%	4.42%
AEP	M_IN2	6.85%	14.96%	4.97%	4.85%	5.36%	12.27%
AEP	GI_IN2	9.59%	27.01%	9.56%	11.01%	14.56%	19.97%
AEP	AVG_IN2	7.53%	21.17%	7.27%	7.99%	10.09%	16.41%
AEP	M_IN1GDP	4.11%	20.44%	8.22%	4.33%	6.26%	8.70%
AEP	GI_IN1GDP	0.00%	19.71%	0.00%	1.57%	3.96%	7.56%
AEP	AVG_IN1GDP	2.05%	20.07%	4.02%	3.01%	5.11%	7.85%
AEP	M_IN2GDP	7.53%	20.07%	12.62%	10.22%	13.67%	19.54%
AEP	GI_IN2GDP	1.37%	18.61%	4.59%	7.47%	12.01%	18.40%
AEP	AVG_IN2GDP	4.11%	19.34%	8.60%	8.91%	12.64%	18.97%



- The percentages by which each model's error exceeded the best performer were averaged across zones and then averaged across the time periods to come to a final ranking.
- Again, it can be seen that Global Insight's Index 1 with GDP was the best performer in the near term forecast horizons, however, in the later years, when it was not the best performer, it was off by a wide margin. Moody's Index 1 was the best performer overall, according to this measure.

Percent by which error is greater than that of the most accurate forecast										
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year			Average	Ranking
M_GMP	90%	56%	30%	33%	24%	150%			64%	13
GI_GMP	109%	57%	53%	59%	73%	160%			85%	15
AVG_GMP	83%	47%	40%	45%	47%	149%			69%	14
M_GDP	44%	46%	58%	58%	88%	376%			112%	18
GI_GDP	19%	25%	38%	53%	85%	367%			98%	16
AVG_GDP	30%	35%	48%	56%	87%	372%			104%	17
M_IN1	17%	14%	18%	14%	14%	43%			20%	1
GI_IN1	48%	20%	20%	22%	34%	33%			30%	7
AVG_IN1	29%	15%	19%	18%	24%	31%			23%	2
M_IN2	18%	14%	19%	17%	20%	52%			23%	3
GI_IN2	44%	21%	23%	27%	42%	119%			46%	12
AVG_IN2	28%	16%	21%	22%	31%	88%			34%	10
M_IN1GDP	18%	18%	25%	23%	33%	110%			38%	11
GI_IN1GDP	10%	6%	9%	15%	29%	105%			29%	6
AVG_IN1GDP	10%	12%	17%	19%	31%	107%			33%	9
M_IN2GDP	18%	20%	29%	28%	43%	47%			31%	8
GI_IN2GDP	9%	8%	14%	22%	40%	52%			24%	4
AVG_IN2GDP	12%	14%	22%	25%	42%	50%			27%	5

Load Forecast Accuracy – WN to Forecast

- The previous slide was showing the rankings for the zones averaged. Below is the ranking for the RTO with ATSI and DUKE as well as for Mid-Atlantic.

zone	Model	Current Year	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Average	Rank
PJM_MA	M_GMP	59%	41%	23%	19%	11%	15%	0.28	13
PJM_MA	GI_GMP	116%	46%	34%	38%	38%	47%	0.53	17
PJM_MA	AVG_GMP	80%	34%	26%	27%	23%	30%	0.37	14
PJM_MA	M_GDP	80%	54%	51%	45%	48%	62%	0.57	18
PJM_MA	GI_GDP	34%	32%	32%	40%	46%	58%	0.40	15
PJM_MA	AVG_GDP	57%	43%	42%	42%	47%	60%	0.49	16
PJM_MA	M_IN1	23%	8%	4%	0%	0%	0%	0.06	2
PJM_MA	GI_IN1	41%	9%	5%	7%	9%	14%	0.14	8
PJM_MA	AVG_IN1	32%	8%	4%	3%	4%	7%	0.10	5
PJM_MA	M_IN2	20%	12%	7%	3%	2%	3%	0.08	3
PJM_MA	GI_IN2	41%	11%	6%	9%	11%	17%	0.16	10
PJM_MA	AVG_IN2	32%	10%	7%	6%	7%	10%	0.12	6
PJM_MA	M_IN1GDP	43%	18%	17%	12%	13%	20%	0.20	11
PJM_MA	GI_IN1GDP	0%	0%	0%	4%	7%	14%	0.04	1
PJM_MA	AVG_IN1GDP	20%	9%	8%	8%	10%	17%	0.12	7
PJM_MA	M_IN2GDP	39%	20%	18%	13%	14%	21%	0.21	12
PJM_MA	GI_IN2GDP	5%	4%	4%	8%	11%	18%	0.08	4
PJM_MA	AVG_IN2GDP	23%	11%	11%	11%	13%	20%	0.15	9
RTO_ATSI_DUKE	M_GMP	22%	16%	13%	15%	7%	22%	0.16	12
RTO_ATSI_DUKE	GI_GMP	72%	48%	36%	38%	40%	49%	0.47	18
RTO_ATSI_DUKE	AVG_GMP	47%	30%	24%	26%	23%	36%	0.31	15
RTO_ATSI_DUKE	M_GDP	47%	45%	38%	33%	37%	48%	0.41	17
RTO_ATSI_DUKE	GI_GDP	22%	23%	23%	28%	35%	45%	0.29	14
RTO_ATSI_DUKE	AVG_GDP	33%	34%	30%	30%	36%	47%	0.35	16
RTO_ATSI_DUKE	M_IN1	5%	0%	3%	0%	0%	0%	0.01	1
RTO_ATSI_DUKE	GI_IN1	22%	16%	9%	9%	12%	13%	0.13	10
RTO_ATSI_DUKE	AVG_IN1	13%	8%	6%	4%	6%	7%	0.08	5
RTO_ATSI_DUKE	M_IN2	7%	6%	7%	4%	3%	7%	0.05	3
RTO_ATSI_DUKE	GI_IN2	23%	19%	11%	12%	16%	19%	0.17	13
RTO_ATSI_DUKE	AVG_IN2	15%	12%	9%	8%	10%	13%	0.11	8
RTO_ATSI_DUKE	M_IN1GDP	10%	14%	10%	5%	7%	11%	0.10	7
RTO_ATSI_DUKE	GI_IN1GDP	0%	4%	0%	2%	6%	10%	0.04	2
RTO_ATSI_DUKE	AVG_IN1GDP	5%	9%	5%	4%	6%	11%	0.07	4
RTO_ATSI_DUKE	M_IN2GDP	13%	19%	15%	10%	13%	17%	0.15	11
RTO_ATSI_DUKE	GI_IN2GDP	3%	8%	5%	7%	12%	17%	0.09	6
RTO_ATSI_DUKE	AVG_IN2GDP	8%	13%	10%	9%	12%	17%	0.12	9

Incorporating Zonal Weighting: WN Accuracy

- Using this zonal weighting scheme, accuracy results were recalculated.
- Results are fairly similar to previous analysis with Moody's Index 1 still on top. Moody's Index 2 moves into the second spot with Global Insight Index 1 with GDP essentially in a tie.

Percent by which error is greater than that of the most accurate forecast, weighted										
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year		Average	Ranking	
M_GMP	77%	50%	26%	29%	21%	40%		40%	13	
GI_GMP	99%	57%	57%	59%	74%	82%		71%	18	
AVG_GMP	76%	46%	40%	43%	47%	61%		52%	14	
M_GDP	44%	45%	61%	57%	84%	102%		66%	17	
GI_GDP	20%	25%	42%	52%	81%	98%		53%	15	
AVG_GDP	32%	35%	52%	55%	82%	100%		59%	16	
M_IN1	15%	12%	19%	12%	14%	9%		13%	1	
GI_IN1	37%	23%	23%	23%	37%	29%		29%	10	
AVG_IN1	22%	16%	21%	18%	25%	19%		20%	4	
M_IN2	16%	14%	21%	18%	22%	21%		18%	2	
GI_IN2	35%	24%	27%	29%	45%	45%		34%	12	
AVG_IN2	23%	18%	23%	23%	34%	33%		26%	8	
M_IN1GDP	16%	19%	28%	22%	33%	34%		25%	6	
GI_IN1GDP	6%	9%	15%	18%	33%	34%		19%	3	
AVG_IN1GDP	9%	13%	21%	20%	33%	34%		22%	5	
M_IN2GDP	16%	21%	33%	29%	45%	44%		31%	11	
GI_IN2GDP	7%	11%	20%	25%	46%	44%		25%	7	
AVG_IN2GDP	10%	16%	26%	27%	45%	44%		28%	9	



Load Forecast Accuracy – Actual Peak to Model Solved with Actual Data

- In addition to comparing forecasted values to weather normalized peaks from each summer, PJM also tested what models would have predicted for annual peaks had they possessed perfect knowledge of peak day conditions.
- Models were developed using GMP, GDP, Index 1, Index 2, Index 1 with GDP and Index 2 with GDP from both vendors individually, as well as using an average of the drivers from both vendors.
- Once models were developed for each zone using economic data from that December's vintage of economic data, the models were solved for peak days using actual weather that occurred on the peak day and using September, 2011's vintage of economic data as a proxy for actual economic conditions.

Load Forecast Accuracy – Actual to Actual

- Straight percent differences between forecasts and weather normalized values could understate errors due to positive and negative values cancelling out. While having a sense of the directionality of the error is important, we chose to focus the analysis simply on the magnitude of the errors.

				2006	2007	2008	2009	2010	2011
COMED	GI_GMP	Model Solved	2006	24,500	22,398	21,586	21,309	22,169	24,357
COMED	GI_GMP	Model Solved	2007		21,983	21,184	21,320	22,634	24,217
COMED	GI_GMP	Model Solved	2008			21,142	21,288	22,145	24,383
COMED	GI_GMP	Model Solved	2009				21,772	22,239	24,386
COMED	GI_GMP	Model Solved	2010					22,248	23,806
COMED	GI_GMP	Model Solved	2011						24,044
COMED	GI_GMP	Zonal NCP	Zonal NCP	23,996	21,970	20,976	21,218	21,915	23,754

ZONE	model_type	fcst_vintage	Current Year	First Year	Second Year	Third Year	Fourth Year	Fifth Year
COMED	GI_GMP	2006	2.54%	1.16%	0.43%	2.91%	1.95%	2.10%
COMED	GI_GMP	2007	1.95%	3.28%	0.48%	0.99%	0.06%	
COMED	GI_GMP	2008	2.65%	1.05%	0.33%	0.79%		
COMED	GI_GMP	2009	2.66%	1.48%	2.61%			
COMED	GI_GMP	2010	0.22%	1.52%				
COMED	GI_GMP	2011	1.22%					
		Average	1.87%	1.70%	0.96%	1.56%	1.01%	2.10%

Load Forecast Accuracy – Actual to Actual

- Once the original “triangle” charts were developed, we were able to translate the analysis to determine how the models performed for the current year, one year, two years...five years into the future.
- Below, Current year is the average of the six pink cells on the previous chart. First year is the average of the five orange cells, etc. There is only one observation for fifth year performance.
- Within each “year”, color formatting indicates which model had the smallest average absolute error with green being smallest moving to red being the largest.

Absolute % difference								
zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year	
COMED	M_GMP	2.09%	1.48%	0.82%	1.75%	1.29%	2.24%	
COMED	GI_GMP	1.88%	1.70%	0.96%	1.56%	1.01%	2.10%	
COMED	AVG_GMP	1.95%	1.59%	0.88%	1.66%	1.17%	2.19%	
COMED	M_GDP	1.85%	2.16%	2.65%	3.21%	2.89%	3.22%	
COMED	GI_GDP	1.85%	2.15%	2.64%	3.18%	2.85%	3.16%	
COMED	AVG_GDP	1.85%	2.16%	2.64%	3.20%	2.87%	3.19%	
COMED	M_IN1	1.60%	1.73%	1.60%	1.68%	1.07%	1.41%	
COMED	GI_IN1	1.58%	1.84%	1.82%	1.75%	0.93%	1.16%	
COMED	AVG_IN1	1.59%	1.78%	1.71%	1.71%	1.00%	1.28%	
COMED	M_IN2	1.62%	1.47%	1.31%	1.61%	0.95%	1.40%	
COMED	GI_IN2	1.61%	1.68%	1.62%	1.72%	1.09%	1.55%	
COMED	AVG_IN2	1.61%	1.57%	1.47%	1.66%	1.02%	1.48%	
COMED	M_IN1GDP	1.64%	2.09%	2.13%	2.03%	1.46%	1.58%	
COMED	GI_IN1GDP	1.84%	2.41%	2.49%	2.36%	1.60%	1.83%	
COMED	AVG_IN1GDP	1.74%	2.25%	2.31%	2.20%	1.53%	1.71%	
COMED	M_IN2GDP	1.55%	1.89%	2.01%	2.07%	1.57%	1.76%	
COMED	GI_IN2GDP	1.84%	2.27%	2.47%	2.61%	2.05%	2.44%	
COMED	AVG_IN2GDP	1.70%	2.08%	2.24%	2.34%	1.81%	2.10%	

Load Forecast Accuracy – Actual to Actual

- After calculating the average error of each model X years out, models were ranked, by X years out, with the lowest ranking being associated with the smallest error.
- Rankings were then averaged across years out and per-unitized to come up with an overall rank. For Comed, Moody's Index 2 was the best performer.
- While this is a easily digestible summary, it does not tell the whole story. It neglects:
 - By what margin does a particular model outperform others
 - Patterns that may exist within the years i.e., does one type of model perform better in the near-term while another performs better in the long-term.

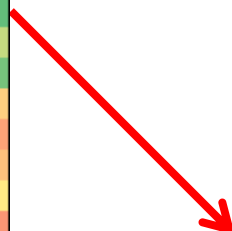
Absolute % difference		Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year	Average Ranking	Adjusted Ranking
zone	NAME								
COMED	M_GMP	2.09%	1.48%	0.82%	1.75%	1.29%	2.24%	9	9
COMED	GI_GMP	1.88%	1.70%	0.96%	1.56%	1.01%	2.10%	7	7
COMED	AVG_GMP	1.95%	1.59%	0.88%	1.66%	1.17%	2.19%	8	8
COMED	M_GDP	1.85%	2.16%	2.65%	3.21%	2.89%	3.22%	17	18
COMED	GI_GDP	1.85%	2.15%	2.64%	3.18%	2.85%	3.16%	15	16
COMED	AVG_GDP	1.85%	2.16%	2.64%	3.20%	2.87%	3.19%	16	17
COMED	M_IN1	1.60%	1.73%	1.60%	1.68%	1.07%	1.41%	5	5
COMED	GI_IN1	1.58%	1.84%	1.82%	1.75%	0.93%	1.16%	5	3
COMED	AVG_IN1	1.59%	1.78%	1.71%	1.71%	1.00%	1.28%	5	3
COMED	M_IN2	1.62%	1.47%	1.31%	1.61%	0.95%	1.40%	3	1
COMED	GI_IN2	1.61%	1.68%	1.62%	1.72%	1.09%	1.55%	6	6
COMED	AVG_IN2	1.61%	1.57%	1.47%	1.66%	1.02%	1.48%	5	2
COMED	M_IN1GDP	1.64%	2.09%	2.13%	2.03%	1.46%	1.58%	10	11
COMED	GI_IN1GDP	1.84%	2.41%	2.49%	2.36%	1.60%	1.83%	14	14
COMED	AVG_IN1GDP	1.74%	2.25%	2.31%	2.20%	1.53%	1.71%	12	12
COMED	M_IN2GDP	1.55%	1.89%	2.01%	2.07%	1.57%	1.76%	9	9
COMED	GI_IN2GDP	1.84%	2.27%	2.47%	2.61%	2.05%	2.44%	15	15
COMED	AVG_IN2GDP	1.70%	2.08%	2.24%	2.34%	1.81%	2.10%	12	12

Load Forecast Accuracy – Actual to Actual

- Keeping the aforementioned limitations in mind, the above analysis was repeated for each zone.
- Within each zone, after the 18 models were ranked according to the average absolute error across all forecast horizons, if a particular model had the lowest error, it got a score of one.
- From this point, for each of the 18 models, we tallied up how often each of them was the best performer. In 8 of 20 zones, Moody's Index 2, with or without GDP, was the best performer.

zone	NAME	Average Ranking	Adjusted Ranking
COMED	M_GMP	9	9
COMED	GI_GMP	7	7
COMED	AVG_GMP	8	8
COMED	M_GDP	17	18
COMED	GI_GDP	15	16
COMED	AVG_GDP	16	17
COMED	M_IN1	5	5
COMED	GI_IN1	5	3
COMED	AVG_IN1	5	3
COMED	M_IN2	3	1
COMED	GI_IN2	6	6
COMED	AVG_IN2	5	2
COMED	M_IN1GDP	10	11
COMED	GI_IN1GDP	14	14
COMED	AVG_IN1GDP	12	12
COMED	M_IN2GDP	9	9
COMED	GI_IN2GDP	15	15
COMED	AVG_IN2GDP	12	12

Row Labels	Sum of score
AVG_GDP	0
AVG_GMP	2
AVG_IN1	0
AVG_IN1GDP	0
AVG_IN2	0
AVG_IN2GDP	0
GI_GDP	2
GI_GMP	2
GI_IN1	0
GI_IN1GDP	0
GI_IN2	2
GI_IN2GDP	0
M_GDP	1
M_GMP	1
M_IN1	0
M_IN1GDP	3
M_IN2	4
M_IN2GDP	4
Grand Total	21



Load Forecast Accuracy – Actual to Actual

- To address the fact that certain models may perform better in shorter or longer forecast horizons, both of the above analysis were repeated, but this time breaking the data out by year.

Load Forecast Accuracy – Actual to Actual

- Here, repeating the tally analysis, it can be seen that GI GMP and GDP based models have the highest frequency of being most accurate, followed by Moody's Index 2 and Moody's Index 2 with GDP.

	Frequency of being the most accurate						Total
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year	
M_GMP	2	-	1	1	3	3	10
GI_GMP	2	2	3	6	5	7	25
AVG_GMP	2	1	1	-	-	-	4
M_GDP	-	-	-	1	1	2	4
GI_GDP	7	6	2	2	2	1	20
AVG_GDP	-	-	-	-	-	-	-
M_IN1	1	1	2	-	1	2	7
GI_IN1	-	2	2	-	3	1	8
AVG_IN1	-	-	-	-	-	-	-
M_IN2	1	4	2	5	2	-	14
GI_IN2	1	1	2	1	1	2	8
AVG_IN2	-	-	-	-	-	-	-
M_IN1GDP	-	1	1	2	1	-	5
GI_IN1GDP	-	-	-	-	-	-	-
AVG_IN1GDP	-	-	-	-	-	-	-
M_IN2GDP	4	2	4	2	1	1	14
GI_IN2GDP	-	-	-	-	-	1	1
AVG_IN2GDP	-	-	-	-	-	-	-
Total	20	20	20	20	20	20	120

Load Forecast Accuracy – Actual to Actual

- When repeating the average ranking analysis, first, by zone, errors were ranked within each year.

zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year
PL	M_GMP	5.42%	5.74%	5.99%	6.13%	3.91%	3.42%
PL	GI_GMP	6.15%	6.82%	6.22%	4.28%	1.17%	0.86%
PL	AVG_GMP	5.81%	6.30%	6.09%	5.17%	2.42%	2.13%
PL	M_GDP	3.88%	4.67%	5.14%	6.65%	6.75%	7.01%
PL	GI_GDP	3.88%	4.66%	5.12%	6.63%	6.72%	6.96%
PL	AVG_GDP	3.88%	4.67%	5.13%	6.64%	6.74%	6.99%
PL	M_IN1	4.39%	4.99%	5.24%	6.29%	6.41%	6.49%
PL	GI_IN1	4.63%	5.43%	5.56%	6.03%	5.68%	6.01%
PL	AVG_IN1	4.51%	5.21%	5.40%	6.16%	6.04%	6.24%
PL	M_IN2	4.48%	5.02%	5.27%	6.16%	5.79%	5.80%
PL	GI_IN2	4.77%	5.51%	5.56%	5.83%	5.10%	5.39%
PL	AVG_IN2	4.63%	5.27%	5.41%	5.99%	5.44%	5.59%
PL	M_IN1GDP	4.00%	4.66%	5.00%	6.28%	6.56%	6.82%
PL	GI_IN1GDP	4.12%	4.89%	5.29%	6.49%	6.83%	7.42%
PL	AVG_IN1GDP	4.06%	4.78%	5.15%	6.38%	6.69%	7.12%
PL	M_IN2GDP	4.03%	4.67%	4.98%	6.20%	6.26%	6.50%
PL	GI_IN2GDP	4.16%	4.87%	5.25%	6.48%	6.75%	7.34%
PL	AVG_IN2GDP	4.10%	4.77%	5.12%	6.34%	6.51%	6.93%



zone	NAME	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year
PL	M_GMP	16	16	16	6	3	3
PL	GI_GMP	18	18	18	1	1	1
PL	AVG_GMP	17	17	17	2	2	2
PL	M_GDP	3	4	6	18	17	15
PL	GI_GDP	1	1	4	16	14	13
PL	AVG_GDP	2	3	5	17	15	14
PL	M_IN1	10	10	8	11	10	9
PL	GI_IN1	14	14	14	5	6	7
PL	AVG_IN1	12	12	12	7	8	8
PL	M_IN2	11	11	10	8	7	6
PL	GI_IN2	15	15	15	3	4	4
PL	AVG_IN2	13	13	13	4	5	5
PL	M_IN1GDP	4	2	2	10	12	11
PL	GI_IN1GDP	8	9	11	15	18	18
PL	AVG_IN1GDP	6	7	7	13	13	16
PL	M_IN2GDP	5	5	1	9	9	10
PL	GI_IN2GDP	9	8	9	14	16	17
PL	AVG_IN2GDP	7	6	3	12	11	12

Load Forecast Accuracy – Actual to Actual

- Then rankings for each model, in each year, were averaged across zones and per-unitized for an overall measure of accuracy.
- According to this measure, Moody's Index 2 had the lowest score, followed by Moody's Index 2 with GDP. It can also be seen that Moody's Index 2 using GDP performs best in the near term.

Average Ranking by forecast period - per unitized							Average Ranking	Adjusted Ranking
Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year			
M_GMP	17	16	13	15	12	8	14	14
GI_GMP	18	18	16	13	10	11	14	16
AVG_GMP	16	17	13	11	11	9	13	12
M_GDP	13	13	18	18	18	18	16	18
GI_GDP	7	7	15	16	16	16	13	12
AVG_GDP	9	11	17	17	17	17	15	17
M_IN1	5	5	4	5	7	6	5	4
GI_IN1	15	15	8	8	3	2	9	9
AVG_IN1	10	8	7	6	5	5	7	7
M_IN2	3	2	2	2	4	4	3	1
GI_IN2	12	10	6	4	1	1	6	5
AVG_IN2	6	6	3	1	2	3	4	3
M_IN1GDP	2	3	5	7	8	12	6	6
GI_IN1GDP	14	13	12	14	15	15	14	15
AVG_IN1GDP	8	9	10	10	13	13	11	10
M_IN2GDP	1	1	1	3	6	7	3	2
GI_IN2GDP	11	12	11	12	14	14	12	11
AVG_IN2GDP	4	4	9	9	9	10	8	8

Load Forecast Accuracy – Actual to Actual

- The previous slide was showing the rankings for the zones averaged. Below is the ranking for the RTO with ATSI and DUKE. Global Insight GMP was the best model, but all GMP-based models performed well.

ZONE	model_type	current_year	first_year	second_year	third_year	fourth_year	fifth_year		average	overall rank
RTO_ATSI_DUKE	M_GMP	1.78%	2.27%	2.27%	2.80%	3.10%	2.60%		2.47%	3
RTO_ATSI_DUKE	GI_GMP	1.99%	2.20%	1.76%	1.51%	1.64%	0.94%		1.67%	1
RTO_ATSI_DUKE	AVG_GMP	1.84%	2.24%	1.99%	2.12%	2.35%	1.75%		2.05%	2
RTO_ATSI_DUKE	M_GDP	2.48%	3.18%	3.91%	4.46%	5.01%	4.57%		3.94%	18
RTO_ATSI_DUKE	GI_GDP	2.47%	3.17%	3.89%	4.44%	4.98%	4.52%		3.91%	16
RTO_ATSI_DUKE	AVG_GDP	2.47%	3.18%	3.90%	4.45%	4.99%	4.55%		3.92%	17
RTO_ATSI_DUKE	M_IN1	1.92%	2.53%	3.20%	3.79%	3.91%	3.19%		3.09%	9
RTO_ATSI_DUKE	GI_IN1	2.12%	2.46%	2.99%	3.49%	3.45%	2.74%		2.87%	7
RTO_ATSI_DUKE	AVG_IN1	2.00%	2.44%	3.09%	3.63%	3.68%	2.96%		2.97%	8
RTO_ATSI_DUKE	M_IN2	1.72%	2.23%	2.84%	3.38%	3.51%	2.82%		2.75%	6
RTO_ATSI_DUKE	GI_IN2	1.96%	2.24%	2.71%	3.18%	3.22%	2.58%		2.65%	4
RTO_ATSI_DUKE	AVG_IN2	1.84%	2.19%	2.77%	3.28%	3.37%	2.70%		2.69%	5
RTO_ATSI_DUKE	M_IN1GDP	1.98%	2.65%	3.39%	3.97%	4.22%	3.57%		3.30%	11
RTO_ATSI_DUKE	GI_IN1GDP	2.21%	2.85%	3.64%	4.26%	4.40%	3.92%		3.55%	15
RTO_ATSI_DUKE	AVG_IN1GDP	2.08%	2.75%	3.52%	4.12%	4.31%	3.75%		3.42%	13
RTO_ATSI_DUKE	M_IN2GDP	1.86%	2.50%	3.20%	3.75%	4.01%	3.38%		3.12%	10
RTO_ATSI_DUKE	GI_IN2GDP	2.12%	2.79%	3.58%	4.21%	4.44%	4.03%		3.53%	14
RTO_ATSI_DUKE	AVG_IN2GDP	1.99%	2.65%	3.39%	3.98%	4.23%	3.71%		3.33%	12

Incorporating Zonal Weighting

- Results however may have been influenced by smaller zones since all zones were treated equally. To account for this possibility, zonal contributions to the RTO's CP from 2006 to 2011 were summed and then divided by the RTO's sum of CPs over that time frame to develop weights.

AE	1.8%
AEP	15.3%
APS	5.4%
ATSI	8.4%
BGE	4.5%
COMED	13.0%
DAYTON	2.2%
DPL	2.6%
DQE	1.8%
DUKE	3.4%
JCPL	4.0%
METED	1.9%
PECO	5.5%
PENLC	1.9%
PEPCO	4.3%
PL	4.7%
PS	6.6%
RECO	0.3%
UGI	0.1%
VEPCO	12.3%

Incorporating Zonal Weighting: Actual to Actual

- Using this zonal weighting scheme, accuracy results were recalculated.
- Results are fairly similar to previous analysis with the Index 2 variables from both vendors performing similarly.

	Weighted Average Ranking by forecast period - per unitized						Average Ranking	Adjusted Ranking
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year		
M_GMP	15	15	10	11	6	6	10.50	11
GI_GMP	18	18	13	9	8	9	12.50	14
AVG_GMP	16	16	9	7	7	7	10.33	10
M_GDP	12	13	18	18	18	18	16.17	18
GI_GDP	6	7	15	14	16	16	12.33	12
AVG_GDP	10	10	17	17	17	17	14.67	16
M_IN1	7	8	5	8	9	8	7.50	7
GI_IN1	13	11	7	4	3	1	6.50	6
AVG_IN1	9	9	4	5	5	5	6.17	5
M_IN2	2	2	2	3	4	4	2.83	2
GI_IN2	8	6	6	2	2	2	4.33	3
AVG_IN2	5	4	1	1	1	3	2.50	1
M_IN1GDP	4	3	8	10	11	11	7.83	8
GI_IN1GDP	17	17	16	15	15	14	15.67	17
AVG_IN1GDP	11	12	12	13	13	13	12.33	12
M_IN2GDP	1	1	3	6	10	10	5.17	4
GI_IN2GDP	14	14	14	16	14	15	14.50	15
AVG_IN2GDP	3	5	11	12	12	12	9.17	9

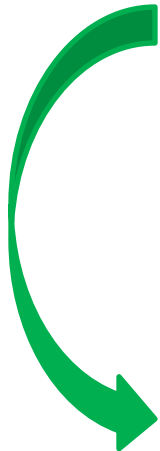
Load Forecast Accuracy – Actual to Actual

- To address the fact that none of the above metrics measure the magnitude of performance improvement, an additional metric was created to measure each model's performance relative to the model that performed the best in that zone and time period.
- This measure is attempting to determine, when a model is the best performer, is it the best by a wide margin or by just a little bit. Likewise, when a model is not the best performer, is it a lot worse, or just a little worse than the best model.

Load Forecast Accuracy – Actual to Actual

- Calculate the percentage by which each model's error exceeds that of the best performing model's error.

zone	NAME	Current year	First year	Second year	Third year	Fourth year	Fifth year
APS	M_GMP	2.65%	2.45%	4.77%	4.29%	4.23%	10.22%
APS	GI_GMP	3.69%	2.11%	4.43%	2.47%	1.72%	4.64%
APS	AVG_GMP	2.78%	2.07%	4.52%	3.16%	2.13%	7.54%
APS	M_GDP	3.88%	2.78%	5.02%	2.80%	1.16%	6.56%
APS	GI_GDP	3.89%	2.79%	5.00%	2.78%	1.11%	6.49%
APS	AVG_GDP	3.89%	2.79%	5.01%	2.79%	1.13%	6.53%
APS	M_IN1	2.82%	2.07%	4.46%	3.63%	4.37%	9.93%
APS	GI_IN1	2.83%	1.60%	4.35%	3.38%	2.66%	8.03%
APS	AVG_IN1	2.83%	1.83%	4.41%	3.51%	3.51%	8.97%
APS	M_IN2	2.83%	1.98%	4.61%	3.64%	3.76%	9.40%
APS	GI_IN2	2.84%	1.65%	4.43%	3.10%	1.99%	7.29%
APS	AVG_IN2	2.83%	1.82%	4.52%	3.37%	2.88%	8.34%
APS	M_IN1GDP	3.25%	2.38%	4.69%	3.19%	3.12%	8.68%
APS	GI_IN1GDP	3.29%	1.97%	4.67%	3.60%	3.04%	8.62%
APS	AVG_IN1GDP	3.27%	2.18%	4.68%	3.40%	3.08%	8.65%
APS	M_IN2GDP	3.35%	2.33%	4.78%	3.05%	2.36%	7.86%
APS	GI_IN2GDP	3.38%	2.12%	4.80%	3.52%	2.78%	8.40%
APS	AVG_IN2GDP	3.37%	2.23%	4.79%	3.29%	2.57%	8.14%
zone	NAME	Current year	First year	Second year	Third year	Fourth year	Fifth year
APS	M_GMP	0.00%	53.56%	9.72%	73.78%	282.16%	120.33%
APS	GI_GMP	39.10%	31.98%	1.88%	0.00%	55.14%	0.00%
APS	AVG_GMP	5.07%	29.41%	3.97%	27.92%	92.23%	62.43%
APS	M_GDP	46.53%	74.08%	15.40%	13.60%	4.69%	41.42%
APS	GI_GDP	46.91%	74.74%	15.01%	12.66%	0.00%	39.95%
APS	AVG_GDP	46.72%	74.41%	15.20%	13.13%	2.35%	40.69%
APS	M_IN1	6.53%	29.24%	2.67%	46.98%	294.58%	114.00%
APS	GI_IN1	6.81%	0.00%	0.00%	37.10%	140.67%	73.11%
APS	AVG_IN1	6.69%	14.57%	1.38%	42.13%	217.12%	93.41%
APS	M_IN2	6.92%	23.76%	6.02%	47.76%	240.08%	102.62%
APS	GI_IN2	7.02%	3.24%	1.77%	25.53%	79.57%	57.04%
APS	AVG_IN2	6.97%	13.62%	3.97%	36.71%	159.90%	79.83%
APS	M_IN1GDP	22.78%	49.06%	7.76%	29.39%	181.98%	87.10%
APS	GI_IN1GDP	24.33%	23.44%	7.32%	46.04%	174.39%	85.71%
APS	AVG_IN1GDP	23.57%	36.16%	7.55%	37.78%	178.23%	86.50%
APS	M_IN2GDP	26.38%	45.95%	9.88%	23.80%	113.24%	69.33%
APS	GI_IN2GDP	27.72%	32.92%	10.34%	42.54%	151.08%	81.11%
APS	AVG_IN2GDP	27.06%	39.42%	10.12%	33.23%	132.40%	75.35%



Load Forecast Accuracy – Actual to Actual

- The percentages by which each model's error exceeded the best performer were averaged across zones and then averaged across the time periods to come to a final ranking.
- Moody's Index 1 was the best performer overall, according to this measure, but any of the Index 1 models are strong performers.

Percent by which error is greater than that of the most accurate forecast							Average	Ranking
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year		
M_GMP	37%	40%	36%	65%	90%	4423%	782%	16
GI_GMP	59%	62%	59%	104%	194%	6034%	1085%	18
AVG_GMP	44%	49%	42%	68%	120%	5204%	921%	17
M_GDP	17%	28%	55%	72%	147%	820%	190%	12
GI_GDP	17%	28%	55%	71%	145%	881%	199%	15
AVG_GDP	17%	28%	55%	72%	146%	850%	195%	13
M_IN1	14%	18%	29%	43%	101%	321%	88%	1
GI_IN1	19%	20%	28%	35%	63%	532%	116%	4
AVG_IN1	16%	19%	28%	39%	81%	428%	102%	2
M_IN2	14%	17%	25%	39%	84%	853%	172%	10
GI_IN2	19%	20%	26%	30%	53%	578%	121%	5
AVG_IN2	16%	18%	25%	34%	68%	712%	146%	8
M_IN1GDP	13%	21%	38%	51%	119%	837%	180%	11
GI_IN1GDP	19%	25%	44%	61%	133%	688%	162%	9
AVG_IN1GDP	16%	23%	41%	56%	126%	437%	116%	3
M_IN2GDP	11%	18%	35%	45%	104%	634%	141%	7
GI_IN2GDP	17%	23%	43%	59%	129%	909%	197%	14
AVG_IN2GDP	14%	20%	39%	52%	117%	524%	128%	6

Load Forecast Accuracy – Actual to Actual

- The previous slide was showing the rankings for the zones averaged. Below is the ranking for the RTO with ATSI and DUKE.

ZONE	model_type	current_year	first_year	second_year	third_year	fourth_year	fifth_year	average	overall rank
RTO_ATSI_DUKE	M_GMP	3%	4%	29%	86%	89%	176%	65%	3
RTO_ATSI_DUKE	GI_GMP	16%	1%	0%	0%	0%	0%	3%	1
RTO_ATSI_DUKE	AVG_GMP	7%	2%	13%	41%	43%	85%	32%	2
RTO_ATSI_DUKE	M_GDP	44%	45%	123%	196%	206%	386%	167%	18
RTO_ATSI_DUKE	GI_GDP	43%	45%	122%	195%	203%	380%	165%	16
RTO_ATSI_DUKE	AVG_GDP	44%	45%	122%	196%	204%	383%	166%	17
RTO_ATSI_DUKE	M_IN1	11%	16%	82%	152%	139%	239%	106%	9
RTO_ATSI_DUKE	GI_IN1	23%	12%	70%	132%	110%	191%	90%	7
RTO_ATSI_DUKE	AVG_IN1	16%	12%	76%	141%	124%	214%	97%	8
RTO_ATSI_DUKE	M_IN2	0%	2%	62%	124%	114%	200%	84%	6
RTO_ATSI_DUKE	GI_IN2	14%	2%	54%	111%	97%	174%	75%	4
RTO_ATSI_DUKE	AVG_IN2	7%	0%	58%	118%	105%	186%	79%	5
RTO_ATSI_DUKE	M_IN1GDP	15%	21%	93%	164%	157%	280%	122%	11
RTO_ATSI_DUKE	GI_IN1GDP	28%	30%	107%	183%	168%	316%	139%	15
RTO_ATSI_DUKE	AVG_IN1GDP	21%	26%	100%	174%	163%	298%	130%	13
RTO_ATSI_DUKE	M_IN2GDP	8%	14%	82%	149%	144%	259%	110%	10
RTO_ATSI_DUKE	GI_IN2GDP	23%	28%	104%	180%	171%	328%	139%	14
RTO_ATSI_DUKE	AVG_IN2GDP	16%	21%	93%	164%	158%	294%	124%	12

Incorporating Zonal Weighting: Actual to Actual

- Using this zonal weighting scheme, accuracy results were recalculated.
- Results are somewhat similar to previous analysis, however, once results are zone weighted, any of the Index models without GDP seem to be good

Percent by which error is greater than that of the most accurate forecast, weighted									
	Current_year	First_year	Second_year	Third_year	Fourth_year	Fifth_year		Average	Ranking
M_GMP	30%	30%	26%	62%	87%	453%		115%	7
GI_GMP	48%	50%	49%	120%	293%	1128%		281%	18
AVG_GMP	33%	37%	28%	57%	143%	742%		173%	14
M_GDP	20%	31%	78%	90%	231%	645%		182%	17
GI_GDP	20%	31%	77%	88%	227%	636%		180%	15
AVG_GDP	20%	31%	78%	89%	229%	640%		181%	16
M_IN1	17%	23%	42%	61%	153%	389%		114%	6
GI_IN1	20%	22%	38%	39%	80%	268%		78%	3
AVG_IN1	18%	22%	40%	49%	115%	328%		95%	5
M_IN2	15%	17%	32%	46%	111%	345%		94%	4
GI_IN2	17%	17%	30%	27%	48%	226%		61%	1
AVG_IN2	16%	17%	31%	35%	78%	284%		77%	2
M_IN1GDP	16%	25%	56%	67%	181%	509%		142%	10
GI_IN1GDP	25%	34%	70%	85%	209%	563%		164%	13
AVG_IN1GDP	20%	29%	63%	76%	195%	529%		152%	11
M_IN2GDP	12%	19%	49%	56%	150%	443%		121%	8
GI_IN2GDP	21%	29%	66%	80%	198%	546%		157%	12
AVG_IN2GDP	16%	24%	58%	68%	174%	489%		138%	9

- For each forecasting method, a set of forecasts was generated and post-processed to construct peak load forecast distributions. The forecast distributions were then analyzed to measure the relative stability between methods, using the forecast coefficient of variation (COV) (the ratio of the standard deviation to its mean) as a measure of forecast stability. In principle, the lower the COV, the more stable the forecast.
- Forecasts were only generated for 2009 through 2015 due to restrictions with the data in some of the historical forecast vintages. COV is then calculated for each year and for each zone.

- After calculating the COVs, the most stable forecast type is identified for each year by zone. These results are then summed to find the frequency that each forecast type is the most stable. Moody's Index 2 is the most stable the most frequently, followed by Moody's Index 1.

Frequency of being the most stable by zone																					
	AE	AEP	APS	ATSI	BGE	COMED	DAYTON	DPL	DQE	DUKE	JCPL	METED	PECO	PENLC	PEPCO	PL	PS	RECO	UGI	VEPCO	Total
Sum of cov_M_GMP	0	5	3	2	6	0	0	0	0	3	1	2	0	1	3	0	1	0	0	2	29
Sum of cov_GI_GMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum of cov_AVG_GMP	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4
Sum of cov_M_GDP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum of cov_GI_GDP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6
Sum of cov_AVG_GDP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum of cov_M_IN1	0	2	0	2	2	0	0	2	6	3	0	5	3	0	0	7	1	0	3	7	43
Sum of cov_GI_IN1	0	0	0	0	0	0	0	0	3	0	0	1	3	0	0	0	3	0	0	0	10
Sum of cov_AVG_IN1	0	0	2	0	0	0	0	2	3	0	0	1	2	1	0	1	2	0	0	0	14
Sum of cov_M_IN2	0	0	0	0	2	0	3	0	5	0	7	2	0	3	7	0	4	0	7	7	47
Sum of cov_GI_IN2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	4
Sum of cov_AVG_IN2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0	6
Sum of cov_M_IN1GDP	3	0	0	1	0	5	2	6	0	4	0	0	0	0	0	0	1	0	0	0	22
Sum of cov_GI_IN1GDP	3	2	0	3	0	2	3	0	2	0	0	1	0	3	0	1	1	1	0	0	22
Sum of cov_AVG_IN1GDP	1	2	0	2	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	10
Sum of cov_M_IN2GDP	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	6
Sum of cov_GI_IN2GDP	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Sum of cov_AVG_IN2GDP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

- A similar analysis can be performed by looking at which forecast type is the most stable by year. The results here are similar with Moody's Index 1 is the most stable with the highest frequency, followed by Moody's Index 2.

Frequency of being the most stable by year										
	2009	2010	2011	2012	2013	2014	2015		Total	
Sum of cov_M_GMP	1	3	5	12	7	3	2		33	
Sum of cov_GI_GMP	0	0	0	0	0	0	0		0	
Sum of cov_AVG_GMP	0	0	1	2	1	0	0		4	
Sum of cov_M_GDP	0	0	0	0	0	0	0		0	
Sum of cov_GI_GDP	1	0	1	1	1	1	1		6	
Sum of cov_AVG_GDP	0	0	0	0	0	0	0		0	
Sum of cov_M_IN1	11	11	9	6	6	9	9		61	
Sum of cov_GI_IN1	4	3	3	0	0	0	0		10	
Sum of cov_AVG_IN1	5	4	3	2	0	1	2		17	
Sum of cov_M_IN2	5	4	7	6	9	11	11		53	
Sum of cov_GI_IN2	2	0	1	1	0	0	0		4	
Sum of cov_AVG_IN2	2	1	2	1	0	0	0		6	
Sum of cov_M_IN1GDP	1	3	5	4	4	3	4		24	
Sum of cov_GI_IN1GDP	10	9	5	0	0	0	0		24	
Sum of cov_AVG_IN1GDP	3	5	1	3	0	0	0		12	
Sum of cov_M_IN2GDP	0	0	0	1	2	2	1		6	
Sum of cov_GI_IN2GDP	1	1	0	0	0	0	0		2	
Sum of cov_AVG_IN2GDP	0	0	0	1	0	0	0		1	

- As with the accuracy analysis, neither of the two prior metrics addresses the magnitude of improvement. An additional metric was created to measure each model's performance relative to the model that was most stable in that zone and year.
- This measure is attempting to determine, when a model is the most stable, is it by a wide margin or by just a little bit. Likewise, when a model is not the most stable, is it a lot less stable, or just a little less stable than the best model.

- The percentages by which each model's COV exceeded the most stable performer were averaged across zones by year. Results were then averaged across years by each forecast type.
- Moody's Index 1 was again shown to be the most stable, followed closely by Moody's Index 2.

Percent by which forecast is less stable than most stable forecast								
	2009	2010	2011	2012	2013	2014	2015	Average
Sum of cov_M_GMP	48%	32%	25%	22%	32%	54%	63%	39%
Sum of cov_GL_GMP	66%	50%	53%	68%	95%	112%	117%	80%
Sum of cov_AVG_GMP	56%	39%	35%	37%	53%	68%	74%	52%
Sum of cov_M_GDP	56%	51%	49%	51%	68%	83%	91%	64%
Sum of cov_GL_GDP	54%	48%	57%	78%	120%	148%	157%	94%
Sum of cov_AVG_GDP	55%	49%	53%	64%	92%	114%	122%	79%
Sum of cov_M_IN1	16%	15%	16%	15%	15%	13%	14%	15%
Sum of cov_GL_IN1	20%	20%	24%	37%	56%	62%	58%	40%
Sum of cov_AVG_IN1	18%	17%	19%	24%	34%	33%	29%	25%
Sum of cov_M_IN2	20%	18%	16%	14%	16%	16%	18%	17%
Sum of cov_GL_IN2	26%	23%	28%	41%	64%	74%	74%	47%
Sum of cov_AVG_IN2	22%	20%	21%	26%	37%	42%	41%	30%
Sum of cov_M_IN1GDP	19%	19%	18%	21%	29%	33%	35%	25%
Sum of cov_GL_IN1GDP	14%	13%	17%	28%	50%	59%	57%	34%
Sum of cov_AVG_IN1GDP	16%	15%	18%	23%	38%	44%	45%	28%
Sum of cov_M_IN2GDP	24%	24%	23%	25%	33%	39%	43%	30%
Sum of cov_GL_IN2GDP	21%	20%	26%	38%	65%	80%	82%	47%
Sum of cov_AVG_IN2GDP	23%	22%	24%	31%	48%	59%	61%	38%

Incorporating Zonal Weighting: Stability

- Overall stability results were recalculated using a zonal weighted average instead of a straight average.
- Results are fairly similar to previous analysis with Moody's Index 1 still on top. Moody's Index 2 remains the second most stable.

	Percent by which forecast is less stable than most stable forecast							Average	Ranking
	_2009	_2010	_2011	_2012	_2013	_2014	_2015		
M_GMP	47%	31%	25%	21%	32%	55%	66%	40%	10
GI_GMP	63%	47%	52%	68%	96%	112%	117%	79%	17
AVG_GMP	54%	37%	35%	37%	54%	69%	75%	52%	14
M_GDP	56%	49%	48%	50%	66%	80%	86%	62%	15
GI_GDP	55%	46%	56%	77%	118%	144%	154%	93%	18
AVG_GDP	55%	47%	52%	62%	91%	111%	119%	77%	16
M_IN1	13%	12%	14%	14%	16%	14%	13%	14%	1
GI_IN1	17%	19%	24%	38%	59%	64%	60%	40%	11
AVG_IN1	15%	14%	18%	24%	36%	36%	32%	25%	4
M_IN2	18%	16%	15%	14%	17%	18%	20%	17%	2
GI_IN2	23%	22%	28%	42%	66%	76%	75%	47%	12
AVG_IN2	19%	18%	20%	26%	39%	44%	44%	30%	7
M_IN1GDP	18%	17%	16%	19%	27%	31%	33%	23%	3
GI_IN1GDP	15%	14%	19%	30%	54%	62%	60%	36%	8
AVG_IN1GDP	16%	14%	18%	24%	39%	45%	46%	29%	5
M_IN2GDP	24%	22%	22%	23%	32%	38%	41%	29%	6
GI_IN2GDP	22%	21%	27%	40%	68%	83%	84%	49%	13
AVG_IN2GDP	23%	21%	24%	31%	50%	60%	62%	39%	9

- Achieving accurate and stable forecast results is desired and so results from each analysis are combined. We first per-unitize the accuracy analysis where we calculated the percentages by which each model's error exceeded the best performer and the stability analysis in which the percentages by which each model's COV exceeded the most stable performer.

Accuracy analysis			Stability analysis		
	Average			Average	
M_GMP	64%	3.20	M_GMP	39%	2.64
GI_GMP	85%	4.26	GI_GMP	80%	5.35
AVG_GMP	69%	3.43	AVG_GMP	52%	3.45
M_GDP	112%	5.58	M_GDP	64%	4.28
GI_GDP	98%	4.89	GI_GDP	94%	6.31
AVG_GDP	104%	5.22	AVG_GDP	79%	5.24
M_IN1	20%	1.00	M_IN1	15%	1.00
GI_IN1	30%	1.48	GI_IN1	40%	2.65
AVG_IN1	23%	1.14	AVG_IN1	25%	1.66
M_IN2	23%	1.17	M_IN2	17%	1.13
GI_IN2	46%	2.29	GI_IN2	47%	3.15
AVG_IN2	34%	1.72	AVG_IN2	30%	1.99
M_IN1GDP	38%	1.89	M_IN1GDP	25%	1.64
GI_IN1GDP	29%	1.45	GI_IN1GDP	34%	2.28
AVG_IN1GDP	33%	1.63	AVG_IN1GDP	28%	1.90
M_IN2GDP	31%	1.54	M_IN2GDP	30%	2.00
GI_IN2GDP	24%	1.22	GI_IN2GDP	47%	3.17
AVG_IN2GDP	27%	1.36	AVG_IN2GDP	38%	2.54

Combining Accuracy and Stability: WN to Forecast , no zonal weights

- With comparable results in hand, the two are combined using a 50/50 weighting. This assumes an equal interest in both stability and accuracy.
- Recall that Moody's Index 1 was found to be the most accurate and most stable, and thus it remains first in this weighted scheme. Moody's Index 2 comes in second and it would take a 95% weighting on accuracy in order to change this ranking (Average Index 1 would become second in this scenario).

				Accuracy and Stability	
	Accuracy	Stability		Weighted Average	Ranking
M_GMP	3.20	2.64	M_GMP	2.92	13
GI_GMP	4.26	5.35	GI_GMP	4.81	15
AVG_GMP	3.43	3.45	AVG_GMP	3.44	14
M_GDP	5.58	4.28	M_GDP	4.93	16
GI_GDP	4.89	6.31	GI_GDP	5.60	18
AVG_GDP	5.22	5.24	AVG_GDP	5.23	17
M_IN1	1.00	1.00	M_IN1	1.00	1
GI_IN1	1.48	2.65	GI_IN1	2.07	10
AVG_IN1	1.14	1.66	AVG_IN1	1.40	3
M_IN2	1.17	1.13	M_IN2	1.15	2
GI_IN2	2.29	3.15	GI_IN2	2.72	12
AVG_IN2	1.72	1.99	AVG_IN2	1.86	7
M_IN1GDP	1.89	1.64	M_IN1GDP	1.77	5
GI_IN1GDP	1.45	2.28	GI_IN1GDP	1.86	8
AVG_IN1GDP	1.63	1.90	AVG_IN1GDP	1.76	4
M_IN2GDP	1.54	2.00	M_IN2GDP	1.77	6
GI_IN2GDP	1.22	3.17	GI_IN2GDP	2.19	11
AVG_IN2GDP	1.36	2.54	AVG_IN2GDP	1.95	9



- Similarly, the accuracy results from our actual to actual approach are per-unitized and combined with stability. The two are combined using a 50/50 weighting. This assumes an equal interest in both stability and accuracy.
- Under this approach, Moody's Index 1 and Average Index 1 are the first and second ranked measures.

			Accuracy and Stability		
	Accuracy	Stability		Weighted Average	Ranking
M_GMP	8.92	2.64	M_GMP	5.78	16
GI_GMP	12.38	5.35	GI_GMP	8.87	18
AVG_GMP	10.51	3.45	AVG_GMP	6.98	17
M_GDP	2.17	4.28	M_GDP	3.22	13
GI_GDP	2.27	6.31	GI_GDP	4.29	15
AVG_GDP	2.22	5.24	AVG_GDP	3.73	14
M_IN1	1.00	1.00	M_IN1	1.00	1
GI_IN1	1.33	2.65	GI_IN1	1.99	8
AVG_IN1	1.16	1.66	AVG_IN1	1.41	2
M_IN2	1.96	1.13	M_IN2	1.55	3
GI_IN2	1.38	3.15	GI_IN2	2.26	11
AVG_IN2	1.66	1.99	AVG_IN2	1.83	6
M_IN1GDP	2.05	1.64	M_IN1GDP	1.85	7
GI_IN1GDP	1.84	2.28	GI_IN1GDP	2.06	10
AVG_IN1GDP	1.33	1.90	AVG_IN1GDP	1.61	4
M_IN2GDP	1.61	2.00	M_IN2GDP	1.81	5
GI_IN2GDP	2.24	3.17	GI_IN2GDP	2.70	12
AVG_IN2GDP	1.45	2.54	AVG_IN2GDP	2.00	9



- The accuracy results from this approach are per-unitized and combined with stability. The two are combined using a 50/50 weighting. This assumes an equal interest in both stability and accuracy.
- Recall that Moody's Index 1 was found to be the most accurate and most stable, and thus it remains first in this weighted scheme. Likewise, Moody's Index 2 was second in both accuracy and stability results and thus remains in second here.

	Accuracy	Stability		Accuracy and Stability	
				Weighted Average	Ranking
M_GMP	3.00	2.87	M_GMP	2.93	12
GI_GMP	5.29	5.72	GI_GMP	5.50	18
AVG_GMP	3.87	3.72	AVG_GMP	3.79	14
M_GDP	4.87	4.48	M_GDP	4.68	15
GI_GDP	3.92	6.70	GI_GDP	5.31	17
AVG_GDP	4.39	5.54	AVG_GDP	4.96	16
M_IN1	1.00	1.00	M_IN1	1.00	1
GI_IN1	2.14	2.90	GI_IN1	2.52	10
AVG_IN1	1.50	1.79	AVG_IN1	1.65	3
M_IN2	1.37	1.20	M_IN2	1.29	2
GI_IN2	2.52	3.41	GI_IN2	2.97	13
AVG_IN2	1.90	2.17	AVG_IN2	2.04	7
M_IN1GDP	1.88	1.66	M_IN1GDP	1.77	4
GI_IN1GDP	1.41	2.62	GI_IN1GDP	2.02	6
AVG_IN1GDP	1.61	2.07	AVG_IN1GDP	1.84	5
M_IN2GDP	2.32	2.08	M_IN2GDP	2.20	8
GI_IN2GDP	1.88	3.56	GI_IN2GDP	2.72	11
AVG_IN2GDP	2.08	2.79	AVG_IN2GDP	2.44	9



Combining Accuracy and Stability: Actual to Actual, zonal weights

- The accuracy results from this approach are per-unitized and combined with stability. The two are combined using a 50/50 weighting. This assumes an equal interest in both stability and accuracy.
- Under this approach, Moody's Index 1 and Moody's Index 2 are the first and second ranked measures. Global Insight Index 2, despite coming out ahead in the accuracy results, is ranked 8th as it is among the least stable measures.

				Accuracy and Stability	
	Accuracy	Stability		Weighted Average	Ranking
M_GMP	1.89	2.87	M_GMP	2.38	10
GI_GMP	4.63	5.72	GI_GMP	5.17	18
AVG_GMP	2.85	3.72	AVG_GMP	3.29	14
M_GDP	3.00	4.48	M_GDP	3.74	15
GI_GDP	2.96	6.70	GI_GDP	4.83	17
AVG_GDP	2.98	5.54	AVG_GDP	4.26	16
M_IN1	1.88	1.00	M_IN1	1.44	2
GI_IN1	1.28	2.90	GI_IN1	2.09	7
AVG_IN1	1.57	1.79	AVG_IN1	1.68	3
M_IN2	1.55	1.20	M_IN2	1.38	1
GI_IN2	1.00	3.41	GI_IN2	2.21	8
AVG_IN2	1.26	2.17	AVG_IN2	1.72	4
M_IN1GDP	2.34	1.66	M_IN1GDP	2.00	5
GI_IN1GDP	2.70	2.62	GI_IN1GDP	2.66	12
AVG_IN1GDP	2.50	2.07	AVG_IN1GDP	2.29	9
M_IN2GDP	2.00	2.08	M_IN2GDP	2.04	6
GI_IN2GDP	2.58	3.56	GI_IN2GDP	3.07	13
AVG_IN2GDP	2.27	2.79	AVG_IN2GDP	2.53	11

