NYISO SCR Baseline Study Analysis

CBL Results

Roger Kirkpatrick
Market Product Specialist
Demand Response Products
New York Independent System Operator

Timothy Hennessy
Senior Principal, Sustainable Use Consulting
DNV KEMA Energy & Sustainability

ICAP/PRL/MIWG
November 14, 2013

DRAFT – FOR DISCUSSION PURPOSES ONLY

Action item from 2011

- **At the January 26, 2011 BIC meeting, the motion to approve the change from APMD to ACL included a commitment by NYISO to conduct an evaluation of the revised baseline methodology in 2013:**

  - *"… and will include in the meeting minutes that the NYISO staff has indicated that in Calendar Year 2013, the NYISO will report to the ICAP Working Group on its evaluation of the revised SCR baseline performance methodology that is part of this motion."*

The Path of the Study

- **October 23, 2012 – NYISO presented the request for data to be sent to the RIPs**

- **November 1, 2012 – NYISO requested data from RIPs for the period of November 1, 2010 through October 31, 2012**

- **February 2013 – NYISO presented the results of the data request, identifying adequate resources in all areas**

  - *Categories of size were combined into three size categories*

- **May 22, 2013 – NYISO presented the Analysis Design for the SCR Baseline Study**

Objectives of the Study

- **Task 1: To evaluate multiple energy CBLs and adjustment options**
    - *To find the combined energy CBL and adjustment mechanism with the best overall accuracy for all days and/or peak days*

- **Task 2: To validate the NYISO's current ACL and ACL alternatives**

- **Task 3: To identify the combination of capacity baseline and energy baseline to use for market participation and performance evaluation**

Analysis Design Approach - CBL

- **Start with the 2011 PJM Baseline Study approach**

  - *Retain metrics: Accuracy, Bias, and Variability*

  - *Expand and adjust segmentations: Size, Facility Type, Weather Sensitivity, and Load Variability*

  - *Add variations of existing NYISO CBL, including accurate modeling of exclusion rules*

  - *Explore multiple in-day adjustment options*

    - **In part to consider the question of uncapped multiplicative adjustment raised in May 2013 decision on Order 745**

  - *Compare Accuracy results to 2011 PJM Study to benchmark current study results*

Baseline Analysis

Baselines by the Numbers

CBL Analysis

Baselines

Individual Baselines Tested...11

Adjustment Pairs Tested...4

Total Baseline/Adjustment Pairs Tested...44

Resources

Summer Resources 2283

Winter Resources 1806

Capability Periods

Summer Capability Periods 2

Winter Capability Periods 2

Total Capability Periods 4

Segmentation of Results

All Days 730

Event-Like Days 15

Weather Sensitivity 2

Facility Size 3

Load Variability 3

Total Segmentations Analyzed...10

Study Criteria

Accuracy - how closely a baseline method predicts resource actual loads in the sample.

Bias - the systematic tendency of a baseline method to over- or under-predict actual loads

Variability - how well baseline predicts hourly load under different conditions and customers

Total Study Criteria Analyzed...3

Individual Observations

	Hours
Total All-Day Hourly Summer Baselines Calculated..........................	925,765,632
Total All-Day Hourly Winter Baselines Calculated.............................	760,947,264
Total Event-Like Day Summer Baselines Calculated...........................	45,806,112
Total Event-Like Day Winter Baselines Calculated.............................	64,842,624

SCR Baseline Study 2012-2013

Supporting Facts

Segment Definitions

- ## Resource Size

  - Small: Up to 100 kW
  - Medium: Between 100 kW and 1,000 kW
  - Large: Greater than 1,000 kW

- ## Weather sensitivity

  - *Sort the peak load for each of the 6 months by capability period in descending order*

  - *Check top 4 of 6 months*

    - For Summer Capability period, if. June, July, and August are in top four months, then designated weather sensitive
    - For Winter Capability period:, if December, January, and February are in top 4 months, then designated weather sensitive

Segment Definitions - continued

- ## Load Variability
  - *Three variability categories (low, medium and high) based on the Coefficient of Variation of the event period loads*
    - Low: 14% of the resources are classified as low variability
    - Medium: 64% were classified as medium variability
    - High: 22% were classified as high variability
  - *Similar approach as PJM's study*

- ## Facility Type
  - *Considered subjective by project team, therefore not used*

Segment Distributions

Category	Capability Period							
	Summer				Winter			
	N	PCT	ICAP (MW)	PCT	N	PCT	ICAP (MW)	PCT
Customer Size								
Up to 100 kW	442	19%	15.6	2%	437	24%	17.6	3%
Between 100 kW and 1,000 kW	1,568	69%	218.7	22%	1,190	66%	205.6	30%
Greater than 1,000 kW	273	12%	741.0	76%	179	10%	457.1	67%
Weather Sensitivity								
Non-Weather Sensitive	732	32%	124.3	13%	988	55%	280.7	41%
Weather Sensitive	1,551	68%	851.0	87%	818	45%	399.5	59%
Load Varibility								
Low	221	10%	544.5	56%	169	9%	268.9	40%
Medium	1,416	62%	344.1	35%	1,137	63%	316.7	47%
High	646	28%	86.6	9%	500	28%	94.7	14%
Total	2,283		975.3		1,806		680.3	

Baselines Tested

#	NYISO Study Name	Short Name	Description	Estimation Method	PJM Study Name
1	NYISO High 5 of 10 (Current NYISO CBL)	NYISO 5 of 10	Average of high 5 of 10 most recent qualifying days.	Average	NYISO Standard CBL
2	NYISO ECBL Middle 2 of 10 (ECBL)	NYISO M2 of 10	Average of middle 2 of 10 most recent qualifying days.	Average	Not Used in PJM Study
3	NYISO High 4 of 5	NYISO 4 of 5	Average of high 4 of 5 most recent qualifying days.	Average	Not Used in PJM Study
4	NYISO High 5 of 8	NYISO 5 of 8	Average of high 5 of 8 most recent qualifying days.	Average	Not Used in PJM Study
5	NYISO 10 of 10	NYISO 10 of 10	Average of 10 most recent qualifying days.	Average	Not Used in PJM Study
6	PJM Economic High 4 of 5	PJM 4 of 5	Average of high 4 of 5 most recent qualifying days.	Average	PJM Economic CBL
7	PJM Middle 4 of 6	PJM Comparable	Average of middle 4 of 6 most recent qualifying days.	Average	(MMU) Middle 4 of 6
8	PJM Emergency Comparable Day, Non-Weather Sensitive	PJM Same Day	Most similar day, excluding weekend/holidays	Matching	PJM Emergency GLD Comparable Day (Non-Weather Sensitive)
9	PJM Emergency Same Day	PJM Settlement	Average of hours pre- and post-event	Average	PJM emergency GLD same day
10	ISONE Standard	ISONE	Average of 90% baseline + 10% meter	Average	ISONE Standard CBL
11	CAISO Standard	CAISO 10 of 10	Average of 10 most recent qualifying days.	Average	CAISO Standard CBL

In-Day Adjustments Tested

- **Unadjusted**
  - *The baseline with no adjustments*

- **Additive**
  - *The additive approach measures the magnitude of the pre-event period load difference (positive or negative), and adds that to the baseline throughout the event period*

- **Multiplicative Adjustment**
  - *The multiplicative approach applies the ratio pre-event period baseline load to the pre-event period observed load to the baseline throughout the event period*
    - **Permitted testing of the current adjustment cap for possible revision**

- **Multiplicative Adjustment (Cap)**
  - *This limits the ratios of the Multiplicative Adjustment to between 0.8 and 1.2*

Analysis Design Approach

- **Define the analysis for the capacity baseline (ACL)**
  - *Compare existing capacity baseline with variations*
    - Assess how load variations across the season impact amount of capacity available
- *Identify a measure of available capacity in advance that closely reflects the estimated load (CBL) during an event*
- *Evaluate the combination of:*
  - *Capacity baseline to use for enrollment and market participation*
  - *Energy baseline to use for performance evaluation*

DRAFT – FOR DISCUSSION PURPOSES ONLY

Analysis Approach

- **Selected baselines were calculated and compared for each of the resources for all days, by capability period**
  - *Summer: 2,283 resources with 975.3 MW of ICAP*
  - *Winter: 1806 resources with 680.3 MW of ICAP*
- **Candidate event days were identified based on system load conditions, and weather conditions**

Candidate Event Day Selection

- **Summer:**

  - *Weekdays with a Cumulative Temperature-Humidity Index at or above 79.20 degrees and peak NYCA load hour >30,500 MW*

  - *5 days in Summer 2011, 4 days in Summer 2012*

- **Winter:**

  - *Weekdays with a peak NYCA load hour >23,700 MW*

  - *4 days in Winter 2010-2011, 2 days in Winter 2011-2012*

Analysis Criteria

- **Summary statistics for the candidate baselines were developed and ranked for each of the candidate baseline based on three criterion:**

  - *Accuracy – How closely a baseline method predicts resource actual loads in the sample*

  - *Bias – The systematic tendency of a baseline method to over- or under-predict actual loads*

  - *Variability – The measure of how well the baseline is at predicting hourly load under many different conditions and across many different customers*

All Resources
All Days

Accuracy Statistic Results - All Days

Summer

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Summer Period / All Days / Summer / All Resources											
Unadjusted Baseline	0.224	0.205	0.195	0.210	0.199	0.192	0.173	0.226	0.226	0.199	0.195
Additive Adjustment	0.155	0.165	0.149	0.152	0.146	0.148	0.168	0.247	0.247	0.145	0.146
Multiplicative Adjustment	0.138	0.151	0.135	0.135	0.130	0.135	0.170	0.247	0.247	0.129	0.131
Multiplicative Adjustment(Cap)	0.159	0.159	0.148	0.154	0.147	0.145	0.159	0.221	0.235	0.144	0.143

Summer Capability Period / All Days / Accuracy Statistic / All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	0.129	0.207	7.350	0.304
NYISO	10 of 10	Multiplicative	0.130	0.219	9.320	0.401
CAISO	10 of 10	Multiplicative	0.131	0.219	14.880	0.457
NYISO	4 of 5	Multiplicative	0.135	0.305	122.840	2.689
NYISO	5 of 8	Multiplicative	0.135	0.263	39.460	1.151
PJM	4 of 5	Multiplicative	0.135	0.271	20.360	0.828
NYISO	5 of 10	Multiplicative	0.138	0.266	39.460	1.142
NYISO	Mid 2 of 10	Multiplicative	0.151	0.362	61.520	1.680
PJM	Comparable	Multiplicative	0.170	1.529	1,188.490	26.300

Winter

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Winter Capability Period / All Days / Accuracy / All Resources											
Unadjusted Baseline	0.211	0.197	0.185	0.200	0.188	0.184	0.175	0.179	0.189	0.182	0.187
Additive Adjustment	0.144	0.149	0.140	0.141	0.135	0.139	0.159	0.211	0.211	0.132	0.134
Multiplicative Adjustment	0.124	0.138	0.123	0.123	0.118	0.123	0.153	0.211	0.211	0.115	0.118
Multiplicative Adjustment(Cap)	0.152	0.154	0.143	0.146	0.138	0.140	0.156	0.194	0.200	0.133	0.136

Winter Capability Period / All Days / Accuracy Statistic / All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	0.115	0.181	6.280	0.273
CAISO	10 of 10	Multiplicative	0.118	0.188	8.380	0.333
NYISO	10 of 10	Multiplicative	0.118	0.193	10.860	0.376
NYISO	5 of 8	Multiplicative	0.123	0.227	33.170	0.885
PJM	4 of 5	Multiplicative	0.123	0.217	10.400	0.472
NYISO	4 of 5	Multiplicative	0.123	0.311	155.460	3.736
NYISO	5 of 10	Multiplicative	0.124	0.231	33.060	0.898
NYISO	Mid 2 of 10	Multiplicative	0.138	0.299	75.230	1.926
PJM	Comparable	Multiplicative	0.153	1.216	1,377.980	32.482

Accuracy Statistic Results - All Days

Summer

Winter

DRAFT – FOR DISCUSSION PURPOSES ONLY   18

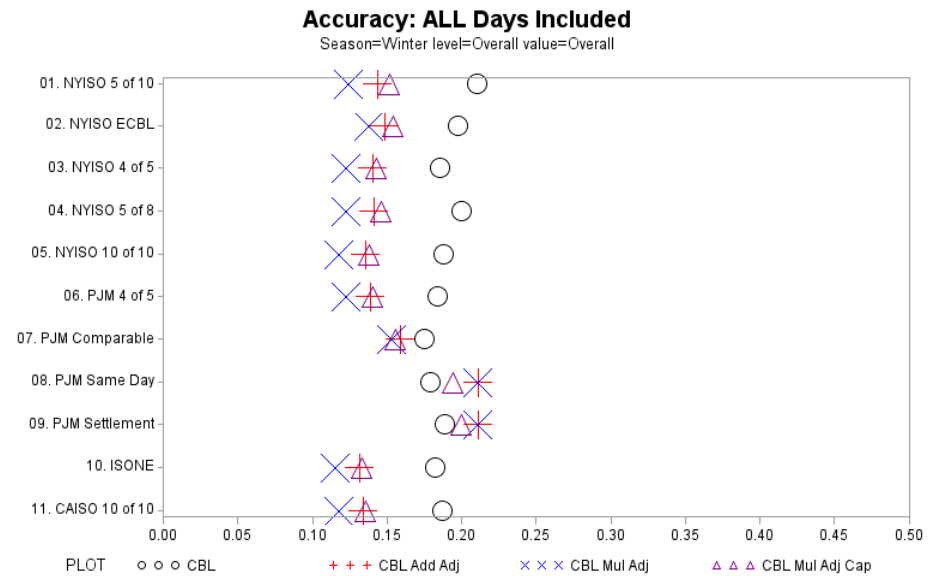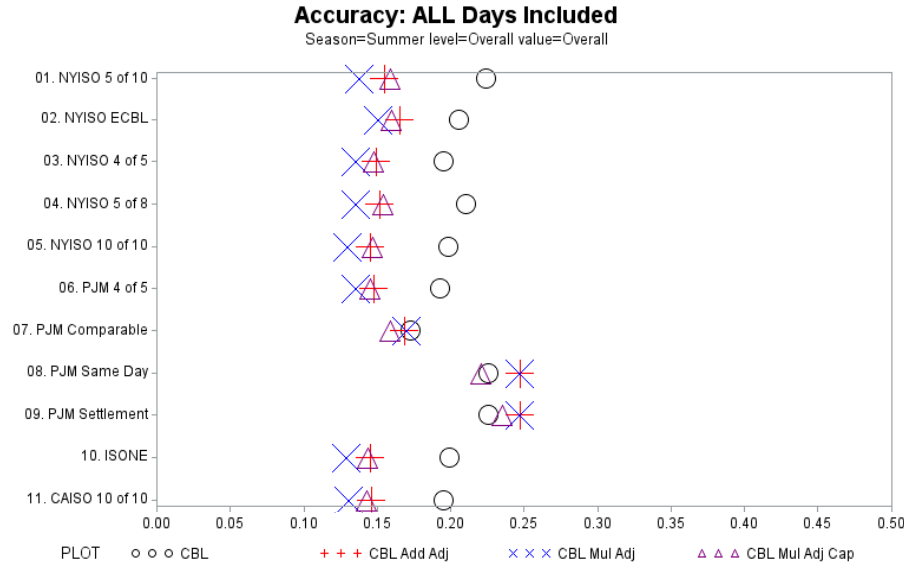# Bias Statistic Results - All Days

Summer

Summer Capability Period — All Days — Summer — All Resources

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.089	0.002	0.033	0.064	0.003	0.035	0.003	0.035	0.066	0.000	0.002
Additive Adjustment	0.016	0.000	0.006	0.012	0.000	0.009	0.002	0.056	0.056	0.001	0.001
Multiplicative Adjustment	0.020	0.004	0.010	0.016	0.001	0.012	0.010	0.056	0.056	0.001	0.002
Multiplicative Adjustment(Cap)	0.042	0.000	0.018	0.032	0.004	0.018	0.002	0.009	0.049	0.000	0.001

Summer Capability Period — All Days — Bias Statistic — All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multi w/Cap	-	-	0.330	0.020
ISONE		Unadjusted	-	0.001	0.410	0.016
NYISO	Mid 2 of 10	Multi w/Cap	-	(0.003)	0.770	0.045
NYISO	Mid 2 of 10	Additive	-	0.008	2.160	0.074
NYISO	10 of 10	Additive	-	0.015	3.010	0.097
CAISO	10 of 10	Multi w/Cap	0.001	0.001	0.240	0.015
ISONE		Multiplicative	0.001	0.003	0.700	0.021
ISONE		Additive	0.001	0.010	1.750	0.064
CAISO	10 of 10	Additive	0.001	0.011	1.660	0.064
NYISO	10 of 10	Multiplicative	0.001	0.019	2.880	0.108
PJM	Comparable	Additive	0.002	0.017	1.520	0.074
NYISO	10 of 10	Unadjusted	0.003	0.043	3.800	0.157
NYISO	Mid 2 of 10	Multiplicative	0.004	0.025	5.510	0.173
NYISO	10 of 10	Multi w/Cap	0.004	0.035	3.600	0.135
PJM	Comparable	Multiplicative	0.010	0.162	132.140	2.929

Winter

Winter Capability Period — All Days — Bias — All Resources

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.084	0.005	0.033	0.063	0.003	0.035	0.010	0.023	0.051	0.002	0.001
Additive Adjustment	0.015	0.002	0.005	0.011	0.000	0.006	0.003	0.067	0.067	0.000	0.001
Multiplicative Adjustment	0.019	0.001	0.009	0.014	0.001	0.009	0.009	0.067	0.067	0.000	0.002
Multiplicative Adjustment(Cap)	0.044	0.002	0.017	0.033	0.006	0.017	0.005	0.035	0.062	0.004	0.003

Winter Capability Period — All Days — Bias Statistic — All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	-	0.003	0.500	0.017
ISONE		Additive	-	0.006	0.870	0.033
NYISO	10 of 10	Additive	-	0.010	2.380	0.081
CAISO	10 of 10	Unadjusted	0.001	0.001	0.360	0.012
CAISO	10 of 10	Additive	0.001	0.008	0.760	0.032
NYISO	10 of 10	Multiplicative	0.001	0.012	1.340	0.066
NYISO	Mid 2 of 10	Multiplicative	0.001	0.016	5.640	0.149
NYISO	Mid 2 of 10	Multi w/Cap	0.002	0.002	0.860	0.043
CAISO	10 of 10	Multiplicative	0.002	0.005	0.820	0.025
NYISO	10 of 10	Unadjusted	0.003	0.037	2.610	0.135
NYISO	4 of 5	Multiplicative	0.009	0.038	8.930	0.279
PJM	Comparable	Multiplicative	0.009	0.148	170.640	4.019

Bias Statistic Results - All Days

Summer

Winter

DRAFT – FOR DISCUSSION PURPOSES ONLY   20

Variability Statistic Results - All Days

Summer

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.205	0.204	0.192	0.200	0.198	0.189	0.172	0.179	0.189	0.199	0.195
Additive Adjustment	0.153	0.165	0.149	0.150	0.145	0.148	0.168	0.205	0.205	0.145	0.146
Multiplicative Adjustment	0.135	0.151	0.135	0.134	0.130	0.135	0.170	0.205	0.205	0.129	0.131
Multiplicative Adjustment(Cap)	0.153	0.159	0.146	0.150	0.147	0.143	0.159	0.189	0.196	0.143	0.143

Summer Capability Period — All Days — Variability — All Resources

Winter

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.191	0.195	0.182	0.189	0.188	0.180	0.174	0.144	0.155	0.182	0.187
Additive Adjustment	0.141	0.148	0.140	0.140	0.135	0.138	0.158	0.168	0.168	0.132	0.134
Multiplicative Adjustment	0.121	0.138	0.123	0.122	0.118	0.122	0.153	0.168	0.168	0.115	0.117
Multiplicative Adjustment(Cap)	0.144	0.153	0.141	0.142	0.137	0.138	0.155	0.155	0.161	0.131	0.136

Winter Capability Period — All Days — Variability — All Resources

Summer Capability Period — All Days — Variability Statistic — All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	0.129	0.206	7.330	0.304
NYISO	10 of 10	Multiplicative	0.130	0.216	9.280	0.388
CAISO	10 of 10	Multiplicative	0.131	0.219	14.840	0.456
NYISO	5 of 8	Multiplicative	0.134	0.257	39.390	1.138
PJM	4 of 5	Multiplicative	0.135	0.269	20.270	0.824
NYISO	4 of 5	Multiplicative	0.135	0.299	122.590	2.679
NYISO	5 of 10	Multiplicative	0.135	0.258	39.390	1.128
NYISO	Mid 2 of 10	Multiplicative	0.151	0.360	61.330	1.672
PJM	Comparable	Multiplicative	0.170	1.519	1,181.530	26.145

Winter Capability Period — All Days — Variability Statistic — All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	0.115	0.181	6.270	0.272
CAISO	10 of 10	Multiplicative	0.117	0.188	8.370	0.332
NYISO	10 of 10	Multiplicative	0.118	0.191	10.820	0.371
NYISO	5 of 10	Multiplicative	0.121	0.224	32.350	0.877
NYISO	5 of 8	Multiplicative	0.122	0.221	32.400	0.864
PJM	4 of 5	Multiplicative	0.122	0.215	10.340	0.468
NYISO	4 of 5	Multiplicative	0.123	0.308	155.270	3.727
NYISO	Mid 2 of 10	Multiplicative	0.138	0.297	75.070	1.921
PJM	Comparable	Multiplicative	0.153	1.206	1,367.830	32.243

Variability Statistic Results - All Days
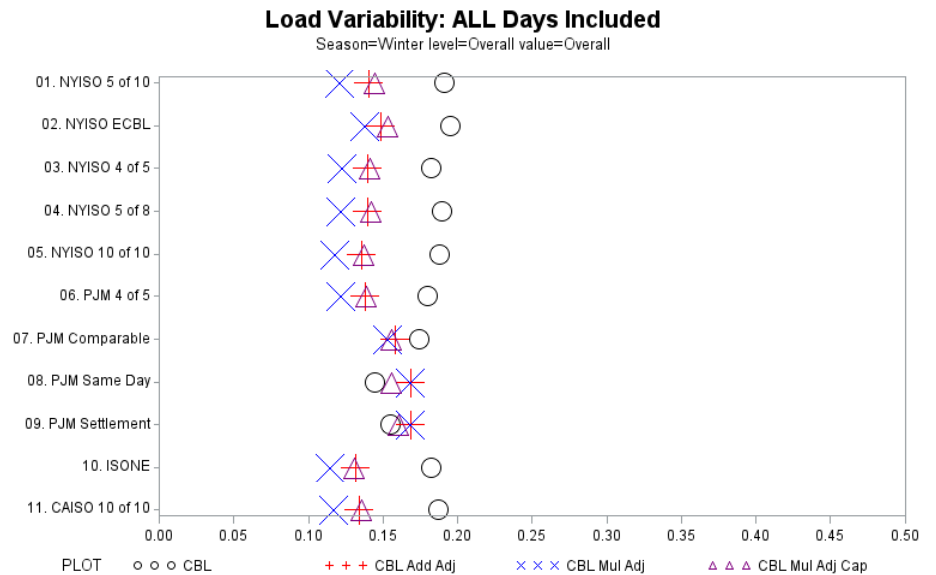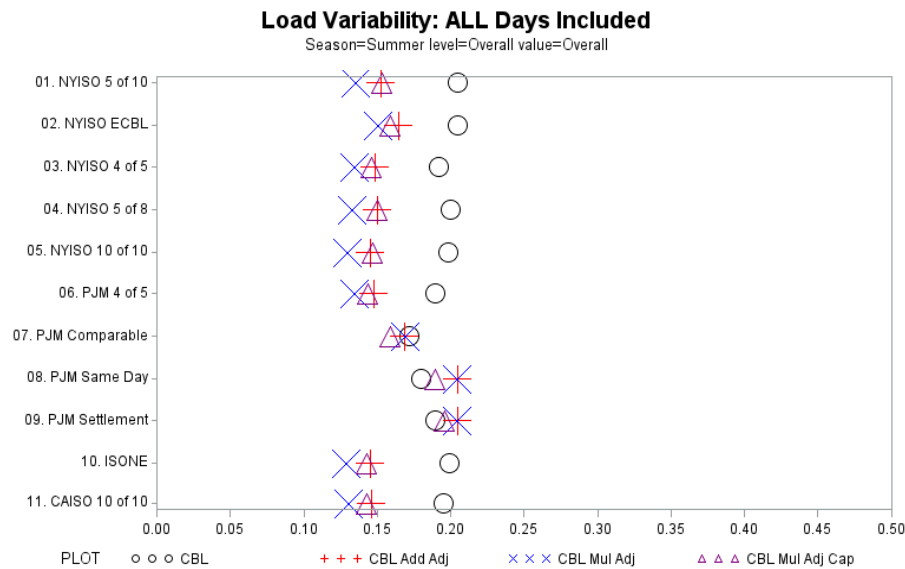
Summer

Winter

All Resources
Event Like Days

Accuracy Statistic Results - Event Like Days

Summer

Summer Capability Period — Peak Like Days — Accuracy — All Resources											
Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.188	0.202	0.183	0.186	0.219	0.160	0.159	0.215	0.197	0.217	0.194
Additive Adjustment	0.140	0.146	0.134	0.138	0.136	0.129	0.169	0.225	0.225	0.134	0.132
Multiplicative Adjustment	0.129	0.138	0.125	0.128	0.124	0.123	0.164	0.225	0.225	0.123	0.122
Multiplicative Adjustment(Cap)	0.141	0.147	0.135	0.141	0.149	0.126	0.159	0.208	0.212	0.144	0.135

Summer Capability Period — Event Like Days — Accuracy Statistic — All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
CAISO	10 of 10	Multiplicative	0.122	0.202	17.910	0.465
ISONE		Multiplicative	0.123	0.195	12.450	0.351
PJM	4 of 5	Multiplicative	0.123	0.224	17.870	0.645
NYISO	10 of 10	Multiplicative	0.124	0.204	25.500	0.605
NYISO	4 of 5	Multiplicative	0.125	0.216	24.120	0.597
PJM	4 of 5	Multi w/Cap	0.126	0.200	12.810	0.354
NYISO	5 of 8	Multiplicative	0.128	0.217	26.300	0.630
PJM	4 of 5	Additive	0.129	0.217	22.810	0.545
NYISO	5 of 10	Multiplicative	0.129	0.219	26.300	0.631
CAISO	10 of 10	Additive	0.132	0.217	22.650	0.534
NYISO	4 of 5	Additive	0.134	0.219	23.250	0.539
ISONE		Additive	0.134	0.220	22.330	0.528
CAISO	10 of 10	Multi w/Cap	0.135	0.201	9.180	0.287
NYISO	4 of 5	Multi w/Cap	0.135	0.247	30.150	0.853
NYISO	10 of 10	Additive	0.136	0.218	23.640	0.555
NYISO	5 of 8	Additive	0.138	0.224	24.670	0.578
NYISO	Mid 2 of 10	Multiplicative	0.138	0.271	34.390	1.050
NYISO	5 of 10	Additive	0.140	0.228	24.680	0.579
NYISO	5 of 8	Multi w/Cap	0.141	0.258	30.440	0.943
NYISO	5 of 10	Multi w/Cap	0.141	0.264	30.440	0.945
NYISO	Mid 2 of 10	Additive	0.146	0.238	23.370	0.555
NYISO	10 of 10	Multi w/Cap	0.149	0.248	29.020	0.888
PJM	Comparable	Multiplicative	0.164	0.484	129.020	3.799

Winter

Winter Capability Period — Peak Like Days — Accuracy — All Resources											
Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.115	0.155	0.143	0.127	0.143	0.139	0.178	0.152	0.158	0.158	0.166
Additive Adjustment	0.094	0.115	0.107	0.097	0.099	0.107	0.125	0.182	0.182	0.097	0.102
Multiplicative Adjustment	0.088	0.110	0.102	0.090	0.089	0.103	0.129	0.182	0.182	0.085	0.092
Multiplicative Adjustment(Cap)	0.092	0.123	0.110	0.096	0.099	0.109	0.151	0.171	0.175	0.100	0.112

Winter Capability Period — Event Like Days — Accuracy Statistic — All Resources — Overall

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	0.085	0.137	2.190	0.178
NYISO	5 of 10	Multiplicative	0.088	0.153	4.080	0.248
NYISO	10 of 10	Multiplicative	0.089	0.139	2.200	0.180
NYISO	5 of 8	Multiplicative	0.090	0.153	4.080	0.249
NYISO	5 of 10	Multi w/Cap	0.092	0.162	12.320	0.404
CAISO	10 of 10	Multiplicative	0.092	0.144	2.470	0.185
NYISO	5 of 10	Additive	0.094	0.157	8.760	0.286
NYISO	5 of 8	Multi w/Cap	0.096	0.163	12.320	0.401
NYISO	5 of 8	Additive	0.097	0.159	8.760	0.285
NYISO	10 of 10	Multi w/Cap	0.099	0.156	11.410	0.357

Accuracy Statistic Results - Event Like Days

Summer   ## Winter

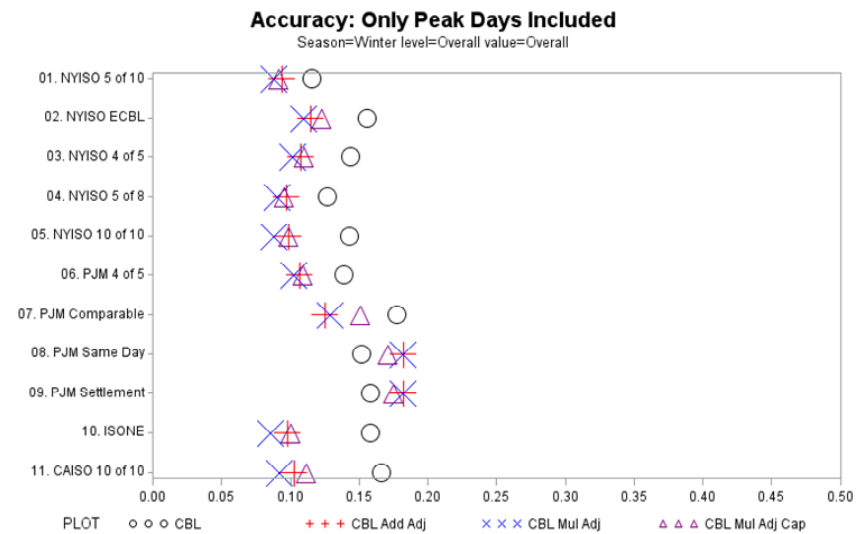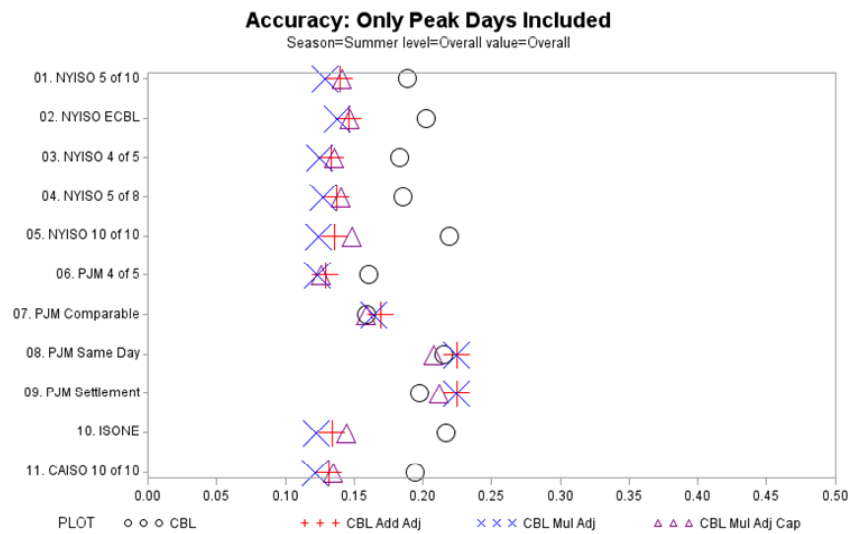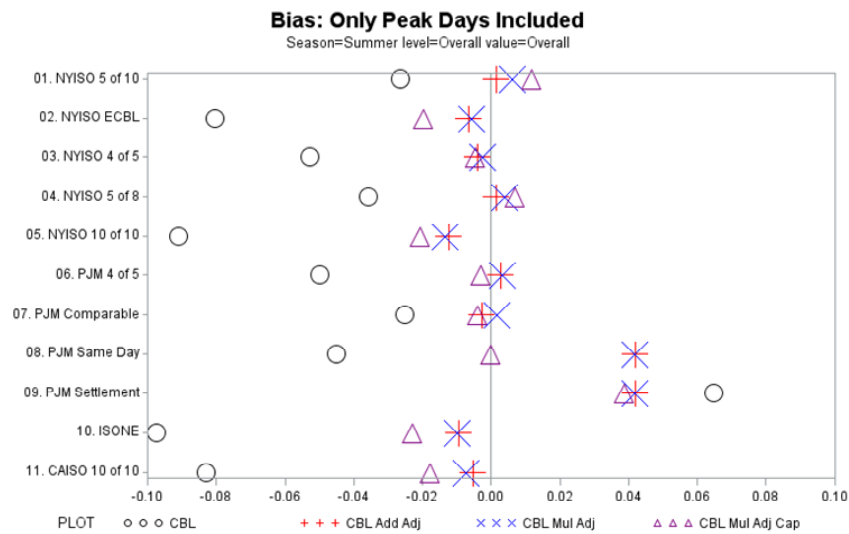# Bias Statistic Results - Event Like Days

Summer

Summer Capability Period
Event Like Days
Summer
All Resources

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.026	0.081	0.053	0.036	0.091	0.050	0.025	0.045	0.065	0.097	0.083
Additive Adjustment	0.002	0.007	0.004	0.001	0.012	0.003	0.003	0.042	0.042	0.010	0.005
Multiplicative Adjustment	0.006	0.006	0.002	0.004	0.013	0.004	0.002	0.042	0.042	0.010	0.007
Multiplicative Adjustment(Cap)	0.012	0.020	0.005	0.007	0.021	0.003	0.004	0.000	0.039	0.023	0.018

Summer Capability Period
Event Like
Bias Statistic
All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
PJM	Same Day	Multi w/Cap	-	0.056	5.880	0.246
NYISO	5 of 8	Additive	0.001	0.031	23.630	0.516
NYISO	4 of 5	Multiplicative	(0.002)	0.032	24.200	0.520
NYISO	5 of 10	Additive	0.002	0.033	23.630	0.517
PJM	Comparable	Multiplicative	0.002	0.078	38.440	1.059
PJM	Comparable	Additive	(0.003)	0.009	8.130	0.188
PJM	4 of 5	Multi w/Cap	(0.003)	0.009	6.050	0.157
PJM	4 of 5	Additive	0.003	0.024	8.570	0.210
PJM	Comparable	Multi w/Cap	(0.004)	(0.006)	1.110	0.060
NYISO	4 of 5	Additive	(0.004)	0.022	23.210	0.494
PJM	4 of 5	Multiplicative	0.004	0.026	6.320	0.210
NYISO	5 of 8	Multiplicative	0.004	0.042	26.200	0.567
CAISO	10 of 10	Additive	(0.005)	0.012	7.800	0.188
NYISO	4 of 5	Multi w/Cap	(0.005)	0.055	24.030	0.691
NYISO	Mid 2 of 10	Multiplicative	(0.006)	0.020	10.410	0.295
NYISO	5 of 10	Multiplicative	0.006	0.047	26.200	0.568
CAISO	10 of 10	Multiplicative	(0.007)	0.003	5.840	0.152
NYISO	Mid 2 of 10	Additive	(0.007)	0.010	9.420	0.221
NYISO	5 of 8	Multi w/Cap	0.007	0.077	29.370	0.786
ISONE		Additive	(0.010)	0.002	7.360	0.187
NYISO	10 of 10	Additive	(0.012)	0.012	22.880	0.502

Winter

Winter Capability Period
Event Like Days
Bias
All Resources

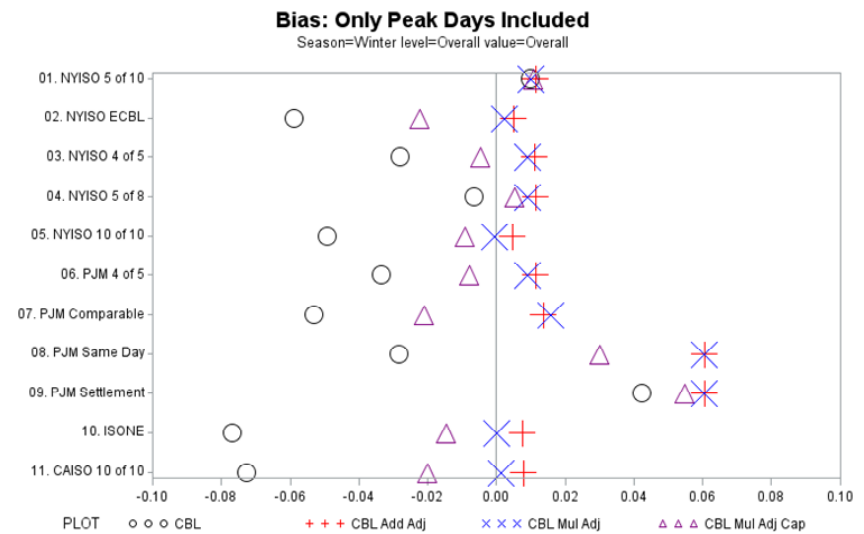| Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.010	0.059	0.028	0.007	0.049	0.033	0.053	0.028	0.042	0.077	0.073
Additive Adjustment	0.011	0.005	0.011	0.012	0.005	0.011	0.014	0.061	0.061	0.008	0.008
Multiplicative Adjustment	0.010	0.002	0.009	0.009	0.000	0.009	0.016	0.061	0.061	0.000	0.001
Multiplicative Adjustment(Cap)	0.011	0.022	0.005	0.005	0.009	0.008	0.021	0.030	0.055	0.015	0.020

Winter Capability Period
Event Like
Bias Statistic
All Resources
Overall

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	-	-	1.290	0.070
NYISO	10 of 10	Multiplicative	-	0.005	1.510	0.090
CAISO	10 of 10	Multiplicative	0.001	0.003	1.310	0.076
NYISO	Mid 2 of 10	Multiplicative	0.002	0.016	2.670	0.130
NYISO	4 of 5	Multi w/Cap	(0.005)	0.014	8.870	0.280
NYISO	10 of 10	Additive	0.005	0.016	2.780	0.117
NYISO	Mid 2 of 10	Additive	0.005	0.018	1.680	0.104
NYISO	5 of 8	Multi w/Cap	0.005	0.036	12.560	0.348
NYISO	5 of 8	Unadjusted	(0.007)	0.027	15.990	0.446
NYISO	10 of 10	Multi w/Cap	(0.009)	0.002	11.710	0.316
NYISO	5 of 10	Unadjusted	0.010	0.051	15.980	0.447
NYISO	5 of 10	Multi w/Cap	0.011	0.049	12.550	0.350

Bias Statistic Results - Event Like Days

Summer

Winter

Variability Statistic Results - Event Like Days

Summer

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.151	0.151	0.135	0.148	0.148	0.126	0.153	0.163	0.168	0.147	0.144
Additive Adjustment	0.131	0.139	0.127	0.130	0.126	0.124	0.167	0.183	0.183	0.126	0.125
Multiplicative Adjustment	0.122	0.132	0.119	0.120	0.115	0.119	0.162	0.183	0.183	0.115	0.116
Multiplicative Adjustment(Cap)	0.131	0.136	0.124	0.128	0.127	0.118	0.157	0.171	0.175	0.129	0.123

Summer Capability Period — Event Like Days — Variability Statistic — All Resources

Winter

Baseline Type	NYISO 5 of 10	NYISO M2 of 10	NYISO 4 of 5	NYISO 5 of 8	NYISO 10 of 10	PJM 4 of 5	PJM Comparable	PJM Same Day	PJM Settlement	ISONE	CAISO 10 of 10
Unadjusted Baseline	0.090	0.121	0.114	0.100	0.100	0.117	0.162	0.119	0.124	0.102	0.117
Additive Adjustment	0.087	0.104	0.098	0.089	0.088	0.099	0.122	0.134	0.134	0.088	0.094
Multiplicative Adjustment	0.082	0.102	0.093	0.084	0.083	0.096	0.125	0.134	0.134	0.079	0.086
Multiplicative Adjustment(Cap)	0.085	0.111	0.100	0.088	0.087	0.101	0.144	0.129	0.129	0.087	0.099

Winter Capability Period — Event Like Days — Variability Statistic — All Resources

Summer Capability Period — Event Like Days — Accuracy Statistic — All Resources

Baseline		Adjustment	Median	Mean	Range	Std Dev.
NYISO	10 of 10	Multiplicative	0.115	0.181	7.260	0.273
ISONE		Multiplicative	0.115	0.186	12.120	0.339
CAISO	10 of 10	Multiplicative	0.116	0.195	17.350	0.448
PJM	4 of 5	Multi w/Cap	0.118	0.190	11.750	0.327
PJM	4 of 5	Multiplicative	0.119	0.215	17.150	0.619
NYISO	4 of 5	Multiplicative	0.119	0.195	8.340	0.313
NYISO	5 of 8	Multiplicative	0.120	0.193	6.750	0.301
NYISO	5 of 10	Multiplicative	0.122	0.194	6.760	0.303
CAISO	10 of 10	Multi w/Cap	0.123	0.190	8.150	0.265
PJM	4 of 5	Additive	0.124	0.207	21.570	0.513
NYISO	4 of 5	Multi w/Cap	0.124	0.211	22.080	0.523
CAISO	10 of 10	Additive	0.125	0.207	21.680	0.510
PJM	4 of 5	Unadjusted	0.126	0.207	14.820	0.385
NYISO	10 of 10	Additive	0.126	0.193	8.340	0.269
ISONE		Additive	0.126	0.206	21.480	0.505
NYISO	4 of 5	Additive	0.127	0.196	5.890	0.241
NYISO	10 of 10	Multi w/Cap	0.127	0.207	21.490	0.518
NYISO	5 of 8	Multi w/Cap	0.128	0.216	22.320	0.547
NYISO	5 of 10	Multi w/Cap	0.131	0.219	22.320	0.548
NYISO	Mid 2 of 10	Multiplicative	0.132	0.261	33.310	1.020
NYISO	4 of 5	Unadjusted	0.135	0.242	27.690	0.644
PJM	Comparable	Multiplicative	0.162	0.473	124.440	3.684

Winter Capability Period — Event Like Days — Variability Statistic — Overall Overall

Baseline		Adjustment	Median	Mean	Range	Std Dev.
ISONE		Multiplicative	0.079	0.129	2.220	0.174
NYISO	5 of 10	Multiplicative	0.082	0.139	3.270	0.215
NYISO	10 of 10	Multiplicative	0.083	0.130	2.110	0.167
NYISO	5 of 8	Multiplicative	0.084	0.140	3.270	0.217
NYISO	5 of 10	Multi w/Cap	0.085	0.137	5.870	0.219
CAISO	10 of 10	Multiplicative	0.086	0.136	2.350	0.179
ISONE		Multi w/Cap	0.087	0.132	2.060	0.158
NYISO	10 of 10	Multi w/Cap	0.087	0.134	4.700	0.191
NYISO	5 of 10	Additive	0.087	0.142	7.020	0.239
NYISO	5 of 8	Multi w/Cap	0.088	0.139	5.880	0.220
ISONE		Additive	0.088	0.143	2.880	0.193
NYISO	10 of 10	Additive	0.088	0.138	3.250	0.179
NYISO	5 of 8	Additive	0.089	0.144	7.020	0.240
NYISO	5 of 10	Unadjusted	0.090	0.151	7.470	0.261

Variability Statistic Results - Event Like Days

Summer

Winter
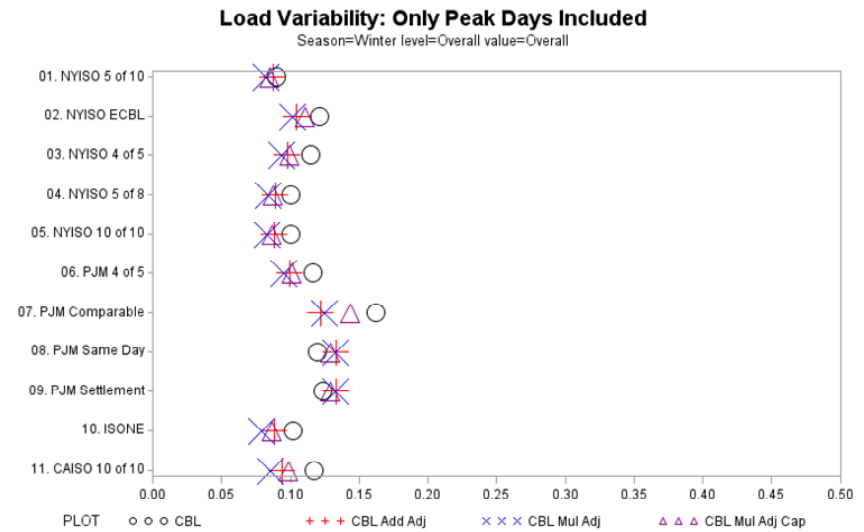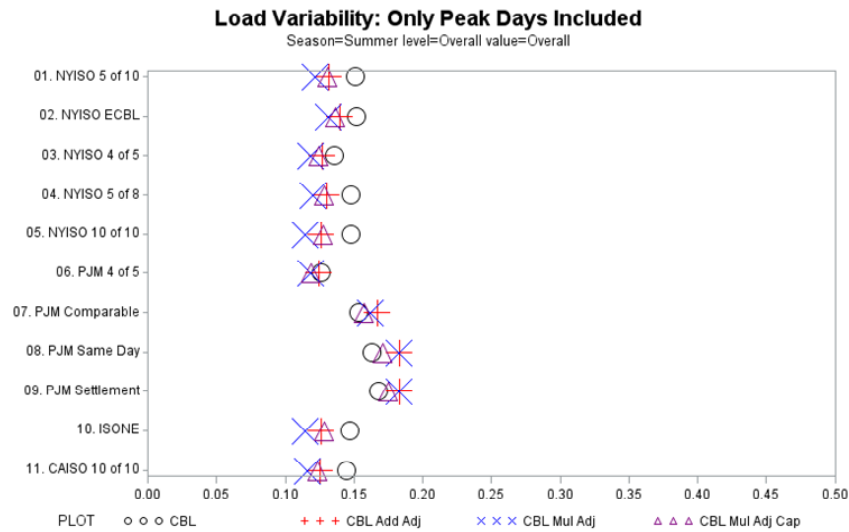
All Resources Observations - Accuracy

- From the All days and Event Like days accuracy analyses, 51 baselines were identified as having high levels of accuracy

- All of these baselines used an adjustment

  - *The most common adjustment was Multiplicative (32 of 51)*

- Three variants of the NYISO's current effective CBL - NYISO 10 of 10, NYISO 5 of 10 and NYISO 5 of 8 - were the most frequently identified baselines (8)

- The following baselines were identified as highly accurate across seasons for each segment analyzed:

  - *CAISO 10 of 10 Multiplicative*
  - *ISONE Multiplicative*
  - *NYISO 10 of 10 Multiplicative*
  - *NYISO 5 of 10 Multiplicative*
  - *NYISO 5 of 8 Multiplicative*

All Resources Observations - Bias

- **From the All days and Event Like days accuracy analyses, 64 baselines were identified as having the least bias**

- **Of these all but seven used an adjustment**
  - *The most common adjustment was the Multiplicative (22)*

- **The NYISO 10 of 10 was the most frequently identified baseline (13)**

- **The following baselines were identified with the least overall bias, in across every season for each segment analyzed:**
  - *NYISO 10 of 10 Additive*
  - *NYISO 10 of 10 Multiplicative*
  - *NYISO Mid 2 of 10 Multiplicative*

DRAFT – FOR DISCUSSION PURPOSES ONLY

All Resources Observations - Variability

- **From the All days and Event Like days accuracy analyses, 54 baselines were identified as having the least variability**

- **All baselines identified used an adjustment.**
  - *The most common adjustment was multiplicative (32)*

- **The NYISO 5 of 10 and the NYISO 10 of 10 were the most frequently identified baselines (8)**

- **The following baselines were identified across seasons for each segment analyzed:**
  - *CAISO 10 of 10 Multiplicative*
  - *ISONE Multiplicative*
  - *NYISO 10 of 10 Multiplicative*
  - *NYISO 5 of 10 Multiplicative*
  - *NYISO 5 of 8 Multiplicative*

DRAFT – FOR DISCUSSION PURPOSES ONLY

Summary Of CBL Results - Accuracy

- **44 combinations of baselines tested in 10 different ways.**

- **Where checkmark is indicated, the CBL was a high performer in each of the four capability periods or seasons of the study.**

- **Baselines/adjustment combinations with statistically significant results (26) were identified.**

- **Those with >90% accuracy (6) are shown in yellow.**

- **Three (3) variations of existing NYISO CBL were top performers.**

BaseLine		Adjustment	All Resources	Not Highly Variable	Up to 100 kW	Between 100 kW and 1000 kW	Greater than 1000 kW	Non-Weather Sensitive	Weather Sensitive	Low Variability	Medium Variability	High Variability	Pct Of Best
CAISO	10 of 10	Multiplicative	√	√	√	√	√	√	√	√	√	√	100%
ISONE		Multiplicative	√	√	√	√	√	√	√	√	√	√	100%
NYISO	10 of 10	Multiplicative	√	√	√	√	√	√	√	√	√	√	100%
NYISO	5 of 10	Multiplicative	√		√	√	√	√	√			√	93%
NYISO	5 of 8	Multiplicative	√		√	√	√	√	√			√	93%
NYISO	4 of 5	Multiplicative				√	√	√	√	√		√	85%
PJM	Comparable	Multiplicative				√	√	√	√				80%
PJM	4 of 5	Multiplicative				√	√			√			78%
NYISO	Mid 2 of 10	Multiplicative				√							70%
ISONE		Additive	√		√	√				√			68%
NYISO	10 of 10	Additive				√	√			√			68%
CAISO	10 of 10	Additive				√				√			60%
NYISO	10 of 10	Multi w/Cap				√	√			√			58%
NYISO	5 of 8	Additive				√				√			55%
CAISO	10 of 10	Multi w/Cap				√				√			53%
ISONE		Multi w/Cap			√	√				√			53%
NYISO	5 of 8	Multi w/Cap				√				√			53%
NYISO	5 of 10	Multi w/Cap				√							50%
PJM	4 of 5	Multi w/Cap				√				√			50%
NYISO	4 of 5	Additive				√				√			48%
NYISO	5 of 10	Additive				√							48%
PJM	4 of 5	Additive				√				√			48%
NYISO	4 of 5	Multi w/Cap				√				√			43%
NYISO	Mid 2 of 10	Additive				√							28%
NYISO	Mid 2 of 10	Multi w/Cap				√							18%
PJM	Comparable	Additive				√							15%

DRAFT – FOR DISCUSSION PURPOSES ONLY

Candidate Energy Baselines Based on All Resources, Best Accuracies

	BaseLine		Adjustment	Summer			Winter		
				Accuracy	Bias	Varibility	Accuracy	Bias	Varibility
NYISO	10 of 10		Multiplicative	0.130	0.001	0.130	0.117	0.001	0.118
NYISO	5 of 10		Multiplicative	0.138	0.020	0.135	0.123	0.019	0.121
NYISO	5 of 8		Multiplicative	0.135	0.016	0.134	0.125	0.014	0.122

- **ISO New England CBL**
  - *Operationally intensive*
  - *Difficult for the NYISO and MPs to administer/manage*
  - *Therefore, was not considered as a candidate CBL*

- **CAISO CBL**
  - *Consistent with the PJM study, only major attributes were modeled by KEMA.*
  - *NYISO 10 of 10 CBL, which was in the top 5 best CBLs, has similar rules and was studied with all the attributes and hence was considered as a candidate CBL.*

In-Day Adjustment Mechanism

- **Candidate energy baselines are more accurate with a multiplicative adjustment**

- **Candidate energy baselines were analyzed to determine the magnitude and distribution of adjustments used**
  - *To compare with the current in-day adjustment cap*

DRAFT – FOR DISCUSSION PURPOSES ONLY

In-day Adjustment Cap

Magnitude and Distribution

- **Table shows the distribution and value of the in-day adjustment from the analysis, for the candidate energy baselines.**

- **Approximately 95% of the adjustments used in the analysis would be captured by the current +/- 20% cap.**

- **Approximately 99% of the adjustments used in the study would be captured by an adjustment cap of +/- 50%, or 0.5 to 1.5.**

Distribution Statistic	NYISO 10 of 10	NYISO 5 of 10	NYISO 5 of 8
100% Max	56.46	315.00	315.00
99%	1.68	1.53	1.57
95%	1.30	1.20	1.22
90%	1.19	1.11	1.13
75% Q3	1.07	1.03	1.04
50% Median	1.00	0.97	0.98
25% Q1	0.92	0.88	0.89
10%	0.76	0.70	0.72
5%	0.56	0.50	0.52
1%	0.17	0.16	0.16
0% Min	0.00	0.00	0.00
Mean	0.99	0.95	0.95
Std Dev	0.28	0.48	0.48

Comparison to the PJM Empirical Analysis of Demand Response Baseline Methods

Comparison to the PJM Empirical Analysis of Demand Response Baseline Methods (Continued)

- **NYISO demand values are based on ICAP. PJM demand values are based on peak load contribution (PLC)**

- **In the NYISO study, seven of the eleven PJM candidate baselines were utilized**
    - *The NYISO study modelled all the attributes of the NYISO 5 of 10 baseline to reflect all NYISO CBL calculation rules*
    - *Added three variants of the NYISO CBL to the study, as well as ECBL used for Order 745*
    - *Final study included 5 NYISO baseline variants, 6 other baselines from other ISOs/RTOs*

- **The PJM analysis included three same day adjustments: load-based multiplicative (uncapped-ratio), additive adjustments, as well as a regression-based adjustment based on the PJM alternative weather sensitive adjustment**
    - *For the NYISO analysis, the regression adjustment was replaced by a multiplicative variant that featured a cap and floor (0.8 to 1.2)*

Comparison to the PJM Empirical Analysis of Demand Response Baseline Methods (Continued)

- **The NYISO baseline analysis used the same statistics (Accuracy, Variability and Bias) developed for the PJM Analysis.**

- **The NYISO high variability load represented 28% of the resources, and 8% of the total ICAP. The PJM high variability load represented 20% of the resources.**

- **Both studies categorized loads based on size:**

  - *NYSO categories were: Up to 100 kW, 100 kW to 1 MW, Greater than 1 MW*

  - *PJM categories were: Up to 500 kW, 500 kW to 2 MW, Greater than 2 MW*

Comparison to the PJM Empirical Analysis of Demand Response Baseline Methods (Continued)

◆ **Conclusions**

- ▪ *NYISO's analysis builds on the experience afforded by and approach developed for the "PJM Empirical Analysis of Demand Response Baseline Methods" and was adapted for the NYISO situation, goals and objectives*

- ▪ *As a result of the fundamental differences in analysis details, the PJM results are not directly comparable to the NYISO results*

Next Steps

- **Complete remaining tasks of the Baseline Study**
- **Stakeholder Presentations**
  - *ACL results to PRLWG/ICAPWG on December 10, 2013*
  - *Summary CBL and ACL results to BIC on December 11, 2013*
- **Complete Overall Report and Recommendations**
- **2014 Project**
  - *NYISO Management Response to SCR Baseline Study*

Questions

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.
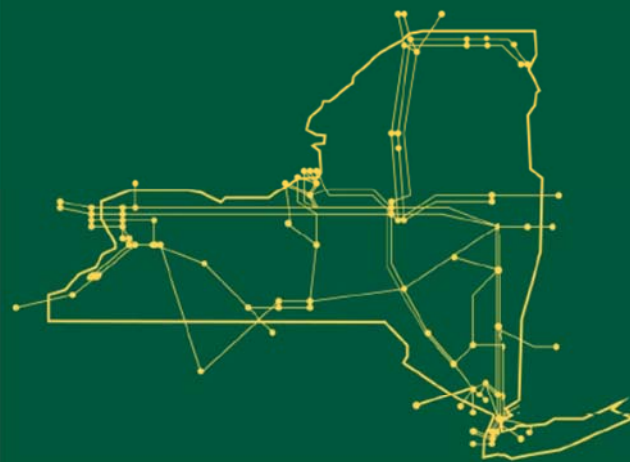
www.nyiso.com

Appendix

Accuracy Statistic Description

- **This statistic describes how closely a baseline method predicts resource actual loads in the sample**

- **Comparison of Accuracy is made by comparing the Median of the relative root mean squared error (RRMSE) of the baselines to actual load.**
  - *By definition, accuracy is a positive value*

- **A baseline for a typical customer with a median RRMSE of 0.10 is one where that baseline could expect to have an hourly error, on average of 10% of their actual load**

- **When comparing the accuracy of different baselines, the smaller the value, the better (or more accurate the accuracy)**

- **The accuracy statistic (RRMSE) is defined as variability plus bias. Accordingly, the Accuracy statistics incorporates both**
  - *Accuracy can be considered "first among equals" of the statistics examined*

Bias Statistic Description

♦ **This statistic describes the systematic tendency of a baseline method to over- or under-predict actual loads**

♦ **Metric: Median of the Average Relative Error (ARE)**

♦ **A median value of 0 would indicate that the typical customer in the sample had no systematic tendency to over- or under-predict loads using that baseline**

♦ **The closer to 0, the better**

♦ **The values in the Table are presented in absolute values**

Variability Statistic Description

- **This statistic measures how well the baseline is at predicting hourly load under many different conditions and across many different customers**

- **Metric: Relative Error Ratio (RER)**

- **The smaller the median RER, the less variable the baseline's error is for the typical customer**

  - *The better the baseline performs across a wide variety of circumstances*

- **By definition, the Variability statistic is a positive value.**