Coincidence Factor Study
Residential and Commercial Industrial Lighting Measures

Prepared for;
New England State Program Working Group (SPWG)

For use as an
Energy Efficiency Measures/Programs
Reference Document for the
ISO Forward Capacity Market (FCM)

Spring 2007

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New England State
Program Working Group (SPWG)

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Acknowledgement:

The authors wish to thank all of the people at the State Program Working Group (SPWG), Northeast Energy Efficiency Partnership (NEEP) who took the time to support and help with this study. Regrettably, we cannot thank everyone individually, but we do want to acknowledge the contributions made by Julie Michaels, Jeff Schlegel Tom Belair, Carol White, Chris Neme and Ralph Prahl. The data, insight, and support provided by these individuals helped to establish the foundation for this report. RLW assumes sole responsibility for any errors or omissions in this report.

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Executive Summary

The New England State Program Working Group (SPWG)[1] contracted with RLW to calculate coincidence factors for residential and commercial and industrial lighting measures that could be consistently applied to energy efficiency programs that may bid into the ISO-NE Forward Capacity Market (FCM) in any of the New England states. As directed by the SPWG, the focus of this effort was on lighting measures.

Resulting coincidence factors presented in this report were developed to work as common values accepted by all New England states for the FCM that can be applied or used as appropriate for measures installed by energy efficiency programs in the New England states that have supported this research effort.

This section of the report describes the analytical results and conclusions for the calculation of the Coincidence Factors (CFs) for the Residential and Commercial and Industrial Lighting measures. Energy Efficiency demand reductions can be classified in the Forward Capacity Market (FCM) as one of three different types of assets, based upon the performance hours that will be used for evaluation. The most straight forward type of asset is On-Peak, because the performance hours are fixed and defined as follows:

- Summer On-Peak: average weekday from 1-5 PM throughout June, July and August.
- Winter On-Peak: average weekday from 5-7 PM throughout December and January.

ISO-NE hourly load data and forecast data were obtained for the past several years from recent energy efficiency program evaluations throughout New England, as described in Appendix A. They were analyzed to determine Seasonal Peak performance hours and Critical Peak performance hours which are defined as follows:

- **Seasonal Peak Hours** occur when Real Time load is equal to or greater than 90% of the 50/50 seasonal peak load forecast during Summer (June – August) or Winter (December and January) months.

[1] Represented by the state regulatory agencies (CT DPUC, Maine PUC, MA DOER, NH PUC, RI PUC, and VT PSB) and associated energy efficiency program administrators (Cape Light Compact, Efficiency Maine, Efficiency Vermont, National Grid (MA, NH & RI), Northeast Utilities (CT&MA), NSTAR, PSNH, United Illuminating, and Unitil (MA&NH)).

- **Critical Peak Performance Hours** occur when the Day Ahead Load forecast is equal to or greater than 95% of the 50/50 seasonal peak load forecast during Summer (June – August) or Winter (December and January) months and also includes shortage hours.
    - **Shortage hours** occur during Operating Procedure 4 (OP4) level 6 or higher events, at level 6 the 30-minute operating reserve begins to be depleted.

Coincidence Factors (CFs) are defined in this study as the fractions of the connected (or rated) load (based on actual lighting Watts, motor nameplate horsepower and efficiency, AC rated capacity and efficiency, etc.) reductions that actually occur during each of the seasonal demand windows. They are the ratio of the actual demand reductions during the coincident windows to the maximum connected load reductions. Under this definition other issues such as diversity and load factor are automatically accounted for, and only the coincidence factor will be necessary to determine coincident demand reductions from readily observable equipment nameplate (rated) information. In other words, coincident demand reduction will simply be the product of the coincidence factor and the connected equipment load kW reduction.

Residential Lighting Coincidence Factor Results

Table i - 1 and Table i - 2 provide the un-weighted and weighted, Summer On-Peak and Winter On-Peak CFs as well as the associated relative precisions for all residential lighting. The CFs were developed using only metered data that were acquired during the winter (December and January) or summer (June, July and August) peak months and the number of loggers used in the analysis is provided in the tables. The weighted CFs were developed by weighting the logger files based upon the connected load that the logger represents and in most cases the weighted results are slightly higher than the un-weighted results. The CFs for the summer range from a low of 0.06 for June to a high of 0.094 for August, with the average summer CF between 0.076 un-weighted and 0.082 weighted. If the average is carried to only two decimal places than the result is a summer average CF of 0.08 for both methodologies. The relative precision for the average summer on-peak period is ±6.1% at the 80% confidence interval.

	Summer On-Peak Hours 1PM - 5PM			
Data Period	Sample Size n	Un-weighted CF	Weighted CF	Un-weighted Rel Precision
June	210	0.060	0.069	±11.6%
July	102	0.081	0.086	±12.5%
August	189	0.094	0.092	±8.7%
Average Summer	501	0.076	0.082	±6.1%

Table i - 1: Summer On-Peak CFs and Relative Precisions Residential Lighting

	Winter On-Peak Hours 5PM - 7PM			
Data Period	Sample Size n	Un-weighted CF	Weighted CF	Un-weighted Rel Precision
December	282	0.263	0.281	±6.5%
January	264	0.301	0.320	±6.5%
Average Winter	546	0.286	0.298	±4.5%

Table i - 2: Winter On-Peak CFs and Relative Precisions Residential Lighting

The winter CFs as expected are higher than the summer CFs ranging from 0.263 for December to 0.320 for January with the average winter CF for all lighting at 0.286 un-weighted and 0.298 weighted. The relative precisions is better during the winter peak periods primarily because the CFs are higher and there is less variation in the data, i.e. the Coefficient of Variation (Cv) is lower. The relative precision of the average winter un-weighted CF is ±4.5% at the 80% confidence interval and the December and January relative precisions are both better than ±10% at the 80% confidence interval.

The Seasonal Summer and Winter Peak performance hours were calculated using historical load data and the 50/50 Seasonal Peak Forecasts from the most recent Capacity Energy Loads and Transmission (CELT) reports. The seasonal peak performance hours were weighted based upon the frequency distribution of the hours observed where the load met or exceeded 90% of the 50/50 seasonal peak forecast and these values were used to calculate a weighted CF for each of the measure types. Table i - 3 and Table i - 4 provide the Summer Seasonal Peak and Winter Seasonal Peak CFs for all residential lighting. The CFs during the summer months range from a low of about 0.08 for June to a high of 0.10 for August, with an Average Summer CF of about 0.09. The relative precision during each of the summer months is within the range of ±10% at the 80% confidence interval. The Winter Seasonal Peak CFs as expected, are higher than the Summer Seasonal Peak CFs ranging from 0.25 in December to 0.28 in January with an Average Winter Seasonal Peak CF for all lighting at 0.26.

	Summer Seasonal Peak Hours (90% of 50/50 Peak)			
Data Period	Sample Size n	Un-weighted CF	Calculated CV	Calculated Rel Precision
June	210	0.075	2.275	±6.3%
July	102	0.091	1.884	±5.3%
August	189	0.104	1.747	±5.2%
Average Summer	501	0.088	1.967	±3.6%

Table i - 3: Summer Seasonal Peak CFs and Relative Precisions Residential Lighting

	Winter Seasonal Peak Hours (90% of 50/50 peak)			
Data Period	Sample Size n	Un-weighted CF	Calculated CV	Calculated Rel Precision
December	282	0.249	1.23	±4.5%
January	264	0.279	1.19	±4.5%
Average Winter	546	0.264	1.21	±3.2%

Table i - 4: Winter Seasonal Peak CFs and Relative Precisions Residential Lighting

Table i - 5 and Table i - 6 presents a comparison of the CFs calculated for the On-Peak Performance hours and the Seasonal Peak Performance hours for both the summer and winter periods. The results show that the Summer Seasonal Peak CF increases over the Summer On-Peak for each month during the summer period and the Average Summer CF increases by 16% from 0.076 to 0.088. The increase is due to a wider range of hours being included in the weighted average calculation including more evening hours, when the CFs are higher. The reverse is true for the Winter Seasonal Peak CFs, which is lower than the Winter On-Peak CFs with the Average Winter CF decreasing by 8% from about 0.29 to 0.26. The decrease is due to a wider range of hours being included in the weighted average calculation including more morning and afternoon hours, when the CFs are lower.

Data Period	On-Peak Un-weighted CF	Seasonal Un-weighted CF	% Change Seasonal/ On-Peak
June	0.060	0.075	126%
July	0.081	0.091	112%
August	0.094	0.104	111%
Average Summer	0.076	0.088	116%

Table i - 5: Comparison of Summer On-Peak and Seasonal Peak CFs Residential Lighting

Data Period	On-Peak Un-weighted CF	Seasonal Un-weighted CF	% Change Seasonal/ On-Peak
December	0.263	0.249	95%
January	0.301	0.279	93%
Average Winter	0.286	0.264	92%

Table i - 6: Comparison of Winter On-Peak and Seasonal Peak CFs Residential Lighting

Commercial & Industrial Lighting Coincidence Factor Results

A similar Coincidence Factor analysis was also conducted for Commercial and Industrial Lighting and Occupancy Sensor measures. The logger data were analyzed by sector so that results could be applied to multiple programs with different participation rates among the different sectors. Table i - 7and Table i - 8 provide the On-Peak CFs for the ten C&I sectors along with the associated relative precisions and total estimated CFs based on a logger weighted strategy and weighting each sector equally. The Summer On-Peak CFs indicates that the Grocery sector has the highest CF of about 0.95, while the Other sector has the lowest CF of about 0.54. All of the sectors have relative precisions that are within ± 5% at the 80% confidence interval. The Grocery sector also had the highest Winter On-Peak CF of about 0.78, while the School sector had the lowest CF of about 0.34. Once again the relative precisions were all quite good with each sector exceeding ± 10% at the 80% confidence interval. As expected the Winter On-Peak CFs were lower than the Summer On-Peak CFs for all of the C&I lighting sectors, because the performance hours occur later in the day as C&I facilities are shutting down and lighting is being switched off.

	Summer On-Peak Hours 1PM - 5PM				
Sector Type	**Sample Size n**	**Calculated CF**	**Logger Weight**	**Calculated CV**	**Calculated Rel Precision**
Grocery	37	0.948	0.026	0.179	±1.9%
Manufacturing	169	0.729	0.119	0.488	±2.4%
Medical (Hospital)	58	0.769	0.041	0.425	±3.6%
Office	259	0.750	0.183	0.438	±1.7%
Other	192	0.543	0.136	0.675	±3.1%
Restaurant	43	0.811	0.030	0.347	±3.4%
Retail	166	0.824	0.117	0.342	±1.7%
University/College	70	0.680	0.049	0.483	±3.7%
Warehouse	59	0.781	0.042	0.359	±3.0%
School	362	0.633	0.256	0.503	±1.7%
Total Weighted by Logger		0.704	1.000		
Total Equal Weight by Sector		0.747			

Table i - 7: Summer On-Peak CFs and Relative Precision C&I Lighting

	Winter On-Peak Hours 5PM - 7PM				
Sector Type	**Sample Size n**	**Calculated CF**	**Logger Weight**	**Calculated CV**	**Calculated Rel Precision**
Grocery	37	0.776	0.026	0.474	±7.1%
Manufacturing	169	0.399	0.119	0.983	±6.9%
Medical (Hospital)	58	0.603	0.041	0.593	±7.1%
Office	259	0.537	0.183	0.725	±4.1%
Other	192	0.426	0.136	0.804	±5.3%
Restaurant	43	0.663	0.030	0.557	±7.7%
Retail	166	0.655	0.117	0.592	±4.2%
University/College	70	0.523	0.049	0.679	±7.4%
Warehouse	59	0.496	0.042	0.787	±9.3%
School	362	0.343	0.256	1.010	±4.8%
Total Weighted by Logger		0.480	1.000		
Total Equal Weight by Sector		0.542			

Table i - 8: Winter On-Peak CFs and Relative Precision C&I Lighting

Table i - 9and Table i - 10 provide the Summer and Winter Seasonal-Peak CFs for the ten C&I sectors along with the associated relative precisions and total estimated CFs based on a logger weighted strategy and weighting each sector equally (which is the simple average of the CFs across all sectors. The Seasonal Peak Performance Hours were determined by analysis of historic ISO-NE Load Data and Forecast Data to determine the frequency distribution for each hour where the demand was greater than or equal to 90% of the seasonal forecast. A simple probabilistic weighting scheme was applied based upon the number of observation during each hour as described in section

3 of this report. The Summer Seasonal-Peak CFs indicates that the Grocery sector has the highest CF of about 0.90, while the Other sector has the lowest CF of about 0.48. All of the sectors have relative precisions that are within ± 5% at the 80% confidence interval during the Summer Seasonal Peak hours. The Grocery sector also had the highest Winter On-Peak CF of about 0.78, while the School sector had the lowest CF of about 0.34. Once again the relative precisions were all quite good with each sector exceeding ± 10% at the 80% confidence interval. As expected the Winter On-Peak CFs were lower than the Summer On-Peak CFs for all of the C&I lighting sectors, because the performance hours occur later in the day as C&I facilities are shutting down and lighting is being switched off.

	Summer Seasonal Peak Hours (90% of 50/50 Peak)				
Sector Type	Sample Size n	Calculated CF	Logger Weight	Calculated CV	Calculated Rel Precision
Grocery	37	0.904	0.026	0.23	±1.5%
Manufacturing	169	0.671	0.119	0.52	±1.7%
Medical (Hospital)	58	0.740	0.041	0.45	±2.5%
Office	259	0.702	0.183	0.48	±1.2%
Other	192	0.476	0.136	0.75	±3.0%
Restaurant	43	0.775	0.030	0.40	±2.5%
Retail	166	0.795	0.117	0.38	±1.2%
University/College	70	0.650	0.049	0.51	±2.5%
Warehouse	59	0.727	0.042	0.41	±2.2%
School	362	0.599	0.256	0.48	±1.1%
Total Weighted by Logger		0.660	1.000		
Total Equal Weight by Sector		0.704			

Table i - 9: Summer Seasonal Peak CFs and Relative Precision C&I Lighting

	Winter Seasonal Peak Hours (90% of 50/50 Peak)				
Sector Type	Sample Size n	Calculated CF	Logger Weight	Calculated CV	Calculated Rel Precision
Grocery	37	0.770	0.026	0.44	±4.6%
Manufacturing	169	0.432	0.119	0.91	±4.2%
Medical (Hospital)	58	0.618	0.041	0.58	±4.5%
Office	259	0.539	0.183	0.71	±2.6%
Other	192	0.428	0.136	0.80	±4.4%
Restaurant	43	0.644	0.030	0.59	±5.3%
Retail	166	0.647	0.117	0.59	±2.7%
University/College	70	0.528	0.049	0.60	±4.2%
Warehouse	59	0.535	0.042	0.70	±5.6%
School	362	0.388	0.256	0.85	±2.7%
Total Weighted by Logger		0.497	1.000		
Total Equal Weight by Sector		0.553			

Table i - 10: Winter Seasonal Peak CFs and Relative Precision C&I Lighting

Table i - 11 provides a comparison of the Summer On-Peak and Seasonal Peak CFs for each of the C&I sectors, which shows that for every sector the Summer Seasonal CFs are lower than the Summer On-Peak CFs. This means that if the C&I lighting were classified as Summer Seasonal Peak assets the demand reductions would be lower.

	Summer		% Change
Sector Type	On-Peak CF	Seasonal CF	Seasonal / On-Peak
Grocery	0.948	0.904	95%
Manufacturing	0.729	0.671	92%
Medical (Hospital)	0.769	0.740	96%
Office	0.750	0.702	94%
Other	0.543	0.476	88%
Restaurant	0.811	0.775	96%
Retail	0.824	0.795	96%
University/College	0.680	0.650	96%
Warehouse	0.781	0.727	93%
School	0.633	0.599	95%
Total Weighted by Logger	0.704	0.660	94%
Total Equal Weight by Sector	0.747	0.704	94%

Table i - 11: Comparison of Summer On-Peak and Seasonal Peak CFs C&I Lighting

Table i - 12 provides a similar comparison of the Winter On-Peak and Seasonal Peak CFs for each of the C&I Lighting sectors. In this case the results are mixed, with 7 of the 10 sectors showing an

increase in the Winter Seasonal Peak CFs compared to the Winter On-Peak CF. This seems to indicate that in general for the winter, C&I lighting would have more demand reduction if classified as a Seasonal Peak asset.

	Winter		% Change
Sector Type	On-Peak CF	Seasonal CF	Seasonal / On-Peak
Grocery	0.776	0.770	99%
Manufacturing	0.399	0.432	108%
Medical (Hospital)	0.603	0.618	103%
Office	0.537	0.539	101%
Other	0.426	0.428	100%
Restaurant	0.663	0.644	97%
Retail	0.655	0.647	99%
University/College	0.523	0.528	101%
Warehouse	0.496	0.535	108%
School	0.343	0.388	113%
Total Weighted by Logger	0.480	0.497	104%
Total Equal Weight by Sector	0.542	0.553	102%

Table i - 12: Comparison of Winter On-Peak and Seasonal Peak CFs C&I Lighting

Commercial & Industrial Occupancy Sensor Coincidence Factor Results

Table i - 13 and Table i - 14 present the Summer On-Peak and Winter On-Peak CFs for occupancy sensors for seven of the ten C&I sectors as well as the total CFs for all seven sectors on a logger weighted basis and by weighting each sector equally. During the Summer On-Peak Period the occupancy sensors installed in the University/College sector had the highest CF of about 0.30, while the Other sector had the lowest CF of about 0.02. The Summer On-Peak CF for the remaining sectors ranged from about 0.21 for Manufacturing to 0.27 for the Office Sector. During the Winter On-Peak the Office sector had the highest CF of about 0.31 and the Other sector had the lowest CF of 0.09. The CFs for the remaining sectors ranged from a low of about 0.17 for the Warehouse sector to a high of about 0.23 for the University/College sector. The relative precision for all of the CFs were estimated by calculating the relative precision of the occupancy sensors profiles, since only aggregate savings profiles were developed for the analysis. In this case we would recommend using the logger weighted Total CFs since the relative precision for individual sector results are not that good particularly during the Winter period.

	Summer On-Peak Hours 1PM - 5PM				
Data Period	Sample Size n	Calculated CF	Logger Weight	Estimated CV	Estimated Rel Precision
Manufacturing	12	0.210	0.035	0.688	±12.7%
Medical	59	0.234	0.170	0.602	±5.0%
Office	69	0.270	0.199	0.559	±4.3%
Other	56	0.017	0.161	0.793	±6.8%
University/College	16	0.304	0.046	0.678	±10.9%
Warehouse	77	0.266	0.222	0.646	±4.7%
School	58	0.239	0.167	0.828	±7.0%
Total Weighted by Logger		0.217	1.000		
Total Equal Weight by Sector		0.154			

Table i - 13: Summer On-Peak CFs and Relative Precision C&I Occupancy Sensors

	Winter On-Peak Hours 5PM - 7PM				
Sector Type	Sample Size n	Calculated CF	Logger Weight	Estimated CV	Estimated Rel Precision
Manufacturing	12	0.190	0.035	1.301	±34.1%
Medical	59	0.213	0.170	0.840	±9.9%
Office	69	0.309	0.199	1.087	±11.9%
Other	56	0.089	0.161	1.053	±12.8%
University/College	16	0.233	0.046	0.827	±18.8%
Warehouse	77	0.175	0.222	1.082	±11.2%
School	58	0.173	0.167	1.527	±18.2%
Total Weighted by Logger		0.197	1.000		
Total Equal Weight by Sector		0.138			

Table i - 14: Winter On-Peak CFs and Relative Precision C&I Occupancy Sensors

Table i - 15 and Table i - 16 provide the Summer Seasonal Peak and Winter Seasonal Peak CFs for the occupancy sensors for seven of the ten C&I sectors. Once again during the Summer Seasonal Peak hours the University/College sector occupancy sensors had the highest CF of about 0.28 and the Other sector had the lowest CF of about 0.02. The CFs for the remaining sectors ranged from about 0.20 to 0.27. The Winter Seasonal Peak CFs were similar to the Winter On-Peak results with the Office sector having the highest CF of about 0.30 and the Other sector having the lowest CF of about 0.07. Once again the relative precision of the CFs were estimated by using the occupancy sensor profiles and the results are better than for the On-Peak periods because the results were taken across more hours. The Summer Seasonal Peak estimated relative precisions for each of the sectors are all within ±10% at the 80% confidence interval, and Winter estimated relative precisions are also within that range for most of the sectors.

	Summer Seasonal Peak Hours (90% of 50/50 Peak)				
Data Period	Sample Size n	Calculated CF	Logger Weight	Estimated CV	Estimated Rel Precision
Manufacturing	12	0.198	0.035	0.712	±8.9%
Medical	59	0.239	0.170	0.649	±3.6%
Office	69	0.274	0.199	0.606	±3.2%
Other	56	0.024	0.161	0.808	±4.6%
University/College	16	0.283	0.046	0.720	±7.6%
Warehouse	77	0.246	0.222	0.700	±3.3%
School	58	0.209	0.167	0.739	±4.2%
Total Weighted by Logger		0.208	1.000		
Total Equal Weight by Sector		0.147			

Table i - 15: Summer Seasonal-Peak CFs and Relative Precision C&I Occupancy Sensors

	Winter Seasonal Peak Hours (90% of 50/50 Peak)				
Data Period	Sample Size n	Calculated CF	Logger Weight	Estimated CV	Estimated Rel Precision
Manufacturing	12	0.172	0.035	1.063	±17.3%
Medical	59	0.221	0.170	0.827	±6.3%
Office	69	0.296	0.199	0.966	±6.9%
Other	56	0.066	0.161	0.990	±7.7%
University/College	16	0.231	0.046	0.819	±11.9%
Warehouse	77	0.183	0.222	0.986	±6.6%
School	58	0.159	0.167	1.140	±8.7%
Total Weighted by Logger		0.191	1.000		
Total Equal Weight by Sector		0.133			

Table i - 16: Winter Seasonal-Peak CFs and Relative Precision C&I Occupancy Sensors

Table i - 17 and Table i - 18 provide a comparison of the Summer and Winter On-Peak and Seasonal Peak CFs for occupancy sensors for seven C&I sectors as well as the totals for all seven sectors calculated on a logger weighted and sector weighted basis. The results for the Summer period show that the Summer Seasonal CFs are lower than the On-Peak CFs for four of the seven sectors and for the total CF using both calculation methods. The results for the Winter period are similar, with five of the sectors having lower Seasonal Peak CFs and lower Total CFs using both calculation methods. Classifying the occupancy sensors as Seasonal Peak assets would result in a slight reduction in demand savings during both periods.

Sector Type	Summer On-Peak CF	Summer Seasonal CF	% Change Seasonal / On-Peak
Manufacturing	0.210	0.198	94%
Medical	0.234	0.239	102%
Office	0.270	0.274	101%
Other	0.017	0.024	144%
University/College	0.304	0.283	93%
Warehouse	0.266	0.246	92%
School	0.239	0.209	87%
Total Weighted by Logger	0.217	0.208	96%
Total Equal Weight by Sector	0.154	0.147	96%

Table i - 17: Comparison of Summer On-Peak and Seasonal Peak CFs Occupancy Sensors

Sector Type	Winter On-Peak CF	Winter Seasonal CF	% Change Seasonal / On-Peak
Manufacturing	0.190	0.172	90%
Medical	0.213	0.221	104%
Office	0.309	0.296	96%
Other	0.089	0.066	75%
University/College	0.233	0.231	99%
Warehouse	0.175	0.183	105%
School	0.173	0.159	92%
Total Weighted by Logger	0.197	0.191	97%
Total Equal Weight by Sector	0.138	0.133	96%

Table i - 18: Comparison of Winter On-Peak and Seasonal Peak CFs Occupancy Sensors

Program Level C&I Lighting CF Calculations

Several of the study sponsors wanted to calculate the C&I Lighting CFs using an alternative method that grouped the logger data into two categories, Large C&I and Small C&I since this provides them with results that are more in-line with their tracking systems, which track results at the program level. The sponsors also wanted to estimate the electrical demand impacts attributable to the interaction between the lighting and the HVAC systems and those results are presented in the following sections as well. The new C&I lighting CFs and interactive effects were only developed for C&I lighting measures, occupancy sensor measures were not included as part of the analysis.

On-Peak Large and Small C&I Lighting Coincidence Factors

Table i - 19 and Table i - 20 provides the Summer and Winter On-Peak Coincidence Factors (CFs) for the Large and Small C&I sectors. For the Summer, the Large C&I has the higher On-Peak CF of about 0.74, while the Small C&I had a Summer On-Peak CF of 0.66. The Coefficient of Variation (CV) and relative precision are also provided and the relative precisions for both the Large and Small C&I CFs are better than ± 3% at the 80% confidence interval. For the Winter, the Large C&I had the higher CF of about 0.58, which was lower than the Summer On-Peak value because the performance hours occur later in the day. The Small C&I CF was about 0.42, which was not unexpected due to the time period of the performance hours. The relative precision for both the Large and Small C&I Winter On-Peak CFs was better than ± 5% at the 80% confidence interval.

	Summer On-Peak Hours 1PM - 5PM			
Program Type	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	408	0.736	0.425	±2.7%
Small C&I	496	0.661	0.497	±2.9%

Table i - 19: Summer On-Peak Coincidence Factors Large and Small C&I Lighting

	Winter On-Peak Hours 5PM - 7PM			
Program Type	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	408	0.576	0.679	±4.3%
Small C&I	496	0.418	0.853	±4.9%

Table i - 20: Winter On-Peak Coincidence Factors Large and Small C&I Lighting

Seasonal Peak Large and Small C&I Lighting Coincidence Factors

Table i - 21 and Table i - 22 provides the Summer and Winter Seasonal Peak CFs for the Large and Small C&I sectors. All of the Seasonal Peak CFs were calculated using the probabilistic hourly values that were developed using historical ISO-NE load and load forecasts as described in the Seasonal Peak analysis section of this report. For the Summer, the results are similar to the On-Peak results however the Seasonal Peak values are lower for both the Large and Small C&I lighting. This is due to the fact that there are more evening hours included in the CF calculation where the lighting operates at a reduced percent on. Once again note that the relative precisions

for both the Large and Small C&I CFs are better than ± 3% at the 80% confidence interval. For the Winter, the results are similar to the On-Peak results however the Seasonal Peak values are slightly higher for both Large and Small C&I lighting. This is due to the fact that there are more morning and afternoon hours included in the CF calculation where the lighting operates at a higher percent on. Once again note that the relative precision for each of the C&I sector CFs is better than ± 5% at the 80% confidence interval.

	Summer Seasonal Peak Hours (90% of 50/50 Peak)			
Program Type	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	408	0.714	0.416	±2.6%
Small C&I	496	0.613	0.493	±2.8%

Table i - 21: Summer Seasonal Peak Coincidence Factors Large and Small C&I Lighting

	Winter Seasonal Peak Hours (90% of 50/50 Peak)			
Program Type	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	408	0.595	0.590	±3.7%
Small C&I	496	0.431	0.738	±4.2%

Table i - 22: Winter Seasonal Peak Coincidence Factors Large and Small C&I Lighting

Comparison of On-Peak and Seasonal Peak CFs for C&I Lighting

Table i - 23 provides a comparison of the Summer On-Peak and Seasonal Peak CF for the Large and Small C&I Lighting, which shows that the On-Peak CF is higher than the Seasonal Peak CF. This is due to inclusion of more evening hours in the Seasonal Peak CF calculation when the percent on for the lighting is lower. This means that if the C&I Lighting measures were classified as Summer Seasonal Peak assets instead of Summer On-Peak assets the demand reduction would be lower for both Large and Small C&I Lighting. Table i - 24 provides the same comparison for the Winter On-Peak and Seasonal Peak CFs for C&I Lighting. In this case the Winter Seasonal Peak CFs are higher than the Winter On-Peak CFs. This indicates that for the Winter, both Large and Small C&I Lighting would have more demand reduction if classified as a Seasonal Peak asset.

Program Type	Summer On-Peak CF	Summer Seasonal CF	% Change Seasonal/ On-Peak
Large C&I	0.736	0.714	97%
Small C&I	0.661	0.613	93%

Table i - 23: Comparison of Summer On-Peak and Seasonal Peak CFs C&I Lighting

Program Type	Winter On-Peak CF	Winter Seasonal CF	% Change Seasonal/ On-Peak
Large C&I	0.576	0.595	103%
Small C&I	0.418	0.431	103%

Table i - 24: Comparison of Winter On-Peak and Seasonal Peak CFs C&I Lighting

Commercial & Industrial Interactive Demand Coincidence Factors

Table i - 25 and Table i - 26 provides the Interactive Summer and Winter On-Peak CFs for the Large and Small C&I sectors. For the Summer, the Large C&I has the higher Interactive On-Peak CF of about 0.14, while the Small C&I had an Interactive Summer On-Peak CF of 0.13. The Coefficient of Variation (CV) and relative precision are also provided and the relative precisions for both the Large and Small C&I CFs are better than ± 6% at the 80% confidence interval. For the Winter, the Small C&I sector has the higher Interactive On-Peak CF of about -0.05, while the Large C&I sector had an Interactive Winter On-Peak CF of -0.004. The Coefficient of Variation (CV) and relative precision are also provided and the relative precisions for both the Large C&I CF was ± 72% and the Small C&I CF was ± 27% at the 80% confidence interval. This was because CFs are so small and the coefficients of variation are so large.

Program Type	Interactive Summer On-Peak Hours 1PM - 5PM Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	0.139	0.718	±4.7%
Small C&I	425	0.125	0.907	±5.6%

Table i - 25: Interactive Summer On-Peak Coincidence Factors C&I Lighting[2]

[2] The number of log files (n) is lower than in the previous tables because we were unable to determine the maximum lighting demand reduction and were therefore unable to calculate the interactive demand reduction. In order to calculate the interactive CF it was necessary to calculate the interactive demand

Program Type	Interactive Winter On-Peak Hours 5PM - 7PM			
	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	-0.004	10.955	±72.4%
Small C&I	425	-0.051	4.273	±26.6%

Table i - 26: Interactive Winter On-Peak Coincidence Factors C&I Lighting

Table i - 27 provides the Interactive Summer Seasonal Peak CFs for the Large and Small C&I sectors. All of the Interactive Seasonal Peak CFs were calculated using the probabilistic hourly values that were developed using historical ISO-NE load and load forecasts as described in the Seasonal Peak analysis section of this report. The sector level results are similar to the Interactive Summer On-Peak results however the Interactive Summer Seasonal Peak values are higher. This is due to the fact that the Seasonal peak hours occur during times of high ambient temperatures when AC systems are operating and some Summer On-Peak hours occur at times of low ambient temperature when cooling systems are not operating. Once again note that the relative precisions for both the Large and Small C&I CFs are better than ± 6% at the 80% confidence interval.

Program Type	InteractiveSummer Seasonal Peak Hours (90% of 50/50 Peak)			
	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	0.154	0.714	±4.7%
Small C&I	425	0.137	0.907	±5.6%

Table i - 27: Interactive Summer Seasonal Peak Coincidence Factors C&I Lighting

Table i - 28 provides the Interactive Winter Seasonal Peak CFs for the Large and Small C&I sectors. All of the Interactive Seasonal Peak CFs were calculated using the probabilistic hourly values that were developed using historical ISO-NE load and load forecasts as described in the Seasonal Peak analysis section of this report. The sector level results are similar to the Interactive Winter On-Peak results however the Interactive Winter Peak values are slightly higher. Once again note that the relative precision for the Large C&I CF was ± 75% and the Small C&I CF was ± 26% at the 80% confidence interval because of the very small CFs and large coefficients of variation.

reduction and the lighting demand reduction based on the lighting CF for the logger so that the dimensionless ratio could be calculated.

Program Type	Interactive Winter Seasonal Peak Hours (90% of 50/50 Peak)			
	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	-0.004	11.341	±75.0%
Small C&I	425	-0.050	4.249	±26.4%

Table i - 28: Interactive Winter Seasonal Peak Coincidence Factors C&I Lighting

Combined C&I Lighting and Interactive Demand Coincidence Factors

An estimate of the combined Lighting and Interactive Demand CFs can be calculated by adding the Lighting and Interactive CFs together. These values could be used to determine the total demand reduction including interactive effects. Table i - 29 through Table i - 32 present the Summer and Winter, On-Peak and Seasonal Peak Combined CFs. Note that the relative precisions for both the Large and Small C&I CFs are better than ± 7% at the 80% confidence interval.

Program Type	Combined CF Summer On-Peak Hours 1PM - 5PM			
	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	0.877	0.385	±2.5%
Small C&I	425	0.798	0.456	±2.8%

Table i - 29: Combined Summer On-Peak Coincidence Factors C&I Lighting

Program Type	Combined CF Winter On-Peak Hours 5PM - 7PM			
	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	0.576	0.685	±4.5%
Small C&I	425	0.369	1.117	±6.9%

Table i - 30: Combined Winter On-Peak Coincidence Factors C&I Lighting

Program Type	Combined CF Summer Seasonal Peak Hours (90% of 50/50 Peak)			
	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	0.871	0.376	±2.5%
Small C&I	425	0.758	0.458	±2.8%

Table i - 31: Combined Summer Seasonal Peak Coincidence Factors C&I Lighting

	Combined CF Winter Seasonal Peak Hours (90% of 50/50 Peak)			
Program Type	Sample Size n	Calculated CF	Calculated CV	Calculated Rel Precision
Large C&I	376	0.594	0.598	±4.0%
Small C&I	425	0.382	0.993	±6.2%

Table i - 32: Combined Winter Seasonal Peak Coincidence Factors C&I Lighting