Table 5–6 provides the hourly frequencies for the summer season, showing that for June, six of the eight seasonal peak hours occurred during the same hours as the on-peak hours. There were no seasonal peak hours in July or August (non-holiday weekdays from 1 PM to 5 PM). The weights shown in the table along with the average monthly lighting profiles were used to calculate the 2008 summer seasonal peak CFs.

Table 5–6: Frequency Weighting for Summer Seasonal Peak Hours

Month	Hour Ending	Frequency	Weight
June/Summer Avg.	13	1	0.125
June/Summer Avg.	14	1	0.125
June/Summer Avg.	15	1	0.125
June/Summer Avg.	16	2	0.25
June/Summer Avg.	17	2	0.25
June/Summer Avg.	18	1	0.125
June/Summer Avg. Total		8	1

Table 5–7 provides the Winter Seasonal Peak Coincidence Factors for the each of the two winter months as well as the winter average for all of the residential lighting using the hourly frequencies for the 2007/2008 winter season to determine performance hours. The Winter Seasonal Peak monthly CFs range from 0.249 for December to 0.217 for January, and the average Winter Seasonal Peak CF is 0.226. The December Seasonal CF is identical to the On-peak CF because the performance hours are the same. Note that the Winter Seasonal Average has a relative precision of ±10.1% at the 80% confidence interval.

Table 5–7: Winter 2007/2008 Seasonal Peak Coincidence Factors

Date Period	2007/2008 Winter Seasonal Peak (90% of 50/50 CELT Peak)		
	Number of Products	Coincidence Factor	Relative Precision
December	64	0.249	±18.3%
January	164	0.217	±12.2%
Average Winter	**228**	**0.226**	**±10.1%**

Table 5–8 provides the Summer Seasonal Peak Coincidence Factors for the month of June, which was the only month during which the seasonal peak occurred. The average Summer Seasonal Peak CF is 0.110. The Summer Seasonal Average has a relative precision of ±9.8% at the 80% confidence interval.

Table 5–8: Summer 2007/2008 Seasonal Peak Coincidence Factors

Data Period	2007/2008 Summer Seasonal Peak (90% of 50/50 CELT Peak)		
	Number of Products	Coincidence Factor	Relative Precision
June	632	0.110	±9.8%
Average Summer	**632**	**0.110**	**±9.8%**

5.4 Post Stratification Analysis

This section presents the post stratification of coincident factors and hours of operation.

5.4.1 Coincident Factors

The NMR team examined the impact of the room or place being served by the markdown CFL on monthly weekday lighting load profiles. Table 5–9 shows the winter on-peak CFs broken out by room type category. These values range from a high of 0.302 in living rooms, family rooms, offices, kitchen, and dining rooms to a low of 0.146 in all ‘other’ rooms in the home.

Table 5–9: Winter On-Peak Coincidence Factors by Room Type

Room Type	Winter On-Peak Hours 5 PM-7 PM		
	Number of Products	Coincidence Factors	Relative Precision
LR/FR/Off/Kitch/DR	108	0.302	±11.7%
Other	120	0.146	±37.2%
Average Winter	**228**	**0.220**	**±10.2%**

Table 5–10 presents the summer on-peak CFs by room type category ranging from a high of 0.110 in living rooms, family rooms, offices, kitchens, and dining rooms to a low of 0.106 in all ‘other’ rooms in the home.

Table 5–10: Summer On-Peak Coincidence Factors by Room Type

Room Type	Summer On-Peak Hours 1 PM-5 PM		
	Number of Products	Coincidence Factors	Relative Precision
LR/FR/Off/Kitch/DR	864	0.110	±8.3%
Other	1,026	0.106	±8.4%
Average Summer	**1,890**	**0.108**	**±5.9%**

The team also examined CFs for the markdown CFLs installed in hard-wired fixtures and portable lamps (e.g., table and floor lamps). Table 5–11 provides the winter on-peak CFs by these lighting applications. The CF for fixtures is 0.194, while the value for lamps is 0.265. Fixtures achieved better precision (±13.2%) than lamps (±16.1%).

Table 5–11: Winter On-Peak Coincidence Factors by Application

Application	Winter On-Peak Hours 5 PM-7 PM		
	Number of Products	Coincidence Factors	Relative Precision
Fixtures	145	0.194	±13.2%
Lamps	83	0.265	±16.1%
Average Winter	**228**	**0.220**	**±10.2%**

Table 5–12 shows the summer on-peak CFs by the type of fixture in which markdown CFLs are installed. The CF for portable lamps is 0.084 and for hard-wired fixtures is 0.123. The precisions around these estimates are ±10.7% and ±7.0%, respectively.

Table 5–12: Summer On-Peak Coincidence Factors by Application

Application	**Summer On-Peak Hours 1 PM-5 PM**		
	Number of Products	Coincidence Factors	Relative Precision
Fixtures	1,133	0.123	±7.0%
Lamps	757	0.084	±10.7%
Average Summer	**1,890**	**0.108**	**±5.9%**

5.5 Hours of Use Analyses

We conducted four different analyses related to hours of use. The first analysis estimates hours of use by room and fixture type. The second reports the monthly operating hours for the CFLs logged in this study, and compares hours of use to previous studies of CFL use from New England. The third compares customer-reported hours of use from the on-site survey to actual hours of use collected from the loggers. The final set of analyses examines whether or not actual hours of use differs by the number of CFLs installed in households.

5.5.1 Hours of Use by Room and Fixture Type

Table 5–13 shows annual hours of use broken out by room type category. Living rooms, family rooms, offices, kitchens, and dining rooms averaged approximately 1,084 hours annually, while all ‘other’ rooms averaged 747 annual hours.

Table 5–13: Annual Hours of Use by Room Type

Room Type	**Sample Size (n)**	**Annual Hours**	**Relative Precision**
LR/FR/Off/Kitch/DR	303	1,083.5	±10.4%
Other	358	747.0	±11.5%
Overall	**661**	**901.2**	**±7.7%**

Table 5–14 presents the hours of annual use by the fixture type in which markdown CFL are installed. Hard-wired fixtures averaged 924 annual hours while portable lamps averaged 869 hours annually.

Table 5–14: Annual Hours of Use by Application

Application	**Sample Size (n)**	**Annual Hours**	**Relative Precision**
Fixtures	390	923.7	±10.1%
Lamps	271	868.9	±12.1%
Overall	**661**	**901.2**	**±7.7%**

5.5.2 Monthly Operating Hours

Table 5–15 compares the monthly operating hours from the current study to those from long-term metering studies performed for NEES in 1994[32] and in MA, RI, and VT in 2004[33]. Due to the fact that very little monitoring took place in October (4 loggers) and November[34] (12 loggers), we assumed that the same proportion of hours that occurred during those months in the 2004 study also occurred in the current study (as shaded in the table). The table shows that participants in the current study had approximately 16.0% fewer hours of annual use (1,010 annually or 2.8 daily) than did the participants in the 1994 NEES study (1,202 annually; 3.3 daily), but 1.3% more hours than the 2004 MA, RI, VT study (996.7 annually; 2.7 daily). These results suggest that the use of markdown CFLs (as monitored in this study) is very similar to the use of other recently obtained CFLs (as monitored in the 2004 study) but has dropped since 1994. This straightforward comparison of the monitored results of the current and 2004 studies does not reflect adjustments made to operating hours in the 2004 study which were based on other data collected as a part of that impact evaluation. After applying the adjustments, the study recommended the usage of 3.2 operating hours for CFLs, pointing to a possible reduction in operating hours from the 2004 study to the current, although lacking similar inputs for the current study we cannot conclude this with confidence.

Table 5–15: Monthly Operating Hours Compared to Previous Studies

Month	Current Study		1994 NEES Study		2004 MA, RI, & VT	
	Total Wgtd Hours	% of Total Wgtd Annual Hours	Total Hours	% of Total Annual Hours	Total Hours	% of Total Annual Hours
January	103.5	10.25%	136.5	11.36%	97.3	9.76%
February	95.3	9.43%	137.1	11.41%	79.9	8.01%
March	77.6	7.69%	106.8	8.89%	87.0	8.73%
April	67.3	6.67%	96.8	8.05%	76.7	7.69%
May	73.4	7.27%	97.4	8.10%	74.7	7.49%
June	80.0	7.92%	84.8	7.05%	71.5	7.18%
July	77.1	7.64%	70.8	5.89%	69.3	6.96%
August	72.0	7.13%	61.8	5.14%	73.5	7.37%
September	71.4	7.07%	68.1	5.67%	79.8	8.01%
October	93.6	9.27%	83.2	6.92%	92.4	9.27%
November	98.0	9.71%	130.8	10.88%	96.8	9.71%
December	100.8	9.98%	127.9	10.64%	97.9	9.82%
Total	**1,010.0**[a]	**100.00%**	**1,202.0**	**100.00%**	**996.7**	**100.00%**
Number of products	661		n/a		92	

[a] Operating hours differ from those reported in Table 5–13 and Table 5–14

[32] Xenergy (1994) *Residential Lighting Study*, New England Electric Systems.

[33] RLW and NMR (2005) *Extended Residential Logging Results*, Massachusetts, Rhode Island, and Vermont Electric Utilities and Cape Light Compact.

[34] These loggers were installed in 2007 on products that were verified to be markdown products as part of the concurrent Northeast Lighting Persistence Study.

5.5.3 Comparing Customer-Reported and Logged Hours of Use

As part of the on-site survey, the technicians asked respondents how many hours they used all lighting products in their homes. These data were originally collected for a task on cost-effective installations, which the sponsors decided to drop from this evaluation. However, the sponsors expressed interest in an analysis that compared reported to actual hours of use. Therefore, to understand a customer's ability to provide accurate estimates of daily hours of use, we compared the customer-reported daily hours of use that were gathered through the on-site survey to the actual daily hours of use collected by the lighting loggers. Table 5–16 shows that the average customer-reported daily use (3.2 hours per day) was approximately 22% *higher* than the actual logger daily use (2.6 hours per day). In other words, the respondents overestimated how many hours they use the products.[35]

It is interesting that when customers reported less than 3 hours of use per day, their estimates (1.3 hours per day) were approximately 22% *less* than the actual daily hours of use (1.7 hours per day) on average—that is, those reported low hours of use typically underestimated usage, in contrast to the overall findings. Conversely, when customers reported 3 or more hours of use per day, their average estimates (5.8 hours per day) were approximately 49% *higher* than the actual daily hours of use (3.9 hours per day), in keeping with the overall results that respondents typically over estimate how many hours they use CFLs.

Table 5–16: Reported versus Logged Hours of Use

Customer Reported Hours Per Day	Average Reported Hours Per Day	Number of Loggers	Averaged Logged Hours per Day	% Difference
0 to 3 hours	1.3	309	1.7	-22.3%
3 or more hours	5.8	222	3.9	48.6%
All reported hours	**3.2**	**531**	**2.6[a]**	**22.4%**

[a] Estimate limited to the respondents who provided an estimate of their average reported hours of use for each product, so the average reported here differs from the 2.8 logged daily hours of use discussed in Section 5.5.1.

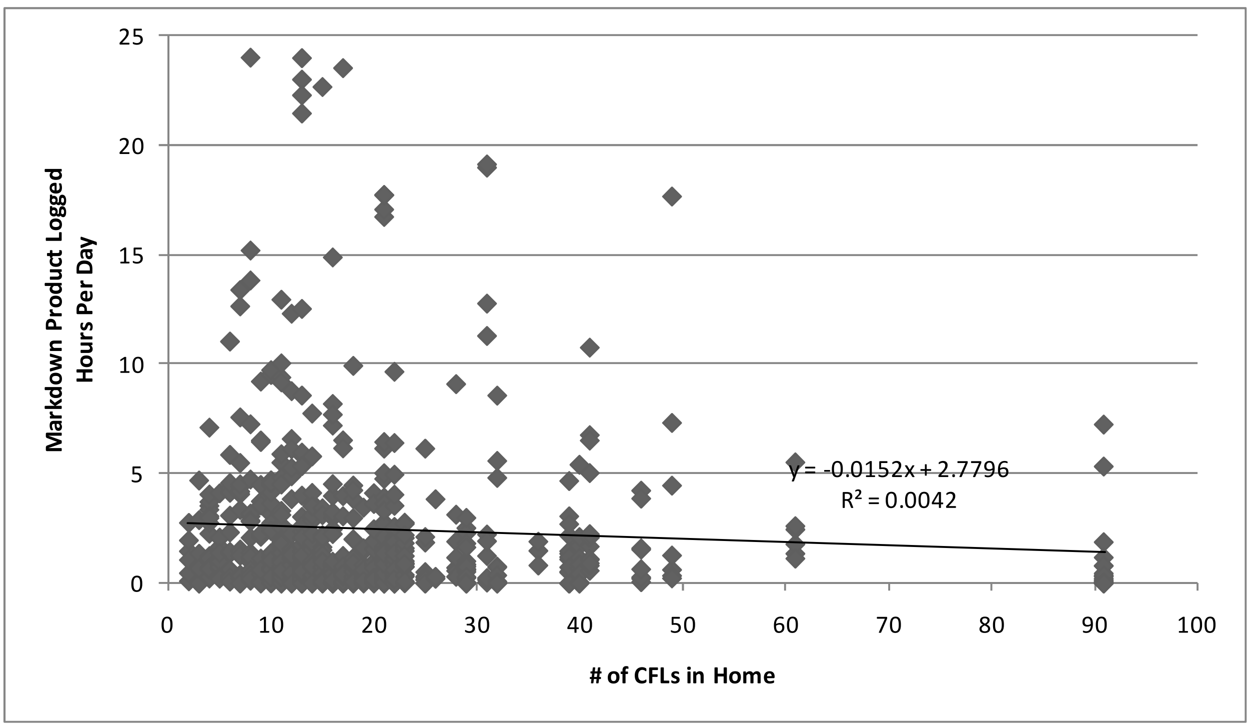
[35] One reviewer of a previous draft asked if customers round to the nearest half or full hour when giving their estimates of usage and what impact rounding might have on the results. We found that customers tend to round to the nearest quarter hour when giving estimates of less than one hour and to the nearest half hour when usage is more than one hour. All rounding in this open-ended question was done by the customer and not the analysts, so we do not believe it skews the results in any way.

5.5.4 Comparing Hours of Use by Number of CFLs Installed in the Home

During the summer of 2008, the sponsors requested an additional analysis of usage by how many CFLs respondents have installed in their homes. Figure 5-3 plots the daily hours of use gathered from each lighting logger against the number of CFLs installed in each home to examine whether use of markdown products differs by how many CFLs the respondents have installed in their homes overall. For example, one customer in the sample had 91 CFLs installed and operating at the time of our visit. The vertically plotted points in the figure at 91 on the x-axis represent the daily hours of use gathered by the loggers installed at this home.

The slight downward slope of the trend line suggests that respondents with more CFLs installed in their home tend to install markdown products in less frequently used fixtures than respondents with fewer CFLs. However, the coefficient of determination (R^2) value of 0.0042 shown in the figure suggests that the relationship between these two variables is very weak. This value means that only 0.42% of the variation found in the markdown product logged hours of daily use can be explained by the variation in the number of CFLs installed in each customer's home. Therefore, we find no statistically reliable evidence to support the hypothesis that hours of use differs by the number of CFLs installed in the home.[36]

Figure 5-3: Comparison of Logged Daily Hours of Use to Number of CFLs Installed in the Home



[36] A reviewer of this document suggested we try weighted least squares (WLS) regression, which we did. The results of the WLS regression suggested a similar pattern that in Figure 5-3 and the explained variance (R^2 improved only to 0.01.)

Figure 5-4 plots the daily hours of use gathered from each lighting logger against the number of markdown CFLs purchased by each household in the sample. The relationship between these two variables is even weaker than the relationship between the variables in Figure 5-3 above, and we find no statistically reliable evidence to support the hypothesis that hours of use differ by the number of markdown CFLs purchased by the homeowner.

Figure 5-4: Comparison of Logged Daily Hours of Use to Number of Markdown CFLs Purchased

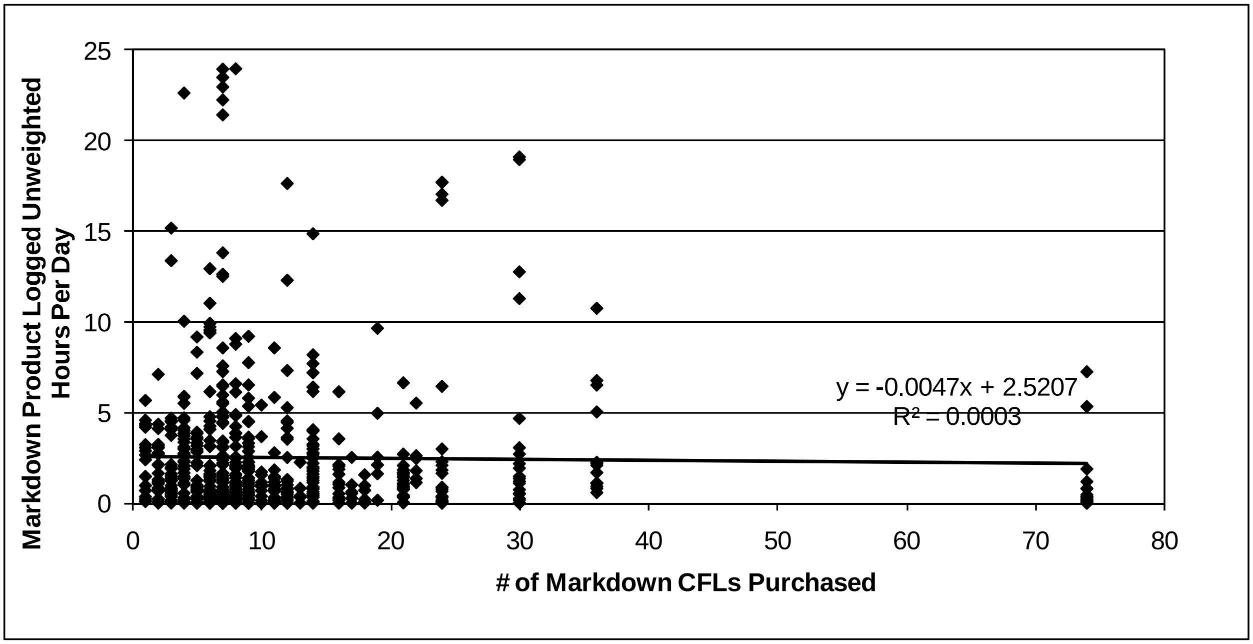


Figure 5-5 and Figure 5-6 on the next page present the strength of the relationship between the number of markdown CFLs purchased by the homeowners in the sample to the winter and summer coincidence factors, respectively. As was the case with the results in the figures above, these results do not provide any statistically reliable evidence to support the hypotheses that winter coincidence factors or summer coincidence factors differ by the number of markdown CFLs purchased by the homeowner.

Figure 5-5: Comparison of Logged Daily Hours of Use to Number of Markdown CFLs Purchased

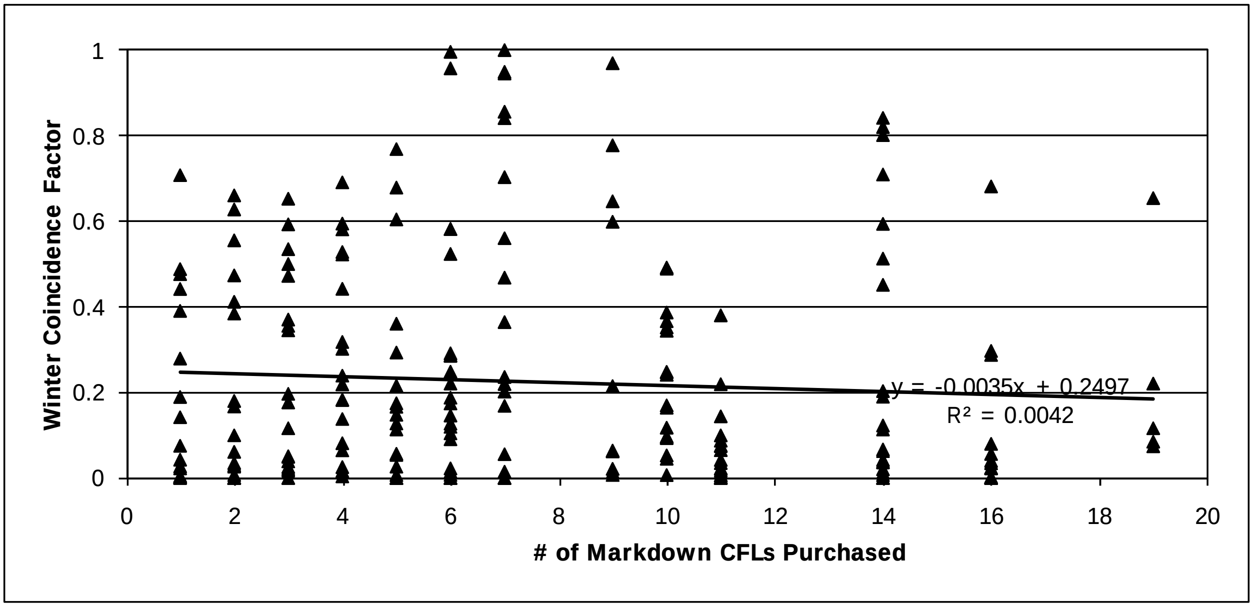
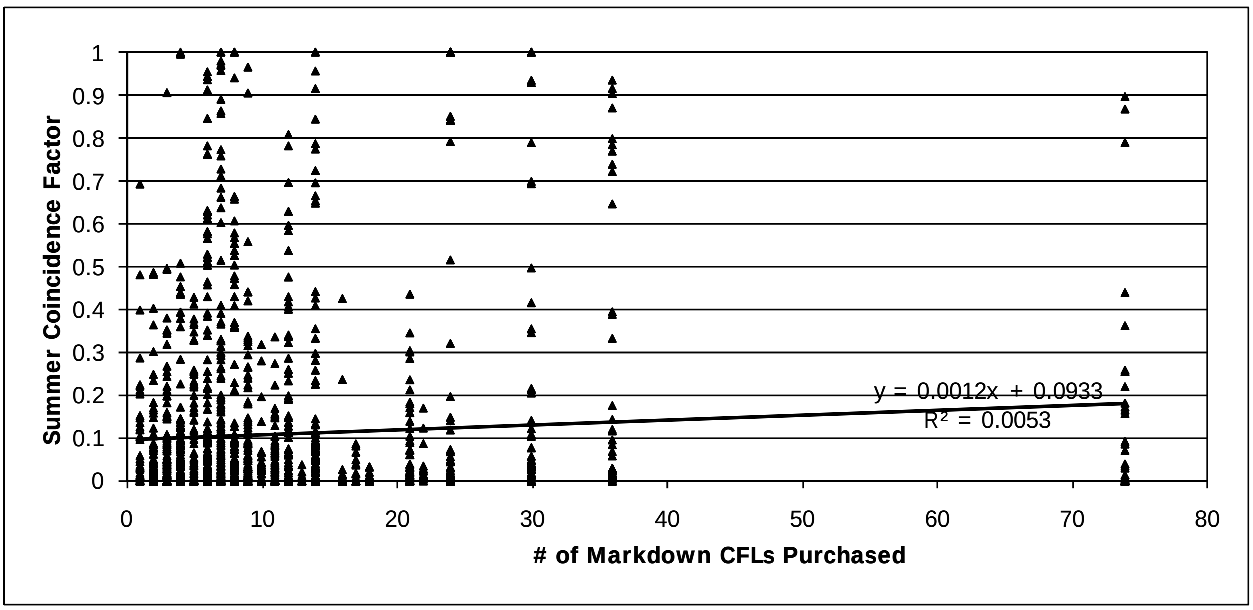


Figure 5-6: Comparison of Logged Daily Hours of Use to Number of Markdown CFLs Purchased



5.6 Bulb and Wattage Displacement

The sponsors use an estimate of delta watts—or the change in wattage between the previous bulb installed and the replacement CFL—in order to calculate energy savings. The on-site survey asked customers to report the wattage of the bulb they had installed prior to the current CFL, and then the technician noted the wattage of the CFL currently in place. This method is commonly used in studies of retail-based CFL programs; only in direct install programs can evaluators be certain of the wattage of the product being replaced by a CFL. Yet, it is true that all delta watt estimates reported here (including those from the measure life study) are based on customer self-report and subject to respondent recall error.

The results from the on-site survey and lighting inventory suggest that the wattage reduction associated with markdown CFLs in this study is 46 delta watts, a decrease from the 49 delta watts calculated for the MA-RI-VT study in 2004 (Table 5–17). The reduction in delta watts reflects the fact that current study participants originally had installed lower-wattage products that they then replaced with even lower wattage markdown CFLs. Surprisingly, respondents to both the current study and the 2004 MA-RI-VT study reported that only 2% of the currently installed CFLs replaced other CFLs—we had expected this percentage to rise in the current study. Therefore, we cannot assume that the lower wattage of the replaced bulbs was due to more of them being CFLs in the first place. It is also worth noting that, in the current study, respondents only reported replacing CFLs and incandescent bulbs with the markdown CFLs; no halogen, fluorescent, or other types of bulbs were replaced with markdown CFLs. Delta watts by load zone ranged from a low of 41.4 in Rhode Island to a high of 48.9 in West-Central Massachusetts. Table 5–18 presents the margin of error and 80% confidence interval around these estimates.

Table 5–17: Wattage Displacement by Load Zone

Load Zone	**# of Bulbs**	**Average Wattage, Logged CFLs**	**Average Wattage, Replaced Bulbs**	**Delta Watts**
Connecticut	297	15.0	62.7	47.7
Northeast MA	171	16.0	63.0	46.9
Southeast MA	209	14.9	59.6	44.7
West-Central MA	78	16.8	65.7	48.9
Rhode Island	174	15.0	56.4	41.4
Vermont	154	16.2	61.5	45.2
Overall	**1,083**	**15.5**	**61.2**	**45.7**
MA-RI-VT study	**170**	**20.7**	**69.4**	**48.7**

** Results reported only for products for which the wattage of both the original and replacement bulb were known. Includes products that were installed and then removed from service.

6 Conclusion: Updated Savings Parameters

The sponsors of the current markdown study also sponsored the New England Measure Life study. Together, these two studies have provided updated data that the sponsors may want to use in their calculations of energy savings.[39]

This study provides estimates of CFs, delta watts, and daily and annual hours of use. As its name implies, the measure life study provided estimates of how long CFLs survive, on average, once they have been obtained by consumers and installed. Table 6–1 displays each of these estimates together with its 80% confidence interval. The methods used to calculate most of these estimates have been described in detail in either the current markdown study or the measure life study.

Table 6–1: Savings Estimation Parameters

Parameter	Source	Precision Factor	Estimate	80% Confidence Interval	
				Low	High
Winter Coincidence Factor On-Peak	Markdown	±10.2%	0.220	0.198	0.242
Winter Coincidence Factor Seasonal	Markdown	±10.1%	0.226	0.203	0.249
Summer Coincidence Factor On-Peak	Markdown	±5.8%	0.108	0.102	0.114
Summer Coincidence Factor Seasonal	Markdown	±9.8%	0.110	0.099	0.121
Daily Hours of Use	Markdown		2.8	2.6	3.0
Annual Hours of Use	Markdown		1,022[b]	949	1,095
Delta Watts	Markdown		45.7	45.2	46.2
Markdown CFL Measure Life[a]	Measure Life		6.8	6.2	7.4
First Year Installation Rate	Both		76.6%	75.2%	78.1%
First Year Installation Rate	Markdown		76.6%	75.1%	78.2%
First-Year Installation Rate	Measure Life		76.8%	72.6%	81.0%
Lifetime Installation Rate	Both		97.6%	97.1%	98.1%
Lifetime Installation Rate	Markdown		97.4%	96.8%	98.0%
Lifetime Installation Rate	Measure Life		99.1%	98.1%	100.0%

[a] Based on CFLs models obtained through coupon and direct install programs that are also offered in various New England markdown programs.
[b] Calculated as 2.8 x 365. However, annual operating hours is listed as 1,010 in Table 5–15, with the difference being due to rounding error.

[39] In separate studies, the NMR team has developed additional estimates for the Massachusetts sponsors reported separately to them.

Appendix A: Demographic and Housing Characteristics

This appendix presents the demographic characteristics gathered during through the on-site participant survey and compares those characteristics, when possible, to the 2007 *American Community Survey* (ACS) conducted by the United States Bureau of the Census. We have combined the ACS data for the four states into one regional estimate for comparative purposes. The percentage of 'don't know/refused' responses, when shown, is based on the total number of respondents, while the actual responses to the question are based on the number of people/households responding. This keeps the on-site response groups comparable to those for the ACS.

An average 3.3 people lived in each household that participated in the on-site survey, which is larger than most households in the four-state study area (Table A–1). However, as our purpose was to log markdown CFLs and not a representative sample of households, we did not sample or weight by ownership patterns or any other demographic or housing characteristics.

Table A–1: Owner-Occupied Housing and Average Household Size

(Number of Households)

Measure	Winter	Summer	Overall	ACS
Owner-occupied	94%	90%	92%	77%
Average Household Size	3.3	3.2	3.3	2.6
Number of Households	**32**	**104**	**136**	**4,424,965**

Respondents to the on-site survey were more likely than adults overall to have received a bachelor's or graduate degree (Table A–2). Summer panel participants were more likely to have stopped their education at some college (including trade school or an associate's degree), while winter panel participants were more likely to have ceased their education with a high school diploma.

Table A–2: Educational Attainment

(Number of People)

Educational Attainment	Winter	Summer	Overall	ACS
Less than high school[a]	0%	2%	2%	12%
High school graduate	23%	11%	14%	29%
Some college, no degree[b]	13%	23%	20%	23%
Bachelor's degree[c]	35%	41%	39%	21%
Graduate or professional degree	29%	24%	25%	15%
Number of People[d]	**31**	**101**	**132**	**7,866,478**
Don't know/Refused	3%	3%	3%	n/a
Number of People	32	104	136	n/a

[a] Includes 'Less than 9th grade' and '9th to 12th grade, no diploma'
[b] Includes 'Technical and trade school graduates', 'those with associate's degrees'
[c] Includes 'College graduate' and 'those with some graduate education'
[d] Number of respondents for the on-site sample and number of people age 25 and older for the ACS

In keeping with higher educational attainment, respondents to the on-site survey generally had higher household incomes than households throughout the region (Table A–3). It is worth noting that 16% of the respondents refused to answer this question.

Table A–3: Household Income
(Households)

Household Income	Winter	Summer	Overall	ACS
Under $25,000	4%	6%	5%	20%
$25,000 - $34,999	4%	7%	6%	8%
$35,000 - $49,999	7%	15%	13%	12%
$50,000 - $74,999	25%	20%	21%	18%
$75,000 - $99,999	25%	16%	18%	14%
$100,000 - $149,999	29%	20%	22%	15%
$150,000 or more	7%	16%	14%	12%
Number of Households	**28**	**86**	**114**	**4,424,965**
Do not know/Refused	13%	17%	16%	n/a
Number of Households	32	104	136	n/a

More on-site respondents lived in single family attached or detached homes than did households throughout the region (Table A–4). However, more on-site respondents live in mobile homes or other types of units than did households throughout the four states included in this study.

Table A–4: Units in Housing Structure
(Households)

Units in Structure	Winter	Summer	Overall	ACS
Single-family attached or detached	85%	81%	82%	61%
Two or more units	15%	10%	11%	37%
Mobile homes and all other types of units	0%	9%	7%	1%
Number of Households	**32**	**104**	**136**	**4,424,965**

Respondents to the on-site survey tend to live in homes built 20 or more years ago (80%) (Table A–5). Although the ACS groupings are not entirely comparable to those used in the on-site survey, it is worth noting that 52% of the housing stock in the four-state region was built in or prior to 1950, suggesting that the homes in the sample are slightly older than homes regionally.

Table A–5: Age of Housing Structure[a]

Home Age	Winter	Summer	Overall
<1 year	0%	1%	<1%
1-5 years	9%	1%	3%
5-10 years	3%	5%	4%
10-20 years	9%	10%	10%
20-50 years	22%	50%	44%
>50 years	53%	30%	36%
Don't know	3%	3%	3%
Number of Households	32	104	136

[a] ACS data on age of housing units are not comparable due to different reported age groupings.

Finally, Figure A-1 displays the average number of occupants at home during each hour of the week day. Three occupants are generally homes from 5:00 PM of one evening through 6:00 AM the next morning. Two occupants are home from 7:00 AM until 9:00 AM, when just one person remains in the house until 3:00 PM and 4:00 PM. These patterns likely reflect individuals going to work and/or school. Occupancy patterns are similar in summer and winter, with the minor exception of the 7:00 AM hour when one fewer individual is in the home during the summer.

Figure A-1: Occupancy by Hour of the Week Day