Nexus Market Research, Inc.

RESIDENTIAL LIGHTING MARKDOWN IMPACT EVALUATION

FINAL

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Submitted to:

Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont

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1 Executive Summary

The purpose of this study was to provide updated information to the sponsors of markdown and buydown programs (hereafter markdown programs) in the New England states of Connecticut, Massachusetts, Rhode Island, and Vermont that would assist in their calculations of demand and energy savings for CFLs obtained through these programs (hereafter, markdown CFLs). Specifically, the report presents load shapes, coincidence factors, delta watts, daily and annual hours of use, and first-year and lifetime installation rates. Tasks completed toward the estimation of these parameters for calculating energy savings include:

- The development of a sample of markdown participants through a random digit dial (RDD) telephone survey
- An on-site survey and lighting inventory to gather information on factors related to lighting use (especially product placement and usage) and
- The logging of markdown CFLs installed in participating homes at the time of the on-site survey.

This executive summary summarizes the highlights and key findings of these activities.

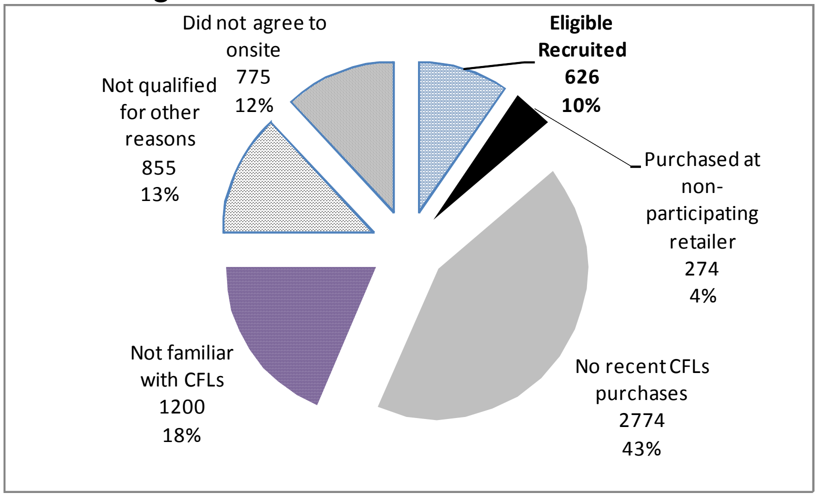
It is important to note that the evaluation team designed the RDD survey and sampled homes for the on-site visits with the sole purpose of finding recently purchased and installed markdown CFLs. This reflects a directive from the sponsors; the fact that the evaluation team was under tight time constraints related to the timing of the kickoff meeting (October 19, 2007), the need to identify a panel of participants and install loggers in their homes in time for the winter peak lighting period, and the sponsors' requirement that we provide preliminary winter load shape and coincidence factor results by February 28, 2008 necessitated the use of this method. The survey questionnaire and sampling techniques explicitly eliminated households that did not have recently purchased markdown CFLs installed in the home. The RDD and on-site surveys, furthermore, included very few questions on demographics, housing characteristics, or other issues that may help explain some of the findings reported below (although we provide breakdowns when possible and relevant by such variables as the number of recently obtained markdown CFLs in the home). In short, this study focused on finding and logging a representative sample of markdown CFLs to obtain the necessary information to update demand and energy savings parameters. It was not designed to provide a representative sample of households—or even all markdown purchases—in the region, nor was it meant to provide detailed information on all factors that may affect lighting in the home.

1.1 Task 2: Develop Sample of Product Purchasers (Chapter 3)

The NMR team relied on a brief RDD survey designed solely to determine if respondents had recently purchased and installed any markdown CFLs. We fielded the survey twice: the first from December 5 to December 16, 2007, to recruit households for the winter on-site logging panel, and the second in February 11 to March 10, 2008, to recruit households for the summer on-site logging panel. As soon as the interviewer could determine whether or not a respondentwas eligible for the on-site portion of this study and determined if the respondent was willing to do so, the call was terminated. The average respondent spent less than five minutes on the phone. It is important to keep in mind that the panel season refers to when the products were *logged* and not when they were *obtained*. Respondents purchased products logged for the winter panel between August and early December 2007, while products logged in the summer panel were obtained between November 2007 and February 2008.

Figure 1-1 presents the results of the recruitment efforts. Overall, about 10% of the respondents surveyed were both eligible for the on-site study and willing to take part in it. The lack of any recent purchases (43%) served as the most common reason for exclusion from the on-site study. As discussed in more detail in Chapter 3, a slightly greater percentage of winter panel respondents were eligible for and willing to take part in the on-sites (12%) than summer panel respondents (9%).

Figure 1-1: RDD Recruitment Results

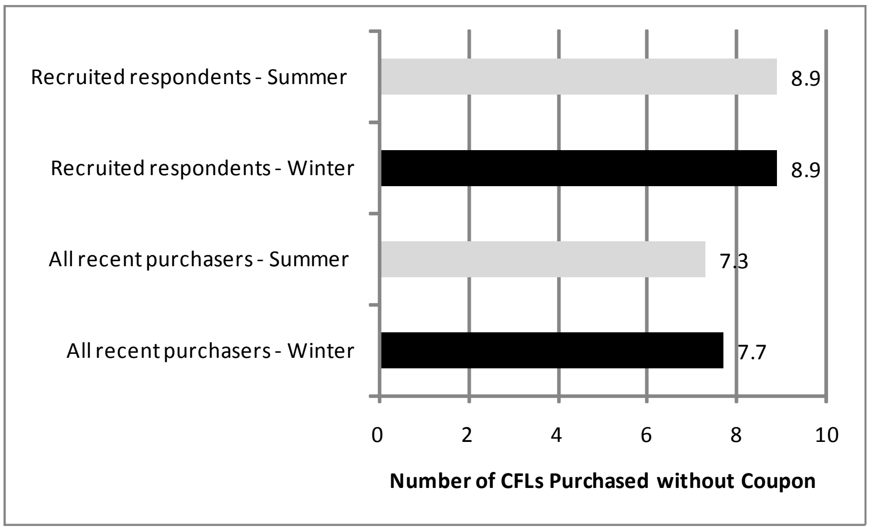


One of the screening questions asked respondents how familiar they were with CFLs. While 83% of winter panelists and 82% of summer panelists reported being at least ‘slightly familiar’ with CFLs, the percentage of summer panelist (70%) who stated that they were ‘very familiar’ with CFLs was significantly lower than among winter panelists (81%). Due to the nature of the recruitment survey, we did not collect information to help us explain this unexpected finding.[1]

[1] A reviewer voiced concern that awareness in this survey was lower than that estimated from a similarly worded question in the recent NMR (2008) *Telephone Survey Results for Market Progress and Evaluation Report (MPER) 2007 Massachusetts ENERGY STAR® Lighting Program.* The Massachusetts study suggested that familiarity was 89% (94% when descriptions of additional types of CFLs were included). We believe the discrepancy relates to the fact that the Massachusetts study included numerous call backs to boost response rates in an effort to represent the state population while the current survey focused less on response rates and more on getting people on the phone to find out if they had eligible products.

The data presented in Figure 1-2 show that 'recruited individuals'—that is, those who were eligible for and agreed to take part in the on-site—reported purchasing more CFLs in both the summer and winter panel than did all RDD survey respondents who had recently purchased CFLs. This suggests that recruited respondents may be more committed to CFLs than the other recent purchasers. While we did not collect information during the RDD survey to explore this question in more detail, the analyses reported in Chapter 4 examine such issues as the relationship between commitment to CFLs and the number of markdown CFLs found during on-site visits, as well as the type and age of home included in the on-site portion of the study.

Figure 1-2: Average Numbers of CFLs Purchased by Panel



The NMR team supplemented recruitment through the RDD survey by identifying households taking part in the New England measure life study who also had recent markdown purchases.[2] A total of 18 households were recruited into the current markdown study in this manner.

[2] NMR and RLW (2008) *Residential Lighting Measure Life Study*. Submitted June 10, 2008.

1.2 Task 4: Product Placement and Usage (Chapter 4)

After developing a sample of participants through the RDD survey, we created a sample design for the on-site visits that ensured we would visit homes in each load zone that had purchased various numbers of markdown CFLs. The design served only as a guide because the on-site conditions encountered by the technicians sometimes differed from what the respondent reported on the phone. Table 1–1 summarizes the disposition of products reported through the RDD survey, as well as additional recently purchased markdown products identified in the home that were not originally reported by the respondent during the RDD survey (i.e., the respondent forgot about them or obtained them between the RDD survey and the on-site visit). Differences observed between households recruited in the summer and winter panels are discussed in Chapter 4.

Table 1–1: Disposition of Products Reported as Purchased during RDD Phone Survey and All Qualified Markdown Purchases Found On-site
(Based on products found in homes identified through RDD survey)

Product Disposition	Overall	
	#	%
Markdown CFLs reported during phone survey (customer recall)	1,868	100%
RDD markdown CFLs reported and found	1,137	61%
RDD markdown CFLs reported but not purchased	703	38%
RDD markdown CFLs installed elsewhere	28	1%
All markdown CFLs found in home	1,544	100%
Markdown CFLs logged	1,073[a]	69%
RDD markdown CFLs logged	666	61%[a]
New markdown CFLs found and logged	407	38%[a]
Markdown CFLs eligible not logged	239	15%
Markdown CFLs in storage or removed	232	15%
Loggers placed in all homes	657	%

[a] Percentage based on the CFLs logged.

The markdown participants installed CFLs in a greater percentage of sockets (31%) compared to participants in the measure life study (27%) and the 2003 Residential Lighting Impact Study conducted for the sponsors in Massachusetts, Rhode Island, and Vermont (26%).[3] They also had a predisposition toward lower wattage lighting products, no matter what type of bulb was installed in the socket. Respondents who recently obtained eleven or more CFLs were the most likely to have a greater proportion of sockets devoted to CFLs and to have lower wattage lighting products installed throughout their homes. Such respondents, however, on average had a greater number of sockets in their homes. While we cannot explain this finding based on the data collected as part of this study, it may be that such respondents have more multiple-socket fixtures or circuits rated only for lower wattage products instead of a few higher-wattage fixtures.

[3] NMR and RLW (2008) *Measure Life.* NMR and RLW (2004) *Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs.* Submitted October 1, 2004.

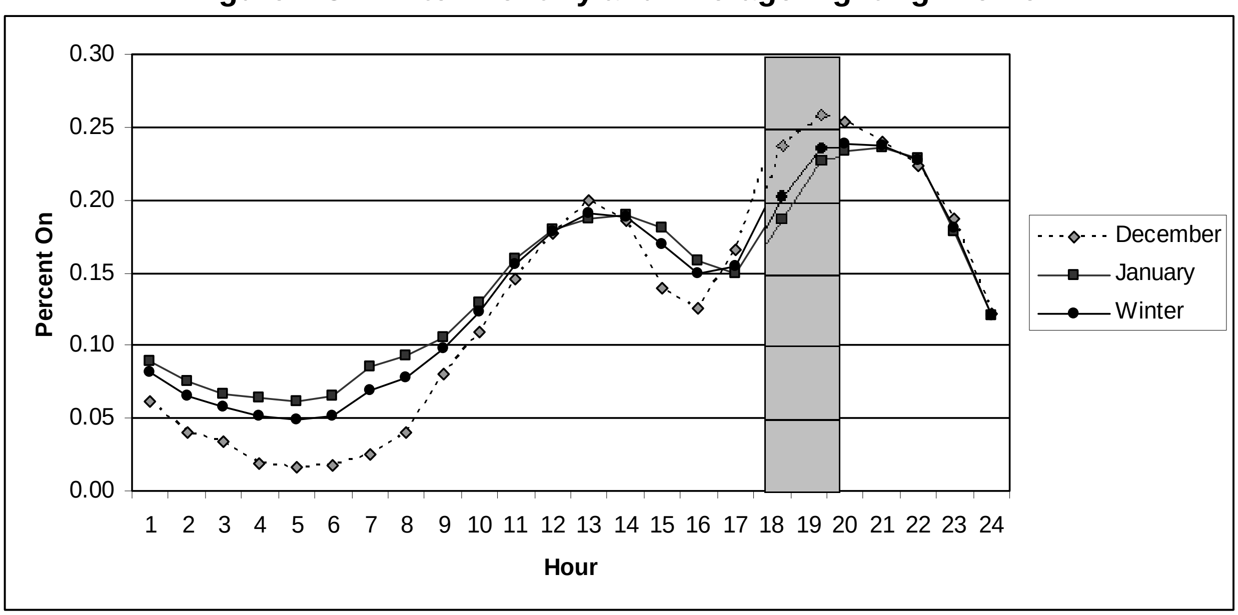
Alternatively, they may be installing lower-wattage products to reduce the electricity costs associated with having so many sockets in their homes.

1.3 Task 5: Energy and Demand Savings (Chapter 5)

This task involved the calculation and estimation of various parameters related to energy savings resulting from the use of markdown lighting products. Figure 1-3 and Figure 1-4 present the winter and summer lighting profiles and Table 1–2 summarizes the energy savings parameters, with related precision factors for the coincidence factors and 80% confidence intervals for all. Details on the development of these parameters as well as additional analyses and comparisons to other studies are presented in Chapter 5, but here we provide a simplified explanation of the data reported in Table 1–2.

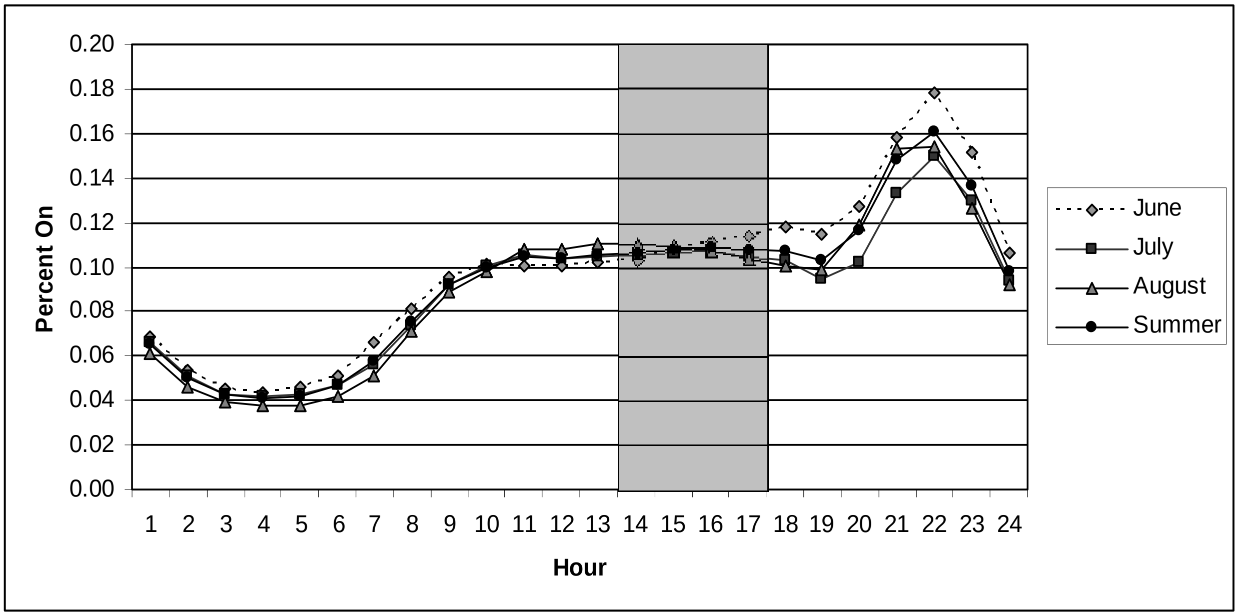
Coincidence factors are ratios that represent the percentage of CFL operation during a period of interest and are one component of the demand reduction calculation. The winter on-peak hours are during non-holiday weekdays from 5 PM to 7 PM. The summer on-peak hours are during non-holiday weekdays from 1 PM to 5 PM. Therefore, the operation of markdown CFLs coincides about 22% to 23% of the time with the period of peak electricity usage; in summer, the coincidence is around 11%. The other parameters in the table factor into the calculation of annual and lifetime energy savings. Average daily and annual hours of use are calculated from the amount of time the logger determined each markdown CFL was turned on. The typical change in watts is the average difference between the customer self-reported wattage of the bulb in place before the CFL was installed in the socket and the wattage of the CFL currently in the same socket. The first year installation rate denotes the percentage of markdown CFLs that get installed within a year of their purchase, while the lifetime installation rate is the percentage that will get installed at some point after the first year.

Figure 1-3: Winter Monthly and Average Lighting Profile[a]



[a] Results reported by the hour ending at the time listed.

Figure 1-4: Summer Monthly and Average Lighting Profile[a]



[a] Results reported by the hour ending at the time listed.

Table 1–2: Savings Estimation Parameters

Parameter	Estimate	Precision Factor	80% Confidence Interval	
			Low	High
Winter Coincidence Factor On-Peak	0.22	±10.2%	0.20	0.24
Winter Coincidence Factor Seasonal	0.23	±10.1%	0.20	0.25
Summer Coincidence Factor On-Peak	0.11	±5.8%	0.10	0.11
Summer Coincidence Factor Seasonal	0.11	±9.8%	0.10	0.12
Daily Hours of Use	3		3	3
Annual Hours of Use	1,022[b]		949	1,095
Typical Change in Watts	46		45	46
First Year Installation Rate	77%		75%	78%
Lifetime Installation Rate	97%		97%	98%

[a] Additional measures as well as estimates taken to a greater number of decimal places are reported in Table 6–1 in the full report.
[b] Calculated as 2.8 x 365 (2.8 is the more precise estimate). However, annual operating hours is listed as 1,010 in Table 5–15, with the difference being due to rounding error.

2 Introduction

The purpose of this study was to provide updated information to the sponsors of markdown and buydown programs (hereafter markdown programs) in the New England states of Connecticut, Massachusetts, Rhode Island, and Vermont that would assist in their calculations of demand and energy savings for CFLs obtained through these programs. Specifically, the report presents load shapes, coincidence factors (CFs), delta watts, daily and annual hours of use, and first-year and lifetime installation rates. Tasks completed toward the estimation of these parameters for calculating energy savings include:

- The development of a sample of markdown participants through a random digit dial (RDD) telephone survey
- An on-site survey and lighting inventory to gather information on factors related to lighting use (especially product placement and usage) and
- The logging of markdown CFLs installed in participating homes at the time of the on-site survey.

This work was carried out by Nexus Market Research, Inc. (NMR) with RLW Analytics (RLW) and GDS Associates (GDS) serving as subcontractors. The sponsors of the study include the following:

- The Cape Light Compact
- The Connecticut Energy Conservation Management Board
- Connecticut Light and Power
- Efficiency Vermont
- NSTAR Electric
- National Grid
- The United Illuminating Company
- Unitil
- Vermont Department of Public Services

It is important to note that the evaluation team designed the RDD survey and sampled homes for the on-site visits with the sole purpose of finding recently purchased and installed markdown CFLs. This reflects a directive from the sponsors: the fact that the evaluation team was under tight time constraints related to the timing of the kickoff meeting (October 19, 2007), the need to identify a panel of participants and install loggers in their homes in time for the winter peak lighting period, and the sponsors' requirement that we provide preliminary winter load shape and coincidence factor results by February 28, 2008 necessitated the use of this method. The survey questionnaire and sampling techniques explicitly eliminated households that did not have recently purchased markdown CFLs installed in the home. The RDD and on-site surveys, furthermore, included very few questions on demographics, housing characteristics, or other issues that may help explain some of the findings reported below (although we provide breakdowns when possible and relevant by such variables as the number of recently obtained markdown CFLs in the home). In short, this study focused on finding and logging a representative sample of markdown CFLs to obtain the necessary information to update demand and energy savings parameters. It was not designed to provide a representative sample of households—or even all markdown purchases—in the region, nor was it meant to provide detailed information on all factors that may affect lighting in the home.

The structure of the report is as follows. Chapter 3 describes the approaches used to recruit markdown purchasers into the study sample, as well as summarizing findings from the brief random digit dial (RDD) telephone survey through which most respondents were identified. Chapter 4 focuses on product placement and usage, as determined through an on-site participant survey and an inventory of all lighting in the home. We compare on-site findings when possible to those reported for the recent New England *Residential Lighting Measure Life Study* (measure life study) and the 2003 impact evaluation conducted for the lighting program sponsors in Massachusetts, Rhode Island and Vermont (MA-RI-VT study).[4,5] Chapter 4 also includes information on participant satisfaction with CFLs. The load shapes and coincidence factors are presented in Chapter 5, including post-stratification analyses by room type and lighting application. Chapter 5 also contains analyses of hours of use, wattage displacement, and installation rates including comparisons to the measure life and previous MA-RI-VT lighting studies. We conclude the report with Chapter 6 which summarizes the CFs that we believe are of the greatest interest to the sponsors and set forth recommendations for various energy saving parameters, including confidence intervals.

3 Task 2: Develop Sample of Product Purchasers

This chapter provides a summary and comparison of results from two RDD surveys fielded from December 5 through December 16, 2007 (referred to as Winter Panel) and February 11 to March 10, 2008 (referred to as Summer Panel). The NMR team designed and administered the surveys to identify households that had purchased products through lighting markdown programs and to recruit a sample to participate in the on-site logging portion of the Evaluation of Residential ENERGY STAR® Lighting Markdown Promotions.[6] For this reason, the survey was brief—the average respondent spent less than five minutes on the phone. The survey addressed the following topics:

- Familiarity with compact fluorescent light bulbs (CFLs)
- Recent purchases of CFLs, including purchases made with rebate coupons
- Price of CFLs purchased without rebate coupons
- Where program CFLs were purchased
- If program CFLs are currently installed,
- Disposition of program CFLs not currently installed, and
- Willingness to participate in the on-site study

[4] NMR and RLW (2008) *Residential Lighting Measure Life Study*. Submitted June 10, 2008.
[5] NMR and RLW (2004) *Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs.* Submitted October 1, 2004.
[6] Note that 18 additional homes were recruited through the New England Measure Life Study. As they responded to a similar survey for that study, we did not also ask the measure life recruits to answer the markdown on-site survey.

It is important to keep in mind that the ‘winter’ or ‘summer’ panel refers to when the products were *logged* and not when they were *obtained*. Respondents purchased products logged for the winter panel between August and early December 2007, while products logged in the summer panel were obtained between November 2007 and February 2008. It should also be noted that we recruited some households for the markdown study from the measure life study. Specifically, when technicians visited measure life homes, they asked the respondents if they had any recent purchases meeting the description of markdown CFLs (i.e., price, model number, and where purchased). If so, the respondent was asked if the technician could place loggers on the markdown products. A total of 18 measure life households had eligible markdown products and agreed to have loggers placed on those products.

3.1 Sample Design and Reasons for Disqualification

The sample design reflects two primary considerations. First, all New England Independent System Operator (ISO) regions in which the sponsors operate were adequately represented. We accomplished this by oversampling households from Rhode Island and Vermont and undersampling them in Connecticut and Massachusetts.[7,8] The second consideration was to recruit enough households to meet the sampling needs for the on-sites (see Chapter 4) while allowing for drop-outs (i.e., respondents who changed their mind about the on-site) and those who failed to meet additional qualifications applied after the survey (e.g., respondents who purchased CFLs at non-participating retailers).[9]

[7] The NMR team and the sponsors had discussed establishing a threshold number of initial calls in each state in order to insure adequate representation of all load zones. However, this disproportionate sampling approach introduced sampling error and would have forced an increase in the number of homes sampled, thereby increasing the budget. It was decided that we would stay with the original sample size, but discuss the allocation of logged products with the sponsors, as we have done in recent e-mails regarding the on-site survey and sampling methods.

[8] We did not specify the sample size for each of the three regions within Massachusetts, but the randomized nature of the study insured representation in of all three. Each of the other three states is its own region.

[9] The sample design called for logging a total of 678 CFLs. However, when analyzing the winter panel data, it became apparent that we needed 678 independent observations, requiring the total placement of 678 loggers, not CFLs, which we accomplished by increasing the number of loggers that were placed for the summer panel.

3.1.1 Sample and Sampling Error

As discussed more in Chapter 4, the sampling needs for the on-site portion of this study required a greater number of participants in the summer panel than the winter panel due to higher error ratios associated with coincidence factors for summer lighting than for winter lighting. Using the conservative assumption that each household participating in the on-site would have 2.5 recently purchased markdown CFLs, we estimated needing 87 households in the winter panel and 184 *additional* households in the summer panel (for a total of 271).[10] Knowing that some households recruited through the RDD would decide not to participate in or would be deemed ineligible for on-site logging, we estimated that we would need 300 qualified respondents from the RDD survey in the winter panel and 600 in the summer panel to meet the on-site sampling needs (Table 3–1). As illustrated in Table 3–1, the overall sampling error for the RDD survey at the 90% confidence interval assuming a 50%/50% break in responses was less than three percent. The error for the winter panel was 5.0% and for the summer panel was 3.4%, with the difference simply reflecting the larger sample taken for the summer panel. The sampling errors for states never exceed 12%.

Table 3–1: Sample Design and Error

States	Households[a]	Winter		Summer		Overall	
		Sample	*Sampling Error*	*Sample*	*Sampling Error*	*Sample*	*Sampling Error*
Connecticut	1,268,519[b]	75	9.6%	150	6.7%	225	5.5%
Massachusetts	2,034,113[c]	130	7.2%	260	5.1%	390	4.2%
Rhode Island	405,627	50	11.7%	100	8.3%	150	6.7%
Vermont	253,808	45	12.4%	90	8.7%	135	7.1%
Overall	**3,962,067**	**300**	**5.0%**	**600**	**3.4%**	**900**	**2.7%**

[a] As reported in the 2006 American Community Survey
[b] Excludes areas served by municipal utilities
[c] Excludes areas served by municipal utilities and by Western Massachusetts Electric

[10] In reality, respondents to both the RDD and on-site surveys purchased more than 2.5 CFLs, so we had to visit only 157 homes to log the required number of CFLs.

We surveyed a total of 1,761 people in the winter RDD survey and 4,836 people in the summer RDD survey (Table 3–2) in order to determine their eligibility and willingness to take part in the later on-site portion of the study. The higher number of respondents in the summer survey reflects the need for a greater number of eligible households to meet the summer on-site panel sampling needs. The incidence rate—that is, the percentage of people who responded to the survey who met the survey-specified qualification criteria for taking part in an on-site visit and agreed to participate in the on-site visit if selected—was 17% for the winter panel and 13% for the summer panel and overall (shaded rows in Table 3–2). Once we screened out the recruited respondents who purchased at non-participating retailers, the incidence rate dropped to 12% for the winter panel and 9% for the summer panel and overall.[11] NMR had originally estimated an incidence rate of between 12% and 17%, based on the results of the 2006 Massachusetts Lighting Consumer Survey, which is on target with the winter panel but slightly more optimistic than what was found in the summer panel.[12] Among respondents not eligible for the on-site visit, most (42% in each panel) had not purchased CFLs in the months considered in this study.

Table 3–2: Disposition of all RDD Survey Respondents

Sub-group	Winter		Summer		Overall	
	#	%	#	%	#	%
Eligible Recruited Respondents	205	12%	421	9%	626	9%
Recruited but purchased at non-participating retailer[a]	95	5%	179	4%	274	4%
No recent CFLs purchases	743	42%	2,031	42%	2774	42%
Not familiar with CFLs	308	17%	892	18%	1200	18%
No qualified purchases or installations[b]	207	12%	648	13%	855	13%
Did not agree to on-site	186	11%	589	12%	775	12%
Not sure of number purchased	17	1%	76	2%	93	1%
Number of Respondents	**1,761**	**100%**	**4,836**	**100%**	**6,597**	**100%**

[a] Respondents purchased bulbs costing less than $3 on average and have at least some of them installed, but did so at non-participating retailers.
[b] See Table 3–3 for more detail.

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[11] Note that we did not include store-based termination in the survey because it would have required very complicated programming. The list of included and not-included stores changed between the winter and summer panels as some stores joined the program later in the year. Notably, these included Lowe's, Hannaford's, Price Chopper, and Shaw's.
[12] Nexus Market Research, RLW Analytics, Shel Feldman Management Consulting, and Dorothy Conant (2007) *Market Progress and Evaluation Report (MPER) for the 2006 Massachusetts ENERGY STAR® Lighting Program*. "Appendix B – Consumer Survey." Submitted July 2007.

3.1.2 Reasons for Disqualification

Table 3–3 displays the characteristics of respondents with no qualified purchases or installations in either panel.[13] As shown, most disqualified respondents either paid more than $3 for each of their recently purchased CFLs (42% in both the winter and summer panels) or did not recall the price they had paid (27% in the winter panel and 31% in the summer panel). Fifteen percent of respondents in both panels purchased all recent CFLs with rebate coupons. The remainder of respondents had failed to install any of the CFLs (9% in the winter panel and 6% in the summer panel), or could not recall the number of packs purchased in recent months (8% in the winter panel and 7% in the summer panel). The differences between the winter and summer panels are minimal.

Table 3–3: Reasons for Disqualification among Willing Participants

Reasons for Disqualification	Winter		Summer		Overall	
	#	%	#	%	#	%
Paid more than $3 for each CFL	86	42%	269	42%	355	42%
Did not know the price	55	27%	204	31%	259	30%
All coupon purchases	31	15%	94	15%	125	15%
No recent purchases installed	18	9%	38	6%	56	7%
Not sure of number purchased[a]	17	8%	43	7%	60	7%
Number of Respondents	**207**	**100%**	**648**	**100%**	**855**	**100%**

[a] This group differs from those in the second-to-last row of Table 3–2 in that they originally provided an estimate of the number of products they purchased but then did not know how many multi-packs or single packs of CFLs they purchased.

3.2 Sample Characteristics

The sections below describe the characteristics of the sample, including the respondents' familiarity with CFLs, recent CFL purchases, stores where CFLs were purchased, and reasons for not installing the purchased products.

3.2.1 CFL Familiarity

Familiarity with CFLs was high among households served by the sponsors. Most respondents (83% of all 1,761 respondents in the winter and 82% of all 4,836 respondents in the summer) said they were at least "slightly familiar" with CFLs prior to taking part in the recruitment survey.[14] Table 3–4 displays familiarity among respondents who actually purchased CFLs in the past few months, as well as those who were aware of CFLs but had not purchased them just prior

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[13] This group is separate from those disqualified because they purchased at the non-participating stores, were not at all familiar with CFLs, or were not willing to take part in the survey.

[14] A reviewer of a previous draft voiced concern that awareness in this survey was lower than that estimated from a similarly worded question in the recent NMR (2008) *Telephone Survey Results for Market Progress and Evaluation Report (MPER) 2007 Massachusetts ENERGY STAR® Lighting Program.* The Massachusetts study suggested that familiarity was 89% (94% when descriptions of additional types of CFLs were included). We believe the discrepancy relates to the fact that the Massachusetts study included numerous call backs to boost response rates in an effort to represent the state population while the current survey did not worry about a response rate but focused on getting people on the phone to find out if they had eligible products.

to the survey. As expected, recent CFL purchasers claimed a significantly higher level of familiarity with the products than those who had not purchased CFLs recently. However, respondents in the winter panel reported higher degrees of familiarity than respondents in the summer panel. CFL purchasers from the winter panel were significantly more likely than those in the summer panel to indicate that they are ‘very familiar’ with CFLs (81% vs. 70%, respectively). Summer panel purchasers, in contrast, were more likely to say they are ‘somewhat familiar’ with CFLs (26% for summer panel v. 17% for winter panel). This pattern holds for all other respondent groups listed in Table 3–4, although we conducted statistical tests on differences only for purchasers as a whole and for those who had not purchased CFLs.[15]

Table 3–4: Level of Familiarity with CFLs

(All respondents at least slightly familiar with CFLs by respondent group)

Respondent Group	**Panel**	**Level of Familiarity** Very familiar	Somewhat familiar	Slightly familiar	**Number of Respondents**
Recruited respondents	Winter	82%	16%	2%	205
	Summer	74%	23%	3%	421
Non-participating store	Winter	83%	15%	2%	95
	Summer	67%	29%	4%	179
Did not agree to on-site	Winter	80%	19%	1%	186
	Summer	71%	26%	3%	589
Other not qualified	Winter	78%	16%	5%	207
	Summer	67%	27%	6%	648
All Recent Purchasers**	**Winter**	**81%***	**17%***	**3%**	**693**
	Summer	**70%***	**26%***	**4%**	**1,837**
No recent purchase/ Not sure of Number Purchased**	Winter	57%*	34%	9%*	760
	Summer	48%*	33%	19%*	2,107

* Significantly different between summer/winter panel at the 90% confidence level.
** Significantly different between purchaser/non-purchaser within summer/winter panels at the 90% confidence level.

[15] Because this survey was designed to identify markdown purchasers and recruit them for the on-site portion of this study, we did not ask follow-up questions that would help us explain why the winter panel respondents reported statistically higher levels of familiarity than summer panel respondents. One reviewer of a previous draft of this report suggested that the answer may reflect higher purchase rates of lighting products and seasonal marketing. This may be the case, if more lighting purchases and marketing occurs from August through early December (when winter panel products were purchased) than from November through February (when summer panel products were purchased). Because both RDD surveys were conducted during winter months (December for the winter panel and February and March for the summer panel), we do not believe the seasonal use of lighting has an effect on stated familiarity.

Limited to only the on-site participants, Table 3–5 breaks down respondents' self-reported level of familiarity with CFLs by two factors: 1) the accuracy of the number of recent markdown CFL purchases reported in the RDD survey, and 2) the actual number of markdown CFLs qualified for the study that were found in respondents' homes during the on-site visit. The results are inclusive, with the self-reported level of familiarity being similar for those who accurately named the number of CFLs purchased and those who were off by more than 50%. Likewise, respondents who had six to ten qualified CFLs in their homes claimed lower levels of familiarity than those with one to five qualified CFLs or eleven or more qualified CFLs. Please recall that the focus on finding qualified CFLs to log and not on other factors related to program participation and satisfaction meant that we did not collect additional information that could have helped explain these findings.

Table 3–5: Level of Familiarity by Accuracy in Self-Reported CFL Purchases and Actual Number of Qualified Markdown Products at Time of On-site Visit[a]

(Respondents who participated in the on-site by accuracy and qualified products in home)

Analysis Group	Respondent Group	Level of Familiarity			Number of Respondents
		Very familiar	Somewhat familiar	Slightly familiar	
Percentage of products never purchased	All RDD products purchased	74%	24%	1%	86
	Up to 50% of RDD products never purchased	90%	10%	0%	31
	51% or more RDD products never purchased	71%	29%	0%	21
Actual qualified products in home[b]	One to five	81%	16%	3%	32
	Six to Ten	69%	31%	0%	52
	Eleven or more	83%	17%	0%	54

[a] We provide more discussion of never purchased and all qualified products in Chapter 4.
[b] Includes markdown CFLs purchased after the RDD survey.

3.2.2 Recent CFL Purchases

This section summarizes data by the number of *recently purchased CFLs reported during the RDD survey; actual purchase numbers may differ from those reported here.* In both the winter and the summer panels, statistically larger proportions of all recent purchasers reported having bought one to five rather than six to ten or eleven or more CFLs (Table 3–6). Overall, 77% of all recent purchasers in the winter panel and 78% of all recent purchasers in the summer panel recalled buying one to ten CFLs. The remaining 24% of winter respondents and 22% of summer respondents remembered recently purchasing eleven or more CFLs. Recruited respondents were more likely to indicate buying eleven or more CFLs (30% winter panel; 29% summer panel) than the groups not recruited, suggesting that recruited respondents may be more committed CFL users, a possibility we explore in more detail below.

Table 3–6: Number of CFLs Purchased by Different Respondent Groups
(All recent purchasers by respondent group)

Respondent Groups	**Panel**	**Number of CFLs**			**Number of Respondents**
		One to Five	Six to Ten	Eleven or More	
Recruited respondents	Winter	35%	35%	30%	205
	Summer	40%	31%	29%	421
Non-participating store	Winter	35%	38%	27%	95
	Summer	41%	34%	25%	179
Did not agree to on-site	Winter	45%	31%	24%	186
	Summer	45%	33%	22%	589
Other not qualified	Winter	49%	36%	15%	207
	Summer	54%	29%	17%	648
All Recent Purchasers	**Winter**	**42%***	**35%***	**24%**	**693**
	Summer	**47%***	**31%***	**22%**	**1,837**

* Significantly different between summer/winter panel at the 90% confidence level.

In the months before the survey, all recent CFL purchasers in either panel reported purchasing an average of eight bulbs (Table 3–7).[16] Most of these purchases were made *without* a rebate coupon. Recruited respondents purchased about nine CFLs with or without a coupon, roughly one bulb more than all recent purchasers.

Respondents in the winter panel who purchased at non-participating retailers bought the most CFLs (ten on average) both with and without a coupon, while summer panel respondents purchasing at non-participating retailers bought nine CFLs, one fewer than their winter counterparts. The differences between the winter and the summer panels might be explained by the fact that the lists of 'participating' and 'non-participating' stores changed between the winter and summer panels, as Lowe's, Shaw's, and other stores joined the markdown programs later in 2007 than other retailers.

Respondents who did not agree to the on-site study said they purchased on average eight CFLs with or without coupons, therefore purchasing one bulb fewer than those who did agree to the on-site study. Respondents who were not qualified for other reasons bought the fewest bulbs (seven overall and six without a rebate coupon) in either panel.

Table 3–7: Total and Average Number of Purchases by Respondent Group
(All recent purchasers by respondent group)

Sub-groups	Panel	All recent purchasers		Non-coupon purchasers		Number of Respondents
		Sum of CFLs	Average # CFLs	Sum of CFLs	Average # CFLs	
Recruited respondents	Winter	1,907	9.3	1,826	8.9	205
	Summer	3,956	9.4	3,754	8.9	420
Non-participating store	Winter	905	9.5	899	9.5	95
	Summer	1,557	8.7	1,518	8.5	179
Did not agree to on-site	Winter	1,474	8.0	1,379	7.5	185
	Summer	4,656	7.9	4,412	7.5	589
Other not qualified	Winter	1,496	7.2	1,225	5.9	207
	Summer	4,726	7.3	3,647	5.6	648
All Recent Purchasers	**Winter**	**5,782**	**8.4**	**5,329**	**7.7**	**692**
	Summer	**14,895**	**8.1**	**13,331**	**7.3**	**1,836**

[16] In the winter panel, we have removed from the analysis one individual who reported purchasing 300 CFLs. In the summer panel, we have removed from the analysis one individual who reported purchasing 900 CFLs.

Breaking the results down by state (Table 3–8 and Figure 3-1), we find that the number of products purchased by recruited respondents ranged from about seven CFLs in the summer panels for Rhode Island and Vermont to eleven CFLs in the summer panel for Connecticut. Likewise, in both the summer and winter panels, recruited households in Connecticut reported purchasing more non-coupon CFLs on average than respondents in all other states.

For all recent purchasers, the average number of CFLs purchased ranged from fewer than seven CFLs in the summer panels for Massachusetts, Rhode Island, and Vermont to nine CFLs in Connecticut. These numbers are similar for the winter panel, ranging from just below seven CFLs in Rhode Island to nine CFLs in Connecticut.

It is important to note that recruited respondents overall, in each state, and in both panels always reported purchasing more CFLs than did all purchasers—including those eligible for the study but who refused to take part in the on-sites. This finding supports the notion mentioned above that the recruited participants are committed CFL users, and their responses may not be entirely representative of the population of markdown purchasers. In Chapter 4 we break some of the key results out by the number of reported and actual CFLs purchased (as well as other factors) in order to examine potential bias associated with their possibly greater commitment to CFLs.

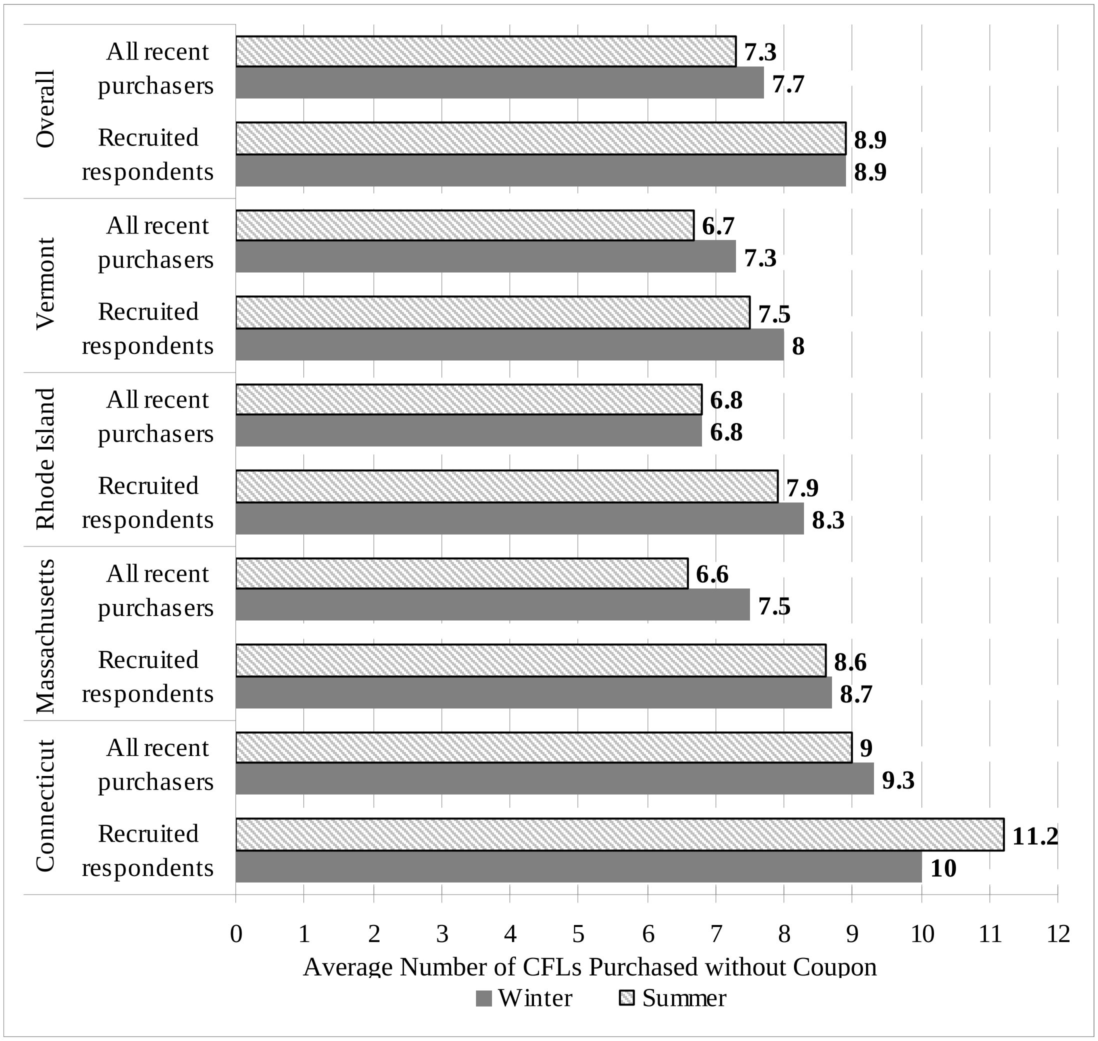
Table 3–8: Total Number and Average Number of Non-Coupon Products Purchased by State and Panels

(All recent purchasers for selected respondent groups)

Survey Group		**Sum of Products purchased without coupon**		**Mean of Products purchased without coupon**		**Number of Recent Purchasers**	
State	Respondents	Winter	Summer	Winter	Summer	Winter	Summer
CT	Recruited respondents	548	1,187	10.0	11.2	55	106
	All recent purchasers	1,339[a]	4,134	9.3[a]	9.0	144	460
MA	Recruited respondents	786	1,522[b]	8.7	8.6[b]	90	178
	All recent purchasers	2,307	5,382[b]	7.5	6.6[b]	309	810
RI	Recruited respondents	300	558	8.3	7.9	36	71
	All recent purchasers	803	2058	6.8	6.8	118	304
VT	Recruited respondents	192	487	8.0	7.5	24	65
	All recent purchasers	880	1,757	7.3	6.7	121	262
Overall	**Recruited respondents**	**1,826**	**3,754**	**8.9**	**8.9**	**205**	**420**
	All recent purchasers	**5,329**	**13,331**	**7.7**	**7.3**	**692**	**1,836**

[a] Data exclude one case in which respondent reported purchasing 300 CFLs.
[b] Data exclude one case in which respondent reported purchasing 900 CFLs.

Figure 3-1: Average Numbers of CFLs Purchased by State and Panel
(All Recent Purchasers and Recruited Respondents)



3.2.3 Where Respondents Purchased Markdown CFLs

Table 3–9 lists the retailers at which respondents purchased non-coupon CFLs costing less than $3 per bulb. Overall and regardless of the number of CFLs purchased, Home Depot was named most frequently. In the winter panel, 64% of respondents said they purchased at least some of their qualified products at Home Depot, followed by Costco (9%) and BJ's (7%). In the summer panel, 48% of respondents said they purchased at least some of their qualified products at Home Depot (48%), followed by Lowes, which joined the program in the last few months of 2007 and accounted for 12% of the summer purchases. The warehouse stores Costco (7%) and BJ's (6%) remained the next most common stores at which respondents purchased qualified products. The team finds it important to note, however, that more than one-fourth of the respondents reported buying at least some qualified products at grocery and hardware stores (including those stores listed in the 'other' category). The participation of these stores is extremely important in areas such as Cape Cod and the Islands where there are few home improvement and warehouse stores. Please note that we cannot provide similar information for all recently purchased CFLs because we did not ask this question for coupon CFLs or CFLs costing more than $3.

Table 3–9: Retailers at which Qualified Respondents Purchased CFLs by Number Purchased and Panel

(All qualified respondents, multiple responses allowed)

Retailer	One to Five		Six to Ten		Eleven or More		All Qualified Respondents [a]	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Home Depot	58%	48%	68%	45%	67%	51%	64%	48%
Costco	5%	3%	10%	9%	11%	11%	9%	7%
BJ's	3%	2%	9%	7%	8%	9%	7%	6%
Ace	9%	6%	3%	4%	4%	4%	6%	5%
Stop & Shop	6%	8%	3%	4%	3%	1%	4%	5%
Aubuchon	2%	6%	1%	4%	1%	3%	2%	5%
True Value	1%	2%	3%	1%	3%	1%	2%	1%
Benny's	6%	3%	1%	3%	3%	2%	3%	3%
Building 19	1%	1%	0%	1%	1%	2%	1%	1%
Lowe's	NP[c]	9%	NP	16%	NP	11%	NP	12%
Price Chopper	NP	4%	NP	1%	NP	1%	NP	2%
Shaw's	NP	1%	NP	2%	NP	2%	NP	2%
Other[b]	8%	5%	0%	4%	0%	2%	3%	4%
Number of Responses	**86**	**271**	**88**	**255**	**79**	**220**	**253**	**746**

[a] Qualified respondents include both those who agreed and did not agree to the on-site, excluding anyone purchasing at non-participating retailers such as Wal-Mart, Target, Ocean, Rite Aid, IKEA, and many independent retailers. While Wal-Mart is a participant, the retailer offers only a small number of products through the sponsors' programs. However, Wal-Mart has its own program in which it offers CFLs at the same price point ($3 or less), and these could have easily have been confused with markdown purchases.
[b] Other stores include various drug stores and local hardware or grocery stores.
[c] NP stands for not participating store at the time of the winter RDD survey.

3.2.4 Why Products Were not Installed

Respondents who had not installed all of their recently purchased CFLs were most often waiting until other bulbs burned out; alternatively, they were simply storing the CFLs for later use (Table 3–10).[17] Other reasons included simply not having gotten around to installing them, product failure, giving them away, installing them elsewhere (e.g., another home or business), and miscellaneous concerns about the CFLs.[18]

Table 3–10: Why Some or All Recently Purchased CFLs Not Installed
(Respondents who have not installed all or some recently purchased CFLs)

Reasons why some or all CFLs are not installed	**One to Five**		**Six to Ten**		**Eleven or More**		**Total**	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Waiting until other burns out	55%	56%	62%	48%	69%	54%	63%	52%
Storing	20%	29%	31%	42%	24%	34%	26%	35%
Not gotten around to it	5%	1%	0%	3%	3%	5%	2%	3%
Failed/burned out	10%	3%	0%	1%	0%	1%	2%	2%
Gave it Away	5%	3%	0%	1%	0%	2%	1%	2%
Installed Somewhere Else	0%	3%	3%	1%	0%	0%	1%	2%
Fixture/dimmer concerns	0%	3%	0%	2%	3%	1%	1%	2%
Other[a]	5%	3%	5%	2%	0%	2%	3%	2%
Number of Responses	**20**	**115**	**39**	**129**	**29**	**87**	**88**	**331**

[a] In the summer panel, other reasons included, for example, purchase of the wrong kind/don't fit, dislike of how the CFLs light up, and fear of mercury.

[17] Note that we do not show a percentage of all purchases not installed because we do not have a full count of products not installed due to the desire to keep the survey short and not to go into detail for each product. Please see Chapter 4 for a discussion of the disposition of markdown in households that participated in the on-site and Chapter 5 for estimates of installation rates.
[18] Some CFLs installed elsewhere may still have been installed within the sponsors' service territories. However, as we did not have access to these other locations, we did not log these CFLs installed elsewhere.

4 Task 4: Product Placement and Usage

Task 4 relied on an on-site survey and lighting inventory to ascertain what respondents did with markdown CFLs after purchasing them. The on-site visit also identified other lighting products the respondent had in the home and additional information relevant to understanding how lighting is used in the home (e.g., occupancy at different times of the day and wattage of all installed lighting products). We begin this chapter by explaining the on-site sampling needs and how we chose the on-site sample and the methods used in the homes. We then describe the results from the on-site survey pertaining to how lighting is used in the household. Please note that findings regarding wattage displacement (delta watts) and installation rates are presented in Chapter 5 as they relate directly to energy and demand savings. Appendix A summarizes the demographic characteristics of the on-site survey respondents.

4.1 On-Site Sample Design and Product Identification

Our estimate of the on-site sample size required to achieve sampling error of ±10% at the 80% confidence level across load zones is calculated based on the following formula:

$$n_0 = \left(\frac{z \times E}{R}\right)^2 \qquad n_1 = \left(\frac{n_0}{1 + \frac{n_0}{N}}\right)$$

where,

n_0 = the required sample size before adjusting for the size of the population,
z = a constant based on the desired level of confidence, e.g., 1.282 for the 80% level of confidence,
E = Error ratio describing the relationship between the observed savings and the predictor for observed savings,
R = the desired relative precision,
n_1 = the required sample size after adjusting for the size of the population using the *finite population correction factor,*
N = the population size, i.e., the number of sample points in a particular treatment group.

The error ratio is of central importance to this sample design. Based on historical data on summer and winter peak coincidence work that RLW has done in the Northeast, an error ratio of 1.15 is appropriate for winter and 2.03 for Summer. Since we are interested in 80/10 for both seasons, the use of the higher ratio, 2.03, is necessary for the final summer data. Given that the markdown population for this sample design was unknown, we assumed that the population was large enough not to require correction for finite population. Based on this error ratio and large population assumption, we calculated that 678 markdown CFL observations were required to provide the precision desired by the sponsors for the summer and that 217 were needed for the winter. The 217 CFLs logged in the winter would be included among the 678 also logged in the summer.

One-hundred-thirty-nine of the 157 (89%) homes visited as part of this study were randomly selected from among the 626 eligible homes recruited through the winter and summer recruitment survey discussed in Chapter 3.[19] The other 18 homes were recruited through the measure life study, as described in Chapter 3. We allocated the individual households to one of 12 sampling strata (three strata in each of the four states) using a method known as probability proportionate to size—in this case the number of reported, non-coupon CFLs purchased per home (Table 4–1). This insured that we had adequate representation of households that had purchased different numbers of CFLs. We then assigned each household a random number and sorted them within each stratum accordingly. We called households in this randomized order, attempting numerous call-backs if they were not reached. If a household declined to participate or if they did not respond to numerous call-backs, we then attempted to call the next household in the same stratum.

As shown in Table 4–1, the team switched its on-site sampling strategy between the winter and summer panels. As described above, we originally anticipated needing to log 678 CFLs to meet the 80/10 precision requirements for the Forward Capacity Market (FCM). Therefore, in the winter panel, we placed loggers to meet at least the 217 CFLs required from that portion of the study. Upon analyzing the data, however, it became apparent that we actually needed 217 *independent observations*, but multiple bulbs on a single logger are not independent of each other. Therefore, for the summer panel, we focused on the number of *loggers* that we needed to place in order to reach the 678 independent observations for the entire study.

[19] Note that no products were logged in two homes, so the coincidence factors and load shape data are based on 155 homes, not 157.

Table 4–1: Sample Design for On-site Visits

(Base – Number of CFLs)

Panel	State & Number of Bulbs Purchased per Home	Bulbs from RDD[a]		Bulbs Needed for On-site		Estimated Homes to be Visited	
		#	%	#	%	#	%
Winter	CT 1 – 5	68	3%	5	2%	3	8%
	CT 6 – 10	184	7%	15	7%	3	8%
	CT More than 10	549	21%	45	21%	5	13%
	MA 1 – 5	141	5%	11	5%	4	11%
	MA 6 – 10	368	14%	30	14%	4	11%
	MA More than 10	462	17%	38	18%	4	11%
	RI 1 – 5	61	2%	5	2%	3	8%
	RI 6 – 10	178	7%	15	7%	3	8%
	RI More than 10	184	7%	15	7%	2	5%
	VT 1 – 5	57	2%	6	3%	3	8%
	VT 6 – 10	146	5%	12	6%	2	5%
	VT More than 10	264	10%	20	9%	2	5%
	Total	2,662	100%	217	100%	38	100%
Summer		**Bulbs from RDD[a]**		**Independent Observations Needed for On-Site**		**Estimated Homes to be Visited**	
		#	%	#	%	#	%
	CT 1 – 5	118	3%	17	3%	7	8%
	CT 6 – 10	267	8%	40	8%	6	7%
	CT More than 10	703	20%	104	20%	10	12%
	MA 1 – 5	260	7%	39	7%	15	18%
	MA 6 – 10	401	11%	60	12%	9	11%
	MA More than 10	726	21%	108	21%	10	12%
	RI 1 – 5	108	3%	16	3%	6	7%
	RI 6 – 10	169	5%	25	5%	4	5%
	RI More than 10	285	8%	43	8%	4	5%
	VT 1 – 5	83	2%	12	2%	5	6%
	VT 6 – 10	123	4%	18	3%	3	4%
	VT More than 10	264	8%	39	7%	4	5%
	Total	3,507	100%	521	100%	83	100%

[a] This column lists the total number of bulbs found in households that report purchasing the stated number of CFLs during the months covered by the panel. For example, Connecticut households that purchased between one and five CFLs collectively bought a total of 68 CFLs between August and early December.

In the winter panel, the technicians placed up to ten loggers in each home visited, while in the summer panel they placed as many as 20 loggers per home in order to increase the number of independent observations. In both panels, some devices logged more than one product. Winter loggers were kept in place for a minimum of two weeks, but all were removed in early February of 2008 in order to analyze the data for the winter panel.[20] In February new loggers were installed in the winter panel households to continue capturing the operation of the lighting

[20] The varied and relatively short duration of the installation of winter loggers reflected the need to identify a sample, schedule logger placement, log usage, and collect and analyze logged data all in time for the sponsors hard deadline of February 28, 2008 for submission of the draft winter coincide factors and load shapes.

through the spring and summer months for use in the final analysis of impacts. Summer loggers were kept in place for at least the months of June, July, and August, with some being installed as early as April. The loggers were removed from mid-September through early October.

As shown in Table 4–1 above, after conducting the RDD survey we expected to visit 121 homes, but in practice, we visited 157 homes to log the 678 bulbs outlined in the work plan; this includes 139 homes recruited through the RDD surveys and 18 homes recruited from the measure life study. The number of homes visited exceeds that predicted in the sample plan because the on-site visits often found different numbers of products at the home than what the respondent had reported during the RDD survey. In fact, the number of products logged per home differed by an average of six fewer bulbs from the number the respondent had reported in the RDD survey. Ultimately, we have data from only 657 loggers because the remaining 21 failed while in the field and were lost—that is the technicians could not find them upon returning to the home (Table 4–2). The 657 loggers, however, provided enough information to meet the precision requirements for the FCM.

Table 4–2 on the next page summarizes the disposition of CFLs in the 139 participating homes identified through the RDD survey. Based on the results of the RDD survey, we expected to find 1,868 recently purchased markdown products in these respondents' homes, but we actually found only 1,137 (61%). We found more of the expected winter panel CFLs (68%) than summer panel ones (58%), largely due to the summer RDD respondents misstating the number of markdown CFLs purchased.[21] Respondents never actually purchased 38% of the CFLs they reported on the phone—again, largely due to misstating the number of products purchased in the summer panel. However, we find it important to note that only *one* of the 139 homes had no recently obtained and qualified CFLs in the home; all other 138 homes had at least one qualified CFL *installed* in the home, accomplishing the task set forth in our methodology. The other home for which we lack logger data (see Footnote 19) had qualified CFLs but the logger failed in the field.

Technicians found a total of 1,544 markdown products (identified by model number, price, and store of purchase) in the 139 homes recruited through the RDD surveys. They logged 1,073 of these (61%), most of which (666 or 61% of all logged) were originally identified through the telephone recruitment survey.[22] Technicians found and logged 407 additional recently purchased markdown products (38% of all logged) in participating homes. The number of logged CFLs being identified via the RDD survey differed between the summer and winter panels. Specifically, in the summer panel, the technicians logged a larger proportion than in the winter panel of markdown products identified in the home and not via the RDD survey. We believe this reflects the fact that the winter RDD survey and logger placement occurred within a six week period, while the process was spread over four months in the summer panel (due to the need to

[21] For example, the respondent may have misstated the number of CFLs purchased from November through the date of the survey or mistaken other products for CFLs. Alternatively, the products may have been CFLs but were not offered through the markdown program. One summer panel respondent mistakenly identified 110 products as markdown CFLs.
[22] In the development of load shapes and coincidence factors for both panels, we considered each logger installed in each month of the performance period to be an independent observation, so reported sample sizes associated with those analyses (e.g. Table 5–2), exceed those reported in Table 4–2.

place more loggers and a more relaxed timeline). This gave respondents more time to purchase additional CFLs after taking part in the RDD survey—and they appeared to have done so in large numbers.

Technicians did not log or were unable to collect logging data from 239 (15%) of the products, often because of limits we placed on the number of loggers installed per home but also due to the respondent limiting access to some rooms, interference from sunlight, and lost or broken loggers that had actually been placed. Finally, respondents placed 232 (15%) of the products identified over the phone in storage, with summer panel participants being more likely to have products in storage than winter panel participants.

Table 4–2: Disposition of Products Reported as Purchased during RDD Phone Survey and All Qualified Markdown Purchases Found On-site

(Based on products found in homes identified through RDD survey)

Product Disposition	Winter		Summer		Overall	
	#	%	#	%	#	%
Markdown CFLs reported during phone survey (customer recall)	390	100%	1,478	100%	1,868	100%
RDD markdown CFLs reported and actually found	266	68%	871	58%	1,137	61%
RDD markdown CFLs reported but not purchased	96	25%	607	41%	703	38%
RDD markdown CFLs installed elsewhere	28	7%	0	0%	28	1%
All markdown CFLs found in home	299	100%	1,245	100%	1,544	100%
Markdown CFLs logged	213	71%	860	69%	1,073[d]	69%
RDD markdown CFLs logged	180	85%[a]	486	57%[a]	666	61%[a]
New markdown CFLs found and logged	33	15%[a]	374	43%[a]	407	38%[a]
Markdown CFLs eligible not logged[b]	55	18%	184	15%	239	15%
Markdown CFLs in storage or removed	31	10%	201	16%	232	15%
Loggers placed per home	164[c]	100%	493	100%	657[c]	%

[a] Percentage based on the CFLs logged.
[b] Includes CFLs not logged due to limits placed on the number of bulbs logged per home, lost and broken loggers, interference from sunlight, because the room was not in use, or because the owner did not allow the technician access (the participant lived in a retirement facility).
[c] Includes 25 loggers placed in 18 homes recruited through the measure life study.
[d] An additional 30 CFLs were logged in the 18 homes recruited through the measure life study.

Table 4–3 summarizes the accuracy of self-reported CFL purchases from the RDD survey. Specifically, the table compares the number of recently obtained markdown CFLs as reported in the RDD survey with the number never actually purchased and the number of qualified products found in the home at the time of the on-site visit. Note that some of these qualified products may have been purchased between the RDD survey and the on-site visit. The results suggest that RDD survey respondents who reported fewer CFL purchases (i.e., less than eleven) tended to have nearly all of the products they named in the home at the time of the on-site. In contrast, one-third (in the winter panel) to one-half (in the summer panel) of the products were never bought by those reporting CFLs purchases of eleven or more during the RDD survey. Furthermore, when considering all qualified products in the home at the time of the on-site, those with fewer reported purchases tended to have more products eligible for the study than reported on the phone, while those who reported more purchases during the RDD survey tended to have fewer products actually eligible for the study than reported on the phone.

Table 4–3: Accuracy of RDD CFL

	One to Five		Six to Ten		Eleven or More	
	Winter	Summer	Winter	Summer	Winter	Summer
Reported	40	88	61	237	289	1153
Never purchased	0	9	0	27	96	571
% never purchased	0%	10%	0%	11%	33%	50%
Qualified at time of on-site	52	263	75	309	172	673
Qualified as % of Reported	130%	299%	123%	130%	60%	58%

Table 4–4 lists the percentage of households in each purchase category that we expected to find during the visit (columns labeled ‘design’) in order to sample the number of CFLs necessary for our design (see Table 4–1 above). It also presents the percentage of households by number of products actually found in sampled homes while conducting the on-sites (columns labeled ‘actual’). These percentages differ precisely because not all respondents always accurately reported the number of CFLs they had in their homes during the RDD survey *and* because some respondents purchased more CFLs after responding to the RDD survey. In the end, we sampled fewer homes with one to five CFLs (38% design vs. 24% actual), more homes with six or more CFLs (28% vs. 27%), and a slightly higher but comparable percentage of homes with eleven or more CFLs (34% vs. 39%).

Table 4–4: Number of CFLs Actually Purchased

	Winter		Summer		Overall	
	Design	Actual	Design	Actual	Design	Actual
One to Five	34%	27%	40%	23%	38%	24%
Six to Ten	32%	42%	27%	36%	28%	37%
Eleven or more	34%	30%	34%	42%	34%	39%
Number of Households	38	33	83	106	121	139

4.2 Location and Wattage of Products Logged

Table 4–5 summarizes the products logged by load zone for both panels and overall.[23] Generally, the Connecticut load zone had the most participation in both panels, and the West-Central Massachusetts load zone had the least participation because Western Massachusetts Electric did not sponsor this study and was, therefore, not included in the sample recruitment. Participation rates largely remained stable from the winter to summer panel, with somewhat greater participation of Rhode Island residents in the summer panel and somewhat greater participation of Vermont residents in the winter panel.

Table 4–5: Products Logged by Load Zone

(Number of products logged during on-site, including recruitments from measure life study)

Load Zone	Winter		Summer		Overall	
	# of Bulbs	% of Bulbs	# of Bulbs	% of Bulbs	# of Bulbs	% of Bulbs
Connecticut	60	25%	256	30%	316	29%
Northeast MA	41	17%	137	16%	178	16%
Southeast MA	42	17%	161	19%	203	18%
West-Central MA	18	7%	47	5%	65	6%
Rhode Island	31	13%	157	18%	188	17%
Vermont	51	21%	102	12%	153	14%
Overall	**243**	**100%**	**860**	**100%**	**1,103**	**100%**

[23] We do not present coincidence factors and load shape by load zone because one of the primary assumptions in this study is that the logging data serves as an accurate description of regional lighting use, not just for individual zones.

Table 4–6 summarizes the number of products logged by room, as reported from the on-site survey. Respondents installed CFLs in a variety of rooms, with about one-fifth (24%) being installed in the family or living room, and another fifth being installed in kitchen and dining rooms (21%). Bedrooms (16%), bathrooms (14%), and basements (10%) were also among the most common locations for CFLs. There are no substantial differences between where summer and winter panelist installed CFLs. Please note that the total reported number of products logged in this table differs from those reported in Table 4–2 and Table 4–5 because we kept detailed installation data on only those participants who answered the on-site survey. Therefore, we lack such information for those who refused to answer the survey or who were recruited through the measure life study.

Table 4–6: Products Logged by Room Type
(Number of products for which we have on-site survey data)

Room Type	Winter		Summer		Overall	
	# of Bulbs	% of Bulbs	# of Bulbs	% of Bulbs	# of Bulbs	% of Bulbs
Family/Living Room/Den	49	22%	224	24%	273	24%
Kitchen/Dining Room	47	21%	193	21%	240	21%
Bedroom	39	17%	148	16%	187	16%
Bathroom	30	13%	137	15%	167	14%
Basement	29	13%	82	9%	111	10%
Hallway/Foyer /Stairs	20	9%	87	9%	107	9%
Other[a]	10	4%	59	10%	69	6%
Overall[b]	**224**	**100%**	**930**	**100%**	**1,154**	**100%**

[a] Other room types included exterior, all exterior buildings, mudroom, playroom, sunroom, studio, closet, laundry, and varying types of workrooms.
[b] Results subject to rounding.

Comparing to previous studies, we find that the participants in the current study of markdown CFLs generally resemble those found in the 2004 MA-RI-VT study as well as the recent New England measure life study. [24] There appears to be a slight tendency for the markdown participants in this study to spread their CFLs out more throughout the home than did respondents to the other studies, but the differences are not large.[25]

Table 4–7: Location of Products by Room Type, Current Study and Comparison Studies

Room Type	Current Markdown	2004 MA-RI-VT	2008 Measure Life	
			Coupon	Direct Install
Family/Living Room/Den	24%	36%	23%	22%
Kitchen/Dining Room	21%	19%	16%	19%
Bedroom	16%	14%	16%	24%
Bathroom	14%	5%	9%	10%
Basement	10%	6%	11%	10%
Hallway/Foyer	9%	10%	8%	5%
Other[a]	6%	9%	15%	10%
Overall[b]	**1,154**	**693**	**330**	**244**

[a] Other rooms in the current study included exterior, all exterior buildings, mudroom, playroom, sunroom, studio, closet, laundry, and varying types of workrooms.
[b] Results subject to rounding error.

[24] NMR and RLW (2004) *MA-RI-VT*; NMR and RLW (2008) *Measure Life*.
[25] One reviewer of this document pointed out that the fact that average operating hours per bulb may not have decreased much (see Chapter 5), because markdown CFL purchasers install and use their CFLs in similar locations to other respondents. In contrast, one would expect operating hours to decline when participants place CFLs in lower-use applications, which is not the pattern displayed in the data.

Table 4–8 summarizes the reasons respondents gave as to why they installed markdown CFLs in particular locations. Although the question was originally intended to elicit responses about the thought-process behind putting a CFL in, for example, the living room compared to the closet, most respondents provided a response more in keeping with why they chose to use CFLs over other types of bulbs. Therefore, most bulbs were placed (89% in the summer panel, 87% in the winter panel) in a particular location to save energy; saving money was the second most common reason given (14% in the summer panel, 16% in the winter panel). Just 5% of respondents provided answers that focused on the merits of installing a CFL in a particular location, stating that the CFL was in a high use are or that the area needed more light.

Table 4–8: Reasons for Installation in Particular Location

(Number of markdown products previously or currently installed, multiple reasons allowed)

Reason	Winter	Summer	Overall
Save energy	87%	89%	88%
Saving money	16%	14%	15%
High use area	3%	2%	2%
Needed more light	9%	1%	3%
Other	6%	2%	3%
Number of products[a]	**326**	**1,220**	**1,546**

[a] Total number of products exceeds the number reported logged by room type in Table 5–19 because the question was asked of products that had been installed and then removed from service as well as eligible products that could not be logged for various reasons.

Respondents reported that they installed about three-fourths (73% in the summer panel and 76% in the winter panel) of the markdown CFLs within a day of purchasing them. Winter-panel respondents installed an additional 13% of the CFLs within a week of purchasing them. Summer-panel respondents were not sure when they installed 23% of products, compared to 9% of winter panel respondents, perhaps because a longer time had elapsed between the purchase of the product and the date on which they answered the survey.[26]

Table 4–9: When Markdown CFLs Installed

(Number of markdown products for which installation date could be determined)

When Installed	Winter	Summer	Overall
Within a day	76%	73%	74%
Two days to a week	13%	1%	4%
Within a month	2%	0%	1%
Within six months	0%	2%	2%
Don't remember	9%	23%	20%
Number of products	**328**	**1,225**	**1,553**

[26] It is important to note that more time elapsed between the time the summer panelist responded to the RDD survey and when the on-site visits occurred, compared to the winter panel. This reflects the fact that the team was under tight time constraints in the winter panel; both the RDD and placement of loggers all occurred from December 5 through January 14. In contrast, recruitment for the summer panel began on February 11 and continued until March 10. Logger placement began at the beginning of April and continued through the end of May.

The patterns of installation by the number of recently purchased markdown CFLs actually found in the home are similar, with one exception: respondents who purchased eleven or more products were less likely to recall when they installed the CFLs than are those with fewer purchases. This confirms a finding reported in the measure life study that the more CFLs a household obtains, the less likely they are to recall the details of product installation and disposition.

Table 4–10: When Markdown CFLs Installed

(Number of markdown products for which installation date could be determined)

When Installed	One to Five	Six to Ten	Eleven or More	Overall
Within a day	78%	78%	71%	74%
Two days to a week	0%	4%	4%	4%
Within a month	4%	2%	0%	1%
Within six months	0%	2%	2%	2%
Don't remember	18%	14%	23%	20%
Number of products	**89**	**404**	**1,041**	**1,534[a]**

[a] Unique case identification did not match reported in RDD files for two respondents and 19 products.

4.3 Lighting Inventory

As part of the on-site visit, the technicians conducted a thorough inventory of *all* lighting products in the visited homes—both those currently installed as well as those in storage. We present the results of this inventory below, providing comparisons to findings from the recent New England measure life study when possible.

4.3.1 Socket count of all lighting products

The participants in the on-site portion of the study had an average of 50 sockets per household. As shown in Table 4–11, most sockets held incandescent bulbs (59%). The percentage ranged from a low of 57% in the households in Massachusetts to 63% in the households in Rhode Island. CFLs were the second most common type of bulb installed in sockets (31%). The households visited in Connecticut had the highest percentage of CFLs in sockets (33%) while the participating households in Rhode Island had the lowest (28%). Few traditional fluorescent lights (8%), halogens (2%), or LEDs were observed in the households.[27]

Table 4–11: Lighting Products Installed in Respondents' Homes by State
(All filled sockets in participating homes)

Bulb Type	CT	MA	RI	VT	Overall
Incandescent	59%	57%	63%	58%	59%
CFL	33%	31%	28%	32%	31%
Fluorescent	7%	9%	7%	10%	8%
Halogens	1%	3%	1%	<1%	2%
LED	0%	<1%	0%	<1%	<1%
Number of sockets	**1,877**	**2,808**	**1,301**	**825**	**6,811**[a]
Number of Households	41	50	29	16	136
Average Sockets per Household	**46**	**56**	**45**	**52**	**50**

[27] See Table 4–20 below on the type of fixtures in which these bulbs are installed.

Comparing the socket counts from the current markdown to the recent measure life study and the MA-RI-VT lighting study yields two interesting observations (Table 4–12, shaded rows). First, the markdown respondents had installed CFLs in a greater percentage of sockets (31%) than had the respondents to the measure life study (27%) or the MA-RI-VT study (26%). Second, the socket counts differ for some states when compared to the measure life study. The count is higher in the measure life study for two states (Connecticut 46 markdown v. 60 measure life and Rhode Island 45 markdown and 65 measure life) but higher in the markdown study for Vermont (52 markdown and 40 measure life). The socket count is similar between the two studies in Massachusetts (56 markdown and 55 measure life) and overall (50 markdown and 53 overall).

Table 4–12: Socket Count for Current Study Compared to Other Studies

(All filled sockets in participating homes)

Study	Bulb Type	CT	MA	RI	VT	Overall[a]
Markdown	Percentage of CFLs	33%	31%	28%	32%	31%
	Number of sockets	1,877	2,808	1,301	825	6,811
	Number of Households	41	50	29	16	136
	Average Sockets per Household	46	56	45	52	50
Measure Life	Percentage of CFLs	25%	24%	16%	38%	27%
	Number of sockets	1,975	8,453	1,295	1,543	15,168
	Number of Households	33	153	20	39	285
	Average Sockets per Household	60	55	65	40	53
MA-RI-VT	Percentage of CFLs					26%
	Number of Households					114

[a] Total for the measure life study based on the entire New England region, not just the four states included in this markdown study.

Table 4–13 presents information that provides further confirmation that those households purchasing more markdown CFLs are committed users, but also provides an additional explanation besides commitment for their large numbers of CFLs purchases. In particular, the percentage of CFLs installed increased as the number of recent markdown purchases increased. At the same time, however, those with more recent purchases also had substantially more sockets in their home than did those with smaller numbers of CFL purchases.

Table 4–13: Lighting Products Installed in Respondents' Homes by Number of Qualified CFLs in Home

(All filled sockets in participating homes)

Bulb Type	One to Five	Six to Ten	Eleven or More	Overall
Incandescent	64%	62%	54%	59%
CFL	21%	27%	38%	31%
Fluorescent	12%	9%	7%	8%
Halogens	3%	2%	1%	2%
LED	<1%	0%	<1%	<1%
Number of sockets	**1,248**	**2,548**	**2,974**	**6,770**[a]
Number of households	32	52	51	135
Average sockets per household	**39**	**49**	**58**	**50**

[a] Unique case identification did not match reported in RDD files for one respondent with 41 sockets.

Because of the differing levels of commitment indicated by the socket count, and because of the potential divergence of results of this study from those of previous studies, we examined the bulb type and socket count data by type of residence and age of the home (Table 4–14 and Table 4–15). Both analyses can be seen as proxies for the size of the home, as single family homes are usually larger than other types of residences and newer homes, on average, are larger than older ones.[28] The results, however, are limited by small sample sizes and the fact that we did not explicitly draw our sample to achieve a representative distribution based on these factors, thus curtailing our ability to draw generalize results beyond participating households. Among these households, however, it appears that households generally had CFLs installed in 30% to 41% of the sockets (the results for the duplex were biased by one outlier with numerous sockets with incandescent bulbs), but also that single family homes had more sockets than other types of homes (Table 4–14). Regarding the age of the home, newer homes had more sockets, on average, but the percentage of CFLs installed in sockets demonstrated no conclusive pattern (Table 4–15).

Table 4–14: Lighting Products Installed by Type of Residence

Type of Residence	**Single-family**	**Townhouse or row house**	**Duplex or two-family building**	**Three or four family building**	**Other**
Incandescent	58%	58%	74%	56%	52%
CFL	31%	30%	13%	41%	42%
Fluorescent	9%	5%	10%	2%	6%
Halogen	2%	5%	4%	0%	0%
LED	0%	2%	0%	0%	0%
Number of Sockets	**5,933**	**261**	**281**	**121**	**215**
Number of Homes	110	6	5	5	10
Average Number of Sockets	**53.9**	**43.5**	**56.2**	**24.2**	**21.5**

Table 4–15: Lighting Products Installed by Age of Residence

Age of Home	**<5 years**	**5-10 years**	**11-20 years**	**21-50 years**	**>50 years**	**Don't know**
Incandescent	65%	51%	54%	58%	63%	33%
CFL	27%	46%	30%	33%	25%	62%
Fluorescent	8%	2%	15%	7%	9%	5%
Halogen	0%	1%	1%	2%	3%	0%
LED	0%	0%	1%	0%	0%	0%
Number of Sockets	**344**	**334**	**868**	**3,061**	**2,088**	**116**
Number of Homes	5	6	13	59	48	5
Average Number of Sockets	**68.8**	**55. 7**	**66.8**	**51.9**	**43.5**	**23.2**

[28] Note that the sample sizes are too small to examine further breakdowns of the data by type or age of residence or to cross tabulate them with other variables such as owner-renter status or the number of CFLs in the home.

Table 4–16 compares the wattages of all products in the home in the current markdown study to those in the measure life study. One important pattern emerges from this comparison—the markdown respondents consistently had slightly smaller wattage products installed in sockets in their home. Likewise, the maximum wattage installed was always substantially lower in the markdown sample.

Table 4–16: Bulb Wattage by Bulb Type
(Number of sockets by type of installed bulb)

Measure	Study	CFL	Incandescent	Fluorescent	Halogen	LED
Min	Markdown	3	5	11	5	0.7
	Measure Life	3	3	7	10	0.3
Max	Markdown	70[a]	250	80	300	8
	Measure Life	120[a]	300	110	500	25
Average	Markdown	16	56	33	45	4
	Measure Life	18	57	35	63	8
Total sockets	**Markdown**	**2,106**	**4,003**	**564**	**132**	**6**
	Measure Life	**4,023**	**9,027**	**1,447**	**653**	**15**

[a] Although these are high wattages for most CFLs, we have verified that such CFLs exist. While the possibility exists that technicians may have mistakenly noted the wrong wattage, it is also possible that respondents had such CFLs in their home.

The respondents that had eleven or more qualified markdown CFLs in their homes had lower wattage CFLs and incandescent bulbs than did those with fewer qualified products (Table 4–17). Given that CFLs and incandescent bulbs comprise the majority of bulbs installed in sockets, this finding indicates a tendency for those who recently obtain many markdown CFLs to install lower wattage products overall than do those who obtained fewer markdown CFLs. While we cannot explain this finding based on the data collected as part of this study, one potential explanation is that such respondents have multiple socket fixtures or circuits rated only for lower wattage products instead of a few higher wattage fixtures. Alternatively, they may be installing lower wattage products to reduce the electricity costs associated with having so many sockets in their homes.

Table 4–17: Bulb Wattage by Bulb Type and Number of Qualified CFLs in Home
(Number of sockets by type of installed bulb and number of qualified CFLs in home)

Type of Bulb	One to Five	Six to Ten	Eleven or more	Number of Sockets
CFL	18	17	15	2,090
Incandescent	57	58	54	3,978
Fluorescent	37	28	36	564
Halogen	36	51	45	132
LED	7	n/a	3	6
Total Sockets	**1,248**	**2,548**	**2,974**	**6,770**

4.3.2 Location of Lighting Products in Households

The inventory also examined the rooms where lighting products were installed (Table 4–18). Overall, respondents were most likely to install CFLs in dining rooms and kitchens (19% of all sockets filled with CFLs), living rooms (18%), and bedrooms (17%).The most common lighting products, incandescent bulbs, were also usually installed in bedrooms (20% of all sockets filled with incandescent bulbs), dining room or kitchens (19%), and bathrooms (19%). Traditional fluorescent tubes were most commonly installed in basements (45% of all sockets filled with fluorescents tubes), while halogens were most frequently located in kitchens and dining rooms (48% of all sockets filled with halogens). LED bulbs were most frequently observed in dining rooms and kitchens or in hallways (33% each). Less than 10% of all lighting products—as well as CFLs—were installed on the exterior of the home or in garages or barns.

Table 4–18: Lighting Products by Installed Location in Home[a]
(All sockets by type of installed bulb)

Locations of Bulbs	CFL	Incandescent	Fluorescent	Halogen	LED[e]	Overall
Dining Room/Kitchen	19%	19%	18%	48%	2	19%
Living Room	18%	11%	5%	16%	0	13%
Bedroom	17%	20%	5%	8%	0	18%
Bathroom	12%	19%	5%	8%	1	15%
Basement	11%	8%	45%	9%	0	12%
Hallway/Foyer	9%	9%	2%	1%	2	8%
Exterior[b]	6%	7%	10%	2%	0	7%
Office/Den[c]	4%	4%	2%	8%	1	4%
Laundry/Work Rooms	1%	1%	6%	0%	0	1%
Other Rooms[d]	1%	2%	0%	0%	0	1%
Closet	0%	1%	3%	0%	0	1%
Number of Sockets	**2,106**	**4,003**	**564**	**132**	**6**	**6,809**

[a] The groupings in this table differ from those in the previous ones because of the great sample size for presenting more room types individually.
[b] Includes garages, barns, and sheds
[c] Includes computer/conference rooms, dens, studios, studies, and libraries
[d] Includes sun rooms, attics, gyms, porches/decks, and saunas
[e] Number of responses shown due to small sample size

Participants in the markdown and measure life studies generally installed CFLs and incandescent bulbs according to similar patterns (Table 4–19). Both types of bulbs were most common in dining rooms, kitchens, living rooms, bedrooms, and bathrooms. Respondents in each panel displayed a slight preference for CFLs in the basement (11% and 13% for CFLs vs. 7% and 8% for incandescent), whereas incandescent bulbs slightly edged out CFLs in bedrooms (19% and 20% for incandescent vs. 17% and 18% for CFLs).

Table 4–19: CFLs and Incandescent Bulbs by Location in Home, Markdown and Measure Life Studies[a]

(All sockets filled with CFLs and incandescent bulbs)

Location of Bulbs	CFL		Incandescent	
	Markdown	Measure Life	Markdown	Measure Life
Dining Room/Kitchen	19%	15%	19%	19%
Living Room	18%	19%	11%	14%
Bedroom	17%	18%	20%	19%
Bathroom	12%	12%	19%	17%
Basement	11%	13%	8%	7%
Hallway/Foyer	9%	9%	9%	9%
Exterior	6%	9%	7%	9%
Office/Den	4%	3%	4%	2%
Other	2%	2%	5%	4%
Number of Sockets	**2,106**	**4,023**	**4,003**	**9,027**

[a] Room groupings similar to those in Table 4–18 but some have been collapsed to allow for comparability to the measure life study.

4.3.3 Fixture Types

Table 4–20 shows the type of fixtures in which *all* lighting products were installed. Ceiling mounted fixtures (31%) were the most common type of fixture found in participants' homes, followed by wall mounted fixtures (19%) and table lamps (15%). The patterns were very similar for the measure life study. We did not collect information on whether or not these fixtures were dimmable.

Table 4–20: Lighting Products by Fixture Type, Markdown and Measure Life Study

(All sockets by study)

Fixture Types	Markdown	Measure Life
Ceiling Mounted	31%	35%
Wall Mounted	19%	19%
Table Lamp	15%	14%
Recessed	11%	7%
Suspended	10%	11%
Ceiling Fan	7%	6%
Floor Lamp	4%	4%
Other	4%	4%
Number of Sockets	**6,811**	**15,168**

4.3.4 Bulbs in Storage

The technicians also searched for all bulbs in storage. Table 4–21 compares the results of this search with those from the measure life study. Perhaps because they had already installed so many CFLs in sockets, respondents tended to store more non-CFLs than CFLs. We did not whether or not they intend to use these non-CFL bulbs.

Table 4–21: Bulbs in Storage by Type of Bulb

(All bulbs in storage by bulb type)

Bulb Type	Markdown	Measure Life
CFLs	46%	59%
All others	54%	41%
Number of Products	742	2,538

In keeping both with their greater commitment to CFLs and the greater number of sockets in the home, respondents who had purchased more markdown CFLs recently had more CFLs in storage than incandescent bulbs, exceeding the percentages of CFLs in storage for households who recently purchased fewer CFLs.

Table 4–22: Bulbs in Storage by Type of Bulb and Number of Qualified CFLs in Home

(All bulbs in storage by bulb type and qualified CFLs in home)

Bulb Type	One to Five	Six to Ten	Eleven or More	Overall
CFLs	28%	43%	58%	46%
All others	72%	57%	42%	54%
Number of Products	**144**	**336**	**262**	742

Respondents will use CFLs to replace other CFLs (34%), incandescent bulbs (39%), or one or the other (22%) (Table 4–23). This differs from the measure life study in which respondents more frequently said they would use a CFL to replace a CFL or whichever type of product needed to be replaced. That is, while the markdown purchasers already had CFLs installed in more sockets than did the measure life participants, they former plan to convert even more sockets to CFLs.

Table 4–23: What Type of Bulb will be Replaced by Stored CFLs
(All stored CFLs)

Replaced Bulb Type	Markdown	Measure Life
CFL	34%	46%
Incandescent	39%	8%
CFL or Incandescent	22%	44%
Don’t know/Nothing	5%	2%
Number of Products	**339**	**922**

Respondents with just one to five as well as those with eleven or more recently purchased CFLs were the most likely to say they will use a stored CFL to replace another CFL. Those with six to ten CFLs were not yet certain if a CFL will replace another CFL or an incandescent bulb.

Table 4–24:What Type of Bulb will be Replaced by Stored CFLs by Qualified Markdown CFLs in the Home
All stored CFLs)

Replaced Bulb Type	One to Five	Six to Ten	Eleven or More	Overall
CFL	37%	27%	39%	34%
Incandescent	24%	33%	49%	39%
CFL or Incandescent	17%	37%	9%	22%
Don't know/Nothing	22%	3%	2%	5%
Number of Products	**41**	**146**	**152**	**339**

4.4 Satisfaction with CFLs

Participants were asked to indicate their level of satisfaction with CFL light bulbs on a ten point scale from one-very dissatisfied to ten-very satisfied (Figure 4-1). Overall, participants were very satisfied, with 74% of the 135 respondents rating satisfaction with an eight or higher. While there were no differences in satisfaction by panel, the more qualified markdown CFLs respondents have in their homes, the more likely they were to rate their satisfaction at eight to ten, rather than five to seven (Figure 4-2).

Figure 4-1: Satisfaction with CFLs

(All respondents; n = 135 – one observation missing)

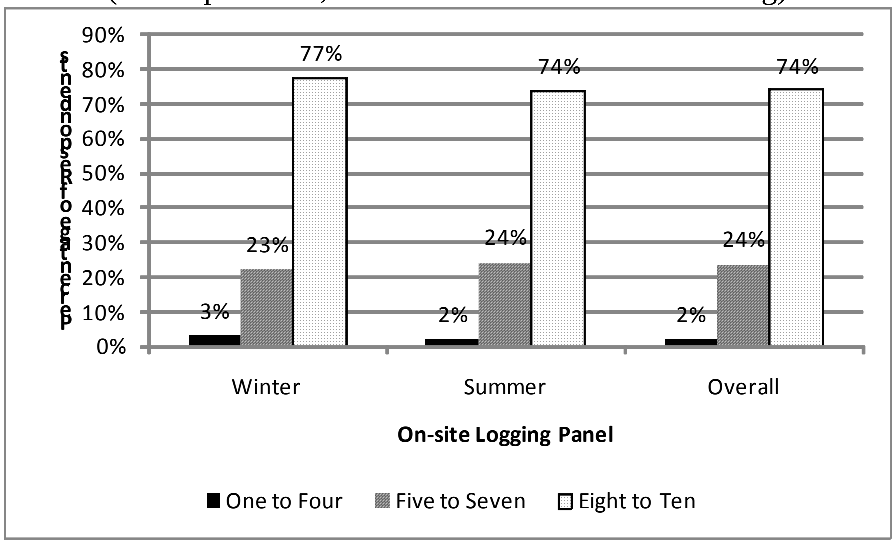
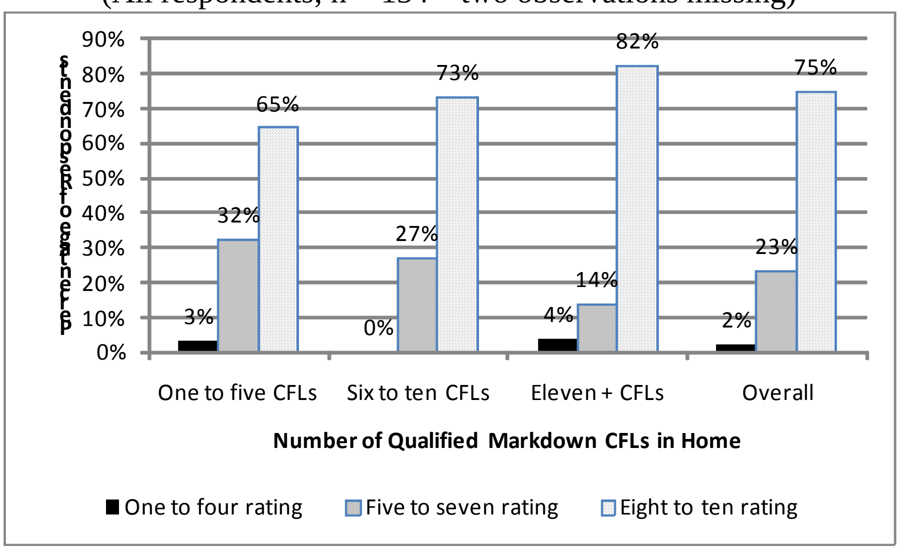


Figure 4-2: Satisfaction with CFLs by Number of Qualified CFLs in Home

(All respondents; n = 134 – two observations missing)



Participants were also asked whether they had given away CFLs. In fact, 27% of respondents overall (29% of summer panelist and 22% of winter panelists) had given CFLs away. On average these 34 individuals had given away 2.4 CFLs, with a range from one to 12 CFLs. They gave the CFLs away to a variety of people, including family members, members of their church congregation, friends, and clients in the case of an electrical contractor.

Table 4–25: Given CFLs Away
(Respondents giving away CFLs)

Give Away CFL	Winter	Summer	Total
Yes	22%	29%	27%
No	78%	70%	72%
Do not know	0%	1%	1%
Number of Respondents	**32**	**103**	**135**

5 Task 5: Energy and Demand Savings

This chapter describes the analysis and results for the following:

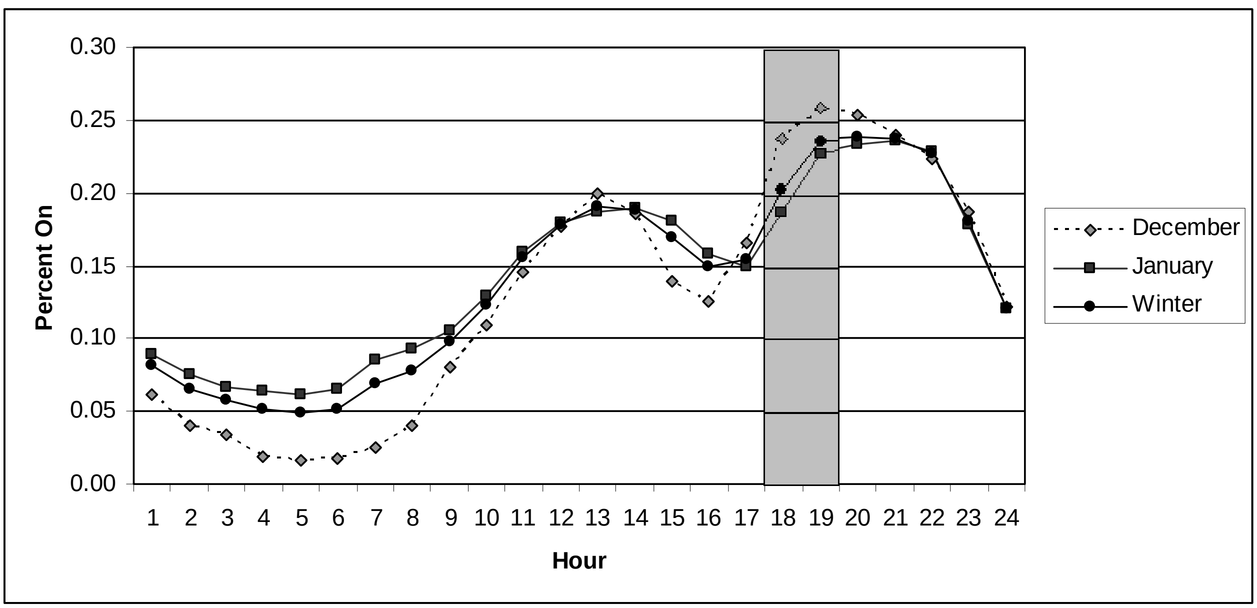
- The development of monthly load shapes for December and January (when the winter peak occurs) and for June, July, and August (when the summer peak occurs) for the lighting observed.
- The calculation of coincidence factors.
- The calculation of monthly operating hours.

5.1 Develop Monthly Load Shapes

This task consisted of using the time-of-use lighting logger data to create average weekday and average weekend/holiday monthly load shapes. These load shapes were determined through the use of 15 minute transition data from all loggers installed. The data were logged and analyzed independently, and not in aggregate.

Figure 5-1 presents a graphical comparison of the December, January, and average winter profiles for the markdown lighting based upon the weekday, non-holiday logger data.[29] The shapes and magnitudes of the profiles during each month are very similar during most of the hours of the day and particularly during winter performance hours (5:00 PM to 7:00 PM, based on the ending hour), which are shaded.

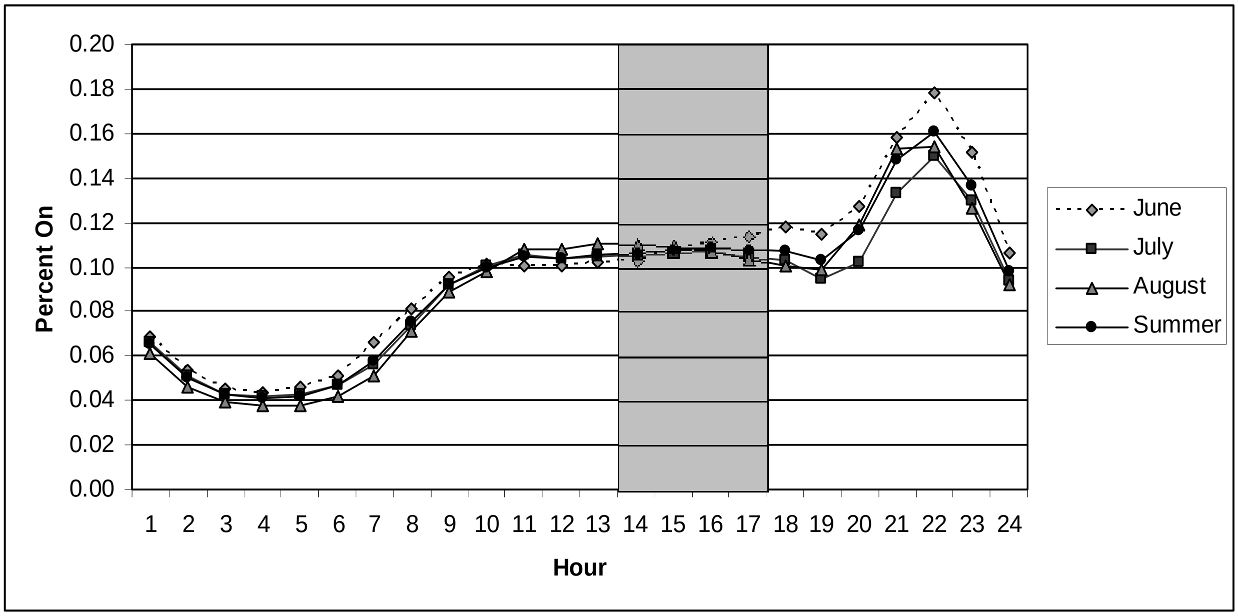
Figure 5-1: Winter Monthly and Average Lighting Profile



[29] The average logging time for winter loggers was 42 days, despite the fact that they were placed from between mid-December and mid-January.

Figure 5-2 presents a graphical comparison of the June, July, August, and average summer profiles for the markdown lighting based upon the weekday, non-holiday logger data. The shapes and magnitudes of the profiles during each month are virtually identical during most of the hours of the day and particularly during summer performance hours (1:00 PM to 5:00 PM, based on the ending hour), which are shaded. It is interesting to note in the figure that summer lighting use of the logged products peaks between 8:00 PM and 11:00 PM, later than the performance hours, a likely consequence of the greater amount of daylight.

Figure 5-2: Summer Monthly and Average Lighting Profile



5.2 Calculate Coincidence Factors

The data used to inform the monthly lighting load shapes were then used to calculate CFs during the New England Independent System Operator (ISO-NE) summer and winter On-peak and Seasonal Peak performance hours. The CFs are essentially ratios that represent the percentage of operation during a period of interest and are one component of the demand reduction calculation. The winter on-peak hours are during non-holiday weekdays from 5 PM to 7 PM. The summer on-peak hours are during non-holiday weekdays from 1 PM to 5 PM.

Table 5–1 provides the winter sample size, on-peak CFs, and relative precision for the winter months.[30] The winter CFs ranged from a low of 0.208 for January, to a high of 0.249 for December, with the winter average CF of 0.220. The relative precision for December and January is ±18.3% and ±12.4%, respectively at the 80% confidence interval, with the winter average having a relative precision of ±10.2% at the 80% confidence interval. Like the summer results below, note that the average winter calculations are based on treating each logger in each month as an individual observation. Therefore, the reported sample sizes sometimes diverge from those reported for the total number of products logged (e.g., in Table 4–2).

Table 5–1: Winter On-Peak Coincidence Factors and Relative Precisions

Data Period	Winter On-Peak Hours 5 PM-7 PM		
	Number of Products	Coincidence Factor	Relative Precision
December	64	0.249	±18.3%
January	164	0.208	±12.4%
Average Winter	**228**	**0.220**	**±10.2%**

Table 5–2 provides the summer sample size, on-peak CFs, and relative precision for the summer months. The summer CFs ranged from a low of 0.106 for July, to a high of 0.109 for June, with the summer average CF of 0.108. The relative precision for June, July, and August is ±10.0%, ±10.6%, and ±10.1%, respectively at the 80% confidence interval, with the summer average having a relative precision of ±5.9% at the 80% confidence interval. We remind the reader that the sample size represents each logger in each month and includes loggers placed for both the winter and summer panels.

Table 5–2: Summer On-Peak Coincidence Factors and Relative Precisions

Data Period	**Summer On-Peak Hours 1 PM-5 PM**		
	Number of Products	Coincidence Factor	Relative Precision
June	632	0.109	±10.0%
July	629	0.106	±10.6%
August	629	0.108	±10.1%
Average Summer	**1,890**	**0.108**	**±5.9%**

5.3 Calculating Residential Lighting Seasonal Peak Coincidence Factors

The seasonal peak performance hours were developed so that they could be used to estimate the seasonal peak performance CFs. Since the performance hours are dynamic and will vary based upon ambient weather conditions, it is impossible to determine the performance hours with 100% accuracy prior to the seasonal peak period. Analyses of the winter 2007/2008 and summer 2008 ISO-NE system loads were performed to determine the actual seasonal peak hours, which are

[30] Please recall that none of the loggers was in place for the entire month of December due to the timing of the study, particularly the late kick off date coupled with the need to identify a sample and schedule on-site visits.

defined as occurring when the real-time system peak load meets or exceeds 90% of the most recent 50/50 peak load.

Table 5–3 provides a listing of the winter 2007/2008 seasonal peak hours, which occurred during seven hours when the real-time system load was greater than or equal to 20,763 MW or 90% of the 50/50 Capacity, Energy, Loads, and Transmission (CELT) forecasted winter peak of 23,070 MW. Note that during the month of December there where two seasonal peak hours during hour ending 18 and two seasonal peak hours during hour ending 19. Since the operation of lighting is not related to ambient temperature a specific hour analysis of coincidence is not necessary.[31]

Table 5–3: 2007/2008 Winter Seasonal Peak Hours

2007/2008 Winter 50/50 Peak		**23,070**
90% of 07/08 Winter Peak		**20,763**
2007/2008 Seasonal Peak Hours		
Date	**Hour Ending**	**System Load (MW)**
1/3/2008	19	21,774
1/3/2008	18	21,699
1/3/2008	20	21,334
12/13/2007	18	21,305
12/13/2007	19	20,976
12/17/2007	18	20,960
12/17/2007	19	20,945

[31] In this case we would have very little actual logger data available for analysis during 12/13/07 and 12/17/07.

Table 5–4 provides a listing of the summer 2008 seasonal peak hours, which occurred during eight hours when the real-time system load was greater than or equal to 25,173 MW or 90% of the 50/50 CELT forecasted summer peak of 27,970 MW. Note that during the month of June there where two seasonal peak hours during hour ending 16 and two seasonal peak hours during hour ending 17.

Table 5–4: 2008 Summer Seasonal Peak Hours

2008 Summer 50/50 Peak		**27,970**
90% of 08 Summer Peak		**25,173**
2008 Seasonal Peak Hours		
Date	**Hour Ending**	**System Load (MW)**
6/10/2008	17	26,138
6/10/2008	15	26,102
6/10/2008	16	26,059
6/10/2008	14	25,965
6/10/2008	18	25,729
6/10/2008	13	25,451
6/9/2008	17	25,444
6/9/2008	16	25,398

Table 5–5 provides the hourly frequencies by month (December and January) and for the winter season, which shows that for December the seasonal peak hours occurred during the same hours as the on-peak hours (non-holiday weekdays from 5 PM to 7 PM). The January seasonal peak hours were distributed equally across three hours: hour ending 18, 19 and 20. The weights shown in the table along with the average monthly lighting profiles were used to calculate the 2007/2008 winter seasonal peak CFs. Consistent with ISO-NE’s expectations, the weighting is performed by month so that separate Demand Reduction Values (DRVs) can be calculated for each month.

Table 5–5: Frequency Weighting for Winter Seasonal Peak Hours

Month	**Hour Ending**	**Frequency**	**Weight**
December	18	2	0.5
December	19	2	0.5
December Total		**4**	**1**
January	18	1	0.333
January	19	1	0.333
January	20	1	0.333
January Total		**3**	**1**
Winter Average	18	3	0.429
Winter Average	19	3	0.429
Winter Average	20	1	0.143
Winter Average Total		**7**	**1**

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.

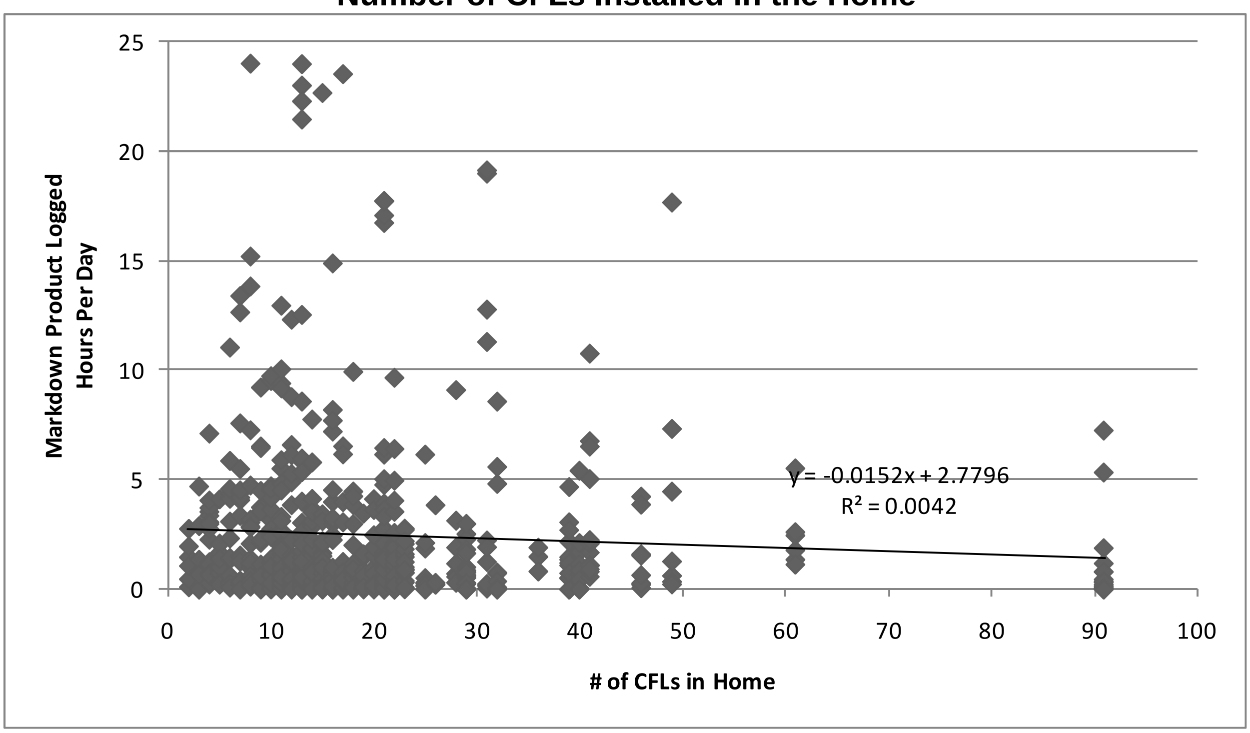
[35] One reviewer of a previous draft asked if customers round to the nearest half or full hour when giving their estimates of usage and what impact rounding might have on the results. We found that customers tend to round to the nearest quarter hour when giving estimates of less than one hour and to 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

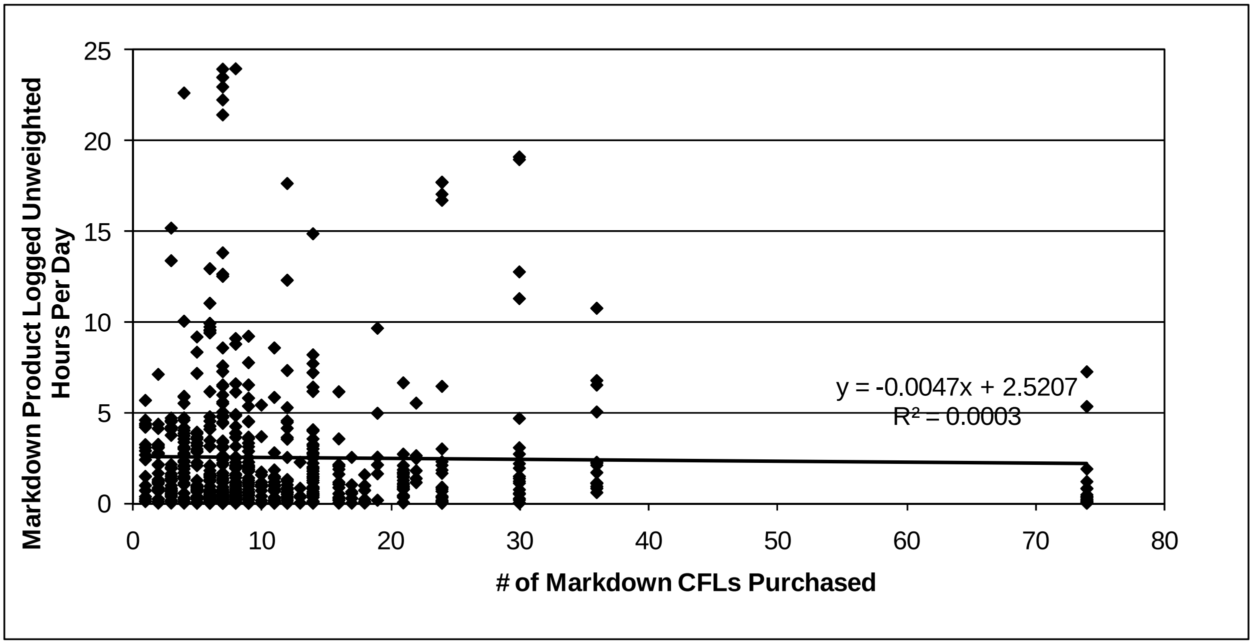


Figure 5-5 and Figure 5-6 on the next page present the strength of the relationship between the number of markdown CFLs purchased by the homeowners in the sample to the winter and summer coincidence factors, respectively. As was the case with the results in the figures above, these results do not provide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

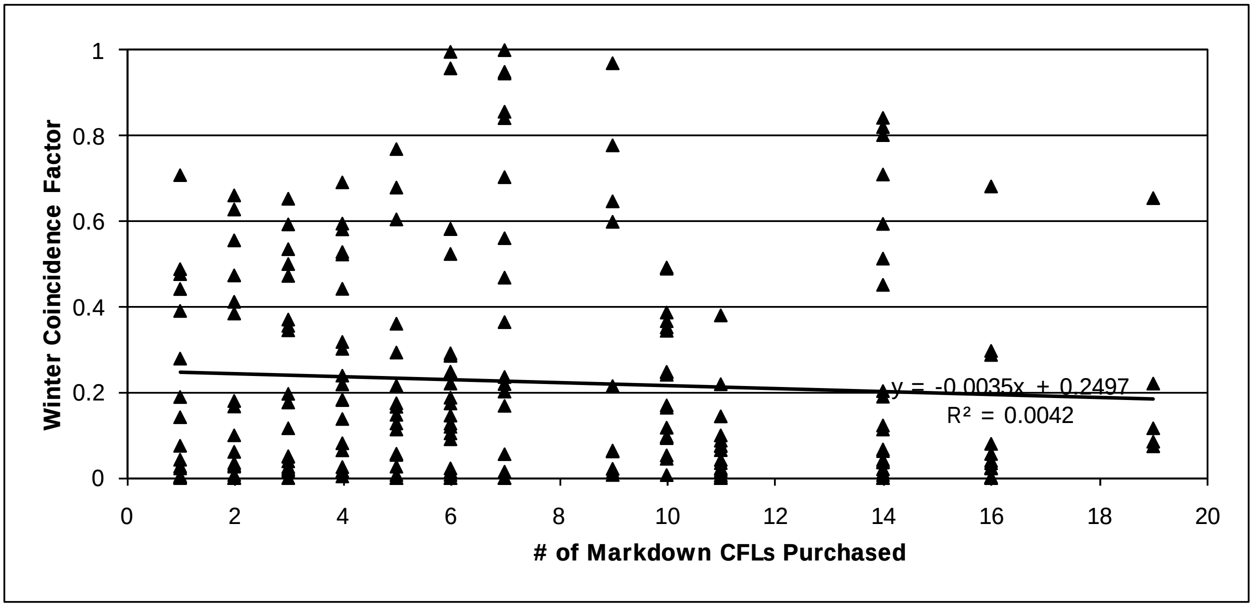
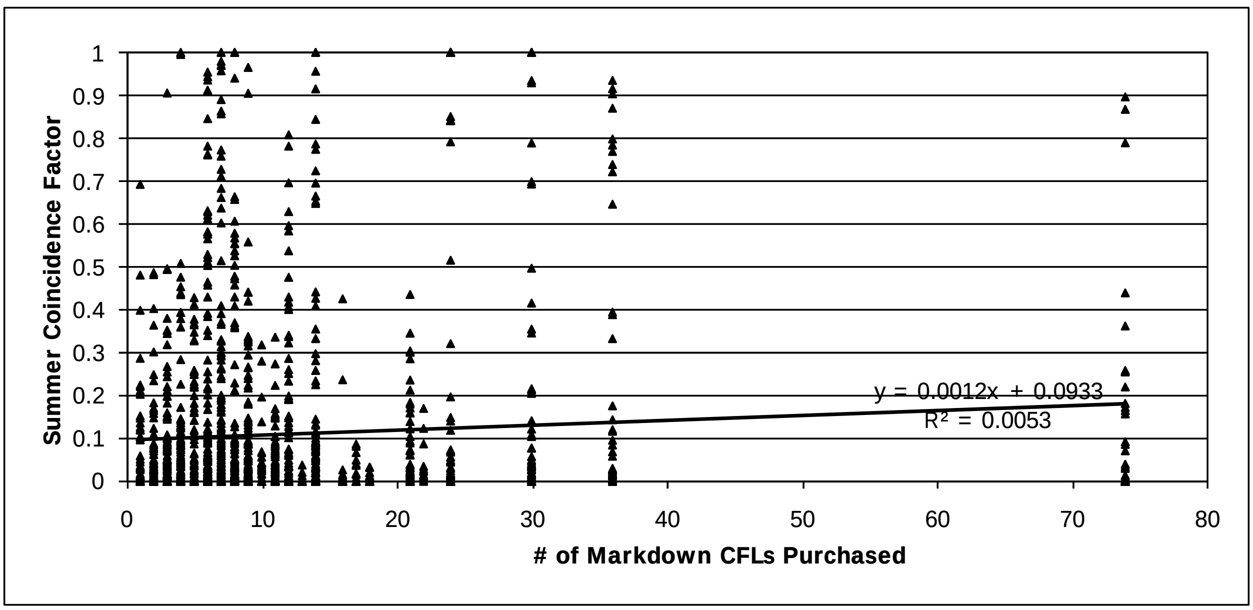


Figure 5-6: Comparison of Logged Daily Hours of Use to Number of Markdown CFLs Purchased



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.

Table 5–18: Wattage Estimates with 80% Confidence Intervals by Load Zone

Load Zone	Delta Watts	Margin of Error*	Confidence Interval	
			Low	High
Connecticut	47.7	1.0	46.7	48.6
Northeast MA	46.9	1.2	45.7	48.1
Southeast MA	44.7	1.1	43.6	45.8
West-Central MA	48.9	1.7	47.2	50.6
Rhode Island	41.4	1.6	39.8	42.9
Vermont	45.2	1.5	43.8	46.7
Overall	**45.7**	**0.5**	**45.2**	**46.2**

* Margin of error is equal to z-score x standard error. At the 80% confidence interval the z-score is 1.282.

The wattage displacement varies only slightly by room type, with the delta watts being lowest in kitchen and dining rooms (44.4 watts) and highest in the miscellaneous other rooms (47.8 watts.)

Table 5–19: Wattage Replacement by Room Type

Room Type	# of Bulbs	Average Wattage, Logged CFLs	Average Wattage, Replaced CFLs	Delta Watts
Family/Living Room/Den	264	15.6	61.4	45.8
Kitchen/Dining Room	225	14.7	59.1	44.4
Bedroom	170	15.9	60.8	44.9
Basement	97	16.8	63.6	46.8
Bathroom	160	14.5	60.1	45.5
Hallway/Foyer /Stairs	103	14.0	61.3	47.3
Other[a]	64	19.3	67.1	47.8
Overall	**1,083**	**15.5**	**61.2**	**45.7**

[a] Other rooms in the current study included exterior, all exterior buildings, mudroom, playroom, sunroom, studio, closet, laundry, and varying types of workrooms.

The finding that delta watts decreased from the 2004 MA-RI-VT study to the current one raises the question of whether the various study sponsors should keep their current estimates of delta watts or adopt those presented in this study. While this decision is up to the sponsors, the NMR team presents the following points for consideration. As presented above, the participants in the current study had a greater proportion of CFLs installed than participants in either the 2004 MA-RI-VT or the 2008 New England Measure Life studies, suggesting that the current study participants may be more predisposed to the use of CFLs than coupon or catalog purchasers or those obtaining CFLs through direct install programs. Furthermore, they appeared to have been more predisposed to the use of lower wattage incandescent products as well.[37] The most important issue to consider, however, is whether or not the on-site participants differ from the overall *population of markdown purchasers*—the program approach that currently accounts for the delivery of the vast majority of CFLs in New England. By design, we excluded from the on-sites the markdown participants who had not immediately installed all of their CFLs, and this

[37] While we can only speculate why, perhaps these respondents are more likely to have sockets that require the use of lower wattage products. Alternatively, perhaps they purposely chose lower wattage incandescent to save energy, and then moved on to CFLs through the markdown program to save even more energy.

may mean that the on-site sample differs in some ways from the overall population of markdown purchasers. Furthermore, the study participants appear to be fairly committed to CFLs when compared to measure life respondents and even those markdown participants who did not participate in the on-site. However, while the NMR team acknowledges these differences, we do not believe they bias the wattage replacement results primarily because the respondents are not replacing CFLs with other CFLs in large numbers. It is our recommendation that the sponsors adopt the estimates for delta watts presented in this study for their markdown programs, but we are less confident of its use for coupon, catalog, or direct install program.

5.7 Installation Rate

Neither the measure life study nor the markdown study was designed to develop an estimate of installation rates. The measure life study provided some information on how many products were installed, but the focus of that study was on CFLs that had been in homes for up to six years by the time of the study. While this design allowed us to identify how long CFLs survived when installed, it was less reliable as a method of identifying the installation rate precisely because so many of the products we were seeking had reached the end of their useful lives and customers had a difficult time recalling the disposition of all the products they had obtained through the sponsors' programs. The current markdown study collected information on product installation versus storage at two different points: first in the RDD survey and then during the on-site visit. Yet, these bits of information on CFL installation are limited and incomplete due to the focus of the markdown RDD survey on finding households with installed markdown products, ending the recruitment call as soon as possible, and then conducting on-sites *only at homes in which at least one markdown product was thought to be installed.* In other words, we purposefully excluded from the on-sites any RDD survey respondents who reported storing all of their markdown CFLs at the time of the survey.

Despite these shortcomings, we recognize that the sponsors of this and the measure life study would like to see updated estimates of installation rates. In order to develop such estimates, NMR included the number of 'not installed' recent markdown purchases as reported in the RDD by respondents who had not installed any of their recently purchased markdown products. We adjusted this number for the proportion of RDD products actually sampled and found during the on-site visits (Table 5–20). We then pooled the adjusted data from the RDD survey together with installation data from the markdown and measure life on-site visits.[38] The resulting rate is 76.6% for the pooled estimate; individual estimates for the markdown and measure life products arrive at nearly the same result (Table 5–21). We also calculated a lifetime rate based on the stated intention of respondents to install CFLs at a later date (Table 5–21 and Table 5–22). The estimated lifetime installation rate is 97.6% for the pooled estimate from both studies, ranging from 97.4% for the markdown study to 99.1% for the measure life study.

[38] We included only 2006 products from the measure-life-study participant recall of the disposition of CFLs dropped precipitously after 2006. We did not include direct install products because, by definition, they are installed during a home energy audit or during the construction of an ENERGY STAR qualified home.

Table 5–20: Calculation of Number of Products Never Installed from RDD Survey

Purpose	Measure	Winter	Summer
Verified data used to adjust RDD survey results for not installed products	Row A: Number of non-coupon purchases reported– all *recruited* RDD respondents	1,826	3,754
	Row B: Number of markdown CFLs *sought* during on-site visits	390	1,478
	Row C: Number of *sought* markdown CFLs actually found during on-site visits	266	871
Application to RDD survey results for not installed products	Row D: Number of non-coupon purchases reported-RDD respondents not installing any qualified purchases	86	225
	Row E: Proportion expect to find if on-site had been conducted (Row D x [Row B ÷ Row A])	18	89
	Row F: Number actually expect to find if on-site had been conducted (Row E x [Row C ÷ Row B])	13	52

Table 5–21: Calculation of First-Year and Lifetime Installation Rates

Measure	Markdown	Measure Life	Both
Total number of products	1,202	168	1,370
Number of products ever installed[a]	921	129	1,050
First-year installation rate	**76.6%**	**76.8%**	**76.6%**
Number of products likely to be installed in future[b]	250	37	287
Lifetime number of products to be installed[c]	1,171	166	1,337
Lifetime installation rate	**97.4%**	**99.1%**	**97.6%**

[a] Includes products that have been removed. The measure life estimate adjusts for product removal, while the installation rate captures all products that have ever been installed.
[b] See Table 5–22 for calculations
[c] Sum of current and future installations

Table 5–22: Calculation of Products Likely to be Installed

	Number not installed	Percent to be installed	Number to be installed
Winter on-site	29	91%	27
Summer on-site	187	87%	163
Winter RDD (no installed products)	52	94%	49
Summer RDD (no installed products)	13	90%	12
Measure Life	39	96%	37

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