Thomas R. Teehan
Senior Counsel

December 18, 2008

VIA HAND DELIVERY & ELECTRONIC MAIL

Luly E. Massaro, Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

RE: Docket 3999 – National Grid Tariff Advice Filing to Amend RIPUC No. 2006, Qualifying Facilities Power Purchase Rate
Response to Record Request

Dear Ms. Massaro:

Enclosed please find ten (10) copies of National Grid's[1] response to a Record Request issued at the technical session on December 17, 2008 in the above-captioned proceeding.

In addition, per the Commission's request, the Company is providing a copy of the PowerCost Monitor Pilot Program Evaluation prepared by Opinion Dynamics Corporation.

Thank you for your attention to this transmittal. If you have any questions, please feel free to contact me at (401) 784-7667.

Very truly yours,

Thomas R. Teehan

Enclosures

cc: Docket 3999 Service List
Paul Roberti, Esq.
Steve Scialabba, Division

[1] Submitted on behalf of The Narragansett Electric Company d/b/a National Grid.

Certificate of Service

I hereby certify that a copy of the cover letter and / or any materials accompanying this certificate was electronically mailed, sent via U. S. Mail and/or hand-delivered to the individuals listed below.

_____
Joanne M. Scanlon

December 18, 2008
Date

National Grid – Tariff Advice to Amend QF Power Purchase Rate to implement amended provisions of R.I.G.L. Sections 39-26-2 and 39-26-2(g)-(k) - Docket No. 3999
Service List updated on 12/1/08

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Record Request 1

Request:

Please provide an estimate of the costs associated with the installation of 35MW of renewable generating capacity that could ultimately be shifted to other ratepayers.

Response:

The Company has made a number of assumptions in order to provide the requested cost estimate. First, the generating capacity installed is comprised of approximately 26MW (75% of total installed capacity of 35 MW) of wind generation with an average capacity factor of 25% and 9 MW of solar generation with an average capacity factor of 13%. Second, approximately 75% of the net metered customers are billed on Rate G-32, 15% are billed on Rate G-62 and 10% are billed on Rate G-02. And, third, approximately 25% of the total generated kWhs are exported (i.e. eligible for renewable generation credits) and the remaining 75% are consumed by the customer. Based on these assumptions, the Company estimates that the costs not paid by the net-metered customers, which would ultimately be paid by other customers, are as follows:

Distribution:$500,000 (applicable distribution kWh charge times total generated kWhs)

Transmission :$365,000 (Transmission Adj. Factor times total generated kWhs)[1]

Transition: $108,000 (Transition Charge times total generated kWhs)

Commodity:$750,000 (Standard Offer Charge less Wholesale Market Price times net metered (exported) kWhs)

Total: $1,723,000

The analysis is based upon retail rates currently in effect and the ISO average wholesale market price for the period July 2007 through July 2008.

Prepared by or under the supervision of: Timothy Roughan

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[1] Note that, to the extent that the generating facility is operating at the time of the Company's peak demand, transmission expenses billed to the Company may be reduced and, therefore, the estimate of transmission expense may be slightly overstated. However, on average, the reduction in expense is likely to be insignificant.

Final Report for:

POWERCOST MONITOR PILOT PROGRAM EVALUATION

Draft

Prepared for:

NATIONAL GRID

NSTAR ELECTRIC

WESTERN MASSACHUSETTS ELECTRIC COMPANY

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December 10, 2008

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EXECUTIVE SUMMARY

During the summer and fall of 2007, National Grid, NSTAR Electric, and Western Massachusetts Electric Company (WMECO) ran pilot programs to investigate the effectiveness of providing customers with a PowerCost Monitor (PCM), which gives them access to real time information about their home electricity use.

National Grid, NSTAR Electric, and WMECO implemented coordinated but separate pilot programs to distribute PCMs to a small number of customers. Table ES-1 shows the three utilities' different marketing strategies, product prices, and targeted customer segments.

Table ES-1: Summary of PCM Distribution Activities

Utility	Marketing Strategy	Customers Targeted	Installation Method	Price
National Grid	Audit Program	Audit participants	MassSave contractor	Free
	Direct Mail	General public	Customer	$9.99
				$49.99
NSTAR	Press release, media	General public	Customer	$29.99
	Direct mail			
WMECO	Direct mail to previous audit participants	Previous audit participants	MassSave contractor	Free

The ODC team was hired to assess:

1. the success of the different PCM marketing strategies employed by the three utilities;
2. customer responses to different PCM price points, including those employed in the pilot programs;
3. customer perceptions of value/usefulness of PCMs relative to other energy efficiency services the utilities might provide;
4. short-term and long-term behavioral changes among participating customers as a result of using the PCM;
5. energy savings attributable to the pilot programs.

In Phase 1 of this research, ODC conducted telephone interviews with 478 customers who received a PCM and 266 customers who were offered a PCM but did not accept the offer. In Phase 2, the ODC team conducted a follow-up survey with 348 of the participants interviewed in Phase 1 and conducted a billing analysis. Below we present the findings from our Phase 1 and Phase 2 efforts.

Summary of Findings

Installation, Programming and Use

- At the time of the Phase 1 survey (December 2007/January 2008), 76% of customers had installed the PCM. Installation rates ranged from 66% to 75% for customers who were mailed a PCM. Another 2% installed it between the Phase 1 survey and the Phase 2 survey (June/July 2008). Overall, more than one-quarter (27%) of customers who received a PCM had not set it up 8 to 12 months after receiving it.
- Most of the customers (62%) who had not set up the PCM at the time of the Phase 1 survey stated that they just had not gotten around to it. Others had difficulty attaching the transmitter to the meter or programming the display unit. These reasons were also the most common among customers who still had not set up their PCM at the time of the Phase 2 survey.
- Among customers who did install the PCM, 43% found it easy to install the transmitter and 58% found programming the display unit to be easy. However, many did not find the process easy.
- Among those who had difficulty installing the transmitter, 32% said it was difficult to align and 24% said it was difficult to set up in general. Among those who had difficulty programming the display unit, 21% said it was hard to find the kWh cost, 15% said it was difficult to program, and 15% said the directions were confusing.
- Almost all of the customers (96%) who installed and programmed the PCM (or had it done for them) used the device after it was first set up.
- Of all customers who received a PCM: 73% installed and used the device after they first got it; 49% were still using it after two to six months; and 35% were still using it after eight to 12 months.
- Most customers who stopped using their PCM cited technical reasons for doing so. At the time of the Phase 1 survey customers indicated that the PCM did not work well (40%), that the batteries died (23%), or that the PCM broke (22%). These technical difficulties continued to be the most common ones when we followed up with the participants six months later.

Maintenance and Reliability

- Many customers (40%) report having had some technical problems with the PCM after two to six months of use. The most commonly mentioned problems were dead batteries, the PCM not working correctly, and it not working in the rain or cold. Of customers with technical issues, 59% had taken steps to resolve them at the time of the Phase 2 survey – 17% were successful in resolving the issue while 42% were not.
- At the time of the Phase 1 survey, only 15% of customers who used their PCM had called the toll-free number to get technical support. More than half (59%) of the customers were satisfied with the representative's ability to answer their questions.

Marketing Strategy

The utilities used different marketing strategies and prices to promote and distribute the PCM (See Table ES-1).

- By far the highest number of PCMs (2,628 or 75% of all PCMs) were distributed through NSTAR's media campaign.
- Adoption rates for the different marketing strategies varied substantially. Offering customers a free PCM during an energy audit was the most successful strategy (National Grid Audit Program; 94.3% adoption rate), followed by offering previous audit customers a free PCM through direct mail (WMECO; 13.7% adoption rate).
- The net cost per installed PCM ranged from a low of $150 for the National Grid Audit Program to a high of $223 for the NSTAR $29.99 direct mail campaign.[1]
- Only 23% of non-participants recall receiving an offer for a PCM.
- Many non-participants who recall the PCM offer but did not order a PCM feel that they do not need a PCM, because they already know about their electricity use, they already save all the electricity they can, or they already have too many gadgets in their house. Only 13% of non-participants indicate that the price of the PCM prevented them from ordering the unit.
- Participants feel the best way for their utility to inform them with offers such as the PCM is through bill inserts while non-participants prefer direct mail.

Price Points

PCM's were offered at four different price points (free, $9.99, $29.99, $49.99). The retail value is $145.

- Few customers would have been willing to pay the full cost of $145 but many would have paid more than they did. Customers who indicate that they would have paid more are more likely to go up only by one price point rather than by two, independent of what they actually paid.
- Most of the non-participants who recall receiving the offer report that they would have purchased the PCM if the price had been lower. However, cost does not appear to be the only barrier to participation since only 13% indicate that they didn't order the PCM because it cost too much.
- Non-participants who do not recall the offer were evenly split between the price points they would be willing to pay ($0, $9.99, $29.99, $49.99).

Customer Perceptions of Value of PCM

- Most customers (69%) decided to get a PCM to see how much it costs to use certain appliances.

[1] WMECO's cost per installed monitor is currently estimated at $380. However, WMECO has not been able to confirm this cost or explain the cost components. Since it is significantly higher than any of the other costs, it is excluded from the current comparison.

- About half (53%) of participants who have used the PCM find the information it provides useful.
- Non-participants are evenly divided in their perception on the usefulness of the PCM in helping them lower their electric bill.

Behavioral Changes

- About half (48%) of the participants who have used their PCMs report that their awareness of energy efficiency and actions they can take has increased somewhat as a result of using the PCM. The other half thinks their awareness has increased significantly (27%) or has remained the same (23%).
- The percentage of participants taking no or only a few steps to conserve electricity in their homes decreased from 53% before using the PCM to 32% after first using the PCM. Conversely, the percentage of customers taking all possible steps increased from 11% before PCM use to 17% when they first started using the PCM.
- Overall, 46% of all PCM recipients and 63% of participants who installed and initially used the PCM indicate that they have made changes in their electricity-using behavior as a result of their PCM use.
- Over the short-term almost half of participants (48%) who made changes in their electricity-using behavior were still taking all of the additional steps they took after first using the PCM. Only 4% said they reverted back to their old behavior.
- Phase 2 survey results show *increased* energy-saving behaviors in the long term compared to the short term. For example, the percentage of customers who report taking all possible steps to conserve electricity in their homes increased from 17% when they first started using the PCM to 33% at the time of the Phase 2 survey. However, economic conditions have changed significantly between the Phase 1 survey and the Phase 2 survey. It is unclear to what extent these changes can be attributed to PCM use.

Energy Savings

- Many customers (60%) who have changed their behavior have noticed a decrease in their electric bill since using the PCM. Approximately half of these estimate their savings to be between 5% and 10%.
- The billing analysis shows annual electricity savings per PCM installed and used by customers of 317.6 kWh (or 2.9% of annual usage). Electricity savings per PCM *distributed* are estimated to range from 201.9 kWh (or 1.9% of annual usage) to 317.6 kWh (or 2.9% of annual usage), depending on the utility and distribution strategy used.
- Total savings for the pilot program are estimated to be approximately 790 MWh per year.

Recommendations

Installation, Programming and Use

More than one-quarter (29%) of interviewed customers who were mailed a PCM had not set it up two to six months later. While most of these customers (62%) indicated that they just had not gotten around to it yet, 28% were not able to attach the transmitter to the meter and 14% were not able to program the display unit. Even among customers who did install the PCM, many did not find the process easy. The most common difficulties were with programming the display, finding the kWh cost, and aligning and setting the transmitter. In addition, those who had difficulty programming the display mentioned the directions as an issue.

- **Call to follow-up.** The significant rate of non-installation among customers who were mailed a PCM represents a significant reduction in potential savings from a PCM program. In a future PCM program, steps should therefore be taken to increase the installation rate. The two main reasons for non-installation – "not having gotten around to it" and technical difficulties – could be mitigated through a follow-up call that reminds the customer that they have the PCM and provides assistance in the case of technical difficulties. Such a call could be placed one to two weeks after the customer has received the PCM.[2]

Maintenance and Reliability

Many customers (40%) report having had some technical problem with the PCM within the first two to six months of use. In addition, 21% of all customers who received a PCM stopped using it because of technical difficulties (the PCM did not work well, the batteries died, or the PCM broke). Notably, National Grid customers who had their monitors installed during a home energy audit are more likely than other customers to report that they no longer use the PCM because it broke. Since these customers did not receive technical service with their PCM, it is possible that they mistakenly think the device was broken, when a call to the technical service hotline might have helped them determine the cause for the problem they experienced.

- **Provide technical support to all customers.** Technical support should be made available to all PCM customers, irrespective of the marketing and installation strategy. This might have resolved some of the technical problems audit customers experienced with their PCM.
- **Determine cause for low resolution to technical issues.** Of the customers with technical/battery problems at the time of the Phase 1 survey, 17% had resolved them when we called them back six months later. An additional 42% tried to resolve their problems but failed, and 40% did not attempt to resolve their issues. Of the customer who could not resolve their problems (n=35), 34% called Blue Line, 23% tried to resolve the problem themselves, and 17% called their utility company. If maintenance and reliability continues to be a problem with PCMs, the utilities might consider working with Blue Line to determine the cause of the technical problems reported by customers.

[2] In a similar program implemented by BC Hydro, Blue Line Innovations, the manufacturer and distributor of the PCM, employed this strategy. Blue Line contacted customers within one week of their self-installation to ensure that customers were successful in their installation and satisfied.

Marketing Strategy

The different marketing strategies employed by the three utilities resulted in different numbers of distributed PCMs, different adoption and installation rates, and different cost per installed monitor. Installation through the MassSave/RCS home energy audit program resulted in the highest adoption rate (94%), the highest installation rate (100%), and the lowest net cost per installed PCM ($150). However, this approach does not reach as wide of a customer base as other strategies, and it targets customers that might already be better informed about energy efficiency and therefore have a lower savings potential. NSTAR's media campaign, on the other hand, resulted in the highest number of PCM requests by far (2,628 or 75% of all distributed PCMs) at the second lowest cost per PCM ($180).

- **Include media coverage in marketing strategy.** If the goal of future PCM offerings is to distribute the largest number of PCMs possible, the marketing strategy should include a media component. As described above, this approach is relatively cost-effective and resulted in a significant customer response. The only drawback of this approach is that it is not possible to target specific customer groups, e.g., customers with electric heat. If the utilities prefer a more targeted strategy, they should consider the direct mail strategy or bill inserts. When asked directly, participants and non-participants prefer that utilities reach them through bill inserts or direct mail.

Price Points

While few participants would be willing to pay the full cost of $145 for the PCM, most are willing to pay one price point higher than the one they paid. The adoption rate for the PCM at $9.99 (5.7%) and $29.99 (4.8%) is similar, while the adoption rate drops dramatically for the $49.99 price point (0.3%).

- **Continue with a price point of $29.99.** Overall, the price point of $29.99 appears to be the highest of the test price points that is still reasonable to customers. For future offerings, we recommend a price point at or below $29.99.

Behavioral Changes and Energy Savings

After installing and using the PCM, 63% of customers reported making changes to their electricity usage. In addition, more customers reported taking all possible steps to save electricity after first using the PCM than before. However, only 27% indicated that their awareness of energy efficiency and actions they can take increased significantly.

- **Provide information on energy saving behaviors with the PCM.** To increase customers' energy saving behavior, the utilities should consider providing information on energy saving behaviors when shipping the PCM. This could include examples of actions customers could take to reduce their electricity use as well as information about available utility rebates. While some electricity-saving actions might be obvious, e.g., turning off a TV when not watching, customers might not be aware of other actions they could take, e.g., unplugging chargers or turning off power strips. A list of energy saving actions might give customers additional ideas of actions to test with their new PCM and might thus lead to greater savings.

1. INTRODUCTION AND STUDY BACKGROUND

During the summer and fall of 2007, National Grid, NSTAR Electric, and Western Massachusetts Electric Company (WMECO) ran pilot programs to investigate the effectiveness of providing customers with a PowerCost Monitor (PCM), which gives them access to real time information about their home electricity use. PCMs were provided using different marketing strategies and at different price points. The objective of the pilot was to assess the costs and benefits of PCMs in residential households in Massachusetts.

Opinion Dynamics Corporation (ODC), with subcontractor Megdal & Associates, was contracted to conduct an evaluation of the 2007 pilot program. The following five research objectives were selected for this evaluation:

1. Assess the success of the different PCM marketing strategies employed by the three utilities;
2. Assess customer responses to different PCM price points, including those employed in the pilot programs;
3. Assess customer perceptions of value/usefulness of PCMs relative to other energy efficiency services the utilities might provide;
4. Assess short-term and long-term behavioral changes among participating customers as a result of using the PCM;
5. Assess energy savings attributable to the pilot programs.

This report presents final results from this research effort. During Phase 1, ODC conducted primary research and a review of PCM marketing materials. The primary research effort included quantitative interviews with 478 customers who participated in the PCM pilot program and 266 customers who were targeted for participation but did not participate. Phase 2 of our evaluation included a follow-up survey with 348 of the participants interviewed in Phase 1 as well as a billing analysis to assess energy savings.

The following sections present a summary of the PCM pilot programs conducted by the three utilities, the methodology used for our research activities, and our findings with respect to the five selected research objectives.

2. SUMMARY OF PCM PILOT PROGRAMS

National Grid, NSTAR Electric, and WMECO implemented coordinated but separate pilot programs to distribute PCMs to a small number of customers. The three utilities used different marketing strategies, established different product prices, had different participation targets, and targeted different customer segments. This section summarizes the different strategies employed by the three utilities. Understanding these strategies is important as several of the research objectives involve a comparison of the different strategies.

National Grid

National Grid distributed a total of 377 PCMs to its customers between June 2, 2007 and August 23, 2007. National Grid used two marketing strategies:

- **Direct install during home energy audit:** National Grid installed 100 PCMs in conjunction with their MassSave/RCS home energy audit program. Conservation Services Group (CSG), the program implementer, randomly selected homes during the audit and installed the meters while at the customers' home between June 2 and July 10. An additional 11 customers were offered a PCM. Of these, six declined the offer and five were not able to install the PCM because of incompatibility with their meter. The cost of this strategy was approximately $15,000.
- **Direct mail campaign:** Beginning in June, National Grid sent almost 5,000 mailings to customers offering the PCM for $9.99 and another 1,800 mailings offering it to customers for $49.99. These mailings resulted in 272 PCM sold at $9.99 and 5 sold at $49.99. PCMs were mailed out for installation by the customer between June 18 and August 23. The cost of this campaign was approximately $42,700.

NSTAR Electric

NSTAR Electric distributed a total of 3,103 PCMs to its customers between May 16, 2007 and August 8, 2007. NSTAR used two distribution methods:

- **Direct mail campaign**: In May 2007, NSTAR sent almost 10,000 mailings to customers offering the PCM for $29.99. This resulted in the sale of 475 PCMs. These were ordered between May 18 and August 8. The cost of this campaign was approximately $70,100.
- **Press Release:** In June 2007, NSTAR submitted a press release to the Boston Globe. Multiple media outlets including Channel 4, Fox 25 News, and This Week in Business contacted NSTAR as a result. The media coverage announced the availability of PCMs for $29.99 and resulted in the sale of 2,628 units. These were ordered between May 16 and August 8.[3] The cost of this distribution method was approximately $354,800.

[3] These dates are based on the tracking spreadsheet. There may have been a tracking error as the order date is earlier than the date of the press release.

WMECO

WMECO installed a total of 32 PCMs between August 17 and November 9, 2007. WMECO used one marketing strategy:

- **Direct install after home energy audit:** WMECO contacted customers who had previously had an energy audit and offered them a PCM, free of charge. MassSave auditors visited the homes of these customers to install the monitors. The cost of this strategy was approximately $12,200.

Table 1 summarizes the PCM distribution strategies of the three utilities. *Appendix C: PCM Marketing Materials* presents the direct mailings used by the three utilities to market the PCM as well as the NSTAR press release.

Table 1: Summary of PCM Distribution Activities

Utility	Marketing Strategy	Customers Targeted	Installation Method	Price	Installation Period	# Customers Targeted	# PCMs Distr.
National Grid	Audit Program	Audit participants	MassSave contractor	Free	6/2/07 – 7/10/07	111	100
	Direct Mail	General public	Customer	$9.99	6/15/07 – 8/23/07[1]	4,745	272
				$49.99	8/20/07 – 8/23/07[a]	1,795	5
NSTAR	Press release, media	General public	Customer	$29.99	5/16/07 – 8/8/07[a]	General public	2,628
	Direct mail					9,978	475
WMECO	Direct mail to previous audit participants	Previous audit participants	MassSave contractor	Free	8/17/07 – 11/9/07	234	32

[a]Order date

It should be noted that customers were pre-screened for compatibility of their meters with the PCM transmission unit. Overall, Blue Line Innovations, the manufacturer and distributor of the PCM, estimates that 40% of WMECO's meters and 15% of NSTAR's meters are not compatible with the PCM. Customers can consult Blue Line's website to determine if their meter is compatible before ordering a PCM, and they can return the PCM if they discover incompatibility after receiving the unit. (Personal communication with K. Sargent from Blue Line, April 2008.)

3. METHODOLOGY

We used a multi-pronged approach of qualitative and quantitative research to meet the research objectives selected for this evaluation. Specific elements of our research approach, and which research objectives they address, are outlined in Table 2 below.

Table 2: Research Objectives and Approach

Research Objective	Qualitative Efforts		Quantitative Efforts		
	Database Review	Program Manager Interviews	Participant Survey	Non-Participant Survey	Billing Analysis (Part and Non-part)
Marketing Assessment	X	X	X	X	
Price Point Assessment	X		X	X	
Relative Value Assessment		X	X	X	
Behavioral Assessment			X	X	
Energy Impact Assessment			X		X

The following subsections describe in more detail the quantitative research approaches used in this evaluation: the participant survey, the non-participant survey, and the billing analysis. In addition to these quantitative efforts, we also reviewed marketing materials and databases of program participants and targeted non-participants, and we conducted interviews with program managers at the three utilities and with the CSG manager in charge of the MassSAVE installations. These qualitative efforts helped us develop a more complete understanding of the strategies employed by each utility and informed our development of the quantitative surveys, including specification of sample sizes.

3.1 Participant Survey

The participant survey was designed as a two-phase effort. The goal was to conduct two separate interviews with 350 participating customers. Because of the likely attrition between the time of the first interview and the time of the second interview (approximately 5 to 6 months later), we attempted to conduct 500 interviews in the first wave, expecting to complete 350 in the second wave. This ratio was based on past similar research we have conducted with participants of energy efficiency programs.

We conducted the Phase 1 survey during December 2007 and January 2008, approximately two to six months after installation of the PCM. This survey included questions about participants' motivation to purchase the PCM, installation and use of the PCM, maintenance and reliability issues, energy efficiency attitudes and behaviors, behavioral changes as a result of using the PCM, perceived energy savings, attitudes towards different PCM prices, other energy services the customer might be interested in, and demographic and other questions about the home in

which the PCM was installed. As indicated in Table 2 above, the participant survey addresses all five research objectives.

We conducted the Phase 2 survey during June and July 2008 – eight to twelve months after installation of the PCM. The timing of the second survey provided sufficient time for customers to develop experience using the PCM and for any long-term behavior modification to emerge. In addition, this second survey explored the degree to which any immediate changes in behavior have become permanent. The survey also gathered information regarding factors that impact energy usage to compare to the initial survey, support the billing analysis, and determine if changes in energy usage are real.

The Phase 2 survey only targeted participants who had already responded to the Phase 1 participant survey. While the response rate to the Phase 2 Survey was very high (80%), it was not possible to reach all Phase 1 participants again. In addition, some of the Phase 1 respondents were excluded from the Phase 2 survey based on their Phase 1 responses.[4] However, many of our analyses are designed to relate survey findings to all PCM recipients (e.g., "X% *of all participants* still use the PCM 8 to 12 months after they received it" rather than "X% *of participants who used the PCM after 2 to 6 months* still use it after 8 to 12 months"). Therefore, we made two types of adjustments to the Phase 2 data for those types of analyses:

(1) To represent the 20% of Phase 1 participants we were not able to reach again, we weighted the Phase 2 data for those types of analyses. Our weighting approach assumes that Phase 2 non-respondents are similar to Phase 2 respondents. A comparison of demographic and select other data from the Phase 1 Survey for these two groups showed that there is no significant difference between them. (See *Appendix B: Profile of Respondents*.)

(2) To relate the data back to all participants, we added the excluded Phase 1 respondents to some of our long-term analyses. For example, respondents who in the Phase 1 survey indicated that they had returned their PCM or that it had broken are assumed to no longer use the PCM at the time of the Phase 2 survey. These participants would be added to the response tally, even though they were not included in the Phase 2 survey.

The remainder of this report identifies Phase 2 data that has been weighted and combined with Phase 1 data with the following: "Base includes weighted Phase 2 data and Phase 1 data." Where this approach was taken, we display the sample size as the (unweighted) number of Phase 2 respondents plus the added respondents from Phase 1.

Table 3 summarizes the sampling targets and completion rates for the participant surveys, by utility and marketing strategy. The sampling targets were selected to provide statistical significance at the 90/10 level for each unique utility/marketing strategy/price point combination. The final participant surveys, as fielded, are attached as *Appendix D: Phase 1 Participant Survey* and *Appendix E: Phase 2 Participant Survey*, respectively.

[4] Since the Phase 2 survey focused on long-term PCM use and behavior changes, we did not attempt to reach Phase 1 respondents who had indicated that they are no longer using the PCM for reasons that made it improbable that they would use it again. This includes Phase 1 respondents who had given the PCM away or returned it; whose PCM broke; or who had never been able to figure out how to install or set up the PCM.

Table 3: Sampling Targets and Completion Rates for Participant Surveys

Utility	Marketing Strategy	Price	# PCMs Distr.	Phase 1 Survey		Phase 2 Survey	
				Target	Completed	Eligible	Completed
National Grid	Audit Program	Free	100	70	61	61	45
	Direct Mail	$9.99	272	100	100	92	71
		$49.99	5	5[1]	3	3	2
NSTAR	Press release, media	$29.99	2,628	150	150	136	114
	Direct mail	$29.99	475	140	140	118	95
WMECO	Direct mail to previous audit participants	Free	32	32[1]	24	24	21
TOTAL				**497**	**478**	**434**	**348**

[1]We attempted a Census for these survey strata.

In addition to using weighted Phase 2 data, as described above, we also considered presenting Phase 1 data on a sample-weighted basis. Phase 1 quotas (completion targets) were set to achieve statistical significance at the 90/10 level within each quota group in the Phase 2 survey (accounting for attrition between the Phase 1 and Phase 2 surveys). As a result, we oversampled smaller strata relative to larger ones. Weighting the Phase 1 data to account for this sampling strategy would entail use of the following sample weights:

Table 4: Tested Sample Weights for Phase 1 Participant Survey

Utility	Marketing Strategy	# PCMs Distr.	# of Surveys Completed	Sample Weight
National Grid	Audit Program	100	61	1.64
	Direct Mail	272	100	2.72
		5	3	1.67
NSTAR	Press release, media	2,628	150	17.52
	Direct mail	475	140	3.39
WMECO	Direct mail to previous audit participants	32	24	1.33

A comparison of Phase 1 survey results on a weighted and unweighted basis showed no significant differences for any of the key results discussed in this report. To facilitate presentation and avoid confusion, we therefore decided to present all Phase 1 results on an unweighted basis.

3.2 Non-Participant Survey

We conducted the non-participant survey in January 2008, approximately seven months after the utilities' PCM marketing efforts. The non-participant survey included customers who were offered a PCM, either through a direct mail effort or as part of an energy audit. The survey did not include NSTAR customers who might have been exposed to NSTAR's media efforts but did not participate in the program.

The non-participant survey included questions about customers' energy efficiency attitudes and behaviors, recall of PCM marketing materials, reasons for not ordering a PCM, attitudes towards different PCM prices, other energy services the customer might be interested in, and demographic about the customers and their homes.

Table 5 summarizes the sampling targets and completion rates for the non-participant survey, by utility and marketing strategy. As with the participant survey, the sampling targets were selected to provide statistical significance at the 90/10 level for each unique utility/marketing strategy/price point combination. The final non-participant survey, as fielded, is attached as *Appendix F: Non-Participant Survey.*

Table 5: Sampling Targets and Completion Rates for Non-Participant Survey

Utility	Marketing Strategy	Price	# Non-Participants[1]	Target	Completed
National Grid	Audit Program	Free	6	6[2,3]	1
	Direct Mail	$9.99	4,473	70	70
		$49.99	1,790	70	70
NSTAR	Press release, media	$29.99	General public	--	--
	Direct mail	$29.99	9,503	70	70
WMECO	Direct mail to previous audit participants	Free	202	55	55
		TOTAL		**271**	**266**

[1]Non-participants are customers who were targeted by the PCM marketing effort but did not participate in the program (targeted customers minus participants).
[2]An additional 5 customers accepted the offer, but the transmitter did not fit on their meter.
[3]We attempted a Census for this survey stratum.

Similarly to the Phase 1 survey, we considered presenting non-participant data on a sample-weighted basis to reflect the different proportions of customers interviewed in each survey stratum. A similar comparison of non-participant survey results on a weighted and unweighted basis showed no significant differences for any of the key results discussed in this report. Again, we therefore decided to present all Phase 1 results on an unweighted basis.

3.3 Billing Analysis

To assess energy savings, our billing analysis examined the difference between pre-use and post-use electricity usage for customers who installed and used a PCM. The analysis did not include customers who received the PCM during an energy audit (i.e., the National Grid "Audit Program" strategy) or who were targeted because they had previously had an energy audit (i.e., WMECO customers). These audit customers were excluded because the audits likely resulted in changes in energy use behavior at the same time the PCM was installed, making detection of PCM-related impacts difficult. However, only 132 out of 3,512 PCMs were distributed through an audit-related strategy. Therefore, our billing analysis excludes less than 4% of distributed PCMs.

Data Preparation

NSTAR and NGRID provided electricity use data for customers who reported in the Phase 1 survey that they had installed the PCM. NSTAR provided monthly kWh from June 2006 to July 2008; NGRID provided monthly kWh data from April 2005 to July 2008. We cleaned these data to ensure that only customers of interest (i.e., those who installed and used the PCM) and only valid billing histories were included. PCM installation and use determinations are based on self-reported information provided in the Phase 1 survey. Table A-1 in Appendix A summarizes the data cleaning steps undertaken to eliminate customer records that were not included in the billing analysis.

The NSTAR billing data already included weather data corresponding to each customer's monthly electricity usage. The data included the number of heating degree days (HDD) and cooling degree days (CDD) for the specific days in the customer's billing cycle (calculated from the daily averages during the cycle using a balance temperature of 65 degrees).[5] We developed similar HDD and CDD data for the NGRID participants using daily weather data for the Worcester Regional Airport station, which was obtained from the National Oceanic and Atmospheric Administration (NOAA).

In addition to billing and weather data, we included survey data for PCM users. The variables included changes with potential energy use implications that occurred in the home during our analysis period. These changes included addition or replacement of appliances, changes in the number of people living in the home, as well as other items.

Finally, we included Massachusetts weekly retail gasoline prices for the time period in our analysis, obtained from the U.S. Energy Administration.[6] We converted weekly gas prices into

[5] *A "degree day" is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 65 degrees F. (The "mean" temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by 2.) If the mean temperature for the day is, say, 5 degrees higher than 65, then there have been 5 cooling degree days. On the other hand, if the weather has been cool, and the mean temperature is, say, 55 degrees, then there have 10 heating degree days (65 minus 55 equals 10).* Quoted from http://www.srh.noaa.gov/ffc/html/degdays.shtml.

[6] The website containing the data was http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_history.html.

daily gas prices by matching each day in our billing dataset to the closest weekly date in the gas price dataset. We then calculated average gas prices for the specific days in the customer's billing cycles.

Ultimately, our regression dataset included 6,927 records, reflecting monthly electricity use for 243 customers (174 NSTAR customers and 69 NGRID customers). All individuals included in the regression dataset had pre-PCM use and post-PCM use usage data.

Regression Approach

Ordinary Least Squares

All of the regression models were estimated using ordinary least squares (OLS), a common method for billing analyses. OLS is the Best Linear and Unbiased Estimator (BLUE) provided certain assumptions are met. Two of these assumptions are discussed here as potential issues in billing analyses:[7]

- **Assumption 1: No autocorrelation.** It is assumed that, for any two sets of values for the k independent variables, the error terms are uncorrelated. When these error terms *are* correlated, you have autocorrelation. Autocorrelation is a common problem when dealing with time-series data or cross-sectional time series data. If systematic changes take place over time and the variables that measure these changes are not included in a time-series or cross-sectional time series model, then the errors in the model (the residuals) are correlated to time – i.e., they are not independent. We found evidence of autocorrelation in earlier models. To help address this issue, a common and readily available variable, billing read date, was added to the model.
- **Assumption 2: No heteroscedasticity.** It is assumed that the variance[8] of the error term[9] is constant. When this does not occur, the model is exhibiting heteroscedasticity, which is a violation of the assumptions of OLS. This is a common problem with commercial and industrial evaluations where the residual can be correlated with the size of the customer or the size of their usage. It is not, however, a common problem for residential billing analysis, so we did not address this issue in the analysis.

Multicollinearity

Multicollinearity can also be an issue in billing analyses. This occurs when independent variables in the model are more highly correlated with each other than with the dependent variable. Multicollinearity can be detected when the addition of correlated variables to a regression model (in an attempt to obtain the "cleanest" coefficient for the variable of interest) results in a loss of statistical significance in the variables of interest. However, when the variables included in a model are shown to be statistically significant, multicollinearity is not likely to be a significant problem because each variable plays an independent part in the model. While some of our earlier

[7] Assumptions taken from: Berry, W. D., & Feldman, S. 1985. *Multiple Regression in Practice*. Newbury Park, CA: Sage Publications.
[8] The variance is the average of the squared deviations from the mean.
[9] The error term, sometimes called the residual, is the difference between the predicted and the observed values of the dependent variable.

models found issues with multicollinearity, most of the variables in the final model were statistically significant. We therefore concluded that multicollinearity was not an issue in our final model.

Fixed-Effects Models

At the outset of the billing analysis, we expected that finding a program effect would be difficult, given (1) the small sample size available for this analysis and (2) the small savings expected from a program that only targets behavior. Residential data can be very 'noisy' because large changes can occur in billing data from month to month and across the years which are driven by multiple factors. Finding an effect from a measure that is expected to be very small (i.e., less than 10% of the monthly bill) is known to be difficult using residential bills. Given these issues, we chose to estimate "fixed-effects models" in addition to regular non-fixed effects models, both of which were estimated using ordinary least squares. The fixed-effects model is advantageous as it allows us to hold constant differences across customers that do not change over time (such as size of house), resulting in less noise and a better fit of the model to the data. To create the fixed-effects model, dummy variables were created for each customer and added to the model. These dummy variables are included to capture the static differences between customers, i.e., those factors that significantly affect energy usage but do not change pre-post PCM use. These differences would include the size of their home, its direction, color of roof, general construction, number of people in the home, whether they have air-conditioning or not, etc.

Final Model Specification

The specification for our final model is as follows:

$$E_{it} = B_1\, INSTALL_i + B_2 POST_i + B_3 DAvgCDD_{it} + B_4 DAvgHDD_{it} + B_5 (DAvgCDD_{it})^2 + B_6 (DAvgHDD_{it})^2 + B_7 ReadDate_{it} + B_{8i} + \ldots + B_{ni+}\, e_{it}$$

where:

E_{it}	=	Average daily energy consumption for customer "*i*" in month "*t*" from the billing data.
$POST_i$	=	Dummy variable, where 1 = time periods for customer "*i*" that are clearly post use of the PCM.
$INSTALL_i$	=	Dummy variable, where 1 = time periods for customer "*i*" that could be during installation of the PCM.
$AvgDailyCDD_{it}$	=	Average daily CDD for customer "*i*" in month "*t*," as defined by that customer's billing cycle.
$AvgDailyHDD_{it}$	=	Average daily HDD for customer "*i*" in month "*t*," as defined by that customer's billing cycle.
$(AvgCDD_{it})^2$	=	Average daily CDD squared for customer "*i*" in month "*t*," as defined by that customer's billing cycle.
$(AvgHDD_{it})^2$	=	Average daily HDD squared for customer "*i*" in month "*t*," as defined by that customer's billing cycle.
$ReadDate_{it}$	=	The read date of the meter for customer "*i*" in month "*t*."

$B_{8i}...B_{ni}$	=	Identified for customer (customer "i"), which allows us to create the fixed-effects model.
$B_1...B_n$	=	Estimate coefficients.
e_{it}	=	Statistical error term, for unexplained variance in observed average energy consumption for customer "*i*" in month "*t*."

The following subsections provide additional information on the independent variables included in our final model, as shown above, as well as other variables that were tested but not included in the final model.

Pre/Post Variables

"Post" is a dummy variable that takes on a value of 0 for periods that are clearly *before* the first use of the PCM and a value of 1 for periods *after* the first use of the PCM.[10] The coefficient of this variable represents the effect of the program, i.e., the change in electricity use after using the PCM.

"Install" is a dummy variable that denotes the deadband around the first use of the PCM. It takes on a value of 1 for time periods that could contain the first use date and a 0 for all other periods.[11] The purpose of including this variable is to obtain a more accurate estimate of the "Post" variable by attempting to make sure that any post month is a complete month when the PCM was in use.

Weather Data

Weather is one of the most important predictors of energy use in residential homes and is commonly included in billing analyses. Our analysis used average daily CDD and average daily HDD. These variables attempt to account for differences in home cooling and heating over the course of a year as a result of changing outdoor temperatures. Since home cooling and heating choices do not always directly correspond to outdoor temperatures, CDD and HDD are proxies for customer responses to weather.

Weather variables can be included as an integer (i.e., average daily CDD and average daily HDD) and as a squared integer (i.e., average daily CDD*average daily CDD and average daily HDD*average daily HDD). Squaring the weather variable makes it non-linear, which helps to account for the issue of heating or cooling choices not directly corresponding to outdoor temperatures. We ran multiple models, using both the integer and squared integer approaches.

Read Date

The read date was included in the customer datasets provided by the utilities. As discussed previously, we added this variable to the model to address autocorrelation.

[10] Specifically, this variable was calculated as follows: If the month of the read date is two or more months after the month of the use date, then the variable is 1; otherwise it is 0.

[11] This variable was calculated as follows: If the month of the read date was the same, 1 month before, or 1 month after the date of first use, then the variable is 1; otherwise it is 0. The date of first use is the self-reported month and year the customer began using the PCM.

Other Tested Variables

The two participant surveys asked questions about changes made in customers' homes (during the analysis period) that could significantly affect their electricity usage. Such changes might explain increases or reductions in electricity usage over time and are therefore sometimes included in billing analyses. We added the five changes expected to have the largest effects on electricity usage to the model: whether the customer bought or replaced a large screen TV, a fridge, a freezer, or an air conditioner, and whether the number of residents had changed. However, the addition of these variables to the model resulted in other variables being dropped, indicating calculation problems and a model that could not be trusted. One potential reason for these problems might be the small sample size of only 243 customers. The limited degrees of freedom in our analysis could have affected our ability to include other variables in our regression, such as the change variables. Therefore, our final model did not include change variables.

As a very broad economic indicator, we attempted to account for the concern people may have been feeling over high gas prices which could have led them to change behaviors in the home to save on their utility bills (as one area to reduce dollars spent by the household). We added gas prices (in cents per gallon) as a variable to our model. The variable was not statistically significant in the model and did not significantly reduce autocorrelation. Therefore, it was not included in the final model. However, we present the results of our final model plus gas prices in Table A-5 in Appendix A.

4. FINDINGS

This section presents the findings from the evaluation of the PCM pilot programs. The findings are organized around the five research objectives selected for this evaluation:

1. Assessment of PCM marketing strategies,
2. Assessment of PCM price points,
3. Assessment of customer perceptions of value of PCM,
4. Assessment of short-term and long-term behavioral changes, and
5. Assessment of energy savings from PCM pilot programs.

In addition, we present research findings addressing (1) PCM installation, programming, and use, and (2) PCM maintenance and reliability.

4.1 PCM Installation, Programming, and Use

National Grid, NSTAR Electric, and WMECO distributed a combined 3,512 PCMs to their customers between May and November of 2007. Of these, approximately 96% were sent to the customer by mail, with instructions on how to install and program it, and 4% were directly installed by a utility contractor.

Our Phase 1 survey of program participants asked several questions about the customers' experience installing and programming the PCM as well as their use of the device. Table 6 presents the share of customers who report having installed and having used the PCM. The results show that the installation rate of PCMs distributed to customers through the mail ranges from 66% to 75%, with no statistical difference between the four groups.[12] Almost all customers who installed their PCM report using it.

Table 6: Short-Term PCM Installation and Initial Use

Utility	Marketing Strategy	Price	% PCMs Installed	% PCMs Initially Used
National Grid	Audit Program	Free	100%[1]	97%
	Direct Mail	$9.99	72%	69%
		$49.99	67%	67%
NSTAR	Press release, media	$29.99	75%	71%
	Direct mail	$29.99	66%	64%
WMECO	Direct mail to previous audit participants	Free	100%[1]	100%

[1]Participants were not asked installation questions because the PCMs for these groups were directly installed by a program contractor.

[12] Note that National Grid customers participating through the Audit program and WMECO customers had their PCM installed by a contractor; therefore their installation rate was 100%.

Reasons for Not Setting Up the PCM

More than one-quarter (29%) of interviewed customers who were mailed a PCM had not set it up two to six months later. Most of these customers (62%) stated that they just had not gotten around to setting it up yet. However, 28% of customers who had not set up their unit at the time of the Phase 1 survey indicated that they could not figure out how to attach the transmitter to their meter, and another 14% had difficulty programming the unit.

Table 7: Reasons for Not Setting Up the PCM
(Multiple Response)

	Phase 1 Did Not Set Up (n=112)
Haven't gotten around to it yet	62%
Couldn't figure out how to attach transmitter to meter	28%
Couldn't figure out how to program display unit	14%
Gave it away	2%
Returned it	2%
Other	8%
Don't know/Refused	2%

The Phase 2 survey followed up with the customers who had not "gotten around" to installing the PCM to see if they have installed it since the Phase 1 survey. Only 13% of them have. Of the ones who still haven't set up the PCM, almost half continue to cite "Haven't gotten around to it yet," and another 33% cite difficulty attaching the transmitter or setting up the display unit as the main reasons for not setting up the PCM.

Most of the customers (82%) who did initially set up their PCM and have used it find that the instructions are sufficient to make full use of the PCM. Those who do not find the instructions sufficient think they could be written more clearly or in less technical language. A few customers suggest that a trouble shooting guide would have been helpful.

Difficulties with PCM Installation and Programming

We also asked customers who received the PCM by mail and reported having set it up how easy or difficult it was to install the transmitter and program the PCM, using a 10-point scale. Less than half found it easy to attach the transmitter to the meter, and 58% found programming the display unit to be easy. Notably, NSTAR customers were significantly more likely to find attaching the transmitter to their meter difficult compared to National Grid customers. There were no differences between the two customer groups in terms of programming the display unit.

Table 8: Ease of Installing and Programming PCM

	Attaching Transmitter to Meter[1] (n=279)			Programming the Display Unit[1] (n=279)
	Total	National Grid	NSTAR	
Easy (Rating 8, 9 or 10)	43%	69%	34%	58%
Neutral (Rating 4, 5, 6 or 7)	36%	24%	40%	29%
Difficult (Rating 1, 2 or 3)	19%	4%	24%	8%
Don't know	2%	3%	1%	5%

[1]Rated using a 10-point scale where 10 is "very easy" and 1 is "very difficult."

Customers who rated attaching the transmitter or programming the unit as "neutral" or "difficult" (a seven or lower on the 10-point scale) were asked why they thought it was not easy. About one-third of those with difficulty installing the transmitter think it is difficult to align the transmitter to the meter, and 21% of those with difficulty programming the display unit had problems finding the cost per kWh.

Table 9 summarizes reported customer difficulties installing the transmitter; Table 10 summarizes reported customer difficulties programming the display unit.

Table 9: Difficulty Installing Transmitter
(Multiple Response)

	Installing Transmitter Not Easy (n=154)
Difficult to align	32%
Difficult to set up	24%
Instructions were not clear	15%
It doesn't work/could not get it to work	6%
Wasn't difficult to set up	5%
Took too long	4%
My meter is difficult	3%
Rain affects the monitor	1%
Meter is not compatible with the monitor	1%
Other	8%
Don't know/refused	3%

Table 10: Difficulty Programming Display Unit
(Multiple Response)

	Programming Display Unit (n=103)
Hard to find rate/kWh cost	21%
Hard to program	15%
Directions were confusing	15%
Hard to set up/get to work	9%
Fairly easy to set up	8%
Problems getting it to work with meter	8%
Difficult to understand	6%
Other	10%
Don't know/refused	12%

PCM Use

To determine both short-term (2 to 6 months after installation) and long-term (8 to 12 months after installation) PCM use patterns, we asked participating customers about their use of the PCM immediately after it was set up, at the time of the Phase 1 survey (December 2007/January 2008), and at the time of the Phase 2 survey (June 2008/July 2008).

Almost all of the customers (96%) who installed and programmed the PCM (or had it done for them) used the device after it was first set up. However, given the low installation rates among some customer groups (see Table 6 above), less than three-quarters (73%) of all customers who received a PCM did use the device. Furthermore, at the time of the Phase 1 survey, use of the PCM had significantly declined with only 49% of PCM recipients still using it. At the time of the Phase 2 survey, almost one year after receiving the PCM, this share had further decreased to 34%.

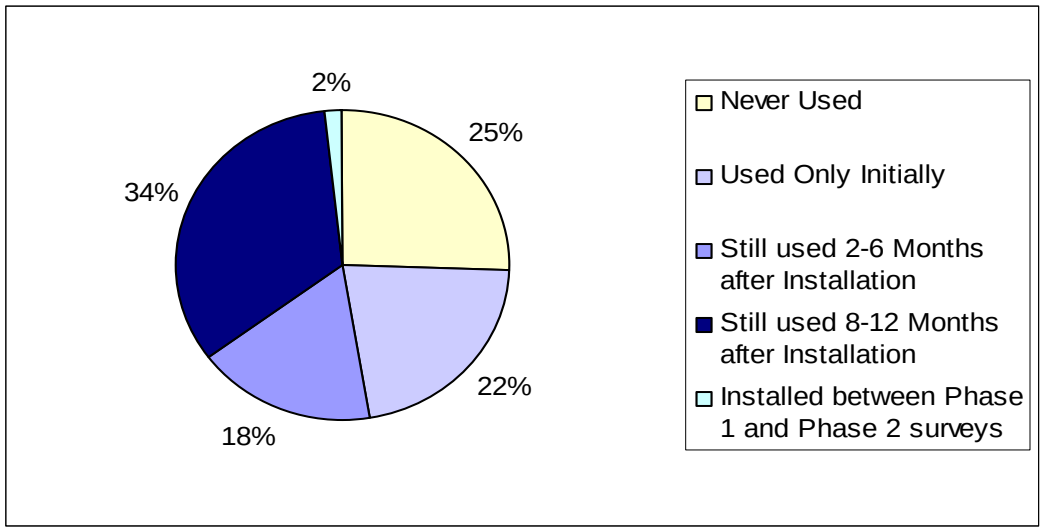
Table 11 summarizes these results.

Table 11: Use of PCM
(of All Customers Who Received a PCM)

	Total	NGRID	NSTAR	WMECO
Initial use after receipt of PCM	(n=478)	(n=164)	(n=290)	(n=24)
Used PCM initially	73%	79%	67%	100%
Didn't use PCM initially	27%	21%	32%	0%
Don't know/refused	--	--	1%	--
2-6 Months after receipt of PCM	(n=478)	(n=164)	(n=290)	(n=24)
Used PCM at time of Phase 1 survey[1]	49%	52%	44%	83%
Didn't use PCM at time of survey	50%	47%	55%	17%
Don't know/refused	<1%	<1%	<1%	--
8-12 Months after receipt of PCM	(n=407)[3]	(n=163)[3]	(n=284)[3]	(n=21)[3]
Used PCM at time of Phase 2 survey[1,2]	34%	30%	33%	66%
Didn't use PCM at time of survey	64%	68%	64%	34%
Don't know/refused	1%	1%	1%	--

[1]Includes responses of "yes" and "sometimes" to question "Are you still using the PowerCost Monitor now?"
[2]Does not include respondents who first installed the PCM after the Phase 1 survey.
[3]Base includes weighted Phase 2 data and Phase 1 data.

Figure 1: PCM Use Patterns
(as Reported by Participating Customers)[1]



[1]Base includes weighted Phase 2 data and Phase 1 data.

Most customers who stopped using their PCM cited technical reasons for doing so. At the time of the Phase 1 survey customers indicated that the PCM did not work well (40%), that the batteries died (23%),[13] or that the PCM broke (22%). National Grid customers who had their

[13] PCM battery life is estimated to be approximately six months but is affected by extreme temperatures (personal communication with K. Sargent from Blue Line, April 2008). Since most participants installed their PCMs between

monitors installed during a MassSave audit were more likely than other customers – at the time of the Phase 1 survey – to report that they no longer use the PCM because it broke. Since these customers did not receive technical service with their PCM, it is possible that they mistakenly thought the device was broken, when a call to the technical service hotline might have helped them determine the cause for the problem they experienced. Interestingly, few customers reported no longer using the PCM because they felt they did not benefit from the information any longer.

Table 12 presents the reasons for no longer using the PCM at the time of the Phase 1 survey. Similar reasons were cited by customers who had stopped using their PCM at the time of the Phase 2 survey.

Table 12: Reasons for No Longer Using the PCM at the time of the phase 1 survey (Multiple Response)

	Total (n=114)	Media (n=32)	Direct Mail (n=56)	WMECO Mail/Audit (n=4)	NGRID Audit (n=22)
Didn't work well/correctly	40%	38%	46%	50%	27%
Batteries died and I haven't replaced them	23%	34%	18%	25%	18%
It broke	22%	16%	18%	25%	41%
Don't need it any more/I now know how much electricity is being used	9%	6%	11%	--	9%
Was never able to figure it out	4%	3%	5%	--	--
Too cold/didn't want weather to damage it	2%	3%	2%	--	--
Gave it away	1%	--	2%	--	--
Other	5%	--	9%	--	5%
Don't know/refused	1%	3%	--	--	--

Not surprisingly, the frequency of looking at the PCM display decreases over time. While 78% of customers who used the PCM reported initially looking at it more than once per day, only 35% report doing so at the time of the Phase 1 survey and 21% at the time of the Phase 2 survey.

June and August 2007, our survey is likely to have reached many customers around the time when the batteries would be expected to fail.

Table 13: Frequency of Looking at the PCM

	After First Starting to Use the PCM (n=349)	At the Time of the phase 1 survey (n=349)	At the Time of the phase 2 survey (n=308)[1]
More than once per day	78%	35%	21%
Once a day	14%	14%	11%
A couple of times per week	3%	11%	6%
About once per week	1%	3%	3%
A few times a month	-	1%	1%
About once per month	<1%	1%	<1%
Less than once per month	-	<1%	<1%
No longer use it	N/A	33%	56%
Don't know/refused	3%	1%	1%

[1] Base includes weighted Phase 2 data and Phase 1 data.

4.2 PCM Maintenance and Reliability

Many customers (40%) report having had some technical problem with the PCM within the first two to six months of use. The most commonly mentioned problems were dead batteries, the PCM not working correctly, and the PCM not working in the cold or rain. National Grid customers who received their PCM from the MassSave auditor are significantly more likely to say they had problems with the batteries dying and the PCM not working correctly than those who received their PCM in the mail. Since the National Grid audit customers had their PCMs installed for them, they may not have read the instructions and therefore may have more problems operating and understanding it. As indicated above, these customers were also not provided with the toll-free technical support phone number.

Table 14: Technical Problems with the PCM
(Multiple Response)

	Total (n=141)	Media (n=46)	Direct Mail (n=66)	WMECO Mail/ Audit (n=8)	NGRID Audit (n=21)
Batteries (don't last long, died, had to change them)	20%	17%	18%	13%	33%
Doesn't work	19%	17%	15%	13%	38%
Doesn't function in the cold or rain	19%	20%	23%	25%	5%
Have to adjust or reset sensor often	8%	9%	11%	--	--
Doesn't pick up usage reading from meter	6%	11%	5%	--	5%
Trouble getting it to work	6%	7%	8%	--	5%
Loses signal/bad alignment	6%	2%	9%	13%	--
Inaccurate readings	6%	4%	2%	13%	19%
Only works sometimes/starts and stops working	6%	4%	6%	25%	--
Doesn't function in extreme heat	4%	7%	3%	--	--
Doesn't fit with my meter/doesn't stay connected	2%	7%	--	--	--
Range not powerful enough	1%	2%	2%	--	--
Other	1%	--	2%	--	--

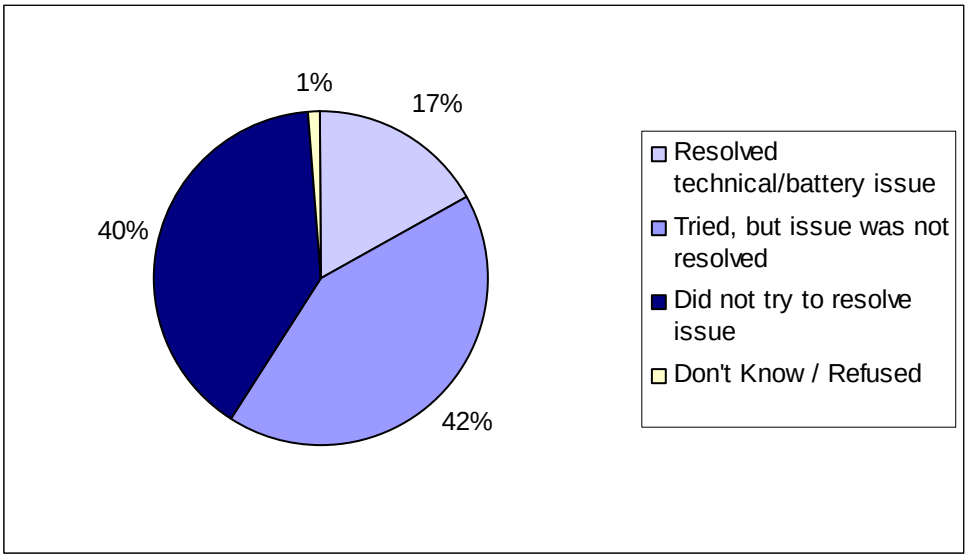
At the time of the Phase 1 survey, only 15% of customers who used their PCM called the toll-free number to get technical support, with NSTAR customers being more likely to have called for technical support than National Grid customers. We asked customers who called the technical support number to rate their satisfaction with the representative's ability to answer their questions. Fifty-nine percent of those who called are satisfied with the representative's ability to answer their questions (a score of 8, 9, or 10 on a 10-point scale). Most customers who are not satisfied say that the representative could not answer their question. A few others report that they could not get through to someone or no one returned their call.

Table 15: Satisfaction with Technical Support Representative

	Total (n=53)
10 (very satisfied)	34%
9	8%
8	17%
7	4%
6	4%
5	6%
4	--
3	4%
2	2%
1 (very dissatisfied)	15%

Of the customers with technical/battery problems at the time of the Phase 1 survey, 17% had resolved them when we called them back six months later. An additional 42% tried to resolve their problems but failed, and 40% did not attempt to resolve their issues. (See also Figure 2 below.) The majority of those who were successful in resolving their problem replaced the batteries in the PCM. Of the customer who could not resolve their problems (n=35), 34% called BlueLine, 23% tried to resolve the problem themselves and 17% called their utility company.

Figure 2: Resolution to Technical/Battery Issues (n=78)



4.3 Assessment of PCM Marketing Strategies

The three utilities used different marketing strategies and prices to promote and distribute the PCMs (see also Table 3 above):

- National Grid distributed 272 PCMs at $9.99 and 5 PCMs at $49.99 through a direct mail campaign, and directly installed 100 PCMs at no charge through its Energy Audit Program.
- NSTAR Electric distributed 475 PCMs at $29.99 through a direct mail campaign and 2,628 at $29.99 through a press release and subsequent media coverage.[14]
- WMECO offered the PCM at no charge through direct mail targeted at previous audit participants and subsequently directly installed 32 PCMs.

To assess the success of these different marketing strategies we compared them in terms of acceptance rates and the net cost per installed monitor. We also present survey information about non-participants' recall of PCM promotional materials and reasons for not ordering a PCM, and preferred ways of customers to be reached with offers such as the PCM.

Adoption Rates for Directly Targeted Customers

Adoption rates for the different marketing strategies varied substantially. The three main factors explaining this difference appear to be convenience of participation, targeting of the promotional material, and price. Not surprisingly, the most successful strategy was offering customers a free

[14] NSTAR initially planned to distribute 200 PCMs. However, because of the many customer requests as a result of the press release, NSTAR decided to fulfill all requests for PCMs received through July 31, 2007.

PCM during an energy audit (National Grid; 94.3% adoption rate), followed by offering previous audit customers a free PCM through direct mail (WMECO; 13.7% adoption rate). Both of these strategies benefited from a low price and from targeting customers who are likely to have an interest in energy efficiency. Notably, however, convenience of participation appears to be the most important factor as National Grid customers – who did not have to respond to a mailing or set up an installation appointment – accepted the offer at almost seven times the rate compared to WMECO customers.

The remaining three strategies differed only by price.[15] Again, not surprisingly, the strategies offering a lower price were more successful then the strategies offering a higher price: 5.7% of targeted customers accepted the $9.99 offer, 4.8% accepted the $29.99 offer, and 0.3% accepted the $49.99 offer. The notable difference between the $49.99 offer and the other two offers suggests that $49.99 is beyond the willingness-to-pay of most customers. (See also discussion of price points in Section 4.4 below.)

Table 16: PCM Adoption Rates

Utility	Marketing Strategy	Price	# Customers Targeted	# PCMs Distributed	Adoption Rate
National Grid	Audit Program	Free	106[1]	100	94.3%
	Direct Mail	$9.99	4,745	272	5.7%
		$49.99	1,795	5	0.3%
NSTAR	Press release, media	$29.99	General public		
	Direct mail	$29.99	9,978	475	4.8%
WMECO	Direct mail to previous audit participants	Free	234	32	13.7%

[1]An additional 5 customers accepted the offer, but the transmitter did not fit on their meter.

Net Cost per Installed Monitor

Net cost per installed monitor is a measure of the cost-effectiveness of the different marketing/distribution strategies. Net costs include the cost of the PCM as well as shipping and handling, direct installation, and the cost of the direct mailing effort (paid for directly by the utility or through a flat fee per distributed PCM). The net cost per installed monitor for this pilot program ranged from $150 to $223 and are summarized in Table 17 below.[16]

For this pilot effort, National Grid's direct installation during energy audits was the most cost-effective distribution strategy with $150 per installed PCM. This strategy entailed no marketing cost and guaranteed a 100% installation rate, although distribution cost were relatively high at $45 per PCM. Distribution based on NSTAR's media release ranked second with $180 per

[15] NSTAR Electric's general media strategy is not included in this comparison as the overall number of customers exposed to the media effort is unknown.

[16] WMECO's cost per installed monitor is currently estimated at $380. However, WMECO has not been able to confirm this cost or explain the cost components. Since it is significantly higher than any of the other costs, it is excluded from the current comparison.

installed PCM as a result of no marketing cost and a slightly higher installation rate compared to the direct mail strategies. The cost structures for National Grid's and NSTAR's direct mail marketing strategies were very similar with Blue Line charging a flat fee per PCM, which covered the cost of the PCM, shipping, and (for National Grid only) marketing. The net costs per installed monitor for these three strategies differed due to the different prices customers paid for the units – which offset the utilities' costs – and the installation rates. As a result, the direct mail strategy with the $49.99 price point was slightly more cost-effective than the other two, since National Grid was reimbursed $40 for each distributed PCM.

Table 17: Cost-Effectiveness of Marketing/Distribution Strategies

Utility	Marketing Strategy	Price	Net Program Cost	# PCMs Distr.	Estimated# PCMs Installed[1]	Net Cost / Installed PCM
National Grid	Audit Program	Free	$14,988[2]	100	100	$150
	Direct Mail	$9.99	$42,160[3]	272	196	$215
		$49.99	$575[3]	5	3	$192
NSTAR	Press release, media	$29.99	$354,780[4]	2,628	1,971	$180
	Direct mail	$29.99	$70,062[5]	475	314	$223
WMECO	Direct mail to previous audit participants	Free	$12,156[6]	32	32	$380

[1]Estimated based on the total number of PCMs distributed and the installation rates from the Phase 1 participant survey.
[2]Based on a Blue Line charge of $105 per PCM plus CSG implementation expenses.
[3]Based on a Blue Line charge of $155 per PCM. For the $9.99 offer, Blue Line collected the money to cover their shipping and handling. For the $49.99 offer, Blue Line credited National Grid $40.00 per PCM.
[4]Based on a Blue Line charge of $135 per PCM.
[5]Based on a Blue Line charge of $135 per PCM plus $5,937 for direct mailing.
[6]Calculated as total program cost ($24,000) minus evaluation costs ($11,844). WMECO has not been able to confirm this value.

Non-Participants' Recall of Marketing Materials and Reasons for Not Ordering PCM

The adoption rates presented in Table 16 above show that many targeted customers did not respond to the offer. Of these non-participating customers, only 23% recall receiving the PCM offer, with NSTAR Electric customers being more likely to recall the mailing than National Grid and WMECO customers.

Table 18: Non-Participant Recall of PCM Offer

	Total (n=266)	NGRID Audit Free (n=1)	NGRID Mail $9.99 (n=70)	NGRID Mail $49.99 (n=70)	NSTAR Mail $29.99 (n=70)	WMECO Mail Free (n=55)
Yes	23%	--	20%	21%	36%	11%
No	66%	100%	63%	66%	53%	87%
Don't know	12%	--	17%	13%	11%	2%

Non-participants who recalled the PCM offer were then asked why they did not order a PCM. Many of these non-participants feel that they do not need a PCM, because they already know about their electricity use, they already save all the electricity they can, or because they already have too many gadgets in their house. Only 13% of non-participants indicate that the price of the PCM prevented them from ordering the unit. These include 33% of the customers who were offered a PCM for $49.99 and 12% of the customers who were offered a PCM for $29.99. Other reasons for not ordering a PCM include not knowing how to use it, thinking it would not help, and not being able to order one because the utility reached its limit or they missed the deadline.[17]

Table 19: Reason for Not Ordering a PCM
(of Customers Who Recall Receiving Offer; Multiple Response)

	Non-Participants (n=60)
No need for one	23%
Cost too much	13%
Don't need another gadget	15%
Already save all I can	12%
Other	32%
Don't know	12%

When asked what additional information would have made them more likely to order a PCM, 83% of these non-participants say that no other information would have convinced them to order one. Others think more details on how the PCM works, how to set it up, or an estimate of likely savings would have made them more likely to order a PCM.

[17] Some customers might have tried to participate in the program but were not able to because their meter was not compatible with the PCM transmitter. However, none of the surveyed non-participants cited this as a reason for not participating.

Best Ways to Reach Customers with Offers

Participants feel the best way for their utility to reach them with offers such as the PCM is through utility bill inserts; non-participants prefer direct mail. Not surprisingly, non-participants who recall the PCM offer are significantly more likely to prefer direct mail than those who do not recall the offer (60% compared to 45%). Conversely, non-participants who do not recall the offer are significantly more likely to prefer bill inserts than those who recall the offer (23% compared to 10%).

Table 20: Best Way to Reach Customers with Offers Such as PCM (Multiple Response)

	Participants					Non-Participants[1]		
	Total (n=478)	Media (n=150)	Direct Mail (n=243)	WMECO Mail/ Audit (n=24)	NGRID Audit (n=61)	Total (n=264)	Direct Mail (n=208)	WMECO Mail/ Audit (n=55)
Insert with utility bill	54%	45%	60%	63%	54%	21%	19%	29%
Direct Mail	24%	16%	29%	42%	16%	50%	53%	38%
TV or radio advertising	18%	23%	15%	8%	20%	1%	1%	--
Information on utility website	8%	10%	7%	4%	5%	8%	7%	11%
Newspaper or journal advertising	8%	7%	9%	4%	5%	2%	2%	--
Phone call	2%	2%	1%	--	5%	11%	9%	22%
Email	2%	4%	1%	--	--	2%	2%	--
Through MassSave audit	4%	1%	2%	8%	20%	--	--	--
Word of mouth	4%	5%	2%	--	7%	--	--	--
Have someone come to my house/door to door	1%	1%	1%	--	5%	--	--	--
Referrals	1%	1%	1%	--	--	--	--	--
Other	1%	1%	--	--	2%	1%	1%	--
Don't know/refused	7%	11%	6%	8%	--	5%	6%	--

[1]One NGRID Audit Non-Participant indicated preferring direct mail.

4.4 Assessment of PCM Price Points

During the pilot period, the three utilities offered and distributed PCMs at four different price points: for free, for $9.99 (the cost of shipping and handling), for $29.99, and for $49.99. The full price of the device is approximately $145. Most of the PCMs (88%) were distributed by NSTAR Electric for $29.99; only five PCMs were sold for $49.99.

To determine suitable price points for potential future PCM programs, we asked both participants and non-participants about their willingness-to-pay for a PCM. Participants were reminded of what they paid for the device and were asked if they would have paid the higher price points, including the full cost of $145. Table 21 summarizes the responses of participating customers. The results show that few customers who ordered a PCM would have been willing to pay the full cost of $145. However, many customers who paid $29.99 or less for the PCM indicate that they would have paid more. For example, 73% of customers who received the PCM for free would

have been willing to pay $9.99 or more, and 41% percent of customers who paid $9.99 would have paid $29.99 or more. Notably, customers who indicate that they would have paid more are more likely to go up by only one price point rather than by two, independent of what they actually paid. For example, 34% of customers who paid $29.99 say they would have paid $49.99; in contrast, only 9% of customers who paid $9.99 say they would have paid $49.99 but 31% say they would have paid $29.99.

Table 21: Willingness-to-Pay for PCM – Participating Customers

Would Pay…	Received for Free (n=85)	Purchased for $9.99 (n=100)	Purchased for $29.99 (n=290)	Purchased for $49.99 (n=3)
$145, full price	0%	1%	2%	0%
$49.99	15%	9%	34%	66%
$29.99	29%	31%	58%	NA
$9.99	29%	54%	NA	NA
$0	24%	NA	NA	NA
Don't know	2%	5%	6%	33%

We also asked customers who did not order a PCM about their willingness-to-pay. If they recalled receiving the PCM promotional materials, they were reminded of the price offered to them and were asked if they would have ordered a PCM if it had been offered at the lower price points. Customers who did not recall the offer were asked about all price points. Table 22 summarizes the responses of non-participating customers. Most of the customers who recalled receiving the PCM offer indicate that they would have ordered it if it the price had been lower or if it had been offered for free. For example, 60% of customers who recalled receiving the offer for $29.99 would have been willing to buy it if it had been $9.99. However, some customers would not have ordered a PCM, even if it had been offered for free. (It should be noted that the sample sizes of non-participants who recalled the offer are small. Responses may therefore not be representative beyond the interviewed sample.) Customers who did not recall the PCM offer were evenly split between the various price point options: approximately 20% each would have ordered the PCM at $49.99, $29.99, $9.99, and no charge, while another 20% would not have ordered the PCM, even if it had been for free.

Table 22: Willingness-to-Pay for PCM – Non-Participating Customers

Highest Price Customer Would Have Paid	Recalled Offer of…[1]			Did Not Recall Offer (n=156)
	$9.99 (n=14)	$29.99 (n=25)	$49.99 (n=15)	
$49.99	N/A	N/A	N/A	20%
$29.99	N/A	N/A	20%	19%
$9.99	N/A	60%	20%	19%
$0 (would have ordered if free)	57%	20%	40%	21%
Would not have ordered even if free	43%	20%	20%	21%

[1]Customers who were offered a PCM at no cost were not asked what they would have paid.

While many of the non-participating customers who recalled the offer indicate that they would have ordered a PCM if the price had been lower, cost does not appear to have been the only barrier to their participation in the program: Only 13% of these non-participants note cost as a reason for not ordering a PCM (see Table 19). All of these customers received PCM offers for either $29.99 or $49.99. However, based on the responses to these price point questions, the price of the PCM was at least one contributing factor to their decision not to order a PCM.

4.5 Assessment of Customer Perceptions of Value of PCM

Customers who participated in the PCM pilot programs were asked (unaided) about the reasons for getting a PCM. Most customers (69%) cite seeing how much it costs to use certain appliances as the reason. Saving money and saving energy are other reasons for ordering a PCM. Almost half of National Grid customers who received a free PCM during their energy audit indicate that the "good deal" they received was a factor in their decision, significantly more than for any other customer group.

Table 23: Why Customers Decided to Get the PCM
(Multiple Response)

	Total (n=478)	NGRID Audit Free (n=61)	NSTAR Media $29.99 (n=150)	NGRID Mail $9.99 (n=100)	NGRID Mail $49.99 (n=3)	NSTAR Mail $29.99 (n=140)	WMECO Mail Free (n=24)
To see how much it cost to use certain appliances	69%	62%	67%	70%	100%	74%	54%
To save money	29%	33%	20%	36%	--	31%	33%
To save energy	26%	26%	21%	29%	--	27%	33%
Looked like a good deal/got a discount/free	18%	49%	16%	11%	--	12%	21%
Other	2%	--	2%	3%	--	2%	--
Don't know/refused	1%	2%	3%	1%	--	1%	--

We also asked both participating and non-participating customers how useful they find the PCM. Non-participants were first provided a description of the PCM. About half (53%) of participating customers who have used the PCM find the information it provides useful (rating of 8, 9, or 10 on a 10-point scale). Non-participant responses are evenly divided in their opinion about the usefulness of the PCM in helping them lower their electric bill. About one-third thinks it would not be useful (rating of 1, 2 or 3 on a 10-point scale), another one-third (31%) thinks it would be useful, and the last third gives a neutral rating (rating of 4, 5, 6 or 7).

Table 24: Usefulness of the PCM

	Participants Who Have Used the PCM[1] (n=349)	Non-Participants[1] (n=266)
Useful (Rating 8, 9 or 10)	53%	31%
Neutral (Rating 4, 5, 6 or 7)	34%	34%
Not Useful (Rating 1, 2 or 3)	10%	36%
Don't know	2%	--
Mean	7.2	5.1

[1]Rated using a 10-point scale where 10 is "Extremely useful" and 1 is "not at all useful."

Customers who have the PCM set up and have used it find that the display that shows how much energy they are using is the most useful information provided by the monitor.

Table 25: Most Useful Information Provided by the PCM
(Multiple Response)

	Participants That Installed and Have Used the PCM (n=349)
Shows how much energy you are using	47%
Shows how much energy certain appliances are using	37%
Temperature	8%
Nothing	1%
Other	3%
Don't know/refused	9%

Usefulness of Other Utility Services

We also asked customers how useful various other services would be in helping them save electricity. For each service, customers were asked to rate its usefulness on a 10-point scale (with 1 being "not at all useful" and 10 being "extremely useful"). Table 26 shows the percentage of participants and non-participants who rate each service as useful (an 8, 9 or 10 on the 10-point scale). Notably, both participants and non-participants agree in their relative ranking of the various services, with rebates on Energy Star appliances and tools that automatically control appliances being rated as the most useful services. In addition, participants rate each service as more useful than non-participants.

Table 26: Usefulness of Services in Saving Energy

Energy Saving Service	% Participants Rating Service as Useful (8, 9 or 10) (n=478)	% Non-Participants Rating Service as Useful (8, 9 or 10) (n=266)
Rebates on Energy Star appliances	73%	56%
Tools that automatically turn off/down appliances	71%	54%
Hourly pricing	66%	51%
Rebates on LED lighting	65%	49%
Home Energy audit[1]	59%	43%
Website that provides info on energy use and tips	52%	42%
Rebates on Energy Star air conditioning	51%	39%
Referrals to HVAC contractors to improve your AC system	23%	19%

[1]Customers who were offered the PCM due to their participation in the audit program were not asked this question (participant n=393, non-participant n=210).

Additional services mentioned by customers include rebates and information on solar and/or wind energy, general information and education on how to save energy, and rebates.

4.6 Assessment of Short-Term and Long-Term Behavioral Changes

Most participating customers (85%) think energy efficiency is important (a rating of 8, 9, or 10 on a 10-point scale). In addition, almost 80% of participating customers consider themselves very aware of actions they can take in their home to save energy.[18] About half (48%) of the participants who have used their PCMs feel that their awareness of energy efficiency and actions they can take has increased somewhat as a result of using the PCM. The other half thinks their awareness has increased significantly (27%) or has remained the same (23%).

To assess short-term and long-term behavior changes, we asked participants several questions about their energy-using behavior before using the PCM, immediately after using the PCM, 2 to 6 months after using the PCM (at the time of the Phase 1 survey), and 8 to 12 months after using the PCM (at the time of the Phase 2 survey). These questions included:

- Whether participants had made changes in their electricity-using behavior as a result of using the PCM;
- The number of steps participants were taking to reduce electricity use in their homes before using the PCM, when they first started to use it, and after 8 to 12 months of use;
- Frequency of specific steps they were taking before using the PCM and additional steps taken after first using the PCM; and
- Whether the additional steps were still taken after 2 to 6 months and after 8 to 12 months of use.

[18] See *Appendix B: Profile of Respondents* for more detail on customer responses to questions about energy efficiency attitudes, awareness, and behaviors, including a comparison of participants and non-participants.

It should be noted that the timing of the Phase 2 survey (June/July 2008) makes assessment of the effects of PCM use on long-term energy-related behavior difficult. The Phase 2 survey was fielded as gas prices reached historic highs and economic concerns began to deepen. Likely influenced by these changes, the Phase 2 survey shows *increases* in electricity-saving behaviors compared to the Phase 1 survey. In contrast, PCM-induced behavior changes would be expected to *decrease* over time as the novelty of using the device wears off and old habits can be expected to return, at least for some participants. While this increase in long-term electricity-saving behavior cannot be attributed to use of the PCM, it is possible that prior use of the PCM provided customers with information that enabled them to take the energy saving actions they reported in the Phase 2 survey.

Unfortunately, the study design does not allow for a direct assessment of this potential delayed effect. Non-participants were not included in the Phase 2 data collection effort, which would have allowed for a comparison of long-term behavior changes between participants and non-participants. Furthermore, our billing analysis did not include a non-participant comparison group.

As a result, when reviewing the information about long-term behavioral changes presented in the following subsection, the reader should keep in mind that the PCM influence on these changes is uncertain.

Changes in electricity-using behavior as a result of using the PCM

Overall, 46% of all PCM recipients and 63% of participants who installed and initially used the PCM indicate that they have made changes in their electricity-using behavior as a result of their PCM use.

Number of steps taken to reduce electricity use

While customers consider themselves very aware of actions they could take to reduce electricity usage, many admit to not taking all energy saving actions of which they are aware. Only 11% of participants indicate that they took all steps and 35% indicate that they took most steps of which they are aware to reduce electricity use in their home *before* using the PCM. However, participants do report taking more steps to reduce electricity use in their home after initial use of the PCM. The percentage of customers indicating taking no or only a few steps decreased from 53% before using the PCM to 32% after first using the PCM. At the time of the Phase 2 survey, this percentage had further decreased to 20% (see Table 27 below). Conversely, the percentage of customers who report taking all possible steps increased from 11% before PCM use to 17% when they first started using the PCM and 33% at the time of the Phase 2 survey.

Table 27: Steps Taken to Reduce Electricity Use in Home
(of Participants Who Installed and Used the PCM)

	Participants Before Using PCM (n=349)	Participants When First Starting to Use PCM (n=349)	Participants 8-12 Months After Starting to Use PCM (n=281)
All possible steps	11%	17%	33%
Most steps	35%	50%	47%
A few steps	42%	26%	17%
No steps	11%	6%	3%
Don't know	1%	1%	-

Both the Phase 1 and the Phase 2 surveys asked for the reasons that participants conserve energy. "Cost of electricity/lowering my electric bill" was the number one reason for conserving energy at the time of the Phase 1 survey (94%) and the Phase 2 survey (97%). Notably, environmental reasons have become less important at the time of the Phase 2 survey, potentially indicating the increasing importance of economic factors.

Table 28: Reasons for Taking Steps to Reduce Electricity Use in Home
(of Participants Who Took Steps Before or After Using the PCM)

	At the Time of the Phase 1 Survey (n=345)	At the Time of the Phase 2 Survey (n=274)
Cost of electricity/lower my bill	94%	97%
Environmental reasons	43%	27%
It's the right thing to do	6%	9%
Family or relatives	1%	2%
Other	1%	1%

Frequency of specific steps taken to reduce electricity use and additional steps

We asked participants about the frequency with which they engaged in a number of energy saving actions *before* using the PCM and about additional steps they were taking *after first starting to use the PCM*. Table 29 summarizes the responses. The table shows that participating customers – before using the PCM – were more likely to wait to run their washing machine, dryer, and dishwasher until they are full than to turn off computers or unplug chargers when not using them. Approximately two-thirds of participating customers also indicate always having selected Energy Star appliances before using the PCM. Other steps to save energy, reported by more than one-third of participants, include adding insulation, purchasing new windows and appliances, and lowering heating temperatures.

The main additional steps taken after using the PCM include turning off lights more often (41%), turning off the TV when not watching (23%), replacing additional light bulbs with CFLs (23%), turning off computers when not in use (18%), and unplugging chargers when not in use (17%).

National Grid customers who received the PCM as part of an energy audit are significantly more likely to report that they have made changes to their electricity-using behavior than the other customers groups. However, when probed about the relative influence of the audit as opposed to the PCM, many of the reported changes appear to be partially or mostly influenced by the audit rather than the PCM.

Table 29: Energy Saving Behaviors Before and Immediately After PCM Use
(of participants who used PCM and took steps before use; n=312)

	Participants Before Using PCM (Prompted)						**Additional Steps Taken After First Using the PCM** (Unprompted)
	Always	**Most of the Time**	**Sometimes**	**Rarely**	**Never**	**Does Not Apply/Don't Know**	
Turn off lights when leaving a room	40%	41%	15%	2%	2%	--	41%
Turn off the TV when not watching	52%	24%	13%	4%	4%	2%	23%
Turn off your computer when not in use	21%	21%	19%	13%	22%	4%	18%
Unplug chargers when not using them	21%	10%	16%	13%	37%	3%	17%
Limit use of AC or increase temp setting	34%	26%	21%	3%	7%	10%	14%
Wait to run dishwasher until full	65%	13%	5%	1%	4%	10%	9%[1]
Wait to run washing machine until full	67%	18%	10%	1%	4%	1%	9%[1]
Wait to use the clothes dryer until full	64%	17%	10%	1%	4%	4%	12%[1]
Keep temp on hot water heater lower	40%	10%	4%	6%	22%	19%	5%
Turn faucet off while shaving or shampooing	31%	13%	20%	7%	25%	4%	3%
Select Energy Star appliances	65%	15%	11%	1%	3%	4%	6%
Replace light bulbs with CFLs when they burn out	43%	22%	18%	5%	12%	<1%	23%
Replace light bulbs that are still working with CFLs	29%	14%	25%	8%	22%	2%	

[1]Run appliance less often.

To test long-term behavior changes, we repeated the questions about the frequency with which participants engaged in energy saving actions at the time of the Phase 2 survey. Similar to the question about the number of steps discussed above, the Phase 2 survey showed substantial *increases* in long-term energy-saving behavior. As described above, the influence of PCM use on these long-term behaviors is unknown. The results of this comparison are presented in Table 30 below.

Table 30: Energy Saving Behaviors Before Use of PCM and After 8 to 12 Months

		(Prompted; Phase 1 n=312, Phase 2 n=272)					
		Always	Most of the Time	Sometimes	Rarely	Never	Does Not Apply/Don't Know
Turn off lights when leaving a room	Before Using PCM	40%	41%	15%	2%	2%	--
	After 8-12 Months	69%	29%	2%	--	< 1%	--
Turn off the TV when not watching	Before Using PCM	52%	24%	13%	4%	4%	2%
	After 8-12 Months	74%	19%	4%	1%	< 1%	2%
Turn off your computer when not in use	Before Using PCM	21%	21%	19%	13%	22%	4%
	After 8-12 Months	38%	22%	19%	6%	11%	4%
Unplug chargers when not using them	Before Using PCM	21%	10%	16%	13%	37%	3%
	After 8-12 Months	35%	14%	15%	15%	19%	3%
Limit use of AC or increase temp setting	Before Using PCM	34%	26%	21%	3%	7%	10%
	After 8-12 Months	53%	26%	10%	1%	2%	8%
Wait to run dishwasher until full	Before Using PCM	65%	13%	5%	1%	4%	10%
	After 8-12 Months	79%	10%	1%	1%	< 1%	8%
Wait to run washing machine until full	Before Using PCM	67%	18%	10%	1%	4%	1%
	After 8-12 Months	82%	15%	3%	< 1%	--	--
Wait to use the clothes dryer until full	Before Using PCM	64%	17%	10%	1%	4%	4%
	After 8-12 Months	79%	11%	4%	< 1%	< 1%	5%
Keep temp on hot water heater lower	Before Using PCM	40%	10%	4%	6%	22%	19%
	After 8-12 Months	67%	7%	3%	2%	10%	11%
Turn faucet off while shaving or shampooing	Before Using PCM	31%	13%	20%	7%	25%	4%
	After 8-12 Months	38%	13%	18%	7%	24%	< 1%
Select Energy Star appliances	Before Using PCM	65%	15%	11%	1%	3%	4%
	After 8-12 Months	74%	13%	3%	1%	1%	9%
Replace light bulbs with CFLs when they burn out	Before Using PCM	43%	22%	18%	5%	12%	<1%
	After 8-12 Months	60%	19%	13%	2%	6%	<1%
Replace light bulbs that are still working with CFLs	Before Using PCM	29%	14%	25%	8%	22%	2%
	After 8-12 Months	37%	9%	24%	3%	25%	1%

[1]Run appliance less often.

Longevity of additional steps taken

Behavioral changes due to increased awareness and education are often only temporary. To determine if the additional energy saving actions reported by participating customers have lasted beyond the "novelty phase" of using the PCM, we also asked participants if they are still taking these additional actions at the time of the Phase 1 and Phase 2 surveys. Over the short-term almost half of these participants (48%) were still taking all of the additional steps they started taking after first using the PCM. Only 4% said they reverted back to their old behavior. Customers who received their PCM through the mail and installed it themselves were significantly more likely to say that they are still taking all the additional energy reducing steps compared to customers who had the PCM installed by a utility contractor during or after an energy audit.

The same question asked at the time of the Phase 2 survey shows similar long-term increases in energy-saving behavior as discussed above. Based on these results, some respondents had stopped taking actions at the time of the Phase 1 survey but had resumed them by the time of the Phase 2 survey.

Table 31: Still Taking Actions to Save Energy

	At the time of the Phase 1 survey			At the time of the Phase 2 survey		
	Total (n=211)	Self Installed (n=157)	Contractor Installed (n=54)	Total (n=171)	Self Installed (n=129)	Contractor Installed (n=42)
I'm still taking all of the additional energy-reducing steps I took when I first used the PCM	48%	52%	37%	60%	64%	45%
I'm still taking most of the steps	38%	32%	54%	33%	29%	48%
I'm still taking some of the steps	9%	10%	7%	1%	2%	0%
My energy-use behavior now is the same as it was before I used the PCM	4%	5%	2%	5%	4%	7%
Don't know/Refused	--	--	--	1%	2%	--

Equipment purchases attributed to the PCM

The Phase 2 survey asked respondents who had made behavioral changes as a result of using the PCM: (1) if they had purchased or replaced various pieces of energy-using equipment – e.g., refrigerators, TVs, washers, dryers, or boilers – since the Phase 1 survey; (2) if the new equipment was ENERGY STAR rated; and (3) if the purchase/replacement was due to the use of the PCM. Since these questions were designed to support the billing analysis, they were only asked of customer who did not receive the PCM during or following an in-home energy audit.

The responses to these questions show that approximately 13% of all non-audit PCM participants purchased a new piece of energy-using equipment between the Phase 1 and Phase 2 surveys. Of these, 21% (or 3% of all non-audit PCM participants) attributed their equipment purchase to their use of the PCM.

Table 32: Equipment Purchases Due to PCM Use

	NGRID-Mail		NSTAR-Media		NSTAR-Mail		TOTAL	
	#	% of All	#	% of All	#	% of All	#	% of All
All Non-Audit PCM Participants	103		150		140		393	
Installed & Used PCM	71	*69%*	106	*71%*	89	*64%*	267	*68%*
Changed Behavior	44	*43%*	66	*44%*	51	*36%*	162	*41%*
Purchase Equipment (wght)[1]	13	*12%*	23	*15%*	17	*12%*	53	*13%*
Because of PCM (wght)[1]	1	*1%*	6	*4%*	4	*3%*	11	*3%*

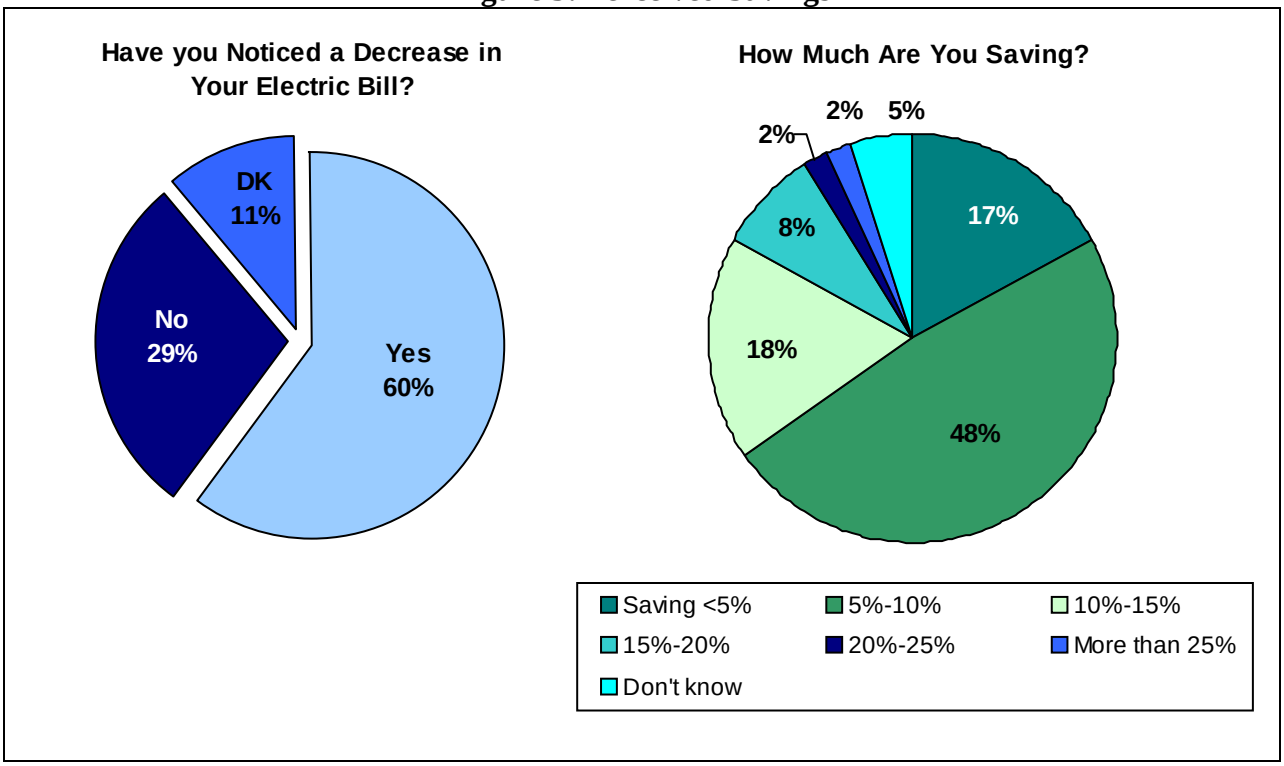
[1]Responses were weighted to account for customers who could not be reached for the Phase 2 survey.

4.7 Assessment of Energy Savings from PCM Pilot Programs

Customer Perceptions of Energy Savings

Program participants who report having made changes to their energy-consuming behavior were asked if they had noticed a decrease in their electric bill since using the PCM. More than half (60%) of customers who have changed their behavior have noticed a decrease in their electric bill, and slightly less than half of customers who have noticed a decrease in their electric bill think that their savings are between 5% and 10%.

Figure 3: Perceived Savings



Billing Analysis

As described in the methodology section, the final model used in the billing analysis is a fixed-effects model which controls the variance seen in the data. Weather is controlled for through the inclusion of two variables, AvgDailyCDD and AvgDailyHDD. The squared terms for average daily CDD and average daily HDD are included to account for hypothesized non-linearity in the relationship between weather and energy usage. The addition of the read date variable addresses the autocorrelation problem.

Based on the billing analysis, PCM users use 0.87 kWh less electricity per day after using the PCM compared to before using the PCM. The results also show expected increases in electricity use on warmer days (variable AvgDailyCDD) and decreases in electricity use on colder days (variable AvgDailyHDD). The coefficients for these variables are all statistically significant (at the 1% level).

The coefficient on the Install variable is statistically significant and has a larger absolute value than the coefficient on Post, which could mean that the Install variable is capturing some of the PCM savings. In order to test this, we also ran a simpler pre-post model. This involved dropping the Install variable from the model and replacing Post with a new variable (Post2) which took on the value of 1 if the month of the read date was the same or after the month of the use date, and a 0 otherwise. The coefficient on Post2 was -0.7 (p=0.001), which was smaller in absolute value than Post, indicating that we are capturing the energy savings appropriately with our final model.

Table 33 presents the results of the final model.

Table 33: Billing Analysis Regression Results

Dependent variable: Average Daily kWh				
Independent Variable	**Coefficient**	**Standard error**	**t**	**p-value**
Post *(our variable of interest)*	-0.87	0.23	-3.85	<.001
Install	-1.01	0.37	-2.77	0.01
AvgDailyCDD	1.42	0.21	6.84	<.001
AvgDailyHDD	-0.22	0.04	-5.95	<.001
AvgCDD squared	0.00	0.02	0.20	0.84
AvgHDD squared	0.01	0.00	11.09	<.001
ReadDate	0.00	0.00	18.37	<.001
Dummy 1 to Dummy 242 *(used to create the fixed-effects model)*				
R^2 = 0.942; *n* = 6,927 Correlation between residuals and lag 1 residuals = 0.625, p<.001				

Savings per PCM Used

Based on the results of the regression model and the average electricity usage of customers included in the billing analysis, we estimated the average annual electricity savings per household that can be attributed to use of the PCM.

- We estimate the average daily savings due to PCM use to be 0.87 kWh per household per day. This translates into annual savings of 317.6 kWh per household (0.87 * 365). Using a 95% confidence interval, the high and low estimates are 481.8 kWh and 157.0 kWh, respectively. Using a 90% confidence interval, the high and low estimates are 456.3 kWh and 182.5 kWh, respectively.

- The average electricity usage of the 243 customers included in the billing analysis was 29.8 kWh per day or 10,877 kWh per year (29.8 * 365).
- In percentage terms, the average annual savings for PCM users are estimated at 2.9% of the annual household kWh use, with a range from 1.4% to 4.4% (95% confidence interval). Using a 90% confidence interval, the range is 1.7% to 4.2%.

Table 34 summarizes these calculations.

Table 34: Per Home Energy Savings Due to Use of the PCM

Average Annual Usage

Average annual usage = 29.8 kWh/day* 365 days = 10,877 kWh per household

Regression results:

Post coefficient = -0.87
95% Confidence Interval: -1.32, -.43; 90% Confidence Interval: -1.25, -0.50
Average annual savings during analysis period = 0.87 * 365 = 317.6 kWh or **2.9%** of annual usage

Range of savings:

Using 95% confidence interval:

Low estimate: Annual savings during analysis period: 0.43 * 365 = 157.0 or **1.4%**
High estimate: Annual savings during analysis period: 1.32 * 365 = 481.8 or **4.4%**

Using 90% confidence interval:

Low estimate: Annual savings during analysis period: 0.50 * 365 = 182.5 or **1.7%**
High estimate: Annual savings during analysis period: 1.25 * 365 = 456.3 or **4.2%**

The results of our analysis are comparable to other estimates of PCM-related savings. An analysis by Mountain Economic Consulting and Associates Inc. called *The Impact of Real-Time Feedback on Residential Electricity Consumption: The Hydro One Pilot* in March 2006 estimated savings for residential customers who received a PCM. While the approach for this study was different from ours, involving more than 400 participants and control customers and covering varied geography and weather, the results were comparable at a savings of 6.6% of electricity use. Another study of pilot programs[19] conducted by Newfoundland Power and BC Hydro found that families in Newfoundland and Labrador reduced their electricity consumption on average by 18% after using the PCM. Families in British Columbia taking part in the study reduced their electricity consumption by an average of 2.7%. However, that figure rose to 9.3% during the winter peak.

Pilot Program Savings

As described above, per household savings for customers who *installed and used* the PCM are estimated to be 317.6 kWh per year. To estimate total savings of the pilot program, this value has to be applied to all customers who received a PCM and installed and used it. We estimated the total number of PCMs installed and used based on responses to our Phase 1 participant survey.

[19] *Results of Two-Year Study Demonstrates Residential Electricity Monitors Help Homeowners Conserve Electricity in a Big Way*, accessed at http://www.bluelineinnovations.com/documents/pr-ceati.pdf, on October 15, 2008.

Table 35 summarizes these statistics, by utility. The table shows that, across all three utilities, 74.3% of customers who received a PCM installed it and 70.6% used it. The total number of program PCMs used by customers is therefore estimated to be 2,479 (3,512 * 70.6%).

Total annual savings from the pilot program were then estimated by multiplying the total number of customers who used the PCM (2,479) by the average annual savings of 317.6 kWh determined through the billing analysis.[20]

Table 35: Estimated Program Electricity Savings Due to Use of the PCM

	National Grid		NSTAR		WMECO		TOTAL	
PCMs	#	% of Distr.	#	% of Distr.	#	% of Distr.	#	% of Distr.
Distributed	377	--	3,103	--	32	--	3,512	--
Installed	299	79.4%	2,278	73.4%	32	100%	2,609	74.3%
Used	288	76.4%	2,159	69.6%	32	100%	2,479	70.6%
Average Annual Savings per PCM Used: 317.6 kWh								
Total Annual Savings		91,469		685,698		10,163		787,330

Savings per PCM Distributed

For future program planning purposes, it is also useful to express average savings on a "per PCM distributed" basis rather than a "per PCM used" basis. This will allow the utilities to estimate savings based on program participation, without having to make adjustments for installation and use rates. Average annual savings per PCM distributed can be calculated by dividing total savings by the number of PCMs distributed. Average annual percentage savings are calculated by dividing average annual kWh savings by 10,877 kWh, the average annual electricity usage per household.

Table 36 summarizes the estimated savings per PCM distributed, by utility and for the pilot program overall. Note that the average savings per PCM *distributed* are smaller than the average savings per PCM *used*. This is because customers who received a PCM but did not use it are not expected to realize savings. Note also that the average annual savings per PCM distributed are different for the three utilities because of the different use rates of their customers.

Table 36: Average Annual Savings per PCM Distributed, by Utility

	National Grid	NSTAR	WMECO	TOTAL
Total Annual Savings	91,469	685,698	10,163	787,330
# of PCMs Distributed	377	3,103	32	3,512
Average Annual Savings (kWh)	242.6	221.0	317.6	224.2
Average Annual % Savings	2.2%	2.0%	2.9%	2.1%

[20] This calculation includes audit participants, who were excluded from the billing analysis due to anticipated difficulties in differentiating changes in energy use behavior due to the audit from those due to the PCM. Audit participants might have different energy use behavior from the customers included in the billing analysis. However, since only 4% of all PCMs were distributed through an audit-related marketing strategy, any differences between these two groups are likely to have minor effects on overall program savings.

Since use rates also varied within a single utility by marketing strategy, different average savings per PCM distributed can be expected by a utility, depending on the marketing strategy employed. Table 37 shows the total number of PCMs used, by marketing strategy, calculated based on the number of PCMs distributed (see also *Table 1: Summary of PCM Distribution Activities*) and the percentage of PCMs used (see also *Table 6: Short-Term PCM Installation and Initial Use*). Total annual savings of each marketing strategy was estimated by multiplying the number of PCMs used by 317.6 (the average savings per PCM used). As above, dividing total savings by the number of PCMs distributed yields the average savings per PCM distributed, and average annual percentage savings are calculated by dividing average annual kWh savings by 10,877 kWh (the average annual electricity usage per household).

Table 37: Average Annual Savings per PCM Distributed, by Utility and Marketing Strategy

	National Grid			NSTAR		WMECO	
	Audit[1]	**$9.99**	**$49.99[1]**	**Media**	**$29.99**	**Mail/Audit[2]**	**TOTAL**
# of PCMs Distributed	100	272	5	2,628	475	32	3,512
% of PCMs Used	97%	69%	67%	71%	64%	100%	71%
# of PCMs Used	97	188	3	1,857	302	32	2,479
Total Annual Savings (kWh)	30,807	59,709	--	589,783	95,915	10,163	787,330
Average Annual Savings (kWh)	308.1	219.5	--	224.4	201.9	317.6	224.2
Average Annual % Savings	2.8%	2.0%	--	2.1%	1.9%	2.9%	2.1%

[1]Annual savings not estimated due to small sample size.
[2]Customers who received a PCM during or following an audit were not included in the billing analysis. The average annual savings per PCM distributed for these marketing strategies assumes that audit customers realize the same energy savings as the customers included in the billing analysis.

APPENDIX A: DATA CLEANING AND ALTERNATIVE MODELS FOR BILLING ANALYSIS

Table A-1: Summary of Records Removed in Cleaning the Data

NSTAR	
Number of starting records = 4762, number of customers = 189	
	Number of records
Starting records for electric customers	4,762
Records deleted - 0 or missing usage	-23
Individuals deleted - had 0 days for all records	-50
Individuals deleted - more than half records had 0 usage	-25
Individuals deleted - duplicate records	-48
Individuals deleted - never used the PCM	-271
Individuals deleted - did not know their use date	-50
Final NSTAR records	4,295
Final NSTAR customers	174
NGRID	
Number of starting records = 21,546, number of customers = 373	
Starting records	21,546
Individuals deleted - customers who received the PCM but are not part of the billing analysis (did not install it or went through the audit program)	-17,541
Duplicate records (deleted)	-1167
Records deleted due to 0 usage	0
Individuals deleted - never used the PCM	-117
Individuals deleted - missing use date	-43
Individuals deleted – addresses where the resident changed	-46
FINAL NGRID records	2,632
Final NGRID customers	69
TOTAL RECORDS	6,927
Total customers	243

Alternative Model Specifications

As with many analyses of this type, we ran more than one model during the analysis.

Table A-2 presents the results of one alternative model which provides reasonable savings estimates and contains the important variables such as time (which addresses autocorrelation) and weather. It is a fixed-effects model and therefore controls the variance, resulting in a high R-squared value of 0.94. This alternative model had very similar savings estimates to the final model (3.2% of annual usage), providing assurance that the savings we found are valid. The range of savings based on this model is 1.7% to 4.7%.

We did not use this model as our final model because it does not take into account the non-linearity between weather and behavior, which we felt was an important consideration.

Table A-2: Alternative Billing Analysis Results

Dependent variable: Average Daily kWh				
Independent Variable	**Coefficient**	**Standard error**	**t**	**P-value**
Post	-0.94	0.23	-4.14	<.001
Install	-0.41	0.36	-1.13	0.26
AvgDailyCDD	1.81	0.07	27.64	<.001
AvgDailyHDD	0.16	0.01	16.19	<.001
ReadDate	0	0	17.22	0.001
Dummy 1 to Dummy242 *(used to create the fixed-effects model)*				
$R^2 = 0.939$; $n = 6{,}927$ Correlation between residuals and lag 1 residuals = 0.681, p<0.001				

Some of the tested regressions contained interaction terms between the program variable ("post") and the weather variables. However, the model results including the interactive effects were counter-intuitive. When we attempted to determine the overall savings if energy use and cooling degree days were interacted within the model, we saw that more energy was used during a cooler period (i.e., the post period used more energy, but had few cooling degree days; see Table A-4). It is possible that this may have been due to how people react to their day-to-day weather and used their AC differently during a "warm" versus a "cool" summer. However, another possible explanation for this is that we do not have enough post-use summer data or post-use hot summer data, and that we are missing potential savings. We chose to reject this particular model because of these results.

Table A-3 shows the time periods involved in the pre-use data and post-use data, which supports the lack of hotter days in the post period.

Table A-3: Number of Records in the Pre-use and Post-use Periods

Time Period	Time Dates	Number of pre-use records	Number of post-use records
Spring 2005 to Spring 2007	April 28, 2005 – May 31, 2007	3,699	3
Summer 2007	June 1, 2007 - August 31, 2007	694	62
Fall 2007 to Spring 2008	September 4, 2007 - May 31, 2008	127	2,036
Summer 2008	June 2, 2008 - July 25, 2008	0	306
Total		4,520	2,407

Not only were there a relatively small number of records during the summer for our analysis, in comparison to the 30-year average weather, the summer weather in the "Post" period of the analysis was much cooler than a normal summer. The results from a billing analysis with a normal summer could be quite different. Therefore, more accurate savings estimates might be derived if a follow-up impact evaluation is conducted that includes complete post-use summer usage (particularly if there is closer correlation between post-retrofit CDD and long-run CDD).

Table A-4: Weather Pre- and Post-Use of the PCM

	Mean for AvgDailyHDD	Mean for AvgDailyCDD
Pre-use	14.84	1.23
Post-use	18.34	0.46
30-year average	16.84	1.70

Another alternative model includes all the variables of the final model as well as a variable for gas prices. The results are presented in Table A-5. Given that the coefficient on the gas prices variable was not statistically significant and the addition of this variable does not reduce autocorrelation, we do not include gas prices in the final model. The savings estimate for this model is 2.6%, and ranges from 0.5% to 4.6%.

Table A-5: Alternative Results – Model Including Gas Prices

Dependent variable: Average Daily kWh				
Independent Variable	**Coefficient**	**Standard error**	**t**	**p-value**
Post *(our variable of interest)*	-0.76	0.31	-2.42	0.02
Install	-0.99	0.37	-2.69	0.01
AvgDailyCDD	1.43	0.21	6.86	p<.001
AvgDailyHDD	-0.23	0.04	-5.96	p<.001
AvgCDD squared	0.00	0.02	0.14	0.89
AvgHDD squared	0.01	0.00	11.10	p<.001
ReadDate	0.00	0.00	16.20	p<.001
Gas prices	-0.00	0.00	-0.54	0.59
R^2 = 0.942; *n* = 6,927 Correlation between residuals and lag 1 residuals = 0.624, p<.001				

APPENDIX B: PROFILE OF RESPONDENTS

This appendix profiles energy efficiency attributes and demographics for program participants and non-participants. Participant data is based on responses to the Phase 1 survey. For comparison purposes, this data is presented in two ways: (1) for all Phase 1 respondents combined and (2) broken out by the respondents' Phase 2 status, i.e., Phase 2 respondent, Phase 2 non-respondent, and excluded from Phase 2 survey due to Phase 1 responses. This comparison of respondents by Phase 2 status shows that Phase 2 respondents are not significantly different from Phase 2 non-respondents.

Energy Efficiency Attitude, Awareness, and Behavior

Q. EE1: How important is energy efficiency to you?[1]

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Rating 8, 9 or 10	85%	86%	86%	84%	87%
Rating 4, 5, 6 or 7	14%	13%	14%	16%	12%
Rating 1, 2 or 3	--	1%	--	--	1%

[1]Rated using a 10-point scale where 10 is "extremely important" and 1 is "not at all important."
A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

Q. EE2a: How aware are you of energy efficiency and actions you could take in your home to reduce your consumption of electricity?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Very Aware	79%	79%	83%[C]	68%	71%
Somewhat aware	20%	20%	16%	27%	27%
Neither aware nor unaware	1%	<1%	1%	5%	<1%
Not very aware	<1%	<1%	--	--	2%
Not at all aware	--	--	--	--	<1%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

Q. EE3b: Steps taken to reduce electricity use in your home

	Phase 1 Participant Survey – Before Using PCM			Non-Participant Survey
		Phase 2 Status		
	Total (n=349)	Respondent (A) (n=281)	Non-Respondent (B) (n=68)	Total (n=266)
All possible steps	11%	10%	16%	23%
Most steps	35%	35%	37%	48%
A few steps	42%	43%	37%	27%
No steps	11%	11%	9%	3%
Don't know	1%	1%	1%	--
A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.				

Q. EE3c: What are your reasons for taking steps to reduce electricity use? (Multiple Response)

	Phase 1 Participant Survey – Before Using PCM			Non-Participant Survey
		Phase 2 Status		
	Total (n=345)	Respondent (A) (n=279)	Non-Respondent (B) (n=66)	Total (n=266)
Cost of electricity/lower my bill	94%	94%	91%	92%
Environmental reasons	43%	41%	50%	36%
It's the right thing to do	6%	5%	11%	7%
Family or relatives	1%	1%	2%	2%
Other	1%	<1%	2%	<1%
A/B Indicates statistically significant difference based on a 90% confidence interval.				

QEE4: Baseline Energy Saving Behavior (Always or most of the time)

Do you always, most of the time, sometimes, rarely, or never…	Always or most of the time			
	Phase 1 Participant Survey – Before Using PCM			Non-Participant Survey
		Phase 2 Status		
	Total (n=312)	Respondent (A) (n=250)	Non-Respondent (B) (n=62)	Total (n=259)
Turn off lights when leaving a room	81%	81%	82%	94%
Turn off the TV when not watching	76%	77%	73%	88%
Turn off your computer when not in use	42%	41%	44%	42%
Unplug chargers when not using them	31%	28%	44%[A]	58%
Limit use of AC or increase temp setting	60%	60%	56%	69%
Wait to run dishwasher until full	78%	79%	77%	75%
Wait to run washing machine until full	85%	85%	84%	94%
Wait to use the clothes dryer until full	81%	80%	82%	89%
Keep temp on hot water heater lower	50%	51%	44%	60%
Turn faucet off while shaving or shampooing	44%	44%	45%	49%
Select Energy Star appliances	80%	80%	84%	82%
Replace light bulbs with CFLs when they burn out	65%	63%	73%	63%
Replace light bulbs that are still working with CFLs	43%	40%	55%[A]	43%
A/B Indicates statistically significant difference based on a 90% confidence interval.				

QEE4: Baseline Energy Saving Behavior (Sometimes)

Do you always, most of the time, sometimes, rarely, or never…	Sometimes			
	Phase 1 Participant Survey – Before Using PCM			Non-Participant Survey
		Phase 2 Status		
	Total (n=312)	Respondent (A) (n=250)	Non-Respondent (B) (n=62)	Total (n=259)
Turn off lights when leaving a room	15%	16%	11%	4%
Turn off the TV when not watching	13%	12%	16%	8%
Turn off your computer when not in use	19%	19%	19%	11%
Unplug chargers when not using them	16%	18%[B]	10%	11%
Limit use of AC or increase temp setting	21%	19%	27%	9%
Wait to run dishwasher until full	5%	6%	3%	2%
Wait to run washing machine until full	10%	9%	13%	4%
Wait to use the clothes dryer until full	10%	9%	13%	3%
Keep temp on hot water heater lower	4%	4%	3%	6%
Turn faucet off while shaving or shampooing	20%	21%	16%	16%
Select Energy Star appliances	11%	12%	8%	7%
Replace light bulbs with CFLs when they burn out	18%	19%[B]	11%	16%
A/B Indicates statistically significant difference based on a 90% confidence interval.				

QEE4: Baseline Energy Saving Behavior (Rarely or never)

Do you always, most of the time, sometimes, rarely, or never…	Rarely or Never			
	Phase 1 Participant Survey – Before Using PCM			Non-Participant Survey
		Phase 2 Status		
	Total (n=312)	Respondent (A) (n=250)	Non-Respondent (B) (n=62)	Total (n=259)
Turn off lights when leaving a room	4%	4%	6%	2%
Turn off the TV when not watching	8%	9%	6%	13%
Turn off your computer when not in use	35%	36%	35%	19%
Unplug chargers when not using them	50%	51%	47%	22%
Limit use of AC or increase temp setting	10%	11%	5%	6%
Wait to run dishwasher until full	5%	6%	3%	2%
Wait to run washing machine until full	5%	5%	3%	2%
Wait to use the clothes dryer until full	5%	6%	5%	3%
Keep temp on hot water heater lower	28%	28%	26%	15%
Turn faucet off while shaving or shampooing	22%	32%	34%	7%
Select Energy Star appliances	4%	4%	5%	5%
Replace light bulbs with CFLs when they burn out	17%	18%	15%	17%
Replace light bulbs that are still working with CFLs	30%	32%	23%	39%
A/B Indicates statistically significant difference based on a 90% confidence interval.				

EE5a: Other Baseline Energy Saving Steps

	Phase 1 Participant Survey – Before Using PCM			Non-Participant Survey
		Phase 2 Status		
	Total (n=312)	Respondent (A) (n=250)	Non-Respondent (B) (n=62)	Total (n=259)
Added insulation	31%	32%	27%	21%
New windows	16%	15%	18%	15%
Lower heating temperature	--	--	--	12%
Air dry clothes	3%	3%	5%	10%
Had an energy audit	10%	9%	14%	7%
Turn off lights/appliances when not in use	10%	10%	9%	7%
Unplug appliances/electronics when not in use	--	--	--	7%
Cover/insulate windows/doors	--	--	--	6%
Use natural light	--	--	--	5%
Use firewood/fireplace	--	--	--	5%
Use wood stove	3%	3%	--	5%
Don't use heat as much	--	--	--	4%
Turn off computer	--	--	--	2%
Use appliances/electronics less often	--	--	--	2%
New furnace/heating system	8%	8%	5%	2%
New appliances	16%	15%	18%	2%
Use motion detector for lights	--	--	--	2%
Weatherstripping	8%	8%	5%	1%
CFLs	5%	6%	--	
Solar panels	3%	3%	5%	
Programmable thermostat	2%	1%	5%	
Other	10%	10%	9%	11%
Don't know	12%	11%	14%	6%
A/B Indicates statistically significant difference based on a 90% confidence interval.				

Q. EE6a: Did you ever have an energy audit conducted in your home?

	Phase 1 Participant Survey			Non-Participant Survey
		Phase 2 Status		
	Total (n=266)[1]	Respondent (A) (n=281)	Non-Respondent (B) (n=68)	Total (n=266)
Yes	59%	58%	61%	54%
No	41%	41%	39%	45%
Don't know	1%	1%	--	1%

[1]Only asked of participants who did not receive their PCM through or after an audit program and who report having installed and used the PCM.
A/B Indicates statistically significant difference based on a 90% confidence interval.

Demographics

Q. D1: What type of residence do you live in?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Single family	86%	85%	88%	86%	90%
Duplex or two family	7%	8%[B]	3%	5%	5%
Apartment or condo 2-4 unit	2%	2%	2%	--	2%
Apartment or condo 4+ unit	2%	1%	2%	7%	1%
Townhouse	1%	1%	1%	2%	<1%
Mobile home	<1%	1%	--	--	1%
Other	<1%	1%	--	--	<1%
Refused	1%	1%	2%	--	<1%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

Q. D2: Do you own or rent your home?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Own	95%	95%	94%	93%	95%
Rent	3%	3%	2%	7%	5%
Refused	2%	2%	3%	--	1%
A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.					

Q. D3: Approximately how old is your home?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
0-4 years	2%	2%	2%	2%	3%
5-10 years	8%	8%[C]	8%	2%	6%
11-15 years	6%	5%	7%	7%	7%
16-20 years	8%	9%[B]	5%	7%	6%
21-40 years	26%	26%	27%	23%	26%
41-80 years	32%	32%	29%	43%	33%
81 or more years	16%	16%	19%	16%	17%
Don't know/Refused	2%	2%	3%	--	2%
A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.					

Q. D4: What is the primary heating fuel used in your home?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Gas	36%	36%	29%	48%[B]	24%
Oil	49%	49%[C]	56%[C]	36%	56%
Electric	7%	7%	6%	5%	7%
Propane	3%	3%	1%	-	5%
Wood	-	-	-	-	6%
Other	4%	3%	5%	9%	1%
Don't know	2%	1%	3%	2%	<1%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

Q. D5: Does your home have… (% of respondents answering "yes")

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Electric dryer	76%	74%	81%	82%	85%
Electric hot water heater	30%	31%	29%	30%	39%
Electric stove	68%	67%	74%	64%	70%
Pool	14%	12%	20%	14%	18%
Hot tub	11%	11%	8%	18%	9%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

Q. D6: Counting yourself how many people are in your household?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
1	7%	8%[B]	4%	9%	15%
2	36%	37%	35%	32%	37%
3	15%	13%	20%	18%	17%
4	25%	27%[B]	18%	25%	17%
5	11%	9%	18%[A]	14%	10%
6	2%	3%	-	-	2%
7 or more	1%	2%	1%	-	--
Refused	2%	2%	4%	2%	1%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

Q. D7: What is the highest level of education that you have completed so far?

	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Less than high school	<1%	<1%	-	-	2%
High school graduate	9%	9%	7%	7%	16%
Technical or trade school grad	2%	3%	1%	2%	4%
Some college	10%	9%	14%	9%	14%
College graduate	35%	36%	29%	32%	25%
Some graduate school	4%	4%	6%	5%	4%
Graduate degree	37%	36%	38%	4%	32%
Don't know/Refused	3%	3%	5%	2%	3%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

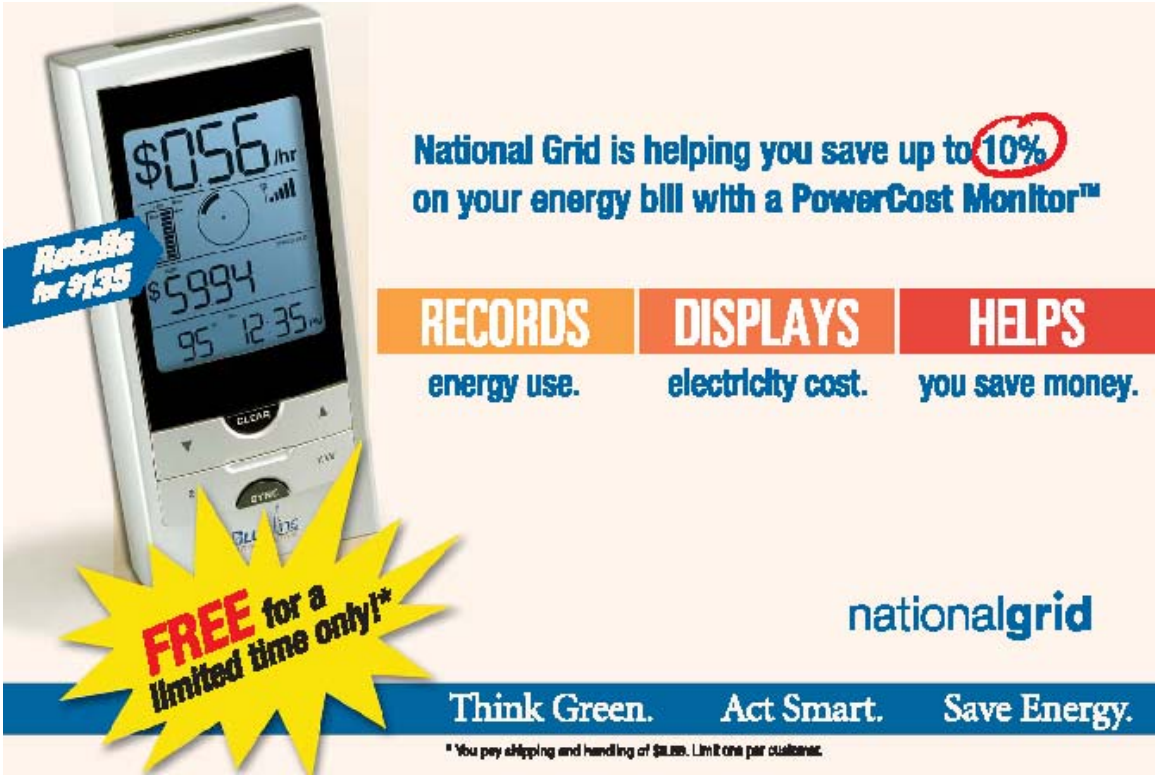
Q. D8: Which category best describes your total household income in 2006 before taxes?

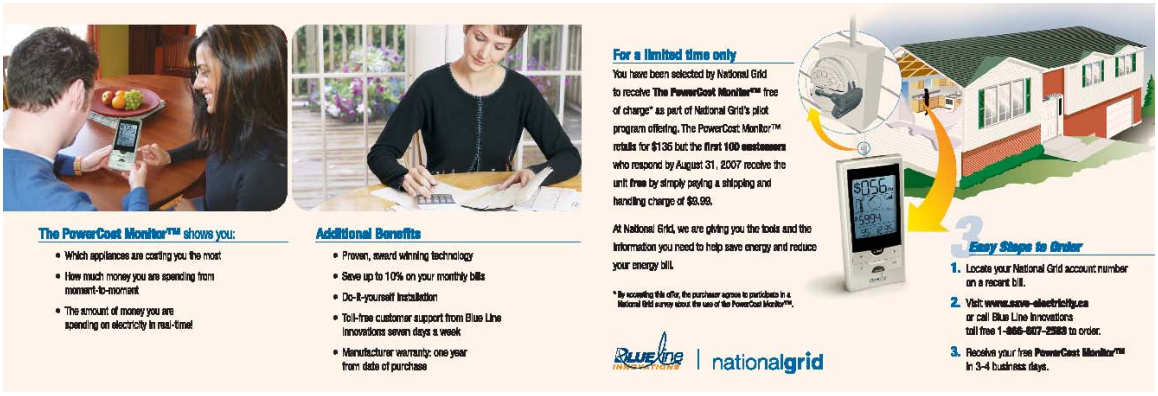
	Phase 1 Participant Survey				Non-Participant Survey
		Phase 2 Status			
	Total (n=478)	Respondent (A) (n=348)	Non-Respondent (B) (n=86)	Excluded (C) (n=44)	Total (n=266)
Under $20,000	1%	2%	-	2%	4%
$20,000-$40,000	6%	6%	7%	5%	8%
$40,000-$60,000	8%	9%	8%	7%	15%
$60,000-$80,000	12%	11%	13%	14%	16%
$80,000-$100,000	12%	13%	10%	9%	12%
$100,000-$150,000	18%	18%	16%	25%	9%
$150,000 or over	15%	15%	14%	16%	9%
Don't know/Refused	27%	26%	31%	23%	28%

A/B/C indicates statistically significant difference based on a 90% confidence interval. Comparison conducted for Columns (A), (B), and (C) only.

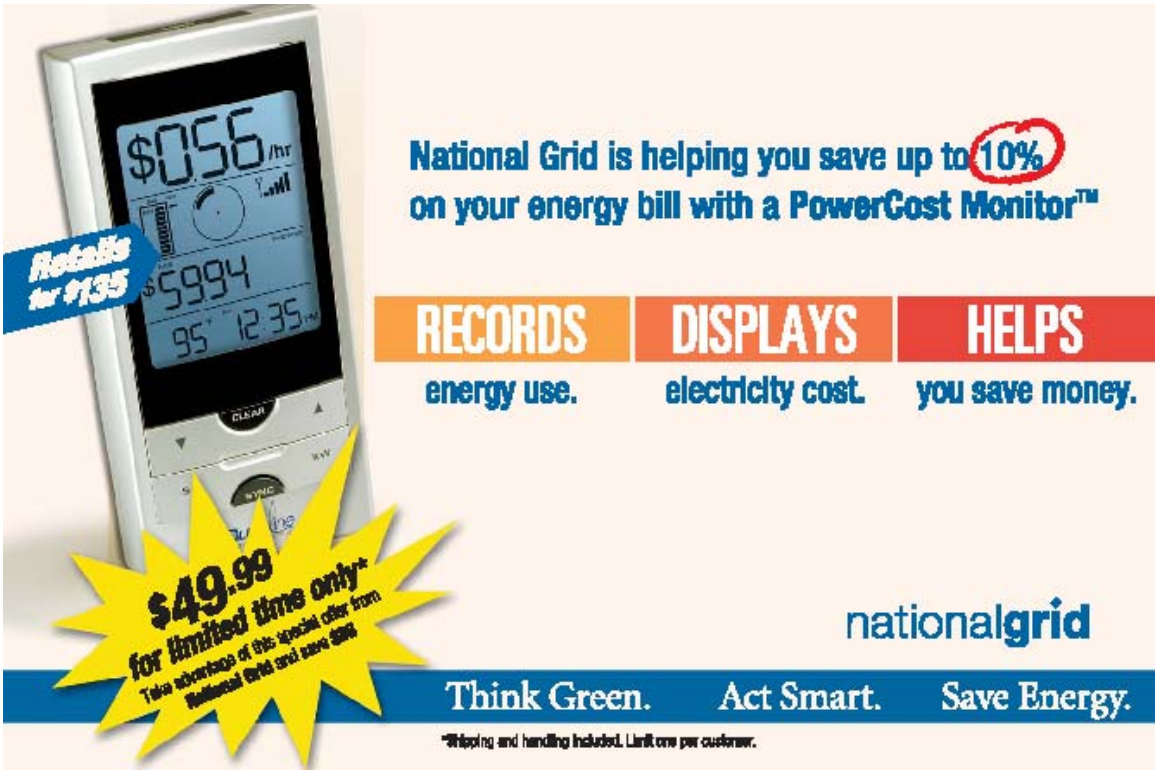
APPENDIX C: PCM MARKETING MATERIALS

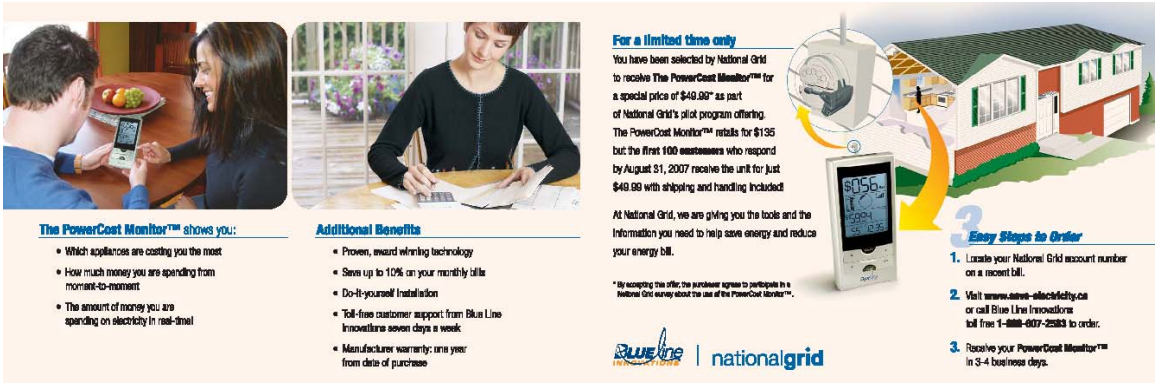
National Grid's $9.99 Direct Mail Offer





National Grid's $49.99 Direct Mail Offer





NSTAR Electric's $29.99 Direct Mail Offer

NSTAR ELECTRIC
One NSTAR Way
Westwood, MA 02090

FPO

Special instant rebate helps you take charge of your power!

NSTAR Electric's Boston Globe Press Release

CONSUMER BEAT

The phantom menace

Idle devices waste electricity throughout your home, padding your monthly utility bill. But there are ways to help you cut down.

By Bruce Mohl, Globe Staff | June 10, 2007

Turn off all the lights in your house at night and wander around. You'll be amazed at how many devices continue to glow.

Utility executives call it phantom load, the electricity that flows to devices that are turned off but still drawing power. A microwave with a clock that's on 24 hours a day. A TV that's not on but continuously consuming electricity so it's ready when you hit the remote's "on" button. Wireless phone chargers that keep drawing power even when no phone is plugged in.

Individually, none of these turned-off devices use much power. But together they represent an estimated 2 to 8 percent of a home's electricity usage. For someone in the Boston area with a 6 percent phantom load, that's more than $5 a month, or $60 a year.

Across Massachusetts, according to NStar Corp., a 6 percent phantom load would have cost residential customers $200 million last year and wasted enough electricity to power every home in Cambridge, Somerville, Newton, and Waltham for a year.

The cost across New England would have been $450 million, or enough electricity to serve Boston, Hartford, and Portland for a year.

"There is a waking up going on around this," said Tom May, chief executive of NStar, the utility serving the Boston area. "Once you become aware of it, you see it all over the place."

May said he was in a kitchen recently that had clocks on the stove, the microwave, the coffee maker, and the wall. "How many clocks do you need?" he asked.

May cautioned that phantom load is just a small piece of a much larger energy conservation puzzle. He said lawmakers need to crack down on energy waste by banning wasteful incandescent bulbs, tightening building codes, and requiring appliances to be designed to minimize phantom load.

He encouraged Massachusetts regulators to give utilities a greater incentive to promote energy savings by making their profit less contingent on how much electricity they sell.

Right now, utilities generally make less money if their customers use less power. Regulators are studying the idea of rewarding utilities for reducing energy consumption.

May said energy use has always been linked to economic growth, but conservation could make it possible to grow without using more energy or building anything but replacement power plants. "It's a lofty but impressive and achievable goal," he said.

To reach that goal, Massachusetts electric utilities are urging their customers to start small.

David W. Allen, a retiree living in West Barnstable on the Cape, says most people can't afford to install solar panels, replace all their windows, or pump insulation into their walls and attics. But he says they can afford to install more efficient light bulbs and stop wasting energy.

"That phantom load is a killer," Allen said. "You don't need a light walking around my house at night. There's a green light showing in every room." Allen says stoves and microwaves should have switches for turning off the 24-hour timers and clocks when they're not in use.

Bill Stack, a residential energy efficiency manager for NStar, last week visited the Milton home of Greg and Mary Hebard to help them identify ways to curb their energy use.

Before touring the home, Stack attached a power cost monitor device to the outside electric meter. The battery-powered device, which NStar customers can buy for $29.95 from Blue Line Innovations (bluelineinnovations.com), transmits data to an in-house monitor that tells the Hebards how much electricity they are currently using, both in terms of kilowatts and cents per hour.

At the Hebard home, the monitor fluctuated quite a bit as Stack made his way through the house turning on and off appliances and lights.

During the half-hour period, the price went as high as 45 cents an hour, when everything was turned on, and as low as 16 cents an hour.

Consumers can also see how much power their idle electronic devices are drawing by going to the website of the Federal Energy Management Program (oahu.lbl.gov). They can learn about energy-saving lights and appliances at energystar.gov.

In the first room on the tour, Stack zeroed in on the plasma TV and DVD player in the corner. Both were drawing electricity even though they weren't in use. Stack said a plasma TV consumes five times as much power as a regular TV when turned off.

He recommended plugging the TV and the DVD player into a power strip that could be

turned off easily when the devices are not in use.

As he continued on the tour, Stack spotted wireless phone chargers that were plugged in and still drawing power even though no phone was being charged.

He said anything with a square plug transformer, including videogame consoles and portable DVD players, contributes to phantom load. The same goes for any device with a remote control.

In the Hebards' basement, no one was using the computer but the speaker light was on, indicating it was still drawing power.

The lights in the basement and the kitchen were all halogens. Stack said the Hebards could get the same illumination at a quarter of the energy cost by shifting to compact fluorescent lights. Compact fluorescent lights cost more but last longer and operate far more efficiently.

Stack estimated the Hebards could save $20 to $30 a month by replacing the halogen light bulbs and putting a handful of their always-on devices on power strips.

Interviewed several days later, Greg Hebard said he had purchased the power strips and planned to follow Stack's other tips. He said he finds himself drawn to the power cost monitor, particularly when someone leaves the refrigerator door open for awhile.

"I'm looking at that thing all the time," he said. "It almost becomes addictive."

WMECO's Free Direct Install Mailing

APPENDIX D: PHASE 1 PARTICIPANT SURVEY

Provided as separate file.

APPENDIX E: PHASE 2 PARTICIPANT SURVEY

Provided as separate file.

APPENDIX F: NON-PARTICIPANT SURVEY

Provided as separate file.