Quantifying Load-Shifting Benefits From A Marketing Campaign

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ABSTRACT

For the past three years, the New York State Energy Research and Development Authority (NYSERDA) has conducted an air conditioner turn-in bounty program, called the Keep Cool Program, along with an aggressive multi-media energy tips marketing campaign to encourage New York residents to use energy wisely during the summer months. The three tips that have been promoted through the campaign are: buy ENERGY STAR® products, shift clothes and dish washing to off-peak (7pm – 7am) hours, and use a programmable thermostat or timer to control air conditioning. This paper presents the Keep Cool marketing campaign and the research used to estimate its impacts and calculate the resulting amount of electric demand shifted due to these behavioral changes.

Background

For the past three years, the New York State Energy Research and Development Authority (NYSERDA) has conducted an air conditioner turn-in bounty program, called Keep Cool, where New York residents can turn in their old, inefficient, working room air conditioner (RAC) and receive a bounty payment toward the purchase of a new, qualifying ENERGY STAR unit. In conjunction with this offer, an aggressive multi-media energy tips marketing campaign (Keep Cool marketing campaign) encourages New York residents to follow three specific tips to use energy wisely during the summer months: buy ENERGY STAR products, shift clothes and dish washing to off-peak (7pm – 7am) hours, and use a programmable thermostat or timer to control air conditioning.

Impetus for this Evaluation

The New York State Public Service Commission (PSC) annually estimates the amount of electric demand shifted during peak times in the summer. This amount is aggregated and can be attributable to any number of load-shifting efforts, including peak demand reduction programs and public "calls to action" announced by the Governor. Knowing that the Keep Cool marketing campaign focused on urging the public to shift energy-intensive tasks to off-peak hours, NYSERDA believed a certain amount of the demand shifted to off-peak times was likely attributable to the marketing campaign's efforts. A telephone survey fielded in 2001 attempted to determine this amount; however, the survey's questions were not designed to adequately quantify electric demand shifts. Instead, the survey was only able to qualitatively address behavior changes. The telephone survey developed for the 2002 marketing campaign, on the other hand, was specifically designed to be able to quantify respondents' behavior and estimate the amount of electric demand (MW) shifted by the respondents during peak times through several specific questions. For purposes of this paper, results presented reflect the 2002 Keep Cool marketing campaign, conducted between May 1 and September 30. Results of the evaluation are applicable to **New York Energy $mart**[SM] territory, which includes the utility service areas of Niagara

Mohawk, New York State Electric and Gas, Consolidated Edison, Orange and Rockland, Rochester Gas and Electric, and Central Hudson Gas and Electric.

Promoting the Marketing Campaign

The 2002 Keep Cool marketing campaign played a significant role in stimulating interest in both the air conditioner bounty offer and the energy tips messaging. Marketing efforts, implemented by DDB Bass and Howes, initially focused on promoting the bounty offer. However, as interest in the bounty offer grew, the marketing efforts were transitioned to focus on the energy tips messaging. The marketing campaign was conducted throughout New York, including the Long Island Power Authority (LIPA) and New York Power Authority (NYPA) territories. Television, newspaper, and radio advertising (including a percentage of advertising produced in Spanish), as well as other opportunities, were used to promote the energy tips messages. Specific promotions and events that served to popularize the tips messages are summarized below:

- The Keep Cool Program was promoted at a Hudson Valley Renegades softball game in July 2002. In addition to energy tips announced over the loud speaker, paddle fans listing the three energy tips were handed out. About 4,000 people attended the game.

- A series of radio remotes were held throughout the state. Radio stations promoted the Keep Cool bounty offer and energy tips at such venues as participating retail stores in order to increase consumer traffic to the stores.

- A website was developed for the Keep Cool Program, which included information on participating retailers, drop off sites, and other Program rules and conditions. In addition, the website also had a page dedicated to tips. Not only was the website linked from NYSERDA's overall residential program website (www.GetEnergySmart.org), but a link to the website was placed on other websites, such as www.accuweather.com, various RAC manufacturers' websites, and LIPA's and NYPA's websites.

- Online marketing materials were developed and placed on various websites. Banner and superstitial advertising focused on the bounty offer, the energy tips, and an optional e-mail newsletter. All of the online marketing materials urged the viewer to visit www.GetEnergySmart.org for more information about the Keep Cool Program and the energy tips.

By the end of the Summer 2002 Keep Cool Program, 141 print stories, 27 television stories, and 24 radio stories about the program had been produced. These stories resulted in over 13 million impressions. In terms of paid advertising, 540 television ads, 4,797 radio ads, 119 newspaper ads, and over 6.6 million online ads were purchased to promote the bounty and tips message. Impressions from paid advertising totaled over 271 million (DDB Bass and Howes. 2002). [1]

[1] A media impression is defined as the sum of the gross audience of all vehicles (*e.g.*, television, radio, newspaper advertisements, etc.) used in an advertiser's schedule. One person in the gross audience could experience hundreds of impressions.

Survey design/development/methodology

NYSERDA conducted baseline and follow-up surveys immediately before and after the 2002 marketing campaign to gauge respondents' awareness of the campaign and to record respondents' behavior prior to and after the marketing campaign. Results were used to measure the effectiveness of the marketing campaign and to estimate the amount of electric demand shifted to off-peak hours. Random samples of New York residents were drawn for both the baseline and follow-up surveys and weighted to be representative of the overall population. The surveys were developed by NYSERDA project and evaluation staff, NYSERDA's then-evaluation assistance contractors, and DDB Bass and Howes, and fielded by TTI market*explorers*, Inc., a subcontractor to DDB Bass and Howes, in May and September 2002.

Questions within the survey were specifically designed to quantify the amount of electric demand shifted. Figure 1 illustrates some sample questions. The amount of behavioral change occurring between May and September was quantified through additional analyses, detailed later in this paper, to estimate the amount of load shifted during this period due to the advertising effort. The change in behavior occurring between the baseline and follow-up surveys could potentially be attributed to the Keep Cool marketing campaign especially given the short amount of time between the survey measurements and given the fact that the surveys were conducted immediately before and after the advertising campaign (*i.e.*, responses were less likely to be spurious).

Figure 1. Sample Survey Questions

Does your household do laundry between 7pm and 7am all of the time, sometimes, rarely, or never?

In an average week, how many loads of laundry does your household wash?

In an average week, how many of these loads would be washed between 7pm and 7am?

Quotas were set for the each of the following behaviors exhibited by the respondents: (1) those who always/sometimes shifted laundry; (2) those who always/sometimes shifted dishwashing; (3) those who owned an RAC with a timer and always/sometimes used the timer to control the temperature; and (4) those who had central air conditioning with a programmable thermostat and always/sometimes used the programmable thermostat to control the temperature.

Key Survey Results

DDB Bass and Howes analyzed changes in behaviors between the baseline and follow-up interviews using a difference of means statistical analysis. Those behaviors that were deemed statistically significant from the baseline to the follow-up surveys were analyzed and then generalized for the New York population. In addition, DDB Bass and Howes removed responses from Long Island respondents so as to report results for **New York Energy $mart^{SM}** Program territory only. Key survey results reflecting **New York Energy $mart^{SM}** Program territory are summarized below (GDS Associates, Inc. and Megdal & Associates. 2003).

- The most significant change between the baseline and follow-up surveys was the shifting of clothes washing and dishwashing to the off-peak period of 7pm – 7am. During the baseline survey, 42% of respondents were already shifting their clothes washing. Results from the follow-up survey found that 71% of respondents shifted their clothes washing to off-peak hours, an increase of 29% from the baseline. For dishwashing, 57% of respondents were shifting in May, with 78% load shifting in September, an increase of 21%.

- The incidence of respondents using timers and programmable thermostats to control their air conditioning units showed no increase over the period covered by the two surveys, and therefore was not analyzed in the load-shifting analysis.

- 64% of respondents were aware of the energy tips advertised by the marketing campaign. By September, 74% were aware of the tips.

- 25% of respondents were aware of the Keep Cool Program in May, with 45% aware in September, accounting for an increase of 20%.

- In May, 56% of respondents were aware of the ENERGY STAR label; by September, that awareness had increased to 72%, an increase of 16%.

- There was an overall increase of 14% in the number of respondents who reported awareness of the ENERGY STAR label and who also owned ENERGY STAR appliances.

The survey results, especially those associated with dish and clothes washing, seem to suggest that significant behavioral change between May and September 2002 could be attributable to the Keep Cool marketing campaign. Thus, results for the clothes and dishwashing behaviors were used to quantify the amount of load shifted during this time.

Load-Shift Analysis

The impact estimates discussed in this paper are based on the subsequent survey data analyses that removed the Long Island respondents. The load-shift analysis methodology was comprised of the following components (GDS Associates, Inc. and Megdal & Associates. 2003):

Step 1: Determine Change in Customer Responses Between the Baseline and Follow-up Survey

The baseline, follow-up, and percentage point gain in load shifting behavior for laundry and dishwasher usage, as described earlier, are summarized in Table 1.

Table 1. Difference in Baseline to Follow-Up Change in Household Behaviors Among Respondents With Appliances

Current Household Behaviors	Baseline Percentage	Follow-Up Percentage	Percentage Point Change
Do Laundry Off-Peak	42%	71%	29%
Operate Dishwasher Off-Peak	57%	78%	21%

In addition to asking respondents whether they operated their clothes washer and/or dishwasher in the off-peak period, the surveys also specifically asked how many off-peak loads of clothes and/or dishes the respondent did in an average week. The values relating to number of off-peak loads are summarized in Table 2.

Table 2. Difference in Baseline to Follow-Up Laundry and Dishwasher Loads Completed in the Off-Peak Period (7pm – 7am) in an Average Week

Household Behavior	Baseline Mean Number of Loads	Follow-Up Mean Number of Loads	Change in Mean Number of Loads Completed Off-Peak
Laundry	2.27	3.08	0.81
Dishwashing	2.79	3.24	0.45

Between Table 1 and Table 2, the advertising campaign appears to have had two positive impacts for load shifting. It caused both more households to shift their usage to off-peak hours, and more laundry and dishwashing loads to be completed off-peak.

Step 2: Estimate the Total Population of Clothes Washers and Dishwashers in New York Energy $mart[SM] Territory

In order to estimate the total impact of behavioral change in **New York Energy $mart[SM]** territory due to the Keep Cool marketing campaign, it was necessary to determine the total number of affected appliances in New York, excluding Long Island. The source for this data was the 2001 Residential Energy Consumption Survey published by the Energy Information Administration (EIA). However, because the EIA data represented New York in entirety, it was necessary to remove the appliances for residents of Long Island to obtain a **New York Energy $mart[SM]** territory count. The population of residential households on Long Island was estimated using the Long Island Lighting Company's residential customer count (*2002 Platts Directory*…). The saturation of clothes washers and dishwashers per household from the EIA data was then applied to the estimated number of Long Island households to estimate the number of appliances on Long Island. The appliance population data is summarized in Table 3.

Table 3. Population Estimate of Clothes Washers and Dishwashers in New York, excluding Long Island

Source	Clothes Washers	Dishwashers
1. NY State Appliance Population (EIA)	4,500,000	2,800,000
2. Estimated Appliance Saturation (EIA)	63.4%	39.4%
3. Long Island Lighting Company Residential Customer Count	941,437	
4. Estimated Appliance Population on Long Island (rounded) *[Line 2 x Line 3]*	597,000	371,000
5. NY State Appliance Population, excluding Long Island *[Line 1 - Line 4]*	3,903,000	2,429,000

Step 3 – Determine Estimates for Appliance Load (kW) and Related Appliance Use Variables

The source for estimates of the average wattage for clothes washers and dishwashers was Niagara Mohawk's brochure entitled *Cost of Operating Home Appliances: Estimating Monthly Energy Use and Cost*. Table 4 illustrates the values as reported in the Niagara Mohawk brochure, as well as the range of values identified from other sources.

Table 4. Typical Wattage of Clothes Washers and Dishwashers

Household Appliance	Typical Wattage (Niagara Mohawk)	Range of Wattage From Other Sources
Clothes Washer	500	500 - 625
Dishwasher (Wash Cycle)	200	200 - 700
Dishwasher (Dry Cycle)	1,000	1,000 - 1,300

In addition to estimating the average wattage of the appliances, it was also necessary to estimate the impacts related to the use of hot water in the off-peak period. Since this study was limited to the impacts related to electrical load, only homes with electric water heating were considered. The 2001 EIA Residential Energy Consumption Survey reports that the saturation of electric water heating in New York is 12.7%.

In determining the load-related impact of electric water heating, it was only necessary to estimate the instantaneous load impact of starting the electric water heater, rather than estimating the energy consumed by heating a specific amount of water that the appliances may have used.[2] This simplifies the estimate of water heating impacts to determining an average wattage rating for electric water-heating elements. The average value for a water-heating element was estimated to be 4,500 watts (4.5 kW) based on General Electric water heating product specifications and an informal survey of plumbing contractors.[3]

The value used for applying the electric load impact related to each of the appliances was determined by multiplying the 4.5 kW by the 12.7% saturation of electric water heating in New York, which resulted in a value of 0.57 kW. For clothes washers, it was also necessary to estimate the percentage of New York residents who do their laundry in cold water only. The percentage of U.S. residents who wash clothes using cold water, for wash and rinse, was estimated to be 30% based upon a 1989 Proctor & Gamble study as referenced in the 1996 E Source Technology Atlas for Appliances (E Source. 1996.). Applying the 30% value to the average demand reduction estimate of 0.57 kW results in a net impact of 0.40 kW for electric water heating.

[2] The assumption inherent in this estimate of load impact is that the water used by either the clothes washer or the dishwasher would be sufficient to require the water heater to come on. Because this analysis is concerned with electric demand (kW), the actual amount of energy needed to heat the water did not need to be determined.

[3] Product specifications on 30 General Electric electric water heaters yielded an average element wattage of 4,447 watts (18 at 4,500; 8 at 3,800; 4 at 5,500). Three plumbing contractors were contacted and asked what was the most common electric water heating element wattage. All three contractors reported 4,500 watts as the most common.

Step 4 - Calculate kW Load Impacts

The estimates and assumptions developed in Steps 1 through 3 were incorporated into a series of calculations. The calculations were divided into three distinct components that were then added together to arrive at the total estimated impact. The description included in this section will refer to the four subsequent steps associated with estimating the clothes washer impacts. The method for determining the impacts for dishwashers was nearly identical.

1 - Impacts from washer motor due to decrease in on-peak laundry use. This first series of calculations estimated the load impact associated with the washer motor only for the 29% increase in respondents who do their laundry in the off-peak period (see Table 1). The 29% increase was applied to the total washer population in New York, excluding Long Island, of 3,903,000 clothes washers. This yielded an estimate of 1,131,870 clothes washers.

The estimated number of affected clothes washers was then multiplied by the value of 3.08 loads per week that respondents reported doing in the off-peak period (see Table 2). This value of 3,486,160 loads of off-peak laundry per week was then multiplied by the average clothes washer wattage of 0.5 kW (see Table 4) to result in 1,743,080 kW (1,743.1 MW) per week used in the off-peak period. To estimate the daily load impact, the weekly estimate was divided by seven to result in 249,011 kW (249.0 MW) of load shifted to the off-peak period.

2 - Impacts from washer motor due to decrease in number of on-peak laundry loads. The second set of calculations estimated the load impact associated with the washer motor only for the 42% of baseline respondents (see Table 1) who have increased the number of off-peak loads from 2.27 per week to 3.08 per week (see Table 2). The net increase in loads per week of 0.81 was applied to the 42% of those who had already been doing laundry in the off-peak period. As before, the 42% was applied to the total washer population in New York, excluding Long Island, and then multiplied by the 0.81 load per week increase to result in 1,327,801 additional loads of laundry shifted to the off-peak period.

The value of 1,327,801 additional loads of off-peak laundry per week was then multiplied by the average clothes washer wattage of 0.5 kW to result in 663,900 kW (663.9 MW) per week used in the off-peak period. The daily load impact was calculated by dividing by seven to result in 94,843 kW (94.8 MW) of additional load shifted to the off-peak period.

3 - Impacts from electric water heating due to total decrease in number of on-peak laundry loads. The third set of calculations estimated the load impact associated with the reduction in the use of electric water heating for the total number of laundry loads done in the off-peak period as estimated in the previous calculations. The average wattage of an electric water heating element of 4.5 kW (as discussed above) was multiplied by the 12.7% saturation of electric water heating in New York to yield a net average wattage 0.57 kW that was used in the off-peak period per load of laundry. This value was further reduced to account for the estimated 30% of New York residents who do their clothes washing in cold water only (provided above). Applying the cold water only estimate resulted in an average per laundry load impact of 0.40 kW.

The total number of laundry loads done in the off-peak period of 4,813,960, as estimated in the previous calculations, was then multiplied by the 0.40 kW to result in 1,922,194 kW (1,922.2 MW) of water heating electric demand per week that is used in the off-peak period. The daily load impact was calculated by dividing by seven to result in 274,599 kW (274.6 MW) of water heating load shifted to the off-peak period.

4 - Total impacts due to decrease in number of on-peak laundry loads. The final calculation involves the addition of three previous load estimates to result in the total estimated load impact due to the number of laundry loads that have been shifted to the off-peak period. Adding the estimated daily load impact values of 249.0 MW, 94.8 MW, and 274.6 MW associated with clothes washing resulted in a total estimated electric load impact of 618.4 MW that was shifted to the off-peak period. An estimated hourly load shift was also calculated by dividing the daily load shift estimate by 12.

The calculation of estimated load impacts due to dishwashing that was shifted to the off-peak period was nearly identical to that of clothes washing with the exception of the adjustment related to washes done in cold water only. An analogous adjustment for dishwashing would have involved an adjustment for those who wash their dishes using the "cool dry" setting; however, there was no data available to estimate this and therefore, it was not included in the analysis.

Summary of kW Impact Assessment

The results reported in this section include the reduction of electric demand (MW) that is used between the hours of 7am and 7pm as a result of the Keep Cool marketing campaign. It is important to note that the electric demand values reported and discussed in this report reflect aggregated demand that has been shifted from the peak period of 7am to 7pm to the off-peak period of 7pm to 7am. Therefore, the MW values included in this report do not reflect electric demand that has been saved, but, rather, demand that has been shifted.[4] However, the level of demand that is shifted at the time of system peak does offer a savings of peak coincident demand.

A summary of the impacts estimated from those who shifted their clothes washing and dishwashing to the off-peak period of 7pm - 7am as a result of the Keep Cool Tips Campaign is provided in Table 5. The hourly values shown in Table 5 present an approximation of the level of demand that could be saved at the time of system peak but are considered approximations due to the lack of information available concerning the time of day that the laundry or dishwashing was previously done.[5]

Table 5. Average Daily MW Shifted to Off-Peak Period (7pm - 7am) Due to 2002 Keep Cool Marketing Campaign

Action	Daily MW Shifted (12-hour aggregate)	Average Hourly MW Shifted*
Clothes Washing	618.4	51.5
Dishwashing	510.6	42.6
Total	1,129.0	94.1

*Note: Because survey results were only available at the weekly level, hourly values should be considered approximations.

While there are likely to be further impacts related to load shifting as well as energy (kWh) saved as a result of the Tips Campaign, such as those related to the increase in ownership of ENERGY

[4] There are very significant differences in costs both directly, and indirectly to all ratepayers, for demand during peak times that cause additional, and often more expensive, power plants to be called upon. Shifting that demand to off-peak times decreases the need for these additional plants to be operating, more fully utilizes the plants that are operating, and, thereby, lowers the peak hour prices to all consumers of peak power.

[5] Hourly values were calculated by equally distributing the daily aggregated MW values over the 12-hour peak period.

STAR appliances, there was insufficient data available to reasonably estimate such impacts and to ensure that these estimates would be net of other **New York Energy $mart[SM]** programs. These impacts may be captured in the savings estimates for these other programs, but it should be recognized that the Keep Cool Tips Campaign appears to have helped accomplish those gains.

In designing the 2003 Keep Cool Tips Campaign survey, NYSERDA has added more detailed questions, such as what specific ENERGY STAR appliances have been recently purchased, so that additional impacts can be attributed to the Keep Cool Tips Campaign effort. In addition, in order to better approximate the impact of clothes washer and dishwasher load shifting on the system peak demand, questions relating to typical washing times prior to shifting and weekday versus weekend behaviors have been added.

Conclusions

Advertising campaigns can have significant impacts on energy efficiency and load shifting activities. However, few studies have taken the necessary steps to quantify the impacts of marketing campaigns. Without the detail needed to quantify the impacts of advertising, advertising is often under-invested in energy efficiency programs. The **New York Energy $mart[SM]** Program, however, places high priority on advertising efforts. An important part of assessing the value and investment of these efforts is to determine their capability to drive behavioral changes. Conducting the necessary research and performing the necessary calculations to determine quantifiable estimates for energy savings, or in this case, the amount of load shifted, can attempt to accomplish this goal.

The baseline and follow-up surveys were constructed to determine advertising-induced behavioral changes and to obtain the detailed behavioral information necessary to calculate demand shift impacts potentially attributable to the Keep Cool marketing campaign. The importance of this type of evaluation on marketing campaigns will prove valuable to other energy efficiency agencies and organizations that conduct marketing campaigns.

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