



Impact of Mysa Smart Thermostat on Energy Savings: Analysis of 138 Utility Bills

Mysa is a smart thermostat designed for electric heating and is compatible with most high voltage electric baseboard or electric fan forced heating systems.

The device provides users with a more efficient means of heating usage which promotes usability and remote operation. This technology is designed to create substantial energy savings and efficiency quantified objectively in this paper.



The study initially compares 138 customer utility bills before and after installation of the Mysa Smart Thermostat. The purpose of the study was to assess the impact on electricity bills after replacing a traditional mechanical or programmable thermostat with the Mysa Smart Thermostat. The study was carried out using a voluntary sample of 29 customers across the United States and Canada. An email was sent to recruit a pool of study participants from existing customers using the Mysa Smart Thermostat. These customers then provided their historical power usage information.



The resulting energy savings showed a 17.78% decrease in electricity use in homes with electric baseboards controlled by Mysa. To ensure the accuracy of the information and analysis, the following limitations to the study have been identified: i) lack of consistent and predetermined study timeframe, ii) minimal sample size, and iii) data collection difficulties. It is also important to note that significant variations in savings can exist from home to home depending on homeowner behaviours and habits, including choice of temperature setpoints [2]. Other factors affecting energy use include appliances, seasonality, weather, geography, and changes in occupants or economic conditions [3].



Mysa is committed to helping the world become more sustainable through energy efficiency and conservation. The importance of sharing the energy saving results of our innovative technology is an integral part of this mission.

Background

Up to 60% of residential electrical energy is controlled via a thermostat, whether it be a traditional analog, programmable, or smart thermostat. Traditional thermostats require manual adjustment on a daily basis to maintain setback temperatures and realize energy savings, such as turning the thermostat down at night or when not at home (“setback”). Programmable thermostats require proper configuration in order to maximize savings [2]. Studies have shown that people do not have the confidence or motivation to overcome their problems with programmable interfaces to actually program the devices and are therefore not using them effectively [3]. Only roughly 30% of programmable thermostats actually use a schedule or programming features. These findings are responsible for the rescinding of the ENERGY STAR designation for high-voltage programmable thermostats in 2009.

The adoption of smart thermostat technology by consumers allows user-friendly control through a web, mobile, or voice platform and bolsters energy savings through additional features like geofencing, control of multiple zones, scheduling, and energy consumption monitoring in real-time.

User behavior is a significant factor in the context of energy efficiency, which is influenced by both comfort and economy [2]. It is thought that smart thermostats encourage energy-conscious behavior by making it easy for users to control the temperature of their homes remotely with a wireless connection, and by giving them the ability to set schedules and vacation modes. To give some perspective, 100% of the participants who took part in this study had an active schedule set for their smart thermostats. Generally speaking, in 2011, 30% of American households had installed programmable thermostats. Of this number, 56% of those homeowners always program their thermostat, 32% sometimes program them, 9% never program them, and 3% do not know how [3]. Additionally, studies have found that there are no significant savings between households using programmable thermostats compared to those using manual thermostats [1]. In contrast, 100% of the households participating in this study had a schedule set and were actively using it.

Comparison of user electricity usage before and after installation of the Mysa Smart Thermostat forms the basis of this white paper, which empirically evaluates the energy savings achieved by a sample of customers.



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Evaluation Methodology

The primary component of this evaluation was a billing analysis which was performed to assess the impacts of Mysa Smart Thermostats on energy usage in electric home heating - the main goal of the study. Power bills were collected from a volunteer sample of Mysa customers which reflected their energy consumption and costs for a period of time before and after the installation of their Mysa Smart Thermostats. The use of voluntary participation among Mysa customers does introduce a factor of participation bias. However, the main goal is to assess the energy savings that can reasonably be achieved by installing Mysa Smart Thermostats to enable easier modification of behaviour. The process for comparing energy consumption must acknowledge that the period before thermostat upgrading may have been warmer or colder than the period after. This consideration leads to the methodology described below.

First, the data from the energy bills was assembled and grouped into two date ranges; "Before" and "After" Mysa installation. To account for the fact that energy consumption varies with the weather, the concept of "Heating Degree Days" (HDD) (For more information, visit <http://www.degreedays.net>) was used to measure the amount of energy used to heat a building while taking into account the outside temperature and conditions. A weather station was selected as close as possible to each Mysa user's home in order to give an accurate representation of the weather in each location. These data points were used in calculating the appropriate HDD for each meter reading. A comparative baseline temperature of 18.5°C (65°F) was chosen as a representative fit for the residential samples in the study. The baseline temperature, put simply, is the outside temperature below which the building will require heating (<http://www.degreedays.net>). Using the base temperature and degree day regression model, it was then possible to summarize the usage and savings across the participant homes in a normalized way, as illustrated in the following equation:

$$\{ 1 - [(\text{Energy Use/HDD})_{\text{After}} / (\text{Energy Use/HDD})_{\text{Before}}] \} * 100 = \text{Percent Savings}$$

In order to accurately estimate the energy savings of participants, it was also important to account for usage changes which were not related to thermostat upgrades or weather changes. For example, savings may vary by participant demographic, changes in occupancy patterns (people moving out or in, vacations, working from home, etc.), and/or housing characteristics (physical changes to the house or appliances). This prompted a closer look at some notable results, specifically savings values which were found to deviate from the median by a significant margin. After a standard deviation analysis, savings found to be in excess of 40% or below 16% were flagged in order to determine if any occupancy or other changes had occurred during the time period of this study. Based on participant responses to inquiry, it was then possible to determine if the data provided to Mysa was reliable for inclusion in the analysis.

Some users place a higher value on the physical comfort over the energy savings provided by Mysa. For the purposes of this study, two customers who have specifically noted that their Mysas are used for improved comfort have been omitted. Being that energy consumption was not important to them, their savings are not representative of the overall potential savings incurred by installing a smart thermostat.

In addition, it was also important to consider the percentage of the total square footage of the home for which the heat was being controlled by Mysa. If the heating systems of the home were primarily controlled by other types of thermostats, and Mysa controlled less than a third (33%) of the entire space, the ability to determine if Mysa was responsible for changes in energy consumption is dubious. Therefore, the upper limit of the findings for savings did not include homes for which control of heat was primarily by other means than a Mysa (>66%).

For each bill, the energy use was calculated for each equivalent HDD. The energy use for time periods before Mysa install were added together and divided by the number of HDD for that period to give a measure of the energy use before install. The same procedure was then applied to the time periods after Mysa install. The difference between these two weighted averages gave the overall average savings per home.

The final sample size for the electric heating analysis was 18 homes dispersed throughout the continental US and Canada in 3 provinces and 5 states. The distribution of samples was fairly even between the two countries, with Canada making up the majority at 56%. The most common province was Quebec (28%), followed by British Columbia (22%), while the most common state was Washington (17%) followed by Colorado (11%).

Findings

The analysis showed an overall reduction in electric energy usage after Mysa installation of between 12% and 17%, for the majority of homes, equal to about 475 to 750 kWh/year per home. On average, homes used 3.83 kWh per HDD before installing Mysas and observed a 17.78% drop to 3.15 kWh per HDD after installing Mysas (figure 1). All homes but one showed energy savings after installing Mysas with energy savings percentages ranging from 1-2% to 50% or more (figure 2). All of the homes in the study had at least 3 Mysa Smart Thermostats, with 4.4 being the average number of Mysa Smart Thermostats per home. We have not estimated the dollar savings due to the wide variation in regional energy prices which are also subject to change over time.

These findings illustrate changes in energy usage that can be observed to have taken place after the installation of the Mysa Smart Thermostat. However, there are several other factors which influence these results which are unrelated to the Mysa Smart Thermostat. Instances where energy savings exceeded 40%, or instances where energy consumption actually increased, can be due to many other changes which might have occurred during the timeframe of the observed power bills.

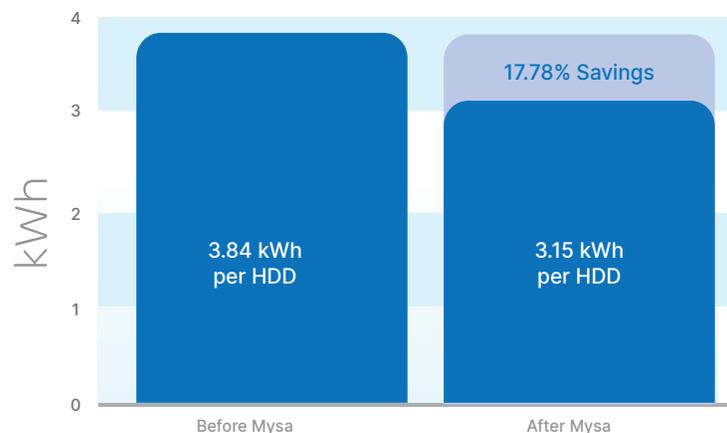


Figure 1: Average energy savings per household per country.

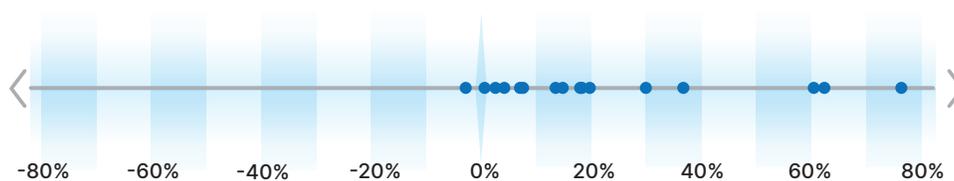


Figure 2: Linear representation of savings percentages per home.

Study Limitations

This study was observational in nature and used a relatively small sample size to represent the overall population, so random usage variations cannot be assumed to average out. Some homes may have experienced an increase in energy usage after Mysa installation, while others may have experienced a larger than expected decrease due to occupancy or retrofit factors as described above.

Conclusions and Recommendations

Ultimately, this paper serves to quantify the energy savings achieved through installation of the Mysa Smart Thermostat. This is done by using a regression analysis which accounts for external weather effects on the results through the use of a normalizing coefficient known as Heating Degree Days.

The findings indicate that most users can expect to save between 12% and 17% on their heating bill after installing Mysa Smart Thermostats to control more than one third (33%) of the heat in their home, all other things remaining equal.

There was no comparable control group used (eg. group of homes that had not installed the thermostat). Therefore, this white paper cannot account for general trends in changing energy usage related to changes in energy prices or other economic factors. Future analyses could incorporate an experiment with controlled variables, comparing identical houses over identical time frames, some of which have installed smart thermostats and others which have installed more traditional programmable and dial thermostats, in order to allow for a more direct comparison of savings.



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References

- [1] A. Meier, C. Aragon, T. Pepper, D. Perry, M. Pritoni, Usability of residential thermostats: Preliminary investigations. *Build. Environ.* 46 (2011) 1891-1898, <https://doi.org/10.1016/j.buildenv.2011.03.009>.
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