

## Summary of Research Findings From the Programmable Thermostat Market



EPA has gathered market and demographic information from market resources, manufacturers, utilities, and other industry groups to analyze market research data and to determine areas of improvement in the specification. In speaking with manufacturers, EPA has found the conversations to be very fruitful and has raised key issues to be addressed within this proposal. Below are some highlights from EPA's preliminary research on these key issues.

EPA's research identified several themes and key qualities that are thought to form the basis for a challenging and valuable ENERGY STAR specification. These qualities can be summarized as follows:

An ENERGY STAR qualified programmable thermostat must:

- 1) Be differentiated in the marketplace by its performance;
- 2) Not sacrifice quality or performance;
- 3) Save users on their utility bills regardless of different geographic regions and dwelling types;
- 4) Be cost-effective to recover their investment in a reasonable time period;
- 5) Not specify specific technologies to implement features and;
- 6) Levels that can be measured and verified with testing.

### **Programmable Thermostats Offer Untapped Potential**

According to the Energy Information Administration (EIA), energy costs for heating and cooling together comprise about 42% of consumer home energy expenditures, on average. Yet much of this energy expenditure seems to be used for space conditioning during times that the home is unoccupied or occupants are sleeping. Therefore, these "unoccupied" periods represent an often-untapped opportunity for reducing home energy consumption. Twenty-five million households currently have a programmable thermostat. To date, 91 million households use thermostats for their home heating, and many of these households offer a market opportunity for programmable thermostats. Sales of programmable thermostats have doubled in the last 10 years. With this increase in market penetration comes the need to address consumer usability issues to aid in future potential energy savings for consumers.

### *Demographics*

Through its research, EPA has found that among households using thermostats for heating, it is estimated that about half of all households (49%) usually do not have someone home during the day.<sup>i</sup> However, during the winter, less than half (42%) of households report turning the heat down and only 2% completely turn the heat off. A slightly higher percentage of households reported turning the heat down (46%) or off (6%) during sleep hours.<sup>ii</sup> The question remains as to why such a large proportion of households do not appear to be adjusting their thermostats according to occupancy. EPA has identified several striking demographic patterns in reported setback practices.

For example, Californians turn back their heat at a more substantial setback than the national average and those in the coldest regions turn back their heat at lower rates than the national average. Further analysis of these patterns and underlying behavior may provide valuable insight to consumer practices and the potential for modifying these patterns.

### *Savings Estimates*

Consumers are often advised that installing a programmable thermostat can save them anywhere from 10 to 30% on the space heating and cooling portion of their energy bills. While reliant on proper use of the programmable thermostat, such savings are easily true in theory; however, there needs to be more field-tested data to better substantiate savings claims. Analyses from recent field studies have suggested that programmable thermostats may be achieving considerably lower savings than their estimated potential. In particular, a study from the Energy Center of Wisconsin showed no statistical difference in heating intensity among their sample of single-family houses when comparing households with programmable thermostats and those without. These studies suggest that, in practice, programmable thermostats may often not be saving the 10%-30% as claimed. However, findings from the Wisconsin study are not conclusive and the research itself has some shortcomings (e.g., consumers were using an older generation of programmable thermostats). A variety of statistical and anecdotal evidence indicates possible reasons as to why discrepancies between predicted and actual savings may exist. In particular:

- 1) Many households (perhaps 30% or higher<sup>iii</sup>) with programmable thermostats may be unable, unwilling, afraid,<sup>iv</sup> uninterested, or otherwise reluctant to deploy default programs or to create or deploy custom programs;
- 2) Many households (about 50%<sup>v</sup>) set back or set up their thermostats manually, thus leaving less savings possibilities to be garnered by a programmable thermostat;
- 3) The automatic program used with the thermostat may not be any more conservative than use of manual thermostats setback or setup by hand;
- 4) Many consumers have mental models<sup>vi</sup> of heating and cooling that lead them to believe they will not save energy from setting up or setting back other than long periods of time.

By better understanding and addressing these issues, manufacturers may be able to increase customer satisfaction and market share, while legitimately claiming substantial savings achievable from using programmable thermostats as prescribed.

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<sup>i</sup> This rate varied modestly across census division and house type; larger variations are found amongst various demographic groups, in predictable ways (e.g., rates are somewhat lower, about 33%, for low-income households and households with older householders).

<sup>ii</sup> Based on 1997 RECS.

<sup>iii</sup> This estimate is based on four sources: preliminary 2001 RECS data; LBNL analysis of 1997 RECS data using adjustments to correct for apparent over-reporting of presence of programmable thermostats; a report by Decision Analysts, Inc.; the aforementioned study by Pigg & Nevius (2000). The RECS data, at least, is self-reported, and none of this survey data can provide much guidance on consistency of use or accuracy of reported use for any case. That is, real consumer thermostat use and temperature set point patterns may often be far more complex than can be captured in one or a few questions on a survey.

<sup>iv</sup> See, for example, Nevius & Pigg (2000), "Programmable Thermostats That Go Berserk: Taking a Social Perspective on Space Heating in Wisconsin." Proceedings of the 2000 ACEEE Summer Study on Energy Efficiency in Buildings: Washington DC, pg. 8.233-8.244.

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<sup>v</sup> As the Energy Center of Wisconsin study suggests, the installation of a programmable thermostat does not translate into more conservative thermostat management regimes.

<sup>v</sup> Willett Kempton. 1986. "Homeowner's Models of the Heating System and Heat Loss Effects on Home Energy Management." Proceedings of the 1986 ACEEE Summer Study on Energy Efficiency in Buildings. American Council for an Energy Efficient Economy. Washington DC. Volume 7. pp. 134-145.

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