UNIVERSITY OF WATERLOO

Goal-setting for Residential Electricity Conservation

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Purpose

To report the early findings regarding the extent to which households were able to use goal setting tools to empower their electricity decision making and thus to achieve electricity conservation. The effects of this goal setting tool on households' electricity consumption are revealed by exploring:

a) the goals the households set and how they adjusted them throughout the month;
b) how households' actual electricity consumption compared to these goals; and
c) the householders' level of engagement with the tool.

Literature

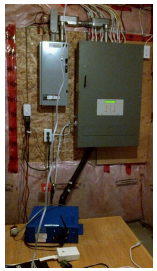
Electricity is embedded in daily behaviours and routines; as a result, it is used unconsciously and becomes invisible, resulting in a lack of awareness about electricity consumption.[1, 2] Providing households with details about their electricity consumption can help to increase awareness, help make electricity more visible, and has the potential to facilitate conservation behaviours.[3, 4]

Goal-setting can advance electricity conservation. Once the goal is set, goal related feedback should be provided to achieve optimal results.[5, 6]

According to Locke & Latham (2002), goal setting is effective because a goal acts as a motivator and encourages people to become more consistent with their actions; it directs attention towards the activity for which the goal was set; and it leads to the discovery and use of new information that can be used to achieve the goals.[7]

Abrahamse et al. (2007) found that when a goal of 5% was set – and when tailored information and feedback were provided – households reduced their electricity consumption by up to 5.3% over 5 months, as compared to the control groups whose electricity consumption increased by 0.7%.[5]

Giving specific, task-level goals, rather than simply telling a person to "conserve electricity", helps the individual focus on the task at hand, leading to better performance and realization of the goal. [8, 9] Also, increasing goal difficulty increases effort to achieve goals.[6, 7]



Energy Hub Management System

This project involves monitoring the electricity consumption of 25 homes from Milton, Ontario, located in the Halton Region of Southern Ontario, and is part of a larger project (the Energy Hub Management System (EHMS) project). The purpose of the EHMS is to "develop and to implement an Energy Hub Management System that will allow static energy users to manage effectively their energy requirements. More specifically, [the EHMS] project will empower energy hubs – that is, individual locations that require energy (e.g., manufacturing facilities, farms, retail stores, detached houses) – so that they can contribute to the development of a sustainable society through the real-time management of their energy demand, production, storage and resulting import or export of energy". [10]

The Webportal

The webportal that is used in this research is an online tool that householders can log on to from any computer with internet access, and from which they can view their consumption data.

Functions of this webportal include:

- House-level and appliance-level data
- The ability to view historic and real-time data
- The ability to view data in kilowatt-hours, dollars or carbon dioxide emissions
- The ability to view data hourly, daily or monthly
- Goal setting tool

In order to gather these data, 17 homes have been outfitted with smart electrical panels and eight homes with energy consumption monitors.

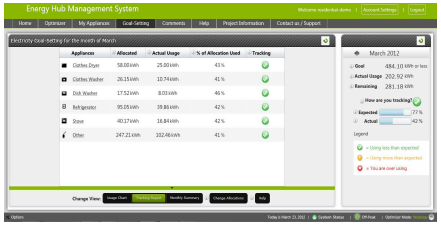


Figure 2. Goal Setting Page
Screenshot of the goals for each appliance in kWh, and the actual usage in kWh and as a percentage of the goal. It also shows whether or not the household is on track to achieve their goal.

Figure 1. Appliance Level Data
Screenshot of the electricity consumption for a hub as a function of the individual appliances, where each bar represents one day, and each colour represents a different appliance.

Goal Setting

This tool allows the householders to set a monthly electricity goal in dollars, kilowatt-hours or carbon dioxide emissions for each appliance and the dwelling as a whole.

The initial goals for each household are based on Ontario values for the size and demographics of an average home.

The household's goals for month n are set based on the total consumption for month n from the previous year and on the distribution of goals from month n-1.

The hub goal for month n can only be changed by the household during the last week of month n-1, while the distribution of this total amount can be re-distributed among appliances at any point during month n.

Household Profile: A Sample of Goal Setting Use

Hub goal increased by 29%, so goal for each appliance increased by 29% and the proportions stayed the same

	System Suggested Goals (kWh)	Self Set Goals (kWh)	Actual Usage (kWh)
Clothes Dryer	57	73	110
Clothes Washer	24	31	7
Dishwasher	24	31	25
Media Centre	24	31	51
Microwave	28	37	3
Refrigerator	28	37	39
Stove	38	49	30
Other	250	323	277

Month	System Suggested Goals	Self Set Goals	Consumption
December	500 kWh	Hub total stayed the same; appliance distribution changed	610 kWh 20 kWh/day
January	610 kWh	n/a	592 kWh 19 kWh/day
February	444 kWh	620 kWh	579 kWh 20 kWh/day
March	473 kWh	610 kWh	542 kWh 17 kWh/day

Increased clothes dryer by 5 kWh; increased stove by 5 kWh; decreased 'other' by 10 kWh

Monthly and daily decrease

Monthly decrease, and daily increase

Monthly and daily decrease

Role of confounds? Weather, season, shift work, more/fewer people in the dwelling, addition/removal of appliances, etc.

Household Profile

- Three-person household: two adults and one child under the age of 5
- House size: 2500-2999 square feet
- High level of webportal engagement (on average at least once a week)
- Low level of electricity consumption (below the provincial average of 800 kWh/month)

Household use of the webportal and responses to a project survey suggest:

- They are unsure of how much electricity their appliances consume, these costs, and the carbon impact of the same
- They believe that conservation is important, and they make a modest attempt to conserve
- Their motivations to participate in the EHMS project are to save more money, to reduce electricity consumption and to learn about the electricity consumption of individual appliances

Next Steps and Conclusions

In the short-term, there will be continued investigation into the households, and how they are setting their goals, and whether or not their goals are being attained. There will also be further investigation into the relationship between webportal engagement and goal setting, specifically seeking to investigate how engagement with the webportal affects how households set their goals, monitor those goals and whether or not they attain these goals.

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