Collective Power: Social Pressure for Energy Conservation

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Abstract

Stemming from the assertion that electricity use habits can be seen not only as individual activity but also as social activity, our team sought to invent a public-realm data visualization device capable of organizing neighbors into small "energy collectives" where each member would be mutually vested in the others' electricity usage. In this system, information for physically adjacent buildings is posted on nearby lamp posts in a vertical meter-like light display that can be viewed for long distances on the urban scale at night. More detailed information about individual participants in the energy collective is provided through an iPhone application accessible through a projection from each pole, enabling members of the public and the collective to improve their energy use habits.

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ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Social Pressure as Incentive

Most innovation in the realm of personal electricity conservation has related to the display of information regarding energy use, but psychologists have suggested that other methods -- besides the display of information on, for example, electric bills -- are necessary to make the incentives for "conservatory behavior" more effective [1]. While logically clear that the first step to energy conservation is the provision of information (one cannot improve behavior without first knowing one's own faults), the attendant behavior shift stands to be increased by other means, more the purview of psychological rather than informational strategies.

Numerous programs have been catalogued which effectively employ the use of small social groups to affect positive change in behavior where other methods have failed [2]. In one example, the mandatory use of clear trash bags employs the use of peer pressure, though without creating a well-defined and structured group. The idea is that by requiring residents to bag their trash and recyclables into clear trash bags (rather than opaque ones), the diligence of their recycling habits will be on display to their neighbors. Anecdotally, clear bag programs are a common way to encourage higher rates of recycling, and they are cited as contributing to large increases in short periods [3], though we were unable to find a centralized study of their efficacy.

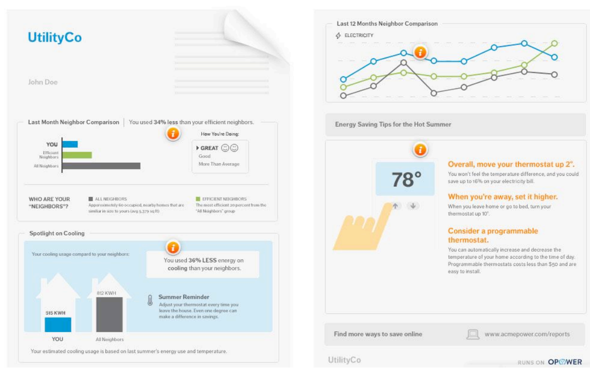

Figure 1. Oopower screenshot.

There is also some precedent for treating energy use as a social behavior. Opower, Inc, is a company which performs statistical analyses of usage data for residential customers, so that individual users can be informed not only of their total usage (kWh), but of their standing relative to their peers (Figure 1). This "social standing" information is conveyed to customers, however, in the private sphere: it is included on a separate report with electricity bills [4]. Even with such a minimal intervention, Opower reports consistent improvements in electrical usage habits [5].

Project Description and Scope

Our project seeks to give this comparative information a public dimension (and to make the social incentive of neighbor-comparison that much more forceful) by displaying it on existing localized infrastructure: street lamps. Our design is intended to introduce a kind of "urban energy use icon" which could become recognizable as indicating the collective energy use of nearby residents. Its primary display, a vertical bar of lights which either shows a low, green value (low electricity use) or a high, red one (high use), indicates how a group of adjacent residential buildings compare to the city's average; the display changes on a weekly basis, giving neighbors time to see how shifts in their habits might influence their group's ranking against the norm. For more detailed information including live information about grid load and a breakdown of electricity use by unit (measured per capita), pedestrians and group-members can scan QR codes in a projection on the ground under the pole.

Ultimately, three pieces of data were seen as necessary to provide the necessary information and incentives on an urban scale:
1) How a particular small group of adjacent neighbors compares to other groups
2) How individual participants compare to each other
3) The real-time load on the grid

The one-week time frame was seen as offering a good balance between longer and shorter possibilities. Shorter time frames might make short term “spikes” visible, and longer time frames might make improvement of personal habits daunting.

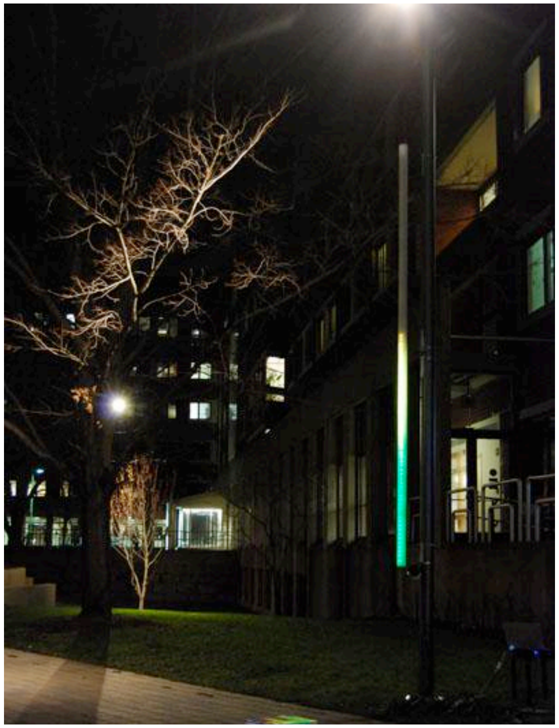

Figure 1. Collective Power prototype, installed at MIT.

Limitations

The central notion of peer-based social pressure being used for improved energy habits has some limitations, and our particular implementation has others. In total, we see the project as specific several ways:

1) Urban density. The number of units per street lamp must make for an appropriate group size, ideally 10-40 units. Higher densities (such as in New York City) would mean that each lamp post displays the energy habits of hundreds of people. High densities could lead to unmanageably large groups. Lower suburban or rural densities might be so low as to have only one member per pole, leading to a public celebration or scolding rather than group-pressure enactment. Thus, we designed the project for low-rise mid-density residential developments, such as those encountered in Cambridge, MA.

2) Opt-in. In order to succeed, the project would require participants to opt-in. An opt-in procedure would make sure that everyone knows what the street lamp is displaying, and their role in it. Not everyone would need to participate in order for the program to be successful. Though no usage information is attached to particular units from the public’s view, group-members are able to identify specific neighbors’ energy usage from the detailed projection display.

3) Residential only. The key concept is that the public display shows apples-to-apples comparisons rather than difficult to understand values, such as kWh. Since it can be very difficult to understand how a commercial building or a hospital would compare to other buildings, Collective Power engages only residential customers who are able to make changes to their energy habits in response to each other.

4) Daytime only. Since our display is a light display, it is useful only at night. Given that the project was already limited to residential uses, we felt this to be an

acceptable compromise, though other versions of the project might include other display choices which would make data such as the current pricing of electricity more usefully accessible.

Execution of the Prototype

The main vertical display bar consists of two strands of Phillips ColorKinetics individually addressable LEDs. These LEDs are fitted within a custom laser-cut plexiglass strip to position them within approximately 1.5″ of each other, and slipped inside a 3″ o.d. plexiglass tube with frosted adhesive material applied to the exterior for light diffusion. The LEDs are powered by a PDS-60ca power supply plugged into a standard house current, and driven through an ethernet connection to a laptop running Rhino, Grasshopper, and Firefly. Firefly is used to read the data file in a CSV format, and display it as blended colors in the individually addressable LEDs. The ground projection, powered by a PICO projector, is an animated processing sketch which reads data from the same CSV file, displaying a broken down version on a per-unit basis as well as the current grid load. The projection contains a series of QR codes which link to an iPhone application (also executed), which is able to provide even more detailed information to those who scan the codes.

It should be noted that our prototype data is based on a single, static CSV file, but that in reality data would be real-time and collected directly from smart-grid connected residential units adjacent to the lamp post..

Conclusions

Collective Power seeks to implement at the prototyping level a new class of data visualization that is not only informative, but actually able to incite individuals to change social habits for the better. As such, it is a provocation whose efficacy would certainly need to be tested. The prototype itself has several limitations in terms of its packaging and inclusion of expensive electronics, but the team feels that these limitations could, with further development, be overcome. Its conceptual limitations bear more consideration. Another round of design work could reveal, perhaps, a device that might be more broadly deployed across urban and suburban space, or which would be useful 24 hours a day. The team believes the fundamentals of the small-group social incentives to be strong, however, and that the functional prototype engenders these concepts well.

Acknowledgements

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References

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[4] http://www.usatoday.com/money/industries/energy/2010-02-01-homeenergy01_ST_N.htm

[5] http://opower.com/utilities/results