

Proposed Agreement between California Energy Commission and Stanford University

Title: Large-Scale Energy Reduction through Sensors, Feedback & Information Technology
Amount: \$500,000.00
Term: 32 months
Contact: David Weightman
Committee Meeting: 9/1/2010

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
10	Electric	Buildings	ARRA	\$1,520,000	\$500,000	\$500,000	33%

Recommendation

Approve this agreement with Stanford University for a 27 month, \$500,000 cost share grant to supplement the contractor's American Recovery and Reinvestment Act of 2009 (ARRA) award. In round 1, DE-FOA- 0000065, Stanford University was awarded \$5,006,011 in DOE ARRA funds and Stanford University is providing \$790,000 in additional match funding to conduct research and on intervention strategies that will induce end-user energy efficiency behavior. The total budget for the project is \$6,296,982.

Issue

Occupant behavior is an important factor in achieving energy savings in buildings. No matter how well a building is designed and constructed to achieve energy efficiency, choices and actions taken by the occupants will always have an important effect on how much energy is consumed. At present, why people make the choices they do, and how to influence those choices in the direction of lower energy consumption, is little understood. Therefore understanding choices and behavior is a key and largely uninvestigated research topic in energy efficiency.

Much more energy information will soon be available, accentuating the importance of human behavior in determining technology success. Current practices to produce energy reductions and shifts through behavior change are mostly limited to marketing (efforts which are difficult to measure as described in the previous paragraph) and rebates/coupons (these programs are implemented to satisfy the high burden of proof required to link a program to its behavioral effects).

Currently, program evaluation measures intermediate proxies for behavior, such as attitudes, which are poorly correlated with actual behavior. This project's information platform would transform program evaluation by knowing who was exposed to what programs, and objectively measuring their specific energy reductions and shifts. This has not previously been done because high resolution sensor data was not available, and now that it is becoming available, no one has yet produced a platform to quantify energy savings for such purposes.

Background

Federal Funding

Under the provisions of the American Recovery and Reinvestment Act of 2009 (ARRA) and the Advanced Research Projects Agency - Energy (ARPA-E) DE-FOA-0000065, Stanford University was awarded \$5,006,001 to conduct research on a system of initiatives that combines behavioral techniques with human-centered design, computation and technology to affect energy behavior. The total budget for the project is \$6,276,982. This total includes \$500,000, that Stanford University must provide to meet the 20 percent cost share requirement set by the United States Department of Energy (DOE). The DOE award to Stanford University was established as a cooperative agreement with a performance period from January 1, 2010 through March 31, 2012. (3) Stanford University developed the project's scope of work and 27 month timeline based on the ARPA-E stated requirements for project performance periods of no more than 4 years.

CEC Cost Share

Stanford University submitted an application to PIER for cost share funding under PON-09-002, Addendum 7, for their ARRA FOA-0000065 project and seeks \$500,000 to use as 10 percent of the required cost share and will self-fund the remaining 10 percent of the project costs to meet the required 20 percent cost share.

The research will take approximately 2 years and 3 months to complete as a result of the extensive monitoring, collection and analysis of field data. (6) According to Kat Shoa of Kat Shoa consulting some studies have measured the effect of feedback on conservation; the reported variance [from the data collected from the studies] of "negative to 18 percent" conservation based on feedback is too high to substantiate actionable results. The same studies showed that "feedback provided in conjunction with dynamic pricing can have an incremental effect on peak reduction in the 0 to 2 percent range... However, a recent study by Boston Consulting Group found that "the majority of consumers surveyed are willing to tap into the information from smart meters to conserve energy." Of additional importance relevant to this proposed program of projects, behavioral experiments have only rarely been performed at [large] scale (Bandura, 2004) and these studies have only evaluated single interventions.

Proposed Work

Stanford researchers will create a common infrastructure for measuring the effect of energy use related behavior intervention strategies that includes installing energy sensing devices in a group of test-bed homes, establishing a shared web client for assessing client responses to energy information, standardizing energy use metrics and sharing common software, databases and computing services to conduct large-scale field research.

Using this common infrastructure, the effects of technologies, policies, community education and media campaigns (interaction design, social networking, games and feedback interfaces) will be assessed to determine their individual and synergistic influence on energy use behavior by individuals and households.

Summarizing, this proposal will: (I) create of an information platform for experimentation and data collection, (II) create a set of interventions and supporting work aimed at promoting energy reductions in households, and (III) inform prescriptive engineering and economic models. Through the platform, the effectiveness of interventions can be evaluated quickly, easily, inexpensively, and at scale. This is possible for two reasons: (1) automatic generation and tracking of experimental manipulations is enabled because the interventions are implemented in electronic media such as an internet sites and mobile applications, and (2) objective measures of behavior change are collected automatically by sensors and aggregated in databases. The behavior change interventions will be implemented through the platform, and explore whether the platform can be adapted for similar larger scale use.

Stanford is supported intellectually by the Precourt Institute for Energy, a new organization that organizes researchers across campus to solve energy problems, and the Human Sciences and Technology Advanced Research Institute, which takes an interdisciplinary behavioral science approach to studying the intersection of humans and technology. With industry, Stanford University has formal collaborations with new companies building sensor technology, and has initiated projects with the Pacific Gas and Electric Company and Google to collaborate on energy feedback field trials.

Justification and Goals

This project "[will develop, and help bring to market] increased energy efficiency in buildings, appliances, lighting, and other applications beyond applicable standards, and that benefit electric utility customers" (Public Resources Code 25620.1.(b)(2)), (Chapter 512, Statues of 2006)).

This will be accomplished by:

- studying, expanding, measuring and improving the understanding of consumer preferences for technologies and programs intended to motivate energy efficient behaviors and energy efficient appliance purchases by consumers and households.