

# CALPLUG STARTS RESEARCH ON SMART SET-TOP-BOXES TO SAVE CALIFORNIA \$455 MILLION ELECTRICITY BILL

---

## Abstract

***California Energy Commission has funded a research project aimed at reducing electricity use in set-top-boxes (STB). The California Plug Load Research Center at UC Irvine will lead this effort to demonstrate a “5W5s” set-top-box prototype that consumes less than 5 watts when nobody is watching TV, and wakes up in less than 5 seconds.***

*“Most people know that an old refrigerator or lights blazing in an empty room can run up an electricity bill. Not as many know that the new household energy hog is the growing number of consumer electronics, in particular, those boxes that serve as cable and satellite TV receivers. Ubiquitous in today’s media-centric homes, set-top boxes are always “on.” They can operate at near-full power, day in and day out, even when the consumer is not watching or recording a show. Set-top boxes are part of the “plug load” – devices that plug into an electrical socket – including cell phone chargers, televisions, computers, printers, tablets, digital video recorders, cameras and more. Alone, these items may not use much energy, but multiplied, they add up. The average household, which contained only four or five devices 20 years ago, now has as many as 50.”<sup>1</sup>*

Since the Energy Star program released Version 2.0 of its standard for set-top boxes (STB) in 2008, STB service providers and manufacturers have made significant improvements in reducing energy consumption. Recently, over 52% of the current STB sales (15 million units) meet the Energy Star 2.0 standard, and more than 48 models now meet Energy Star 3.0. Many service providers and manufacturers have been actively involved with R&D and deployment plans for more efficient STBs, as well as participating in a variety of industry or government recommended energy standards. More efficient integrated chips and circuit designs continue to reduce the overall power consumption during active operation; scalable operating power at chip and system level prevents unnecessary energy loss; technologies for peripheral components, such as hard drive and tuner, improve over each development cycle. This trend, if it continues, can potentially save America up to 15,000 GWhrs annually. The California Energy Commission believes up to 3,000 GWhr/yr of electric saving (equivalent to the annual output of an average 500MW coal-fired power plant) is reachable for the Golden State. That is a \$455 million electricity bill to save. However, even though new unit power usage is going down, older ones remain in service and the number of STBs per household continues to climb. Despite the recent 0.2% decline in total subscribers of the pay-TV industry, the baseline unit number will remain above 160 million, and the projected energy consumption will continue to be a concern.

Undoubtedly, STBs are still among the largest energy users in the plug load category, and there are technical and non-technical issues that may impede further power reductions. The popular pay TV service infrastructures, including cable and satellite, must maintain high quality and security of the multi-channel content delivered through the network. To introduce energy saving solutions, such as various sleep modes, one needs to consider the potential interference with user experience and upstream communication. And to subsidize the cost of upgrading and retrofitting existing systems, a

---

<sup>1</sup>Lori Brandt, Interface Magazine, Calit2 Irvine, Spring 2012

holistic incentive program is needed to combine split interests among utilities, manufacturers, service providers, and consumers.

In order to address this national concern, the California Energy Commission is looking to the California Plug Load Research Center (CalPlug), established last year and housed at UC Irvine, for leadership. The Commission has awarded CalPlug a research contract through its Public Interest Energy Research (PIER) program to support development of energy conserving solutions and industry standards for set-top boxes. CalPlug has been coordinating collaborations among stakeholders while conducting research activities, including design, prototyping, testing and acquisition of STB systems. CalPlug always seeks to work with all interested stakeholders for market viable technical solutions.

*“We know there is great potential for improving the efficiency of these boxes and reducing the cost of operating them,” explains Bradley Meister, a senior mechanical engineer at the Commission. “It was important to find a center that could stay on top of what is possible in energy efficiency and pull together the major players, as well as look at human behavior.”*

*CalPlug is currently measuring the power consumption of a variety of set-top boxes and exploring design alternatives to reduce energy use. Because two-thirds of the energy used by the boxes is consumed when they are off, researchers are looking at the potential of employing a light sleep mode and a deep sleep mode.*

*“The challenge is designing a sleep mode that quickly wakes up and reconnects, so the box can still receive updates from service providers and customers don’t suffer unacceptable interruptions of service,” says Arthur Zhang, CalPlug’s technology manager. “Our goal is to make design recommendations that achieve significant differences in power consumption, are feasible for manufacturers and are user friendly.”<sup>1</sup>*

### **CalPlug STB Research Roadmap**

In July 2012, CalPlug’s STB work authorization from the Energy Commission signaled the commencement of the 18 month period for CalPlug to develop and demonstrate a prototype of next-generation energy-efficient set-top boxes. A “*CalPlug STB Research Roadmap*” has since been proposed to coordinate the efforts in both technology advancement and industry coordination (Figure 1). This roadmap is in sync with the CEC work authorization and external roadmaps, such as the Department of Energy’s STB energy standard (effective 2018) and CableLabs’ cable STB specifications<sup>2</sup>. Inputs from CalPlug’s first STB workshop<sup>3</sup> participants also contributed to the timelines.

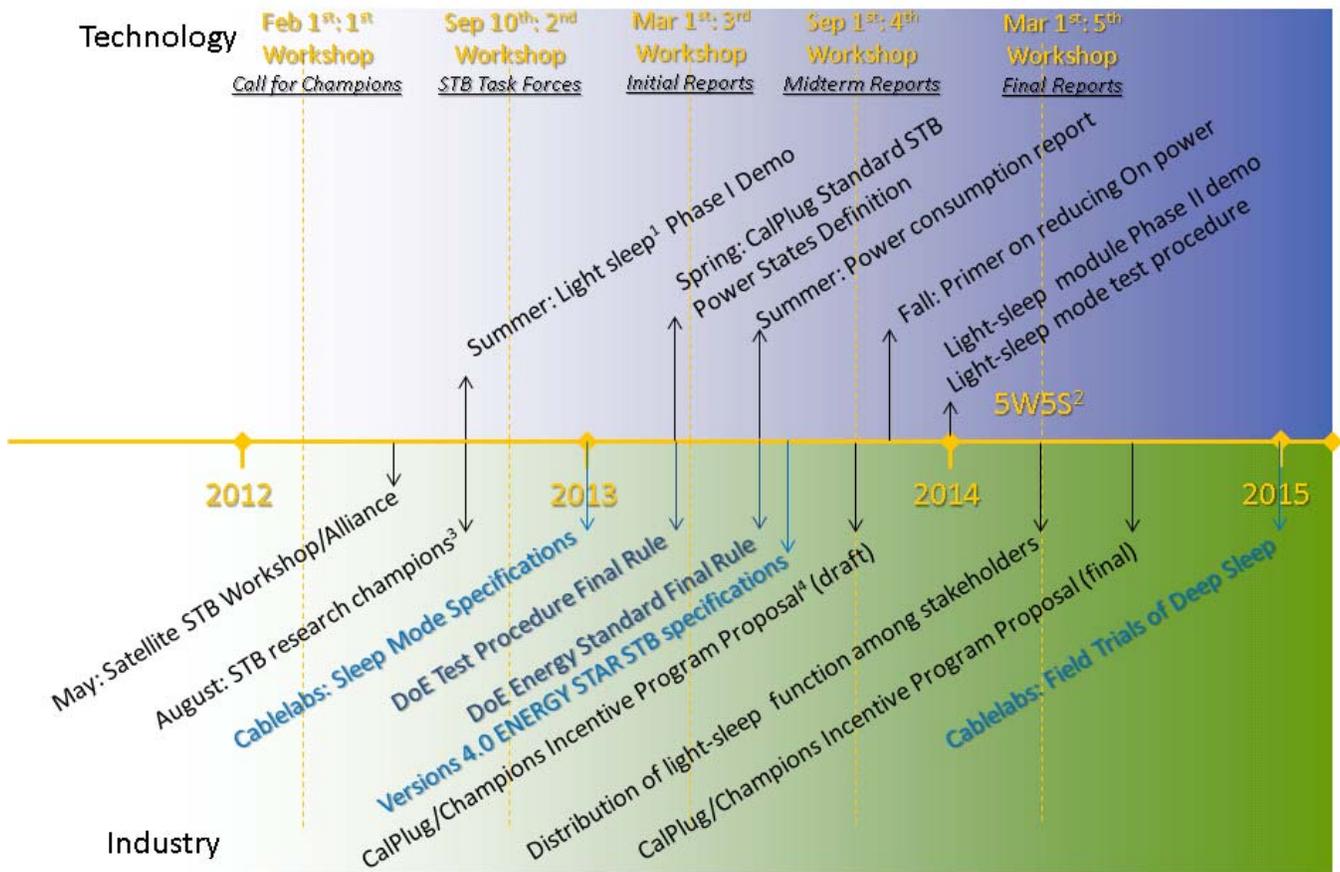
The technology advancement panel in the upper half of Figure 1 sets the goal of “5W5s” in Spring 2014, when the final prototype will be demonstrated using less than five watts of power during “light sleep mode” and less than five seconds to fully wake up. The system development will be delivered in two phases. A standalone STB power controller box will be implemented at the end of Phase I, an integrated solution to complete Phase II.

The industry coordination panel of the roadmap targets a proposal of incentive program by the end of Summer 2014 in order to facilitate the promotion and adoption of efficient STBs. A special task force comprised of content providers, service providers, manufacturers, and utility companies will be working with CalPlug to design and test the efficacy of the incentive program. The goal is to distribute among the stakeholders the costs and benefits associated with STB retrofit or upgrade plans.

---

<sup>2</sup> Cable Television Laboratories, Inc. (CableLabs®) is a non-profit research and development consortium.

<sup>3</sup> <http://calplug.org/index.php/outreach/set-top-box-workshop>



**Figure 1. CalPlug STB research Roadmap.** <sup>1</sup>. Light Sleep Mode: currently defined as a state when the STB has no application requested from the user and network for a defined period. <sup>2</sup>. 5W5S: 5 Watt power consumption during “light sleep” mode; 5 second wake-up time from “light sleep” mode. <sup>3</sup>. STB project champions: experts and leaders volunteered from stakeholder organizations to coordinate with CalPlug in research and communications. Champions will work with CalPlug from August 2012 to Jan 2014. <sup>4</sup>. STB workshop contents are subject to future changes.

To date, CalPlug has recruited eight “STB Project Champions” to engage with the five research tasks. The champions are experts and leaders volunteered from stakeholder organizations to coordinate with CalPlug in research and communications. Champions will devote their time to work with CalPlug during the 18 month period. Significant progress has already been demonstrated to CalPlug visitors, including Mr. Andrew McAllister, a commissioner of the CEC. The research tasks assigned to CalPlug under the new CEC contract are as follows:

**1. Standard terminologies, labeling and testing recommendations for STB power modes**

CalPlug will recommend a standard set of power modes to facilitate technical communications and consumer education. The objective is to have no more than four standard alternative operational levels for an STB, compared to the current mixture of existing terms, including “active”, “idle”, “light sleep”, “deep sleep”, “hibernation”, “shut-down”, “scalable power modes”, etc.

**2. STB power testing and analysis**

To acquire the first hand data, CalPlug seeks to generate a power consumption report for many currently available STB systems. The CalPlug team has been working with leading service providers from different categories to measure actual energy consumption in operational settings, using industry standard test methods. User volunteers may be introduced into the study of usage patterns. Under

mutual agreements and permissions, CalPlug also conducts open-box investigation on certain STBs, in order to perform preliminary design assessment.

### **3. Sleep function with fast recovery and conditional access**

CalPlug plans to demonstrate “light sleep” enabled STB platform in a laboratory environment. We will also explore hardware and software solutions to retrofit already-deployed STBs for the recommended “light sleep” function. Since restart/refresh time from sleep is critical to user experience, we will examine potential triggers from occupancy information and scheduled activities.

### **4. Incentive programs and consumer education**

This task focuses on the effective marketing of efficient STBs. CalPlug will assist the design of an incentive program based on studies of consumer behavior and adoption pattern, in collaboration with utilities and service providers. Besides rigorous comparison of cost sharing models, how to stimulate consumer awareness of energy efficient products and programs is also important.

### **5. Beyond STBs: additional functions**

CalPlug will work with the champions to investigate the various value-added features already being proposed for STBs, such as home energy management systems, home security systems and home telemedicine systems. Peripheral wired and wireless demand-response and power pattern recognition devices are also potential candidates for research. CalPlug’s role will be to ensure that these multi-function packages are energy savers rather than energy hogs.

## ***Conclusion***

The quest for efficient set-top-boxes has its unique risks and opportunities that go beyond technical solutions. This Energy Commission research is being conducted to demonstrate technical viability and generate support for potential adoption from all stakeholders. It is crucial for the CalPlug center to maintain active engagement with participating organizations through regular updates and workshops. The STB Project Champions play important role in technical advisory and communications. CalPlug’s STB research roadmap will continue to incorporate latest developments in both incentive program and codes and standards, while maintaining the ultimate target of “5W5s” STBs.

[www.calplug.org](http://www.calplug.org)