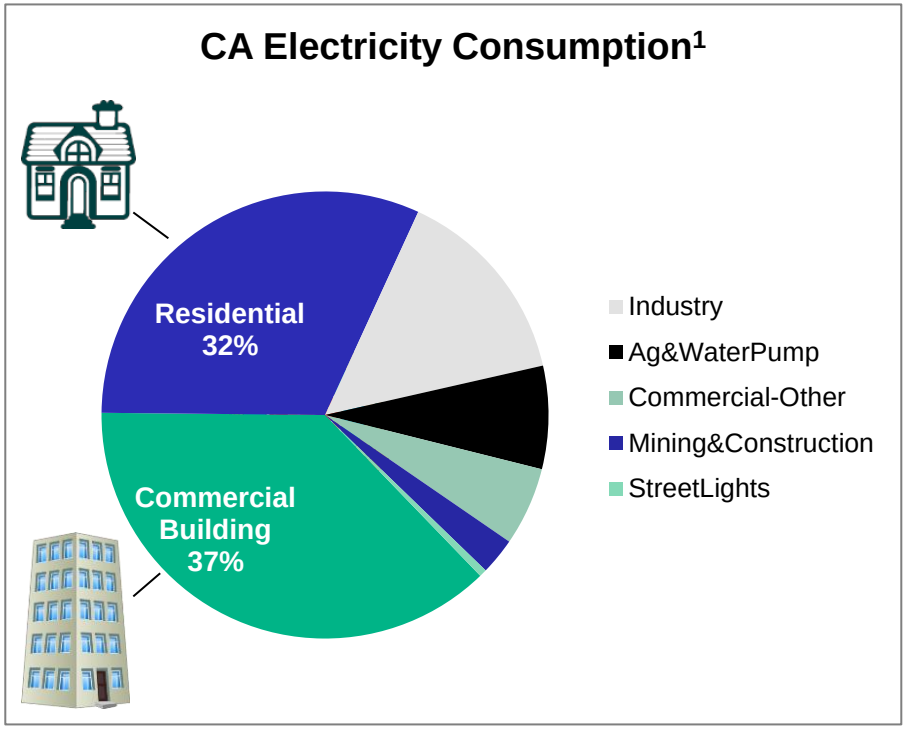
Get Plugged-In on Plug Loads

California's Residential and Commercial Plug Loads and Commission Research

Bradley Meister, Ph.D., P.E.

Energy Efficiency Research Office
Energy Research & Development Division

Buildings are responsible for about 70 percent of California electricity consumption



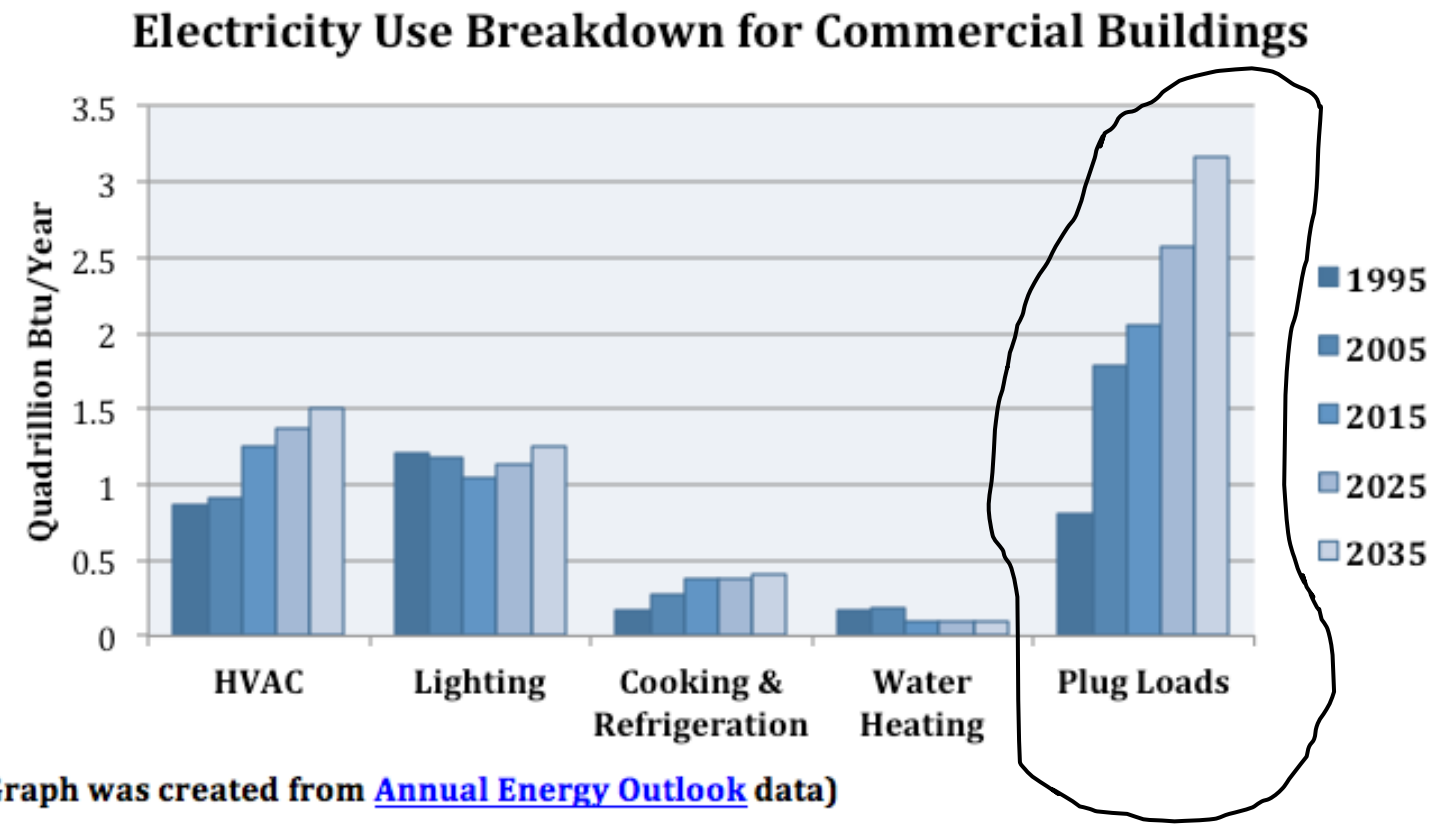
	Power plants (500 MW)
2012	70
2020[2]	79

(1) CA Energy Consumption Data Management System

(2) Projection based on 2000-2013 growth rate

Energy efficiency in residential and commercial buildings is a critical strategy in the decarbonization of CA's electricity sector.

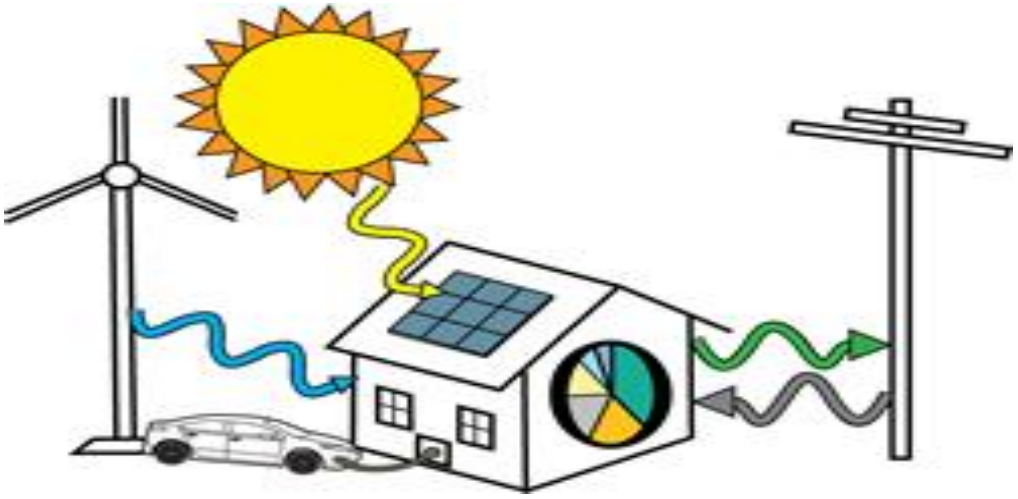
Plug Loads are the Fastest Growing Electrical Load



(Graph was created from Annual Energy Outlook data)

Big Bold Energy Efficiency Strategies

- All new **residential** construction in CA will be zero net energy (ZNE) by 2020.



- All new **commercial** construction in CA will be ZNE by 2030.

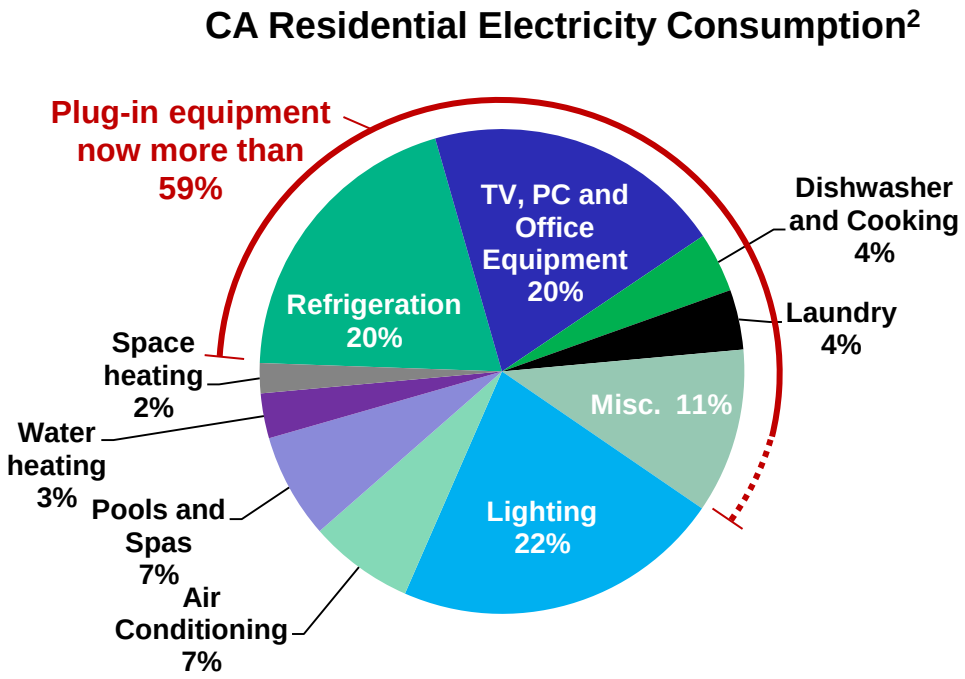
2013 IEPR ZNE Building Definition

- A ZNE Building is one where the net amount of energy produced by on-site renewable energy resources is equal to the value of the energy consumed annually by the building…measured using the CEC's Time Dependent Valuation (TDV) metric. A ZNE Code Building meets an Energy Use Intensity value designated in the Building Energy Efficiency Standards by building type and climate zone that reflects best practices for highly efficient buildings (IEPR 2013).

- In other words…A ZNE (Code) Building accomplishes deep energy efficiency and Demand Response first and then produces as much onsite renewable energy in the course of a year as it consumes (measured using TDV). Does not imply zero energy costs.

Residential Loads

Plug-in equipment now contributes the majority of electricity consumption



(2) CA Residential Appliance Saturation Survey (RASS) 2010.

EIA Annual Energy Outlook 2013 also shows a majority for all of US.

Numerous Residential Loads

- Refrigeration, TV, PC, Office Equipment, Home Entertainment, Dishwasher, Cooking, Laundry

- Electronics
  - Audio/Video-DVD/Game console
  - Networking equipment
  - Computer laptop
  - Computer peripherals
  - Power strip
  - Cordless phone
  - Media server
  - Tablet
  - Set Top box
  - Radio/CD/alarm

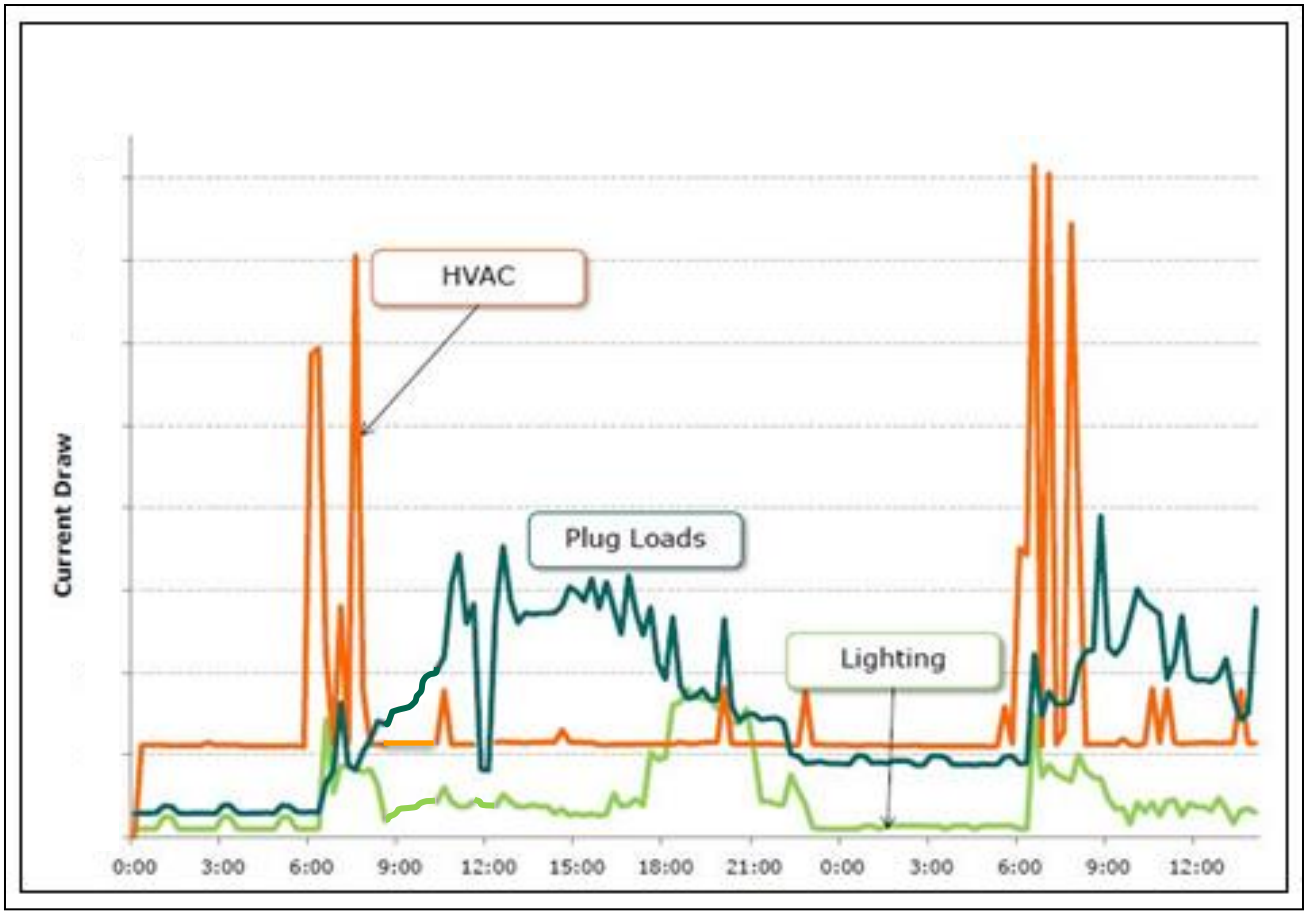
- Other Miscellaneous
  - Security system
  - Security camera
  - Aquarium equipment
  - Fish pond equipment-pump
  - Fish pond equipment-UV irradiator
  - Thermostats, timers
  - Displays

Three major categories of plug-in equipment

Residential Electricity Uses

IN SCOPE: Plug-in equipment			OUT OF SCOPE: Building systems, lighting and EVs
Electronics	Appliances	Miscellaneous	
			

In a highly efficient home office, plug loads can be about 50% of total energy use



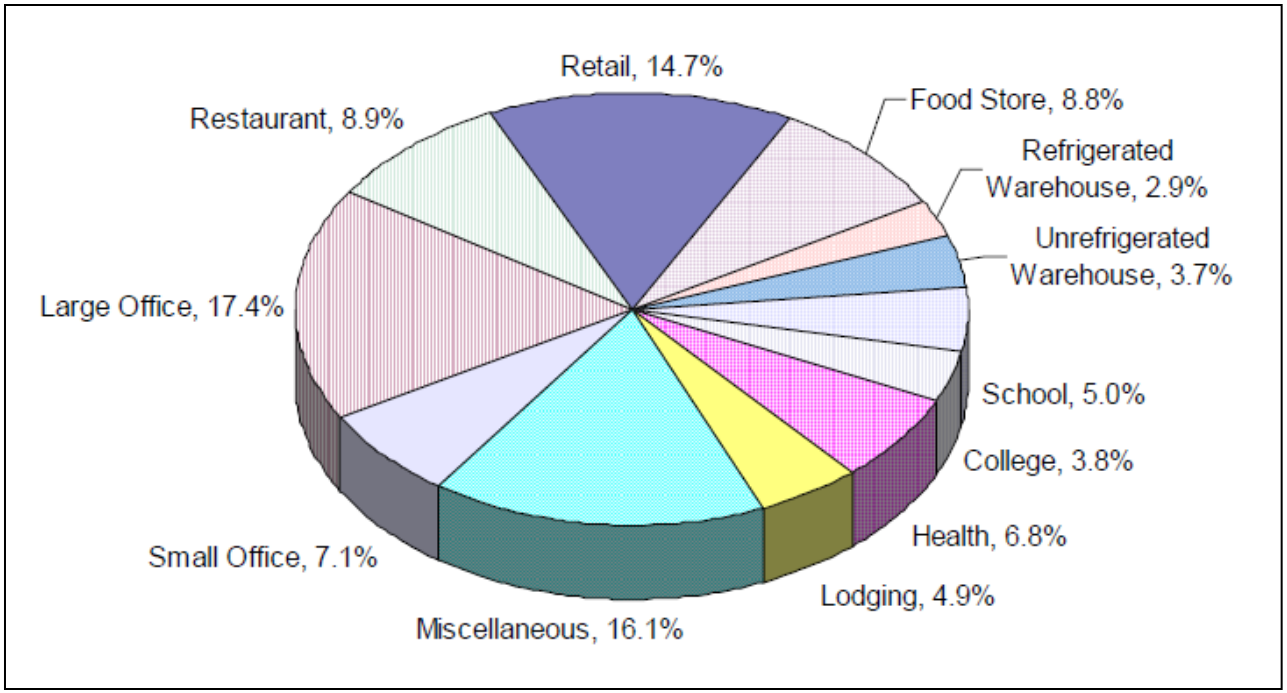
Source:
Energy Manager

Commercial Plug-in Equipment

Broader diversity of commercial building end-uses, resulting in larger variety of plug-in equipment

Data centers

Office equipment



Retail display, kiosk and point of sale

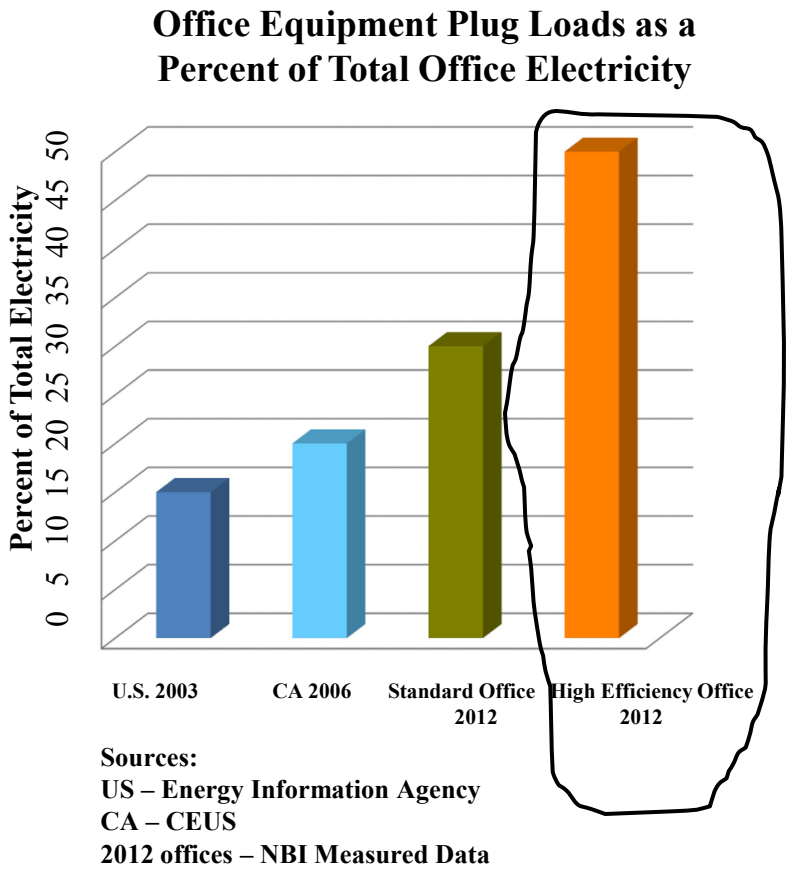
Medical devices

Restaurant and hotel room A/V

CALIFORNIA COMMERCIAL END-USE SURVEY, Figure E-1: Commercial Electricity Use by Building Type

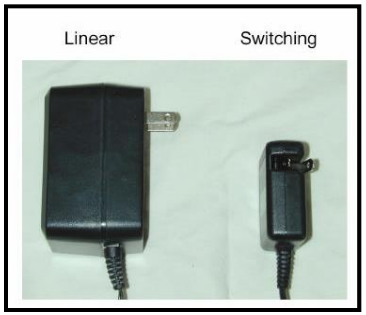
Commercial Loads

- Varied by Industry
  - Office equipment
  - Medical equipment
  - Restaurant
  - Institutional
  - Media
  - Data Centers
  - Retail display and register
  - Food Service Equipment



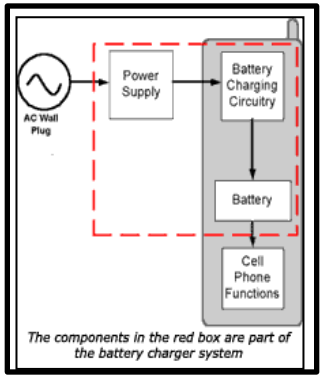
Examples of CEC Past Research Supporting Title 20

- ✓ Developed External Single Volt Power Supply Test Procedure and Primer
- ✓ Tested numerous external single volt power supplies
- ✓ Data to support Title 20 Standard (effective 1/1/2007)
- ✓ **Result: External Single Volt Power Supply Title 20 Standard**



- ✓ Contributed to TV Title 20 Standard Test Procedure
- ✓ Tested numerous TVs
- ✓ Data to support Title 20 Standard (effective 1/1/2011)
- ✓ **Result: TV Title 20 Standard**

- ✓ Developed Battery Charger Test Procedure and Technology Assessment
- ✓ Tested numerous battery chargers
- ✓ Data to support Title 20 Standard (eff. 2/1/2013)
- ✓ **Result: Battery Charger Title 20 Standard**



Benefits of CEC Research Impacting Title 20

Research	CEC Cost	Estimated Annual Monetary Savings*
External Power Supply	$288,541	$100,000,000
TV	$300,000	$800,000,000
Battery Charger	$400,000	$300,000,000

* Savings accrue once measures are implemented

For a one-time investment of $1 million in research funds the State will save approximately $1.2 billion every year

Other Examples of Past CEC Research and Outcomes

- **80 Plus Program** – Initial CEC power supply research with Ecos and EPRI stimulated interest with utilities and led to an initiative to promote energy efficiency in computer power (now over 5,200 qualified power supplies)
- **Energy Star** - Influenced a revised specification for computers that included power factor correction
- **Computers** – Developed a low- and ultra-low energy computers "How Low Can You Go" with Ecos. Research stimulated manufactures to build computers that use less energy
- **Protocol to communicate with an external proxy** – LBNL performed research on proxying. Proxying is a useful method for allowing devices to enter a low-power sleep state while maintaining a virtual presence in the network
- **IEEE 802.3AZ** – LBNL performed research on the Energy Efficiency Ethernet which provides for less power consumption during periods of low data activity

Other Examples of Past CEC Research and Outcomes

- **Efficient Set Top Box** - Calplug developed 5W5S prototype with 5-watt idle power and 5-second recovery time
- **Computer Survey and Monitoring Reports** – Calplug completed research to better understand power management enabling rates. Informed current Title 20 rulemaking on computers
- **Energy Reporting and Display** – Calplug completed research on self-reporting of power consumption by appliances, focusing on computers
- **Efficient Kiosks** – EPRI researched and tested kiosks with improved efficiency up to 98 percent over baseline
- **Efficient Multi-media Computer** – EPRI and Ecova developed, built and tested a high efficiency multi-media computer with 31 percent savings and twice the performance
- **Home Audio Equipment** – EPRI tested receivers, sound bars, subwoofers, powered speakers, and optical disk players. More aggressive strategies for auto power down and idle mode power consumption showed large potential for energy savings

New Research

- Power Management User Interface
  - A recent study conducted by **UC Irvine's Calplug** showed that 86% of desktops observed in a study had no automatic Power Management (PM) settings enabled, and spent an average of 68% of the time on and idle. The goals of this agreement are to reduce energy used by computers by introducing a new user interface that could increase the use of existing PM, and to collect data on users' behaviors toward PM in computers that will be useful for future innovation in energy-efficient design.
- Mobile Efficiency for Plug Load Devices
  - **Aggios, Inc.** will develop energy efficient plug load devices such as set-top boxes, TVS, computers, and game consoles by using mobile design practices, hardware components, and energy management software. The potential energy savings from the different plug load devices range from 20-50%. This project will additionally accelerate deployment of mobile efficiency technologies across products categories influencing variety of policy mechanisms.

New Research

- Gaming System Energy Efficiency without Performance Compromises
  - There are approximately 20 million gaming platforms in use in California. **LBNL** will demonstrate the next generation of gaming systems and help capture the gaming energy savings potential. This project generates information by estimating energy use through a combination of improved hardware, firmware, software, and behavioral adaptations. The results from this project will bring more efficient offerings to the market, identify promising avenues for policy, and lower energy cost required for digital gaming. Project location is in the Bay Area.
- Efficient and ZNE-Ready Plug Loads
  - **LBNL** will develop and demonstrate technologies and strategies that can change the way plug load devices are powered in ZNE buildings. Technologies will target making plug load consumption easier and more efficient to serve with on-site renewable energy sources. Strategies will consist of zero stand by devices, DC to DC devices, and addressing energy use of devices with high reliability power needs.

New Research

- Plug Load Reduction Application
  - **Home Energy Analytics** will develop an engaging and free mobile application that will analyze a home's idle load using smart meter data, help the user identify an inventory of the specific causes, and provide recommendations to reduce it.

- Unlocking Plug Load Energy Savings Through Energy Reporting
  - The goal of this **LBNL** project is to integrate energy reporting into plug-load devices so the energy use of those devices becomes visible and controllable by enabling the reversal of the data communication pathways so that control signals can be sent to individual end-use devices to reduce wasteful operation.

New Research

- Electric Plug Load Savings Potential of Commercial Foodservice Equipment
  - The goals of this Agreement with **Fisher-Nickel** are to: Characterize the type and quantity of unventilated commercial electric cooking and warming equipment; Assess the energy savings through field monitoring within five commercial kitchens; Demonstrate the potential impact of behavior modification on the adoption and implementation of these technologies; Develop business cases; and support and widen existing utilities' energy-efficiency programs and emissions reductions in California.
- Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response
  - **EPRI** will develop integrated plug load control strategies appropriate for different spaces within multiple building types in the commercial sector. The project location is in Palo Alto, CA with demonstration sites in Mountain View, Stanford, and San Francisco, CA. The project expects a potential energy savings of 10% of electricity from plug load usage and will lead to lower cost and greater reliability through plug load control strategies and demand response strategies that incorporate behavior and coordinated operation of plug loads in an integrated building.

Vision for the Future

1. Convert power efficiently (power supply)
2. Store and retrieve energy efficiently (battery charging)
3. Use energy features of advanced technology to reduce power of mainstream electronics where applicable
4. Enable true proportionality between the energy consumed and the useful work delivered by the device
5. Auto-power down equipment and put buildings to sleep automatically when not in use
6. Be shipped with power-saving features enabled by default
7. Clearly communicate operating state to users