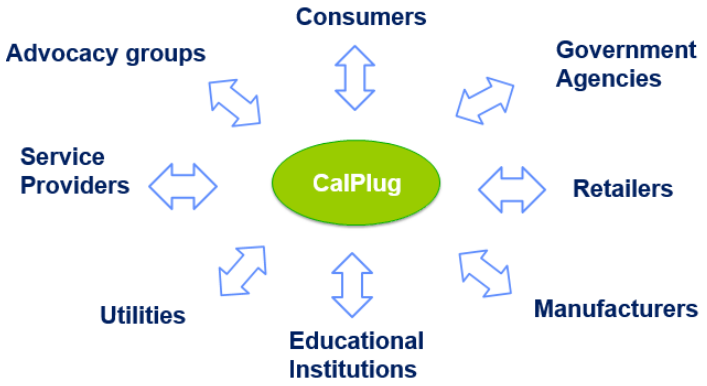
Introduction to CalPlug's Chief Technology Council

CalPlug Objectives

Technology Center: Research and improve Plug Load efficiency

- Resource Efficiency, Efficacy, and Sustainability
- Consumer Behavior
- Minor focus: De-carbonization load
- Technology investigations that help lead the world

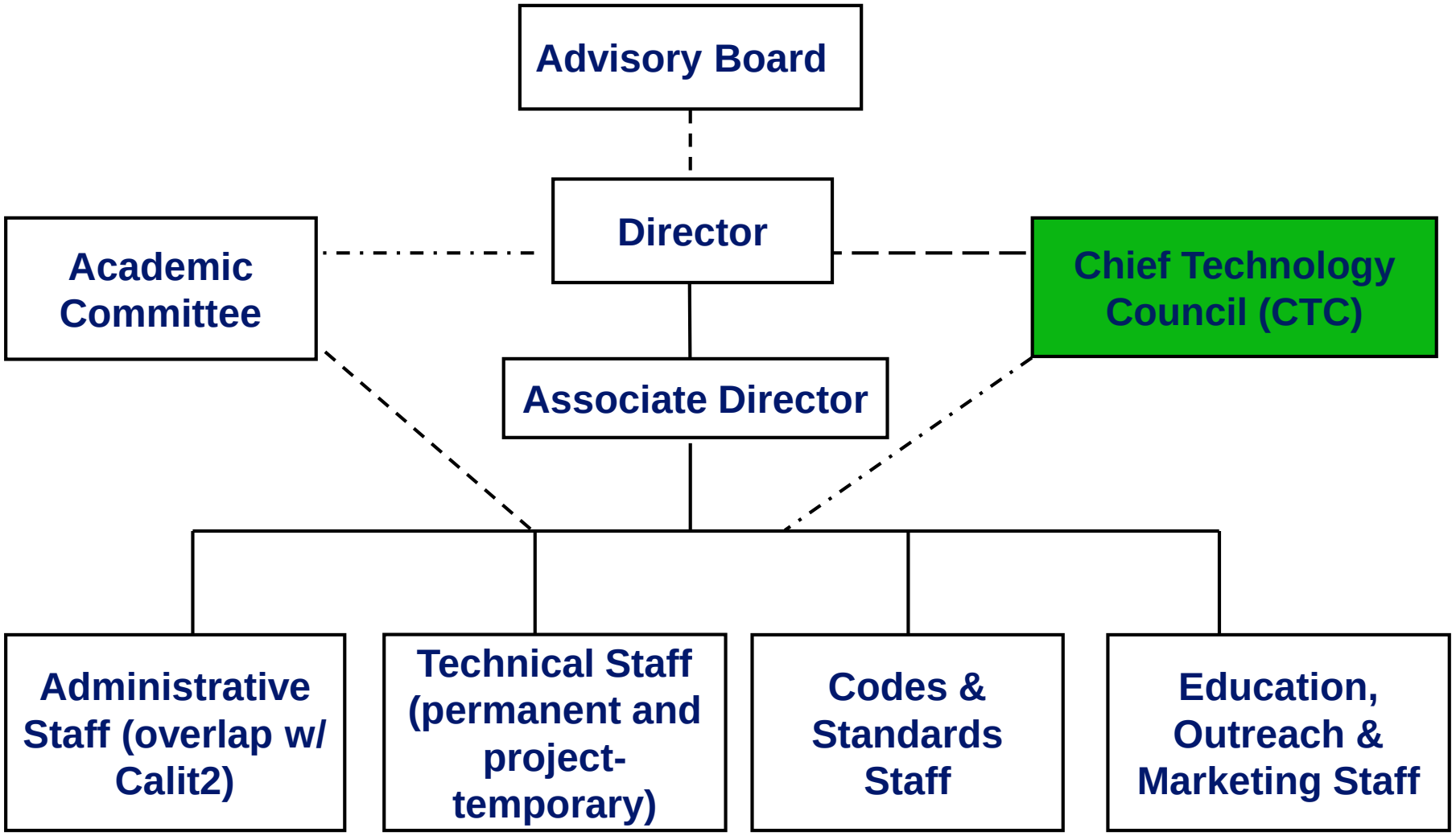


- Priority attention is paid to CA Title 20, Title 24, and AB 32

http://www.energy.ca.gov/appliances/ http://www.bsc.ca.gov/ https://www.arb.ca.gov/cc/ab32/ab32.htm

Technology investigations that help get the plug load (in California) under control and managed.

CalPlug Organizational Structure



CalPlug Chief Technology Council Members

Henry M Wong (sfhenm@gmail.com)- Temp-chair, Leads ISO/IEC standards on resource efficiency metrics for data centres and data centre equipment. 30+yr. computer systems development at Intel. Expertise: semiconductor physics, computer architecture, power management, thermal/mechanical/electrical integration, and new technology ecosystgems.

Alfredo Choperena (alchoper@smartenit.com) - leading roles in Healthcare R&D, Business Development, and Operations as a senior executive at DuPont, Sanofi and Johnson & Johnson. Expertise: technology and medice, wireless communications and the "Internet of Things".

Dan Cregg (dcregg@insteon.com) - the "Father of INSTEON" a simulcast mesh networking technology introduced in 2005. Founder of Smartlync (acquired by SmartLabs) and HomeRun Automation. Expertise: adjunct professor in Computer Engineering.

Stephen Dulac (spdulac@att.com) – Satillite and wireless communications leader/expert for 27+ yrs., with DirectTV, Solidaridad, and Hughes Space and Communications. Holds 14 patents in communications. Expertise: Wireless and satellite communications.

Art Hitomi (arthur.hitomi@numecent.com)- Chief Executive Officer/founder of Numecent. Industry leader in areas of application virtualization and streaming. Experience in internet standards development. Authored 19 issued patents. Expertise: application virtualization and streaming.

Mukesh Khattar (mkhattar@epri.com) - https://www.linkedin.com/in/mukesh-khattar-7096a05

Stephen Palm (stephen.palm@broadcom.com) - Over 30 years of technical experience, specializing for the last 20 years in wireline and wireless data communication technologies, including Wi-Fi, MoCA, HomePlug. 48 US Patents

Vojin Zivojnovic (vojin.zivojnovic@aggios.com) - co-founder/CEO of AGGIOS. Previous: ARM's VP of WW OEM and Foundry business development; Co-founded AXYS Design Automation (Irvine, CA) and CTO in AXYS Design Automation (Germany). Expertise: > 60 research papers in statistical signal processing, DSPs, multicore system design methodology

CalPlug Chief Technology Council

- Assist the Advisory Council on technological areas to be prioritized and may offer the best opportunities. (E.g. Where CalPlug funds)
- Contribute as technology experts, not as commercial representatives
- Contributions to industry and society technology/real world integration
- Attract and develop new leaders

CalPlug Focus: Improve the energy efficiency of Miscellaneous Electrical Loads (MELs),
especially devices that are highly inefficient, operate uncontrolled with long operating hours, or have potential for large energy savings.

Topics include:

- Smart/connected homes, device integration
- Consumer office, schools
- Pool pumps/recirculators
- Device standby power
- Consumer behavior/device interaction
- 3D printers
- Robotics – energy impact
- DC homes
- Builder installed equipment
- Network devices
- Wide bandgap semiconductor
- Lighting / HVAC Integrated Controls
- Water technology- Energy/Water nexus
- Share use devices in residences and offices
- Manufacturing
- Energy impact of cloud computing
- Smart meter data applications

CTC: Advises on technology investigations for CalPlug Advisory Council

CalPlug Current Projects

- ZNE SIM Home/apartment Demonstration (SCE)
- Energy Channel via webTV (SCE)
- Technology Roadmap (SCE)
- Intelligent power management for classroom (Irvine Unified School District)
- APS tier 2 testing methodologies (PG&E: QPL)
- Small data center
- Small Network Equipment
- Integrating building management with occupants' plug loads
- Desktop computer management user interface (CEC PMUI project)
- Increase energy productivity for industry sectors (CESMI – funded)
- Point of use water dispensers: "Coffee Buddy" project
- Shared use device intelligent power management

CalPlug's 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 and clearly communicate operating state to users**
7. **Securely automate and facilitate consumer energy savings policies into current and future plug loads.**
8. **Resource efficient integration of current and emerging technologies**

CalPlug Vision: **Reduce** overall **plug-load** in California through improvement and integration of **power saving features**, **power management** and **emerging technologies**.

Summary and How You Can Help

- The Chief Technology Council (CTC) provides technology advice to CalPlug on energy efficiency and resource sustainability
- Stakeholders and interested parties can support CTC by:
  - ✓ Provide feedback on existing projects, priorities, & issues
  - ✓ Offer insight to unlisted emerging technologies & potentials
  - ✓ Submit comments and/or examples on existing projects
  - ✓ Participate and/or contribute to the list of research projects.
  - ✓ Lobby CA and other policy makers on the importance to fund these projects.

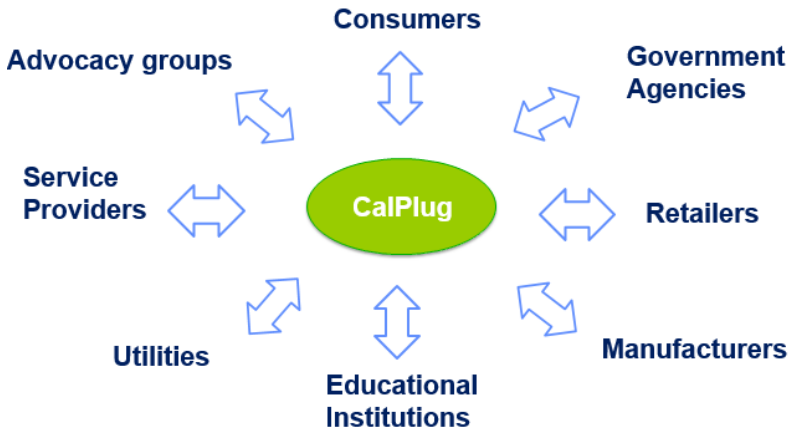
Help CalPlug & CTC advance resource sustainability.
Provide feedback to a CalPlug Technology Council Member

Thank You


CalPlug
California Plug Load Research Center
University of California • Irvine

Backup

New technologies and advisory council roles



Technology Advisory Council

- Contributing as technology experts, not as commercial representatives
- Contributions to industry and society integration
- Attract and develop new leaders

Activities include:

- Develop, implement, measure and verify the energy savings potential of the device.
- Identifying and developing common efficiencies that specific MEL devices must meet, such as through power scaling.
- Improve energy efficiency by integrating MELs such as integration with building energy management systems to minimize energy use.
- Develop, implement, measure and verify the energy savings potential of the integrated devices.
- Testing, validation and development of test protocols for inefficient MEL devices to support future energy codes and standards.
- Research needs to focus on advancing the development and deployment of more efficient consumer devices, consumer electronics and the electronic infrastructure that supports the communication of these devices, such as set-top boxes, TVs, computers and game consoles.
- Improve and develop efficiency improvements to existing and future consumer and MELs, including research to develop and test low cost components, low cost energy reporting technologies, and integration and commissioning of smart controls via an integrator or network.
- Reduce idle loads of devices that are on 24/7 such as microwaves, burglar and security systems, sprinkler, GFICs, alarms, thermostats, and displays.

Comments and activities

Motivating Premise:

- Many consumer devices, consumer electronics and the electronic infrastructure that supports the communication of these devices are inefficient.
- Idle loads of devices that are on 24/7 such as microwaves, burglar and security systems, sprinkler, GFICs, alarms, thermostats, and displays are wasting an enormous amount of energy.
- Most electronic equipment does not have true proportionality between the energy consumed and the useful work delivered by the device (this can include slot machines, fitness equipment, arcades and automated tellers).

Key planned activities:

- Gaming systems/consoles and video conferencing equipment: Develop and test methods that increase energy efficiency and enable sleep modes when equipment is idle. The minimum energy goal is a 20 percent reduction in energy use.
- Develop component-level efficiency improvement and reporting, and components that can be power-scaled between the energy consumed and the useful work delivered by the device. The minimum energy goal is a 30 percent reduction in energy use.
- Develop communication infrastructure protocols that allow devices to report the data in an efficient and flexible manner.
- Develop energy use optimization at the chip level and on other electronic components as a precursor to optimizing whole-device efficiency.
- Develop low-cost hardware that allows devices to measure their energy use and report it to an aggregator, via a network.

Comments and activities

Future plans:

- Identify opportunities for savings due to behavioral changes.
- Evaluate market and industry acceptance and behavior, such as to slight delays in receiving STB programming.
- Address consumer behavioral patterns for equipment use and potential acceptance of new technologies and operating strategies such as response to grid events (demand response) of MELs.
- Develop home networking system and energy management system monitoring to provide real-time energy use information.
- Integrate systems and devices with demand response applications and that work in concert with other energy consuming systems in buildings.
- Develop power supply reporting, internal energy reporting and test procedures for enabling communication between devices.
- Integrate distributed load control to reduce idle loads and manage MELs based on occupancy.
- Mobile or wireless controls for MEL devices and wireless user-friendly interface for maintaining MEL devices in residential and commercial buildings.
- Monitor MEL devices on-site or remotely.
- Future improvements should focus on overall efficiency by integrating MEL devices and other miscellaneous electrical devices together.
- Target MEL devices and components that are integrated for building energy management so that they can minimize energy use in response to occupancy and other schedules.
- Develop systems and devices that inform consumers to make energy efficient choices.
- Energy policy engine (e.g. automation that translates policies to autonomous energy saving behavior of plug loads)

Research areas

- Research for DC microgrids, including, evaluating and developing information on technical and economic feasibility and requirements associated with DC and AC-DC hybrid systems.
- Develop advanced USB connectors beyond type 3C that will increase wattage to accommodate computers with higher end graphic cards, and even appliances. The goal is data rates greater than 20 Gbps.
- Improve efficiency using Wide Band Gap Semiconductor (WBG) power electronics in building technologies
  - WBG materials are a natural fit for power electronics, producing devices that are smaller, faster, and more efficient, with ability to withstand higher voltages and higher temperatures than counterpart silicon-based components.
- Research on what is more feasible, have OEMs and other participants build devices to a particular standard and/or support the migration to DC systems.
- Product areas: Dimmers Motion, occupancy, and photo sensors, Timers, Mobile devices/Wi-Fi enabled lighting devices, Are linear LEDs more energy efficient than 4-foot long Super T8 lamps?
- Broadband access equipment allows consumers to access high-speed Internet service from a provider such as their cable, satellite, or phone company.
- Local/home networks servicing as aggregation points for multiple, connected edge devices such as desktop and laptop computers, printers, game consoles, tablets, and smart TVs. Efficient and effective configuration?
- Evaluate overall energy efficiency, efficacy, life, and cost effectiveness aggregation vs. distributed (e.g. gang of 2 large area LEDs vs. distributed array).
- Evaluate lighting controls and power converters on efficiency in their load power conversion efficiency.