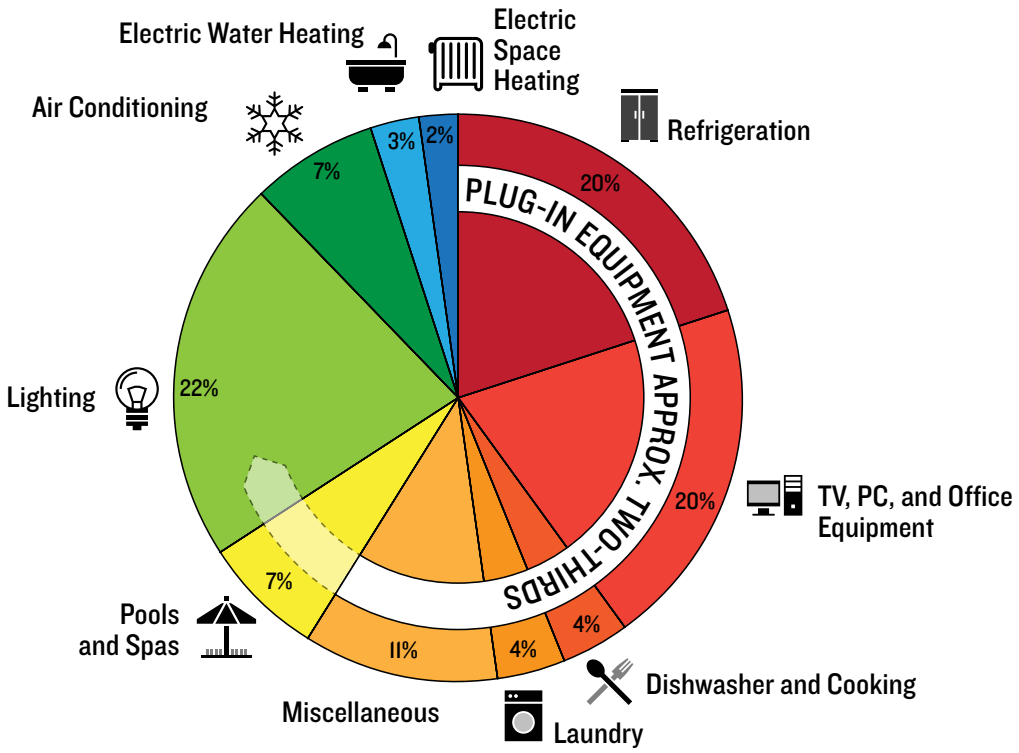
Plug-In Equipment Efficiency:

A Key Strategy to Help Achieve California's Carbon Reduction and Clean Energy Goals

There are more than 50 electronic devices, appliances, and other miscellaneous electric loads plugged into the power outlets of the average California home. These devices are responsible for approximately two-thirds of a typical household's electric use, as illustrated in Figure 1, and plug-in equipment also consumes a significant share of the electricity in many commercial buildings. Unfortunately, much of this energy is wasted through high standby power levels when the devices are not in active use, and through equipment that is not as energy efficient as best practices allow. Given the large waste of electricity, the pollution associated with generating it, and the unnecessary cost to California's residential and business consumers, state policymakers need to assess the problem and implement measures to enable Californians to use energy in a smarter way. **Scaling up plug-in equipment efficiency measures could cut annual electricity bills by $2.5 to $4 billion for California's consumers ($150 to $250 per household) and businesses, as well as avoid substantial amounts of pollution while helping the state meet its carbon reduction and clean energy goals.**

Figure 1: Plug-in Equipment Responsible for Approximately Two-Thirds of California's Residential Electricity Consumption[1]



Note: This chart is focused on electricity. Therefore, it includes only a small share of water and space heating energy, which comes primarily from natural gas in California.

Equipment in the Pools and Spas, Lighting, Air Conditioning, and Electric Space Heating categories is mostly hard-wired to the building, but some is plug-in, such as portable electric spas, plug-in lamps, and portable heaters and air conditioners.

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Electricity generation is the second-largest source of greenhouse gas emissions (after transportation), responsible for 21 percent of California's total climate-warming emissions.[2] Increasing the efficiency of plug-in equipment is a key strategy to reduce California's energy consumption because residential and commercial buildings use 69 percent of all electricity in California, equivalent to the output of 70 large (500-megawatt) power plants.[3] If the 2000–2013 historical growth trend continues, this is projected to grow to 79 power plants by 2030.[4] Increasing the efficiency of California's plug-in equipment is critical to reversing this trend.

WHAT IS PLUG-IN EQUIPMENT?

Plug-in equipment includes every electrical device that plugs into a power outlet in residential and commercial buildings. In homes, typical plug-in equipment includes kitchen and laundry appliances, consumer electronics, and miscellaneous smaller appliances such as personal care products (e.g., electric toothbrushes and shavers), vacuum cleaners, and power tools. Commercial appliances include office and data center equipment; audio/video equipment in hotels and restaurants and on display in stores, kiosk and point-of-sale systems; plug-in medical devices in the health care sector; and so on.

Plug-in equipment is one of the fastest-growing electricity-use categories. More than 50 plug-in devices can be found in the average home today.[5,6] This number—and the associated electricity consumption—is expected to continue to grow as new gadgets are invented, the use of in-home medical equipment increases, and more products like electronics, appliances, home automation devices, and even light bulbs become connected to the Internet around the clock.

In addition, appliances that once were mechanical-only, such as stoves and washing machines, now feature displays and electronic controls. Some remain connected to WiFi or other home networks 24/7, which can cause them to draw significant power around the clock, contributing to the substantial increase in the annual energy consumption of plug-in devices, as shown in Figure 2.

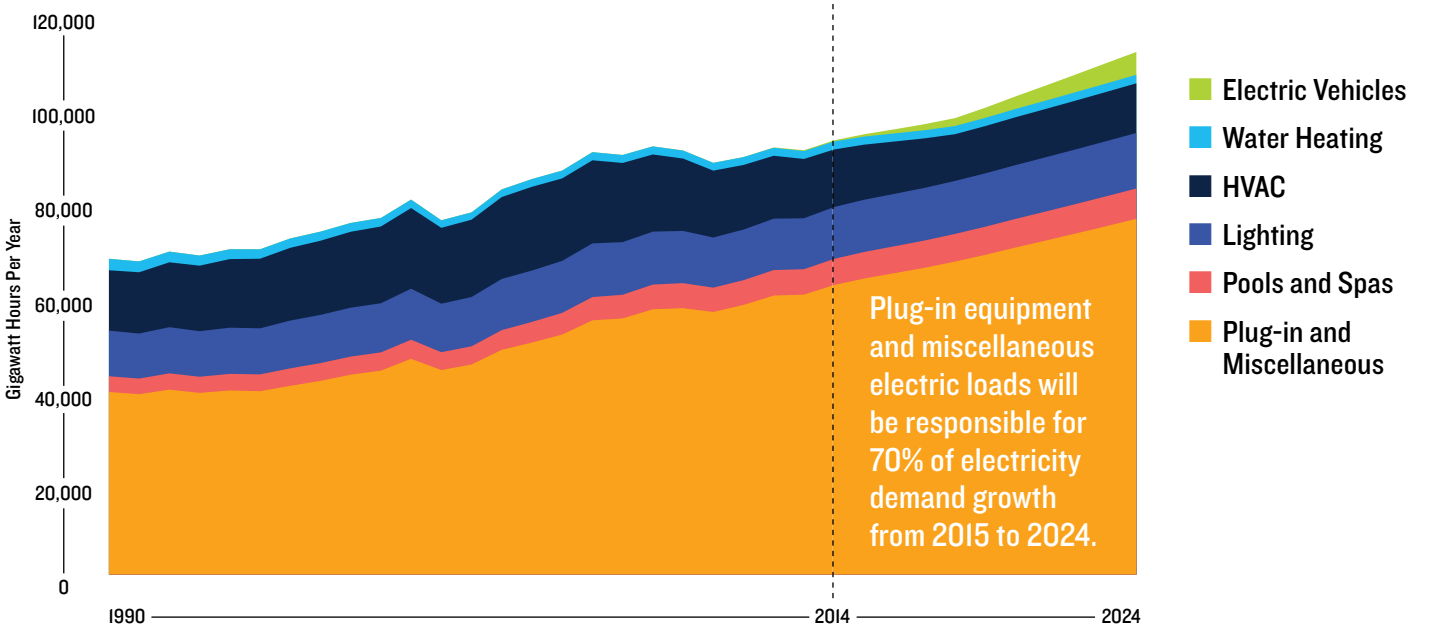
The growth in plug-in electricity consumption—one-third of which goes toward keeping many devices always on, as shown in Figure 3—is a major barrier to reducing energy use, cutting carbon emissions, and meeting California's goal of an 80 percent reduction in greenhouse gases by 2050. It also impedes Governor Jerry Brown's recently announced goal to double the energy efficiency of existing buildings by 2030.

THE PROBLEM

While California has been making progress in reducing plug-in equipment energy use through appliance efficiency programs and standards, their pace and scale do not match other clean energy policies, such as those related to renewable energy, low-carbon fuels, and building codes. Efficiency programs and standards for plug-in equipment need to be accelerated and ramped up to support the state's emissions reduction goals.

1. **Efficiency programs:** Plug-in equipment accounts for just 7 percent of the efficiency program electric savings in California today, a clear disconnect with its two-thirds share of the state's electricity consumption.[9] Current California Public Utility Commission (CPUC) regulations are not designed to incentivize utilities to scale up efficiency programs for plug-in equipment. A more focused approach is essential to capture the huge savings potential in this segment, which is characterized by a large number of miscellaneous electric loads and rapid evolution of the market.

Figure 2: California Residential Electricity Growth Forecast[7]



2. **Appliance efficiency standards:** While California is currently moving forward in establishing energy efficiency standards for a number of appliances, the pace of development of new standards and the revision of existing ones is insufficient to keep up with the rapid growth in plug-in equipment energy use.

THE SOLUTION

To unleash the potential of efficiency programs for plug-in equipment, California needs an increased policy focus on this area, alignment and coordination of state energy agencies around common goals and priorities, adequate resources for implementation, and regulatory reform. These factors will accelerate the pace and scale of progress necessary to meet the state's carbon and energy goals.

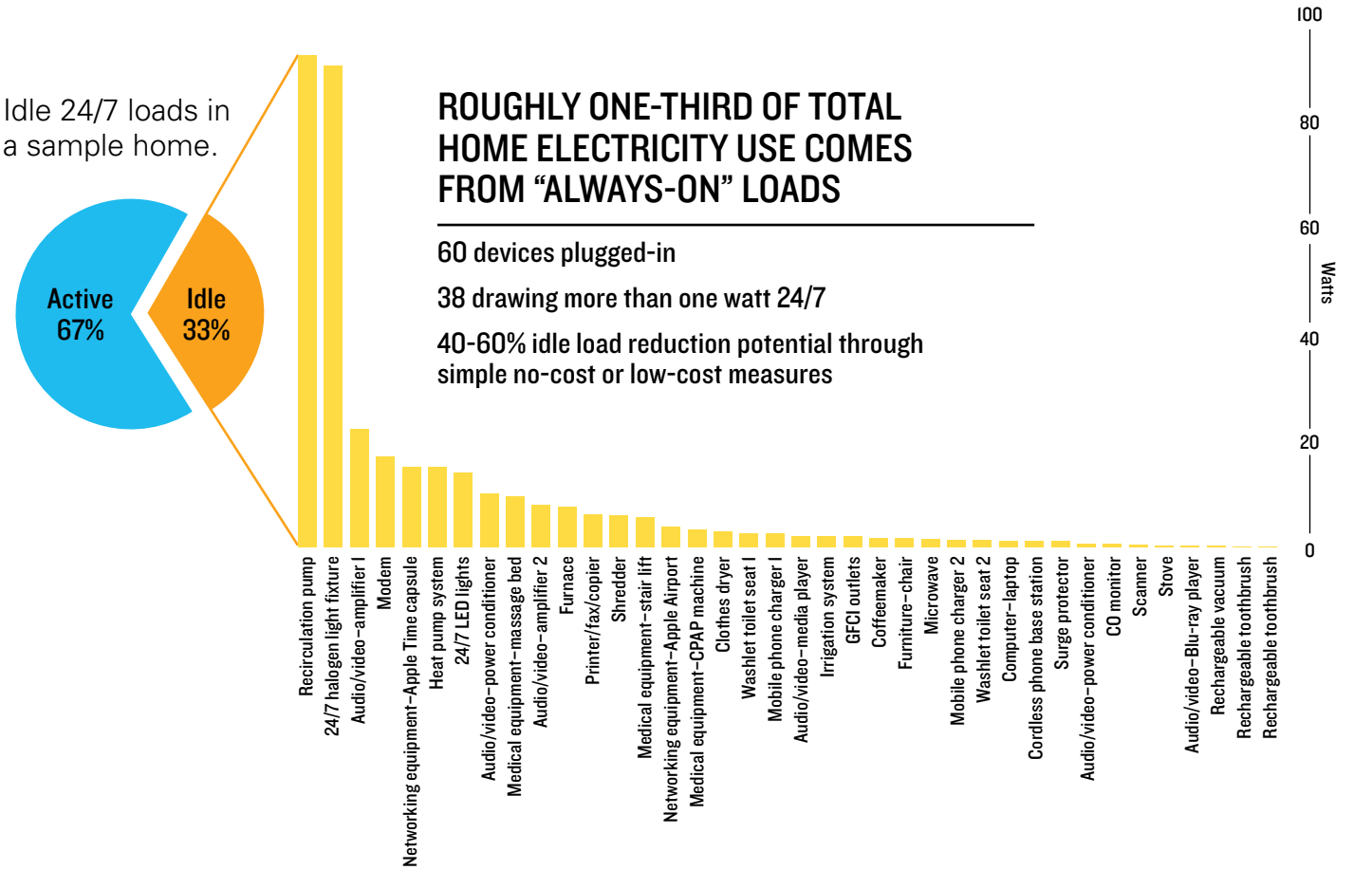
REDUCING PLUG-IN ENERGY USE

There are numerous opportunities to achieve greater efficiency in plug-in equipment, including both market-based (such as efficiency programs) and regulatory approaches. Major ones include:

Energy efficiency programs:

- **Incentivize the adoption of home and office energy management solutions** that monitor and control devices based on occupancy and other factors to optimize energy consumption and cut waste.
- **Utilize energy data analytics** to implement innovative behavior and incentive programs targeted to specific utility customers with high energy-savings potential.
- **Encourage research, development, and deployment of advanced technologies in refrigerators** (e.g. brushless direct current motors, variable speed compressors, LED lighting, thermo-acoustic cooling, etc.), in clothes dryers (heat pump), and in other large appliances.[10]
- **Increase the efficiency of data centers**, which are among the largest and fastest-growing electricity uses in California. The small server rooms and closets found in most office buildings comprise roughly half of the consumption.[11,12] The energy agencies should help scale up data center energy efficiency, especially for the small server rooms and closets, and implement programs to improve the utilization rate of IT (Information Technology) equipment in all data centers, small and large.

Figure 3: Electricity Use by Always-On Equipment in Sample California Home[8]



Minimum energy performance standards:

- **Complete current Title 20 rulemaking.** The California Energy Commission (CEC) should complete the Title 20 rulemaking for phases 1 to 3 (covering 30 electronic, lighting, and other products, including computers, monitors, LED lamps, electric spas, and pool pumps).
- **Develop a standby efficiency standard.** Implement a cross-cutting standby efficiency standard to reduce the power consumption of all products when not in active use. A similar standard has been in effect in Europe since 2008.
- **Expand mobile efficiency levels.** Accelerate market adoption of mobile technology standards to make every plug-in electronic device as efficient as battery-powered devices like phones and tablets.
- **Update existing California efficiency standards.** Strengthen minimum efficiency standards to keep pace with technology development in products like audio equipment and TVs.
- **Strengthen federal standards:** Collaborate with the U.S. Department of Energy to increase the stringency of federal efficiency standards where California is preempted, such as those applying to refrigerators.

These opportunities illustrate the large potential for energy savings in plug-in equipment, and the need for policies to further develop and deploy these efficiency opportunities in support of California's climate and energy goals.

POTENTIAL BENEFITS

NRDC's analysis indicates that scaling up plug-in equipment efficiency would help achieve California's existing energy goals and deliver a major contribution to the state's long-term carbon reduction efforts, including:

Progress toward achieving current goals: doubling the energy efficiency of existing buildings (Governor Jerry Brown), AB758, and Zero Net Energy in new buildings.

Longer-term certainty to the private sector for investments in product energy efficiency and planning for sales in the California market.

20 to 30 billion kilowatt hours (kWh) annual electricity savings by 2030.

3–5 gigawatts peak demand reduction by 2030, avoiding construction of **7 to 10 large power plants** (500 megawatt each).

$2.5 to $4 billion in avoided electricity bills for California's consumers and businesses; **$150 to $250** annual savings per household.

Reduction of **7 to 10 million metric tons of carbon dioxide** pollution annually by 2030, compared with current policies.

EXAMPLES OF PLUG-IN EQUIPMENT EFFICIENCY OPPORTUNITIES

1. Standby Power Leakage in Plug-In Devices

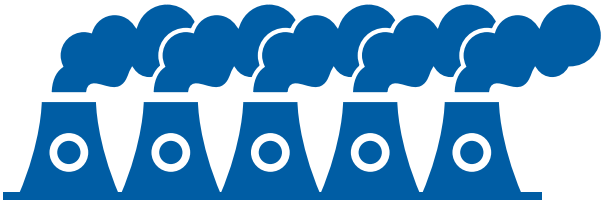
Smart meter data analysis shows that as much as one-third of total electricity in California homes is consumed by devices running continuously around-the-clock, such as recirculation pumps, electronic products that never sleep, unused devices that are still plugged in and drawing power 24/7, etc. Programs encouraging the installation of timers and power strips, and unplugging unused devices, could reduce this energy leakage by half at no or little cost.

Smart meter data analytics enable the targeting of high-idle-load buildings with personalized behavior and incentive utility programs, with built-in measurement and verification.

Longer-term, **Title 20 appliance efficiency standby standards** are needed to ensure that all plug-in devices are designed with low standby power.

Opportunity size:

Eliminate the need for up to 5 power plants



Reduce electricity use equivalent to the annual consumption of all households in the cities of:

2. Mobile Efficiency in Plug-in Electronic Devices

AGGIOS Inc., an Irvine-based company with deep expertise in energy efficiency in mobile devices, demonstrated the application of their advanced energy design and management techniques for the reduction of energy consumption on an IP (Internet Protocol) set-top box, under a California Energy Commission grant.[13]

On the demonstration IPTV set-top box prototype, software optimizations and estimated voltage conversion hardware improvements reduced standby power levels by 84 percent (from 8.8 watts to just 1.4 W) and active use levels by 55 percent (from 9.5 W to 4.3 W).[14]

This demonstrates the potential for low-cost technology solutions to achieve similar efficiency levels in plug-in electronic devices like those already widely available on such mobile devices as phones and tablets.

Electronic devices such as TVs, set-top boxes, and computers are responsible for at least 12 percent of California's residential electricity consumption.[15] If their energy consumption were reduced by half through the implementation of such technologies, it would avoid **1.8 gigawatts** of generation capacity today, the equivalent annual output of **three to four 500-megwatt power plants**, while enhancing California's leadership in low-power technologies that are largely invented in the state—thereby supporting local industry, jobs, and economic growth.

3. Advanced Efficiency in Appliances

Clothes dryers

A recent *NRDC report* found that today's typical electric clothes dryer consumes as much energy per year as a new energy efficient refrigerator, clothes washer, and dishwasher combined.[16] But if all of America's electric clothes dryers were updated to heat-pump technology, which is already in use in many overseas markets, Californians would save roughly $500 million worth of energy and avoid 2 million tons of carbon dioxide emissions annually. Incentive programs and strong efficiency standards are needed to drive adoption of this technology in California.

Refrigerators

A long history of efficiency standards has already significantly reduced refrigerator energy consumption. However, refrigerators continue to be one of a home's largest energy users, and many energy-saving opportunities remain.[17] While refrigerator standards are federally pre-empted, California efficiency programs and collaboration with the U.S. Department of Energy (DOE) to tighten them remain necessary to continue to reduce the energy use of refrigeration appliances.

ENDNOTES

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5 U.S. Energy Information Administration (hereinafter EIA), "Annual Energy Outlook 2014," projected annual rate of growth of plug-in equipment and other uses from 2014 to 2030, aggregation by NRDC.
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