

Plug Loads in the Zero Net Energy Context

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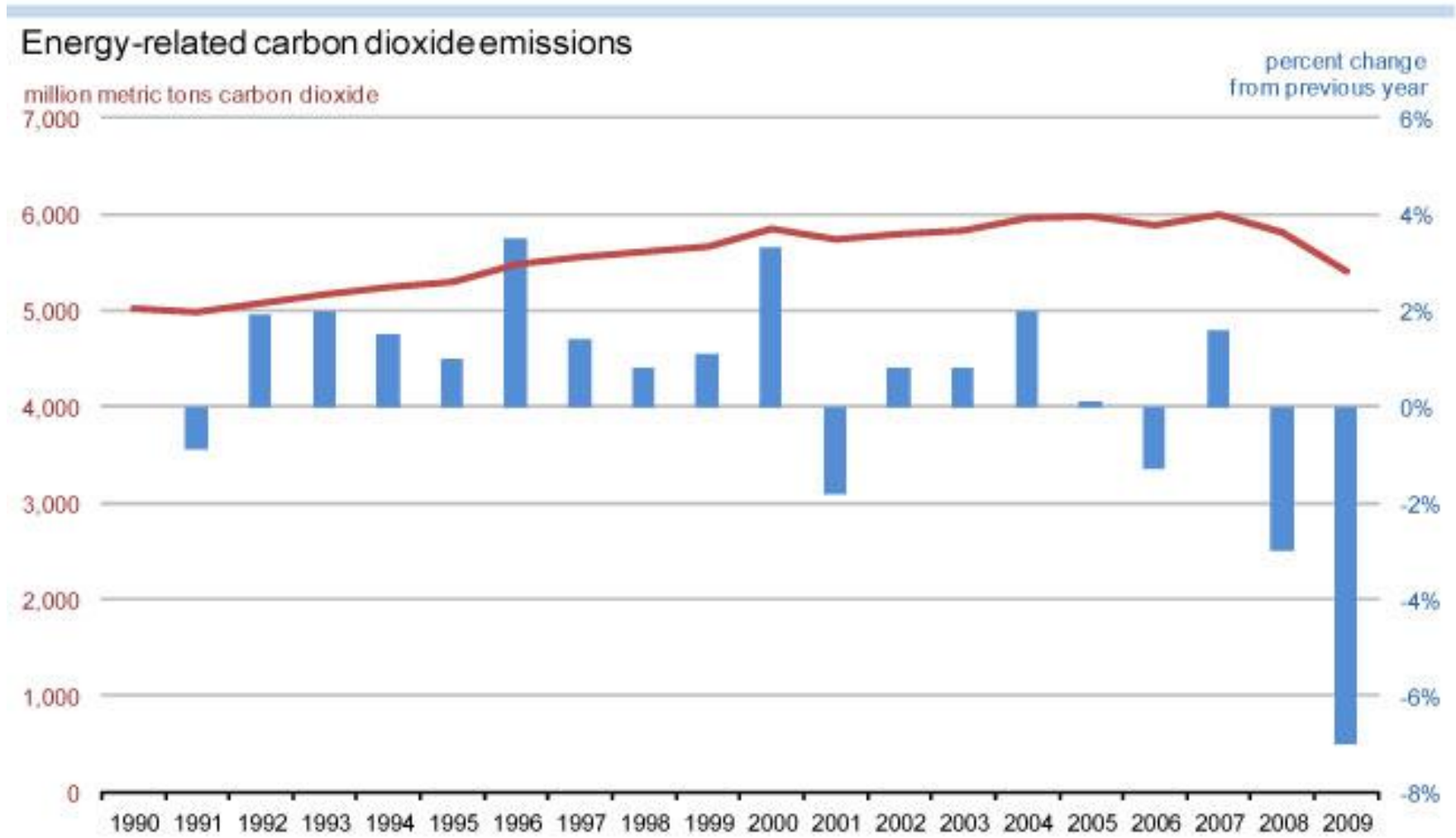
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Global Warming Solutions Act (AB32) of 2006

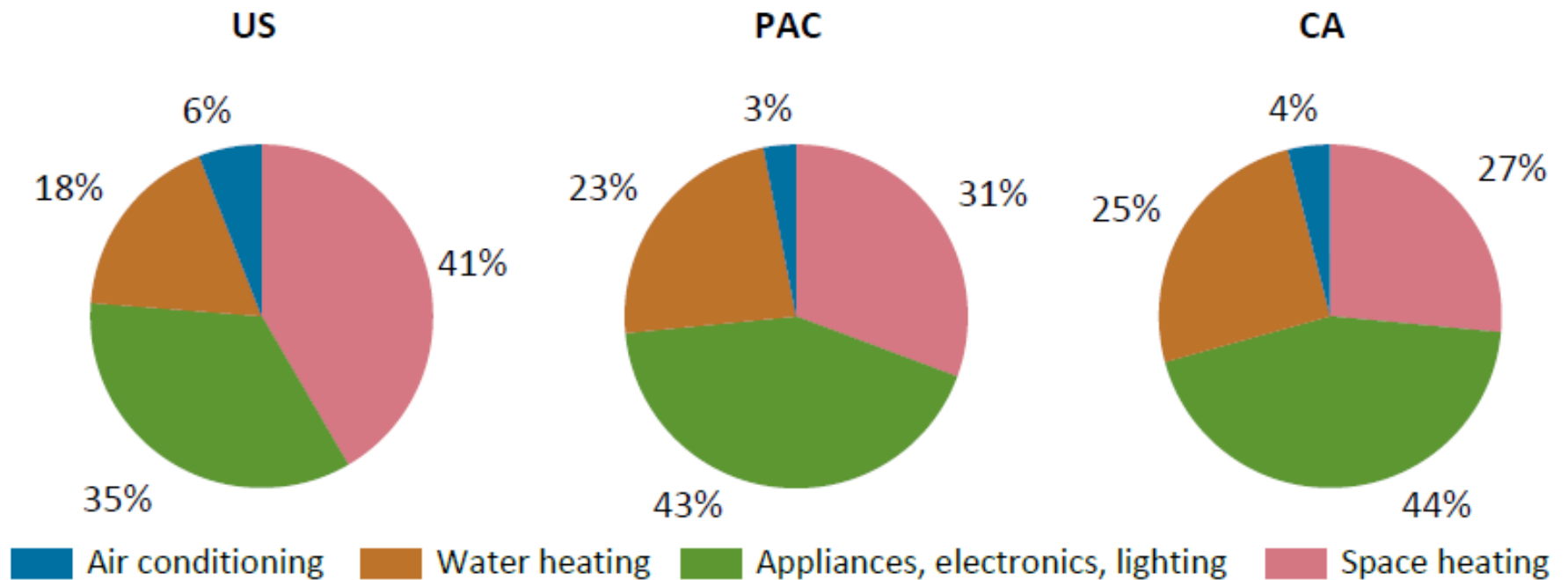
- Air Resources Board develop a scoping plan and update every 5 years (2008, 2013)
- 1990 GHG levels by 2020, 80% of 1990 levels by 2050
- Cap and trade program launched 2012
- Energy efficiency expected to deliver more than 20% of reductions needed



Bending the Curve of US CO₂ Emissions Downward: Need 22 Straight Years of 7% Annual Reductions to Achieve an Absolute Drop of 80%

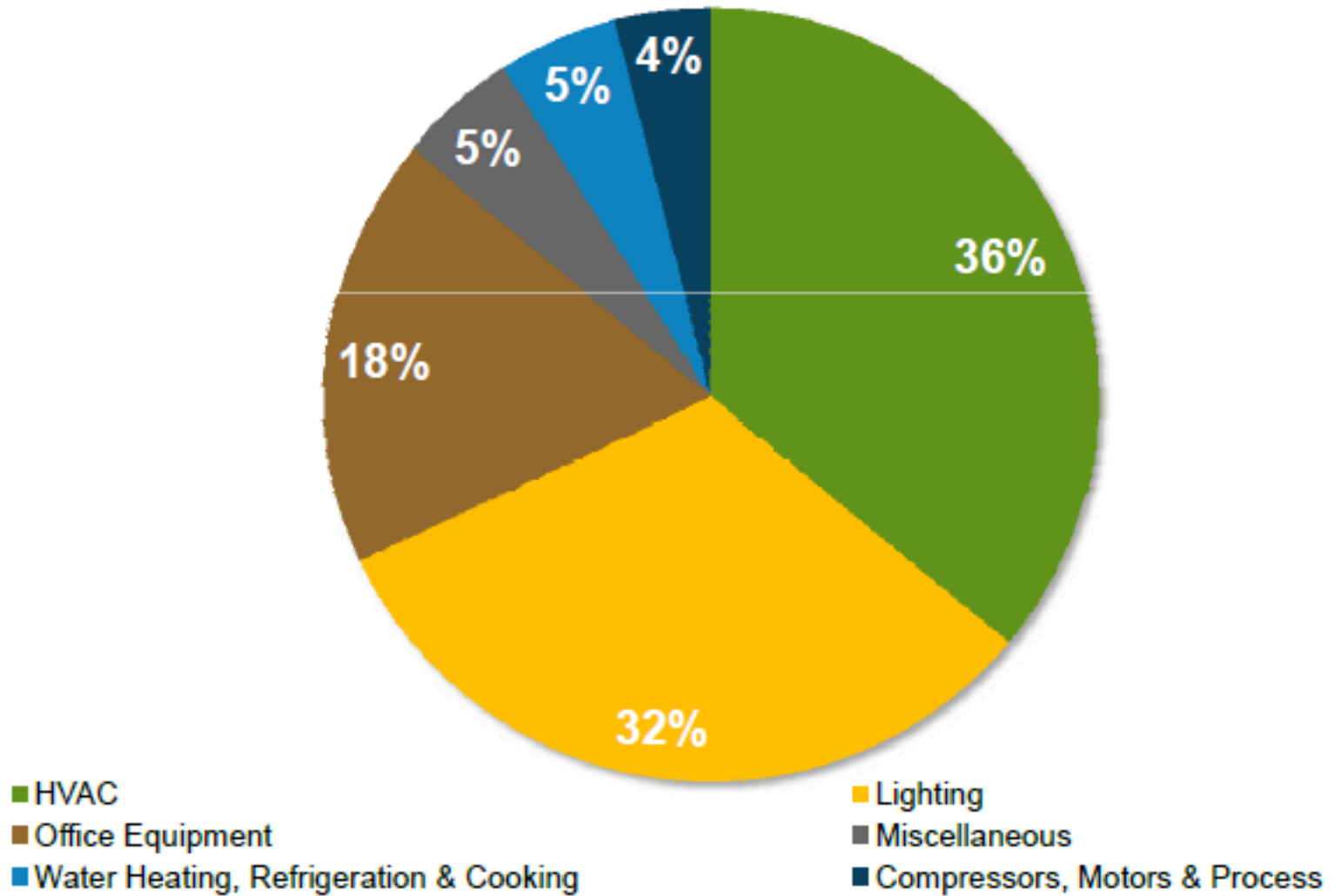


Plug loads are an important part of residential energy use nationwide, but even more so in California



Source: http://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/ca.pdf

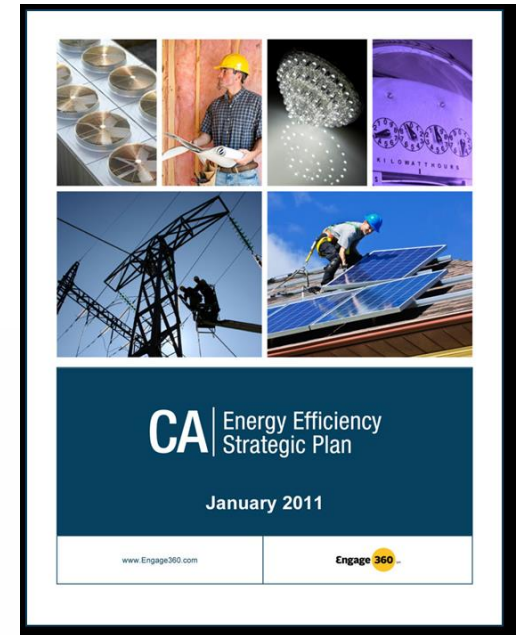
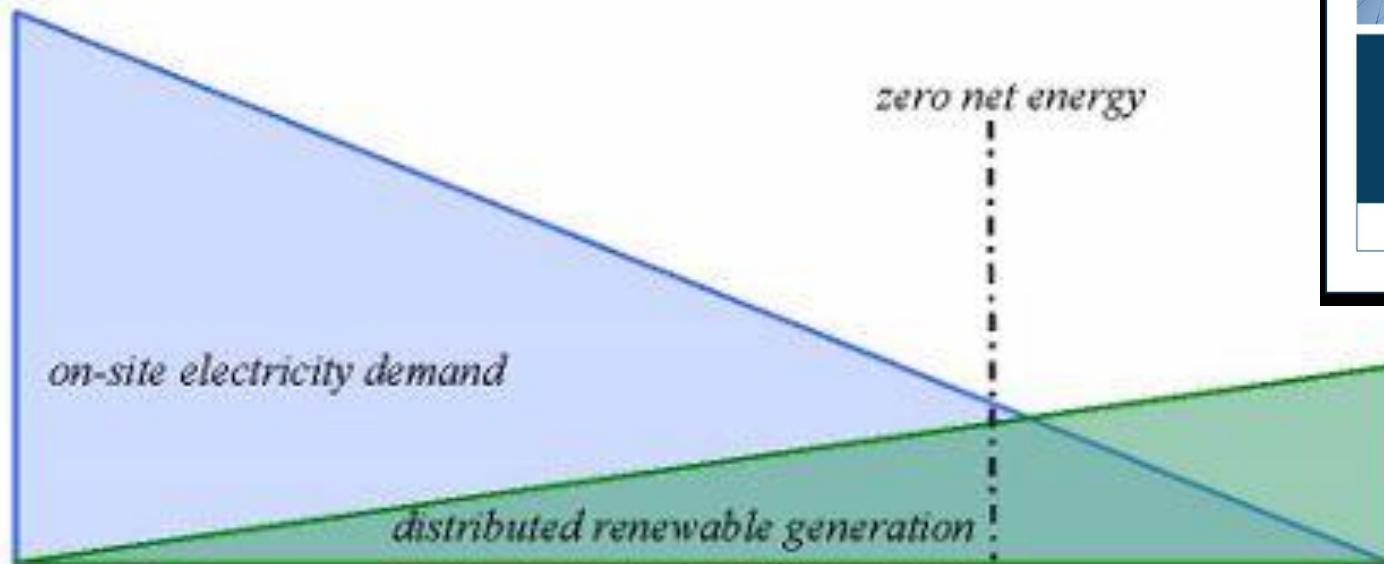
How do California offices use Electricity?



California ZNE goals

100% zero net energy (ZNE) new residential construction by 2020 and commercial buildings by 2030

50% existing buildings ZNE by 2030



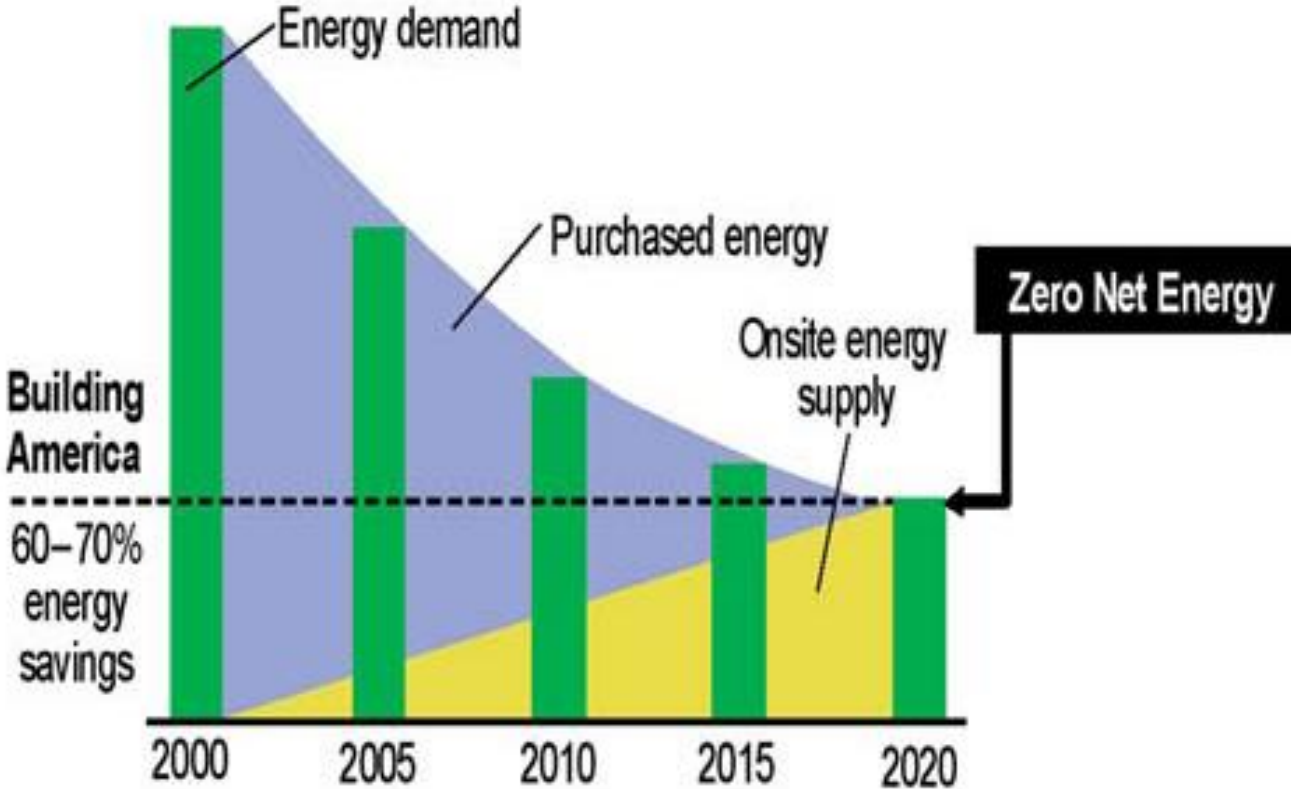
Homes Use Energy in Three Key Ways

- *Structure itself*
 - Insulating qualities of walls, windows, doors, roof, and foundation determined by home's architect and builder – these attributes drive how much energy is needed to keep the home comfortable
- *Items hard-wired to the structure*
 - Furnace, air conditioner, vent fans, water heater, garage door opener, smoke detectors, alarm systems, and most light fixtures are directly attached to the structure; home builder makes most of the key energy efficiency decisions for these devices as well
- *Plug loads (appliances, electronics, portable lighting)*
 - Everything the home occupant purchases separately, brings to the home and plugs in: white goods, consumer electronics, telecommunications and home office equipment, kitchen gadgets, power tools, portable light fixtures, etc.

ZNE Homes Are Achieved Primarily by Reducing Energy Use and Secondarily by Self-Generation

EE=60-70%

RE=30-40%

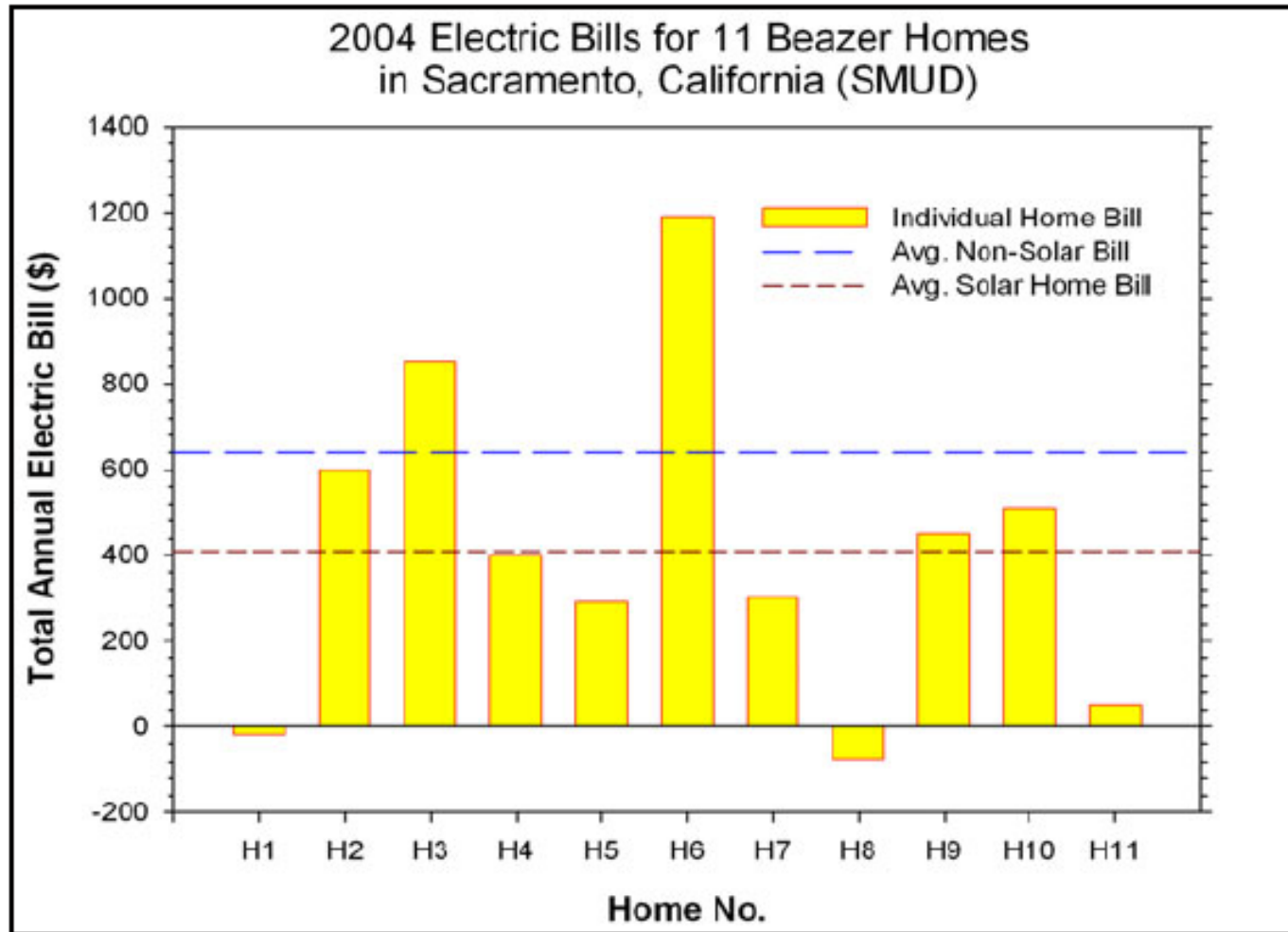


Source: U.S. Department of Energy, Building America Program

What Will It Take for ZNE Homes to Succeed on a Large Scale?

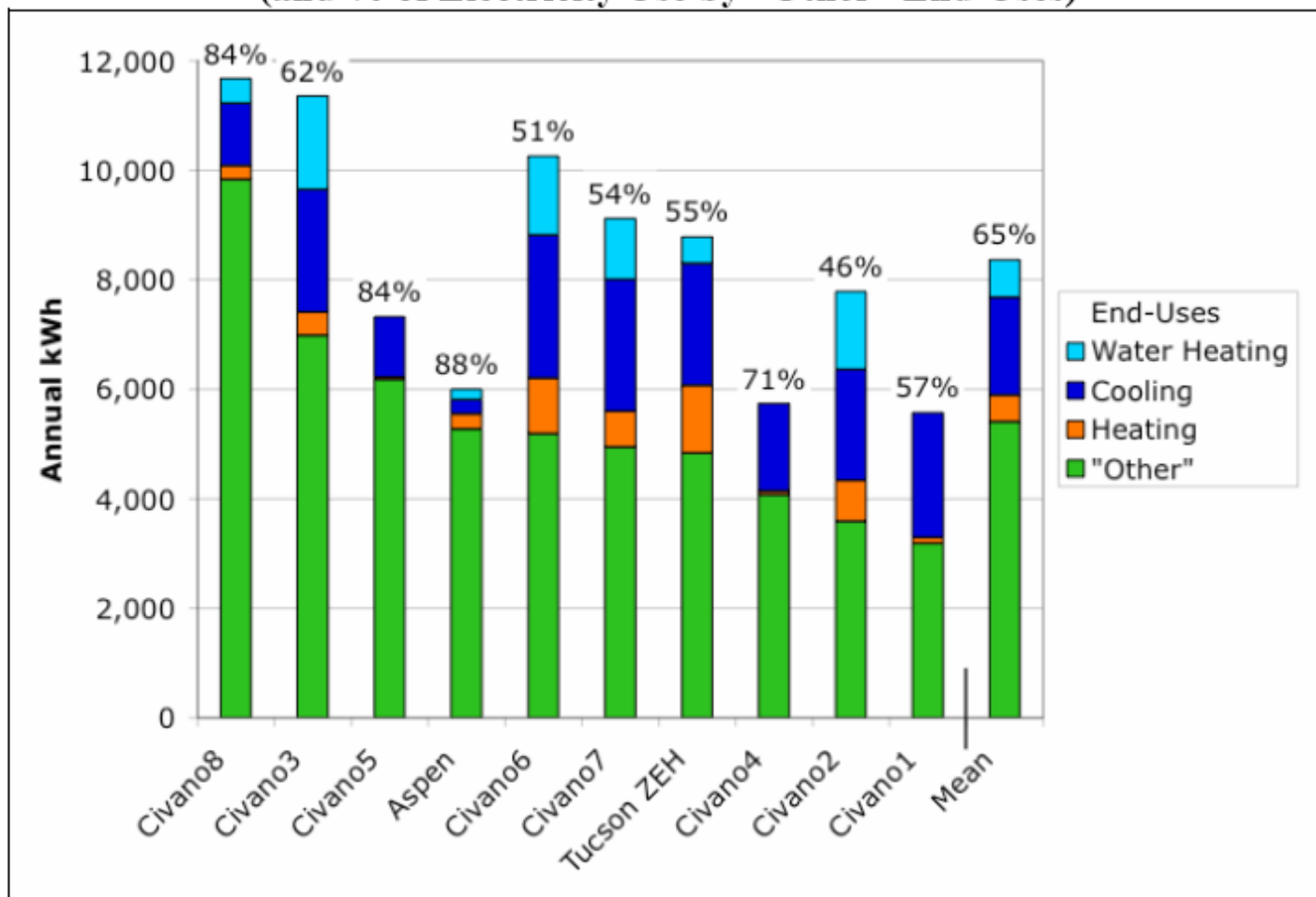
1. Architects, builders and their subcontractors make highly energy efficient choices regarding the building shell and its hard-wired energy-using devices
2. Homeowners and renters make highly energy efficient choices regarding the portable devices they bring to the home
3. (Mandatory efficiency standards, labeling programs and utility incentive programs are helping with 1 and 2)
4. Occupants also learn to *operate* all of the above as efficiently as possible through manual and automatic control, power management, settings, demand response, etc., minimizing their need to purchase electricity and natural gas
5. On-site renewables offset energy purchases, and are small enough and inexpensive enough that they pay for themselves in a reasonable amount of time

The Influence of Occupants: Variation in Energy Use in 11 Otherwise Identical SMUD Solar Homes



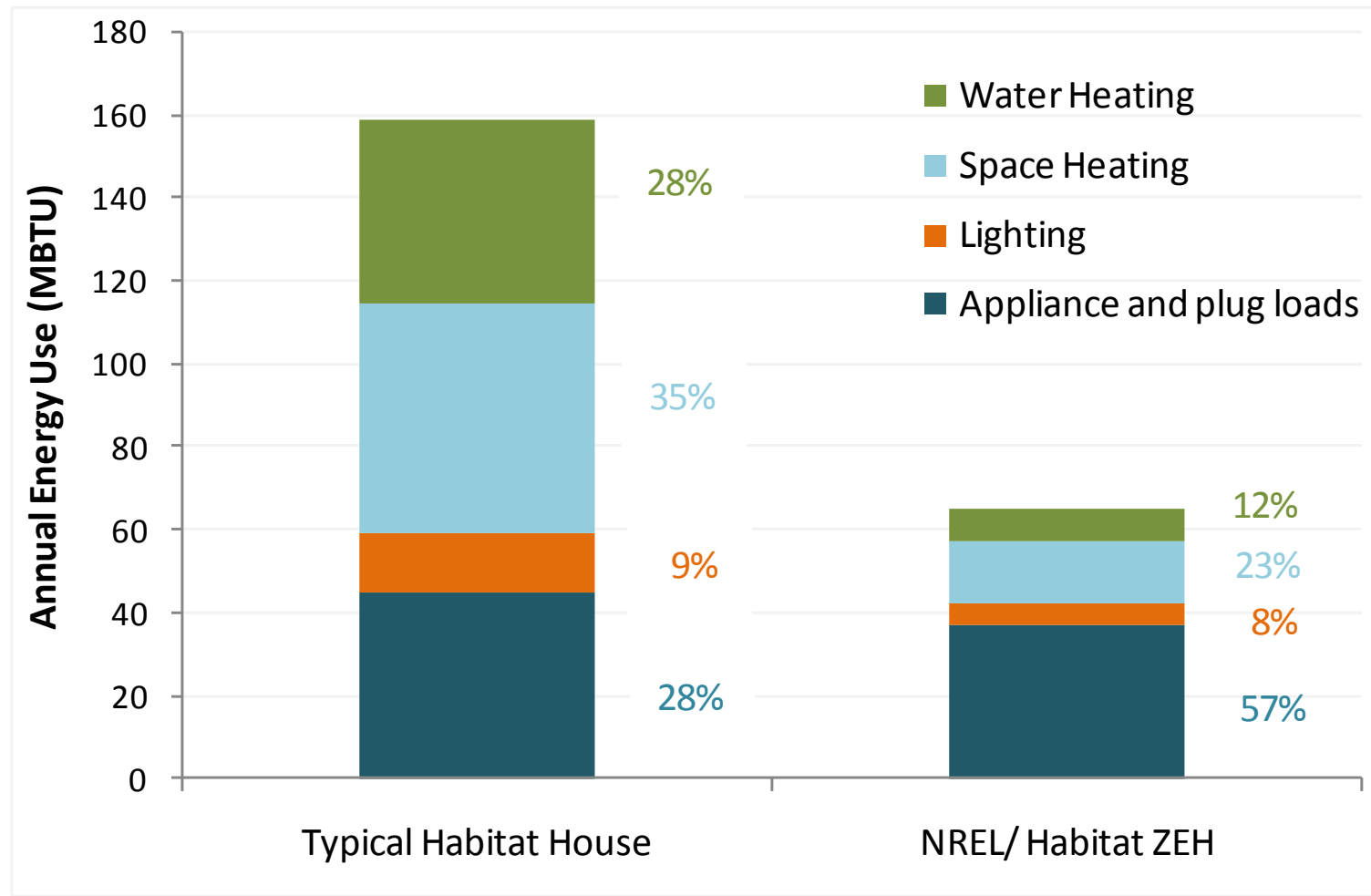
Lighting, Appliances & Plug Loads Are Increasingly Dominant Electricity Users, Especially in Efficient Homes

**Figure 1. Annual Electricity Use by Low-Energy Houses
(and % of Electricity Use by “Other” End-Uses)**

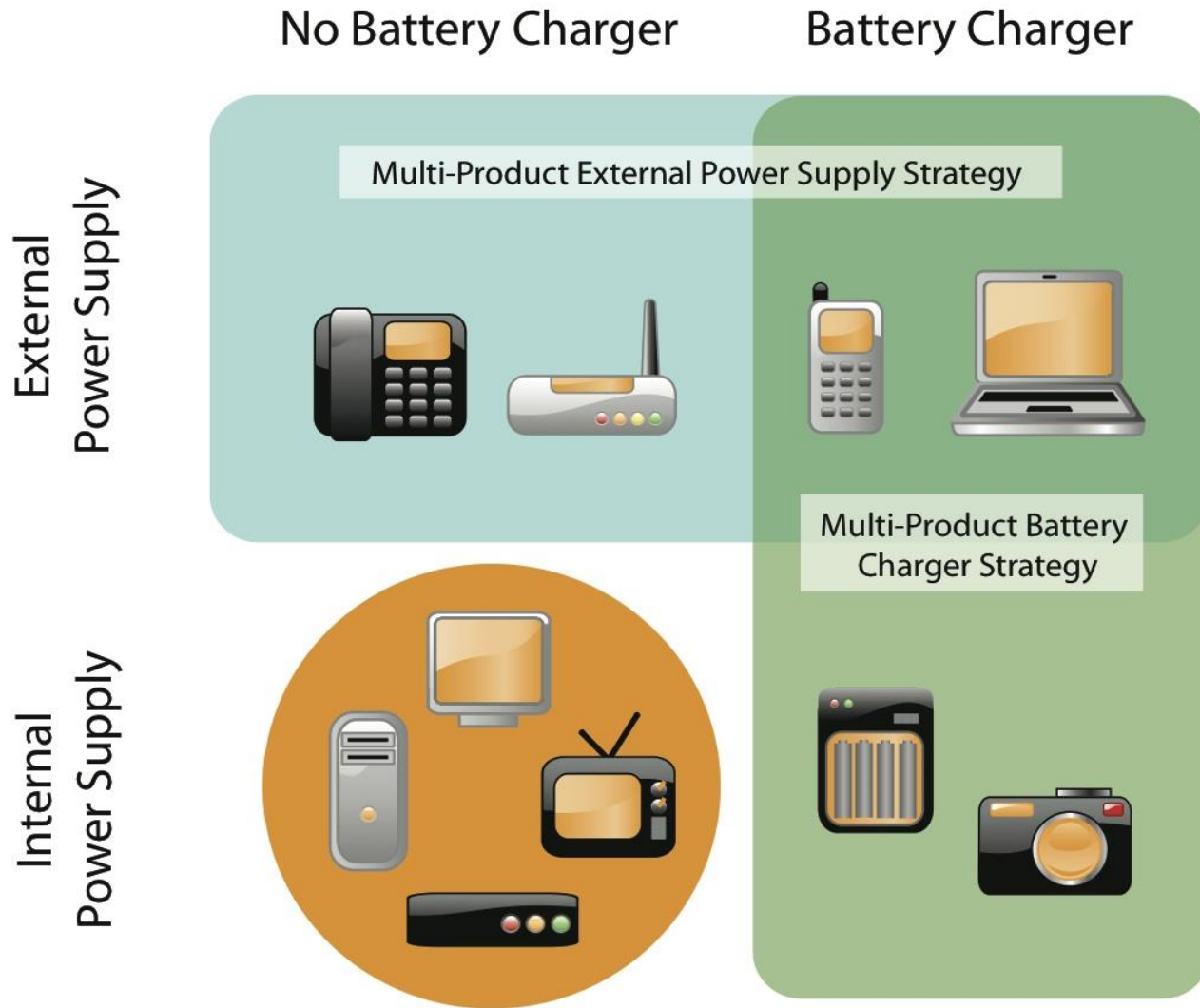


Note: Electricity consumption is actual end-use consumption, before crediting any PV generation.

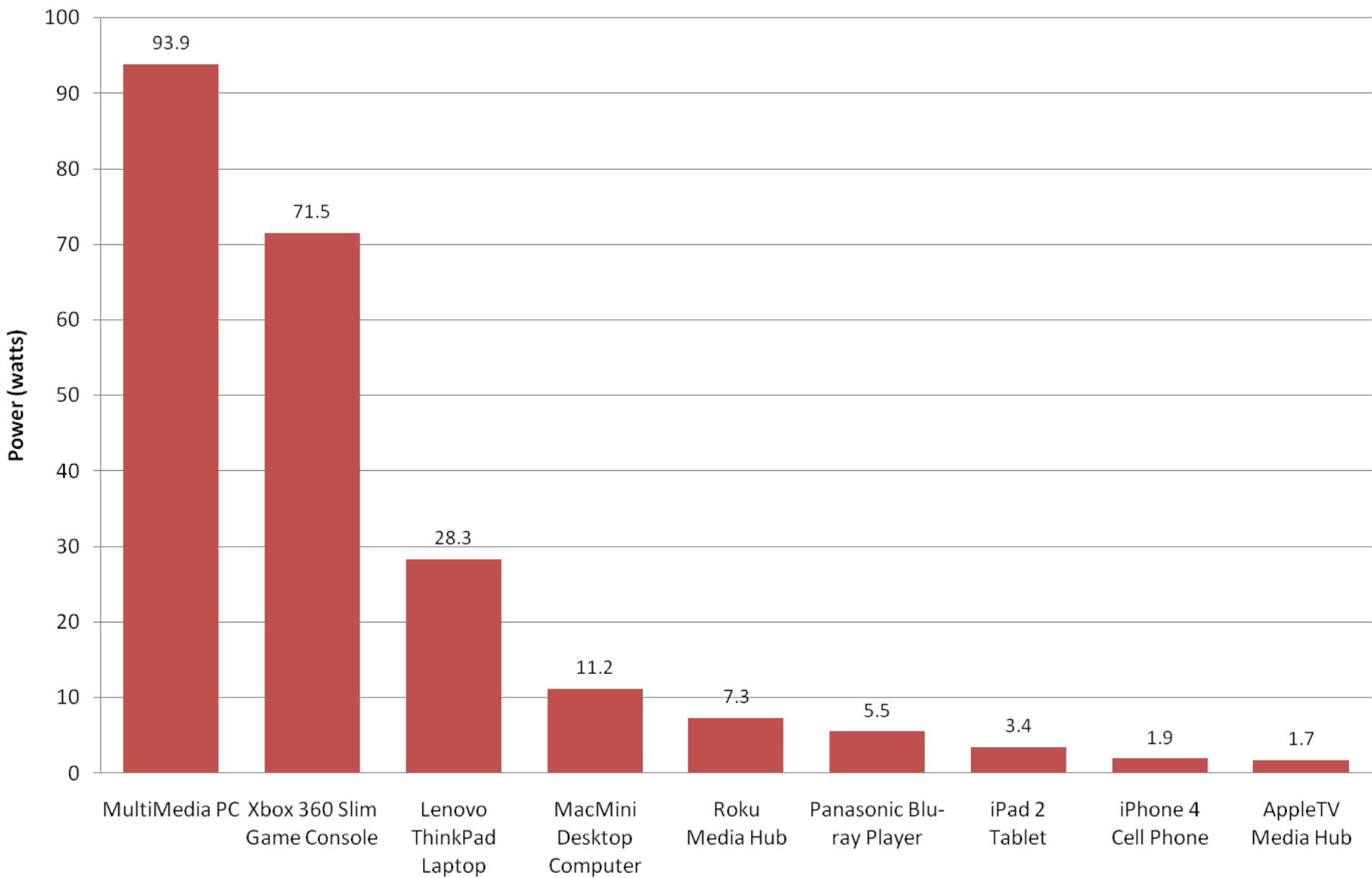
Plug Loads Have Been the Hardest Load for ZNE Design Teams to Reduce



Focus on the "big four" and alternatives



Power Use When Streaming Netflix Video in High-Definition (at least 720p)



The Difference You Can Make By Choosing the Right Plug Loads and Using Them Wisely

| End Use | Efficient House | ZNE House | What Changed? |
|----------------|--------------------|--------------------|---|
| Lighting | 1500 | 600 | 50% CFL → Optimal mix of LED, CFL & HIR + ctrls & daylighting |
| Refrigerator | 750 | 416 | 33 ft ³ Energy Star side by side → 25 ft ³ french door TopTen |
| Dishwasher | 295 | 190 | Energy Star → TopTen with no prewashing, full loads |
| Clothes Washer | 200 | 90 | Energy Star top load → TopTen front load |
| Clothes Dryer | 850 | 450 | Avg electric → Best natural gas or heat pump |
| Television | 719 | 97 | 3 2010 Energy Star TVs (55/40/32") → 1 55" TopTen + tablets |
| Set Top Box | 1183 | 190 | 3 2010 HD DVRs → 1 best 2013 multi-room DVR |
| Computers | 456 | 100 | 2 Energy Star desktops → 1 TopTen desktop + iPad |
| Game Console | 200 | 50 | 1 older Xbox 360 or PS3 → laptop or iPad |
| Other | 200 | 100 | → smart plug strips, timers, efficient EPS & BCS |
| TOTAL | 6353 kWh/yr | 2283 kWh/yr | 64% reduction! |

Thank You

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