Plug Load Success Stories and Remaining Savings Opportunities

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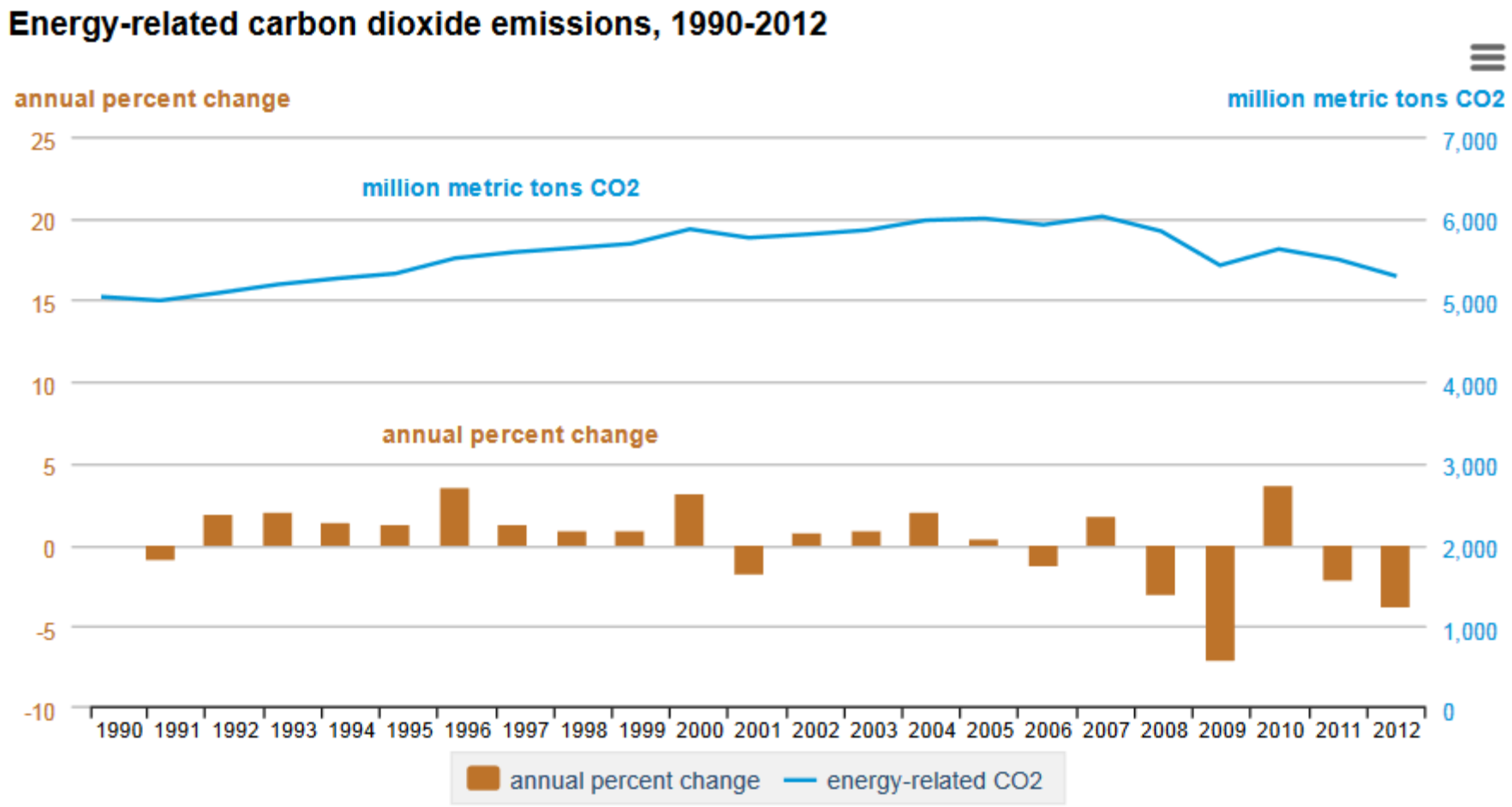
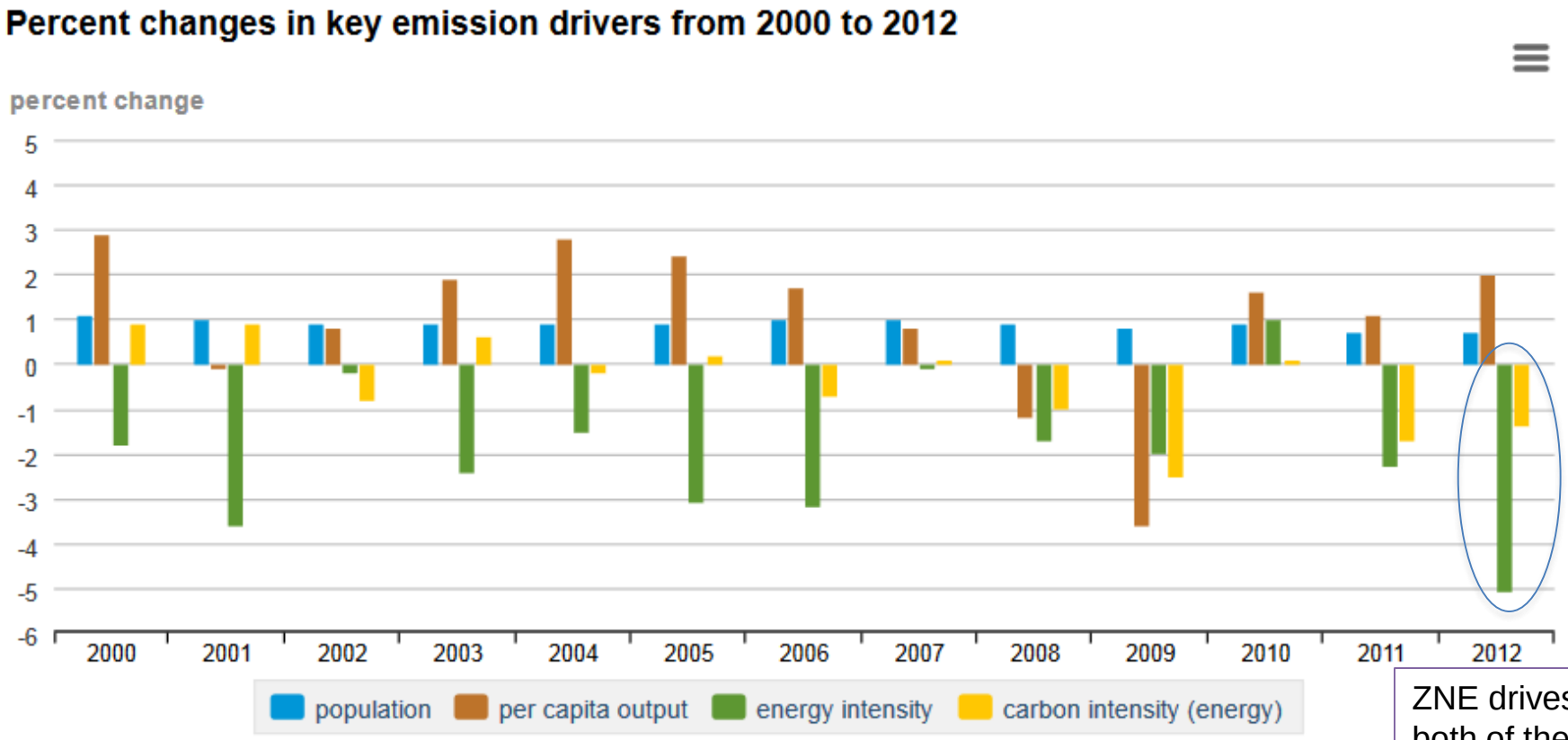
Intelligent Efficiency Conference
November 18, 2014

Largest Annual Decline in US CO_2 Emissions Was 7% in 2009. But We Need 22 Straight Years of 7% Reductions to Achieve a Total Drop of 80%!



Source: http://www.eia.doe.gov/oiaf/environment/emissions/carbon/

Factors Affecting US CO_2 Emissions Over Time



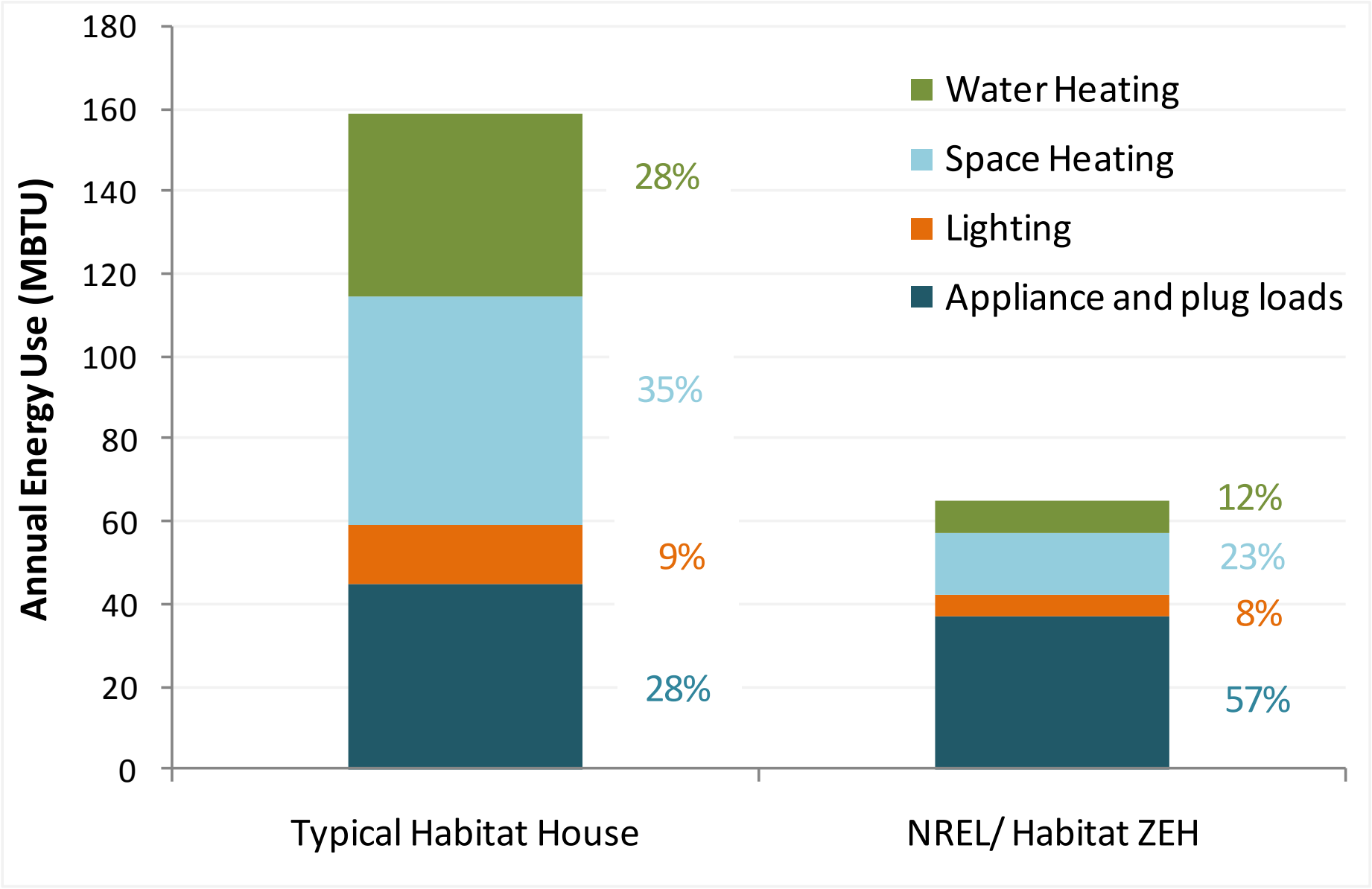
ZNE drives both of these

How Much of the Job Can Increasingly Stringent Building Codes Do?

	Newer Dwellings (Built after 1996)	Older Dwellings	Percent Difference
Annual Electric Household Consumption	7,159	5,960	20%
Annual Gas Household Consumption	468	459	2%
Dwelling Size	2039	1,434	42%
Number of Residents	3.14	2.93	7%
Average Income	86,276	58,082	49%
Percent Single Family	74%	58%	28%
Owners	83%	62%	35%
Saturation of Central AC	78%	41%	93%
Cooling Degree Days	962	900	7%
Cooling Degree Days (those with CAC)	1,119	1,279	-13%
Programmable Cooling Thermostat	85%	47%	83%
Pool Saturation	13%	8%	59%
Average Number of Computers per Home	1.21	0.93	30%
Gas Primary Heating	86%	83%	5%
Heating Degree Days	2,050	2,023	1%
Exterior Wall Insulation Throughout	91%	51%	77%
Attic Insulation	91%	66%	38%
Double Pane Windows Throughout	79%	31%	157%
Low Flow Showerheads Throughout	71%	54%	32%
Average Number of CFLs per Home	2.29	1.74	32%

Homes Use Energy in Three Key Ways

- *Structure itself*
  - Insulating qualities of walls, windows, doors, roof, and foundation determined by home's *architect, engineer 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.

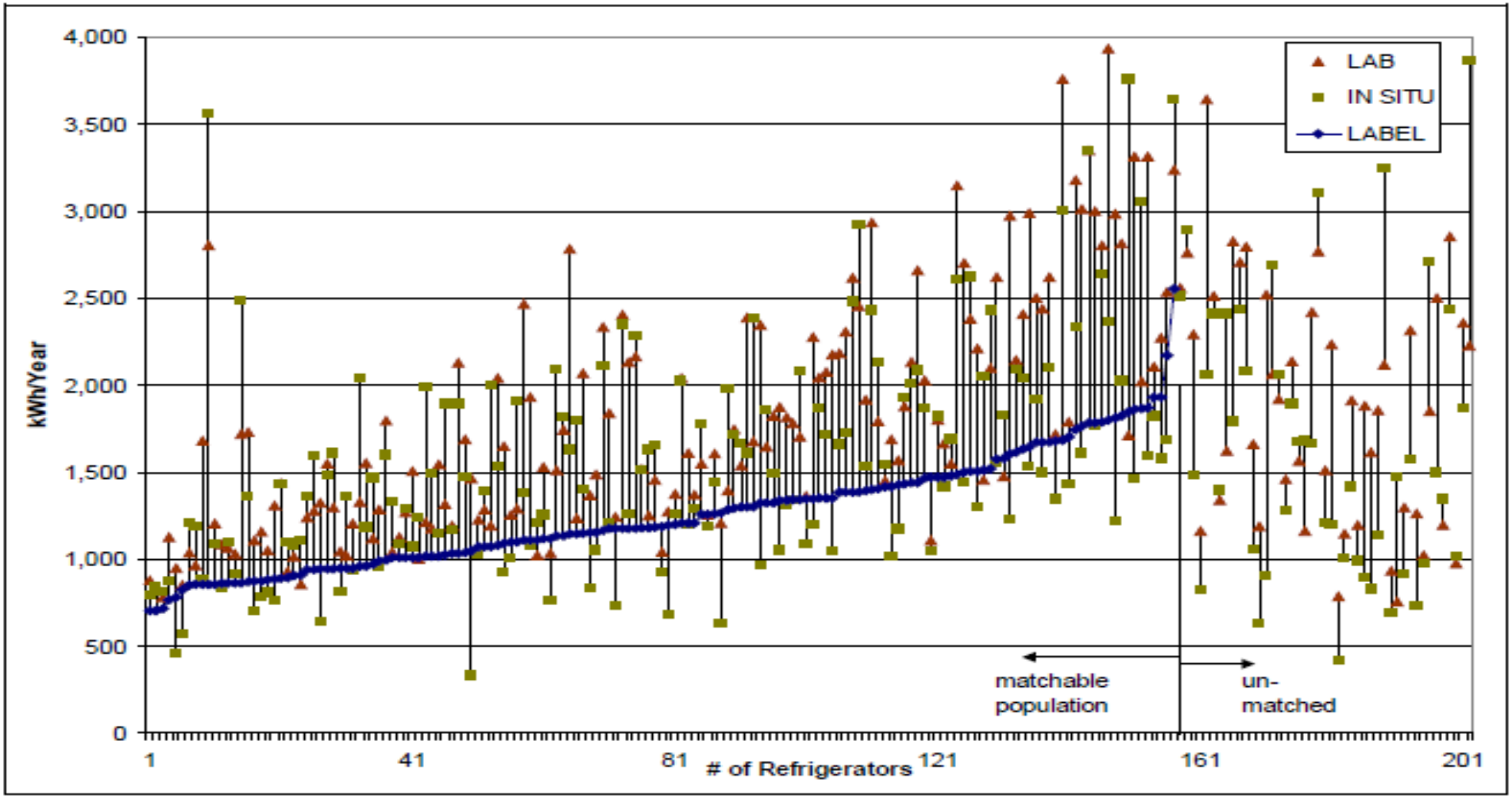


Source: Norton et al. 2008)

ZNE not Reachable by Focusing Only on the Building

- The share of a building's energy use controlled by the decisions of the architect, engineer and builder is dropping steadily
- The more sophisticated the energy-using technology in homes and businesses becomes, the more its energy consumption is driven by occupant behavior
- The more sophisticated technologies like computers and game consoles become, the more people are tempted to use them for applications that they are not optimized to deliver efficiently (like movie watching on a game console)
- We need ZNE occupants for ZNE buildings – people who are trained to buy the right plug-in devices for their application and use them in efficient ways.

Tight Appliance Standards Only Solve Part of the Plug Load Problem

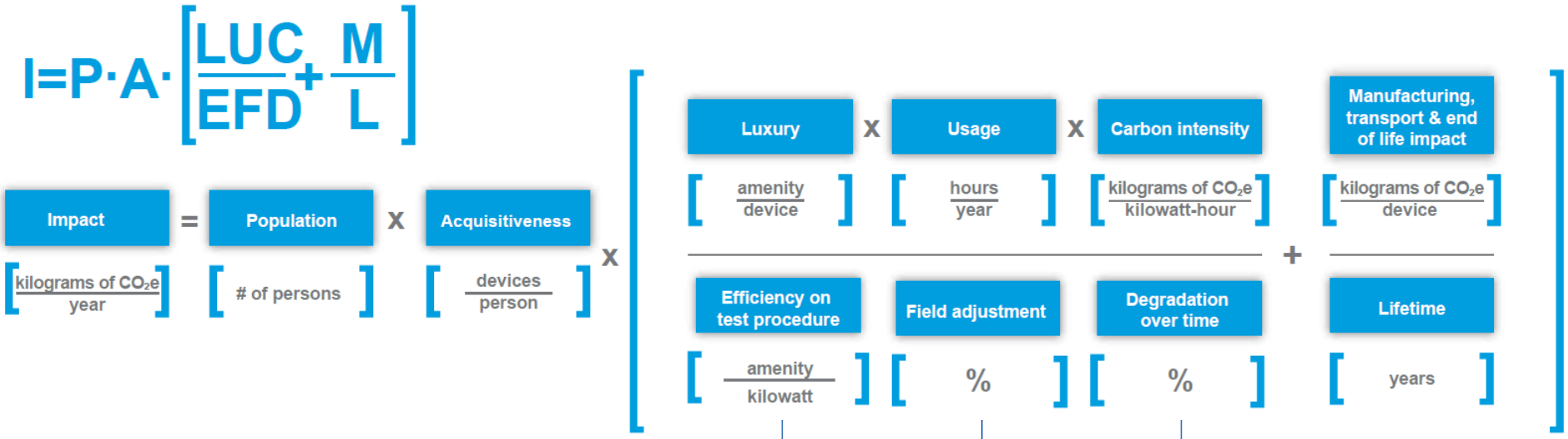


- Blue dots: EnergyGuide label values when fridges were new – 1,274 kWh/year on average
- Green squares: measured energy use of old fridges in homes -- 1,573 kWh/year on average (23% more)
- Red triangles: measured energy use of old fridges in the lab – 1,809 kWh/year on average (42% more)
- Need greater realism in test procedures for new products and a way to adjust values over time

Why Do These Differences Between Test Procedure and Field Data Arise?

- Because government test procedures are first and foremost designed to be affordable and highly repeatable, and secondarily to be realistic and representative of actual use.
- The reasons for divergence in real vs. test procedure energy use vary:
  - Refrigerators – doors opened and closed, food inserted and removed, icemaker operation, room temperature variations, dust on coils, loss of R-value in insulation over time
  - Computers – installation of additional software, connection of additional peripherals, and access to broadband increase idle power in the field, as well as changing the mix of time spent in each mode (particularly if power management is not fully enabled)
  - Televisions – ambient lighting levels in homes differ from those in the test procedure and users can easily choose different display modes and connectivity options than the defaults being measured

Focusing Our Efforts only on Increasing Sales of Efficient Products Misses Most of the Ways to Reduce CO_2 Emissions



1. Make test procedure as realistic and representative as possible

2. Correct for any remaining differences in new products with field adjustment factor

3. Account for degradation or improvement in performance and power use over time in older products

13 to 35% Greater Computer Energy Use in the Real World than Predicted by ENERGY STAR Test Procedure

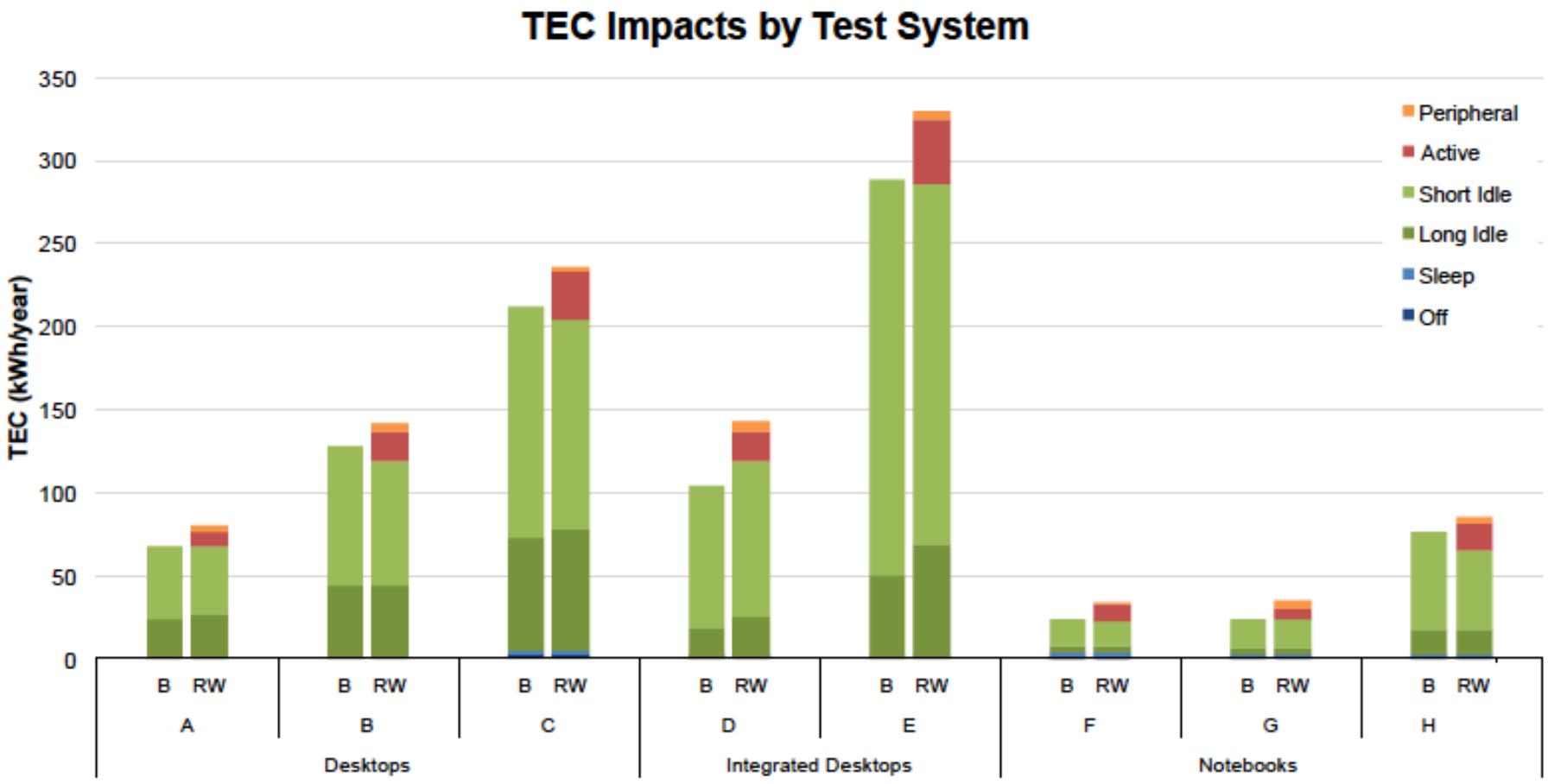
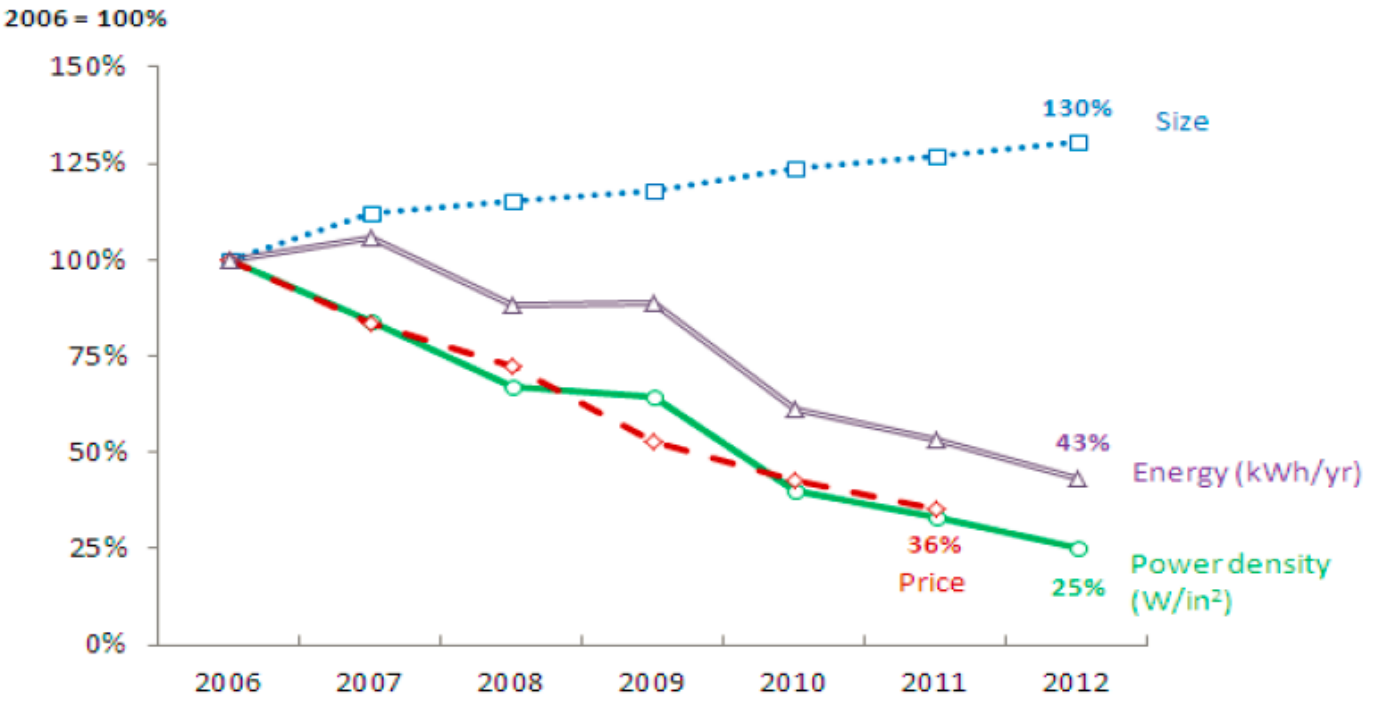


Figure 3: Baseline (B) and real-world (RW) TEC impacts by test system

California IOUs and NRDC addendum to submittal on computers to the CEC, October 27, 2014.

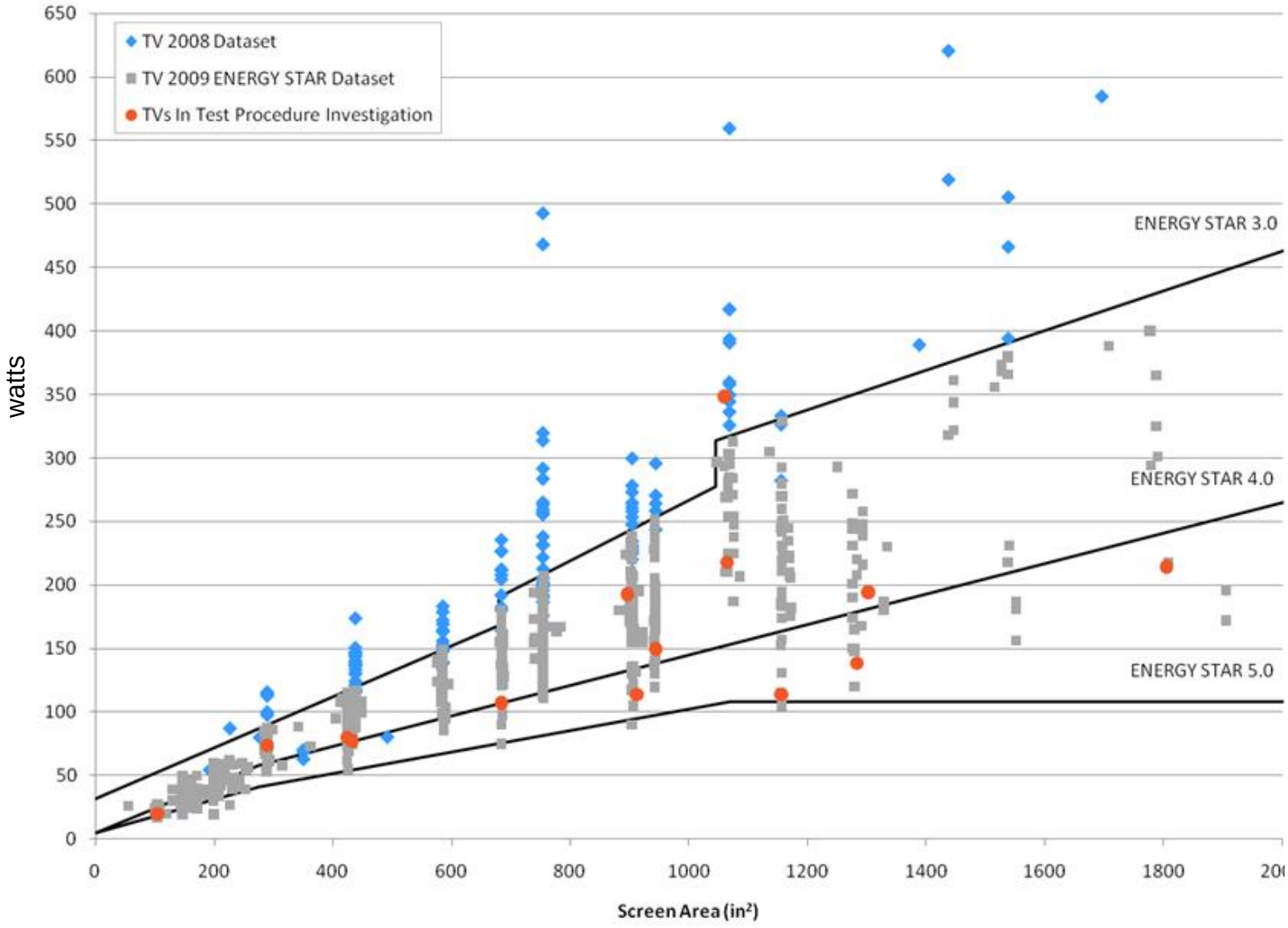
TV Trends Since 2006



- Since 2006, size has increase by 30%, while power density (W/in^2) has improved by 75%. These two factors result in a 57% improvement in average energy consumption.
- The average price for a 32 inch TV in 2011 was almost one-third what is was in 2006. Other size categories have seen similar dramatic decreases in price.

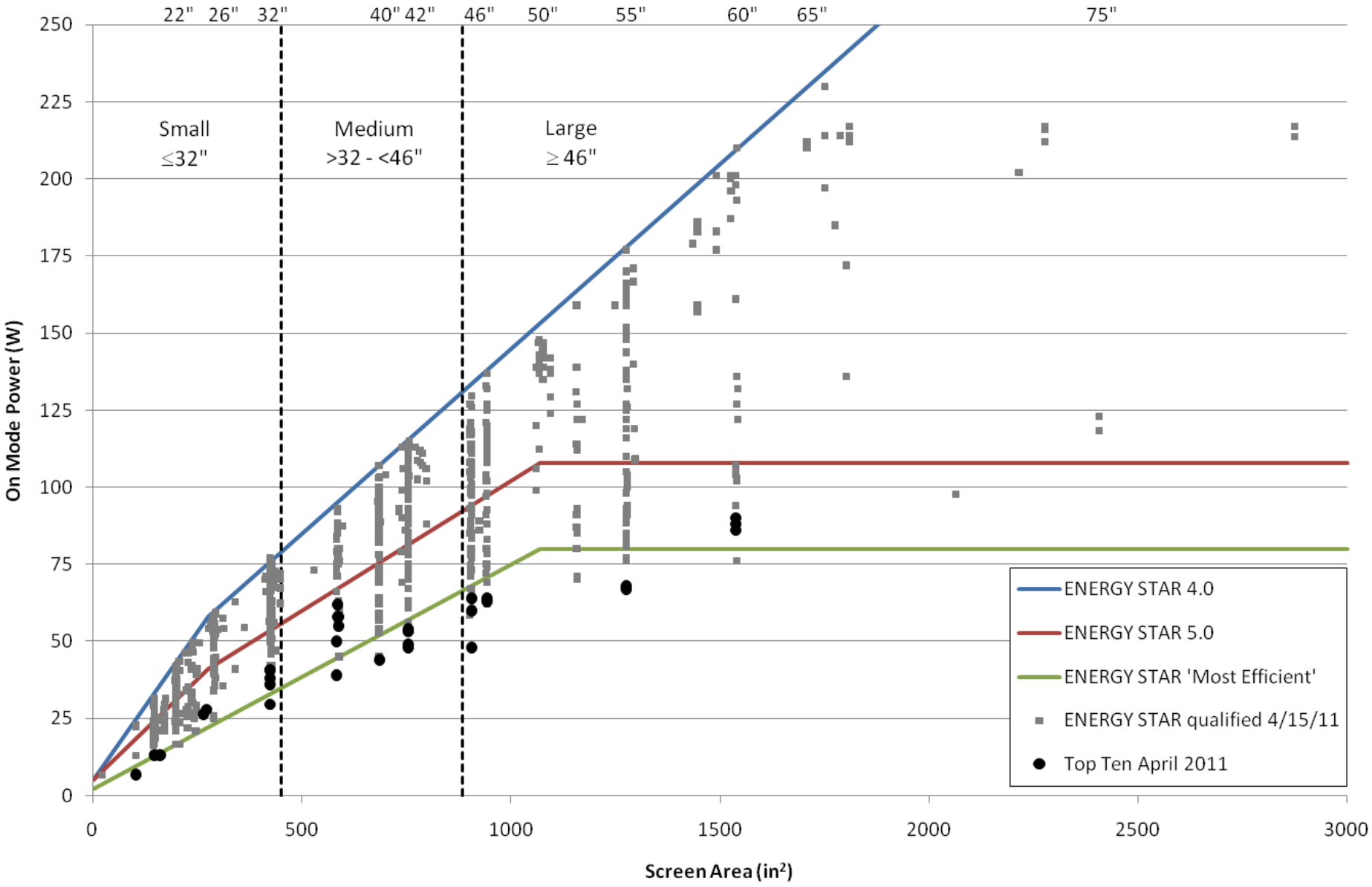
NRDC

How Has TV Power Consumption Changed in Recent Years?

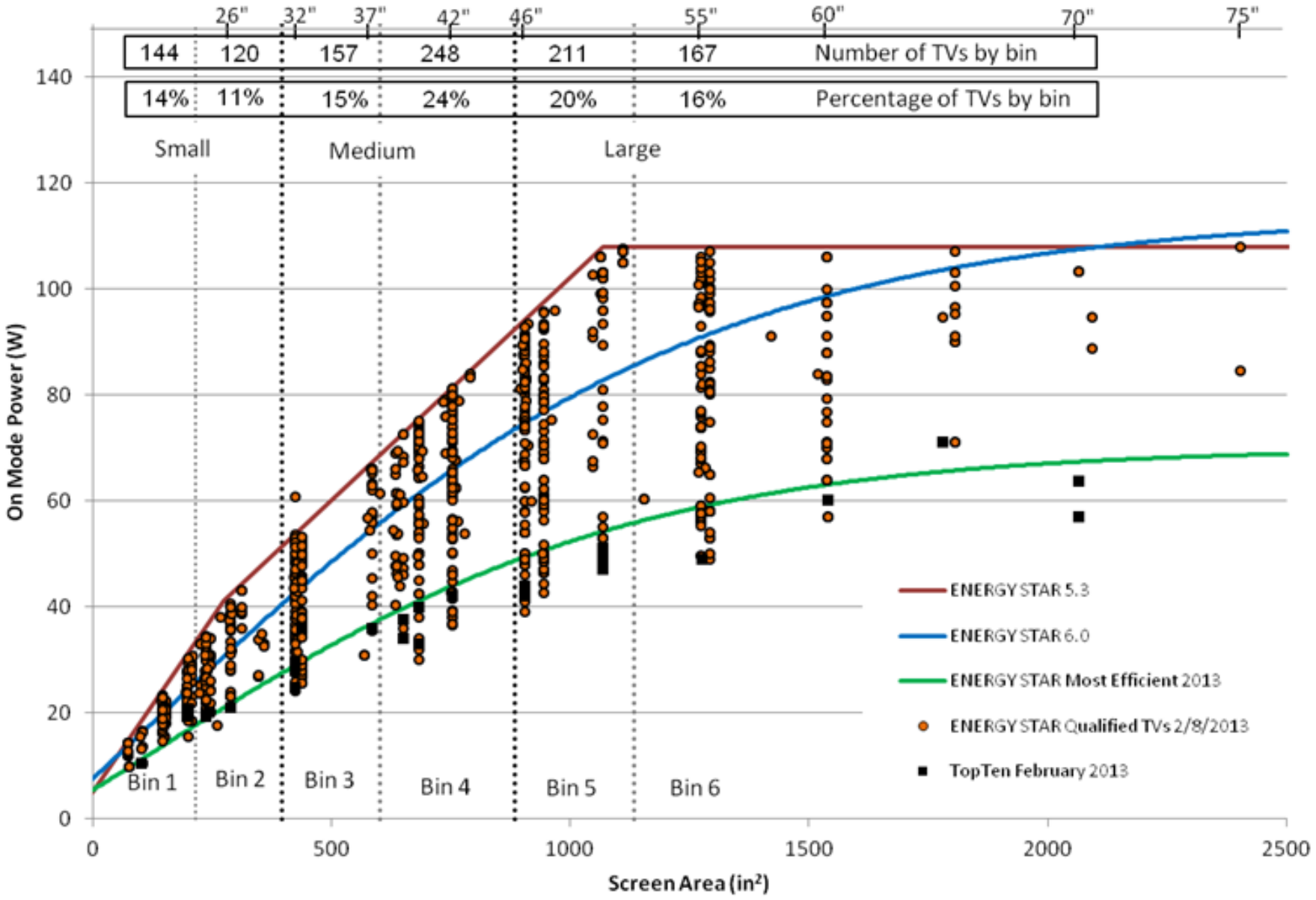


Every 150 watts = another PV panel on the roof

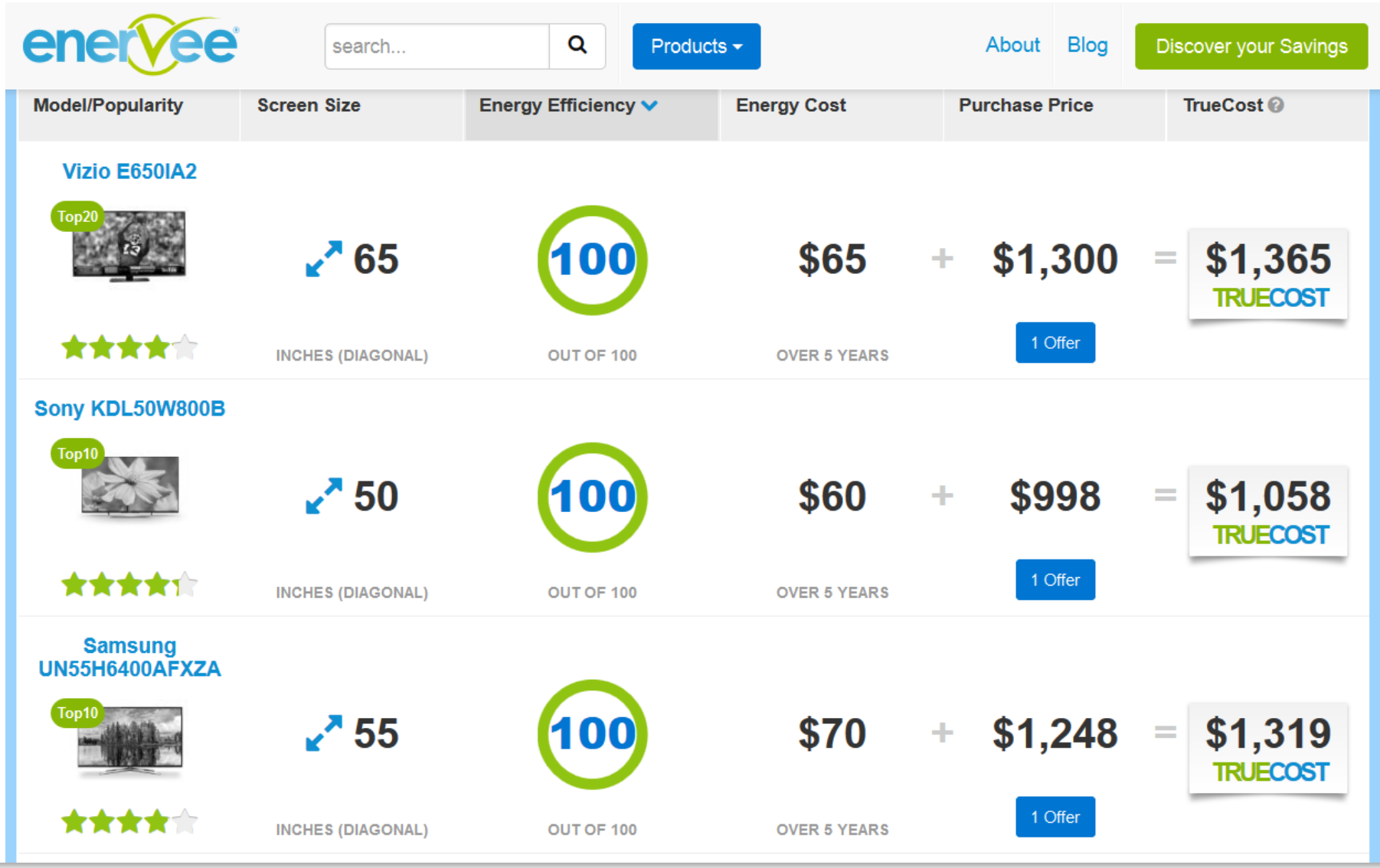
TV Market Status in Early 2011



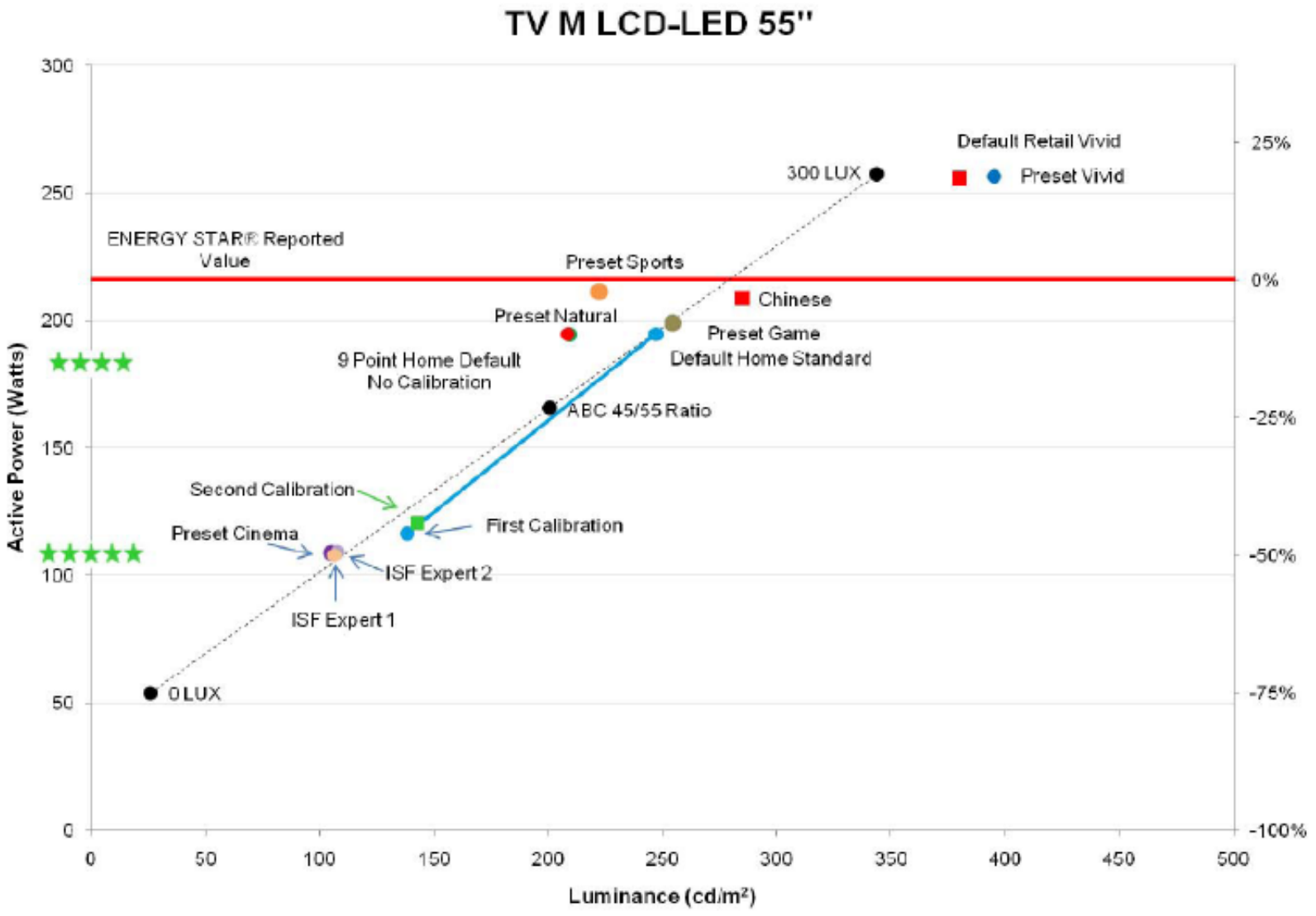
Recent Developments with TVs



Enervee – A New Web-Based Tool for Finding the Most Efficient and Cost Effective Products



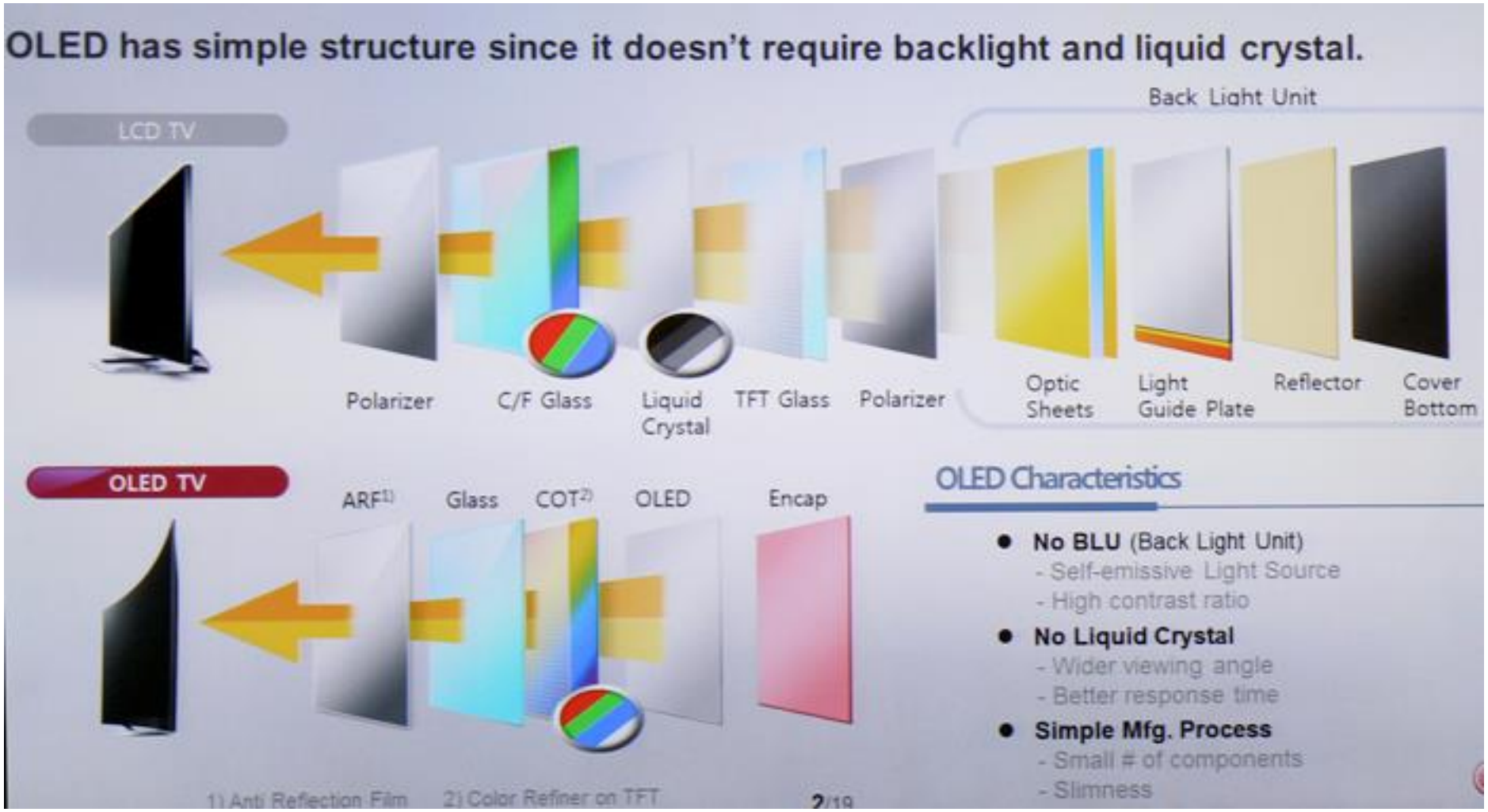
How Efficient Is Your TV? It Depends on How It Is Designed and How You Use It



Key Strategies for Saving Energy in TVs

- Screen area rises fast as diagonal screen size gets bigger, and energy use rises with screen area.
- Don’t buy a screen size any larger than you need. Smaller screens viewed from a closer distance yield a similar field of view.
- Make sure automatic brightness control is switched on.
- View TV in a mostly darkened room for better picture quality and lower energy use.
- Choose cinema or movie mode on your TV instead of retail, vivid or sports mode to save additional power.
- TVs that offer a quick start mode and lots of network capabilities can draw far more power when they appear to be off.
- Early 4K LCD TVs will have higher picture quality but process far more data per second and require brighter backlights to light up their 8 million pixels.
- The newest display technologies like OLED may ultimately prove to be the most efficient, but are still pretty pricey and hard to find.

OLEDs: Simpler Technology Yields Efficiency and Performance Advantages over LCDs



http://www.forbes.com/sites/johnarcher/2014/11/12/oled-for-everyone-lg-explains-how-its-making-oled-tvs-affordable/

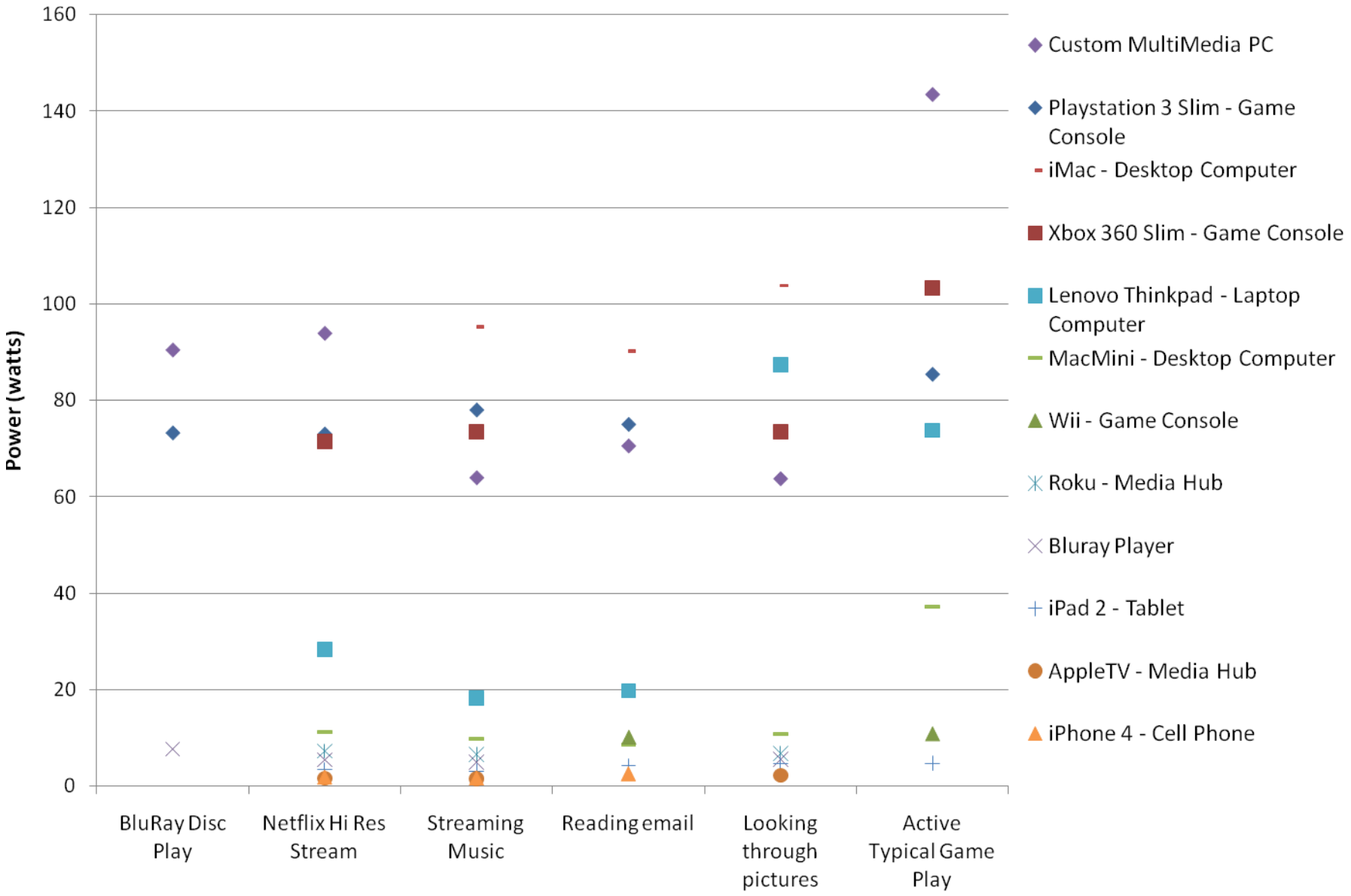
OLEDs Will Prosper Because They Deliver a Better TV Viewing Experience, Not Just Because They Save Energy

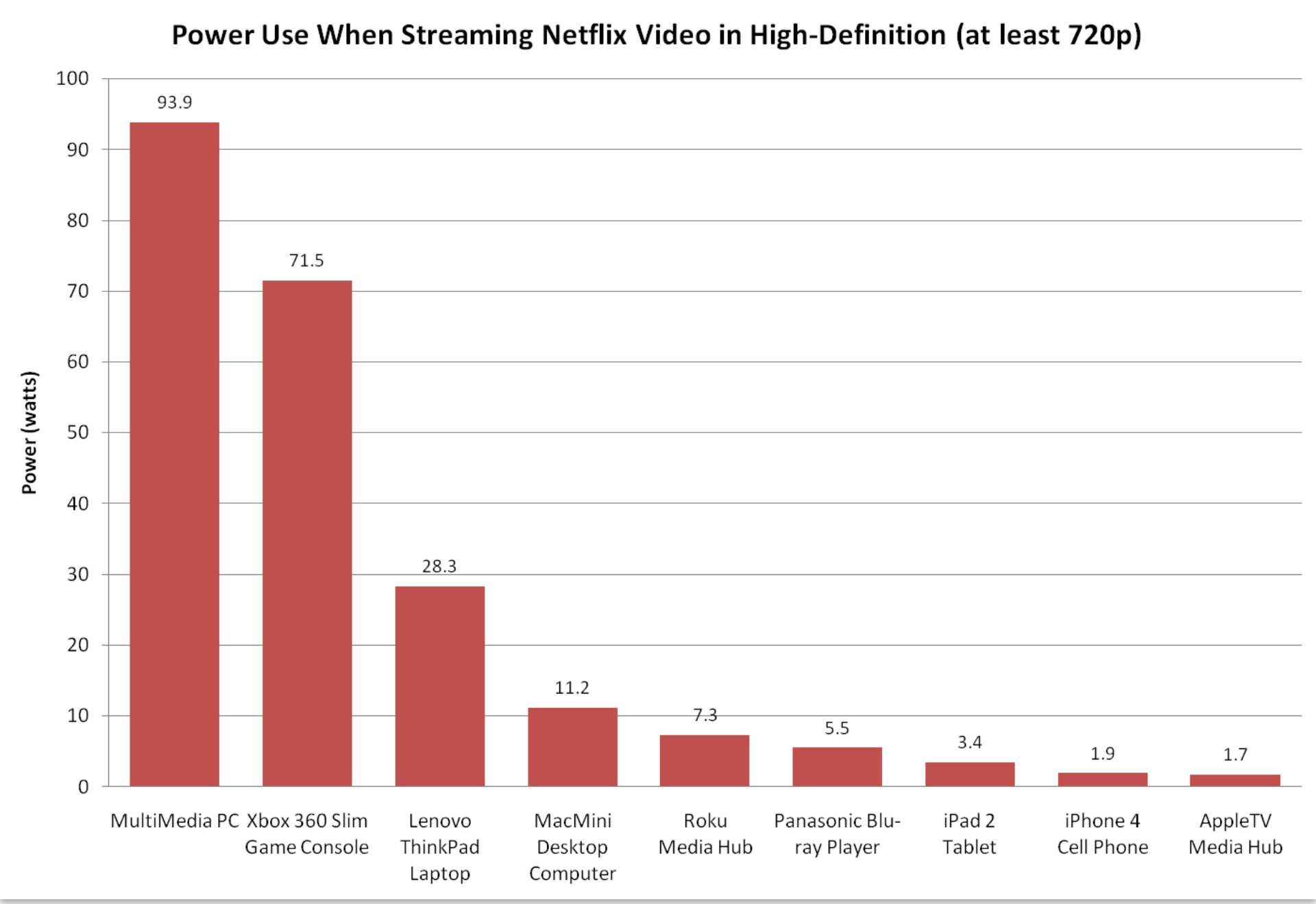

ENERGY GUIDE
$17
As Advertised
OPTICAL
LG OLED TV
THE ULTIMATE DISPLAY

Power Scaling: The Next Frontier

- Electronic products need to do a better job of scaling their power use to how hard they are working.
- Right now, many products like game consoles and set top boxes consume nearly their full power to perform simple tasks like playing music or looking at photos.
- Implication: if multi-functional products can’t do simple tasks efficiently, use simpler products to do simple tasks.

Universal Task Testing Reveals How Well Products Power Scale

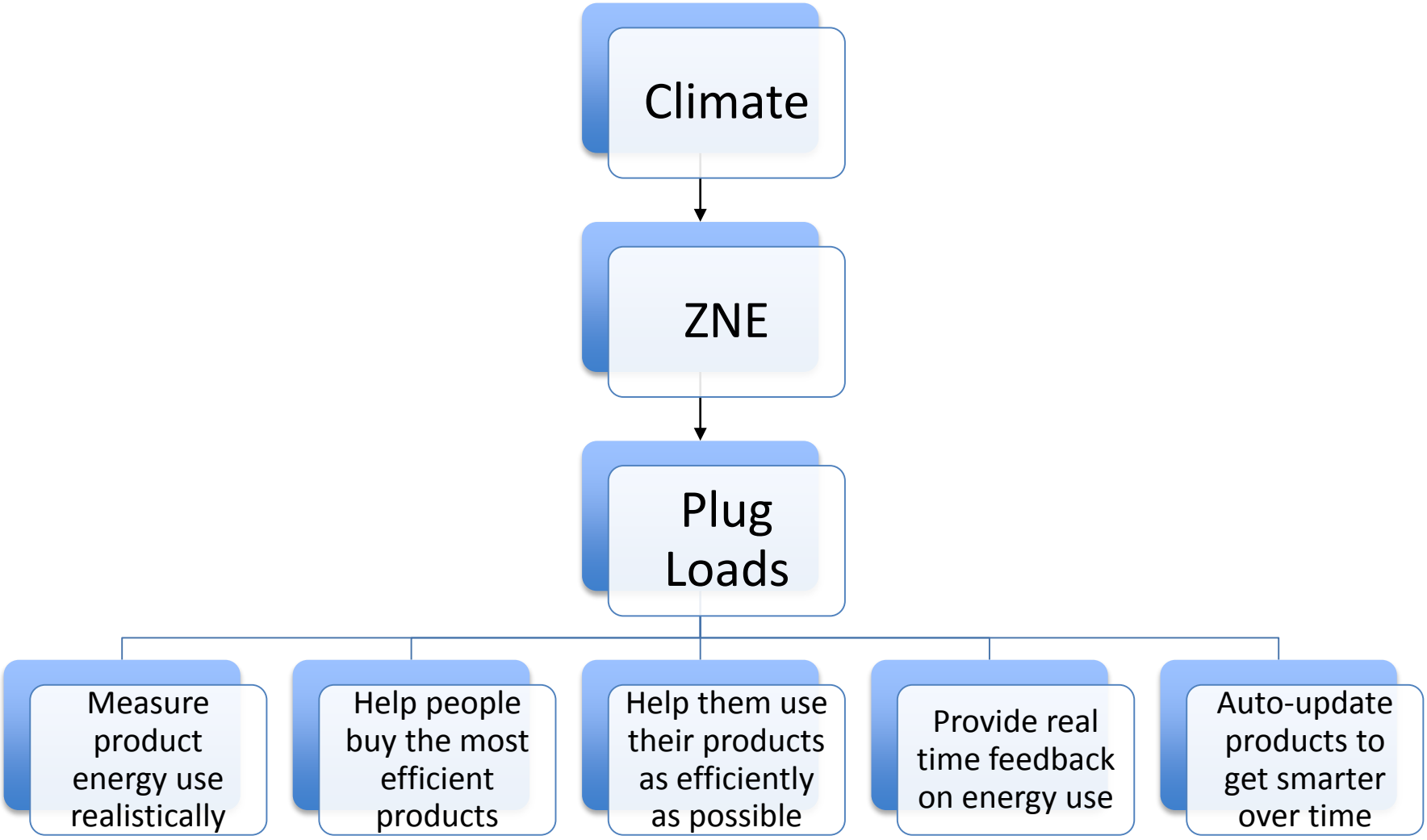



Power Use When Streaming Netflix Video in High-Definition (at least 720p)
Power (watts)
100
90
80
70
60
50
40
30
20
10
0
93.9
71.5
28.3
11.2
7.3
5.5
3.4
1.9
1.7
MultiMedia PC
Xbox 360 Slim Game Console
Lenovo ThinkPad Laptop
MacMini Desktop Computer
Roku Media Hub
Panasonic Blu-ray Player
iPad 2 Tablet
iPhone 4 Cell Phone
AppleTV Media Hub

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 lighting types and controls
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 + tablet
Game Console	200	50	1 older Xbox 360 or PS3 → laptop or tablet
Other	200	100	→ smart plug strips, timers, efficient power adapters
TOTAL	**6353 kWh/yr**	**2283 kWh/yr**	**64% reduction or 11-12 PV panels and associated racking, labor, and inverter capacity avoided!**

Summary


Climate
ZNE
Plug Loads
Measure product energy use realistically
Help people buy the most efficient products
Help them use their products as efficiently as possible
Provide real time feedback on energy use
Auto-update products to get smarter over time

Thank You

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