

Computers Energy Efficiency Innovation and Trends

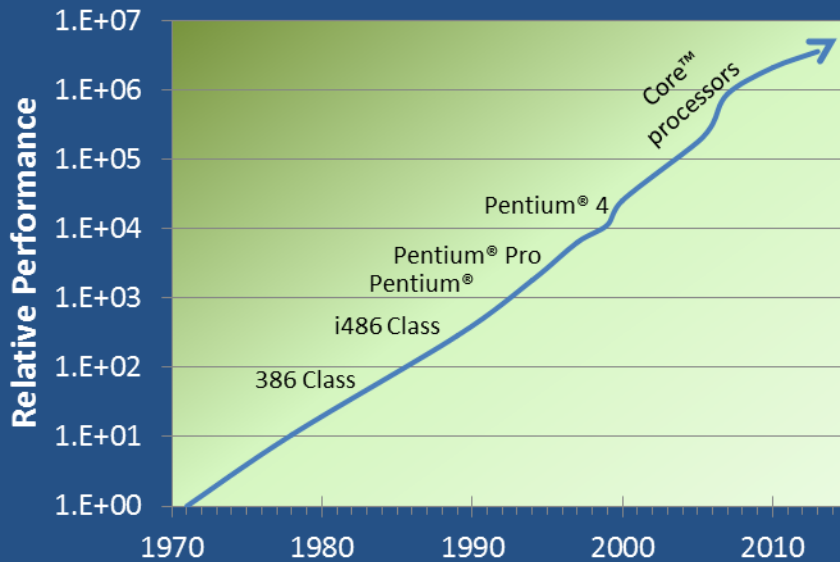
Shahid Sheikh

Intel Corp.

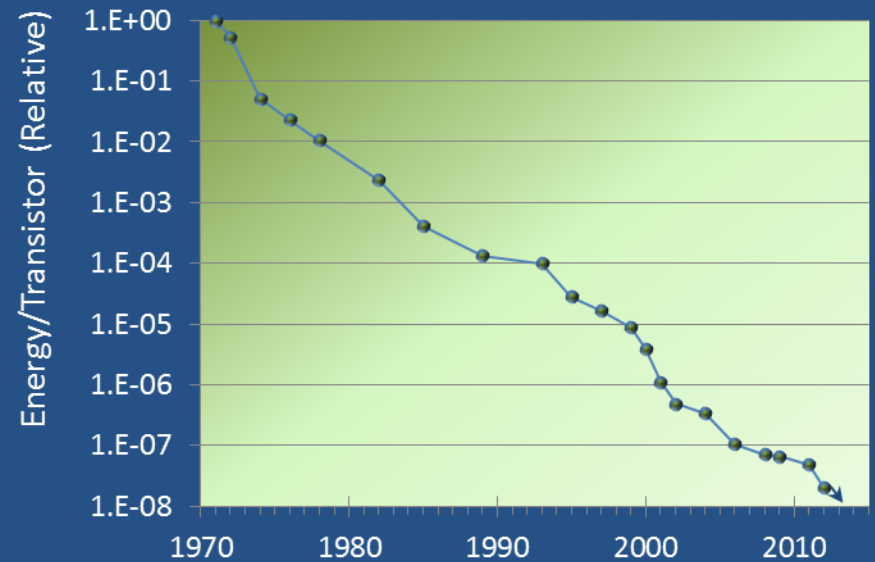
November 6, 2014

Moore's Law drives Energy Savings at the silicon

CPU Compute Capability Over Time*



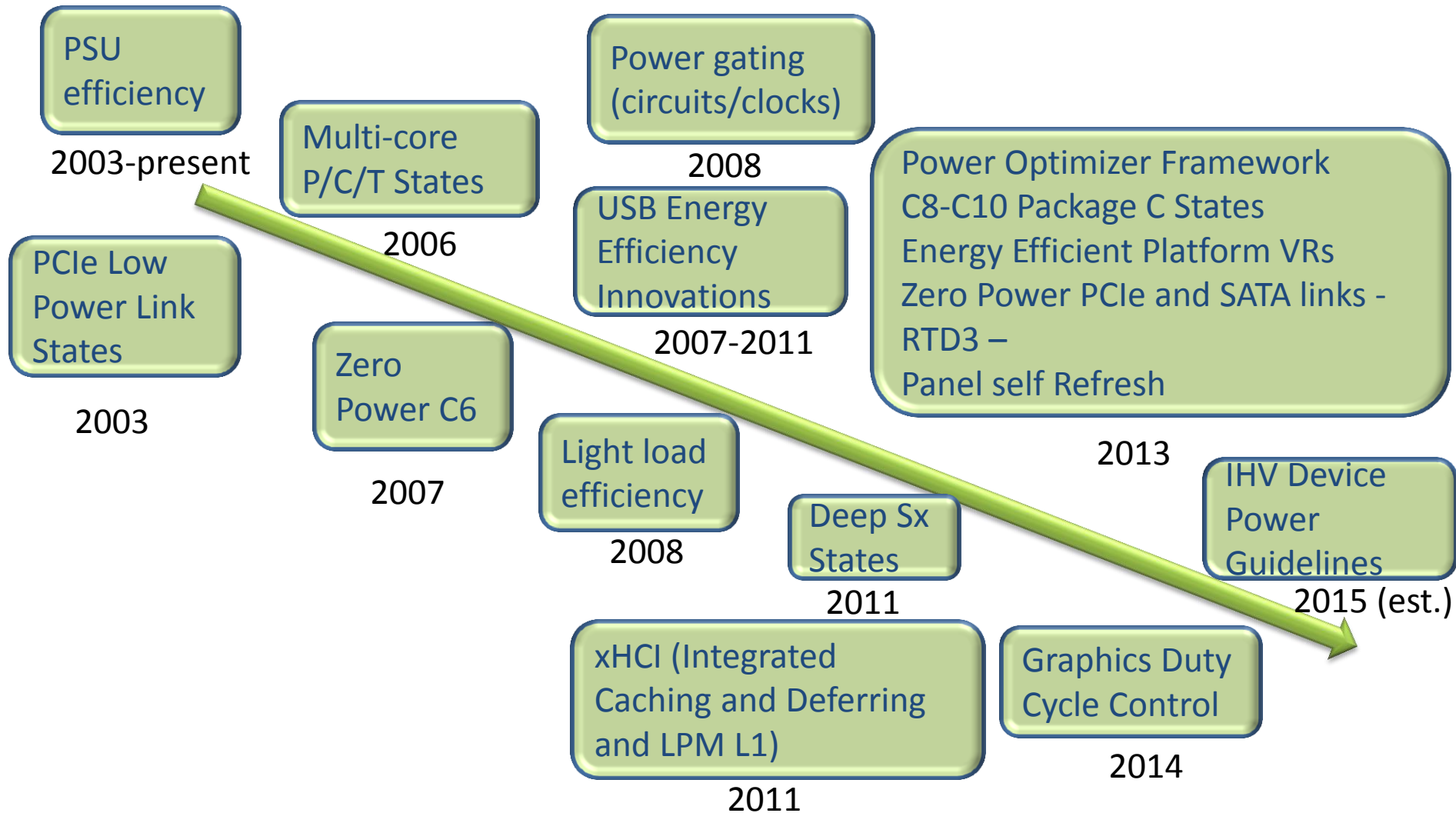
Power Reduction Over Time*



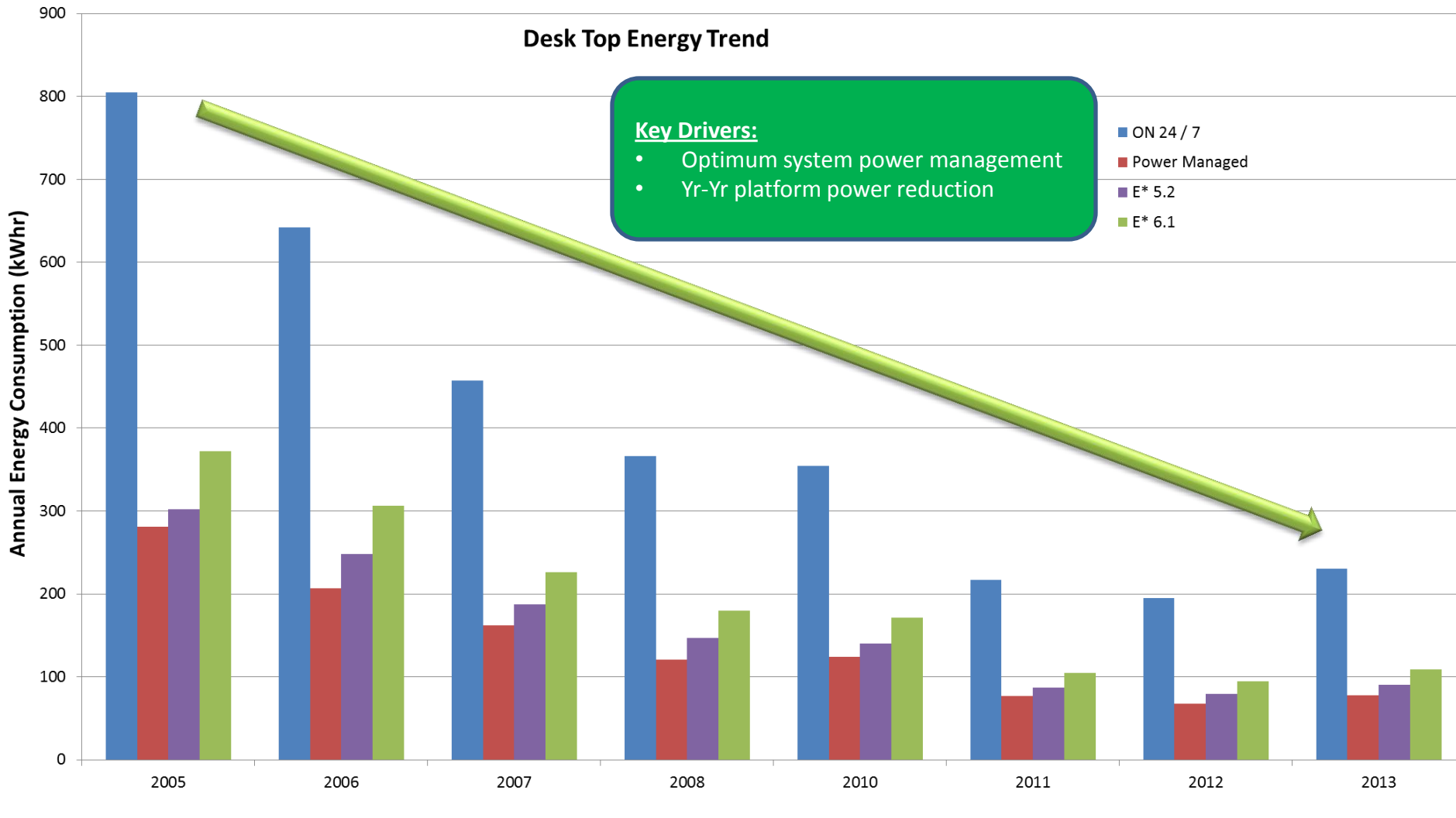
**Source: Intel Corporation – January 2014. Relative performance chart estimates based on reported MIPS and SPEC CPU scores over this time period (as configurations and workloads change with time)*

- ❑ Delivering great performance within power envelope
- ❑ Compute Energy Efficiency → Positive Impact On Environment

Decade of PC Power management innovation



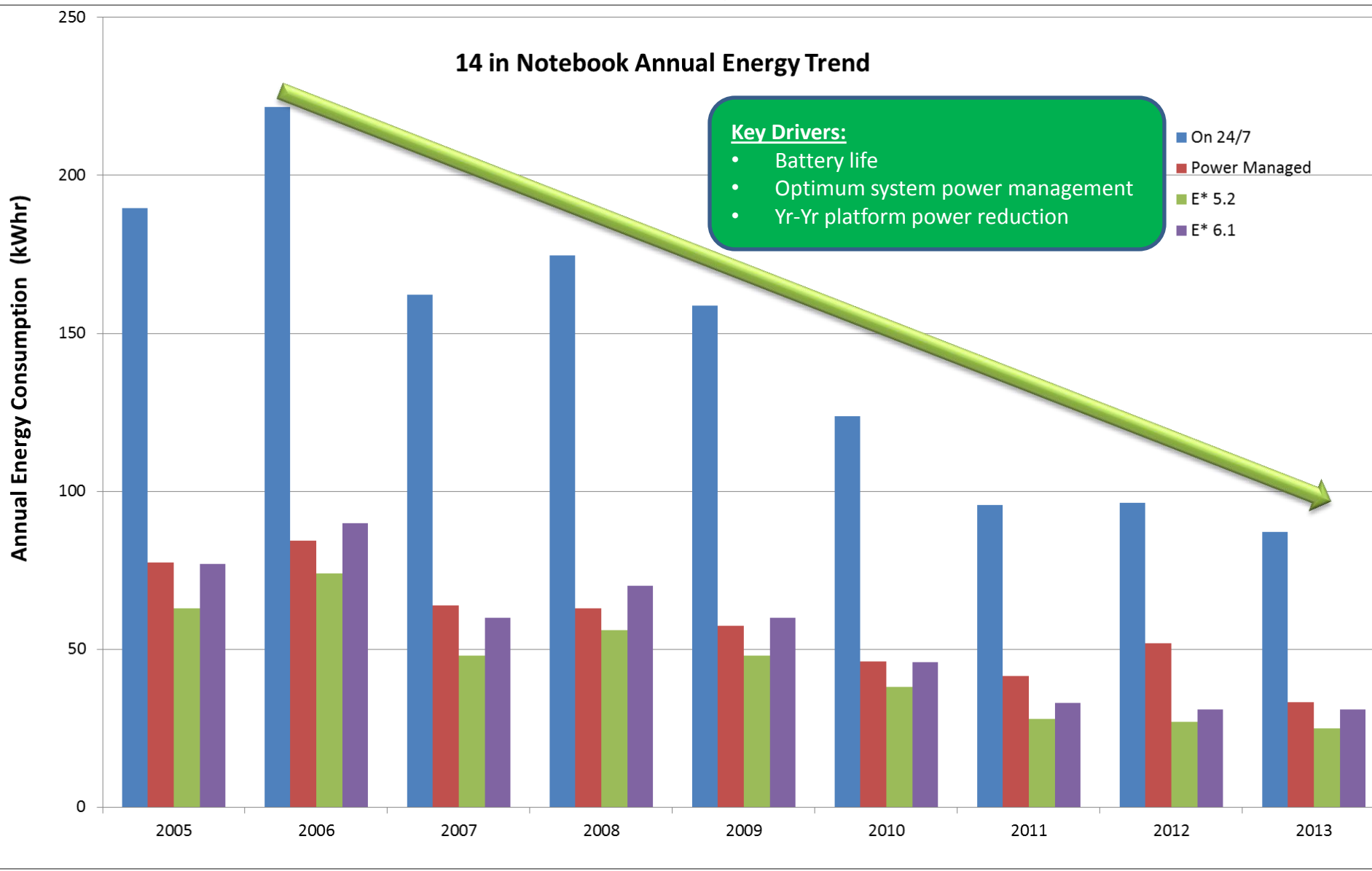
Desktops - Energy consumption



2005 to 2013 desktop Performance up 76%, Energy down 70%

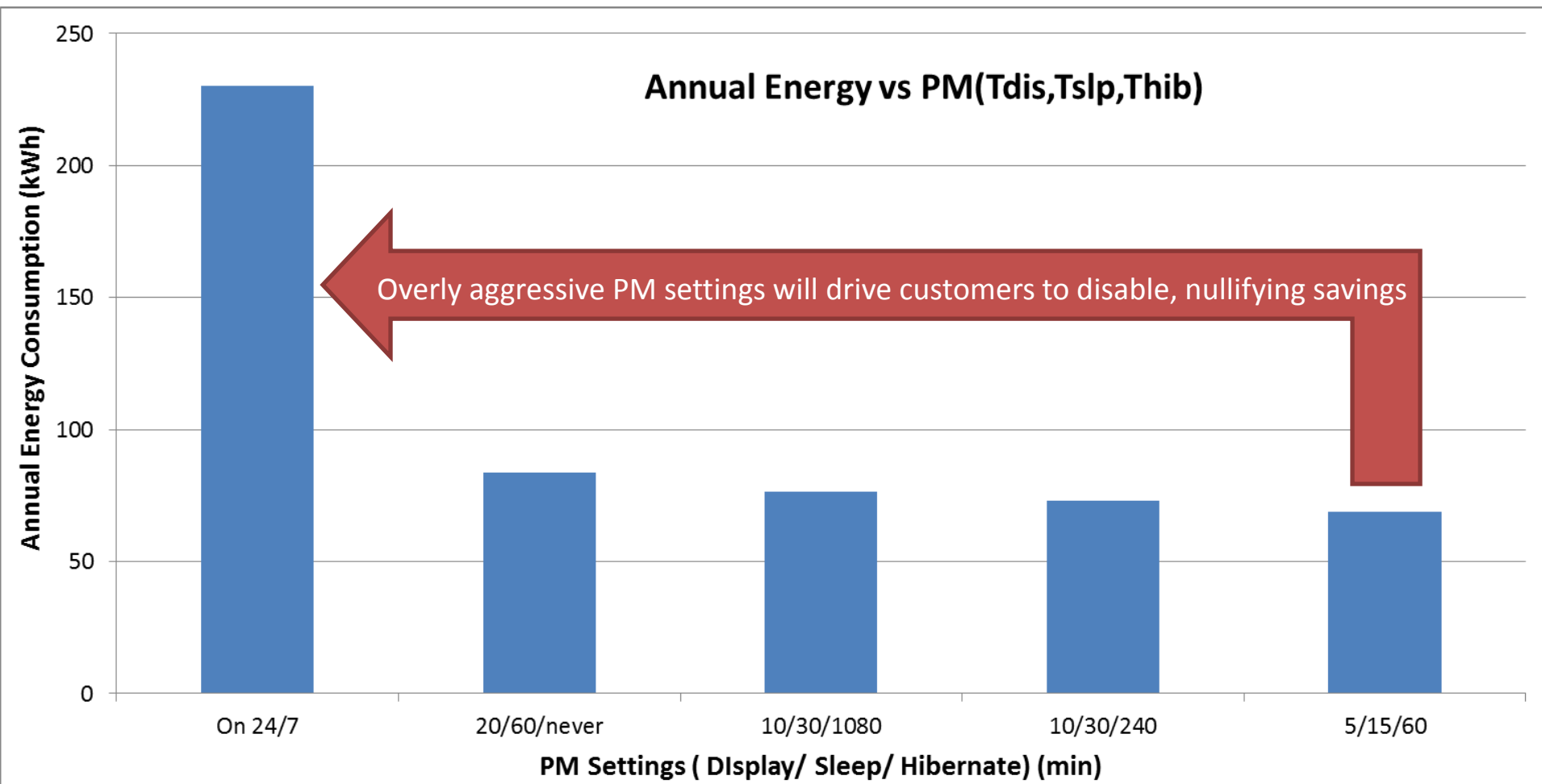
Source: Dell Inc.

Notebooks - Energy consumption

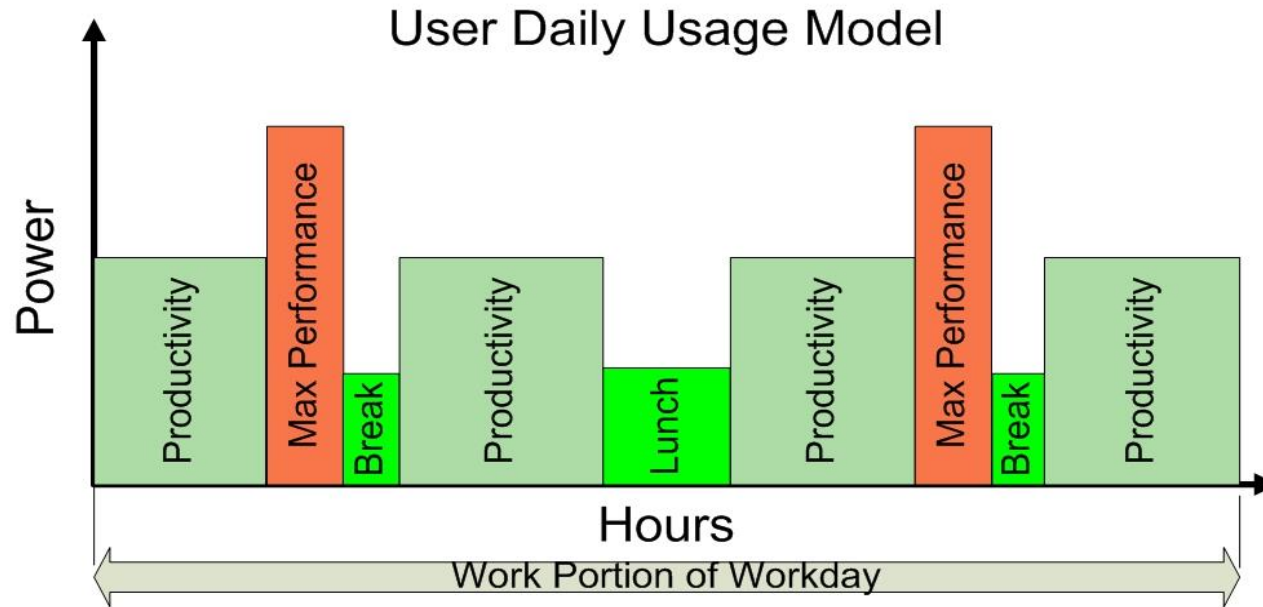


2005 to 2013 mobile Performance up 65%, Energy down 60%

Power Management Savings



Dell's Client Energy Calculator



Break time periods to be programmed with default of 20 min. 2 per day
Lunch time to be 1hour

The active day is broken into a morning and an afternoon session with a lunch break in between these two sessions. Morning and afternoon periods also allow for a 20 minute break which will allow for additional power reduction opportunities.

Morning and afternoon work periods consist of the following sequence.

1. Productivity work session
2. Max Performance work session
3. Break
4. Productivity Work session
 - Productivity – The end user is performing typical office work, such as email document creation or web browsing, using standard office type applications.
 - Max Performance – This represents the end user running some high end application , complex scientific calculations, modeling or 3D games that stresses the system causing significant increases in power consumption.

Source: Dell Inc.

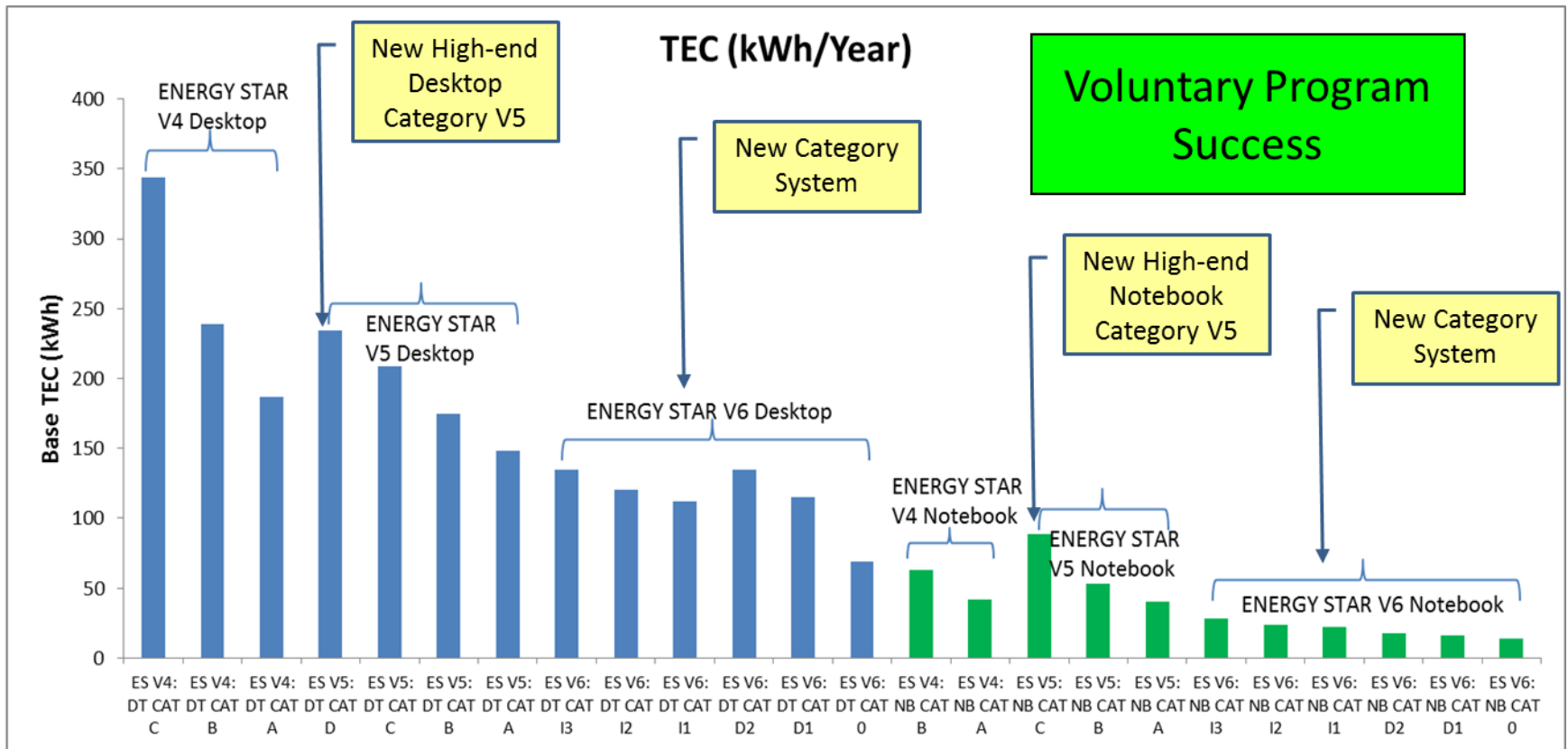
Back-up

Increasing Performance and Productivity

| | 1960 | 2010 | Improvement |
|------------------------|---|---|------------------|
| Electricity Generation | 10,780 Btus per kWh of electricity | 9,980 Btus per kWh of electricity | 8 percent |
| Automobiles | 14.3 miles per gallon of gas | 22.6 miles per gallon of gas | 58 percent |
| Labor Output | 20.6 dollars per working hour | 59.4 dollars per working hour | 188 percent |
| Passenger Airlines | 8,836 Btus per passenger-mile | 2,917 Btus per passenger mile | 196 percent |
| Lighting | Incandescent light bulb at 13 lumens per watt | Compact fluorescent lamp at 57 lumens/watt | 339 percent |
| Computer Systems | 0.015 instructions per second per watt | 40,000,000 instructions per second per watt | 266,666,666,600% |

Source: Skip Laitner, ACEEE, various calculations, January 2011

ENERGY STAR PC generational improvements (V4 through V6) (Lower Energy Consumption and Additional categories)



Voluntary program complementing market driven EE improvements