Innovation in IT

Meeting and Overcoming the Challenges

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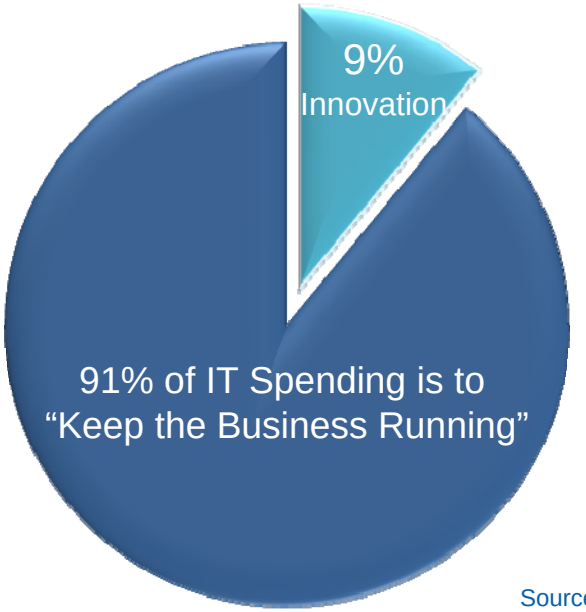
IT Challenges Motivating our Industry

Energy Efficiency

- Rising energy costs
- Power Distribution and Cooling Costs
- Greening of the Data Center

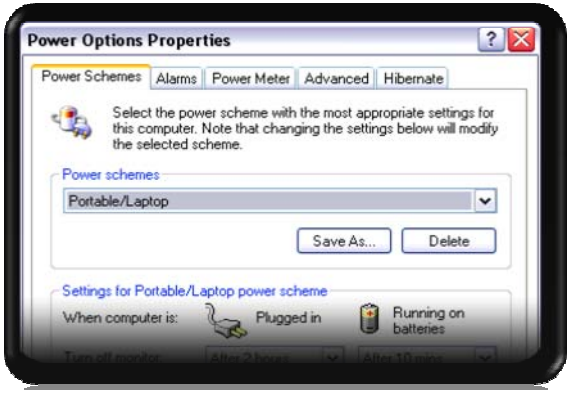


Source: Gartner

Enterprise Manageability

- Underutilized Client and Server Assets
- Access to and cost of Human Capital
- Reduced Budgets

Our Energy Problem Today



The average desktop PC wastes nearly half the power delivered

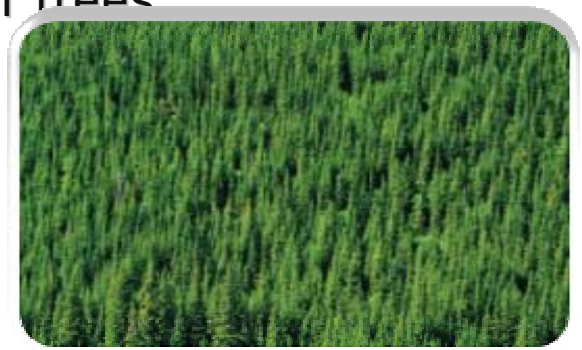
Servers lose approximately one-third of their power

90% of desktops do not utilize power management settings

Collective Impact by 2010

climate savers
smart computing

- **2-Fold Strategy**
  - Increase computing energy efficiency
  - Increase use of power management
- **Goal is to improve computing energy efficiency by 50%**
  - Collectively save an estimated $5.5 billion in energy costs
- **Reduce global CO2 emissions from computing platforms by 54 million tons per year**
  - Equivalent to removal of 11 million autos
  - Eliminating 20 coal plants from the planet
  - Planting 25,000 sq. miles (~65,000 km2) of trees

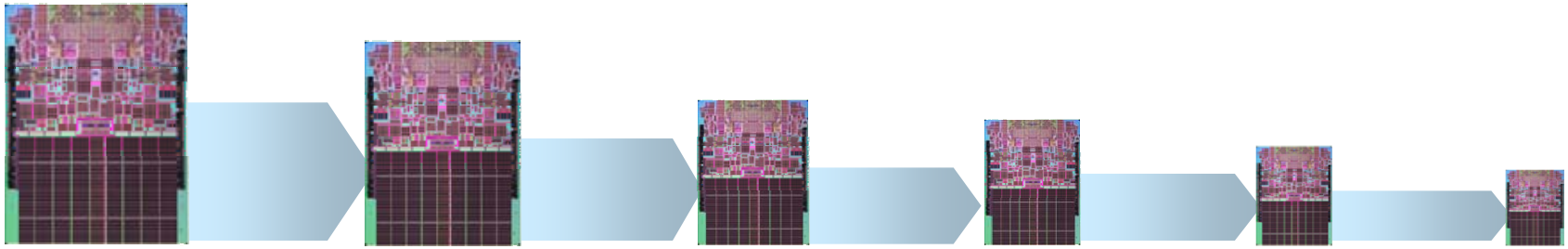


Purpose Built Features

Architectural Enhancements into each Successive Generation

- Performance
- Energy Efficiency
- Virtualization
- Manageability
- Security

Relentless Pursuit of Moore's Law Leads our Innovation



250nm 200mm	180nm 200mm	130nm 200mm	90nm 300mm	65nm 300mm *Dual Core*	45nm 300mm

Industry's 1st 45nm High-K Process Technology

2x Improvement In Transistor Density

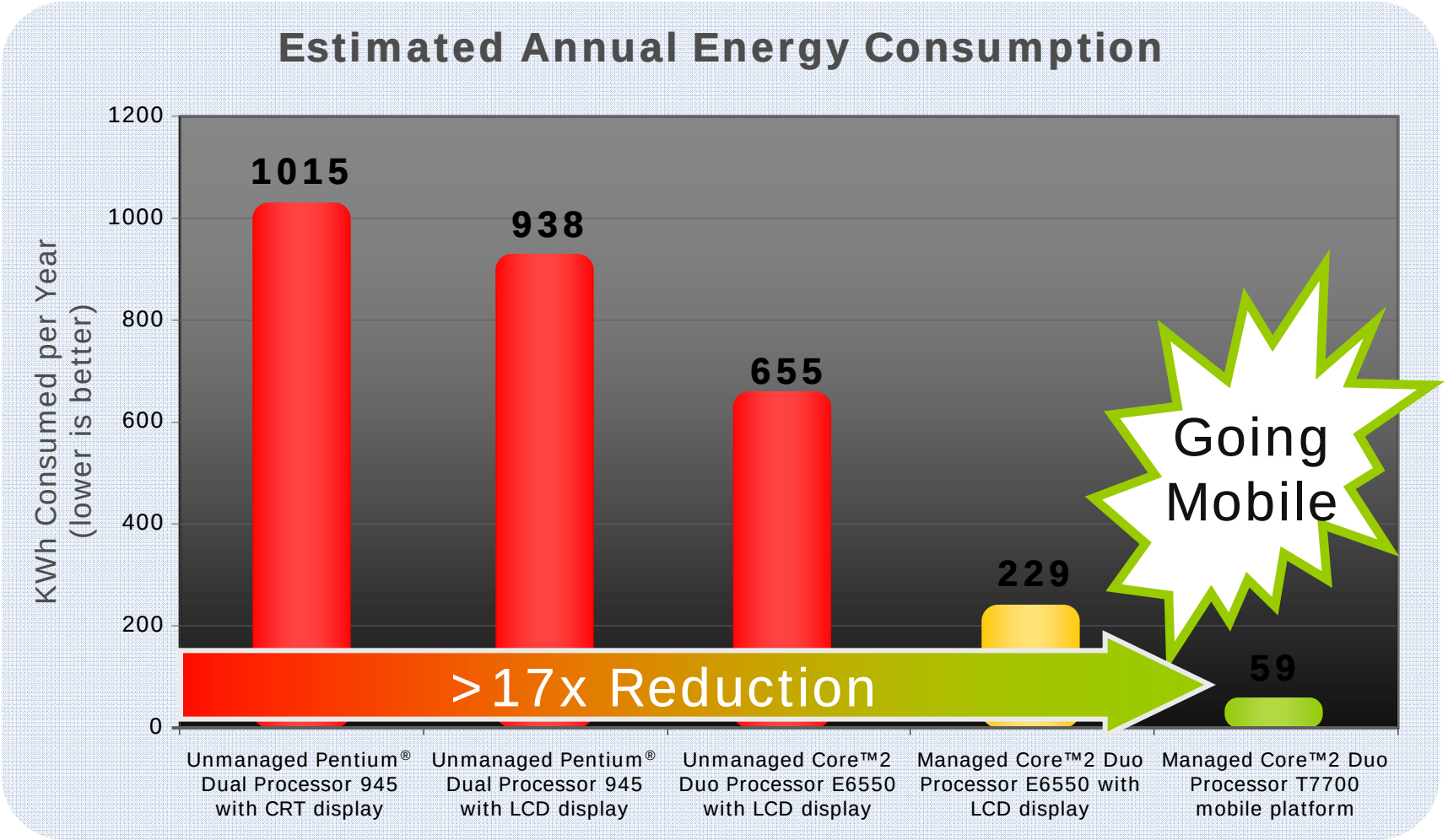
>20% Improvement In Transistor Switching Speed

30% Reduction In Transistor Switching Power

10x Lower leakage when the Transistor is Inactive

Source: Intel

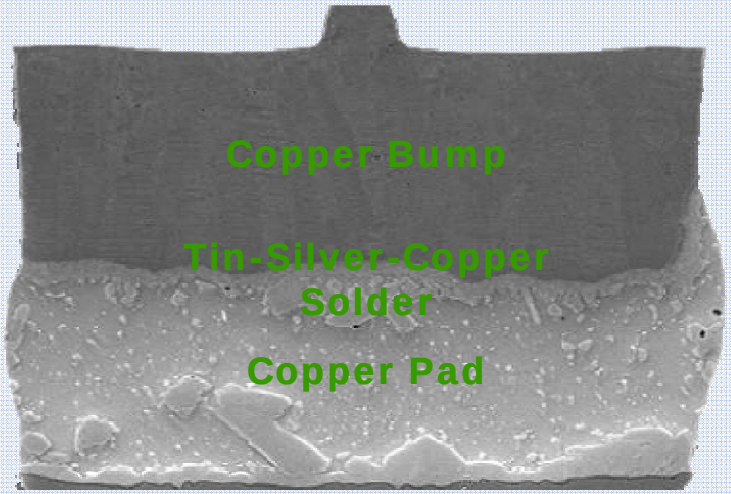
Potential Energy Savings



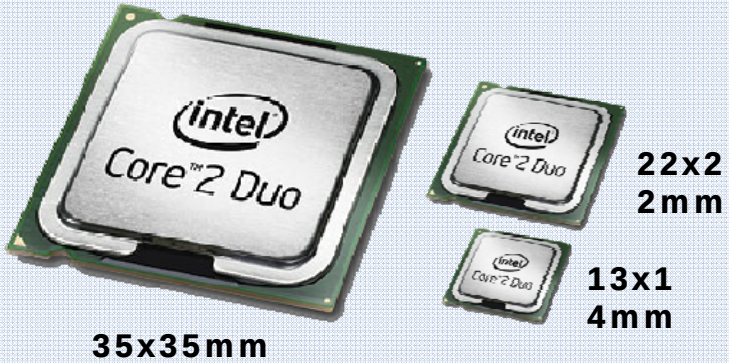
“Green” Includes Reducing Hazardous Waste

With High-k 45nm Process Technology Intel is 100% Lead-Free, and Moving to be Halogen-free* in 2008

Lead Free** Technology

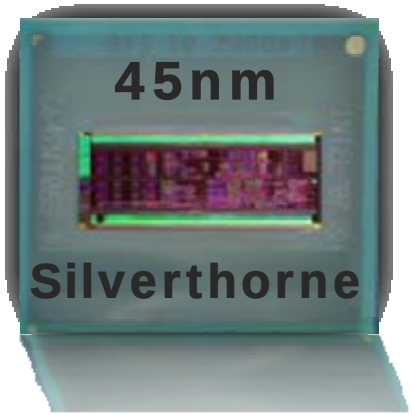


60% Smaller Packaging for New Market Segments



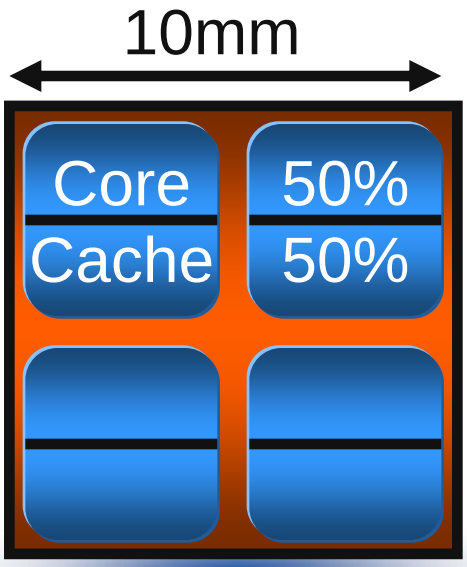
*Residual amounts of halogens are below November, 2007 proposed IPC/JEDEC J-STD-709 standards
* *45nm product is manufactured on a Lead Free process. Lead-free per EU RoHS directive July, 2006. Some E.U. RoHS exemptions may apply to other components used in the product package.

The Magic of Innovation Continues….



Tick	Tock	Tick	Tock	Tick
NEW Microarchitec 65nm	Compaction / Derivative 45nm	NEW Microarchitect 45nm	Compaction / Derivative 32nm	NEW Microarchitect 32nm
2006	2007	2008	2009	2010

Multi Core Innovation



65nm, 4 Cores

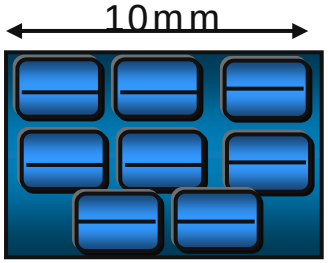
3GHz

10mm die, 5mm each core

Core Logic: 6MT, Cache: 44MT

Total transistors: 200M

45nm

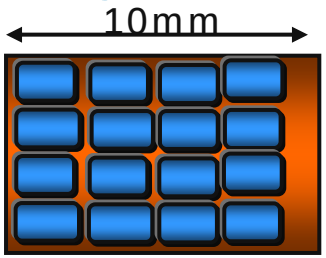


8 Cores, 3GHz

3.5mm each core

Total: 400MT

32nm

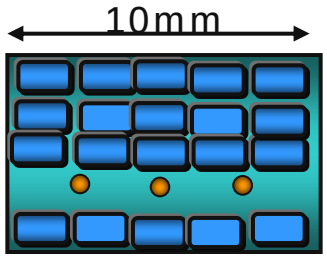


16 Cores, 3GHz

2.5mm each core

Total: 800MT

22nm

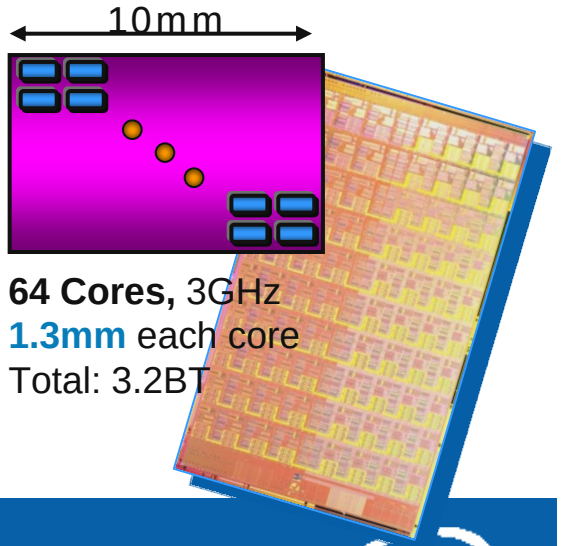


32 Cores, 3GHz

1.8mm each core

Total: 1.6BT

16nm



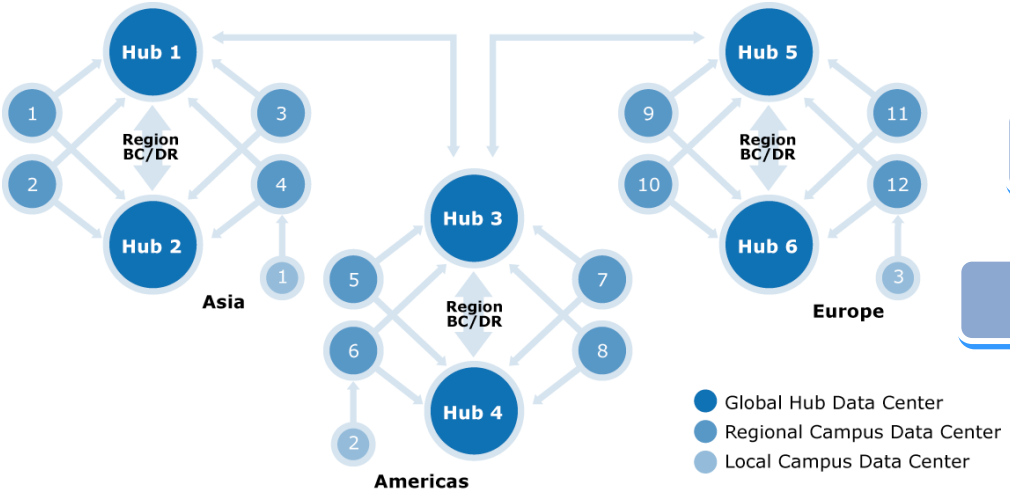
64 Cores, 3GHz

1.3mm each core

Total: 3.2BT

Note: the above pictures don't represent any current or future Intel products

IT Practices @ Intel



243,000 LAN nodes

95,000 e-mail mail boxes

5,335 wireless access points

70,395 instant messaging users

166 terabytes of WAN traffic per month

137 million e-mail messages per month

Data Center Refresh

Utilizing Consolidation and Virtualization

Business Requirement: Deliver 5.1 Million Business Operations Per Second

Using 45nm Quad-Core Intel® Xeon® Processor 5400

2004

- **5.1M bops**
- **6 racks**
- **126 servers**
- **240 sq ft**
- **48 kW**

2008

- **5.1M bops**
- **1 rack**
- **17 servers**
- **40 sq ft**
- **6 kW**

The Bottom Line Benefits for IT (< 2 year ROI[4])

Floor Space
83%
Reduction[1]

Annual Energy Costs
87%
Reduction[2]

Estimated Energy Savings
$53K
Savings[3]

Whitepaper at http://communities.intel.com/servlet/JiveServlet/previewBody/1320-102-1-1374/Transforming%20DC%20Environment.pdf

Why then are data centers using more power?
Because at a lower unit cost,
organizations are CHOOSING to do more computing.

In most cases, that additional computing is <u>displacing</u> other, more energy costly, activities!

Holistic DC View

Lean Data Center

Challenge 'Muda'

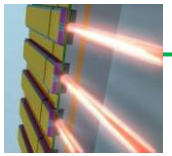
- The 7 Wastes:
  - **Defects**

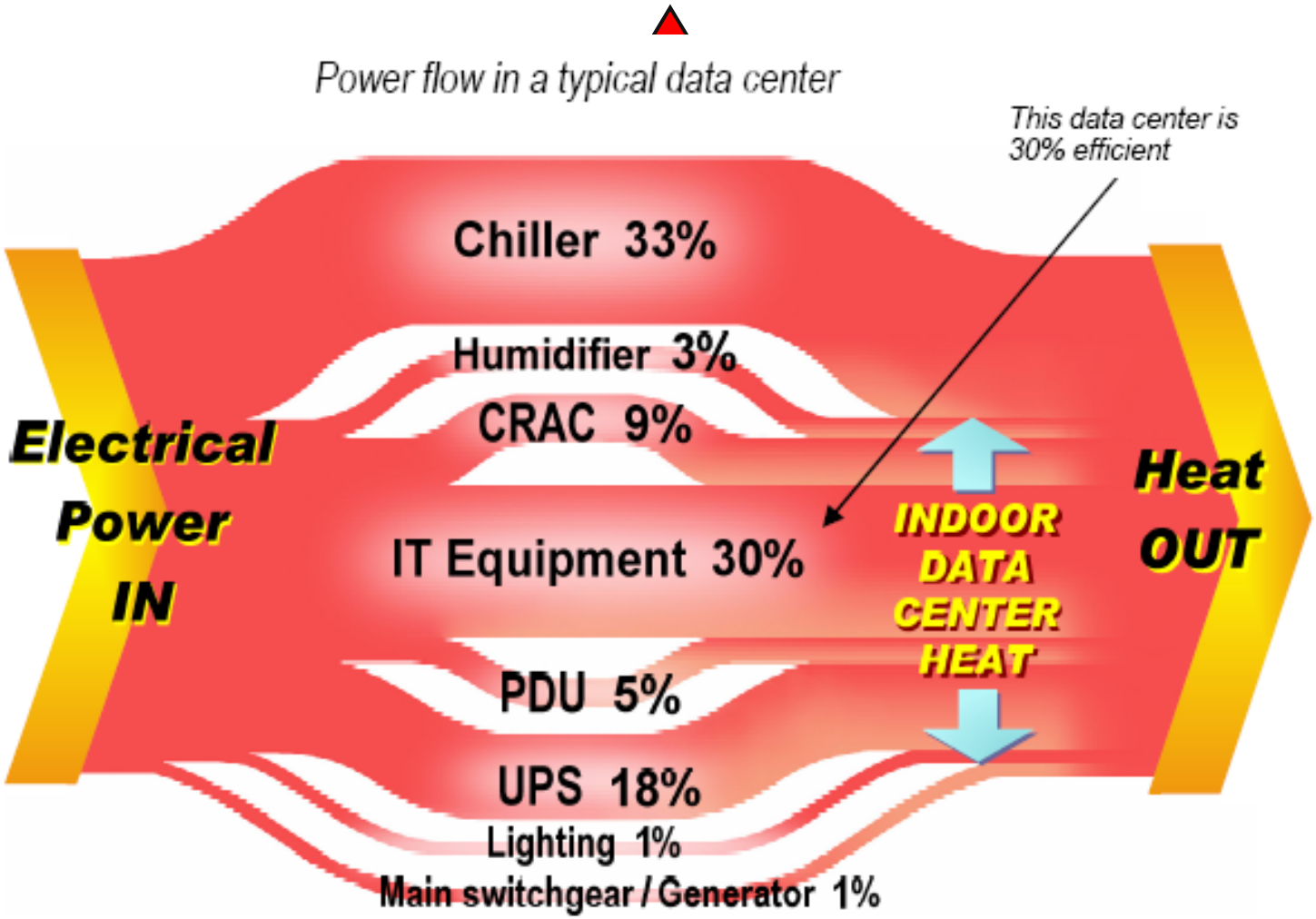
Over production

Transportation

- **Waiting**
- **Inventory**
- **Motion**

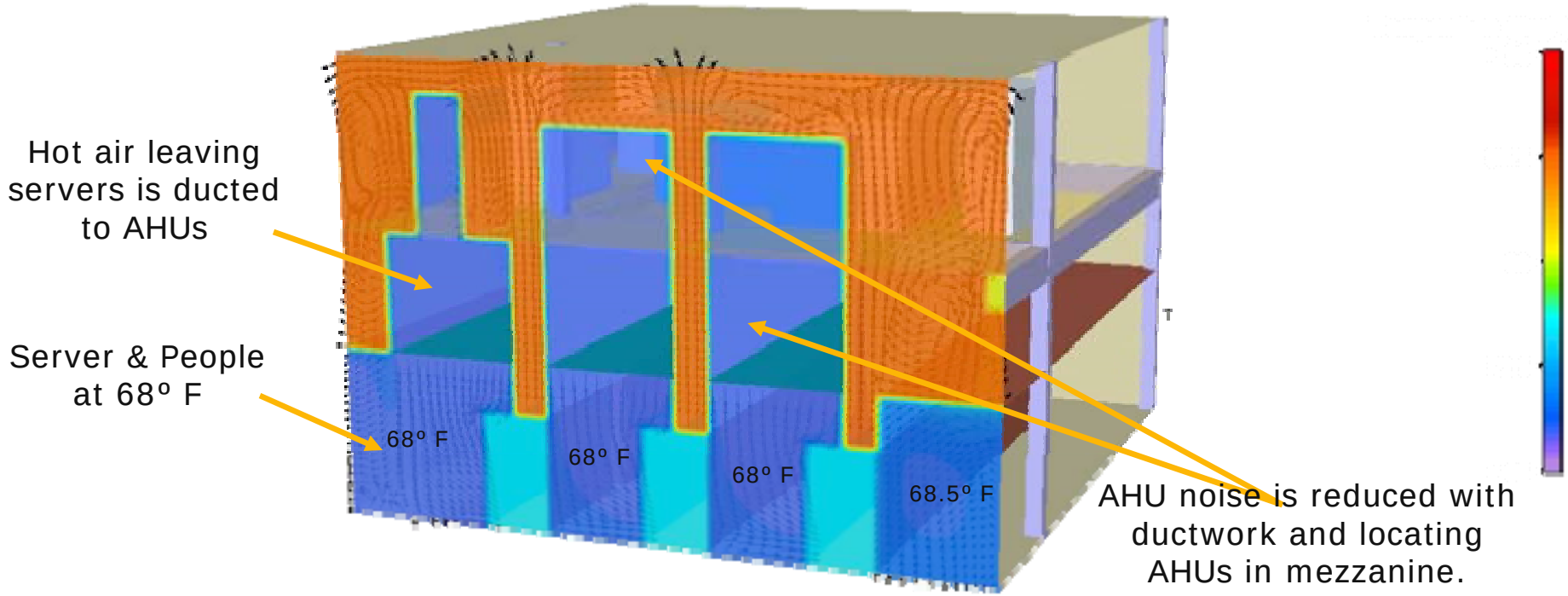
Over processing



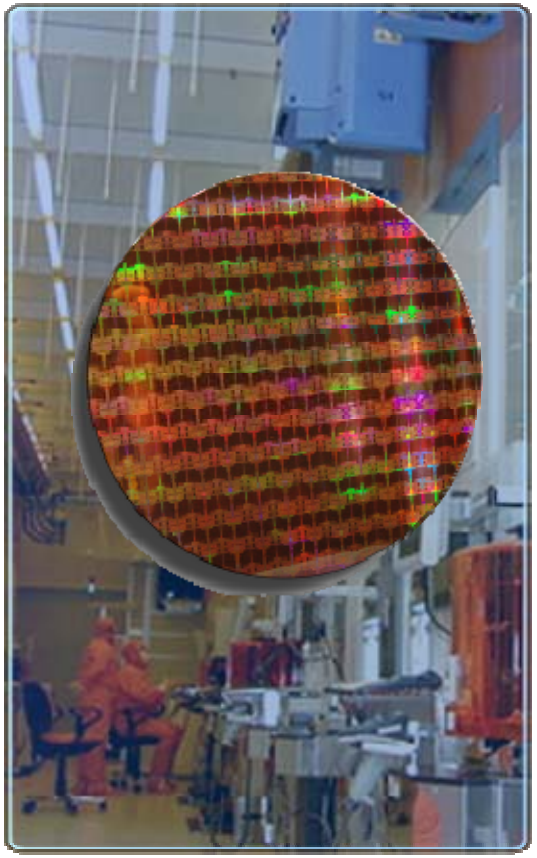


Source: APC Whitepaper 154 – Electrical Efficiency For Data Centers

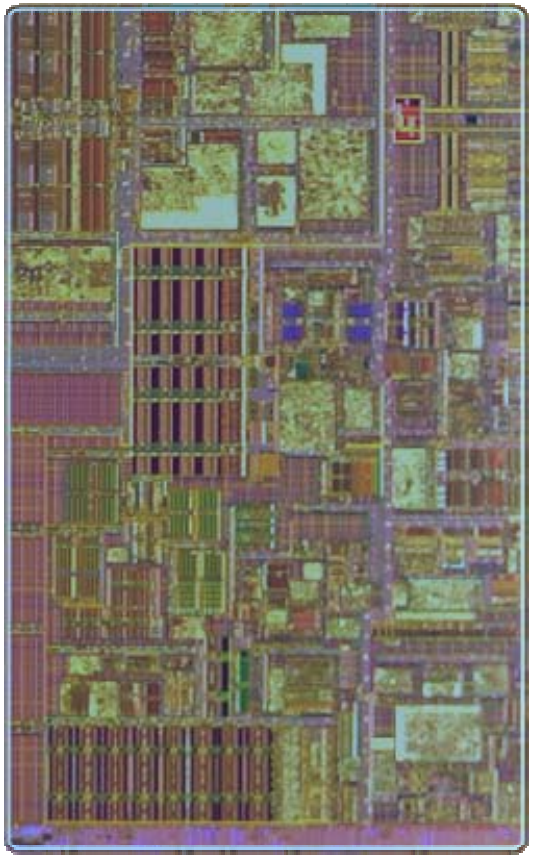
The Key? - Complete Air Management



This model shows dramatic effect of managing heat. Data Center area is at a comfortable 68 F (20C). Required airflow is minimized. Heat transfer from air to air handling unit (AHU) coils maximized. This results in the lowest total operational cost for the heating, ventilating and air conditioning (HVAC) system/kW.



Process Leadership



Architectural Innovation

Platform Design

Platform Design and Approach

Energy-efficient Performance

- Improved Energy Efficient Performance aligned to new Energy Star specifications[1]
- Run security, management tasks in background
- 64-bit applications

- Remote asset, HW, and SW inventory
- Remote diagnostics and repair, even when the PC is powered down or the OS is inoperable
- Manageability agent presence checking
- Remote configuration
- Platform stability – Intel® SIPP

Built-in Manageability

Proactive Security

- Enhanced system defense filters
- Hardware-based isolation and recovery
- Security agent presence checking
- Virtualized intrusion protection, isolation & recovery
- Support for 802.1x & Cisco NAC*
- Intel Trusted Execution Technology

Control Costs by Improving Manageability

vPro™ Technology Enables:

Remote client management— all regardless of system health or if the PC is powered on or not

- **Remotely deploy security patches**
- **Collect PC HW / SW inventories**
- **Diagnose and fix problems**

New for 2008: Client Initiated Remote Access

- Allows PCs inside or outside the firewall to request help
- Remotely unlock Intel® Anti-Theft Technology encrypted HDDs (Q1'09)

Most Secure

- Help protect from virus and worm outbreaks and keep critical agents running

New for 2008: Intel® Anti-Theft Technology protects HDD data from compromise even if PC is stolen or drive is repurposed (Q1'09)

Get Lean, Get Green

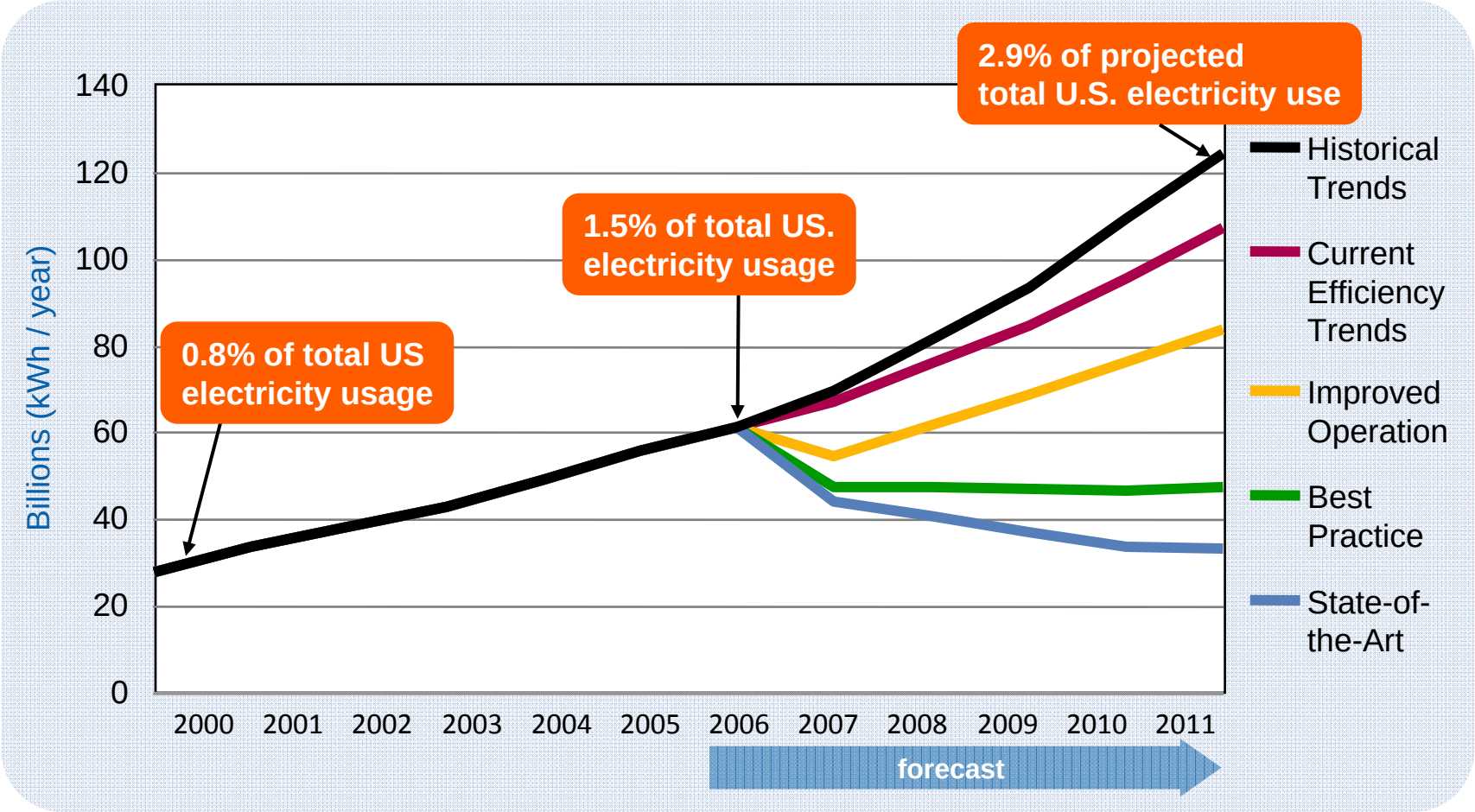
- 45nm High-K Quad-Core
- vPro client management
  - 40% Lower Power
- A 2 Year ROI Replacing Single Core Servers
  - 6x Performance
  - 80% Lower Power
  - 80% Smaller Footprint

For details see www.intel.com/ITopia

Thank You!

Back up Slides

Projected Data Center Energy Use



Source: EPA Report to Congress on Server and Data Center Energy Efficiency; August 2, 2007

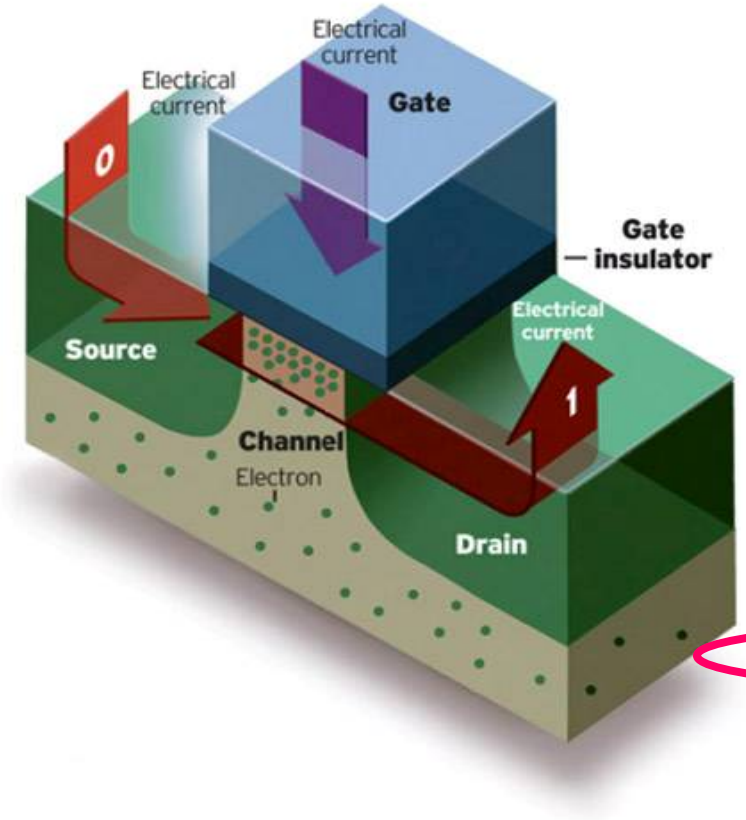
Energy Efficiency Initiatives

A system level specification including components such as processor, chipset, power supply, HDD, graphics controller and memory.

Focused on optimizing data center design, construction, layout to reduce energy use.

Focused on accelerating the availability and adoption of increasingly energy efficient PCs, servers and energy management practices.

45nm Process Technology



"The implementation of high-k and metal materials marks the biggest change in transistor technology since the introduction of polysilicon gate MOS transistors in the late 1960s," said Intel Co-Founder Gordon Moore.

Intel press release, January 26, 2007

The New York Times

INTEL SAYS CHIPS WILL RUN FASTER, USING LESS POWER

20% faster in switching on and off

30% lower power to operate

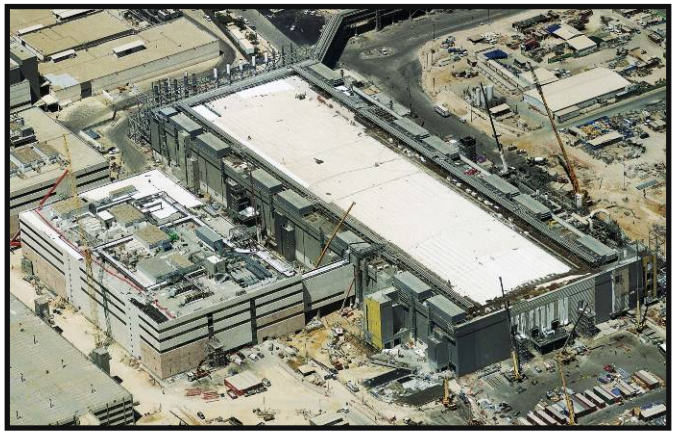
2x as many transistors can fit into the same space

10x lower leakage when the transistor is inactive

Four 45 nm Manufacturing Fabs in 2008

D1D Oregon

Fab 32 Arizona

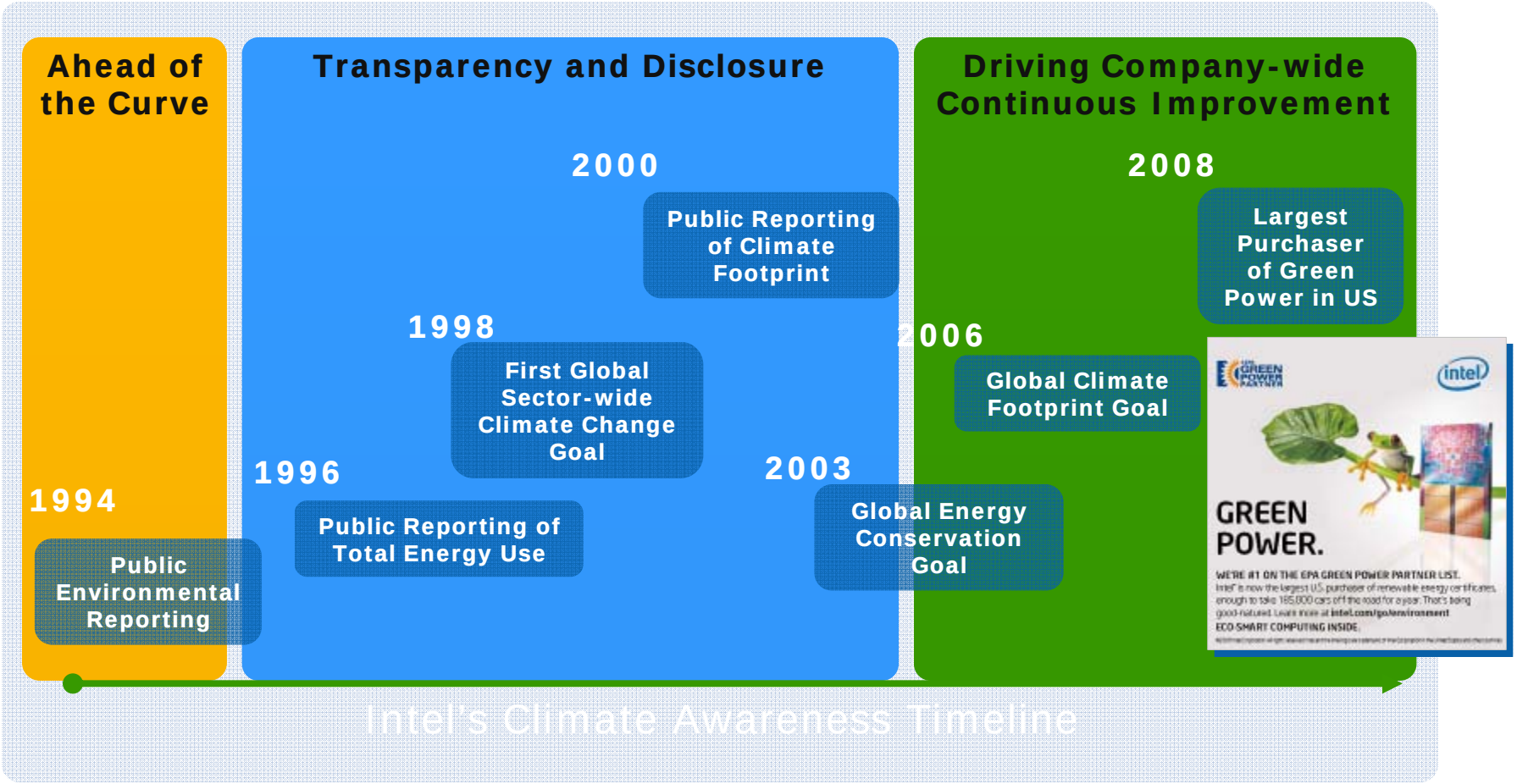


Fab 28 Israel

Fab 11X New Mexico

“Green” Fab 32

Intel's Long History of Environmental Focus



Source: Intel 2006 Corporate Social Responsibility Report

Intel is Largest Consumer of Renewable Energy

Annual Green Power Usage (kWh)	GP % of Total Electricity Use*	Organization Type	Green Power Resources
1. Intel Corporation			
1,302,040,000	46%	Information Technology	Biomass, Geothermal, Solar, Wind
2. PepsiCo			
1,105,045,154	100%	Food & Beverage	Various
3. U.S. Air Force			
899,143,000	9%	Govt. (Federal)	Biogas, Biomass, Geothermal, Solar, Wind
4. Wells Fargo & Company			
550,000,000	42%	Banking & Fin. Srvcs.	Wind

Source: http://www.epa.gov/greenpower/toplists/top25.htm

Intel's Approach to Eco-Technology

Energy Efficient Performance

Design for the Environment

Sustainable Manufacturing

Policy & Industry