IDC HPC Market Update

June 2010

Earl Joseph – ejoseph@idc.com
Jie Wu – Jwu@idc.com
Steve Conway – sconway@idc.com
Lloyd Cohen – lcohen@idc.com
Charlie Hayes – charles.w.hayes@verizon.net

Presentation Agenda

- **HPC Technical Server Market Update**
  - Market Drivers and Barriers
  - New Forecasts for 2010 and to 2014
  - The HPC Market Beyond The Servers
- **HPC User Forum Update**
- **European/EU HPC Research**
- **New IDC HPC Research Plans**

Feel free to ask questions at any time!

IDC's HPC Team

Earl Joseph

- IDC HPC research studies, HPC User Forum and strategic consulting

Steve Conway

- HPC User Forum, consulting, primary user research and events

Jie Wu

- HPC census and forecasts, China research, interconnects and grids

Lloyd Cohen

- HPC market analysis, data analysis and workstations

Beth Throckmorton

- Government account support and special projects

Charlie Hayes

- Government HPC issues, DOE and special studies

Mary Rolph

- HPC User Forum conference planning and logistics

HPC Technical Server Market Update

What Is HPC?

IDC uses these terms to cover all technical servers used by scientists, engineers, financial analysts and others:

- HPC
- HPTC
- Technical Servers
- Highly computational servers

HPC covers all servers that are used for computational or data intensive tasks

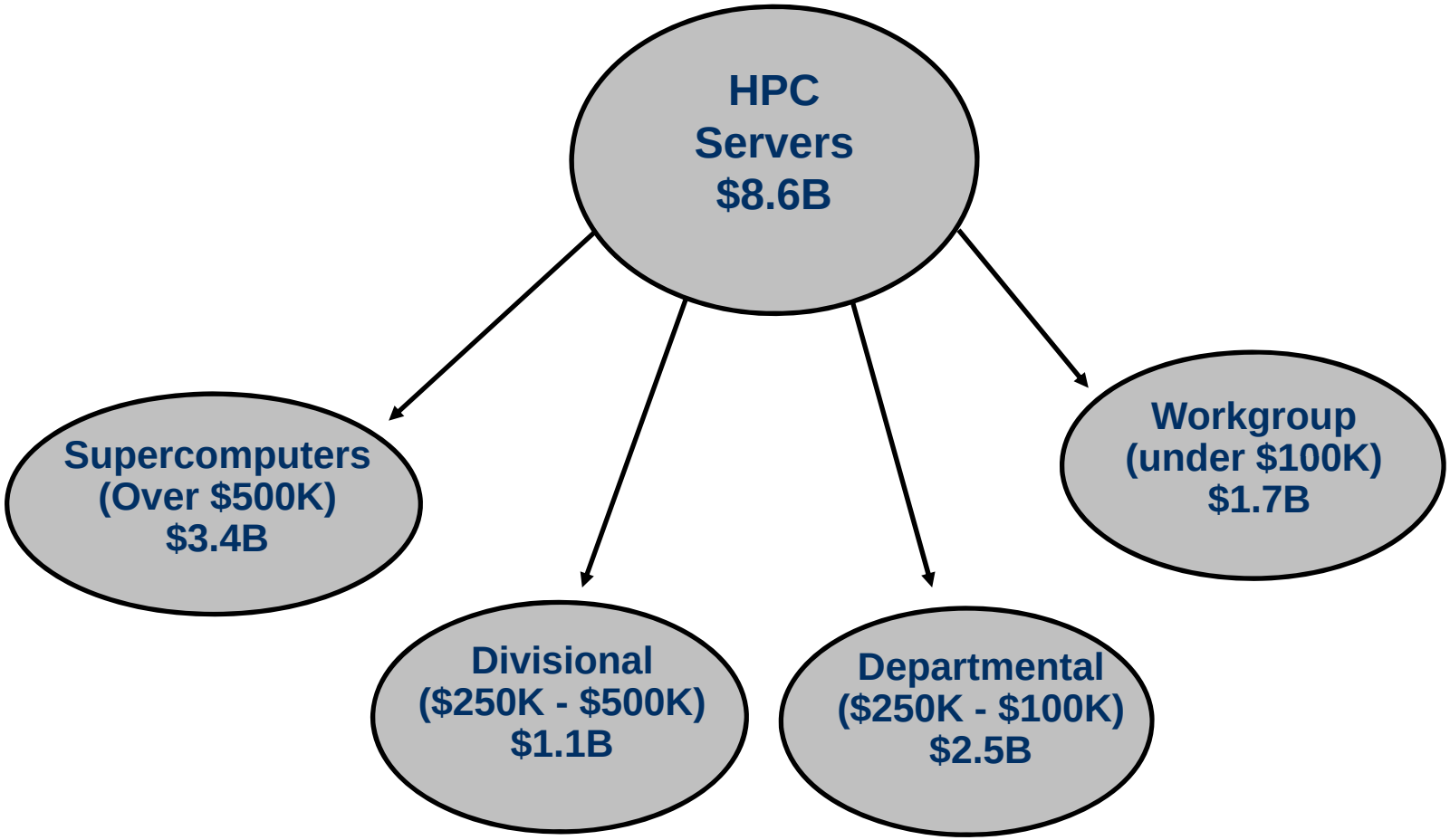
Now getting close to 20% of all servers

IDC HPC Data Sources

Multiple Worldwide HPC data structures:

- Quarterly OEM supplier shipments (HPC Qview)
  - A view of what systems look like when first shipped
  - 15 industry/application segments
- HPC ISV database
- HPC end-user database
  - A view of how systems are used
  - Looking at the whole ecosystem
- Many custom HPC studies each year, result in separate data structures:
  - Petascale research for DARPA, DOD and DOE
  - Supercomputer studies for IBM, Cray, SGI, Fujitsu, etc.
  - On many research teams from exascale to fingerprints
- HPC User Forum meetings (35 so far) to collect requirements, trends and issues

HPC Server Market Size By Competitive Segments (2009 Data)



Top Trends in HPC

The global economy is still impacting HPC → HPC declined 11.6% for 2009 overall

- 2008 was down 3%
  - A major change from19% yearly growth in prior years
  - But the high end grew 25% in 2009

Major challenges for datacenters:

- Power, cooling, real estate, system management
- Storage and data management continue to grow in importance

Software hurdles will rise to the top for most users

- Application scaling and performance is a problem

SSDs will gain momentum and could redefine storage

GPGPUs are starting to gain ground

HPC Market Results: Revenues and System Units

Worldwide Technical Computing Revenue ($K) by Competitive Segment

Competitive Segment	2008	2009	08 vs 09 Growth
Supercomputer	2,686,128	3,369,410	25.4%
Divisional	1,395,817	1,070,764	-23.3%
Departmental	3,167,096	2,516,253	-20.6%
Workgroup	2,522,809	1,680,687	-33.4%
Total	9,771,849	8,637,114	-11.6%

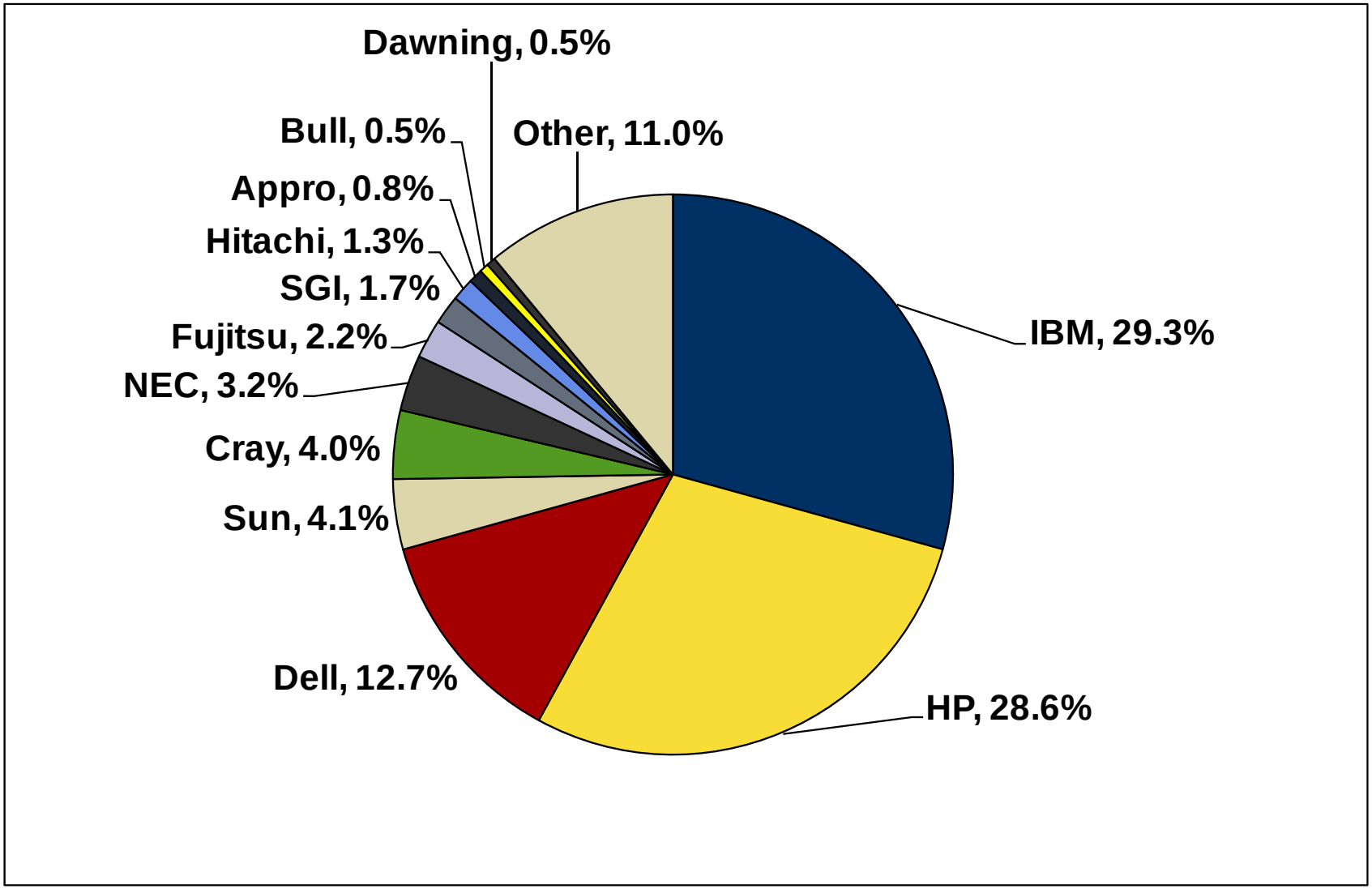
Source: IDC, March 2010

Worldwide Technical Computing Unit Shipment by Competitive Segment, 2

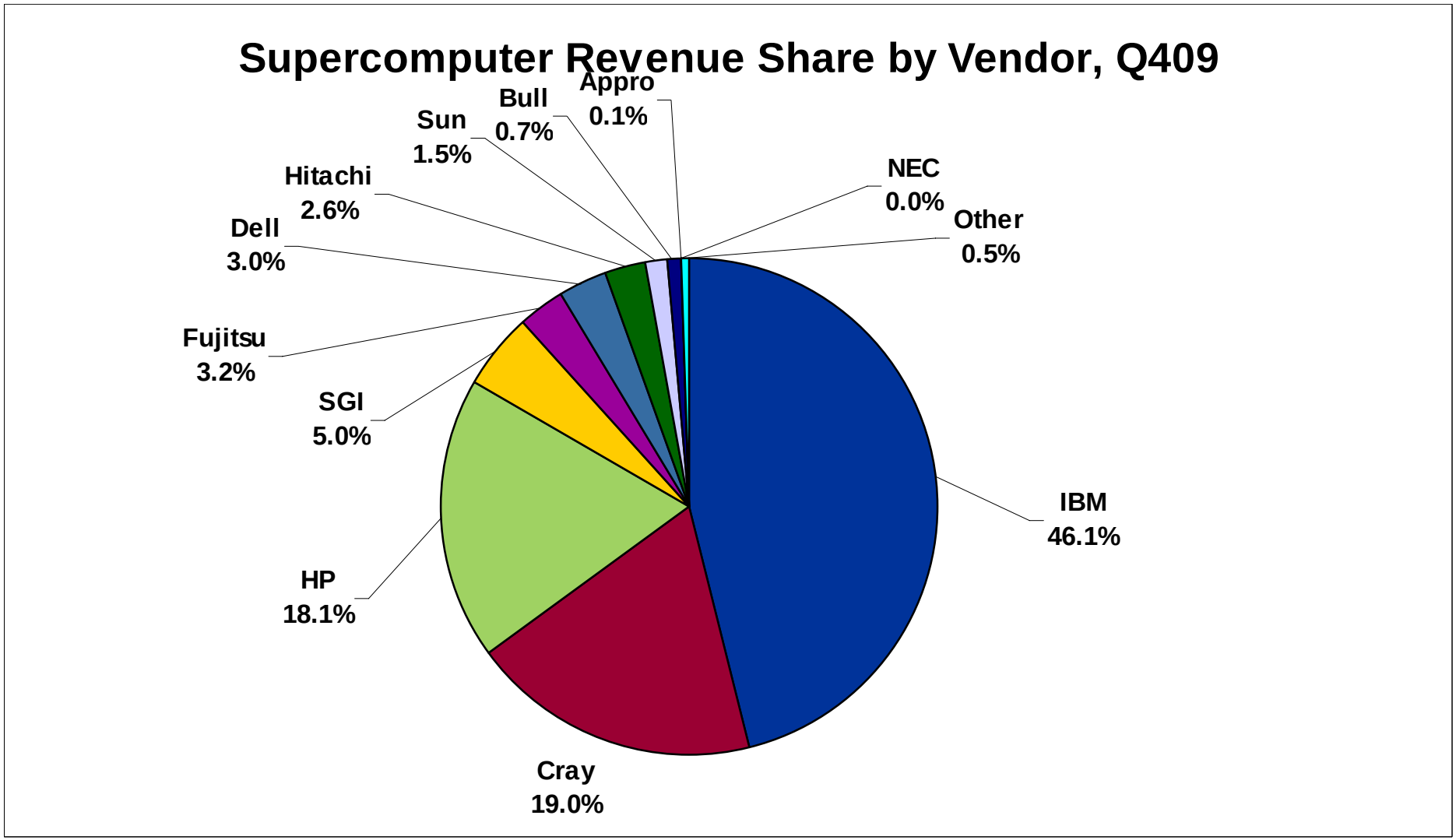
Competitive Segment	2008	2009	08 vs 09 Growth
Supercomputer	1,863	2,100	12.7%
Divisional	4,054	3,574	-11.8%
Departmental	20,105	14,840	-26.2%
Workgroup	148,069	84,090	-43.2%
Total	174,091	104,604	-39.9%

Source: IDC, March 2010

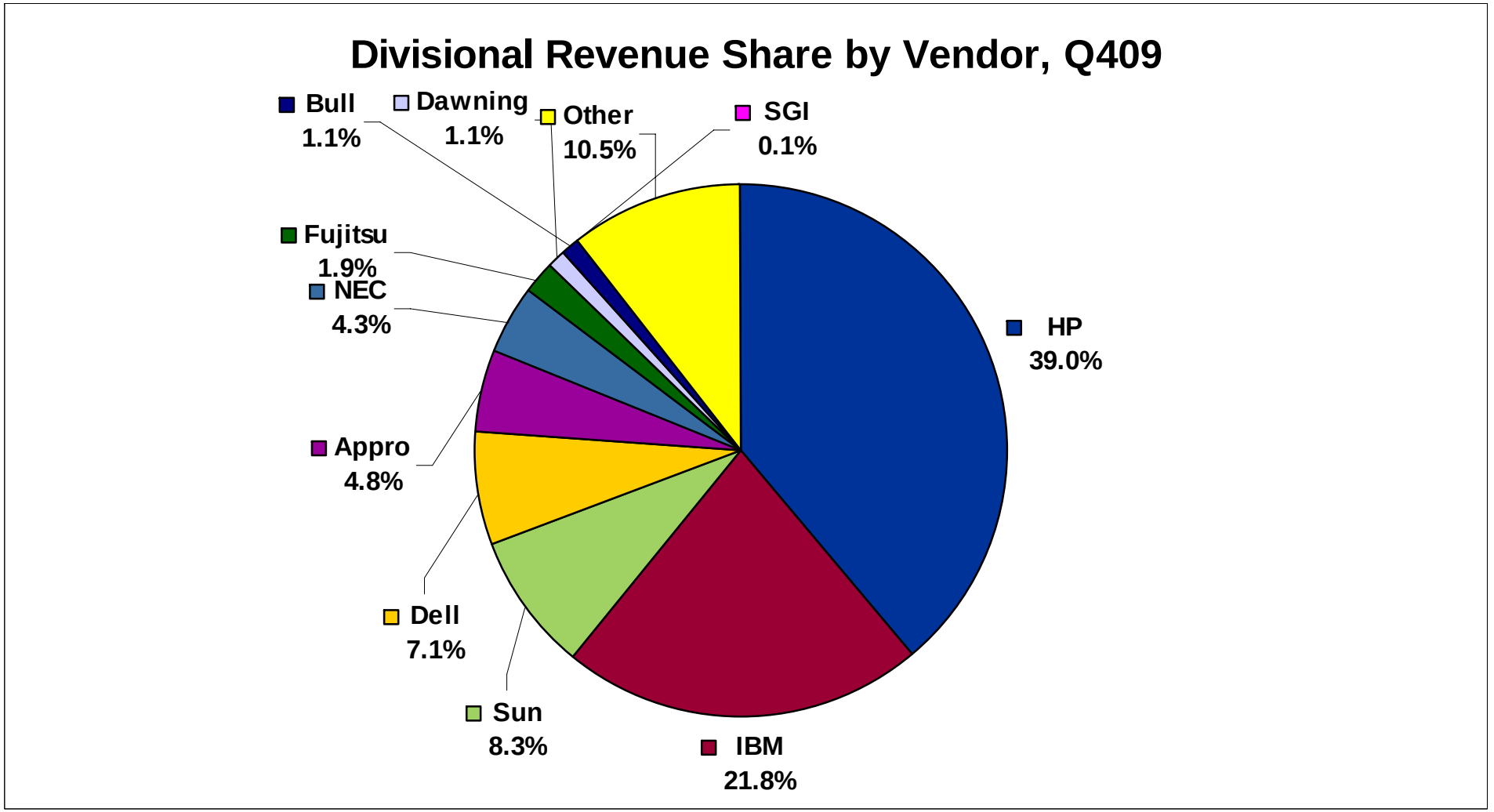
HPC Vendor Revenue Share, 2009



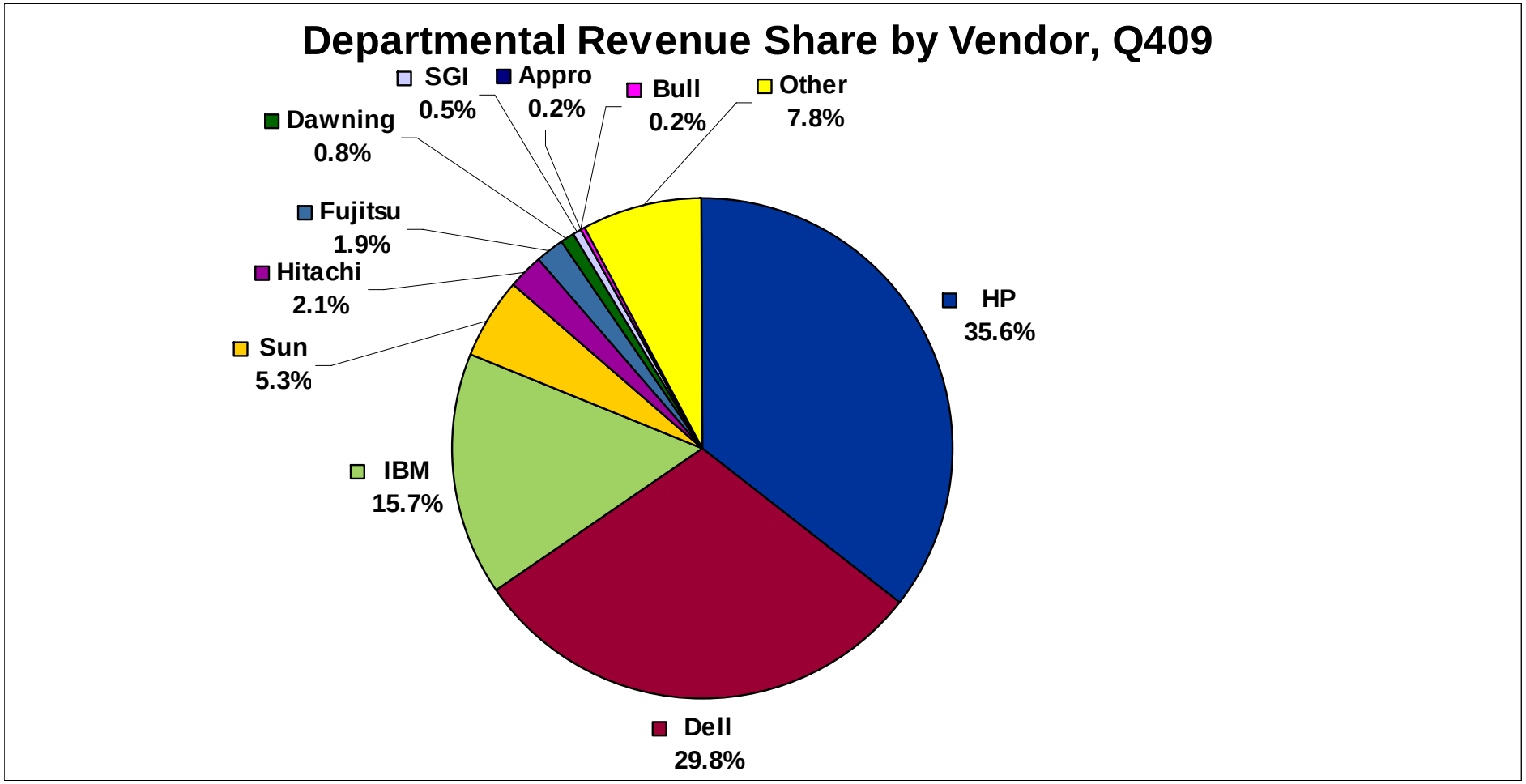
Revenue Share by Vendor
Supercomputer Segment



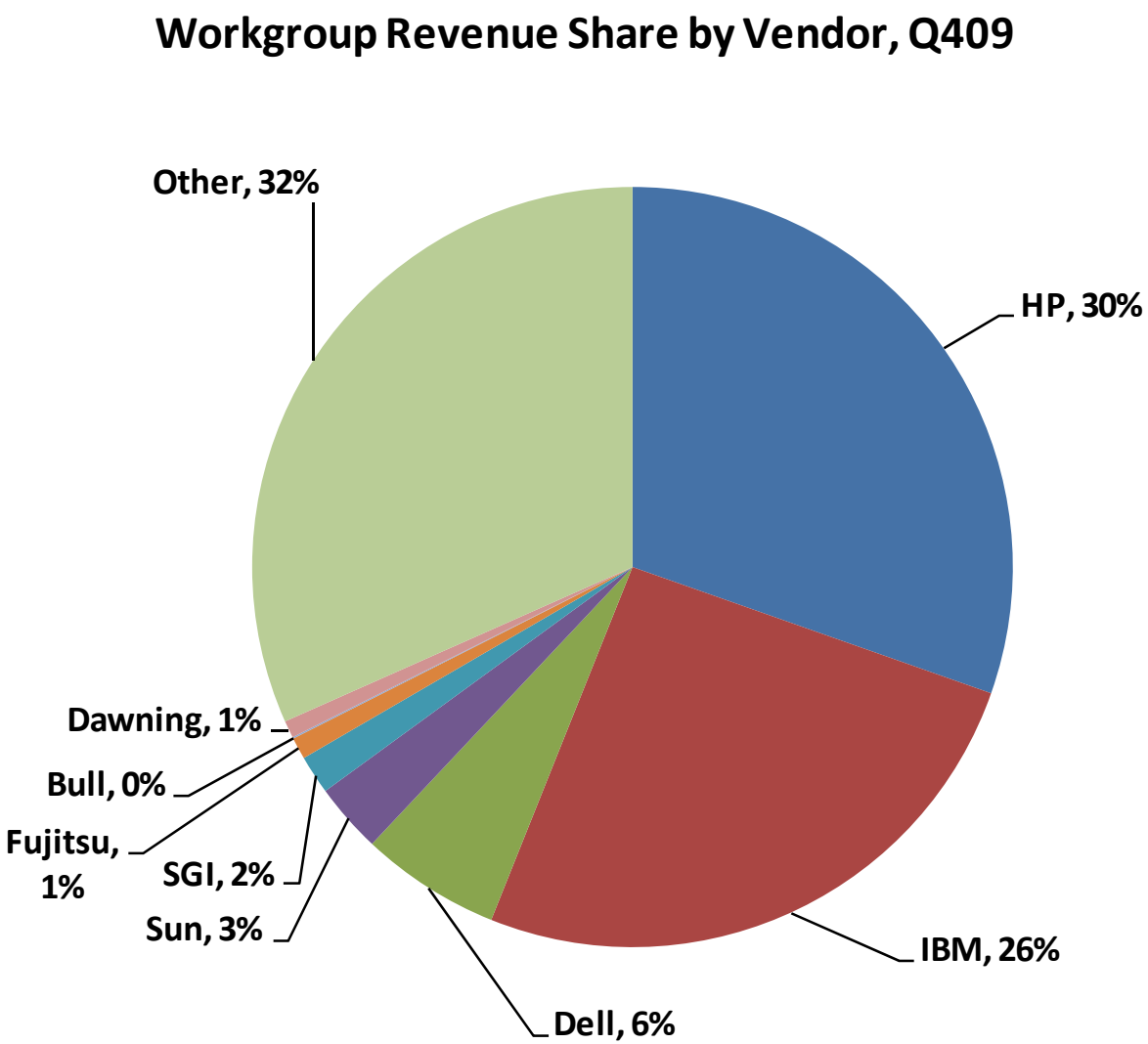
Revenue Share by Vendor Divisional Segment



Revenue Share by Vendor
Departmental Segment



Revenue Share by Vendor Workgroup Segment



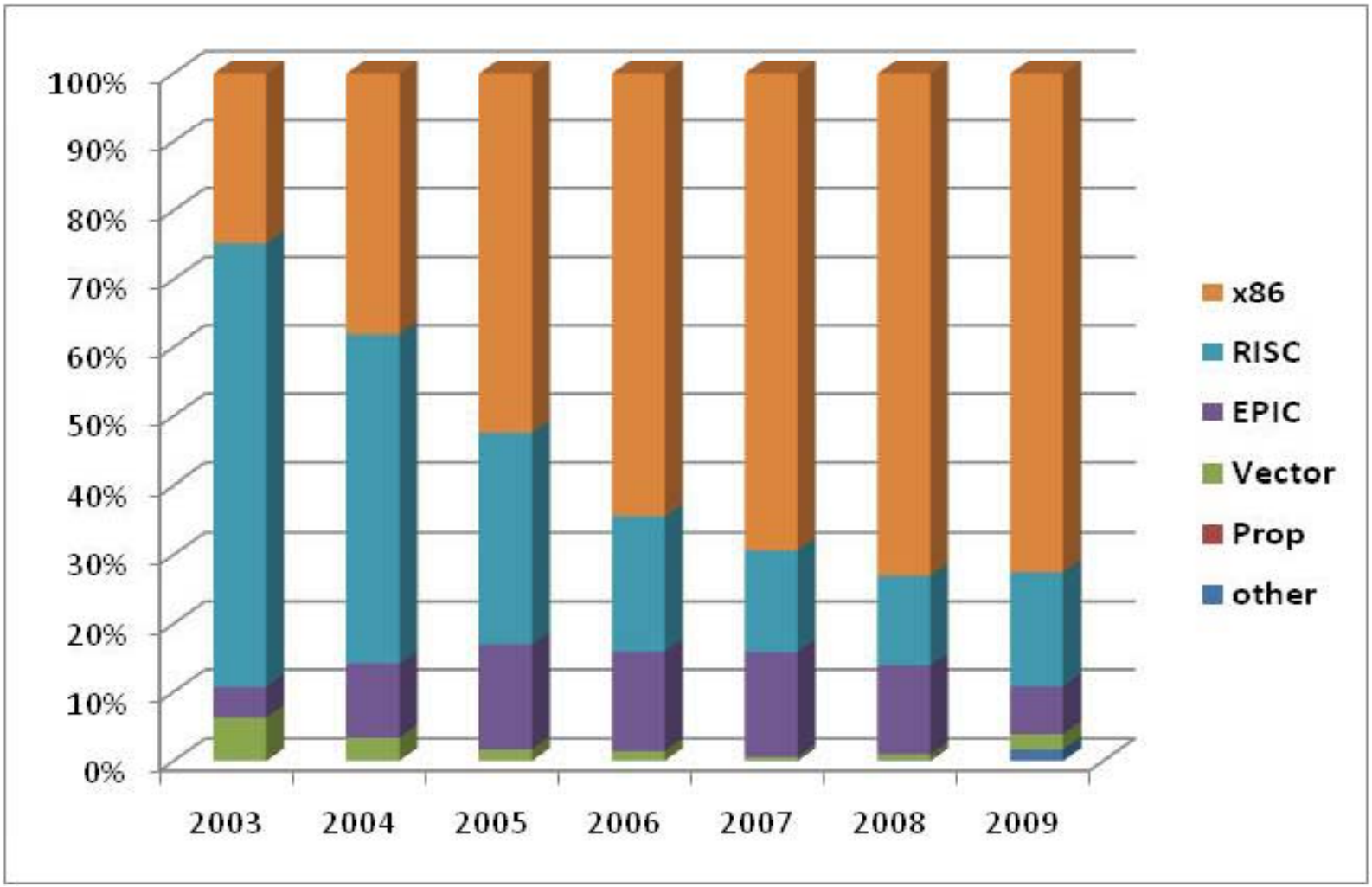
HPC Q4 2009 By Regions

Worldwide Q4 2009 By Region		
Region	Q409	%
Total N.A. Rev.	$1,327,824	51.3%
Total EMEA Rev.	$748,704	28.9%
Total Asia/Pac Rev.	$293,036	11.3%
Total Japan Rev.	$192,615	7.4%
Total ROW Rev.	$24,074	0.9%
Total	$2,586,253	100.0%

HPC Q4 2009 Nodes By Processor Type

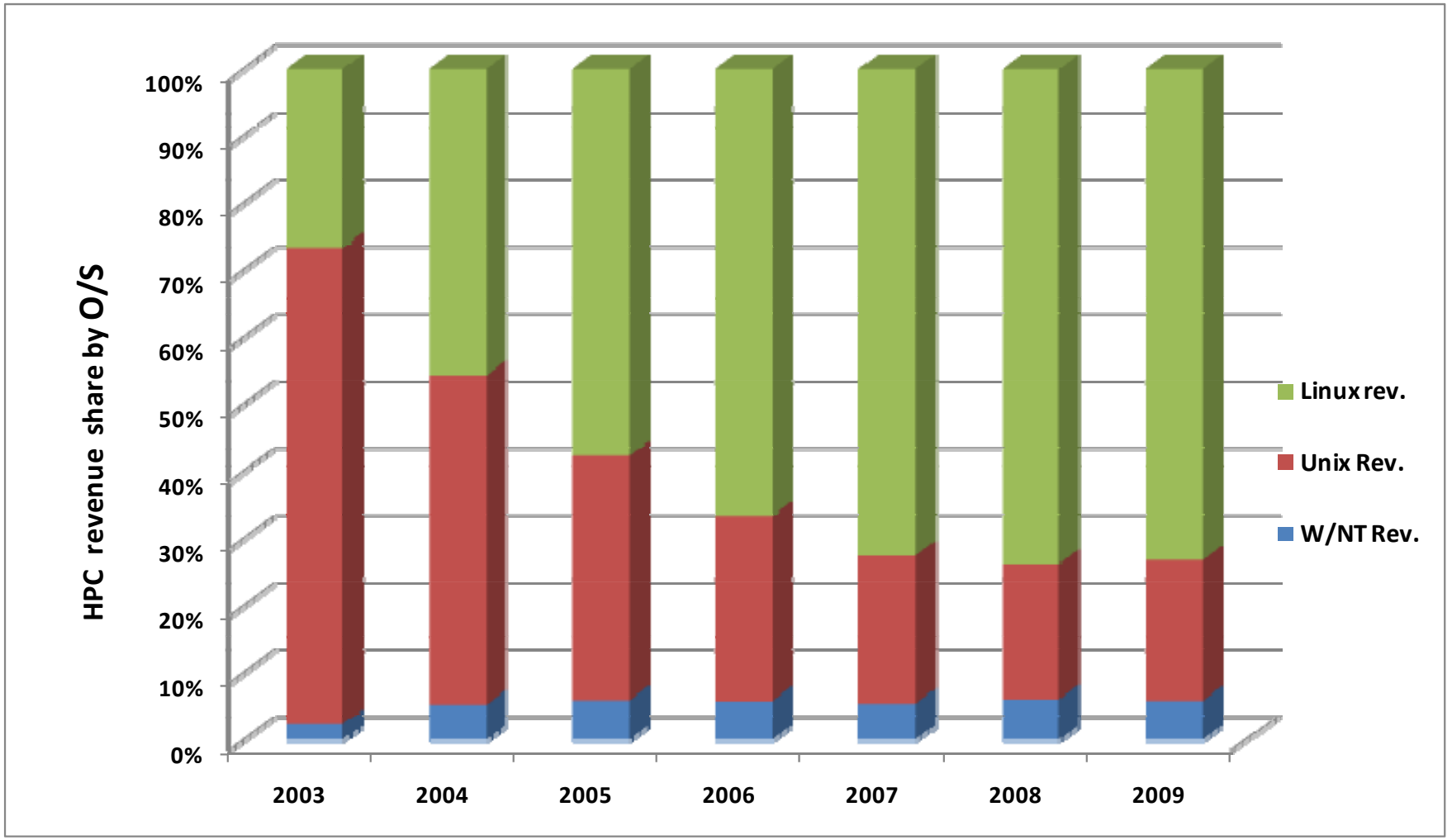
	WW Rev	WW Units	System Node Volume
CPU Type	**Q409**	**Q409**	**Q409**
x86-64	1,920,197	26,873	332,993
EPIC	145,245	707	4,644
RISC	368,233	2,882	4,592
Other	143,000	1	0
RISC-BG	9,600	3	6,144
Grand Total	**2,586,275**	**30,466**	**348,373**

Total HPC Revenue Share by Processor Type



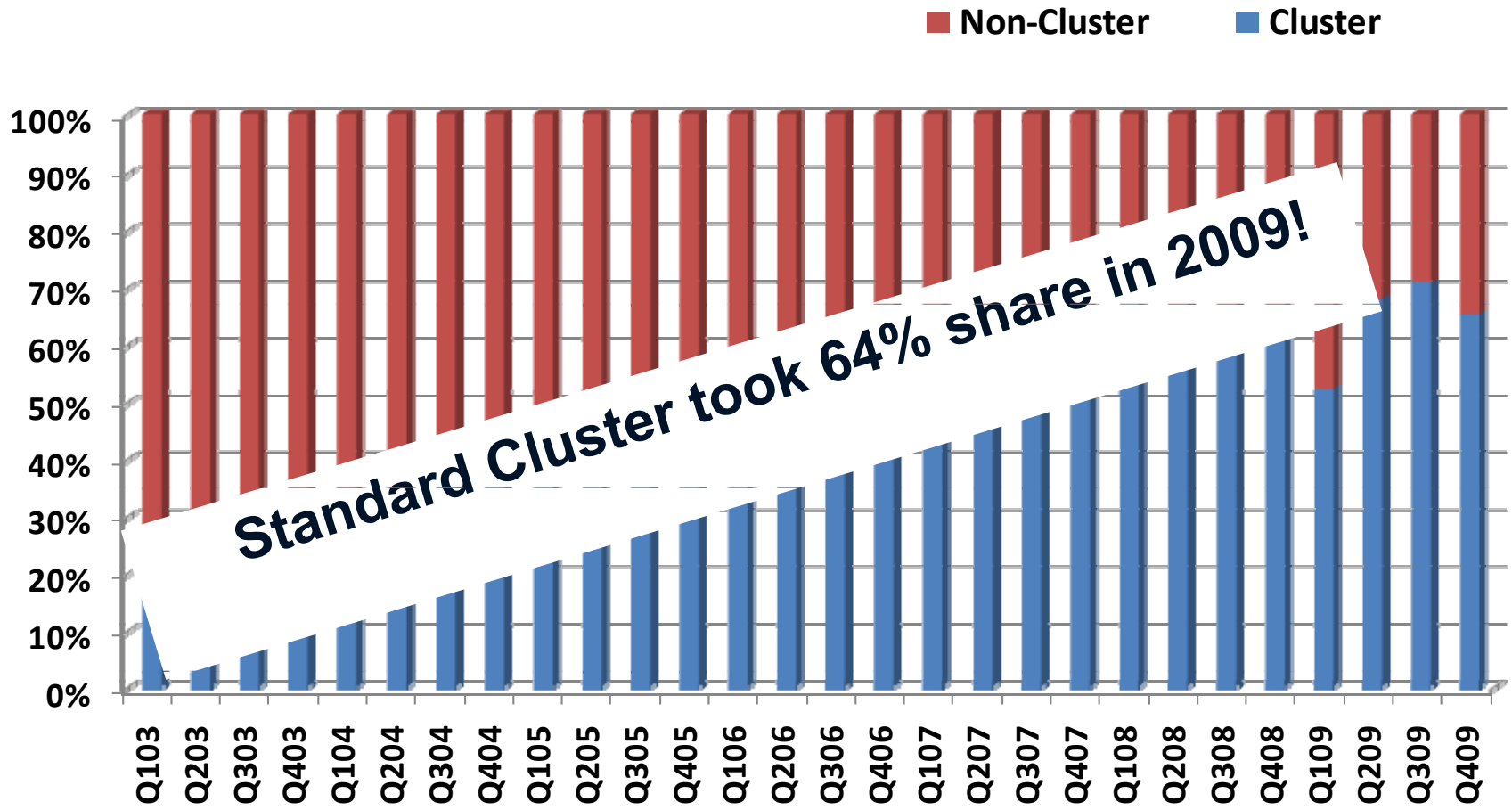
Source IDC, 2010

Total HPC Revenue by OS



Source IDC, 2010

Growth In HPC Clusters, Q103 – Q409



Source IDC, 2010

Why Is Commodity Hot? .. Price!

HPC Server Processor/Sockets Metrics, 2009

CPU Type	System ASP($K)	Ave CPUs /System	$K/CPU	CPUs / $M
x86-64	68.2	27	2.5	399
EPIC	145.2	14	10.3	98
RISC	148.4	22	6.7	149
Vector	2,785.7	29	96.2	10

Source: IDC, 2010

Why is Commodity Hot (Cont'd)

HPC Server Core Metrics, 2009

CPU Type	System ASP($K)	Ave Cores /System	$K/Core	Cores / $M
x86-64	68.2	89	0.8	1302
EPIC	145.2	25	5.8	174
RISC	148.4	49	3.1	327
Vector	2,785.7	29	96.2	10

Source IDC, 2010

HPC Market Drivers and Barriers

The Value of HPC Leadership

Computational modeling/simulation/design is now established as the third branch of scientific inquiry, complementing theory and experimentation.

HPC-driven innovation has become a prerequisite for:

- **Scientific leadership**
- **Industrial leadership**
- **Economic advancement**
- **National/regional security**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WHITE PAPER

Council on Competitiveness Study of ISVs Serving the High Performance Computing Market: Part B — End-User Perspectives

Earl Joseph, Ph.D.
Addison Snell
Christopher G. Willard, Ph.D.
February 2006

Suzy Tichenor, Council on Competitiveness
Steve Conway, Conway Communications

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In this study, 97% of the businesses that had adopted HPC said they could no longer compete or survive without it.

HPC Can Change A Nation's Wealth

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INDUSTRY DEVELOPMENTS AND MODELS

Massive HPC Systems Could Redefine Scientific Research and Shift the Balance of Power Among Nations

Earl C. Joseph, Ph.D. Steve Conway
Jie Wu

872.8200 F.508.935.4015 www.idc.com

IDC OPINION

There is a growing contingent of nations around the world that are investing considerable resources to install supercomputers with the potential to reshape how science and engineering are accomplished. In some cases, the cost of admission for each supercomputer now exceeds $100 million and may soon reach $1 billion. And some countries are laying the groundwork to build "fleets" of these truly large-scale computers to create a sustainable long-term competitive advantage. There are sizable challenges in implementing these truly super supercomputers:

- Along with the cost of the computers, there are substantial costs for power, and cooling and storage.
- In most cases, new datacenters have to be built, and often entire new research organizations are created around the mission.

HPC Leadership Can Provide New Knowledge

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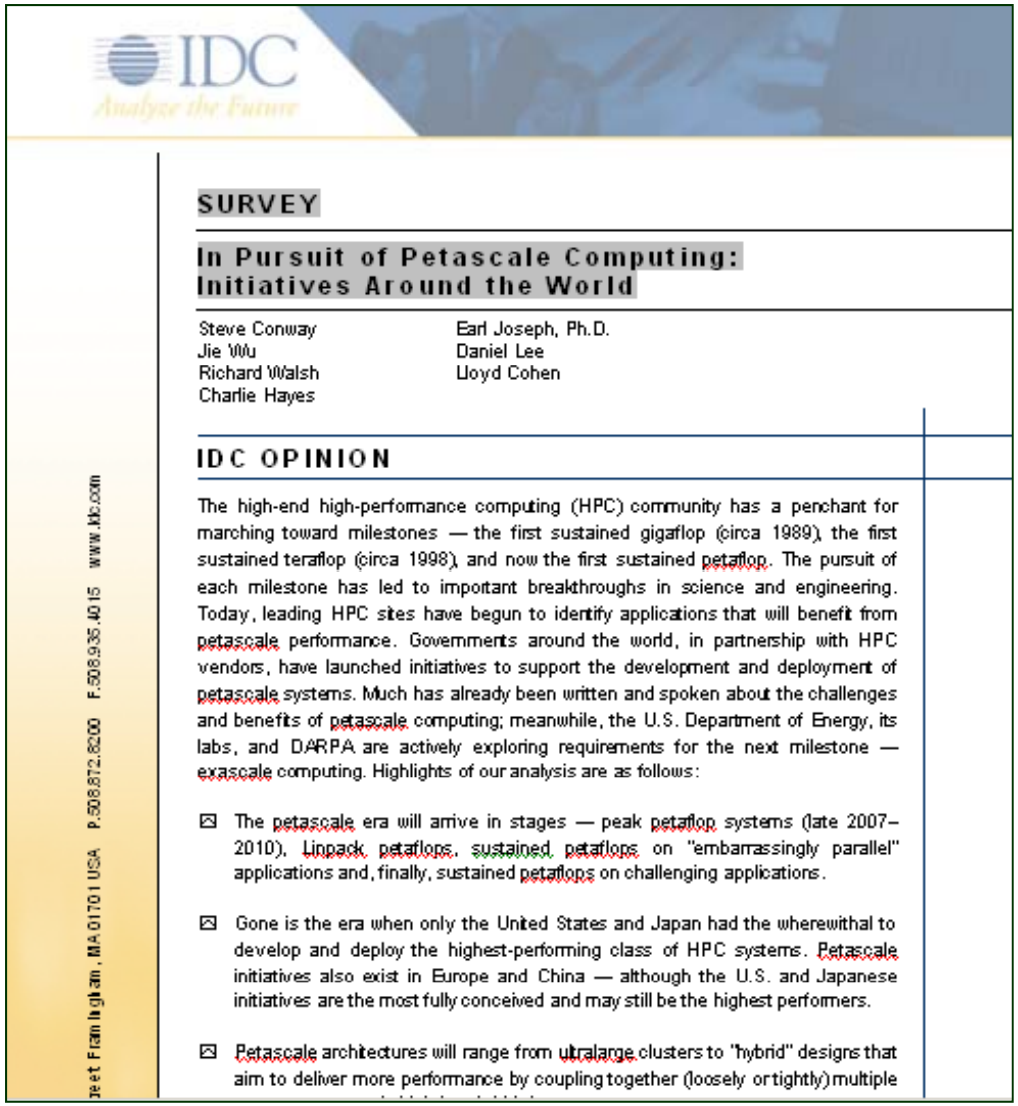
Pushing Back the Frontiers of Science

Petascale Early Science Projects Tackle National/Global Problems

- **Energy for environmental sustainability**
  - **Climate change:** carbon sequestration, weather event impacts on global climate, decadal climate predictive skill in aerosol forcing, global climate at unprecedented resolution
  - **Bioenergy:** recalcitrance in cellulosic ethanol
  - **Solar:** non-equilibrium semiconductor alloys
  - **Energy storage:** charge storage and transfer in nano-structured supercapacitors
  - **Energy transmission:** role of inhomogeneities in high-T superconducting cuprates
  - **Combustion:** stabilizing diesel jet flames for increased efficiency & decreased emissions
  - **Fusion:** ITER design, optimization, and operation
  - **Nuclear energy:** fully-resolved reactor core neutron state
- **Materials and nanoscience**
  - **Structure** of nanowires, nanorods, & strongly correlated materials (magnets)
- **Fundamental science**
  - **Astrophysics:** decipher core-collapse supernovae & black hole mergers
  - **Chemistry:** elucidate water structure in biological & aqueous-phase systems
  - **Nuclear physics:** probe the anomalously long lifetime of Carbon-14
  - **Turbulence:** dispersion relative to air quality modeling and bioterrorism

Research Example: We Have Entered the Petascale Era and Are Heading toward Exascale Computing



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SURVEY

In Pursuit of Petascale Computing: Initiatives Around the World

Steve Conway
Jie Wu
Richard Walsh
Charlie Hayes
Earl Joseph, Ph.D.
Daniel Lee
Lloyd Cohen

IDC OPINION

The high-end high-performance computing (HPC) community has a penchant for marching toward milestones — the first sustained gigaflop (circa 1989), the first sustained teraflop (circa 1998), and now the first sustained petaflop. The pursuit of each milestone has led to important breakthroughs in science and engineering. Today, leading HPC sites have begun to identify applications that will benefit from petascale performance. Governments around the world, in partnership with HPC vendors, have launched initiatives to support the development and deployment of petascale systems. Much has already been written and spoken about the challenges and benefits of petascale computing; meanwhile, the U.S. Department of Energy, its labs, and DARPA are actively exploring requirements for the next milestone — exascale computing. Highlights of our analysis are as follows:

- The petascale era will arrive in stages — peak petaflop systems (late 2007–2010), Linpack petaflops, sustained petaflops on "embarrassingly parallel" applications and, finally, sustained petaflops on challenging applications.
- Gone is the era when only the United States and Japan had the wherewithal to develop and deploy the highest-performing class of HPC systems. Petascale initiatives also exist in Europe and China — although the U.S. and Japanese initiatives are the most fully conceived and may still be the highest performers.
- Petascale architectures will range from ultralarge clusters to "hybrid" designs that aim to deliver more performance by coupling together (loosely or tightly) multiple

5 Speen Street Framingham, MA 01701 USA P.508.872.8200 F.508.935.4015 www.idc.com

- **Petascale systems are in place or planned for Europe, the U.S. and Asia**
- **Multiple applications have been run at sustained trans-petaflop speeds**
- **Exascale planning initiatives are already under way**

HPC Market Drivers and Barriers

Major Customer Pain Points

Software has become the #1 roadblock

- Better management software is needed
  - HPC clusters are still hard to setup and operate
  - New buyers – require “ease-of-everything”
- Parallel software is lacking for most users
  - Many applications will need a major redesign
  - Multi-core will cause many issues to “hit-the-wall”

Clusters are still hard to use and manage

- System management & growing cluster complexity
- Power, cooling and floor space are major issues
- Third party software costs
- Weak interconnect performance at all levels
- RAS is a growing issue
- Storage and data management are becoming new bottle necks
- Lack of support for heterogeneous environment and accelerators

Software Scaling Limitations

TABLE 20

Typical Number of Processors the ISV Applications Use for Single Jobs

CPU Range	Number of Applications	Percent
1	19	24.4%
2-8	25	32.1%
9-32	20	25.6%
33-128	9	11.5%
129-1024	4	5.1%
Unlimited	1	1.3%
Total:	78	100.0%

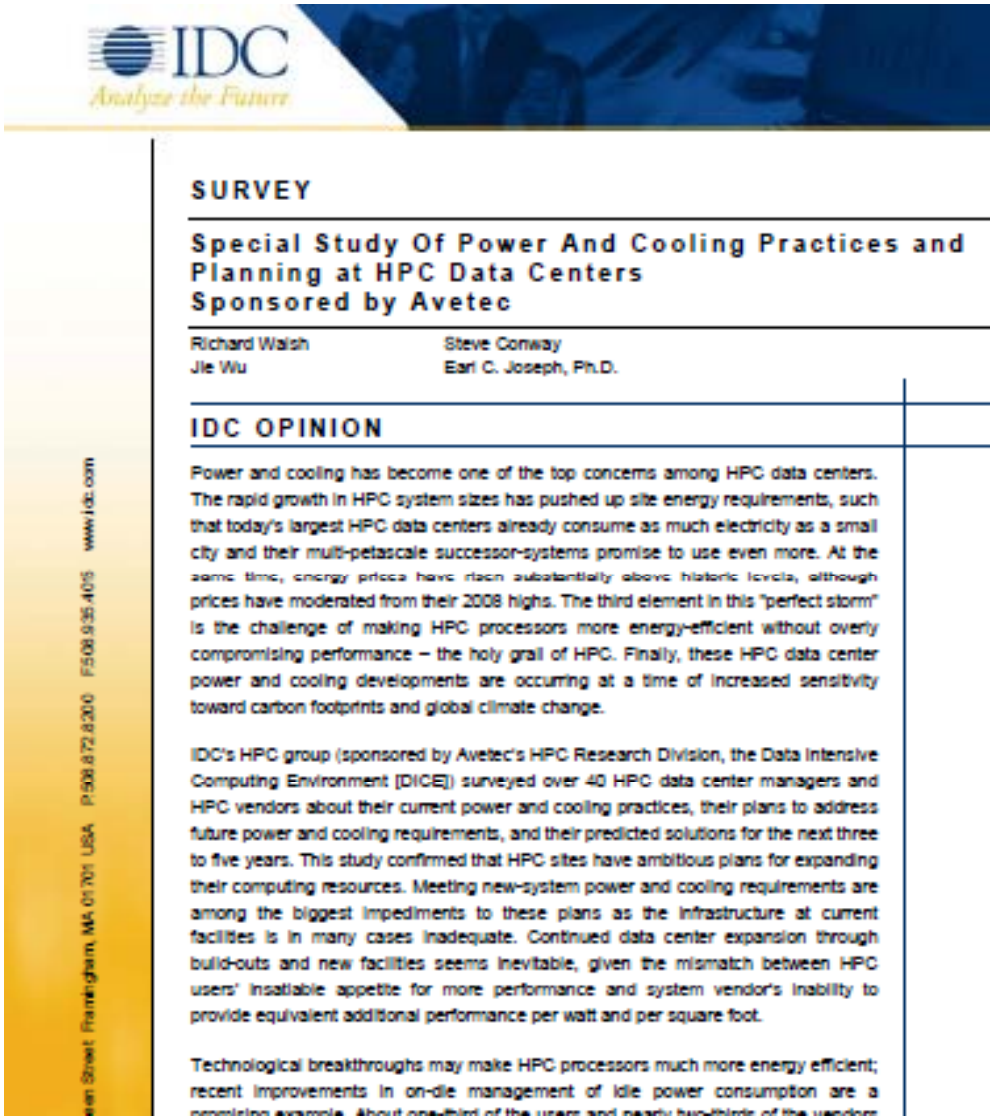
New Challenges Affecting HPC Datacenters

The increase in CPUs and server units is creating significant IT challenges in:

- Managing complexity
  - How to best manage a complex cluster
  - How to install/setup a new cluster without having to buy a large number of separate pieces
- Application scaling and hardware utilization
  - How to deliver strong performance to users on their applications
  - How to make optimal use of new processor and system designs
- Power/cooling and Space

HPC Power And Cooling Issues

Research Example:
Power and Cooling As A Crucial HPC Issue



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SURVEY

Special Study Of Power And Cooling Practices and Planning at HPC Data Centers Sponsored by Avetec

Richard Walsh
Jie Wu
Steve Conway
Earl C. Joseph, Ph.D.

IDC OPINION

Power and cooling has become one of the top concerns among HPC data centers. The rapid growth in HPC system sizes has pushed up site energy requirements, such that today's largest HPC data centers already consume as much electricity as a small city and their multi-petascale successor-systems promise to use even more. At the same time, energy prices have risen substantially above historic levels, although prices have moderated from their 2008 highs. The third element in this "perfect storm" is the challenge of making HPC processors more energy-efficient without overly compromising performance – the holy grail of HPC. Finally, these HPC data center power and cooling developments are occurring at a time of increased sensitivity toward carbon footprints and global climate change.

IDC's HPC group (sponsored by Avetec's HPC Research Division, the Data Intensive Computing Environment [DICE]) surveyed over 40 HPC data center managers and HPC vendors about their current power and cooling practices, their plans to address future power and cooling requirements, and their predicted solutions for the next three to five years. This study confirmed that HPC sites have ambitious plans for expanding their computing resources. Meeting new-system power and cooling requirements are among the biggest impediments to these plans as the infrastructure at current facilities is in many cases inadequate. Continued data center expansion through build-outs and new facilities seems inevitable, given the mismatch between HPC users' insatiable appetite for more performance and system vendor's inability to provide equivalent additional performance per watt and per square foot.

Technological breakthroughs may make HPC processors much more energy efficient; recent improvements in on-die management of idle power consumption are a promising example. About one-third of the users and nearly two-thirds of the vendors

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Power and cooling large HPC systems has become one of the top issues in HPC

This worldwide study found that:

- *"Power and cooling infrastructure limitations were the biggest barriers to increasing HPC resources"*

Power and Cooling Study: Background

- **Power and cooling has become a top concern among HPC data centers**
  - Increases in HPC system sizes have escalated energy requirements
- **At the same time, energy prices have risen substantially above historic levels**
- **The third element in this "perfect storm" is the challenge of making HPC processors more energy-efficient without overly compromising performance – the holy grail of HPC**
- **And these power and cooling developments are occurring at a time of increased sensitivity toward carbon footprints and global climate change and aging infrastructures**

Power and Cooling Study: General Findings

- **HPC data centers' *average* per site:**
  - Available floor space over 26,000 ft^2
  - Used floor space about 17,000 ft^2
    - 63% of available space
  - Cooling capacity 22.7 million BTUs or 1,839 tons
  - Annual power consumption 6.356 MW
- **HPC data centers costs**
  - Annual power cost was $2.9 million or $456 per KW
  - Ten sites provided the percentage of their budget spent on power—average was 23%
  - Two-thirds of the sites had budget for power and cooling upgrades
    - Average amount budgeted is $6.87 million

Power and Cooling Study: Key Finding #1

- **Nearly all the HPC user sites surveyed (96%) consider "green" design criteria important to their HPC system and data center planning process**
  - A substantial majority (71%) plan to include power and cooling efficiency goals and/or metrics in their future plans
  - Nearly all sites were able to describe steps they had taken to make their HPC resources and operations "greener"
    - Including data center flow analysis, hot-aisle cold-aisle containment, moving to higher voltage distribution systems, more regular maintenance schedules, the use of "free" cooling, and the purchase of liquid-cooled systems, among many other measures

Power and Cooling Study: Key Finding #2

- **Approximately two-thirds of user sites plan to expand or build new HPC data centers**
  - Nearly the same percentage (61%) also have budgets in place to upgrade their power and cooling capabilities during the next two to three years
  - The average amount budgeted for power and cooling upgrades is $6.87 million
  - The average data center space currently available is more than 26,000 square feet and on average the data centers and are using just under 17,000 square feet, or 63% of the available space

Power and Cooling Study: Key Finding #5

- **Liquid cooling is the alternative approach being considered most often by the user sites**
  - For cooling HPC systems, products, and data centers, a majority of sites expect to maintain existing air-based cooling methods, but departures from the status quo tended toward increased adoption of water and other liquid cooling technologies
  - Liquid cooling was the top alternative approach being considered by both users and vendors

Power and Cooling Study: Key Finding #7

- **Approximately half of the surveyed user sites (48%) pay for power and cooling costs out of their own budgets**
  - Of the government sites, 75% pay for power and cooling directly out of their own budgets, whereas only 50% of academic sites and 14% of industry sites do this
  - Nearly all of the other sites said that despite having no direct budgetary responsibility for this, they work hard to control power and cooling costs

Power and Cooling Study: Key Finding #10

- **HPC users and vendors differ sharply on the likelihood of game-changing cooling technologies**
  - Just over one-third (36%) of the user sites expect game-changing cooling technologies to emerge in the next five years
  - The vendors were much more optimistic than the user sites, with 62% of them foreseeing the emergence of game-changing cooling technologies in this timeframe

Power and Cooling Study: Power and Cooling by Sub-systems

TABLE 20

Distribution Of Power And Cooling Costs Among HPC Sub-Systems

How do your power and cooling costs divide among your HPC compute, storage, visualization sub-systems?

Response (percentages)	Government	Industry	Academia	All Sites
% Compute	92.6%	81.7%	90.1%	89.7%
% Storage	4.9%	18.3%	8.2%	8.6%
% Visualization	2.1%	0.0%	1.1%	1.3%
Don't know or not sure	0.4%	0.0%	0.6%	0.4%

IDC Top 10 HPC Predictions for 2010

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1. The HPC Market Will Resume Growth in Mid-2010
2. The Race For Global Leadership Will Turbo-Charge the Supercomputers Segment
3. In 2010 Evolutionary Change Will Trump Revolutionary Change
4. Commoditization Will Increasingly Level the Playing Field For HPC Competition
5. The Highly Parallel Programming Challenge Will Increase
6. X86 Processors Will Dominate, But GPGPUs Will Gain Traction As x86 Hits the Wall
7. Infiniband Will Continue To Gain HPC Market Share
8. HPC Storage Will Outpace the HPC Server Market Recovery
9. Power and Cooling Efficiency Will Become More Important, But Is Not Far Along Today
10. Cloud Computing May Be Coming To A Neighborhood Near You

2. The Race For Global Leadership Will Turbo-Charge the Supercomputers Segment

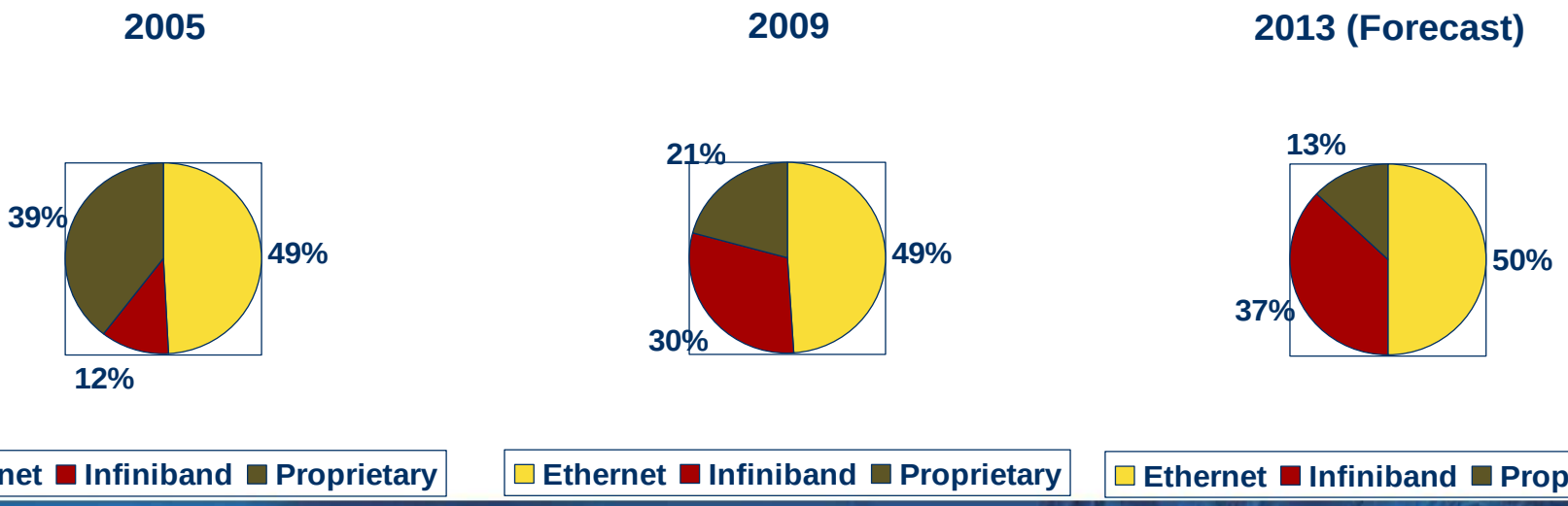
- **The $500K and up Supercomputers segment did very well in 2009 at about $2.6B**
  - IDC predicts it will grow 17% to $3.1B in 2010 and to $4.1B in 2013
  - The $3M+ segment grew a whopping 65% in 2009 to reach $1.0B and we expect it to grow to $1.4B in 2013
- **The race for HPC leadership might turbo-charge the Supercomputers segment possibly for a decade to come**
- **Although the Petascale Era is just dawning, governments around the world are already exploring exascale computing**

6. x86 Processors Will Dominate, But GPGPUs Will Gain Traction as x86 Hits the Wall

- **x86 processors went from near-zero to hero in HPC in the past decade, largely replacing RISC.**
- **x86 will continue to dominate, but GPGPUs will start making their presence felt more in 2010.**
- **Multiple Large HPC procurements have substantial GPGPU content.**
- **GPGPUs provide more peak/Linpack flops per dollar for politics and will inevitably provide more sustained flops for suitable applications.**
- **In 2010, some ISVs will announce plans to redesign their apps with GPGPUs in mind.**

7. Infiniband Will Continue To Gain HPC Market Share

- **Infiniband's share grew substantially, 2005-2009, at the expense of proprietary interconnects, while Ethernet's share remained constant**
- **IDC forecasts that by 2013, the HPC interconnect market will grow to about $2.25B from $2.0B in 2009**
- **It will take a while for 10 GigE to work its way through the HPC market**



10. Cloud Computing May Be Coming To A Neighborhood Near You

- **Clouds offer the ability to quickly add resources, and a way to try before buying**
- **CERN is developing what may be the world's biggest private cloud, to distribute data, applications and computing resources to scientists around the world**
- **NASA is building a private cloud to enable researchers to run climate models on remote systems provided by NASA. This saves NASA from having to help users build the complex models on their local systems**
- **NSF and Microsoft just announced a cloud arrangement**
- **NERSC and the Joint Genome Institute are collaborating on a l cloud initiative related to gene sequencing data**

HPC Market Forecasts

HPC Server Revenue($K) Forecast 2008 - 2014

WW HPC Server Forecast, 2009 - 2014

	2009	2010	2011	2012	2013	2014	CAGR (09-14)
Supercomputer	3,369,410	3,624,352	3,879,294	4,134,237	4,389,179	4,617,522	6.5%
Divisional	1,070,764	1,129,694	1,188,625	1,247,555	1,306,485	1,366,596	5.0%
Departmental	2,516,253	2,698,090	2,879,928	3,061,765	3,243,602	3,479,978	6.7%
Workgroup	1,680,687	1,787,410	1,894,133	2,000,856	2,107,579	2,242,167	5.9%
Total	8,637,114	9,239,547	9,841,980	10,444,413	11,046,846	11,706,263	6.3%

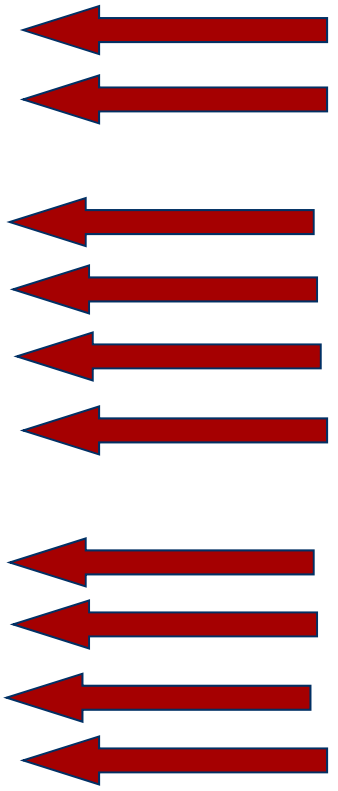
Source: IDC, 2010

Growth Areas: Industry/Application Segments

Worldwide HPC Revenues ($M)		
	2008	2009
Bio-Sciences	$1,412	$1,120
CAE	$1,131	$874
Chemical Engineering	$238	$179
DCC & Distribution	$572	$460
Economics/Financial	$281	$198
EDA / IT / ISV	$751	$540
Geosciences and Geo-engineering	$570	$539
Mechanical Design and Drafting	$112	$73
Defense	$920	$849
Government Lab	$1,460	$1,349
University/Academic	$1,852	$1,641
Weather	$392	$353
Other	$80	$78
Total Revenue	$9,772	$8,252

Source: IDC 2010

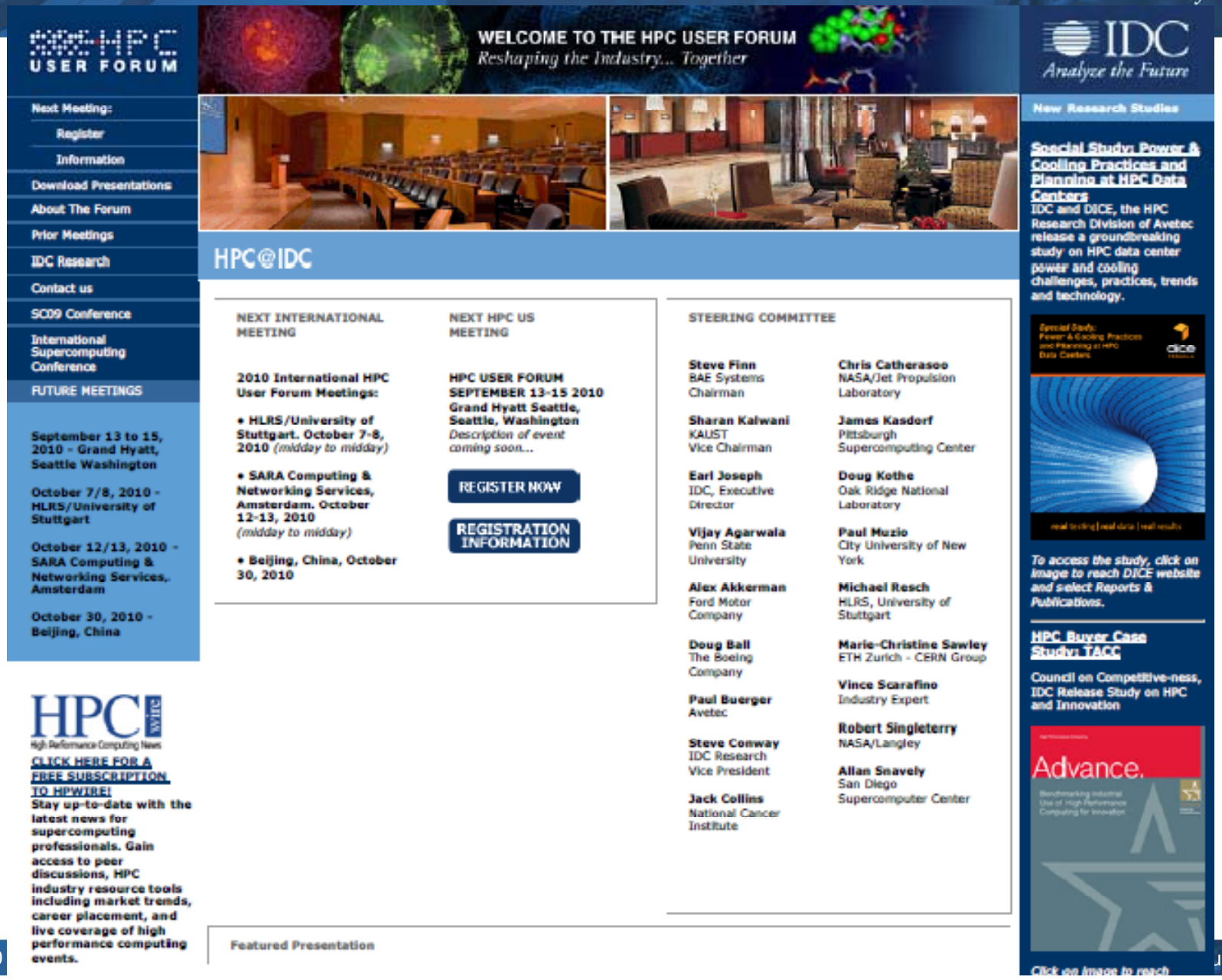
2010 to 2014 Growth Sectors



HPC User Forum Update

Register at: www.hpcuserforum.com

IDC Analyze the Future



HPC User Forum Mission

To Improve The Health Of The

High-performance Computing Industry

Through Open Discussions, Information-sharing

And Initiatives Involving

HPC Users In Industry, Government And

Academia

Along With HPC Vendors

And Other Interested Parties

HPC User Forum Goals

Assist HPC users in solving their ongoing computing, technical and business problems

Provide a forum for exchanging information, identifying areas of common interest, and developing unified positions on requirements

- By working with users in other sectors and vendors
- To help direct and push vendors to build better products
- Which should also help vendors become more successful

Provide members with a continual supply of information on:

- Uses of high end computers, new technologies, high end best practices, market dynamics, computer systems and tools, benchmark results, vendor activities and strategies

Provide members with a channel to present their achievements and requirements to interested parties

Design and Manufacturing: Tier 1

- **Boeing: *"If the solutions can't run during the day or overnight on <500 processors, our airplane designers probably won't use them."***
- **GM: "Bandwidth" means one design (underbody) to create multiple vehicles (body styles). Targeting billion-element models.**
- **BMI: If long-haul trucks had drag coefficient of 0.26 instead of 0.60, U.S. would save 6.8B gallons of diesel ($19B), 75M tons CO2.**

Design and Manufacturing: Tier 1

- **Procter & Gamble: "*The complexity isn't in the chip or the diaper but in the fact that we have to make billions of products a year. The machines that make our diapers have as many parts as a jumbo jet.*"**
- **General Electric: *"Some of our simulations need to be sped up 1–2 orders of magnitude beyond what we can do today, to fit into our product development cycle. It's impossible for us to build iron and then test it. We have to rely on simulation."***
- **Caterpiller: *"We want our modelers not to have to worry about the computers."***

Design and Manufacturing: Supply Chain

- **Coalition forming to drive HPC into the supply chain ("missing middle"):**
  - Council on Competitiveness, National Association of Manufacturers, National Center for Manufacturing Sciences, NCSA, OSC, Nimbis, IDC, Intel and other vendors
  - National Association of Manufacturers: *"HPC is one of the competitive advantages the United States has. We need to have a sense of urgency about this or our manufacturing base will be lost."*
  - Plan to create Software Applications Discovery Initiative (SADI) advisory panel to NSF. Manufacturers and ISVs.

ISV Applications Scalability

- **Multicore is driving ISVs toward a hybrid distributed-shared memory model (SMP within processors, MPP across processors)**
- **To boost scalability, you need to parallelize all scalar bottlenecks, including meshing, I/O and visualization.**
- **Many ISVs are still struggling with licensing models.**
- **There is not much demand yet for running ISV applications in the cloud.**
- **Most ISVs are not rushing to GPGPUs/other accelerators yet: lack of infrastructure, high programming costs, and only parts of the applications map well onto accelerators. More time is needed.**

Training and Development

- **Panel: Chrysler, City University of New York, Computer Sciences Corp., KAUST, NSF and NAG**
- **Skills in short supply:** parallel programmers, system administrators, people with knowledge of HW-SW architecture and domain science
- **Academic preparation:**
  - *"Computer science teaches you to design the hammer, but not how to build anything. Engineering and science curricula stress theory rather than problem-solving."*
  - *"If you overlay computational science onto the course curriculum, it doesn't work. It has to be integrated into the curriculum."*

Important Dates For Your Calendar

Next US Meeting:

- **September 13 to 15, 2010, Seattle Washington**

International Meetings:

- **HLRS/University of Stuttgart, October 7/8, 2010**
- **SARA Computing & Networking Services, Amsterdam, October 12/13, 2010**
- **Beijing, China, October 30th**

September 13 to 15, Meeting Topic Areas

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Main Meeting Topic: General science

Presentation areas:

- **Exascale and near-exascale plans around the world**
- **High-productivity computing – how do we get there?**
- **Application scalability (continued) – algorithm development**
- **"Clearing up clouds" User and vendor panel format, covering both business model and technical models**
- **GPGPU technical panel**
- **Analyzing large unstructured data (NSF is pushing this as the "fourth leg" of computational science)**
- **Aerospace: not just commercial airplanes**
- **Multi-core chips and HPC**

IDC
European/EU
HPC Research

The IDC EU HPC 2020 Strategy Study

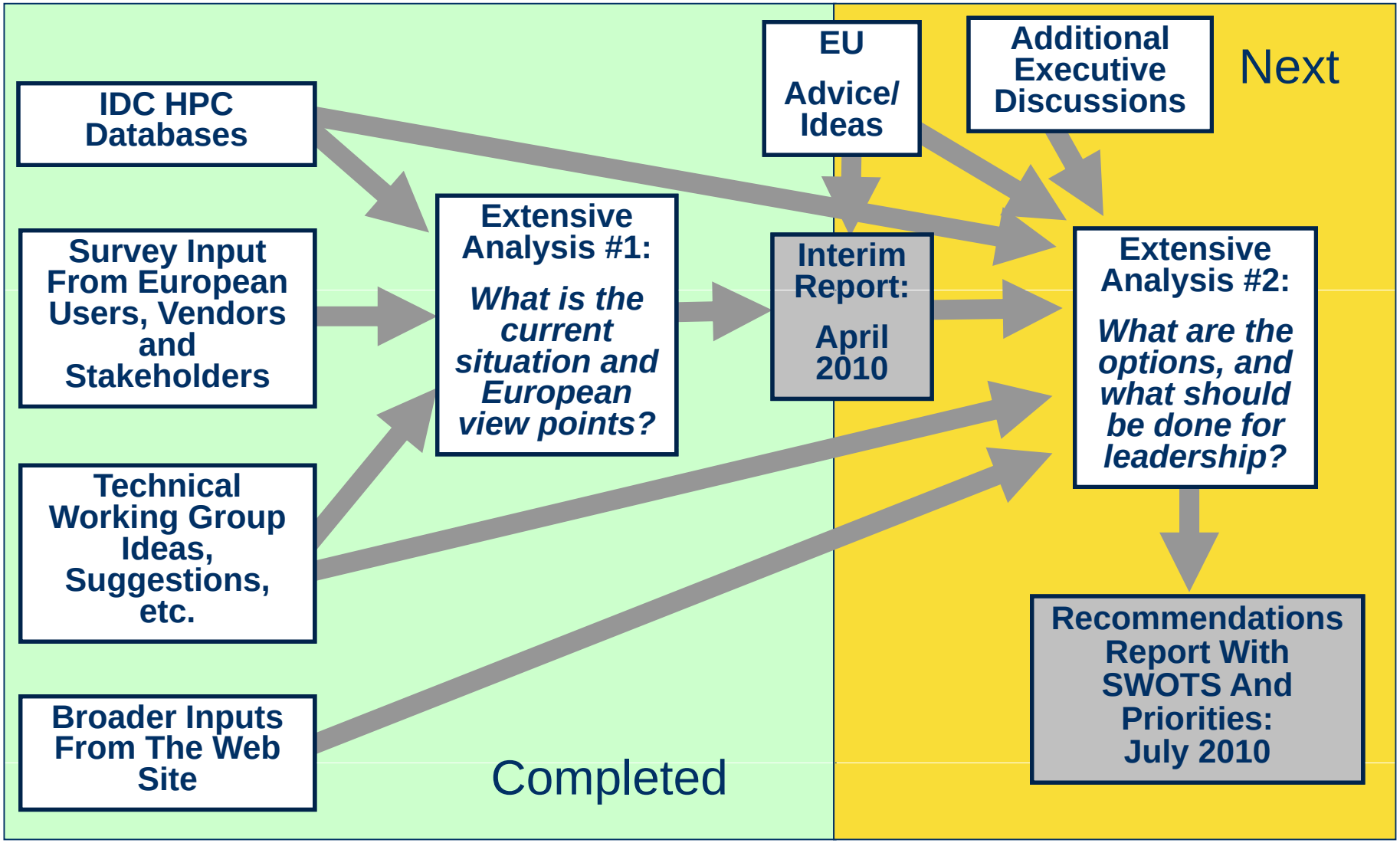
The goals of the study include:

1) Accessing the current situation of high end HPC in Europe, how it compares to other countries, where the EU is strong and weak, what are the threats if the EU doesn't put into place a broader and stronger HPC strategy to 2020
2) Collect what European HPC experts and funders feel are the most important areas for leadership and the best approach to obtain HPC leadership
3) Create a strategy and implementation plan for EU HPC leadership

- This presentation will cover the first two goals, the third goal won't be completed until late July

Contract Number: 2009/S99-142914
EU Contract Manager: Bernhard FABIANEK, Performance Computing Officer
European Commission , DG Information Society , Unit F03 — office BU25 04/087
25 Avenue Beaulieu, B-1160 Bruxelles

Overall Study Process Approach



EU Project Strategic Goals

To develop a complete strategic agenda to guide EU investments in High Performance Computing and to become a leading user and provider of HPC

- To increase the scientific and research competitiveness and European added value on the supply side by 2020
  - Through appropriate investments and partnerships in R&D and deployment
- To bring together industrial and academic users of HPC services and providers of HPC
  - To ensure that the offerings developed match users' requirements and build a common vision on the future developments of HPC systems
- To enlarge and deepen the use of e-Infrastructure computing services within Europe to meet the growing demand from both academia and industry

Interim Report Executive Overview

- **Europe is under-investing in HPC, while other nations are growing their supercomputer investments dramatically**
  - Even in 2009, the most difficult year of the global economic recession
- **Supercomputing revenues (annual spending on systems priced above $500,000) increased by 25% worldwide in 2009**

Interim Report Executive Overview

- **HPC research funding in Europe includes a diversity of EU, national and regional programs, and few countries have a coherent HPC development strategy**
- **HPC stakeholders from research, industry and academia rank U.S. and Japanese HPC research programs ahead of Europe's research programs**

Interim Report Executive Overview

The transition to petascale and exascale computing creates opportunities

- For Europe's scientific and computing communities to return to the forefront of development for the next generation of research and HPC software technologies

EU Purchases By Sector

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TABLE 28

EU Countries HPC Revenue (€000) by Application, 2005–2009

Application	2005	2006	2007	2008	2009	CAGR (05–09)
Bio-Sciences	302,182	331,635	348,304	322,705	265,509	-3.2%
CAE	261,610	294,130	316,270	299,927	252,487	-0.9%
Chemical Engineering	43,681	51,332	57,368	56,064	48,493	2.6%
DCC & Distribution	97,497	102,734	102,900	89,934	69,348	-8.2%
Economics/Financial	42,898	50,917	56,969	55,636	48,018	2.9%
EDA	126,954	141,789	150,907	140,428	115,781	-2.3%
Geosciences and Geo-engineering	107,260	119,138	126,176	117,248	96,894	-2.5%
Mechanical Design and Drafting	38,718	41,583	42,306	37,792	29,774	-6.4%
Defense	131,623	155,652	175,132	174,738	155,639	4.3%
Government Lab	309,590	325,110	324,815	286,797	226,579	-7.5%
Software Engineering	4,472	4,474	4,240	3,520	2,563	-13.0%
Technical Management	22,192	22,058	20,479	16,417	11,285	-15.6%
University/Academic	339,481	365,139	375,398	341,381	278,036	-4.9%
Weather	87,922	93,970	96,225	87,239	70,561	-5.4%
Other	648	2,484	4,422	5,768	6,138	75.4%
Total Revenue	1,916,730	2,102,146	2,201,912	2,035,594	1,677,105	-3.3%

Source: IDC, 2010

Study Highlights: Importance Of HPC

89% of those who responded to the survey felt HPC was extremely important for scientific leadership

- 11% felt it was important
- And no one felt it wasn't important

"Scientific leadership cannot be achieved without a significant presence in HPC."

66% felt that HPC was extremely important for industrial competitiveness

- 34% felt it was important
- And no one felt it wasn't important

"HPC is extremely important for Industry sectors such as aerospace, oil and gas, energy, chemistry and life sciences."

GDP And Supercomputer Spending

GDP And Supercomputer Spending By Country, Sorted By GDP				
	GDP	Average Supercomputer Sales Over Last Five Years	Supercomputers As A Percentage Of GDP	Compared To US
U.S.	14,270,000	1,276,067	0.0089%	100%
Europe	13,295,500	654,339	0.0049%	55%
Japan	5,049,000	278,385	0.0055%	62%
China	4,758,000	67,836	0.0014%	16%
Korea	800,300	66,541	0.0083%	93%
Hong Kong	208,800	15,491	0.0074%	83%
Singapore	163,100	16,324	0.0100%	112%

Study Highlights: Successful HPC Programs (As Seen By HPC Experts)

Most successful international HPC programs:

1. U.S. Department of Energy — SciDAC (10)
2. U.S. Department of Energy — INCITE (9)
3. U.S. National Science Foundation – NSF (8)
4. Japan's RIKEN /Keisoku Project (7)
5. U.S. Department of Defense — DARPA (5)
6. U.S. Department of Defense — HPC Modernization Program (3)
7. PRACE (2)
8. IESP (2)

Most successful EU HPC Programs:

1. PRACE (14)
2. DEISA (10)
3. CEA-DAM (4)
4. CERN (4)
5. HPC Europa (4)
6. Blue Brain –EPFL (2)
7. EGEE (2)
8. ESA (2)
9. Forschungszentrum Juelich (2)
10. GEANT (2)

Top Areas That The Stakeholders Said The EU Should Focus On

What are the most important approaches for EU HPC leadership?		
Approach	Number of Responses	Percentage Of Responses
Making world-class HPC resources more widely available to the EU scientific and engineering communities	57	93.4%
Advancing scientific leadership by using HPC to solve some of the world's most challenging problems	50	82.0%
Making HPC more readily available for the first time to small and medium-size businesses (including industrial supply chains, small educational sites, etc.)	33	54.1%
Having many very large supercomputers, e.g., being at or near the top of the Top500 list of the world's most powerful supercomputers (www.top500.org)	25	41.0%
Building an EU-based HPC vendor community with world-class capabilities in important areas (hardware, software, storage, networking, etc.)	24	39.3%

Next Steps:

Recommendations Report

And We Need Your Inputs!

Proposed Strategic Agenda Report Topics

The Need for an Expanded 2020 HPC Strategy

- The vision and goals for Europe HPC leadership
  - Prioritized leadership areas
- Why HPC policy action is important
  - The potential benefits, risk if no action is taken
  - Supercomputing: EU Needs
- EU Supercomputing strengths and weaknesses, opportunities and threats
  - Key challenges for EU Supercomputing development to 2020
  - Main barriers

Proposed Strategy Options

- Investments required – investment scenarios
  - And potential outcomes possible with each scenario
- The added value of acting at the EU level
- EU Supercomputing development to 2020

Suggested Action Plan

- Implementation scenarios

The Project's Web Site: www.hpcuserforum.com/EU

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In Summary

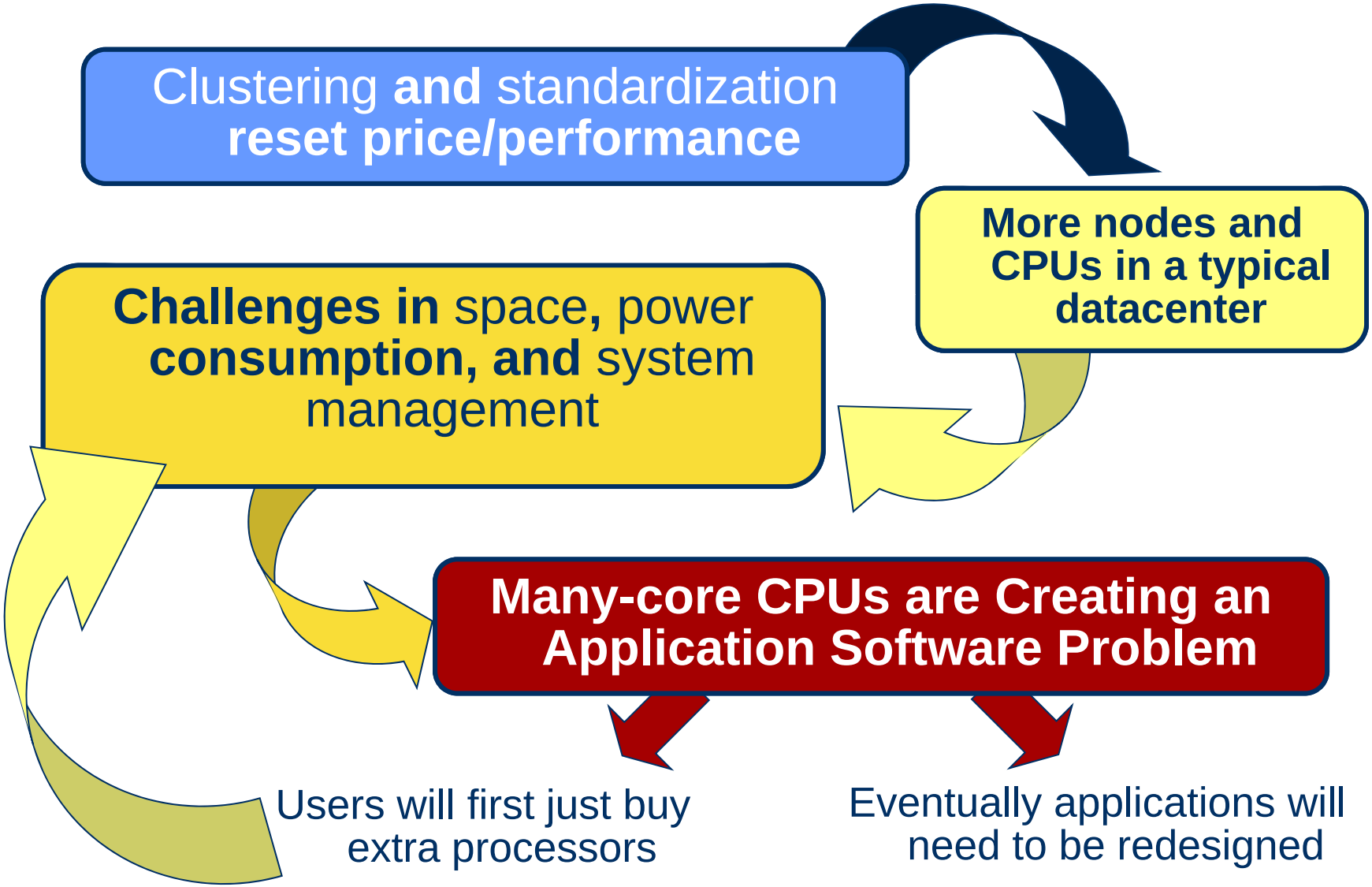
2010 IDC HPC Research Areas

- **Quarterly HPC Forecast Updates**
  - Until the world economy recovers
- **HPC End-user Based Reports:**
  - Clusters, processors, accelerators, storage, interconnects, system software, and applications
  - The evolution of government HPC budgets
  - Emerging markets including China, Russia, etc.
  - SMB and SMS research and award program
  - Clouds in HPC
- **Power and Cooling Research**
- **Developing a Market Model For Middleware and Management Software**
- **Scaling of software**
- **Data Center Assessment and Benchmarking**
- **Worldwide Petascale and Exascale Initiatives**

Why HPC Is Projected To Grow

1. **It has become a competitive weapon**
   - For companies, universities and governments
   - Global competitiveness is driving R&D and better product designs
   - Even small companies can use HPC to gain market share
2. **Governments view HPC leadership as critical**
   - For national pride, but more importantly for economic prosperity
   - It used to be 1 large supercomputer – now its multiple ones
3. **There are very critical HPC issues that need to be solved**
   - Global warming, alternative energy, safe NE, financial disaster modeling, healthcare, homeland security, …
   - And 3D movies and large scale games are fun
4. **At the same time, "live" science and "live" engineering costs have escalated**
   - And time-to-solution is months faster with simulations

Market Dynamics



Questions?

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