Assorted Datacenter & Data Storage Power Trends

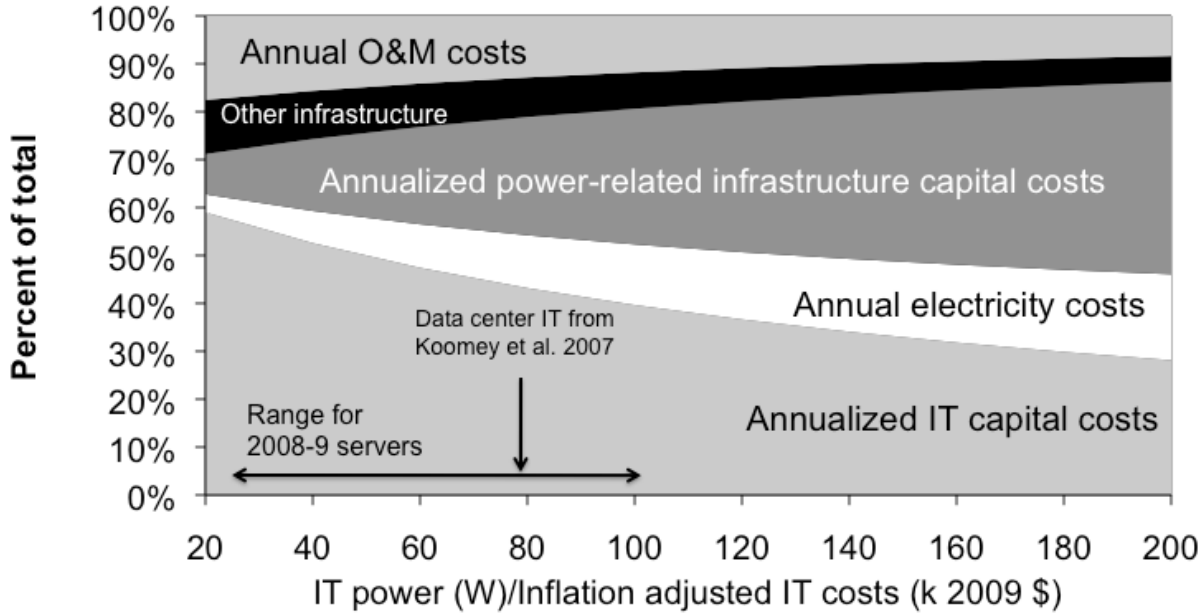

Figure 1: Koomey's (August 2007) Power-related costs grow as power per server cost grows[1]

Data centers are the heart of the global economy. In the mid-1990s, the costs of these large computing facilities were dominated by the costs of the information technology (IT) equipment that they housed, but no longer. As the electrical power used by IT equipment per dollar of equipment cost has increased, the annualized facility costs associated with powering and cooling IT equipment has in some cases grown to equal the annualized capital costs of the IT equipment itself. The trend towards ever more electricity-intensive IT equipment continues, which means that direct IT equipment acquisition costs will be a less important determinant of the economics of computing services in the future. Consider the figure above, which shows the importance of different data center cost components as a function of power use per thousand dollars of server cost. If power per server cost continues to increase, the indirect power-related infrastructure costs will soon exceed the annualized direct cost of purchasing the IT equipment in the data center.

Ken Brill of the Uptime Institute has called these trends "the economic breakdown of Moore's Law", highlighting the growing importance of power-related indirect costs to the overall economics of information technology. The industry has in general assumed that the cost reductions and growth in computing speed related to Moore's law would continue unabated for years to come, and this may be true at the level of individual server systems. Unfortunately, far too little attention has been paid to the true total costs for data center facilities, in which the power-related indirect costs threaten to slow the cost reductions from Moore's law.

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[1] **ASSESSING TRENDS OVER TIME IN PERFORMANCE, COSTS, AND ENERGY USE FOR SERVERS**
Jonathan G. Koomey*, Christian Belady†, Michael Patterson**, Anthony Santos**, Klaus-Dieter Lange††
* Lawrence Berkeley National Laboratory and Stanford University, †Microsoft Corporation, **Intel Corporation, ††Hewlett-Packard Corporation. Final report to Microsoft Corporation and Intel Corporation Released on the web: August 17, 2009
http://www.intel.com/assets/pdf/general/servertrendsreleasecomplete-v25.pdf

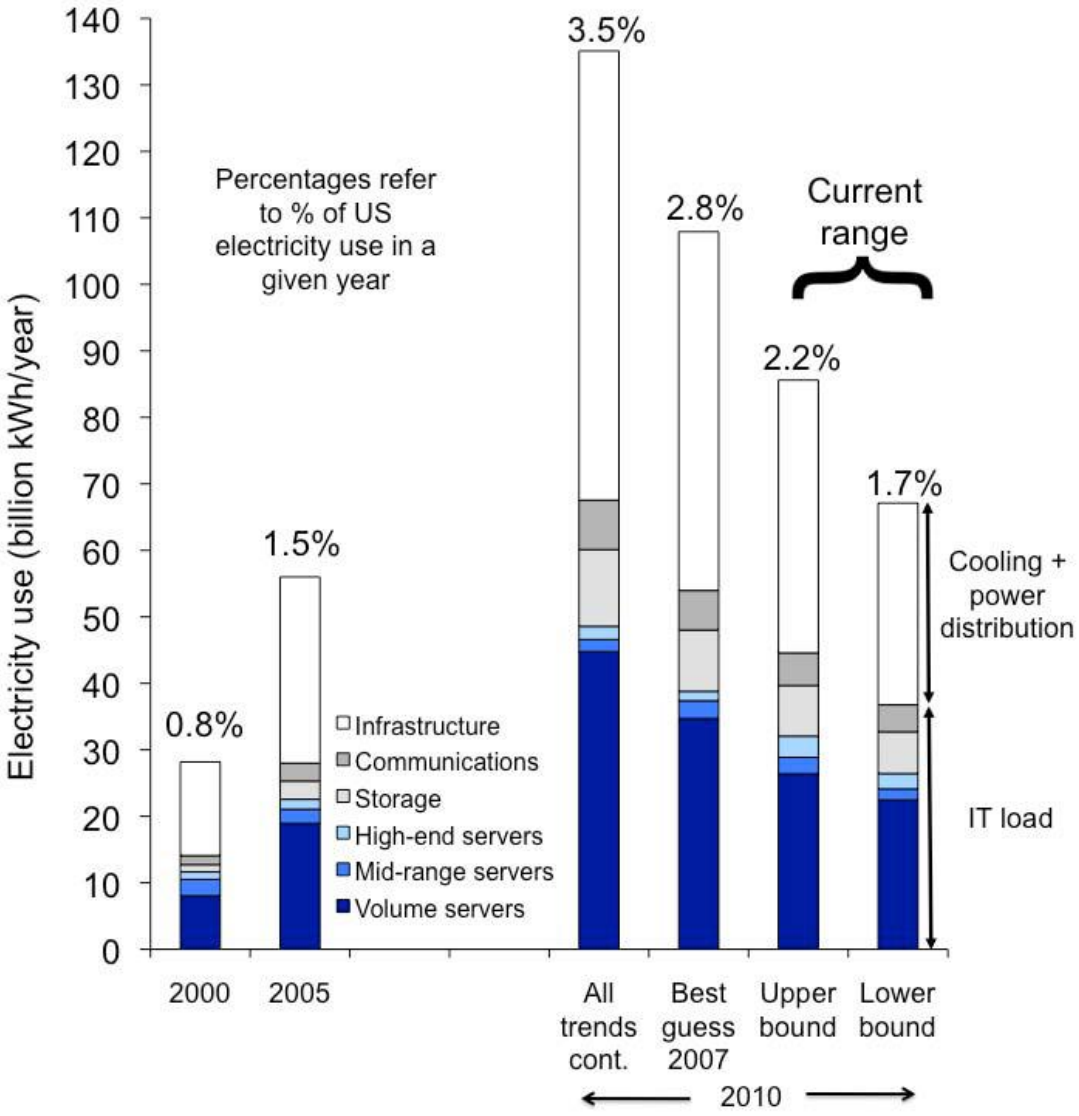

Figure 2: US electricity use for data centers (2000, 2005, and 2010)[2]

There is anecdotal evidence that the need for data storage has been growing more rapidly than the need for computing power in data centers, but the data density of storage devices has also been growing rapidly (doubling every year or so according to Grochowski and Halem (2003)). In addition, the total power used by these devices is primarily related to the number of drive spindles, not to the amount of data they hold, so the relationship between total data storage capacity and total energy use is not a simple one. This analysis uses the projected growth in storage electricity use relative to server electricity use from EPA (2007) but more research is needed to confirm if the history actually matched that projection.

[2] **GROWTH IN DATA CENTER ELECTRICITY USE 2005 TO 2010**
Jonathan G. Koomey, Ph.D., Consulting Professor, Stanford University. A report by Analytics Press, completed at the request of *The New York Times* http://www.analyticspress.com/datacenters.html

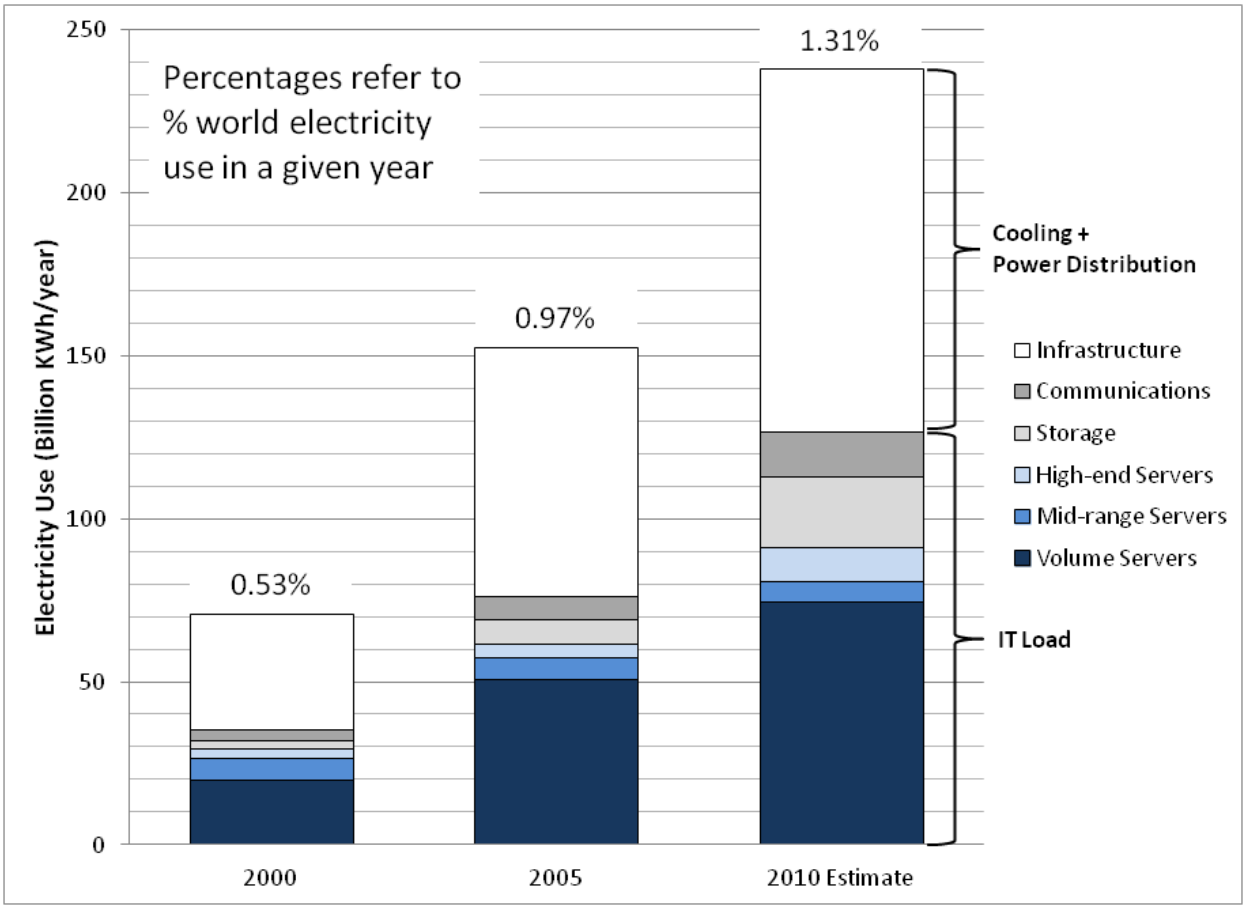

Figure 3: Chart derived from Koomey's (August 2011) electricity use within the data center

Storage was not included in Koomey's original argument regarding power and power-related infrastructure costs exceeding the storage server acquisition cost, other ratios of the chart (**Figure 1**) are relevant in regards to the ratios of (cost of electricity: cost of power related infrastructure) and (cost of electricity: cost of other infrastructure). The cost of O&M (operations, labor, service, and maintenance) is considered a function of the IT equipment acquisition cost.

Koomey's latest report GROWTH IN DATA CENTER ELECTRICITY USE 2005 TO 2010[3] shows that the electricity required to power data centers worldwide has increased 287% over the last decade (**see Figure 3**). Over that same period the electricity required to power storage systems in the data center has increased 770%. **This indicates that the power requirement for storage within the data center is growing at nearly three times the rate of the data center power requirements.** All indications are that increasing power requirements for storage will continue to outpace the total data center power requirements.

[3] **GROWTH IN DATA CENTER ELECTRICITY USE 2005 TO 2010**
Jonathan G. Koomey, Ph.D., Consulting Professor, Stanford University. A report by Analytics Press, completed at the request of *The New York Times* http://www.analyticspress.com/datacenters.html