Executive Summary
Power consumption and cooling issues in the data center are important to companies, as evidenced by a survey conducted by the Strategy Group, an independent research company, on behalf of Ziff Davis Media. The survey found that 7 out of 10 organizations track power consumption and cooling issues, and that among the two, cooling is currently the more significant factor.

Of the 1,177 organizations surveyed, 85 percent have tried to address these issues in a variety of ways. While 44 percent of them were able to supply more power to the data center, 27 percent chose to consolidate servers, 25 percent reorganized their servers into hot-aisle/cool-aisle configurations, and 23 percent increased the size of their data centers.

The survey found that 20 percent of the companies waste some server rack space due to power and cooling issues. Among those companies, the average space wasted amounted to 18 percent of the total rack space.

Despite the concern over power and cooling issues, today only 3 in 10 organizations are actively investigating data center power consumption and cooling as a way to lower costs.

Power consumption and cooling issues have, however, affected server purchases in 3 out of 10 organizations. Nearly two-thirds of them used the vendor’s published power and heat specifications, while 40 percent used power supply ratings. Just over one-third of the companies conducted in-house tests, while 25 percent use the vendor’s power budget calculator tools.

The role of well designed dual-core processors in addressing power and cooling issues is understood by many IT professionals, but business management is largely unaware of their benefits.

Survey Methodology
The survey was conducted online, between November 21 and November 30, 2005, from a sample of technology decision makers selected from the Ziff Davis Media (ZDM) database. Respondents were screened to limit participants to those with data centers at their place of employment and involvement with data center decision making.

A total of 1,177 ZDM subscribers qualified for the survey and completed it. The survey data presented here are accurate to +/- 3 percent at a 95 percent level of confidence.
Power Consumption and Cooling Issues

First and foremost, are power consumption and cooling important issues in today’s data centers? When asked this question, 38 percent of the respondents said that both were equally important, while 21 percent chose cooling as the more important issue and 12 percent chose power consumption (see Figure 1). Of the remaining 29 percent 12 percent suspected that both were issues, but were not currently tracking them. The remaining 17 percent were the fortunate few for whom neither presented an issue.

Sufficient AC power is not a given for many companies, as burgeoning data centers stress the limits of power conditioning and backup systems. Likewise, cooling power tends to be a quantity fixed at the time the data center was constructed or refurbished, but is increasingly taxed as more servers and other computing and communications equipment are added.

As noted, 12 percent of the companies surveyed do not currently track power and cooling issues. While this survey does not deal with the specifics of why they don’t track, it’s likely that they fall within a couple of scenarios. Some companies simply rely on vendors’ assurances that their power and cooling facilities are sufficient to handle their data-processing equipment. Others take a seat-of-pants approach: if the room isn’t too hot, equipment is running reliably, and circuit breakers aren’t popping, they’re happy. Still others would prefer to monitor, but lack the funds and staffing to do so.

Addressing the Issues

The vast majority of the companies surveyed, 85 percent, have had to deal with specific power and cooling issues in their data centers. Among the companies that track power consumption and cooling issues, 44 percent have increased the amount of power supplied to the data center (see Figure 2). Although the process is straightforward, increasing power can be expensive and can involve several vendors, including the electrical utility, the power conditioning/backup power vendor, and a rigging/electrical construction contractor. Electrical construction generally requires permits and inspection, as well.

A quarter of the companies (26 percent) in the group that monitors power and cooling have stopped buying more servers and/or have consolidated existing equipment. “Stopped buying servers” seems a drastic, even futile solution, but any data center can reach its limit in physical size, power supply, or cooling capacity. It’s also possible that this figure reflects the tightness of IT budgets and the capital expense associated with
data center expansion. As a result, some IT managers may need to temporarily freeze computing resources in order to appeal for a major capital expenditure. Within the constraints of a current data center footprint, one of the few choices available is to replace older servers with newer ones.

Many newer servers have significantly greater computing power at the same or even lower heat load and power consumption. State-of-the-art designs use fewer chips and higher-density memory, and disk storage is far denser than what was available even a few years ago, with significantly less waste heat and power demand. With virtualizing software, these more powerful servers can run disparate applications that would otherwise require a dedicated server. Database applications can also often be consolidated onto a single server or cluster.

Another quarter of the group that monitors (25 percent) found that they could “rear-range the furniture” to prolong the life of the data center or handle more heat-producing equipment. Hot-aisle/cool-aisle layouts have become a best practice in many data centers, but their success is contingent upon racks that take in cold air at the front and exhaust warm air at the back. It requires rerouting the cold-air supply plenums and warm-air collection ducts to alternate aisles, but it significantly increases the thermal efficiency of the data center and generally permits racks to be more heavily loaded for a given tonnage in chiller capacity.

Slightly less than a quarter of the monitoring group (23 percent) was able to increase the size of the data center. A larger center with additional power and cooling is a fine solution for companies that have the space. They have the freedom to continue to deploy their existing standard servers or to choose new equipment with minimal regard for the effect on existing servers.

Other solutions are sometimes required, as 16 percent of the monitoring group indicated. They can vary from spot cooling to virtualizing existing servers or moving storage from servers to network-attached storage, among other methods.
Unused Rack Space

Two out of 10 respondents to the survey (21 percent) said that rack space in their data centers goes unused because of power consumption or cooling issues, while the remainder either didn’t know or said the racks were fully utilized (see Figure 3). Among those who said that some rack space goes unutilized, the average amount of unused rack space was 18 percent.

While that may not seem like a lot, consider what it indicates, beyond wasted space:
1. A barrier to expansion
2. An incipient heat problem that will have to be dealt with
3. Underutilized switch/concentrator bandwidth inside the rack
4. Rack power supplies or cooling fans that are not optimally matched to the load

Every unused position in a rack has a hidden cost associated with it, especially if the data center is otherwise at or approaching capacity. The cost of moving beyond the existing rack population level may be very high (building out the data center, replacing or upgrading the power and cooling systems), moderate (replacing the servers and/or racks with more modern, thermally efficient designs), or low (server consolidation). The low-cost approach, unfortunately, is often just a stopgap.

RACK SPACE USAGE

Q: Does rack space in your data center go unused due to power consumption and cooling issues?

Don’t Know 10%  Yes 21%
No 69%

Total respondents = 1,177

Issues Affecting Server Purchase Decisions

Although IT professionals are increasingly aware of the effect power consumption and cooling have on operational costs, the survey respondents indicated that business management is largely unaware of their impact. Less than a third (29 percent) said yes, that business management was investigating power and cooling as a way to lower operational costs, while fully 56 percent said no, and the remainder didn’t know (see Figure 4).

In a similar vein, 62 percent of the respondents said that power consumption and cooling issues did not affect server purchase decisions made in the past year, while 29 percent said that they did, and the remaining 9 percent were unsure (see Figure 5).

Taken together, it appears that power and cooling issues are not having a strong effect
on server purchase decisions—but perhaps it’s time that they should. Given the responses above of those who have had to take specific actions because of power consumption and cooling, it appears that power and cooling issues should play a larger role in future deliberations.

For the 29 percent above who incorporated power and cooling considerations into their selection criteria, 64 percent used the server vendor’s published specifications—a safe, if conservative number. Forty percent used the server’s power supply rating, and an intrepid 34 percent conducted power consumption/cooling tests in-house. Only 25 percent used the vendors’ power budget calculator tools.

While the power calculators only give an estimate, they’re still valuable for considering alternatives such as different processor speeds or different CPUs. Dual Core AMD Opteron processors, for example, have shown markedly lower power consumption and heat generation over equivalent Intel Xeon processors. The difference in a large data center can amount to annual electricity savings alone in the tens of thousands of dollars. A typical power calculator also shows that a rack with servers based on the AMD Opteron processor can be populated more densely, for lower acquisition and ownership costs.¹

Server vendors’ power calculators tend to be very granular, taking into account the type, number and speed of processors, the size and number of disk drives, amount of memory, and the number of PCI cards per server. Cooling system vendors’ load calculators are necessarily broader, encompassing the servers, other data processing equipment, lighting, power conditioning and backup systems, and even people, each of whom is roughly equivalent to a 100-watt bulb. Data processing equipment is typically 70 percent of the heat load.

By using both kinds of calculators, IT managers can select equipment that will maximize performance and minimize cost within a given thermal envelope. Conversely they can set a computational power target and size the power and cooling systems to match it and provide growth for the future.

¹ “Power and Cooling in the Data Center,” AMD, 2005

**LOWERING OPERATING COSTS**

Q: Is data center power consumption and cooling being investigated by business management as a way to lower operational costs?

![Survey Chart]

Total respondents = 1,177
Managing Power and Cooling

Although business management would profit if it were better informed on the value of power and cooling regulation, IT staff are well aware of the benefits. When asked if they would implement system-level tools to manage power and cooling down to the server/rack level, 71 percent said that they would. Of the remaining 29 percent who said that they would not, half (52 percent) didn’t see the benefit to managing down to that level, and nearly 4 out of 10 (38 percent) said that they didn’t have sufficient IT staff to track another management tool.

Interestingly, 20 percent of the respondents who would not implement server/rack-level management tools said that they consider it an issue for the server vendors. Some vendors, especially providers of blade systems, do include management tools with their systems. These tools tend to be very granular, able to manage virtually every aspect of individual blades and the server rack.

Role of Dual-Core Processors

Survey participants were asked for their level of agreement with the statement, “Servers with dual-core processors (two CPU cores on a single chip) can help address data center power consumption and cooling issues.”

Of respondents, 39 percent agreed or strongly agreed, while 33 percent were neutral (see Figure 6). Another 19 percent didn’t know, and only 9 percent disagreed or strongly disagreed. The prevalent positive attitude is a good sign, as is the neutral, waiting-to-be-convinced group, considering that dual-core CPUs will soon be the norm in server designs.

But not all dual-core processors are created equal. AMD has staked out a strong leadership position in dual-core processors that outperform competing x86 server processors, such as the Intel Xeon line, while consuming considerably less power and emitting considerably less waste heat. The AMD Opteron processor was designed from the outset to be a dual-core chip, and its advanced design and construction give it several significant advantages.

First and foremost, it outperforms the competition in virtually every server-oriented benchmark. Dual-Core AMD Opteron processors have taken top honors in comparison tests conducted by respected benchmarking organizations and hardware review publications.
Second, it accomplishes this while consuming considerably less power, thanks in part to a design that integrates both processing cores and the memory controller on a single piece of silicon. The integrated memory controller confers several benefits on the system: one less power-hungry chip on each server motherboard or blade; CPU-speed communication between the CPUs and the memory controller; and elimination of the traditional bottleneck caused by the front-side bus.

Third, it emits less heat, giving the most computing power per watt and the greatest rack density for a given cooling capacity.

**Conclusion**

The survey results discussed here lead to several important conclusions:

1. Power and cooling in the data center are significant concerns. Data centers are phenomenally expensive to build, power and cool, so maximizing performance while minimizing power consumption and heat load are valid, vital concerns for IT management and general business management.
2. Dual-core processors are a key part of getting the maximum benefit from the overall IT investment, but the contribution they can make is currently underappreciated.
3. IT managers want maximum benefit for the least effort, and they are disposed to investigate and invest in technologies that will help them achieve their goals.
4. Server designs are on the brink of a revolution. Dual-core designs offer many advantages over single-core designs, and will quickly become dominant.

Dual-Core AMD Opteron processors are the cutting edge of x86 processor design. IT and business managers alike should seriously consider Dual-Core AMD Opteron-based servers as they plan for the future of their data centers.