TechTarget Custom Media
White Paper

CPUs and Greenhouse Gases: Why Data Center Processor Selection Matters in Achieving Sustainability Goals

Data centers are major consumers of electricity, both for powering servers and keeping them cool. Despite the progress that large data center operators have made in improving efficiency, power demand is expected to continue to grow steadily for the foreseeable future. While hyperscale operators have made great strides in shifting to renewable energy sources, the reality is that fossil fuels generate 60% of U.S. electricity. Businesses that are embracing sustainability as a core objective should factor power consumption into their choice of PCs and servers. Reducing server power consumption can be accomplished by increasing CPU core density. While multi-core processors might use more total power than single-core CPUs, they can also process significantly higher workload volumes, since each core is essentially a microprocessor. The differences between processors are more significant than many people know.

This content was commissioned by AMD, and produced by TechTarget Inc.

AMD

With climate change dominating the headlines, many organizations are embracing sustainability as a core corporate responsibility objective.

More than 90% of CEOs now say sustainability is important to their companies' success, according to Stanford Social Innovation Review, and the World Wildlife Fund estimates that over half of 500 largest organizations in the world have greenhouse gas reduction goals.

There is also growing evidence that improving environmental performance is also good for business: McKinsey says that customers will pay an average of 5% more for products created with sustainable energy sources compared to a comparable non-green alternative; that reducing resource costs can improve operating profits by up to 60%; and that academic research has found that ambitious environmental, social, and governance goals correlate with higher financial returns and lower downside risk.

Data Center Conundrum

Data centers have come under particular scrutiny because of their high energy density. Consequently, IT organizations and professional data center operators are under growing pressure to adopt sustainable practices.

There are sound reasons for this. Data centers consume about 1% of all electricity globally, according to Energy Information, Policy & Technology LLC estimates. The U.S. Department of Energy calculates that figure at 2% domestically. This makes them major targets of efforts to reduce carbon emissions.

Another reason is that the density of data center power consumption means that small improvements can be magnified substantially. The U.S. Department of Energy estimates that a typical data center consumes 10 to 50 times as much energy per floor as an office building.

Hyperscale cloud vendors have been quick to adopt sustainability as a cause, motivated both by altruism and the opportunity to demonstrate their technical virtuosity. They have set an example for others to follow.

For example, Microsoft has publicly said it intends to be carbon negative in its facilities and supply chain by 2030. Amazon Web Services has publicly committed to power its operations with 100% renewable energy by 2025 and Google has announced a goal to become the first major company to operate on carbon-free energy by 2030.

Growth Presents Challenges

Despite this progress, the high market growth rate continues to raise the stakes. The European Union projects that data center energy use in 2025 will be 21% above 2018 levels. In addition to organic growth, the widespread adoption of 5G networks, which require more cells and antennas, is expected to drive an increase in the energy required to power networks of between 150% and 170% by 2026, according to a study by Vertiv and 451 Research, part of S&P Global Market Intelligence.

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Enterprise and small data center operators will be more challenged to make the transition to renewable sources because they lack the resources of the hyperscalers and have less latitude to shift workloads between regions in pursuit of lower energy costs. Their utilization rates are also typically lower, which reduces efficiency and increases cooling costs per unit of processing power. Data center operators have also moved cautiously in their adoption of alternative energy sources because of the risk of outages. Even minor fluctuations in power quality can have disastrous consequences for IT equipment.

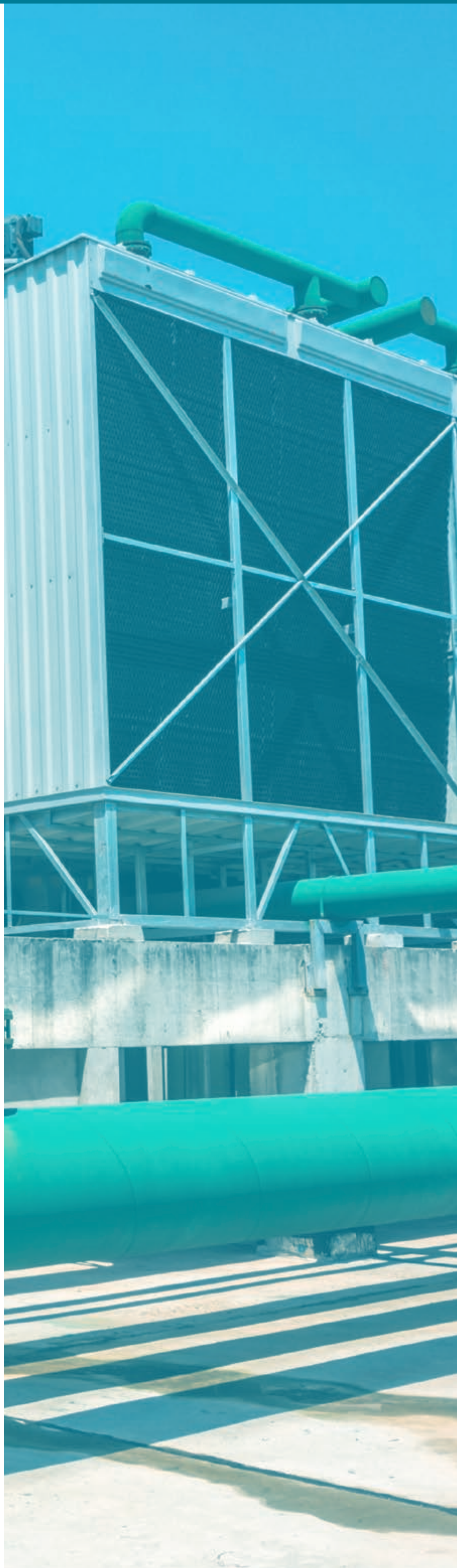
A more practical approach for most companies is to reduce the two largest consumers of power in the data center—servers and cooling—each of which accounts for 43% of all U.S. data center electricity consumption, according to Energy Innovation.

Role of CPUs

Many people are unaware of how CPUs impact power consumption. While figures vary by the type of processor and workload, CPUs are one of the largest consumers of power in a computer. Power usage is also becoming more concentrated in smaller spaces. The Uptime Institute reported that average rack power density in U.S. data centers more than tripled from 2.4 kilowatts per rack in 2011 to 8.4 kilowatts per rack in 2020 and that 20-kilowatt racks and higher are no longer uncommon. This drives up the demand for cooling, which is the other main consumer of power.

Reducing server power consumption per workload is best accomplished by increasing core density. While multi-core processors use more total power than single-core CPUs, they can also process significantly higher workload volumes per chip, since each core is essentially a microprocessor.

An example of how core density can improve power efficiency is the AMD EPYC™ 7003 Series of processors. The high-end 64-core version of this chip consumes about 280 watts of power. "Ongoing architectural improvements, such as the shift from 7-nanometer to 5-nanometer lithography, can provide further efficiency boosts by reducing the width of the pathways that the electric current must traverse, " said Suresh Andani, Senior Director of Cloud Vertical Marketing at AMD.



Ripple Effects

Greater core density can mean fewer racks are required to process the same workload volume. That reduces floor space consumption cooling requirements, and the need for ancillary equipment like uninterruptible power supplies and line conditioners, all of which consume power. All of these factors add up to the conclusion that the choice of CPU in a data center or cloud instance has a significant impact on power consumption and emissions.

No one understands this dynamic better than companies that buy servers by the thousands. With a presence in nearly 200 cities, Cloudflare is one of the world's largest content delivery networks. Its technology ensures that its customers' internet connections are fast and consistent while protecting against network-based attacks like distributed denial of service. It is one of the world's largest consumers of server power and an innovator in power efficiency.

In selecting AMD EPYC™ 7003 Series processors over competitors Intel Xeon CPUs, Cloudflare cited power consumption as a major factor in the decision. Although the competitor's chips matched AMD processors in raw performance, "the power consumption was several hundred watts higher per server—that's enormous," wrote Cloudflare's Chris Howells on the company's blog.

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Toward More Energy Efficient Chips

Innovations in chip design and manufacturing will continue to target sustainability benefits in the future. In addition to committing to continually improving the power efficiency of its processors, AMD has been a leader in setting aggressive efficiency goals across its global operations and supply chain manufacturing.

The company had originally set a goal of improving power efficiency in its mobile processors 25-fold between 2014 and 2020. It exceeded that mark with a 32-fold improvement. AMD has also set a goal to improve the energy efficiency of high-performance computing and artificial intelligence processors by a factor of 30 between 2020 and 2025, 2.5x the rate of the industry trends from 2015-2020, according to Andani.

AMD innovations in chip design have also had positive impacts on manufacturing efficiencies. Two years ago, the company shifted to a "chiplet" architecture in which multiple smaller dies are used instead of a large monolithic die. This has significantly improved yields and thereby reduced the number of chips that have to be discarded. Given McKinsey estimates that large semiconductor fabs can consume up to 100 megawatts of energy per hour, these yield improvements can have a direct and significant carbon impact depending on the source of electricity.

Conclusion

IT organizations are the largest consumers of power in many companies. With sustainability now a top-of-mind issue, IT leaders can set an example for others by making energy efficiency a factor in all decisions.

Whether purchasing on-premises servers or cloud instances, the choice of a processor can add up to thousands of dollars in energy costs over time and minimize carbon emissions by power providers, who are likely to continue to generate most of their supply from fossil fuels for several more years.

Many online calculators can help you determine the impact of processor selection. The AMD EPYC™ Bare Metal and Greenhouse Gas Emissions TCO Estimation Tool can help you understand how processor choice may help advance sustainability goals. All major cloud platforms provide calculators that customers can use to estimate the power consumption of instances based on different types of processors.

About AMD

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Turn your data center into a competitive advantage with AMD—setting superior standards for performance, security and scalability for your most demanding workloads.

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