Enterprise Strategy Group™ by TechTarget

TECHNICAL VALIDATION

The Role of Cisco UCS X-Series in Fulfilling Sustainability Objectives

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Introduction

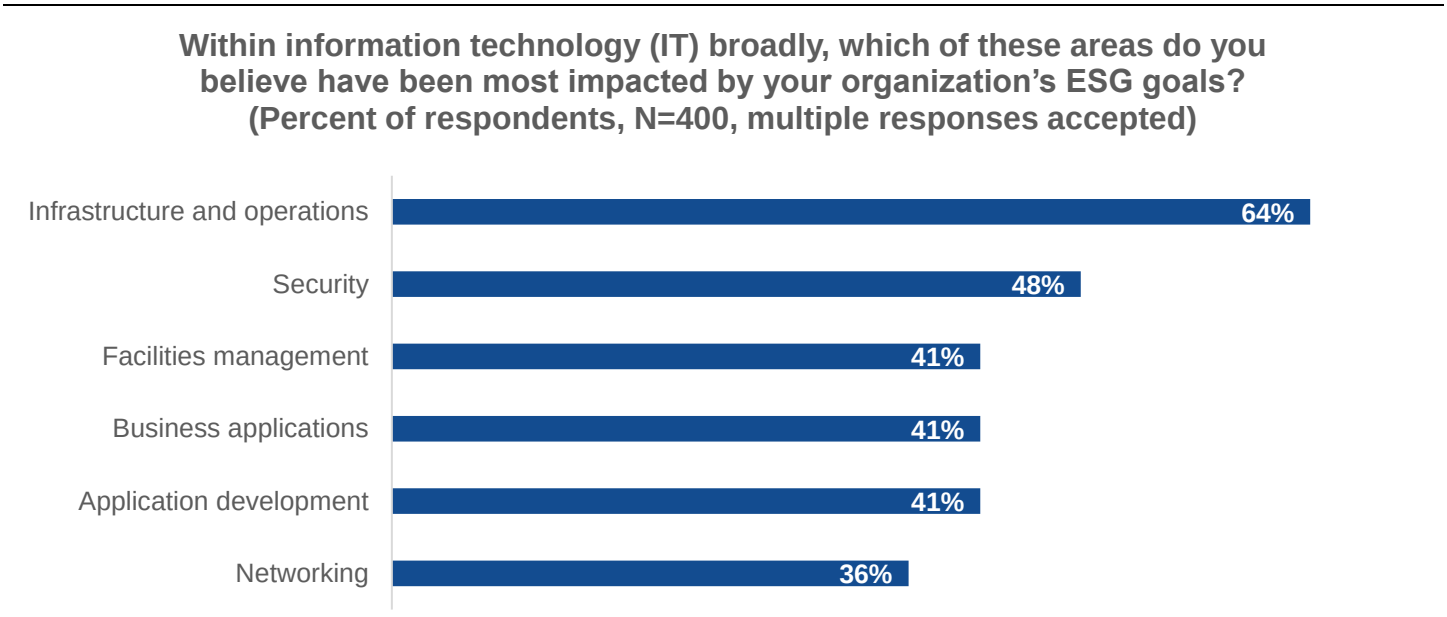
This Technical Validation from TechTarget's Enterprise Strategy Group documents our evaluation of how the Cisco Unified Computing System (UCS) X-Series can help organizations meet goals associated with environmental, social, and governance (ESG) initiatives.

Background

Organizations have recognized that implementing ESG initiatives is actually strategic to the overall business. While Enteprise Strategy Group research found that 46% of respondents have already benefited from improved brand development, 41% cited that they benefited from increased profitability.[1]

This same research also found that ESG initiatives have had a direct and, in most cases, measurable impact on the purchase process for IT solutions. In fact, 85% of respondents have dropped a potential supplier or product due to ESG concerns at least once. To that end, organizations are evaluating how well their suppliers and vendors can help to achieve ESG objectives. Increased scrutiny of vendors operating in the IT infrastructure and operations segments are expected, as over two-thirds of respondents stated that infrastructure and operations are the IT areas that have been the most impacted in their organization by ESG objectives (see Figure 1).

Figure 1. Areas Most Impacted by ESG Goals



Source: Enterprise Strategy Group, a division of TechTarget, Inc.

It is no surprise that organizations would formulate ESG goals involving infrastructure and operations, as these areas have a direct impact on the current state of the environment. In light of rising energy costs and the need to comply with national energy mandates, organizations are stepping up efforts to evaluate the environmental impact of IT vendor products, assessing factors such as material consumption, material reuse, and contribution to greenhouse gas (GHG) emissions.

[1] Source: Enterprise Strategy Group Research Report, *The Role of ESG Programs in IT Decision Making*, September 2022. All Enterprise Strategy Group research references and charts in this technical validation are from this research report.

Accelerating Sustainability with Cisco UCS X-Series

Cisco UCS was designed and developed with sustainability in mind before it's market introduction. The latest generation, Cisco UCS X-Series, is no different, helping both Cisco and its customers in reducing their overall environmental impact (see Figure 2). Some key aspects of the Cisco UCS X-Series that support organizations in achieving their environmental and sustainability goals include modular and consolidated hardware design, converged fabric, centralized power and cooling infrastructure, and materials, manufacturing, and packaging.

Figure 2. Cisco UCS X-Series – Sustainability by Design and Operation

Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

- **Modular and consolidated hardware design:** As with previous generations of Cisco UCS, the consolidated design of the UCS X-Series enables the reuse of components and consumption of fewer parts over time. Compared to traditional rack servers, organizations can reuse the chassis, networking fabric and switches, and shared common parts (power supplies, fans, and cables), even when business requirements change.

  To further consolidate the overall hardware used, the chassis backplane was replaced with direct connect I/O to enable more modularity within the chassis itself (e.g., upgrading UCS X-Series compute nodes to GPU-enabled nodes by directly connecting a PCIe module, removing the need to connect via external cables). This backplane design change reduces airflow resistance, helping the chassis to remove heat more quickly and efficiently.

  To meet the needs of next-generation server power requirements, Cisco changed the way power is distributed across all compute nodes within the UCS X-Series chassis from 12V to 54V. The higher voltage distribution reduces the amount of current and requires less copper. Less current improves AC to DC conversion efficiency and reduces heat generation, thus lowering the cooling burden.

  Without sacrificing the features that organizations need to support their IT infrastructure, the overall reduction in materials used for the UCS X-Series translates into fewer raw materials required to manufacture components over multiple generations, thus reducing GHG emissions.

- **Converged fabric:** Instead of organizations maintaining separate physical networks dedicated to storage, networking, or management, the UCS X-Series enables organizations to direct all traffic types via the UCS-X converged fabric. Furthermore, organizations can achieve end-to-end 100G connectivity per port on the compute node, enabling future traffic growth. By leveraging this converged fabric, organizations can reduce the number of switch fabrics deployed, thus decreasing the number of switches, adapters, ports, cables, and optics required to interconnect switch fabrics with servers or storage systems. Consequently, the reduction in switch fabrics decreases the amount of energy consumed.
- **Centralized power and cooling infrastructure:** Compared to rack servers, the UCS X-Series leverages a centralized power and cooling infrastructure built into the chassis in order to facilitate efficient power transfer

amongst the slotted compute nodes. Using larger fans that boast a high airflow cubic feet per minute (CFM),[2] dynamic power management with intelligent fan control algorithms, and zone based cooling, the UCS X-Series chassis can air-cool fully loaded compute nodes configured up to 350W CPUs. As a result, organizations can consume a fewer number of fans, power supply units, and power cables while decreasing overall power consumption.

- **Materials, manufacturing, and packaging**: Cisco Systems has adopted design and manufacturing practices to reduce overall material and energy waste across all product lines, helping both itself and its customers achieve sustainability objectives. Subsequent designs within each product line eliminate the use of wet paint, significantly reduce the amount of paint/powder coating on chassis and node surface areas, and employ a high percentage of post-consumer and recycled plastic parts. By simplifying overall product designs, such as those related to the UCS X-Series, Cisco eases manufacturing assembly as well as repair with field replaceable components. Cisco's packaging reduces the overall amount of foam packaging with cardboard. (When foam is needed, Cisco utilizes recycled foam packaging.) Finally, Cisco reduces further material consumption by enabling customers to opt out of accessories (e.g., power cables) and decreases paper manual consumption via QR codes.

Once the UCS X-Series is deployed in production networks, organizations can monitor and manage their power consumption and hardware usage via Cisco Intersight. With Intersight Infrastructure Services, organizations can proactively control and allocate power policies to UCS X-Series chassis and nodes such as rebalancing and power capping. Intersight Workload Optimizer helps in optimizing hardware usage so CPU and memory resources are not wasted, without sacrificing workload performance and availability.

Rethinking the design and manufacturing of the Cisco UCS X-Series is part of Cisco's efforts to meet its own sustainability goals. The company, recognizing its responsibility in supporting environmental efforts, issued its first corporate social responsibility (CSR) report in 2005 while the idea of CSR was still in its infancy.

As other organizations were beginning to adopt ESG initiatives, Cisco Systems honed in on the environmental and sustainability goals they wanted to achieve. Using the guidelines provided by the Science Based Targets initiative (SBTi),[3] the company committed to achieving net-zero GHG by 2040. To achieve its net-zero goal, interim targets have been set and published to reduce Scope 1, 2, and 3 emissions. All member companies must present scientific evidence to the SBTi to prove that goals have been met. These goals are to be achieved across all Cisco products.

In addition to backing up claims to the SBTi, Cisco Systems self-regulates any public sustainability statements via two internal CSR offices. When dealing with customer inquiries or fulfilling audit requirements, the CSR offices ensure that statements made on the subject of sustainability are backed up by scientific evidence.

Enterprise Strategy Group Technical Validation

Enterprise Strategy Group validated the sustainability benefits offered by the UCS X-Series. We evaluated how its hardware design can decrease power consumption when in production and support typical enterprise workloads without wasting power.

Decreased Power and Material Consumption via Hardware Consolidation

Computing resources, by far, consume the most power within any data center, as they make up the majority of data center infrastructure. Reducing how much power they consume would help any organization achieve its

[2] CFM is a measurement of a fan's airflow. A higher CFM translates into more airflow for cooling purposes.
[3] The Science Based Targets initiative (SBTi) is a collaboration between the CDP (formerly known as the Carbon Disclosure Project), the United Nations Global Compact, World Resources Institute, and the World Wide Fund for Nature. Over 1,000 companies participate in this collaboration to track corporate climate action.

sustainability objectives. Organizations with data centers should rigorously examine the amount of power to budget when operating and cooling compute resources.

Cisco has historically designed the UCS product line to reduce the number of infrastructure resources and facilitate lower power consumption. The UCS X-Series has been designed to improve power efficiency and cooling when compared with previous UCS rack server releases.

Enterprise Strategy Group Testing

Power and Cooling Comparison between Cisco UCS Rack Servers and UCS X-Series Compute Nodes

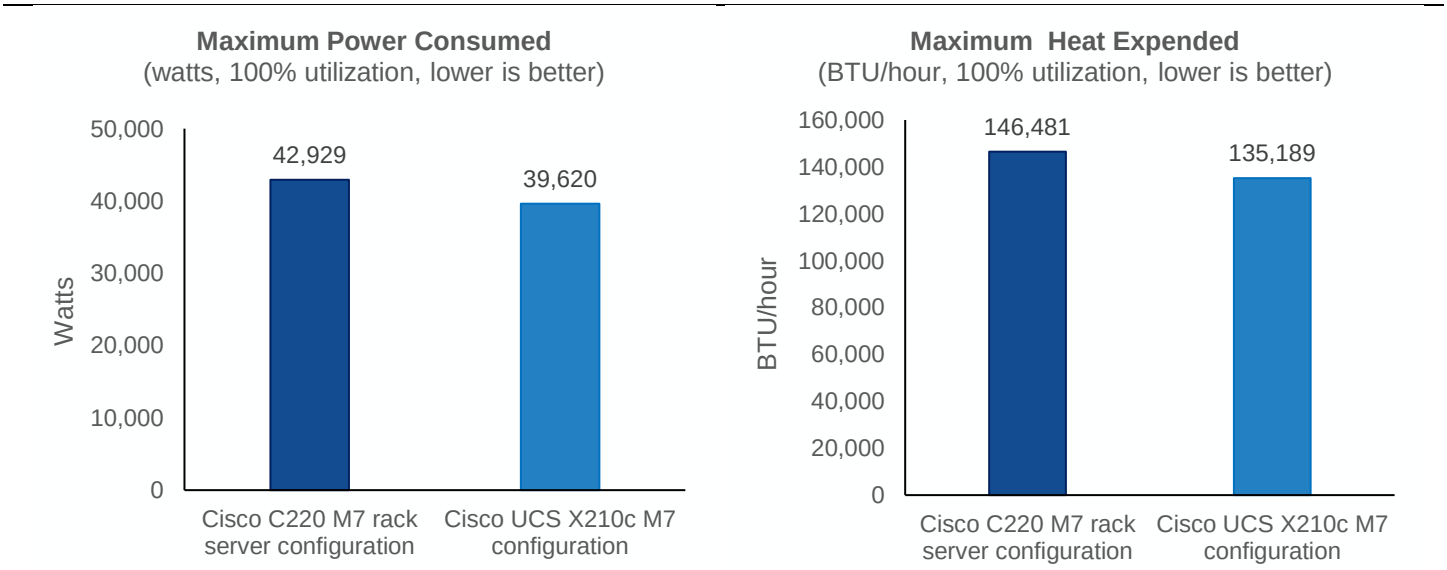
Using the Cisco power calculator, Enterprise Strategy Group first compared the estimated power budget for a 40-node configuration comprised of the UCS X210c M7 compute nodes with the same configuration using the Cisco C220 M7 rack servers. The configurations consisted of:

- 40 UCS X210c M7 nodes in five UCS X-Series chassis. Each node contained two Intel 6430 Intel processors and 1,024 RAM.
- 40 Cisco C220 M7 rack servers.[4]

Both configurations include the switching resources and related components, such as fabric interfaces, adapters, and cables needed to enable end-to-end connectivity between the servers. The number of servers used would allow for traffic growth if the configurations were deployed in production networks. We assumed 100% utilization in both configurations.

Results derived by the Cisco power calculator, shown in Figure 3, revealed a 7.7% reduction in both the estimated power consumption and heat expended.

Figure 3. Estimated Power Consumed and Heat Expended (Assuming 100% Utilization)



Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

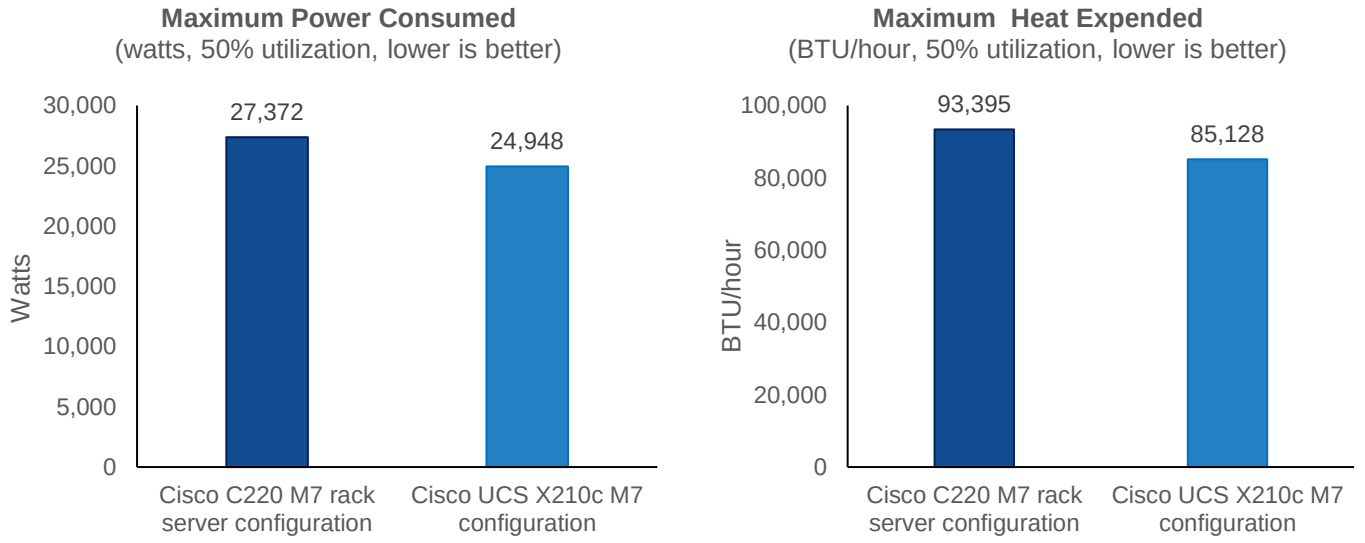
Enterprise Strategy Group should note that this power reduction could also be shown when using power estimates for competitive server configurations. Using the vendor provided public power calculator, we configured a competitive rack server in the same way as the Cisco C220 M7, and the calculator estimated a maximum power

[4] The bill of materials (BOM) for all configurations used in this report is located in the Appendix.

draw of 1,010W; when fans were running at full speed, the power draw increased to 1,221W. Assuming no failures, the Cisco C220 M7 server maximum power draw was shown to be 1,057W. In other words, the UCS X-Series configuration was estimated to draw less power than the rack server configuration, regardless of the vendor. This is due to the consolidation and modular design of the UCS X-Series.

Enterprise Strategy Group then considered the more realistic scenario in which the server infrastructure is running at 50% utilization to allow for spikes in workload activity. Results revealed that both estimated power consumption and heat expenditure reduced by 8.8%

Figure 4. Estimated Power Consumed and Heat Expended (Assuming 50% Utilization)



Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

While both scenarios showed similar reductions, the Cisco C220 M7 rack server configuration consumed a significantly larger number of components than the UCS X210c M7 configuration due to a reduction in the number of power supplies, power cables, Ethernet cables, optics, and cooling fans. Furthermore, a smaller number of fabric ports and cables were required for the UCS X210c M7 configuration due to the unified fabric.

Enterprise Strategy Group should also note the significance of the reduction in components when deploying a 40 UCS X210c M7 node configuration. While the percentage difference was small, imagine deploying thousands of UCS X210c M7 nodes in a single data center. Savings in both material consumption and power can be easily multiplied and go a long way in helping organizations achieve sustainability.

Power and Cooling Comparison between Cisco UCS Blade Servers and UCS X-Series Compute Nodes

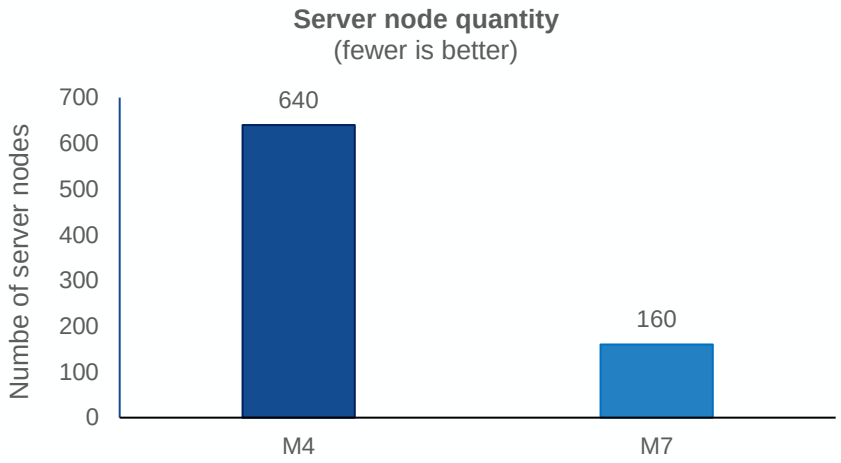
Enterprise Strategy Group then considered how UCS X-Series server consolidation can help in lowering the energy expended for both power and cooling, compared to earlier UCS blade server generations. For this comparison, we considered the highest-selling CPU in a UCS blade server prior to the release of UCS X-Series, the B200 M4 models.

Using SPECint 2017 numbers to characterize the computing power of the CPUs used in the B200 M4 model and the CPUs used in the UCS X210c M7,[5] we then estimated the number of M7 servers that would be needed to match the amount of processing power represented by the number of M4 servers used. Note that we also

[5] For more information on SPEC Integer Rates, please refer to https://www.spec.org/cpu2017/results/rint2017.html.

accounted for the aggregate total RAM to be in place to support the same level of VM load in both configurations. We conservatively estimated a 4:1 consolidation ratio (see Figure 5).

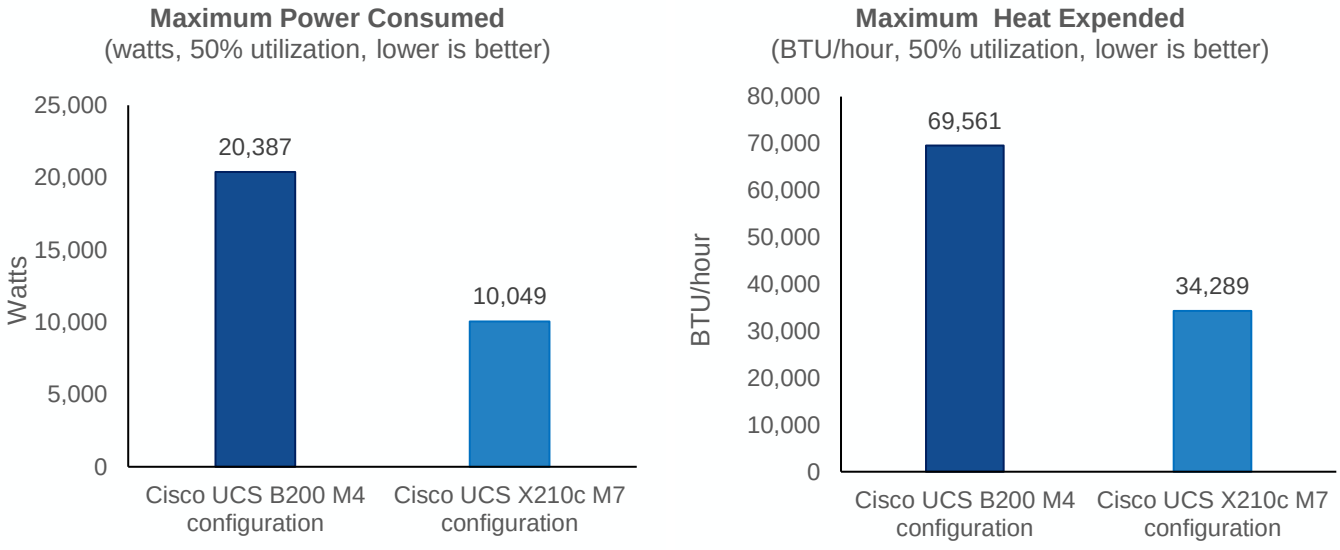
Figure 5. Server Consolidation based on CPU and Memory



Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

We then considered a 64-node configuration for each server type—eight UCS 5108 chassis with 64 UCS B200 M4 blades versus two UCS X-Series chassis with 16 UCS X210c M7 nodes. Again, each configuration contained the required fabric modules and adapters to enable end-to-end connectivity. Results are shown in Figure 6.

Figure 6. Power and Cooling – Consolidating from M4 to Cisco UCS X-Series M7



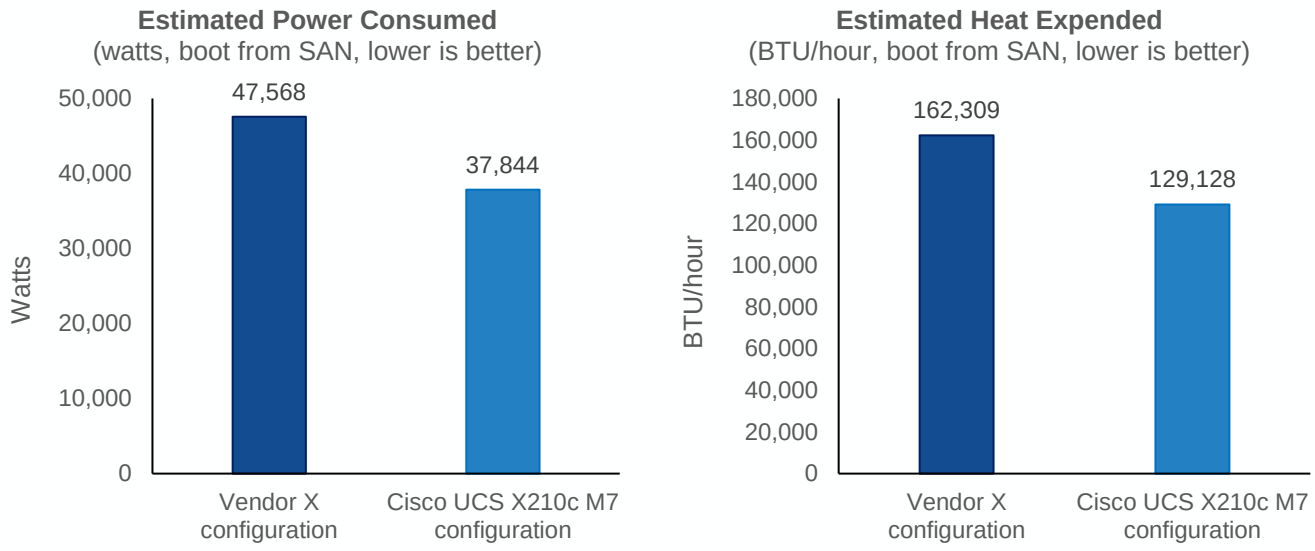
Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

Based on Cisco's power calculator, the estimated power consumption and heat expended decreased by 50.7%. We also noted that overall configuration weight decreased by 62% (almost 1200 pounds).

Power and Cooling Comparison between Cisco UCS X-Series Compute Nodes and Alternative Vendor

Finally, Enterprise Strategy Group compared the estimated power consumption and heat expenditure of a UCS X-Series configuration with a similar configuration of an alternative vendor. Both Cisco and the vendor's power calculators were used to estimate power budgets for each configuration, respectively. The UCS X-Series configuration consisted of 40 Cisco UCS X210c M7 nodes housed in five UCS X-Series chassis. The vendor's configuration consisted of the same number of server nodes and chassis. Both configurations included the appropriate number of switch fabrics, adapters, ports, and accessories to establish end-to-end connectivity. We considered power consumption at the time of booting up both configurations from the SAN. Results are shown in Figure 7.

Figure 7. Power and Cooling – 40 Node Configuration with Cisco UCX X-Series and Alternative Vendor



Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

We saw that the UCS X210c M7 configuration consumed 20.4% less power and expended 20.4% less heat. Also, the UCS X-Series configuration weighed 12% less (2,000 versus 1,764 pounds) while consuming 58% less components.

Why This Matters

A major part of meeting sustainability objectives involves lowering overall power consumption, which aids in reducing GHG emissions. Organizations that manage data centers are already aware of the potential to decrease power consumption, as the IT infrastructure requires large amounts of power so the business can operate.

Enterprise Strategy Group validated that the Cisco UCS X-Series can help organizations consume less power and expend less heat when deployed in data center infrastructure. Using the Cisco power calculator, we calculated the power required to support a Cisco UCS X210c M7 configuration and compared those numbers with power budgets calculated for similar configurations using traditional Cisco rack servers (at 100% and 50% utilization) and previous generation B200 M4 blade servers. We found in all three comparisons that the UCS X210c M7 configurations consumed less hardware and less power while expending less heat. When comparing similar configurations between Cisco and an alternative vendor, Enterprise Strategy Group saw that the UCS-X configurations also consumed less power and expended less heat.

Decreased Power Consumption When Running Workloads

While estimating power budgets helps in understanding how much power and heat will be generated, it is important to characterize how data center infrastructure will operate when running production workloads. This detail can shed light on how a workload contributes to overall power consumption in production infrastructure. With the UCS X-Series, organizations can adjust hardware power settings such as compute node power states, OS power controls and chassis thermal behaviors in order to optimize power consumption and cooling. It is important to understand the impact of adjusting compute nodes for energy conservation and the effect on performance of the application. Cisco tests the X-Series nodes for a variety of conditions in order to provide guidance on these decisions.

Enterprise Strategy Group Testing

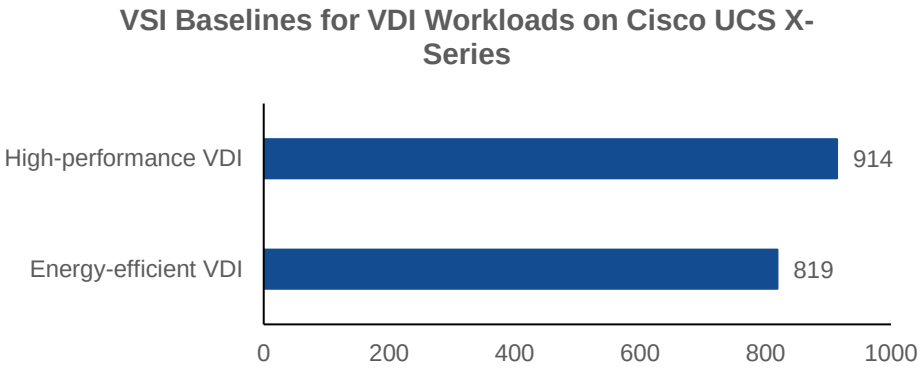
With a Cisco UCS X210c M7 node as the test bed, three groups of tests were conducted with different chassis-level fan thermal policies: balanced, acoustic, and low power. For each thermal policy, we used two different node settings:

- **For an energy-efficient virtual desktop infrastructure (VDI):** Intel OPM enabled, BIOS C1E and C6 enabled, VMware ESXi power settings at low power.
- **For a high-performance VDI:** Intel OPM disabled, BIOS C1E and C6 disabled, VMware ESXi power settings at high performance.

Using LoginVSI, each test group simulated a VDI workload, consisting of 320 Windows 11 desktops running Microsoft Office 2021. Test runs simulated an 8-hour workday in which the system is idle early in the day, with users logging into the system over a window of 48 minutes then running at full capacity for over 6 hours. Once the day is complete, all users log out, and the system returns to an idle state.

Enterprise Strategy Group then focused on test results using the balanced fan policy for running an energy efficient VDI and high-performance VDI. As shown in Figure 8, we saw that the energy-efficient and high-performance scenarios produced similar VSI baseline scores. According to LoginVSI, scores between 800 and 1299 indicate “good” performance. Because the high-performance scenario score was only 11% higher performing than that of the energy-efficient scenario, we concluded that running an energy-efficient scenario will not substantially affect the desktop user experience.

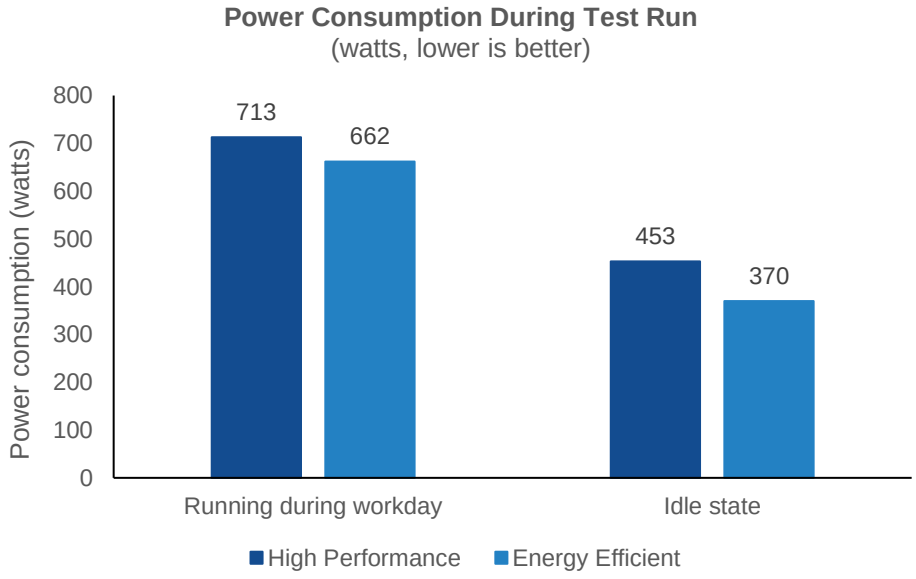
Figure 8. Good VDI Performance without Excessive Power Consumption



Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

Enterprise Strategy Group then compared power consumption between the energy-efficient and high-performance scenarios during the entire workday and in the ready state (end of workday). As shown in Figure 9, the energy-efficient power readings are smaller than those produced in the high-performance scenario. It is important to note that during the ready state, power consumption has decreased by 83W in the energy-efficient scenario. Even during times with little to no user activity, the UCS X-Series can save on power outside of official business hours, which can lead to significant savings in the long run.

Figure 9. Power Consumption During Test Run



Source: Cisco Systems, Inc. and Enterprise Strategy Group, a division of TechTarget, Inc.

Why This Matters

While organizations realize that sustainability improvements in data center infrastructure must occur to meet corporate ESG goals and comply with government mandates, the subsequent choice in hardware should not sacrifice workload performance that can disrupt business operations

Enterprise Strategy Group validated that the Cisco UCS X-Series can help organizations meet sustainability goals without significantly affecting workload performance. We compared results showing the performance achieved when simulating a VDI workload on a UCS X-Series configuration, configured with and without specific host/OS power and cooling settings. We found that the system produced similar performance results in both scenarios. What should be noted, however, is that when "energy-efficient" settings were enabled, power was actually saved during operation and while the system ran idle (i.e., outside of business hours). This savings can contribute to significant power savings in the long term.

Conclusion

Achieving sustainability goals is not just a corporate responsibility that organizations are using to improve their image. By making efforts to address their impact on the environment, organizations can achieve real business benefits, especially increased profitability. Data centers are the ideal place to start achieving sustainability, as data centers house large IT infrastructures that must be powered and cooled to support ongoing business operations. With a growing effort to reduce GHG, organizations need to be mindful of the hardware deployed in data centers as achieving sustainability becomes critical to the business.

The Cisco UCS X-Series has been designed with sustainability in mind. With its modular design and converged fabric, this consolidated design enables organizations to reuse components, even as business requirements change. Forklift upgrades are less frequent, as organizations can reuse core components, particularly the chassis, power/cooling, I/O modules, and switches. The centralized power and cooling system helps to manage power more efficiently. Fewer components—particularly cables and optics—are required while more functionality can be achieved within a smaller footprint. Organizations can also proactively manage power consumption by setting policies with Cisco Intersight. Overall, organizations can reduce material consumption and power expenditure within the data center when deploying the UCS X-Series.

Enterprise Strategy Group validated that the UCS X-Series can help organizations lower their overall power consumption in various scenarios. We specifically compared UCS X-Series configurations with similar configurations consisting of previously released Cisco UCS rack servers, earlier generations of Cisco UCS blade servers, and servers from an alternative vendor. Using publicly available power calculators, we found that the estimated power consumption and heat expenditure for the UCS-X Series configurations were consistently lower than those calculated for the other configurations. We also observed how the UCS X-Series can be energy efficient while maintaining good workload performance in simulated VDI workloads.

The pressure to become a sustainable business is only growing. If your organization needs to address this issue and wants a partner to deliver products in line with sustainability objectives, take a close look at how Cisco Systems has designed sustainability into the UCS X-Series.

Appendix

Comparison – Cisco UCS C220 M7 to UCS X210 M7 (associated with Figure 3 and Figure 4)

Cisco UCS C220 M7 configuration:

- 40 Cisco UCS C220 M7 nodes, each configured with 2 x Intel 6430 CPU and 32 x 32GB DIMM
- 1 x Virtual Interface Card (VIC) 15428
- 2 x 2,300W PSU
- 2 x 6454 Fabric Interconnect (FI), 48 ports active power

Cisco X-Series configuration

- 40 Cisco UCS X210 M7 nodes, each configured with 2 x Intel 6430 CPU and 32 x 32GB DIMM
- 1 x VIC 15420
- 2 x Intelligent Fabric Module (IFM)
- 2 x 6454 Fabric Interconnect (FI), 48 ports active power

Consolidation – Cisco UCS B200 M4 to X-Series M7 Server Consolidation (associated with Figure 5 and Figure 6)

Cisco UCS B200 M4 configuration:

- 64 Cisco UCS B200 M4 nodes, each configured with 2 x Intel 2690v4 CPU and 24 x 32GB DIMM
- 8 x UCS 5108 chassis
- 1 x dual port 10Gb VIC
- 2 x 2208 I/O Modules (IOMs) per chassis
- 2 x 6248 FIs, 48 ports active power

Cisco X-Series configuration

- 16 x X210 M7 nodes, each configured with 2 x Intel 6448Y CPU and 24 x 128GB DIMM
- 2 x UCS X-Series chassis
- 1 x quad port 25Gb VIC 15420
- 2 x 25Gb IFMs
- 2 x 6454 FIs, 48 ports active power

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