



White Paper

FlexPod for a more sustainable data center

Nikhil Joshi, NetApp
Renny Fuchs, NetApp
Rohit Mittal, Cisco

March 2025 | WP-7373

In partnership with



Abstract

This document explains the sustainability needs of a data center and how the FlexPod® platform is a comprehensive solution that can help your business improve sustainability throughout the lifecycle of your data center.

TABLE OF CONTENTS

Summary	3
Introduction to data center sustainability	3
Sustainability considerations in IT	3
Global impact of data centers	3
Introduction to FlexPod	4
Sustainability elements in FlexPod	5
Building a vision for more IT sustainability	5
Designing sustainable technologies	6
Preparing for long-term sustainability	6
Sustainability advantage of a representative FlexPod configuration.....	6
NetApp	10
Cisco	17
FlexPod Validated Designs and automation	25
Where to find additional information	26
Version history	26

LIST OF FIGURES

Figure 1) FlexPod architecture.	5
Figure 2) Comparison of a NetApp FAS8200 hybrid flash system with an AFF A20 all-flash system.	7
Figure 3) Comparison of a NetApp AFF A20 all-flash system with an AFF C250 all-flash system.....	7
Figure 4) Comparison of rack units required for FAS8200, AFF A20, and AFF C250 systems.	8
Figure 5) Server consolidation based on CPU and memory.....	8
Figure 6) Power and cooling: Consolidating from M4 to Cisco UCS X-Series M7.....	9
Figure 7) Comparison of power consumption by FAS8200, AFF A20, and AFF C250 systems.	9
Figure 8) Power and cooling: 40-node configuration with Cisco UCS X-Series and with an alternative vendor's components.....	10
Figure 9) NetApp BlueXP sustainability dashboard.....	14
Figure 10) BlueXP sustainability recommendations.	15
Figure 11) Working environments.	16
Figure 12) Cisco UCS X-Series, powered by next-generation Intel and AMD processors and Cisco Intersight.	18
Figure 13) See, control, and automate operations of your global infrastructure with Intersight.	20
Figure 14) Intersight provides policy-based power management of UCS servers to support more sustainable operations.....	21
Figure 15) Intersight dashboard showing power and energy metrics.	21
Figure 16) Cisco Networking sustainability benefits.	23
Figure 17) Cisco supply chain sustainability due diligence process.	24

Summary

Data center sustainability has become a corporate priority for organizations. This document guides FlexPod® customers and partners on how to design a more sustainable data center. In this white paper, we document the out-of-the-box sustainability features of FlexPod components and the configurations that you can use to make your data center competitively sustainable.

Introduction to data center sustainability

According to Gartner®, “By 2028, two-thirds of organizations will respond to stakeholder pressures by implementing a data center infrastructure sustainability program driven by corporate commitments and new regulatory requirements, a major increase from less than 10% in 2022.”

Gartner also predicts that “By 2028, more than 70% of enterprises will alter their data center strategies, due to limited energy supplies, a major increase from less than 5% in 2023.”¹

A data center consumes significant resources in operating an IT-based business. A data center consumes energy; occupies real estate space; requires personnel hours for deployment, upgrade, and operations; and generates heat, noise, and other waste products throughout its lifecycle. A more sustainable data center is designed such that it delivers optimal performance while keeping costs and the preceding sustainability aspects under control.

Sustainability considerations in IT

A data center administrator must deliver performance, reliability, and security of mission-critical data for their end users, while also optimizing sustainability parameters such as:

- Total energy consumption
- Greenhouse gas (GHG) emissions: clean energy and renewable energy
- Noise pollution: from fans, spinning disks, and AC units
- Waste heat
- Solid waste generation throughout the lifecycle of the data center
- Real estate footprint for equipment
- Human resources used in tending to the hardware

Global impact of data centers

According to the [International Energy Agency](#), in large economies like the United States, China, and the European Union, data centers account for about 2% to 4% of the total electricity consumption today. But because data centers tend to be spatially concentrated, their local impact can be more pronounced. At the time of this writing, the sector had already surpassed 10% of the electricity consumption in at least five U.S. states. And in Ireland, this sector accounted for over 20% of all electricity consumption. The growth of data centers could therefore lead to considerable strain on local power networks, exacerbated by the huge mismatch between rapid data center construction times and the often-sluggish pace of expansion and strengthening of grids and generation capacity. There have already been instances of

¹ Gartner®, Hype Cycle™ for Data Center Infrastructure Technologies, 2024, by Henrique Cecci, Philip Dawson, 27 June 2024. GARTNER and Hype Cycle are registered trademarks of Gartner, Inc. and/or its affiliates in the U.S. and internationally and are used herein with permission. All rights reserved.

jurisdictions pausing new contracts for data centers because of a surge in requests. For regions or countries that are particularly affected, the increasing electricity consumption of data centers could make it more difficult to meet climate targets.

The concept of sustainability is not monolithic. Various geographies across the globe focus on different facets of sustainability, based on their socioeconomic and geopolitical priorities. In regions such as the European Union, being neutral (or even positive!) toward the environment is probably of the utmost importance to the customers who seek to make their data centers more sustainable. They focus on aspects such as making their data center lifecycle carbon neutral or carbon positive. They also try to ensure that their data center runs on renewable or clean energy, such as wind, solar, hydro/tidal, and nuclear energy, instead of coal.

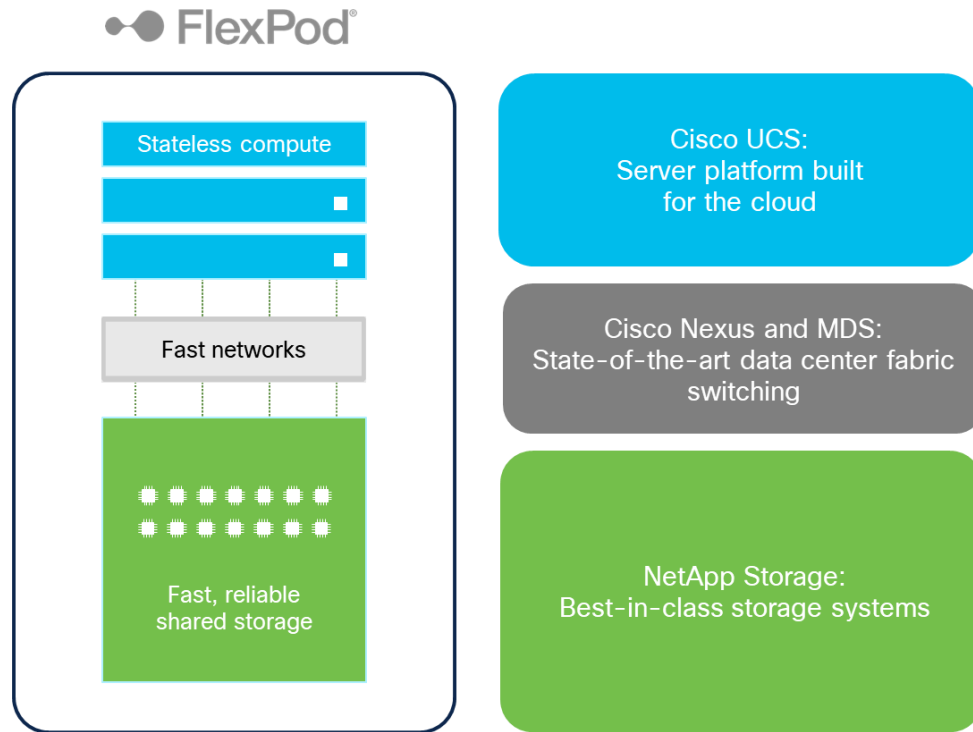
In the United States, customers in population-dense regions such as the East Coast or California may need to focus on the real estate footprint and the noise and heat emissions of their data center. In contrast, data center customers in sparsely populated geographies, such as the U.S. Midwest, may focus on reducing the human intervention required for deployment and operations of their data center, because it's difficult to find and to retain IT specialists.

A common aspect of sustainability, cutting across all geographies, is how to help customers design and operate their data center while increasing their business's financial sustainability. This aspect requires that the data center's lifetime costs and energy consumption be market competitive, when measured per gigabyte stored, per gigabyte networked, or per teraflops computed.

Introduction to FlexPod

FlexPod is a secure, smart, and more sustainable hybrid platform that is engineered to transform your infrastructure and operations. FlexPod unites innovative compute nodes and racks, storage, networking, and management to help you accelerate the delivery of modern workloads and future-proof your environment. The FlexPod reference architecture (Figure 1) is composed of Cisco Unified Computing System (UCS) compute nodes, Cisco MDS and Nexus switches, and NetApp® AFF and FAS systems.

Figure 1) FlexPod architecture.



FlexPod offers value in three pillars: It's secure, smart, and more sustainable than competitor platforms. The secure-by-design FlexPod architecture offers end-to-end security, with threat visibility across your entire network, compute, and storage. Its intelligence lies in the way that you can design, scale, and deploy FlexPod with the growing portfolio of tested and documented reference architectures. And FlexPod enables you to reduce waste, to eliminate forklift upgrades, and to seamlessly transition to increased sustainability with a modular system.

Sustainability elements in FlexPod

As the strain on natural resources intensifies and pollution continues to escalate, there is a growing urgency for data centers to adopt more sustainable practices. Meeting this challenge requires IT teams and business leaders to take decisive steps toward minimizing the environmental impact of their operations. One key strategy is to streamline data center infrastructure by replacing outdated storage, network, and compute systems with solutions that are more compact, energy-efficient, and high-performing. Recognizing this critical need, FlexPod exemplifies sustainability by integrating innovative technologies to reduce the environmental footprint of data centers, setting a positive example for the industry.

Building a vision for more IT sustainability

True sustainability extends beyond choosing efficient solutions for immediate needs—it involves collaborating with technology partners who are dedicated to ongoing innovation in efficiency and environmental stewardship. FlexPod can help your organization on your path toward a more sustainable infrastructure. Backed by the environmental leadership of Cisco and NetApp, FlexPod incorporates cutting-edge technologies that are designed to help reduce the environmental footprint of ITOps while enabling your organization to align your IT investments with long-term sustainability goals.

Designing sustainable technologies

The FlexPod design offers significant benefits by consolidating workloads that run on aging, inefficient hardware. This consolidation reduces data center footprints through denser designs and advanced data reduction technologies. For example, the FlexPod modular storage design combined with NetApp storage technology delivers unparalleled flexibility and ultrahigh density, outperforming other storage solutions. On the compute side, the Cisco UCS X-Series chassis features a midplane-free design that simplifies physical connections, so nodes or modules can be added or replaced effortlessly, without requiring architectural modifications.

Preparing for long-term sustainability

Future-readiness is essential for organizations that aim to effectively reduce their data center footprints. The adoption of adaptable technologies eliminates the need for disruptive and costly forklift upgrades. FlexPod, designed by Cisco and NetApp with a focus on long-term sustainability, combines reduced energy consumption with extended hardware lifespans. For example, the Cisco UCS X-Series minimizes complexity while supporting future innovations such as liquid cooling, energy-efficient CPUs, and advanced interconnect systems. This collaboration between Cisco and NetApp delivers a solution that balances high performance, scalability, and energy efficiency, helping to significantly reduce data center footprints. FlexPod is more than a sustainable solution for today—it is a forward-looking investment that aligns with long-term environmental objectives.

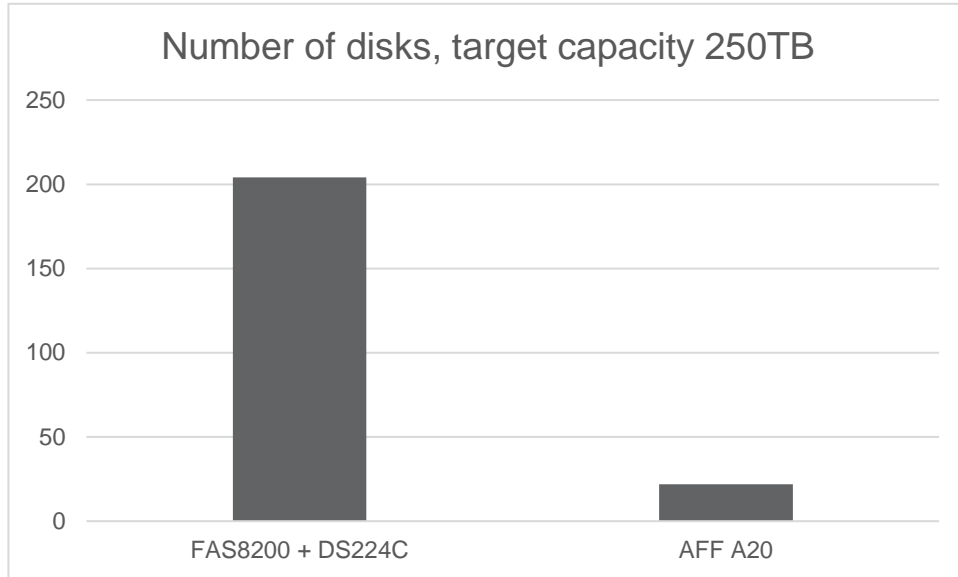
Sustainability advantages of a representative FlexPod configuration

FlexPod components have individually achieved significant milestones in delivering sustainability value to customers. Every layer of the FlexPod stack includes built-in features and optional settings that are designed to enhance sustainability and efficiency. For instance, to create a more sustainable data center that is tailored to your business objectives, you can fine-tune temperature-sensitive storage parameters, configure the NetApp ONTAP® platform to automatically tier cold data, and implement other optimizations.

Workload consolidation

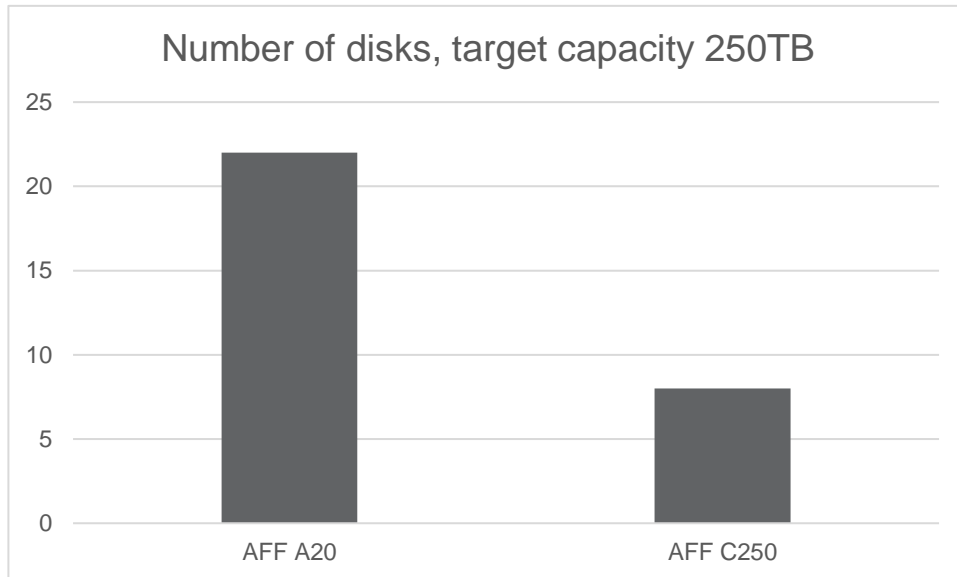
By consolidating workloads and by minimizing data center footprints through denser designs and advanced data reduction technologies, the FlexPod architecture delivers substantial advantages. FlexPod efficiencies have improved with NetApp AFF A-Series and AFF C-Series all-flash storage. In this paper, we present example configurations for comparison. One configuration is the NetApp FAS8200 hybrid flash system with DS224C shelves, using two hundred and four 1.8TB 10K SAS HDDs to hit a target capacity of 250TB. The AFF A20 system at 4:1 data efficiency achieves this capacity with twenty-two 3.8TB SSDs. See Figure 2.

Figure 2) Comparison of a NetApp FAS8200 hybrid flash system with an AFF A20 all-flash system.



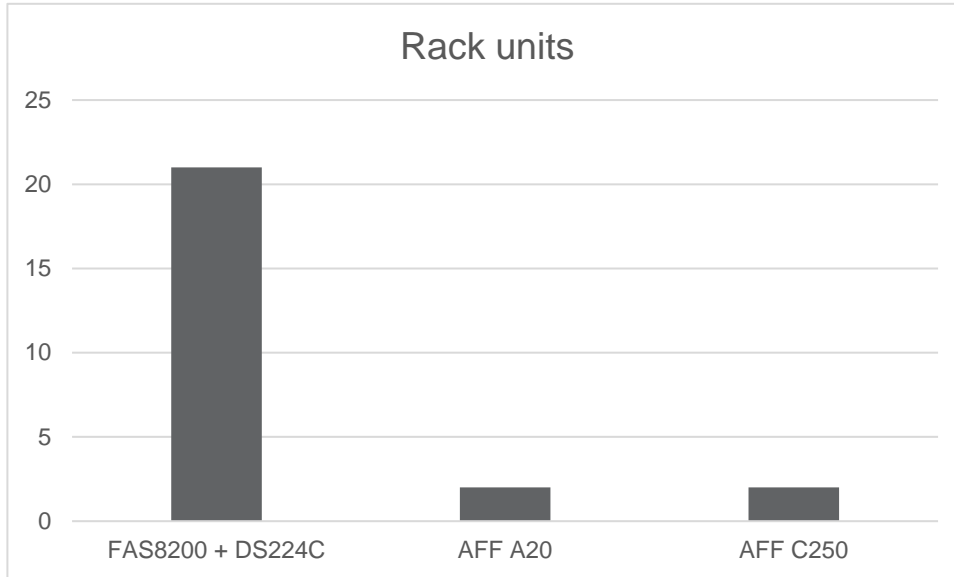
Compared with the AFF A20 system, the AFF C250 system accomplishes this task with eight 15.3TB SSDs, again assuming a 4:1 data efficiency. See Figure 3.

Figure 3) Comparison of a NetApp AFF A20 all-flash system with an AFF C250 all-flash system.



With disk reduction comes rack unit consolidation. The FAS8200 system and DS224C shelves use 21 rack units to house the disks that are needed to hit the target capacity. The NetApp® AFF A20 and AFF C250 systems occupy just 2 rack units of space, leading to a much more compact form factor. See Figure 4.

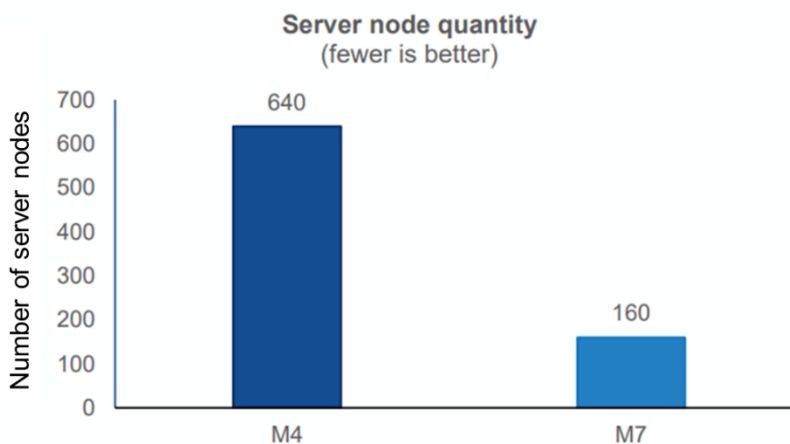
Figure 4) Comparison of rack units required for NetApp® FAS8200, AFF A20, and AFF C250 systems.



The UCS X-Series complements the advantages of NetApp storage systems with significant energy efficiency benefits through server consolidation, which reduces energy requirements for both power and cooling compared with earlier UCS blade server generations. For this analysis, a [study](#) conducted by Enterprise Strategy Group compared the UCS X-Series with the previous UCS B200 M4 Blade Servers, which featured the highest-selling CPU before the X-Series release.

By using SPECint 2017 benchmarks to evaluate CPU performance, the number of UCS X210c M7 servers needed to match the processing power of the UCS B200 M4 servers was estimated. To ensure a fair comparison, the total RAM needed to support equivalent VM loads in both configurations was also considered. A conservative consolidation ratio of 4:1 was applied. See Figure 5.

Figure 5) Server consolidation based on CPU and memory.



Additionally, a comparison was conducted on a 64-node configuration for each server type:

- **UCS B200 M4 setup:** Eight UCS 5108 chassis housing 64 B200 M4 blades
- **UCS X-Series setup:** Two UCS X-Series chassis housing 16 UCS X210c M7 nodes

Both configurations included the necessary fabric modules and adapters for full end-to-end connectivity.

Figure 6) Power and cooling: Consolidating from M4 to Cisco UCS X-Series M7.

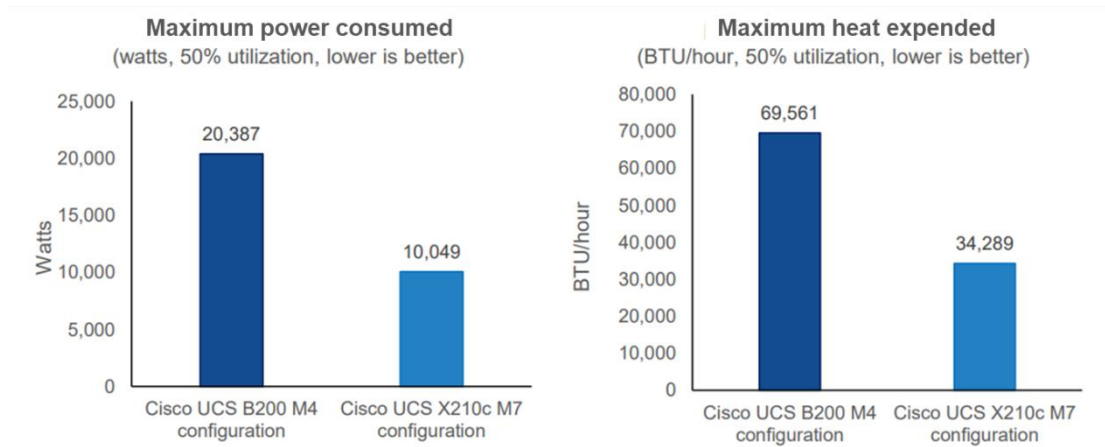
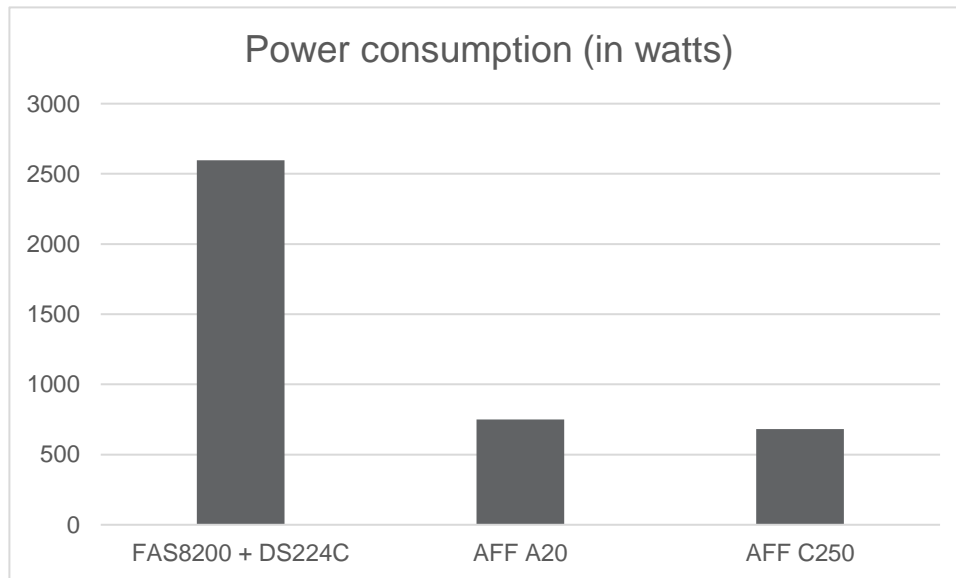


Figure 6 shows the results. According to Cisco’s power calculator, the UCS X-Series configuration achieved a 50.7% reduction in power consumption and heat generation compared with the B200 M4 setup. In addition, the total configuration weight decreased by 62%, equivalent to nearly 1,200 pounds.

Power and cooling

An additional benefit from the space consolidation is energy efficiency. Because the NetApp AFF A20 and AFF C250 systems use SSDs, which require less power than HDDs and do not require additional shelves to hit the target capacity, their overall power consumption is significantly reduced. As Figure 7 shows, the FAS8200 system with nine DS224C shelves consumes 2,596W of power. By comparison, the AFF A20 uses 749.8W, and the AFF C250 uses 682.4W.

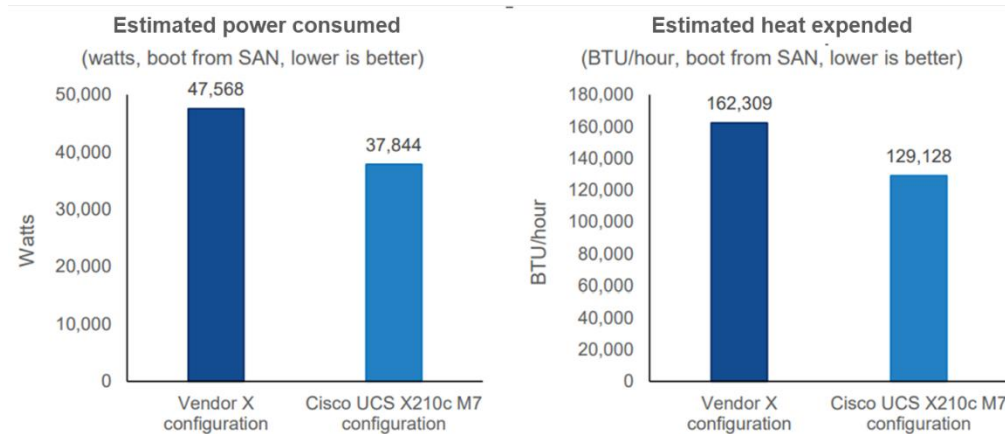
Figure 7) Comparison of power consumption by FAS8200, AFF A20, and AFF C250 systems.



On the compute side, the [study](#) conducted by Enterprise Strategy Group compared the estimated power consumption and heat generation of a Cisco UCS X-Series configuration with a comparable configuration

from an alternative vendor. Power budgets for each configuration were calculated by using the respective power calculators provided by Cisco and the vendor. The UCS X-Series configuration included 40 Cisco UCS X210c M7 nodes housed in five UCS X-Series chassis. Similarly, the other vendor's configuration consisted of the same number of server nodes and chassis. Both setups included the required switch fabrics, adapters, ports, and accessories to enable full end-to-end connectivity. For both configurations, power consumption was measured during the boot process from the SAN.

Figure 8) Power and cooling: 40-node configuration with Cisco UCS X-Series and with an alternative vendor's components.



As Figure 8 shows, the results indicated that the UCS X210c M7 configuration consumed 20.4% less power and generated 20.4% less heat compared with the alternative configuration. Also, the UCS X-Series setup weighed 12% less (1,764 pounds versus 2,000 pounds) and used 58% fewer components.

The following sections explore the FlexPod components from NetApp and Cisco in greater detail, highlighting how they provide sustainability benefits to customers.

NetApp

NetApp prides itself on being a green data company. From working with manufacturers to improve product packaging to encouraging customers to use a free product take-back program, NetApp has been thoughtfully contributing to the circular economy. As part of the same commitment to sustainability, all NetApp products that are used in a FlexPod data center are aimed toward being sustainable by design.

NetApp AFF

NetApp AFF controllers are the best-in-class storage components for FlexPod. Compared with traditional spinning disks, AFF offers tremendous storage consolidation and reduction in your overall energy consumption.

New hardware models

NetApp AFF models offer unified data storage by using new hardware that has been redesigned with sustainability in mind. The new NetApp® [AFF A-Series](#) models deliver industry-leading performance, verified by SPC-1 and SPEC SFS industry benchmarks, for your mission-critical workloads. These systems are optimal for everything from VMware environments, to highly transactional applications (such as Oracle, Microsoft SQL Server, and MongoDB databases), to the most data-intensive AI training, tuning, inferencing, and retrieval-augmented generation (RAG) workloads. With the power of front-end NVMe/FC and NVMe/TCP host connectivity combined with back-end NVMe-attached SSDs, the high-end AFF A1K modular system delivers up to 40 million IOPS and 1TBps throughput in a single cluster through

a unified, scale-out architecture. And these systems do it while offering better power efficiency than their predecessors.

The new [NetApp® AFF C-Series](#) models are designed to modernize general-purpose workloads and to increase IT agility without breaking the bank. By using ultradense capacity flash and by maximizing data efficiency, the AFF C-Series delivers a great balance between all-flash performance and cost-effectiveness for FlexPod customers. The ultradense capacity flash also reduces the real estate footprint of a data center. Organizations that consolidate workloads from hybrid storage solutions benefit from comprehensive data management and full support for block, file, and object protocols—streamlining workflows while reducing power and cooling requirements. Because **with reduced power comes great sustainability**.

Organizations like yours are striving to make their data centers more cost- and energy-efficient while also meeting their performance and capacity requirements. AFF C-Series systems help FlexPod customers achieve these goals by reducing data center costs with a solution that is more sustainable and efficient than hybrid flash and HDD systems. The budget-friendly AFF C-Series is optimal for a wide range of general-purpose applications. It is also an excellent choice for hosting database and VM copies for development and testing (DevTest) sandboxes, and it serves as an ultrareliable replication target. Organizations that modernize from hybrid flash can [reduce their footprint by up to 99%, consume up to 97% less energy, and benefit from the performance of capacity-optimized all-flash storage](#).

The new NetApp ASA models inherit the benefits of the new hardware and extend the sustainability value further with their razor-sharp objective: delivery of an efficient SAN protocol for specific, mission-critical, and business-critical workloads such as VMware and databases such as Oracle, SQL Server, and SAP. These ASA systems contain a redesigned architecture, making SAN a native protocol and avoiding the overhead that would have been necessary to support the NAS protocol. ASA models offer simple, powerful, scale-out all-flash storage with advanced data management and protection features at an extremely affordable price. The ASA family includes NetApp® ASA A-Series models that are designed for the most performance-demanding and mission-critical applications, and NetApp® ASA C-Series models that are optimized for cost-effective deployment of large-capacity and general-purpose applications. The feature-rich, SAN-specific NetApp ONTAP® data management capabilities of ASA systems can reduce your data center storage footprint, power consumption, and carbon footprint with high-density, highly efficient all-flash storage that increases FlexPod sustainability.

NetApp ONTAP

The NetApp ONTAP platform offers the most effective [Storage Efficiency Guarantee](#) across the industry. ONTAP enables your organization to get high performance while minimizing energy usage and GHG. NetApp guarantees a 4:1 ratio for SAN protocols (FC, NVMe, iSCSI), a 1.5:1 ratio for bare-metal NAS protocols (NFS, SMB, CIFS), and a 3:1 ratio for VMware, Microsoft Hyper-V, and Kernel-Based Virtual Machine (KVM) workloads on NAS. To achieve storage efficiency, ONTAP uses technologies such as deduplication, compaction, and compression. You can read more information in the [ONTAP storage efficiency overview](#).

ONTAP ships with most of the storage efficiency features enabled, and you can choose to [further tune the individual features](#) to meet your sustainability goals. Also, you can configure volume-level background deduplication to run automatically by using a predefined [automatic NetApp AFF policy](#).

You can also perform [cross-volume inline deduplication](#) on AFF systems. This feature is enabled by default for all newly created volumes and for all upgraded volumes with volume inline deduplication turned on.

In addition, you can perform [cross-volume background deduplication](#) on your AFF systems. This feature is enabled by default for all newly created volumes and for all upgraded volumes with volume background deduplication turned on.

ONTAP also enables you to tweak the level of compression for frequently updated hot data versus archival cold data. You can use these commands to change the threshold of [temperature-sensitive storage efficiency](#):

- The coldness threshold can be from 1 to 60 days. The default threshold is 14 days.
- Temperature-sensitive storage efficiency is not enabled on NetApp® AFF A70, AFF A90, and AFF A1K systems, which were introduced in ONTAP 9.15.1; those models use a hardware offload processor.

Furthermore, to change the volume efficiency mode, you can also [modify the compression settings on a volume](#).

You can control [inline data compaction](#) on AFF systems at the volume level by using the `volume efficiency modify` command. Data compaction is enabled by default for all volumes on AFF systems.

ONTAP also offers [thin provisioning](#). You can allocate storage in a volume or LUN as it is needed, instead of reserving it in advance. This approach reduces the amount of physical storage that you need by enabling you to overallocate your volumes or LUNs based on potential usage, without reserving space that is not currently being used.

The unified architecture of ONTAP enables you to deploy workloads and use cases by employing various protocols and operating systems on a common FlexPod instance. With the adaptive quality-of-service (AQoS) feature of FlexPod, when multiple workloads are operating in consolidation, each workload receives the necessary share of hardware resources so that the workload can meet its SLAs. Such consolidation, in combination with thin provisioning, enables you to reduce the real estate footprint of your data center. It also helps you reduce the costs and energy consumption that would otherwise be required if each workload operated in a separate, siloed environment, with each silo requiring its own hardware resources overhead.

With minimal effort, you can realize the benefit of these technologies in your day-to-day operations. For example, suppose that you need to supply 5,000 users with storage for home directories, and you estimate that the maximum space needed by any user is 1GB. You can reserve a 5TB aggregate in advance to meet the total potential storage needs. However, let's say that you also know that the home directory capacity requirements vary greatly across your organization. Instead of reserving 5TB of total space for your organization, you can create a 2TB aggregate. Then you can use thin provisioning to nominally assign 1GB of storage to each user but allocate the storage only as needed. You can actively monitor the aggregate over time and increase the actual physical size as necessary.

In another example, suppose you are using a virtual desktop infrastructure (VDI) with a large amount of duplicate data among your virtual desktops. Deduplication reduces your storage usage by automatically eliminating duplicate blocks of information across the VDI, replacing them with a pointer to the original block. Other ONTAP storage efficiency technologies, such as compression, can also run in the background without your intervention.

ONTAP disk partitioning technology delivers greater storage efficiency as well. NetApp RAID DP® technology protects against double disk failure without sacrificing performance or adding disk-mirroring overhead. The advanced SSD partitioning with ONTAP 9 also increases usable capacity by almost 20%.

You can use the NetApp ONTAP [SnapMirror®](#) feature on FlexPod to store your NetApp Snapshot™ copies and backups at a physical location away from your production site. This feature can enhance your data center sustainability by storing the Snapshot copies and backups at a site where you can better comply with the local sustainability regulations.

NetApp provides the same storage efficiency features that are available with on-premises ONTAP also in the cloud. When you migrate your data from on-premises ONTAP to the cloud, the existing storage efficiency is preserved. For example, suppose that you have a SQL Server database that contains business-critical data that you want to move from an on-premises system to the cloud. You can use

NetApp BlueXP™ replication to migrate your data and, as part of the migration process, you can enable your latest on-premises policy for Snapshot copies in the cloud. You can also [save up to 70% on storage costs through automated data tiering to the cloud](#).

Because ONTAP works the same on premises and in the cloud, you can easily and automatically tier off your cold data to the cloud by using [FabricPool](#). The cloud tier can be on NetApp StorageGRID® object-based storage or on ONTAP S3 (beginning with ONTAP 9.8), or on one of the following service providers:

- Alibaba Cloud
- Amazon Commercial Cloud Services
- Amazon Simple Storage Service (Amazon S3)
- Google Cloud
- IBM Cloud
- Microsoft Azure Blob Storage

FabricPool can help you reduce your storage requirements in expensive geographies that have more sustainability compliance regulations by moving the colder data to locations where you can better meet the local sustainability regulations.

You can read further information about [how to add a cloud tier to ONTAP for FlexPod](#).

NetApp BlueXP

You can access NetApp sustainability information in three ways:

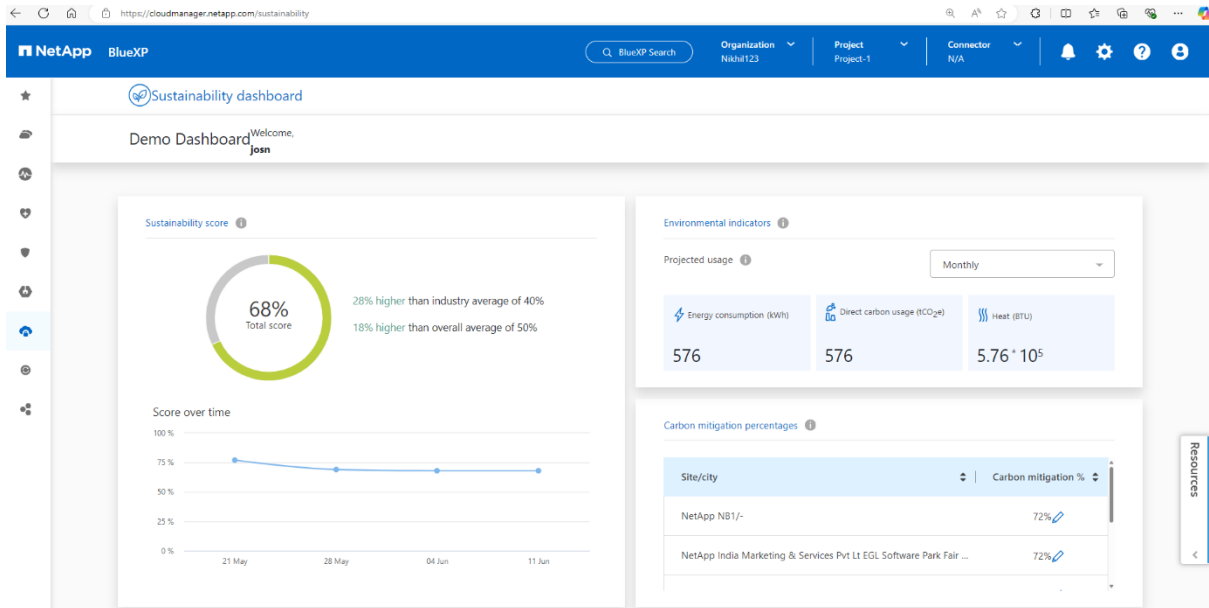
- NetApp BlueXP provides your organization with a single control plane that helps you build, protect, and govern data across your on-premises and cloud environments.
- The BlueXP software-as-a-service (SaaS) control plane includes services that provide storage management, data mobility, data protection, and data analysis and control.
- Management capabilities are provided through a web-based console and APIs.

BlueXP sustainability dashboard

BlueXP sustainability information is sourced from NetApp Active IQ® Digital Advisor. The BlueXP sustainability dashboard (Figure 9) is available to every NetApp customer at no additional cost, and you get intelligent insights into real-time power use, energy consumption, storage optimization, and more. The dashboard generates a top-line sustainability score that evolves over time, representing efficiency in a single key performance indicator.

You can visit the BlueXP sustainability dashboard at <https://console.bluexp.netapp.com/sustainability/> or <https://cloudmanager.netapp.com/sustainability>.

Figure 9) NetApp BlueXP sustainability dashboard.



This sustainability dashboard displays extensive metrics and useful recommendations regarding your organization's sustainability.

Sustainability score

The sustainability score is an assessment of how well you are using key features, services, and best practices that are geared toward improving sustainability. You can track your score over time to see the impact of recommended actions and to review your progress.

The sustainability score is calculated based on a set of rules that are related to your storage systems, with each rule addressing specific risks and providing recommended actions for mitigation. Every rule is given a score to reflect its importance. For example, three rules that are associated with storage systems—maintaining ambient temperature, optimizing capacity utilization, and using a titanium power supply—have scores of 30, 40, and 30 points, respectively. Adding up these scores gives a total of 100, which acts as the denominator.

If storage systems meet all the criteria perfectly, they achieve a sustainability score of 100%. If systems perform at half the optimal level, they might achieve a score of 50%. The total points serve as a standard, which is used to compare the actual performance against the ideal performance. You can implement the recommended actions to enhance your system's compliance with these rules, which will then improve your system's sustainability score.

The score can be classified as:

- 0%–25%: Room for improvement.
- 26%–50%: Good progress toward sustainability.
- 51%–75%: Highly invested in sustainability initiatives.
- 76%–100%: Sustainability is a top priority for your business.

The dashboard also displays the trend of your score over time.

The sustainability score is initially calculated at the cluster level, and then it is aggregated at other levels, such as the customer or watchlist level.

Environmental indicators

The BlueXP sustainability dashboard also displays various environmental indicators, such as your data center's monthly, quarterly, and annual projected energy consumption (kWh); direct CO₂ usage; and heat generation (in British thermal units, or BTUs).

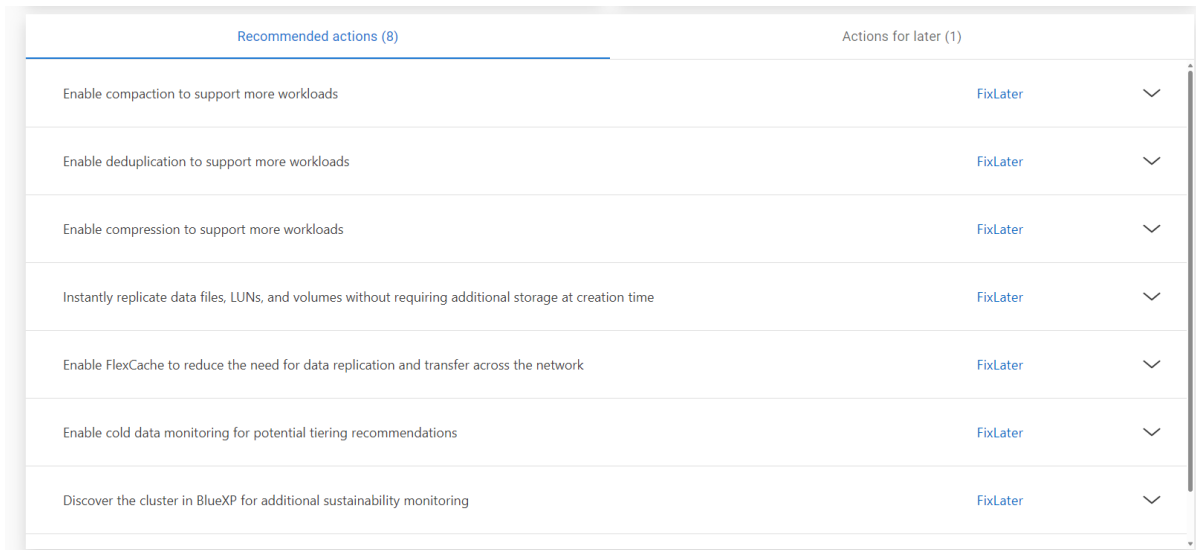
Carbon mitigation percentages

This table in the BlueXP sustainability dashboard shows the percentage of carbon mitigation at each of your sites. The values are calculated by using an unmodified version of the Open Emission Factors Database (OEFDB), validated by [Climatiq](#) and licensed under Creative Commons Attribution–ShareAlike 4.0. If you are taking extra steps to address your data center's carbon footprint, you can adjust the carbon mitigation percentage for specific sites.

Recommended actions

The BlueXP sustainability dashboard also provides actionable recommendations to help you improve your sustainability score (Figure 10). You can fix the low-hanging fruit to improve the score immediately, or you can defer them for later action. If you choose Later, the selected recommended action is moved to the Actions for Later tab. The selected action is then postponed for 30 days. After 30 days, this action moves back to the Recommended Actions tab.

Figure 10) BlueXP sustainability recommendations.



Recommended actions (8)	Actions for later (1)
Enable compaction to support more workloads	FixLater
Enable deduplication to support more workloads	FixLater
Enable compression to support more workloads	FixLater
Instantly replicate data files, LUNs, and volumes without requiring additional storage at creation time	FixLater
Enable FlexCache to reduce the need for data replication and transfer across the network	FixLater
Enable cold data monitoring for potential tiering recommendations	FixLater
Discover the cluster in BlueXP for additional sustainability monitoring	FixLater

Working environments

At the bottom of the sustainability dashboard, you can see the breakdown of the sustainability score across all your working environments (Figure 11). You can choose to see various parameters by clicking the + button on the top right, and then you can download the list for sharing offline with stakeholders. You can see the following parameters for each working environment:

- Site name
- Last NetApp AutoSupport® date
- Sustainability score
- Capacity utilization (%)
- Direct CO₂ usage

- Actual power (kW)
- Heat (BTU/h)
- Recommended actions
- Total capacity in tebibytes (TiB)
- GHG emission rate in kg CO₂ per tebibyte
- Typical power (kW)
- Worst power (kW)
- Median power (kW)
- Real-time power (kW)
- Power consumption in watts per tebibyte

Figure 11) Working environments.

Working Environment	Platform	Site	Last AutoSupport Date	Sustainability score	Capacity utilization (%)
ph703-cluster3		GTS Czech sro	Apr 18, 2023	85%	68 TiB (94%)
ph54483-cluster10		KCP T-Systems Na Pankra...	Apr 09, 2023	85%	14 TiB (13%)
ph4610-cluster5-01		KCP T-Systems Na Pankra...	Sep 19, 2021	85%	2 TiB (5%)
ph13272-cluster3-rzp		KCP DC	Apr 09, 2023	85%	43 TiB (74%)
ph11284-cluster4-rzp		ALEF Distribution CZ sroP...	Nov 14, 2021	85%	42 TiB (71%)
ph703-cluster1		Alef Nula a.s.	Apr 09, 2023	85%	38 TiB (58%)
ph4610-cluster5		Alef Nula a.s.	Apr 09, 2023	85%	20 TiB (62%)
ph13272-cluster1-rzp		RZT T-Mobile Tomickova ...	Nov 14, 2021	85%	3 TiB (19%)
ph50250-cluster2-rzp		RZT T-Mobile Tomickova ...	Apr 09, 2023	85%	3 TiB (18%)

In addition to the sustainability dashboard, BlueXP also offers you resource visibility across your entire organization. It can show underused resources so that you can optimize your resource utilization. It helps you with capacity planning by alerting you to order more storage just when you need it so that you can improve your capital expenditure utilization. These actions not only help you achieve better environmental sustainability by keeping your energy consumption to the optimal levels, but they can also improve your organization's economic efficiency. Powered by AI, this service helps you anticipate your future needs and plan ahead, while reducing risk to your business and saving on costs. With the BlueXP AI-driven recommendations and self-service capabilities, you can reduce the time spent on planning for the future.

[NetApp BlueXP classification](#) (formerly Cloud Data Sense) is a data governance service for BlueXP that scans your corporate on-premises and cloud data sources to map and to classify data and to identify private information. This service can help reduce your security and compliance risks, help decrease your storage costs, and help you with your data migration projects.

Active IQ Digital Advisor API

Your IT administrator can access the [Active IQ Digital Advisor API](#) and design custom applications to view sustainability metrics, or they can generate custom sustainability recommendations that are suitable for your business priorities. [Access to the Active IQ Digital Advisor API catalog](#) is readily available.

Digital Advisor API Services uses automation to add efficiency to your workflows. Inside API Services resides the API catalog, which describes over 100 different API endpoints that are grouped into more than 20 different service areas. These APIs are available to you as a NetApp customer, and they span different areas of interest, such as system information, storage efficiency, performance, health, and upgrades.

You can write code in such a way that it contacts Digital Advisor every day and brings back the latest data in the areas that are of interest to you. You can then use this data to populate your ticketing system or to create your own dashboards, webpages, or reports. The Digital Advisor API catalog has both code samples and a facility for you to try out the APIs in the browser.

NetApp corporate commitment to sustainability

The NetApp [Storage Lifecycle Program \(SLP\)](#) cost-effectively provides more sustainable storage solutions. Under SLP, data center customers can buy storage one time and then perpetually receive nondisruptive tech upgrades, including newer storage systems that deliver market-competitive power savings, media densities, and maintenance costs.

Environmental, social, and governance

NetApp integrates environmental, social, and governance (ESG) principles into its business strategy. NetApp considers energy management and GHG emission reduction to be environmental priorities. In 2024, [NetApp reduced Scopes 1 and 2 GHG emissions by 37%](#) from the company's fiscal year 2020 (FY20) baseline.

Packaging sustainability

The upgraded packaging designs for NetApp products embrace circular economy principles to help eliminate waste. Scheduled for completion in FY25, the new packaging design is the culmination of a 2-year initiative. NetApp began with a packaging lifecycle assessment to drive down the environmental impact. By emphasizing higher quality and sustainability, the new packaging reduces the use of virgin foam and plastic, elevates reusability and recyclability, and improves packaging and shipping efficiency. NetApp is also collaborating with manufacturers to adopt alternative materials that minimize waste throughout the product lifecycle, and the company is working to raise customer awareness about these improvements.

Regulatory compliance and certifications

NetApp is committed to setting a new standard for energy-efficient data storage systems. Some NetApp products have earned the ENERGY STAR® certification, and NetApp intends to meet or to exceed this standard for all new systems and platforms moving forward. The NetApp AFF, FAS, and E-Series data storage systems are ENERGY STAR 2.1 certified for their superior performance and efficiency.

You can find more information about [NetApp's environmental certifications and statements](#).

Cisco

Cisco has long been committed to reducing its environmental impact. Cisco's comprehensive approach to environmental sustainability includes how the company operates its business and how the company helps its customers and suppliers make progress toward their own sustainability goals. It also includes how Cisco does its part to help the world adapt to a changing climate. Cisco's environmental sustainability strategy, The Plan for Possible, guides the company as it advances sustainability in products, accelerates clean energy access, supports suppliers' reduced environmental impacts, and fosters climate resilience in communities.

Cisco UCS

The [Cisco Unified Computing System](#) (Cisco UCS) is an integrated computing infrastructure with intent-based management to automate and to accelerate deployment of all your applications. Its unique architecture provides pools of policy-based composable infrastructure that you can optimize for traditional workloads, data analytics, and cloud-native applications—all within a common operating environment with open APIs for broad interoperability and automation. The Cisco UCS portfolio includes a wide array of products such as blade, rack, modular, and storage-intensive servers, all aimed at enhancing application performance, scalability, and infrastructure management while reducing costs and expediting IT service delivery.

Since its introduction over a decade ago, Cisco UCS has become a leading choice among server vendors, with over 85% of Fortune 500 companies investing in the platform. Its exceptional performance is underscored by more than 150 world performance records, reflecting Cisco's commitment to innovation and to customer-focused solutions.

Cisco UCS X-Series

[Cisco UCS X-Series](#) (Figure 12) is the latest innovation in the Cisco UCS portfolio. Moving beyond the limits of traditional platforms, Cisco UCS X-Series provides the functionalities of both blade and rack servers by offering compute density, storage capacity, and expandability in a single system, embracing a wide range of workloads.

Figure 12) Cisco UCS X-Series, powered by next-generation Intel and AMD processors and Cisco Intersight.



The Cisco UCS X-Series exemplifies Cisco's commitment to sustainability, helping both the company and its customers reduce their environmental impact. Key features that support organizations in achieving their environmental and sustainability goals include a modular and consolidated hardware design; converged fabric; centralized power and cooling infrastructure; and environmentally mindful materials, manufacturing, and packaging:

- **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 the consumption of fewer parts over time. Unlike with the use of traditional rack servers, you 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. (For example, you can upgrade UCS

X-Series compute nodes to GPU-enabled nodes by directly connecting a PCIe module, eliminating the need to connect through 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 that 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 your organization needs to support your 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 having to maintain separate physical networks that are dedicated to storage, networking, or management, the UCS X-Series enables your organization to direct all traffic types through the UCS X-Series converged fabric. Furthermore, your organization can achieve end-to-end 100G connectivity per port on the compute node, enabling future traffic growth. By using this converged fabric, your organization can reduce the number of switch fabrics deployed, thus decreasing the number of switches, adapters, ports, cables, and optics that you need 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.** Unlike with rack servers, the UCS X-Series uses a centralized power and cooling infrastructure that is built into the chassis to facilitate efficient power transfer among the slotted compute nodes. By using larger fans that boast a high cubic-foot-per-minute (CFM) airflow, two dynamic power management algorithms with intelligent fan control, and zone-based cooling, the UCS X-Series chassis can air-cool fully loaded compute nodes that are configured up to 350W CPUs. As a result, your organization can use fewer fans, power supply units (PSUs), and power cables, while decreasing overall energy consumption.
- **Materials, manufacturing, and packaging.** Cisco has adopted design and manufacturing practices that help reduce overall material and energy waste across all its product lines, helping both the company and its customers achieve sustainability objectives. Subsequent designs within each product line eliminate the use of wet paint, significantly reduce the amount of paint and/or powder coating on chassis and node surface areas, and employ a high percentage of postconsumer 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. By using cardboard, Cisco's packaging reduces the overall amount of foam packaging. (When foam is needed, Cisco uses recycled foam packaging.) Cisco also further reduces material consumption by enabling customers to opt out of accessories (for example, power cables), and it decreases paper manual consumption through QR codes.

The redesign and manufacturing of the Cisco UCS X-Series align with Cisco's commitment to sustainability. Cisco has long been a leader in corporate social responsibility (CSR), having issued its first CSR report in 2005 by publishing its first corporate citizenship report. The same year, Cisco first reported to CDP, a global nonprofit that is considered to be the gold standard of environmental reporting. While many organizations were just beginning to adopt ESG initiatives, Cisco focused on defining its environmental and sustainability objectives.

After the UCS X-Series is deployed in your production networks, your organization can monitor and manage energy consumption and hardware usage by using Cisco Intersight.

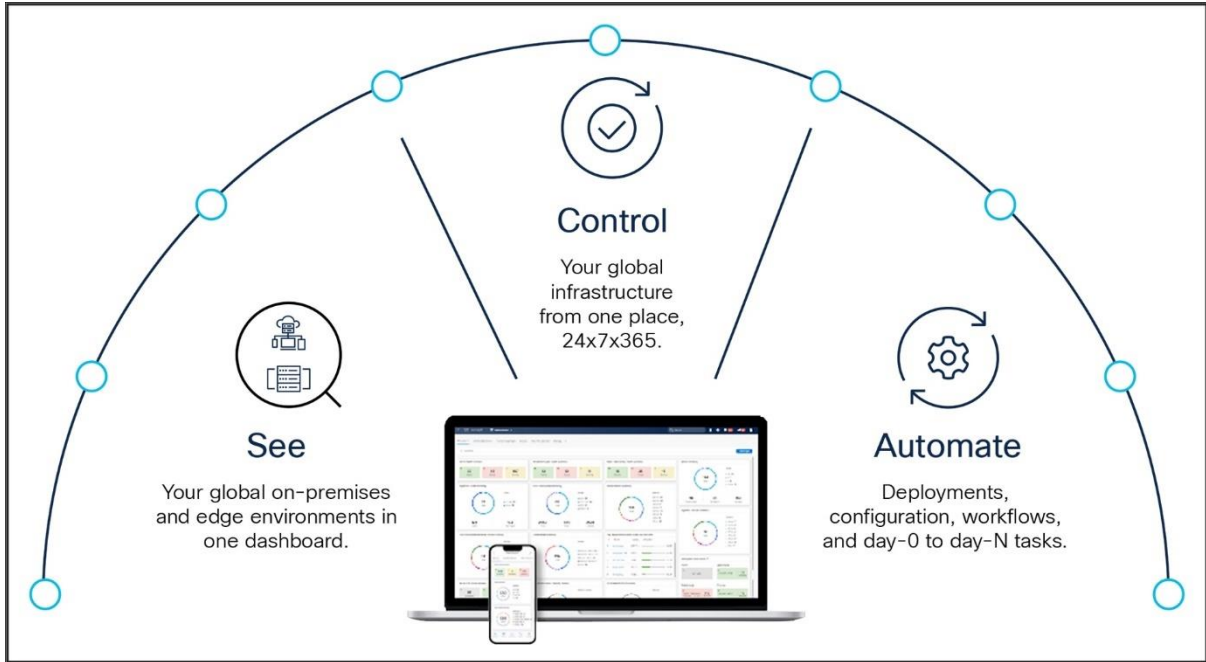
Cisco Intersight

Cisco Intersight is a comprehensive ITOps platform for infrastructure lifecycle management, available as a service or as a connected or private virtual appliance. Intersight enables your IT teams to see, to control, and to automate Cisco UCS, converged, and hyperconverged infrastructure across its lifecycle—wherever the infrastructure is—from one place (Figure 13).

NetApp and Cisco have partnered to offer Intersight as a unified management solution for the FlexPod ecosystem. This integration provides a single control point, simplifying the management of FlexPod infrastructure components, including NetApp storage, SAN switching, Cisco fabric interconnects, and VMs.

Intersight simplifies operations for IT teams who manage traditional and new AI workloads, address increasing demand for compute resources, and face ongoing security challenges. Unlike traditional tools that require repetitive manual processes, Intersight consolidates and automates infrastructure management from the data center to the edge, enhancing efficiency and reliability.

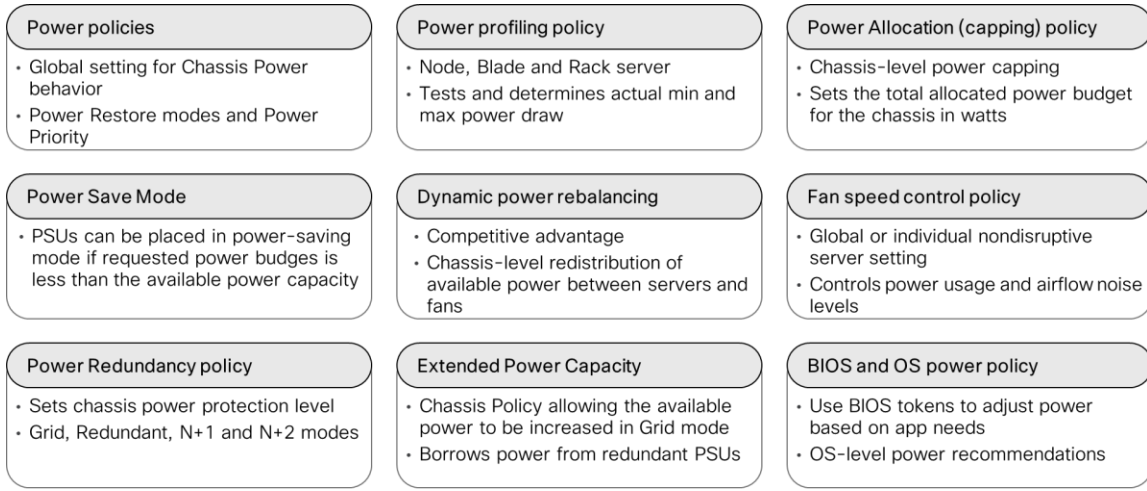
Figure 13) See, control, and automate operations of your global infrastructure with Intersight.



Intersight also helps you address another major use case in achieving more sustainable ITOps. With its role as the centralized operations platform, Intersight helps your organization manage, track, and analyze overall energy consumption across your UCS servers through:

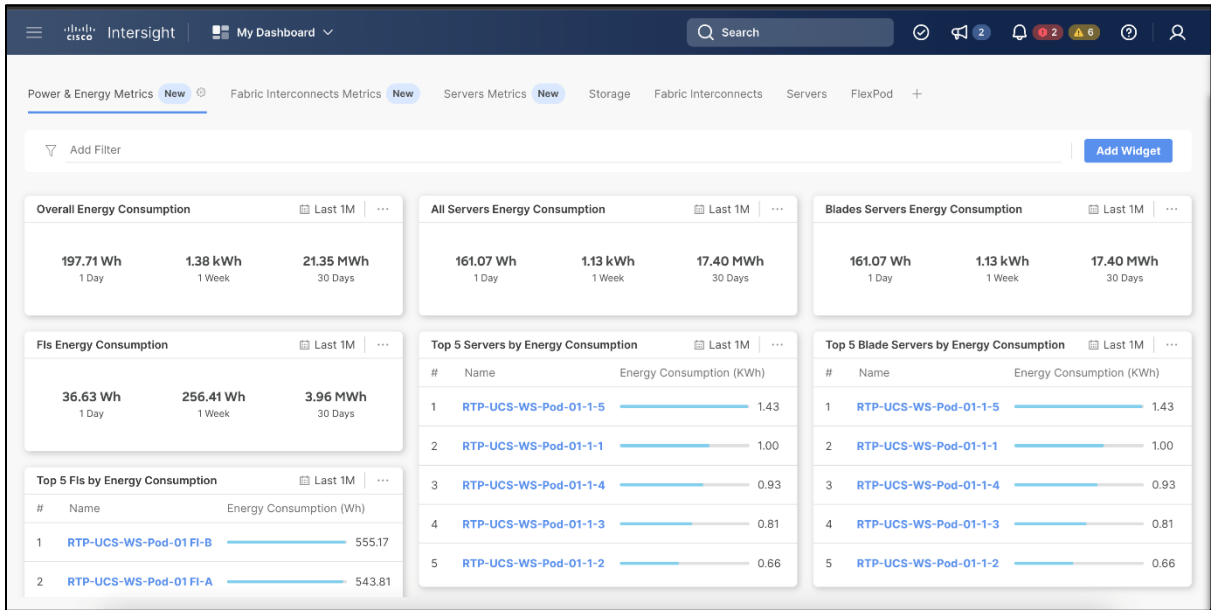
- **Real-time power monitoring and management.** By providing visibility into energy consumption, Intersight helps you identify inefficiencies and implement energy-saving measures such as server consolidation.
- **Policy-based power optimization.** As an Intersight customer, you can set power policies to dynamically adjust server performance based on your workload demands (Figure 14). This capability can minimize energy waste during low-utilization periods.

Figure 14) Intersight provides policy-based power management of UCS servers to support more sustainable operations.



- Sustainability reporting.** As an Intersight customer, you can generate comprehensive reports on UCS server energy usage (Figure 15). This information is key to supporting compliance with sustainability regulations and ESG initiatives.

Figure 15) Intersight dashboard showing power and energy metrics.



Cisco Networking

In an increasingly interconnected world, secure and efficient networking equipment has become critical for nearly every aspect of business and daily life. It is particularly true for storage networking, because reliable data access is essential for applications across industries, including AI. As reliance on networking infrastructure grows, so does the need for more sustainable business practices and technologies.

Designing networking systems that are secure, high-performing, and reliable while minimizing their environmental impact is a key step toward a more sustainable future. Cisco Nexus and Cisco MDS switches provide the bandwidth, latency, modularity, and energy management capabilities that can help your organization build, deploy, and operate a more sustainable networking infrastructure in your data center. Cisco's sustainability efforts reap numerous benefits (Figure 16) and include the following actions:

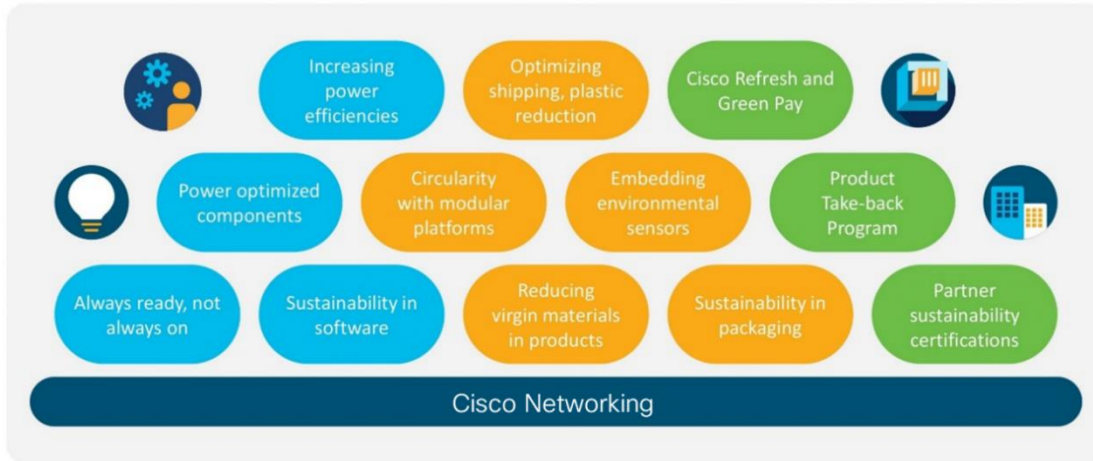
- **Sustainability in hardware and software design.** Energy consumption and power efficiency are critical considerations in more sustainable networking infrastructure. Cisco Nexus and Cisco MDS switches are optimized to reduce your energy consumption and operating costs while maintaining high performance and reliability. These switches extend their lifecycle through modular, highly reliable designs and compatibility with the latest firmware, enabling updated feature sets and robust security postures. This extended usability reduces embodied carbon and overall GHG emissions.

Cisco follows rigorous hardware design principles, activating software features that reduce power footprints. For example, the Cisco MDS 9000 Series Switches incorporate advanced ASICs that double power efficiency with each new generation. The 64G chipsets in these switches include features to lower your energy consumption by reducing port speeds when appropriate. Additionally, power supplies in these switches hold third-party Titanium certification, achieving up to 96% efficiency.

Smart software capabilities, such as remote power-off functionality for unused components, enable your administrators to minimize energy consumption while keeping spare components readily available. These innovations collectively optimize your organization's energy use, reduce waste, and lower your operating costs.

- **Sustainability monitoring and management.** Cisco's Nexus Dashboard provides a comprehensive solution for real-time monitoring and management of energy consumption within your networking infrastructure. With this tool, your administrators can track and analyze both live and historical power usage trends for Cisco Nexus and MDS switches. By offering actionable insights, the Nexus Dashboard empowers your organization to identify opportunities to enhance energy efficiency, to optimize resource utilization, and to reduce operational costs across your network.
- **Circular model for products and packaging.** Cisco's commitment to sustainability extends beyond energy efficiency, with initiatives aimed at reducing waste. The [Cisco Takeback and Reuse Program](#) allows you to return used networking equipment at no cost. Returned products are refurbished, reused, resold, or harvested for components, so nearly 100% of materials are reused or recycled. You may also request a Certificate of Recycling (COR) to support circular economy practices. Additionally, Cisco focuses on [packaging sustainability](#), reducing the use of plastic bags for accessories, replacing virgin raw materials with recycled materials, and improving packaging cube efficiency. These efforts position Cisco Nexus and MDS switches as leaders in more sustainable product design and development, advancing both environmental responsibility and operational excellence.

Figure 16) Cisco Networking sustainability benefits.



Cisco corporate focus on sustainability

As a global technology leader, Cisco is committed to operating in a way that respects human rights, promotes inclusion, empowers vulnerable communities, and protects the planet. Cisco’s comprehensive approach to environmental sustainability encompasses how the company operates its business, engages with suppliers, and supports customers and communities in reducing their environmental impacts while adapting to a changing world.

The Plan for Possible is Cisco’s next-generation environmental sustainability strategy, and it focuses on three key priorities. The first priority is to accelerate the transition to clean energy. Cisco recognizes the urgent need to move away from fossil fuels toward renewable energy sources like wind and solar. The company’s products, solutions, and partnerships are designed to play a key role in facilitating this transition. The second priority is to evolve the business model from linear to circular. The circular economy, built on reducing resource consumption, reusing, and recycling, is vital for achieving long-term sustainability. The third priority is to invest in resilient ecosystems. By strengthening communities through investments in technologies, capabilities, and talent, Cisco supports climate resilience and long-term environmental health.

These priorities are supported by strong governance practices, which help Cisco uphold brand integrity and continue earning the trust of customers, partners, employees, and other stakeholders.

Cisco’s goal is to reach net-zero GHG emissions across its value chain by 2040 by prioritizing reductions across all scopes of emissions. Cisco’s 2040 net-zero goal was approved by the Science Based Targets initiative (SBTi) in 2022 under its Corporate Net-Zero Standard. Cisco was one of the first technology hardware and equipment companies to have its net-zero goal validated under the SBTi Corporate Net-Zero Standard.

Circular lifecycle programs

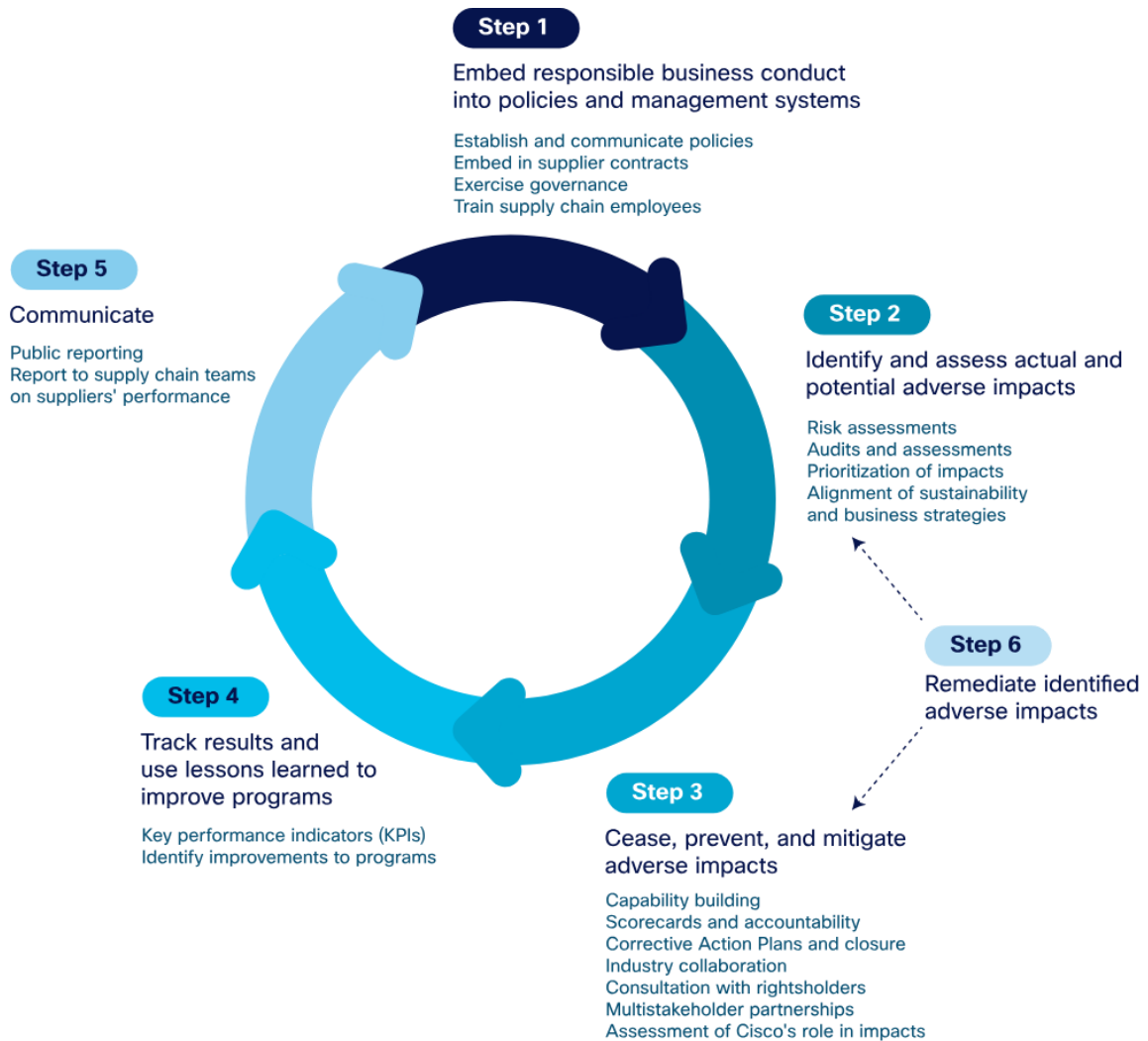
Cisco Refresh provides certified remanufactured equipment for most of the company’s portfolio, extending the lifecycle of products and reducing waste. Through the Cisco Takeback and Reuse Program, the company facilitates the return of end-of-use equipment at no cost, ensuring that it is directed toward its next best use, with nearly 100% of returned products being reused or recycled. Cisco Green Pay, available in select countries, offers a flexible payment solution that eliminates up-front hardware acquisition costs, provides a predictable payment schedule over 5 years, and includes an up-front incentive of 5%. At the end of the term, Cisco recovers the equipment free of charge for reuse or recycling. Additionally, Cisco’s as-a-service and subscription models enable you to adopt recurring

revenue frameworks, supporting circular consumption and the responsible take-back, reuse, and recycling of hardware, further promoting more sustainable practices.

Supply chain sustainability

To help ensure continuous improvement and to drive impactful change, Cisco's sustainability requirements are embedded in the company's supply chain business processes. Cisco uses the Organisation for Economic Co-operation and Development [Due Diligence Guidance for Responsible Business Conduct](#) (OECD Guidance) and the [United Nations Guiding Principles on Business and Human Rights](#) as the basis for supply chain due diligence and sustainability. (See Figure 17.) The company is committed to fostering a more just and sustainable future for workers, communities, and ecosystems within its supply chain. To achieve this goal, Cisco actively identifies, assesses, and mitigates risks to human rights and the environment while engaging collaboratively with suppliers to promote positive outcomes.

Figure 17) Cisco supply chain sustainability due diligence process.



*Based on the OECD Guidance for Responsible Business Conduct

FlexPod Validated Designs and automation

FlexPod proves that the sum can be greater than its parts. With FlexPod, customers like you can achieve more sustainable ITOps because FlexPod offers hundreds of validated designs, deployment guides, technical reports, and white papers for specific use cases and workloads that are important for data centers. These FlexPod reference architectures help you eliminate uncertainty from your data center deployment and management. They enable faster time to production and reduce downtime. FlexPod reference architectures are also accompanied by automation scripts and playbooks to help you quickly replicate the best practices configurations and repeated management tasks, such as periodic backup, in your production environment. FlexPod reference architectures enable you to lower costs, to reduce energy consumption, and to save hundreds of work hours for your IT specialists.

Where to find additional information

To learn more about the information that is described in this document, review the following websites:

- FlexPod home page
<https://www.netapp.com/data-storage/flexpod/>
- NetApp home page about ESG and sustainability
<https://www.netapp.com/esg/sustainability/>
- Cisco home page about environmental sustainability
<https://www.cisco.com/site/us/en/about/purpose/environmental-sustainability/index.html>

Version history

Version	Date	Document version history
Version 1.0	March 2025	Initial release.

Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

Copyright information

Copyright © 2025 NetApp, Inc. All rights reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

LIMITED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data—Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, non-sublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

Trademark information

NETAPP, the NETAPP logo, and the marks listed at <https://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.