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The bridge to possible

Accelerating the Realization of Your Company Sustainability Goals

Using Cisco UCS, X-Series, and Intersight

Chris Dunk, Principal Engineer

BRKCOM-1991

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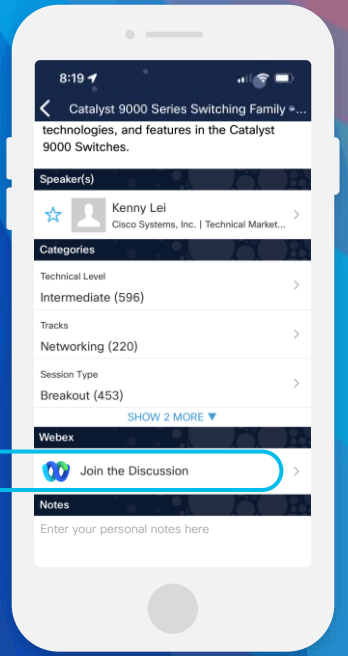

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Agenda

- Why sustainability, now
- How Cisco X-Series meets this challenge
- Intersight power controls
- Power efficiency affects on application performance
- How Modular systems help with sustainability
- Conclusion

Why now? What's changed?

- Urgent global problem
  How can IT help?
- Customer, investor & employee pressure
- Legislation, reporting standards, scrutiny
- Business efficiencies & new opportunities

"Transitioning to a net-zero world is one of the greatest challenges humankind has faced"

United Nations

96%

of G250 companies report on ESG or sustainability[1]

~140 countries with a Net Zero target[2]

Important purchasing factor for consumers[3]

67%

Hiring criteria for 69% of workers[4]

[1] KPMG (2022) [2] Climate Action Tracker (2023) [3] Mckinsey (2020) [4] Gallup (2021)

Sustainability is top-of-mind for customers

Rising energy costs in key regions

- Some EMEA countries have had costs/kwh grow over 10x in the last 12 months
- Energy monitoring and control tools a top customer ask
- Data centers globally consume more energy than some countries(1)

Computing's impact in data center energy usage

- Servers typically constitute around 43% of the power consumed in a modern DC
- 92% of businesses make use of virtualization to optimize server resources
- Power consumption increases to 61.5% when server cooling is added

Compliance to regulations and mandates for data

- US federal data centers mandates for energy efficiency – Data Center Optimization Initiative and Energy Act of 2020(2)
- New reporting mandate rule proposal by SEC
- EU Corporate Sustainability Reporting Directive (CSRD)(3)
- Brazil 2021 federal data center efficiency mandate(4)

(1) https://blog.xmartlabs.com/images/only-one-earth/Untitled.png
(2) https://datacenters.lbl.gov/federal-data-centers
(3)https://www.ey.com/en_ro/news/2022/11/how-the-eus-new-sustainability-directive-is-becoming-a-game-chan
(4)https://www.datacenterdynamics.com/en/news/brazilian-government-mandates-federal-data-centers-should-use-less-energy/

Cisco's Goal
Net zero GHG emissions across our value chain by 2040

Our 2040 net-zero goals and near-term targets are approved by the Science Based Targets initiative (SBTi).

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

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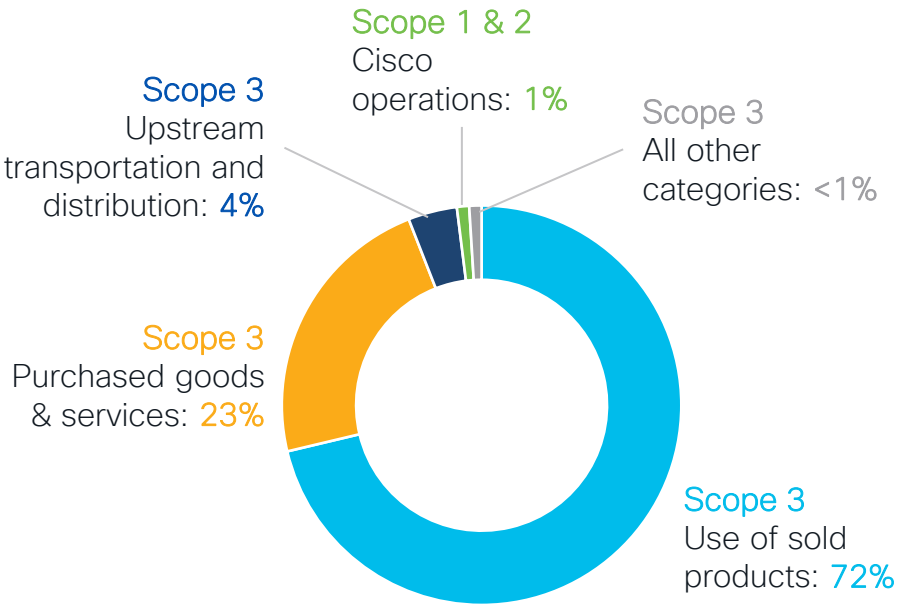


Source: Cisco's Fiscal Year 2022 ("FY 22") Scope 1, 2, and 3 GHG emissions

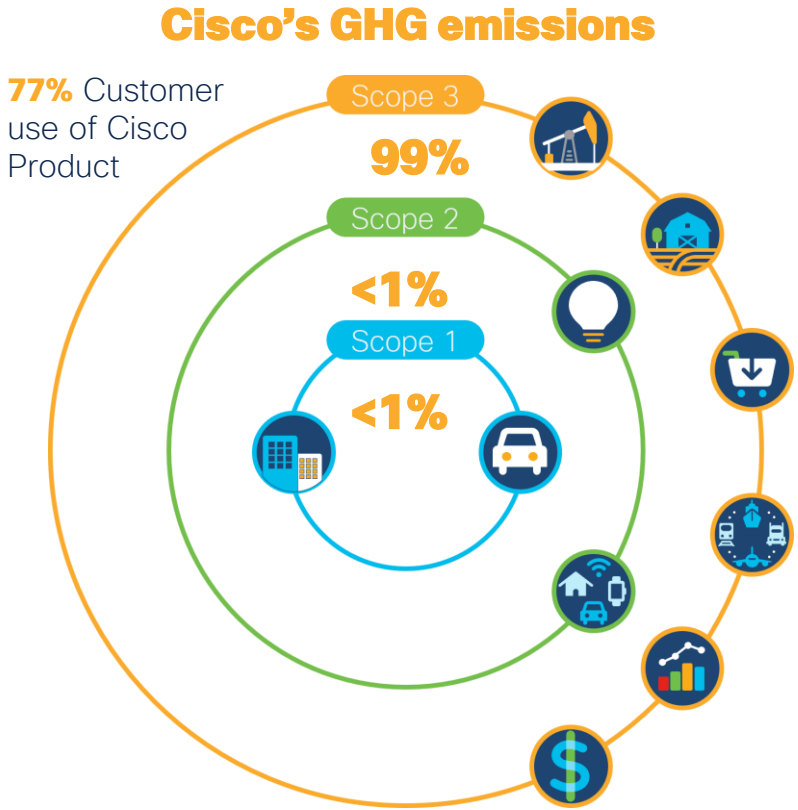
Sustainability Metrics

TYPES OF GREENHOUSE GAS (GHG) EMISSIONS

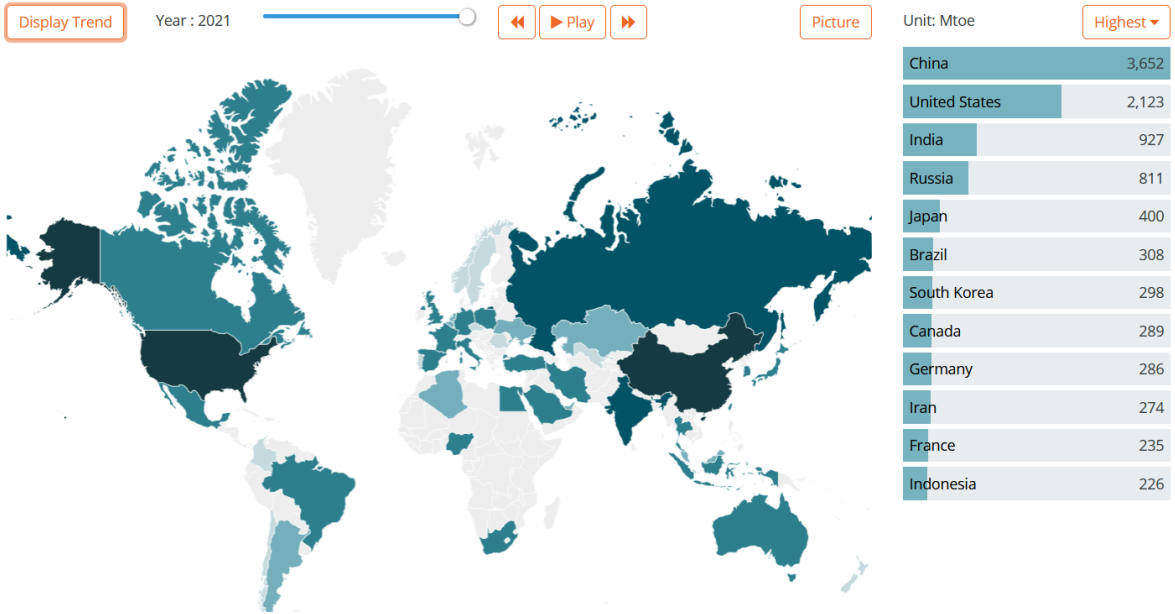
Scope 1: Emissions from fuels we buy and burn within our operations. For example, natural gas used to heat our buildings, back-up generators that run on diesel, gasoline used in Cisco-owned vehicles.

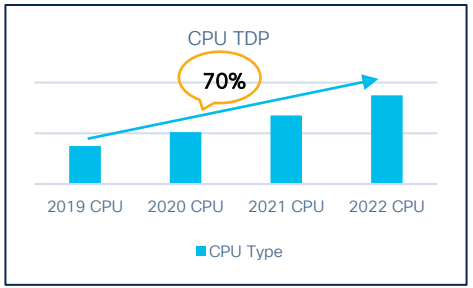
Scope 2: Emissions from electricity we buy for our operations. For example, the power we use in our labs and data centers to power our equipment and keep the lights on.

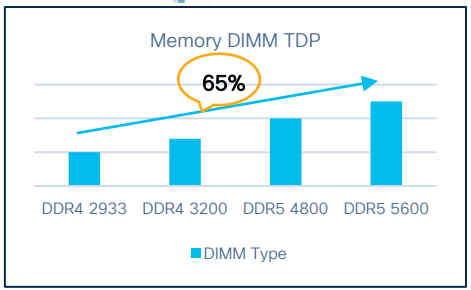
Scope 3: Emissions related to our business, but that we don't own or control. For example, the electricity our products consume after we sell them, our suppliers' energy use, transporting our products, and employee commuting in their personal vehicles.

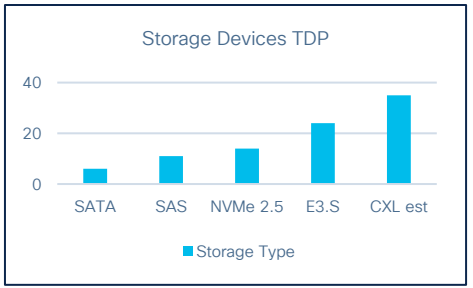


Market trends









https://yearbook.enerdata.net/total-energy/world-consumption-statistics.html

How Cisco X-Series is meeting this challenge

Cisco Sustainable Product Design Guidelines

Double down on power efficiency

Eco certifications

Data-driven sustainability approach and tooling

Modularity, reliability, repairability and extended lifetime

Committed to 100% product return, no e-waste

Partner enablement, certifications and sales programs around sustainability

Incorporate circularity principles in product design (100% by 2025)

Software-driven IT assets optimizations

Rethinking recycling: plastic reduction in products and packaging, recycled plastic

X-Series Sustainability by Design

	Architectural Power & Lifecycle Optimization	Cooling & Fan Optimization
Minimize energy needs	• Unified IO and 100G for all servers reduces adapter, cabling, network and storage port needs • Efficient 54V power distribution to minimize transmission and conversion loss within all system elements • Input power monitoring at system level allows a quicker reaction based on real usage to realize 3-4% overall savings • Titanium rated PSU	• Zone-based cooling to intelligently operate fans where they are needed and not running them at common largest need • Large real estate footprint on server blade modules allows for simpler airflow efficient fan power usage
Extend lifetime Reduce raw materials	• Modularity extending the life of many existing components (PSU, Fan, Case, Risers, and more in future) • Component reduction (switches, cables, mgmt. modules) • X fabric allows for lifecycle upgrades of server modules • Upgrade and expand in the field	• Midplane free design allows for future technologies such as liquid cooling to change the math on PUE in your DC without forklift upgrade of entire racks

X-Series: Sustainability Advantages

Cisco UCS X-Series

- ✓ **Optimized Form Factors** Larger nodes with longer life for emerging technologies
- ✓ **More Power Headroom (over 2x)** Better efficiency at lower loss
- ✓ **Better Airflow** Fewer barriers/lower impedance
- ✓ **Revolutionary high-speed PCIe/CXL topology** for heterogeneous compute and memory composability
- ✓ **Intelligent, intuitive and modular IO** collapsing fabrics reducing adapter, switching, and cabling
- ✓ **Liquid-cooling ready**

Lifecycle Design and Manufacturing

Sustainable Programs:
Using sustainable packaging, eliminated wet paint, 62% reduction powder coating, and product takeback and reuse

Recycled Materials:
Plastic parts that use post-consumer recycled resin

Accessory Waste Reduction:
Opt out of unneeded product accessories and power cords, minimizing waste. Reducing paper manuals to QR codes

Sustainability Visibility, Insights, and Actions with Intersight

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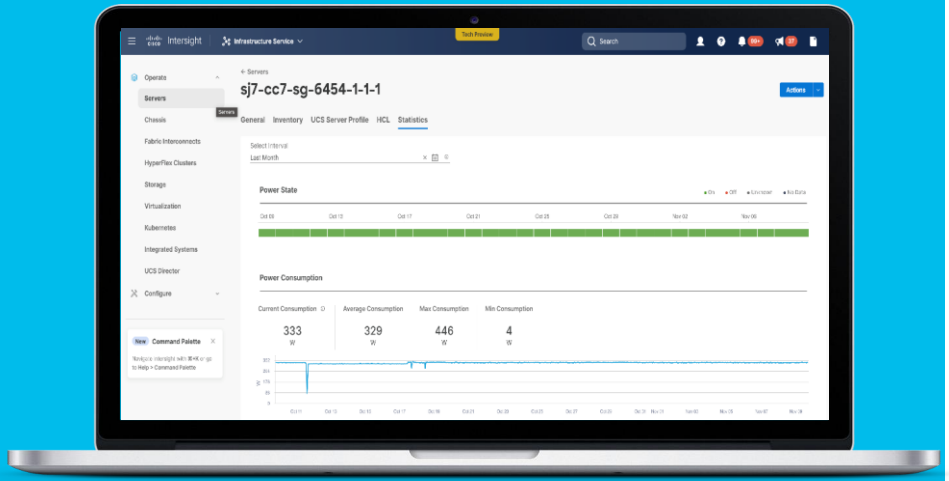
Intersight Infrastructure Service simplifies sustainable operations



Intersight telemetry showing current and historical compute node power usage

Current support for X210c nodes

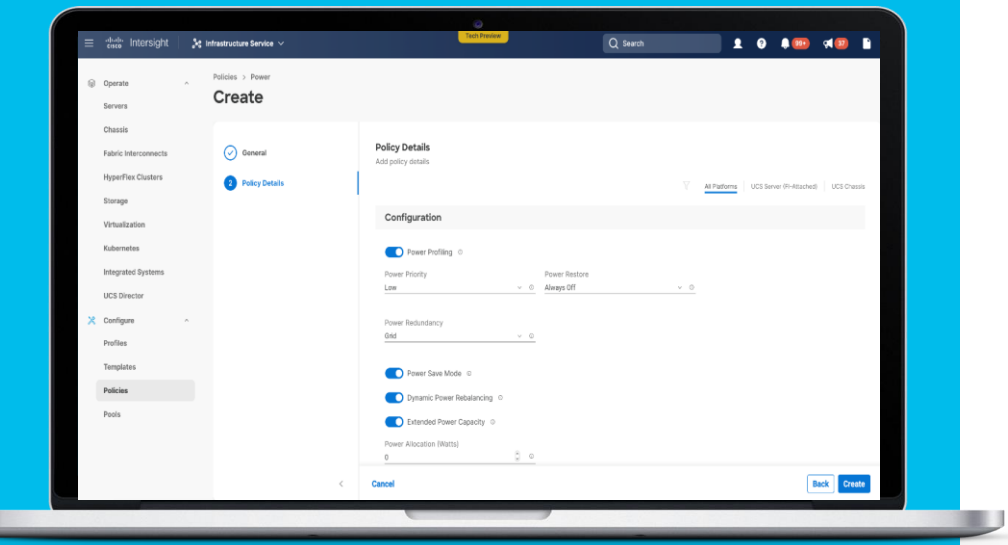
Historical view up to 6 months

Define and execute on business objectives with power visibility and advanced management controls

- Dynamic power rebalancing
- Power Allocation (capping) policy
- BIOS and OS power policy

..and more!

Intersight Power Policies



Intersight power policies provide advanced controls at your fingertips

Manage power behavior across chassis and nodes

Server node BIOS tokens and OS power controls delivered in code

Intersight Infrastructure Service simplifies energy efficient operations

Power policies

- Global setting for Chassis Power behavior
- Power Restore modes and Power Priority

Power profiling policy

- Node, Blade and Rack server
- Tests and determines actual min and max power draw

Power Allocation (capping) policy

- Chassis level power capping
- Sets the total allocated power budget for the chassis in watts

Dynamic power rebalancing

- Competitive advantage
- Chassis level redistribution of available power between servers and fans

Power Save Mode

- PSUs can be placed in power saving mode if requested power budges is less than the available power capacity

Fan speed control policy

- Global or individual non disruptive server setting
- Controls power usage and airflow noise levels

Power Redundancy policy

- Sets chassis power protection level
- Grid, Redundant, N+1 and N+2 modes

Extended Power Capacity

- Chassis Policy allowing the available power to be increased in Grid mode
- Borrows power from redundant PSUs

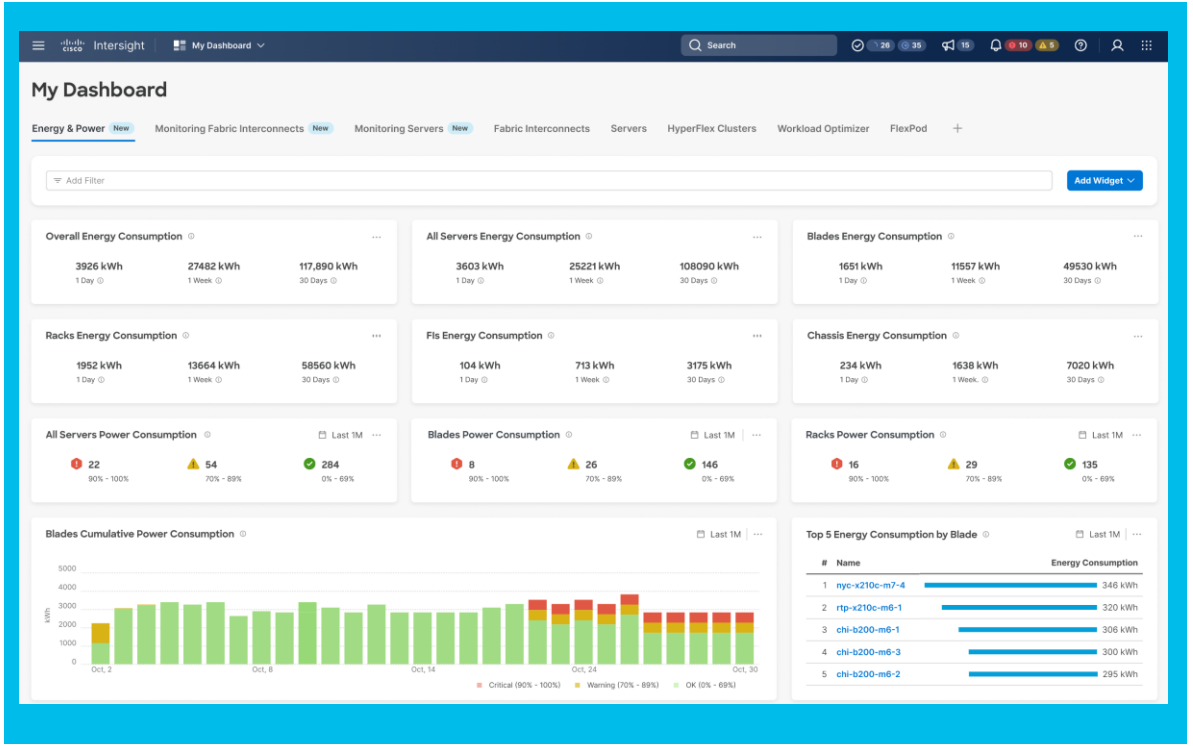
BIOS and OS power policy

- Use BIOS tokens to adjust power based on app needs
- OS level power recommendations

Intersight Energy and Power Metrics

Coming soon to Intersight

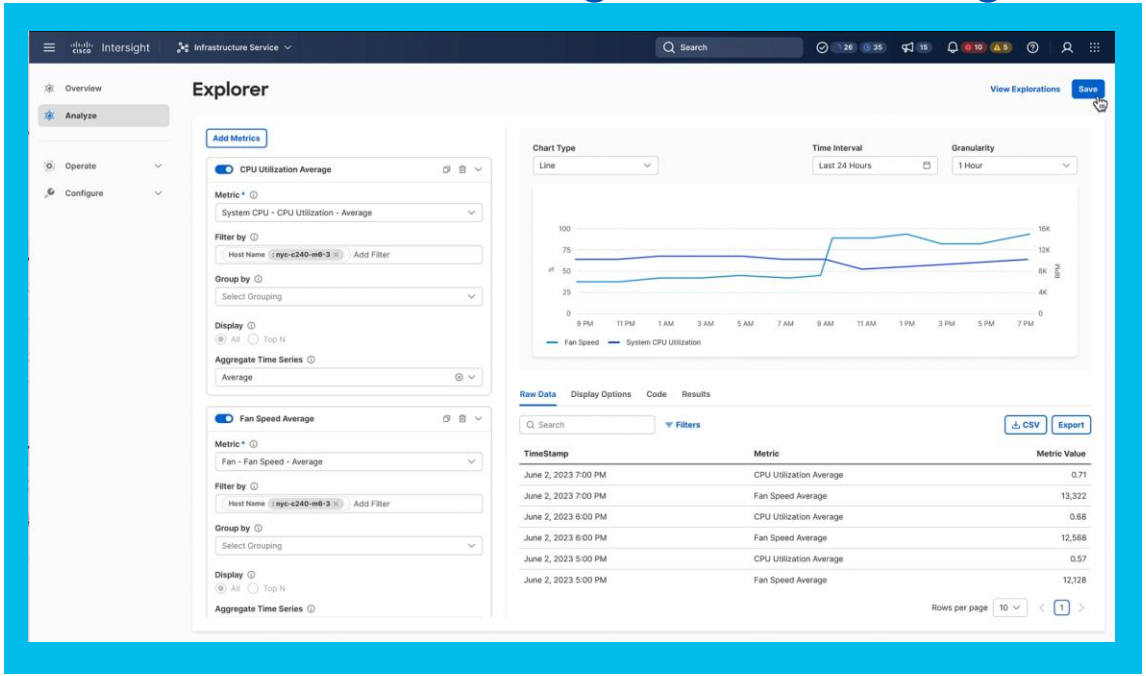
- Entire Infrastructure view of power usage and history
- Default view of widgets and collected data



Intersight Metrics Explorer

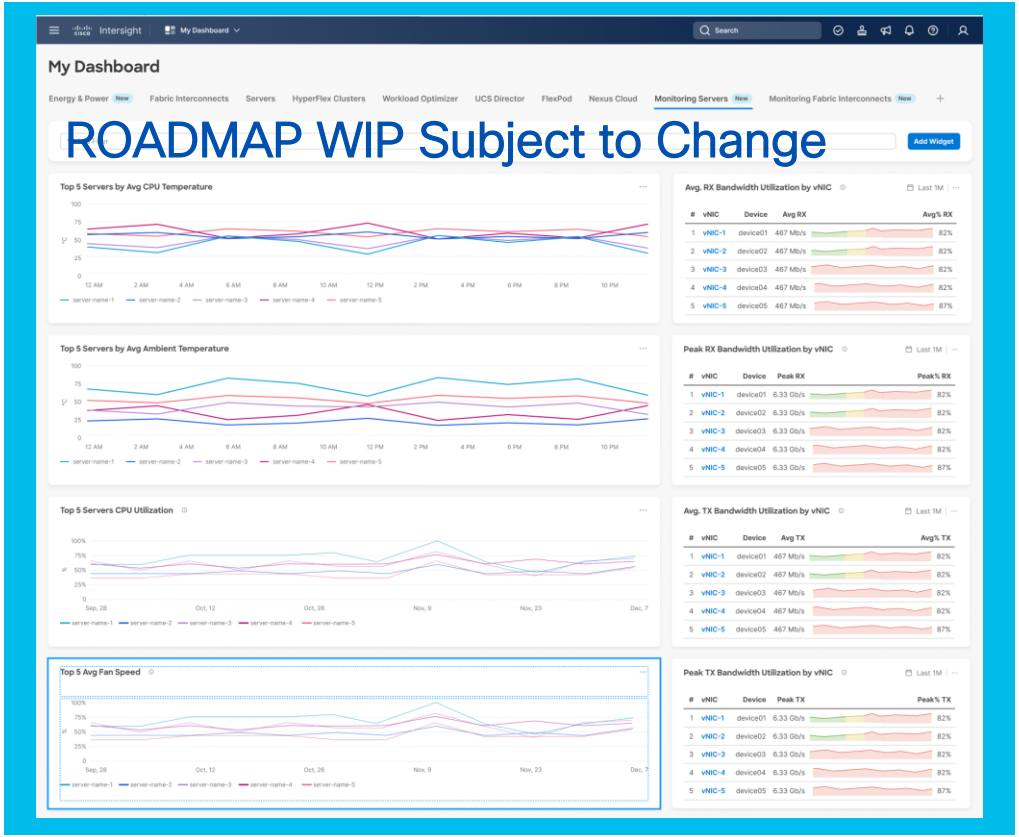
- Explore all metrics captured within Intersight
- Create custom views/widgets and display on dashboard
- Customize data views that are most important to you

Coming soon to Intersight



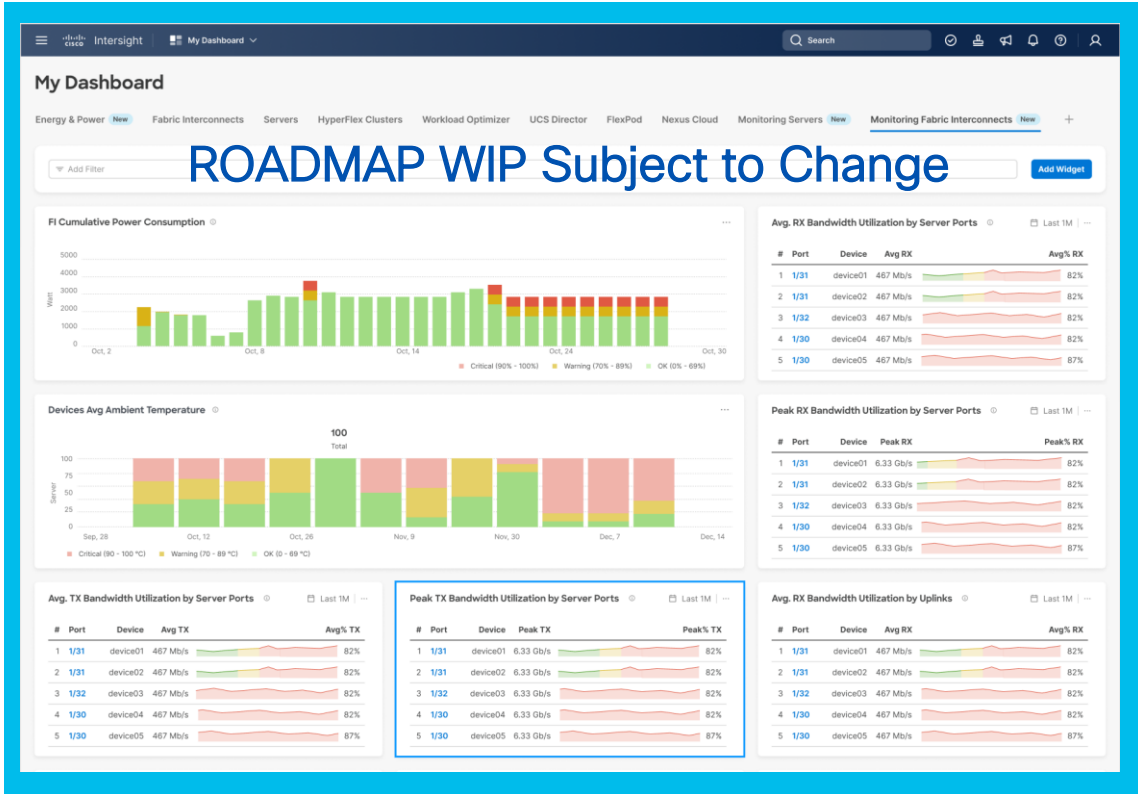
Intersight Metrics and Monitoring for Servers

- New Monitoring view for groups of servers
- Displays highest node metrics including
  - CPU Temp
  - Ambient Temp
  - Fan Speed

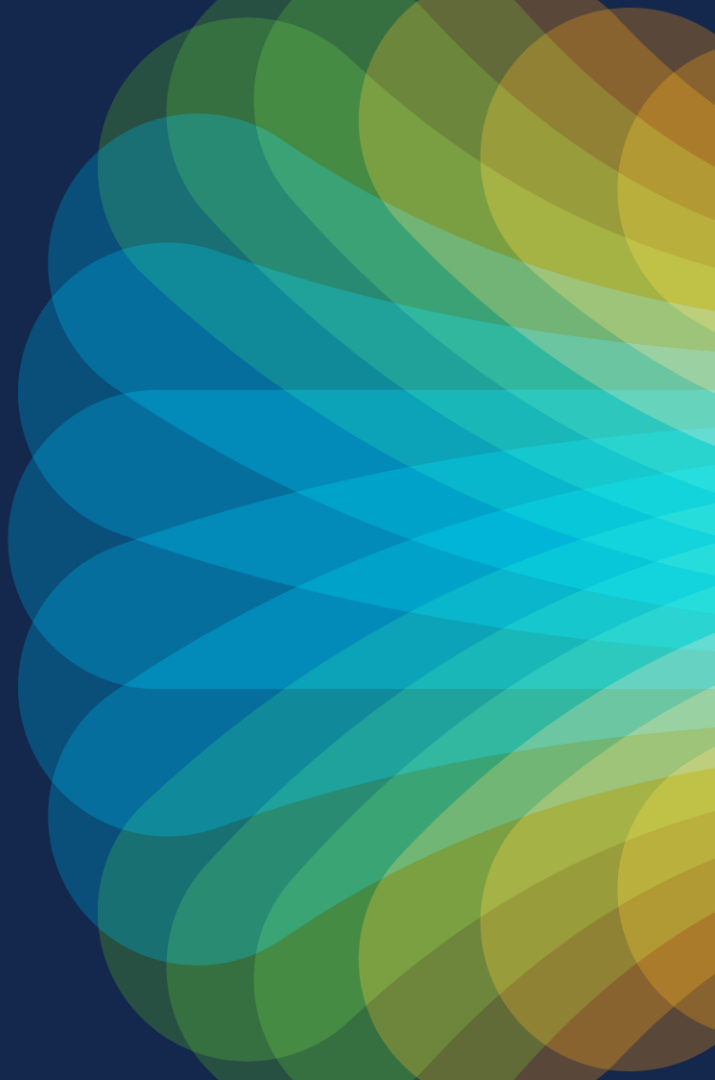


Intersight Metrics and Monitoring Fabric Interconnects

- Group metrics for Fabric Interconnects
- Displays highest node metrics including
  - Cumulative Power Use
  - Ambient Temp
  - Networking Utilization



CPU Power Controls and Impact



Datacenter Power and Hardware Choices

Compute Node

- CPU – core and frequency, number of sockets, TDP
- Memory – 1DPC vs 2 DPC, Cost, Scale
- Storage – connection, capacity, form factor, endurance, price
- Networking – bandwidth, performance, port type and count
- GPU/Accelerators – use cases, number to support

Facility/Rack Level

- How much power to the rack
- Delivered air flow CFM
- Available Space

Intel Optimized Power Mode (OPM)

Goal is to save CPU power with minimal performance impact on select workloads

- Intel shows that best results occur at lower CPU utilization
  - 30-40% utilization has highest power savings
- Configurable in server BIOS or with Cisco Policy

VDI Use Case – Efficiency settings impact on performance and power

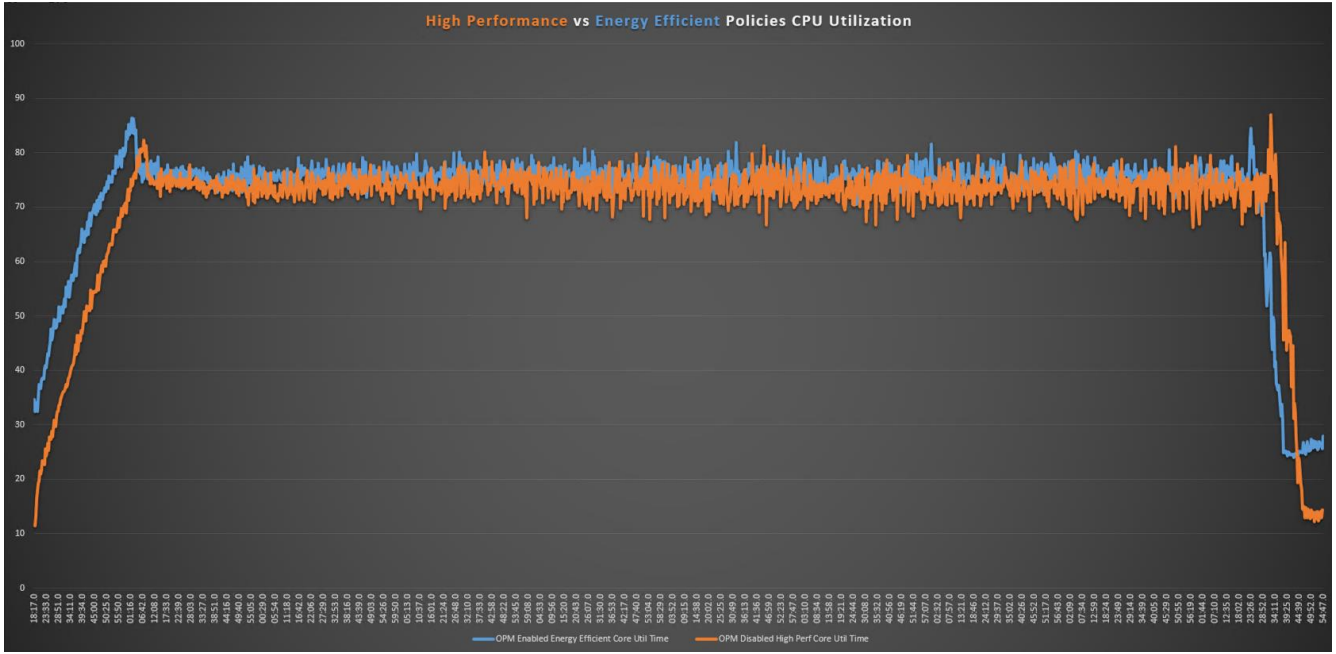
- Cisco X210 M7 Compute Node
- 320 Windows 11 desktops running Office 2021 and LoginVSI 4.1.40
- Each test run to simulate an 8-hour workday
  - System is idle early in the day
  - Users logging in to system over a 48 min window
  - Run for a full workday
  - All users logout and system remains in ready state

VDI Workload Power Configurations

- 3 groups of tests with different Chassis level fan thermal policies: Balanced, Acoustic and Low Power
- Two sets of local node settings configured
  - Energy Efficient VDI: Intel OPM *enabled*, BIOS C1E and C6 *enabled*, ESXi power settings at *low power*
  - High Performance VDI: Intel OPM *disabled*, BIOS C1E and C6 *disabled*, ESXi power settings at *high performance*

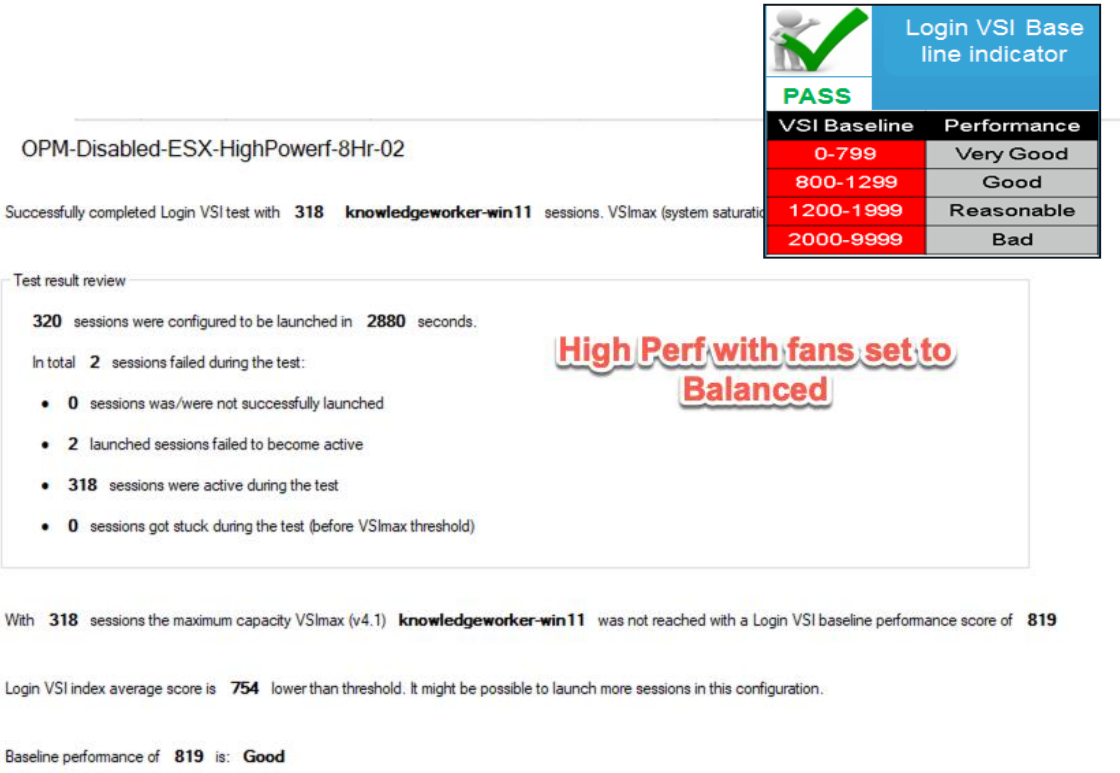
VDI CPU Use at Load

CPU Utilization between 70 and 80%



VDI Workload Performance Without Energy Conservation

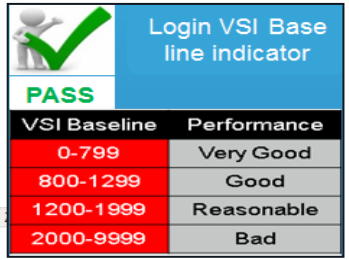
- Balanced fan policy, Intel OPM, BIOS and ESXi OS power settings *Disabled*
- CVD publishable VSI Score of <u>819</u>

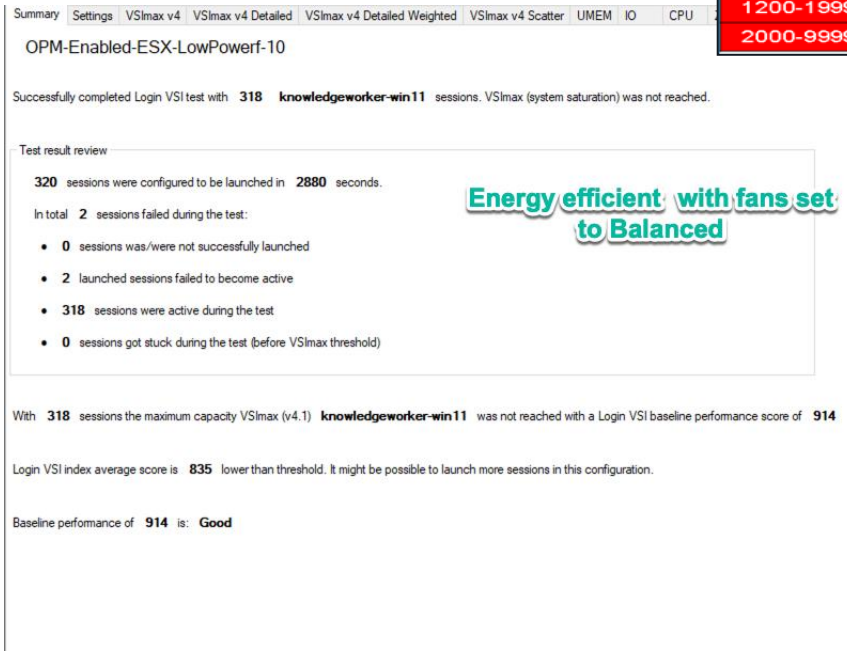


VDI Workload Performance With Energy Conservation

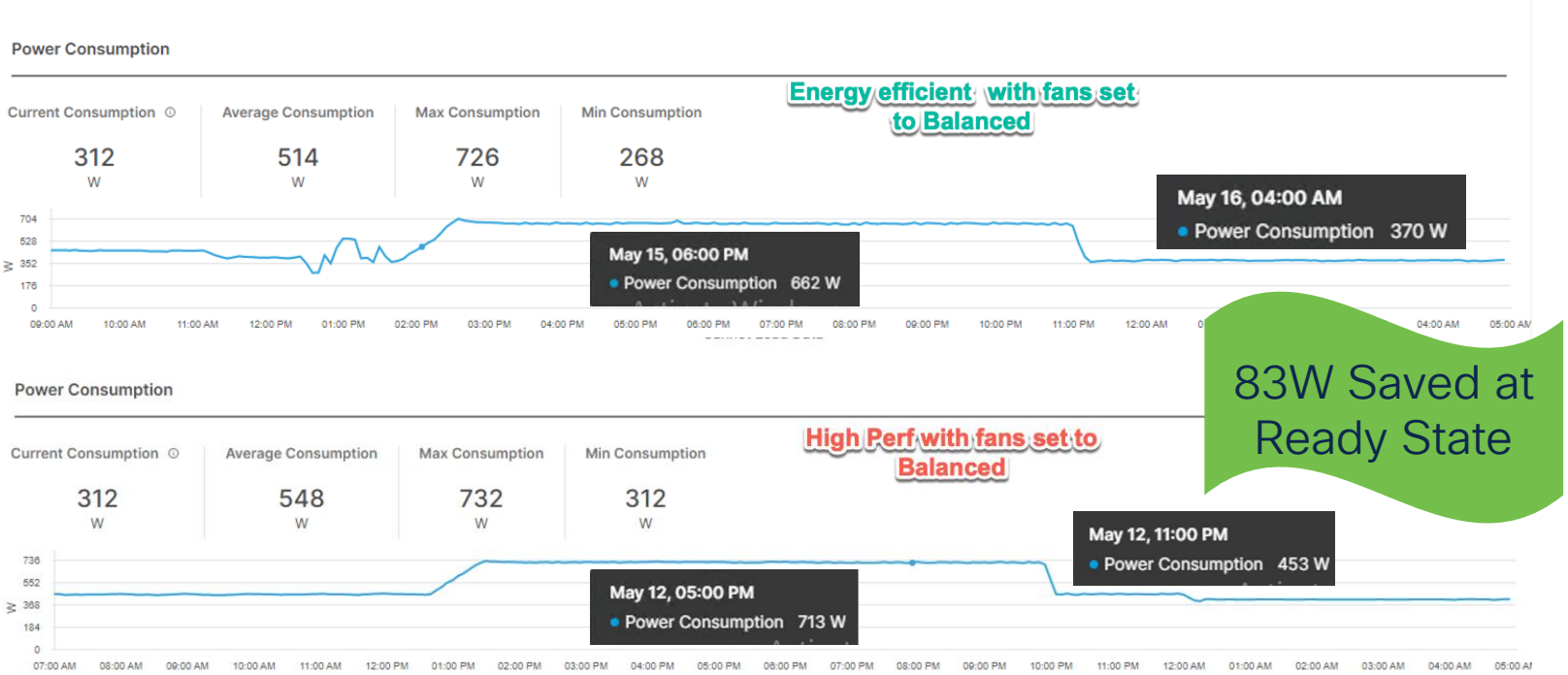
- Balanced fan policy, Intel OPM, BIOS and ESXi OS power settings *Enabled*
- Respectable VSI Score of 914
- Performance difference **11.6%**
- UX will not suffer with this difference

Estimated per node power reduction
51W at load
16 servers saves 55,644 KwH/Year





VDI Test Power Results



SpecInt- Efficiency settings impact on performance and power

- Cisco C220 M7 rack server
- SpecInt performance benchmark
- Run for 1 hr
- Host Power averaged
- Each thread runs a core at max performance
- Host BIOS: C1E disabled, C1 Auto and C6 enabled
- OPM toggled on and off
- Host fan policy Acoustic

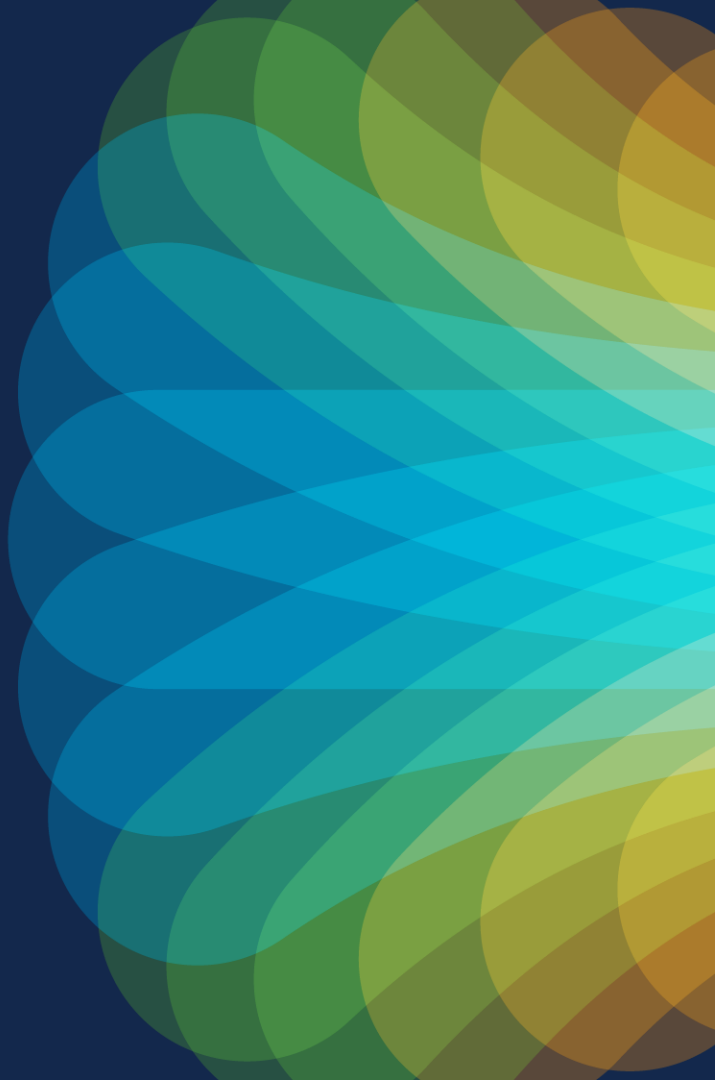
OPM and SpecINT Results

- Increased work (threads), lower the power savings % but smaller performance difference
- Highest power savings at lower to midrange utilization

			OPM Disabled				OPM Enabled					
	BIOS settings	Fan Policy	Threads	Int Rate (OPM Disabled)	Average Power Consumed W (OPM Disabled)	CPU Usage	Threads	Int Rate (OPM Enabled)	Average Power Consumed W (OPM Enabled)	CPU Usage	Power Saving	Performance diff
8462Y+/32 Cores Idle Power: 256 Watts CPU Power (cTDP) – 300 Watts	Default	Acoustic	8	80.9	414	6.3%	8	77	347	6.4%	19.3%	-5.1%
	Default	Acoustic	16	156	519	12.4%	16	149	445	12.5%	16.6%	-4.7%
	Default	Acoustic	32	297	696	25.1%	32	286	614	25.1%	13.4%	-3.8%
	Default	Acoustic	48	415	815	37.5%	48	404	742	37.5%	9.8%	-2.7%
	Default	Acoustic	64	504	845	50.1%	64	496	789	50.1%	7.1%	-1.6%
	Default	Acoustic	90	521	852	70.3%	90	514	808	70.3%	5.4%	-1.4%
	Default	Acoustic	128	589	880	100%	128	587	863	100%	2.0%	-0.3%
	Performance BIOS	Max Power	8	80.4	801	6.3%						

Range most modernization workloads to operate

Memory and Power Usage



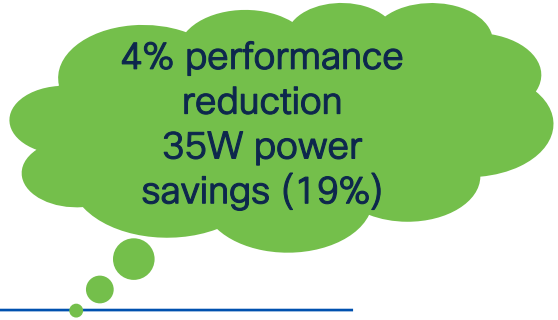
DDR5 Memory and Power Perforamance

- DDR5 requires more power than DDR4
- DIMM Channel population impact to power savings and performance
  - 1DPC consumes more power than 2DPC
    - **33% power difference**
  - 1DPC 4800MHz vs 2DPC 4400MHz
    - **SpecRate_int_base result 936 vs 908**
    - **3% performance difference on this one test benchmark**

DIMM Type/Size	1DPC @4800	2DPC @4400
DDR4 64GB*	5-7.9W	5W
DDR5 64GB*	10.4W	7W

*Source: Sample memory vendor power spec for DIMM power usage

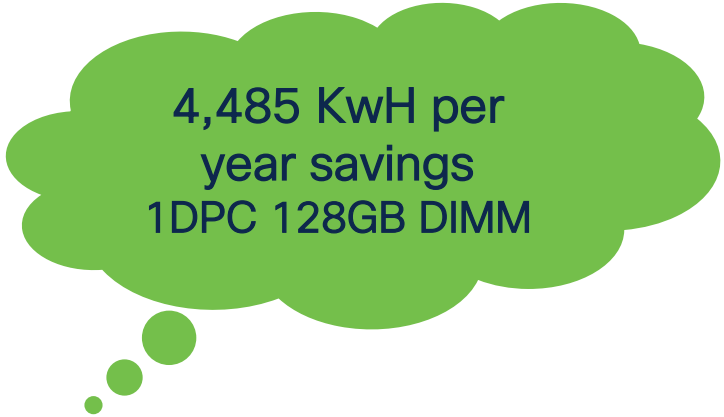
Memory Compare
DDR5 64Gb vs 128GB



	2x64GB Dual Rank DIMM	1X128GB Quad Rank DIMM
System capacity	2 TB	
DIMM configuration	32x64GB	16x128GB
DIMM per Channel	2DPC	1DPC
Max speed	4400MT/s	4800MT/s
List Price (CCW, May 2023)	$8,715 DIMM Pair	$8,666 per DIMM
SPECrate®2017_int_base	908	871
PTAT Total DIMM Power	185.4W	150.2W
PTAT per DIMM Power	5.8W	9.4W
Perf/watt	4.9	5.8

Memory Power Compare at Scale Example

- 128GB DIMM 13W 1DPC X (16) DIMMs
  - 208W Total memory power
- 64GB DIMM 7W 2DPC X (32) DIMMs
  - 224W Total memory power
- (32) compute nodes in a rack
  - Memory power total 128GB DIMMs = 6,656W
  - Memory power total 64GB DIMMs = 7,168W
- **Reduction of raw materials and GHG production by 50%**
- **Consider tradeoff Quad Rank vs Dual Rank memory and bandwidth**



Why Platform Type Matters for Sustainability

Modular System Sustainable by Design

Modular design Benefits

- Future proof design and extending life of chassis, modules and shared common parts
- Centralized power and cooling infrastructure reducing number of fans, PSUs and power cables
- Unified fabric reduces I/O cables and optics
- Component reduction (physical switches, host adapters, cables and management modules)

UCS X-Series

Benefit: Consolidation by doing more with less hardware

Material impacts in rack lifecycle vs. blade

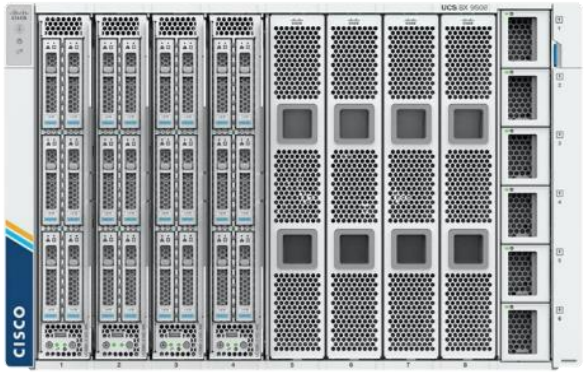
- Example of material used in production by raw weight
- 8 servers @ 3 generations
- 24 total rack servers est 1080 lbs of raw materials
- 24 Modular nodes est 578lbs of raw materials

Modular compare is roughly 50% lower consumption of raw materials and impact of production

3 Lifecycles for comparison

At 8 x 3

Each Server:
~45lb*
= 1080 lb



At 8 x 3:

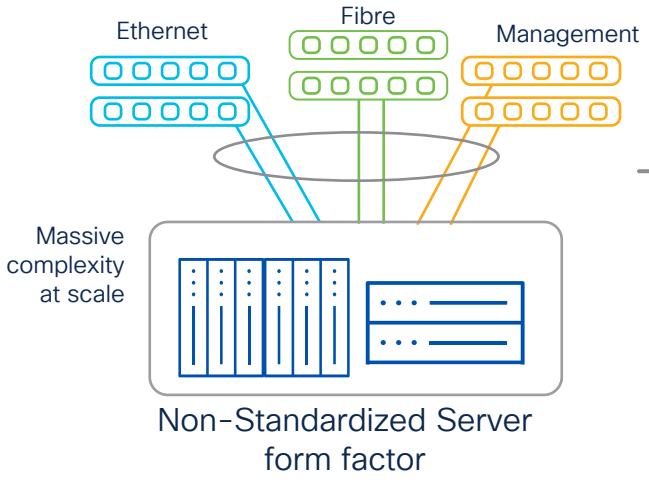
Chassis: ~146lb
Each Node: ~18lb*
= 578 lb

*Server weight used mid-range from published technical specs

Impact of Cisco Converged Fabric Design

Conventional approach

Silos of multiple ethernet and SAN fabrics and adapters



Cisco Unified fabric

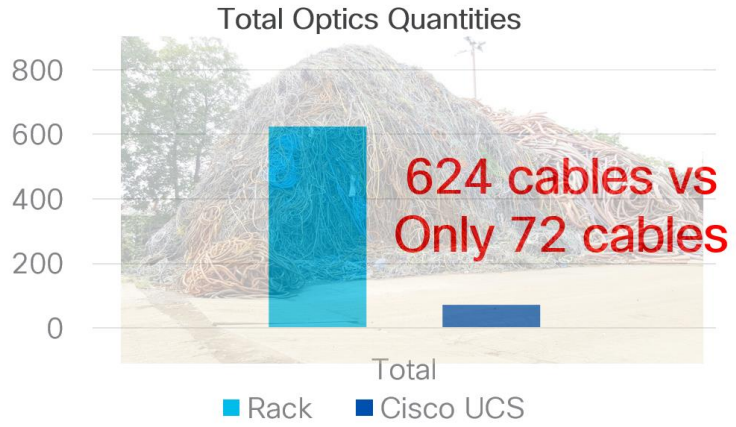
X-Series vs Legacy Rack 48 Server comparison:

Legacy Rack:

- 48 BMC Management cables
- 96 DP Ethernet cables
- 96 FC cables
- 384 Optics (4 ethernet, 4 FC)

X-Series:

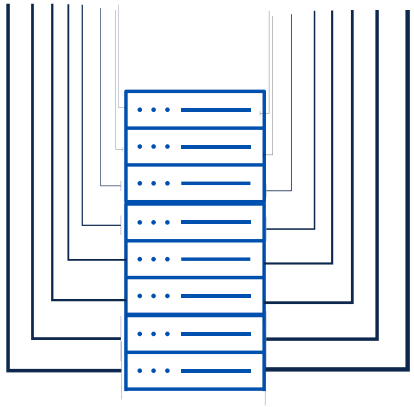
- 24 Chassis 100G cables
- 48 Chassis Optics



Impact of Cisco Power Efficiency Design

Conventional approach

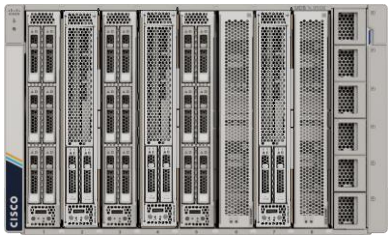
Rack servers requiring Dual PSUs per server for power and redundancy



Rack Servers requiring 2PSUs and cords per server

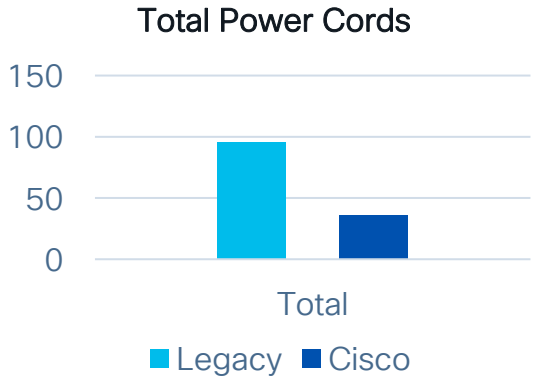
X-Series Power Efficiency

Purpose built for efficient transfer of power, redundancy, and materials reduction



- Efficient 54V Power Distribution
- Reduced Materials with fewer PSUs and cables
- 6 PSUs and cords per chassis

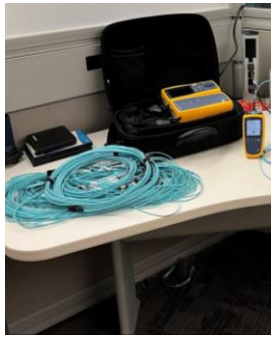
X-Series vs Competitive Rack 48 Server comparison:



96 power cables vs Only 36 cables for X-Series

Cisco IT Cable Recovery and Reuse

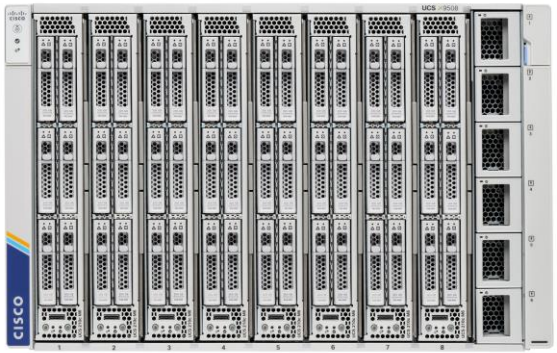
- Goal to reuse all good cables vs recycle and buy new
- Cisco IT standardized on Fiber cables for all connections
  - Reuse cables easier
  - Not dependent on speeds
  - Just replace optics to new technology (10G→40G→100G)
- Able to re-validate as good **90%** of cables
- Saved hundreds of lbs. of cabling from the landfill



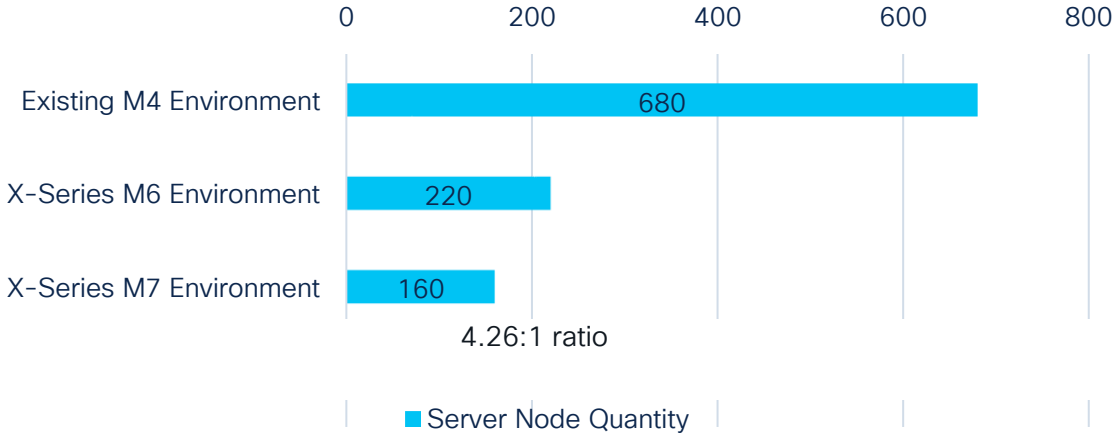
*Solutions - Cisco IT Data Center Sustainability - Cisco

Modernization Impact to Sustainability

Consolidation to M7: Affect on Sustainability



Consolidation workload power =80%
Older gen workload power =50%



713,782 KWh/yr energy reduction

292 Tons CO2e/yr

Up to 15x less hardware
v
typical rack servers

Cisco X-Series M7 Power Benefits
Compared to B200 M4 Blade Servers

68 server consolidation 4.26:1 ratio:
A reduction of total power consumption by up to **53%** using the new X-Series platform resulting in:

102,019 KwH savings

X-Series reduction overall power per year

4.3x less hardware

X-Series fewer **hardware components** required saving 1354lbs of raw material 65% weight reduction

42 Tons CO2e

X-Series reduction in yearly greenhouse gas emissions

*Source: Based on data input into the Cisco power calculator
CO2e ratio calculated using EPA eGRID emission factor

Cisco X-Series M7 Power Benefits
Compared to B200 M4 Blade Servers

104 server consolidation 6.6:1 ratio:
A reduction of total power consumption by up to **69%** using the new X-Series platform resulting in:

189,864 KwH savings

X-Series reduction overall power per year

7x less hardware

X-Series fewer **hardware components** required saving 2334lbs of raw material 76% weight reduction

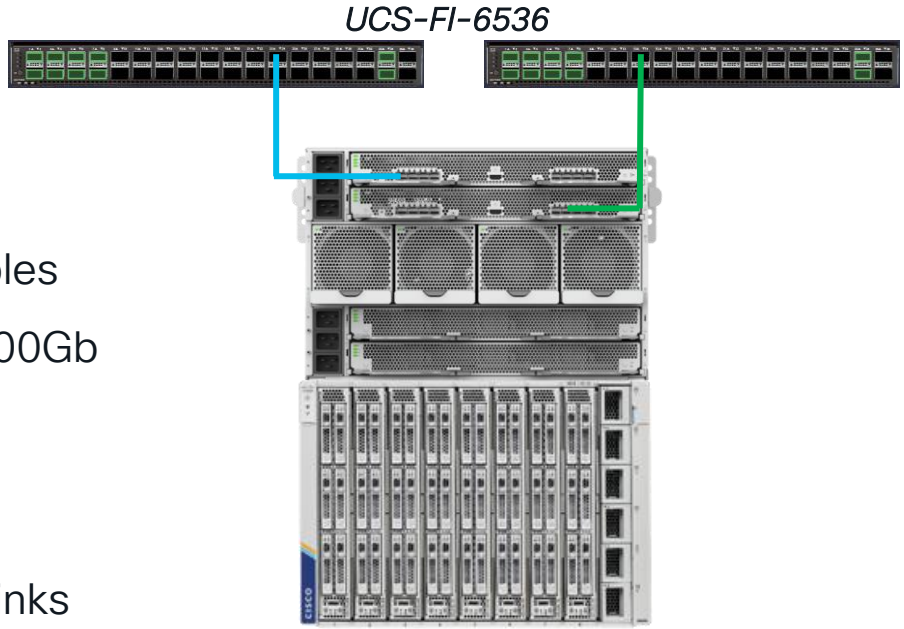
78 Tons CO2e

X-Series reduction in yearly greenhouse gas emissions

*Source: Based on data input into the Cisco power calculator
CO2e ratio calculated using EPA eGRID emission factor

Cisco X-Series Optimized Design
Reducing Materials for a Sustainable Future

- Eliminates Chassis switches
- Unified fabric cables with greater scale (20 chassis)
- Single wire management removes extra cables
- Reduction of server adapters with flexible 100Gb end to end fabric
- Small scale example 16:68 server consolidation
  - X-Series **46** cables/optics including FI uplinks
  - Rack servers up to **884** server cables/optics



Cisco IT Consolidation Analysis

- Using data driven metrics to select CPU and memory combinations to offer the best core per VM ratio
  - Leverage tools to pull VM historical utilization metrics
  - Use SpecInt data for modern CPU comparisons
  - Balance target CPU and memory population
- VM Consolidation from M4 to M7 4.4:1 ratio
  - 1 DC example target shrinking footprint from 490 servers in 62 chassis down to 112 nodes in 16 chassis
  - Est reduction in blade power load 108kW

Fill out your session surveys!

Attendees who fill out a minimum of four session surveys and the overall event survey will get **Cisco Live-branded socks** (while supplies last)!

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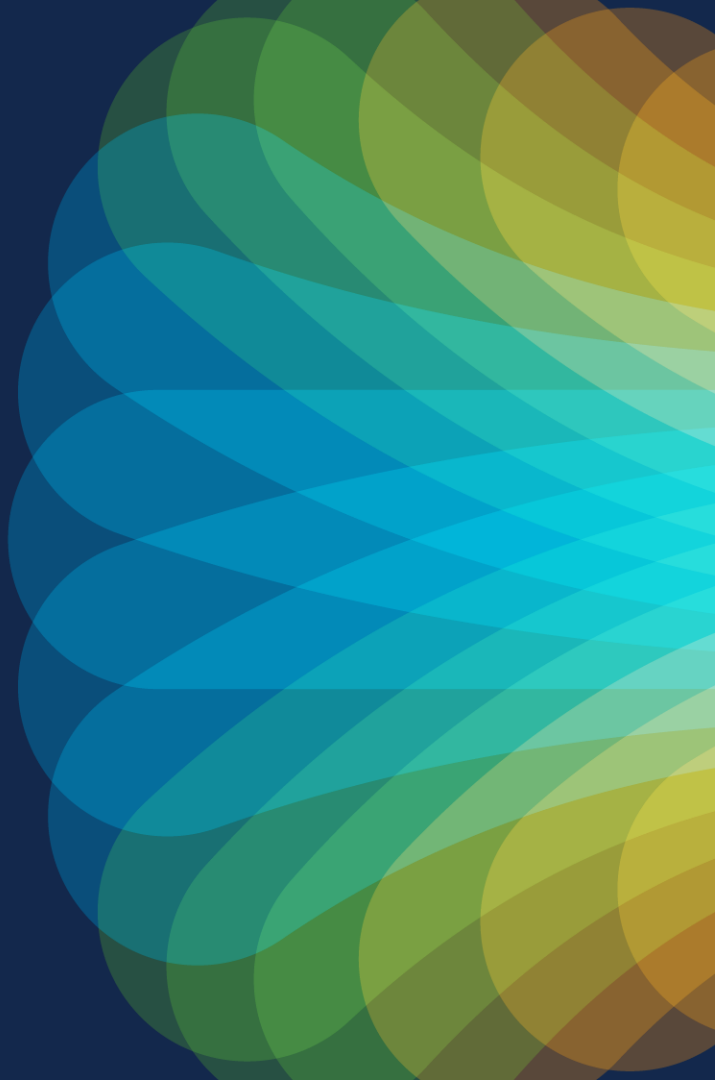
- Book your one-on-one Meet the Engineer meeting
- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs
- Visit the On-Demand Library for more sessions at www.CiscoLive.com/on-demand

The bridge to possible

Thank you



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3. Click on View Your Badges at the top.
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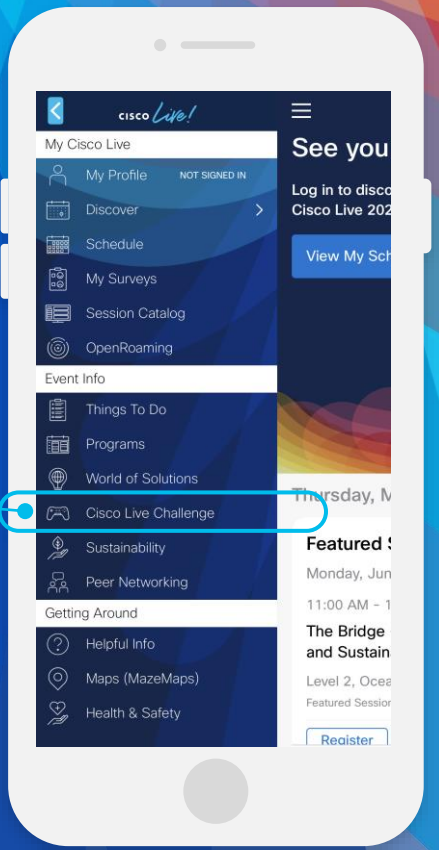


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