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Accelerating the Realization of Your Company Sustainability Goals Using Cisco UCS, X-Series, and Intersight

Chris Dunk, Principal Engineer

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	Catalyst 9000 Series Switching Family * technologies, and features in the Catalyst
	Speaker(s)
	Kenny Lei Cisco Systems, Inc. Technical Market >
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- 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?	"Transitioning to a net-zero world is one of the greatest challenges			
	Customer, investor & employee pressure	humankind has fa	of G250 companies report on ESG or sustainability ¹		
Q	Legislation, reporting standards, scrutiny	~140 countries with a Net Zero target ²	Important purchasing factor for consumers ³	Hiring criteria for 69% of workers ⁴	
\$	Business efficiencies & new opportunities		6/%	Ø	



Sustainability is top-of-mind for customers

https://blog.xmartlabs.com/images/only-one-earth/Untitled.png
 https://datacenters.lbl.gov/federal-data-centers
 https://www.ey.com/en_ro/news/2022/11/how-the-eus-new-

(3)https://www.ey.com/en_to/news/2022/11/how-the-eus-ne

sustainability-directive-is-becoming-a-game-chan

(4)https://www.datacenterdynamics.com/en/news/brazilian-governmentmandates-federal-data-centers-should-use-less-energy/

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5	Some EMEA countries have had costs/kwh grow over 10x in the last 12 months
Rising energy costs in	Energy monitoring and control tools a top customer ask
key regions	Data centers globally consume more energy than some countries ⁽¹⁾
	Servers typically constitute around 43% of the power consumed in a modern DC
Computing's impact	92% of businesses make use of virtualization to optimize server resources
energy usage	Power consumption increases to 61.5% when server cooling is added
Compliance to	US federal data centers mandates for energy efficiency – Data Center Optimization Initiative and Energy Act of 2020 ⁽²⁾
regulations	New reporting mandate rule proposal by SEC
and mandates for data	EU Corporate Sustainability Reporting Directive (CSRD) ⁽³⁾
	Brazil 2021 federal data center efficiency mandate ⁽⁴⁾

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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).



DRIVING AMBITIOUS CORPORATE CLIMATE ACTIO

CISCO



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.

Cisco's GHG emissions





Market trends





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

How Cisco X-Series is meeting this challenge

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Cisco Sustainable Product Design Guidelines



Double down on power efficiency



Modularity, reliability, repairability and extended lifetime



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



Eco certifications



Committed to 100% product return, no e-waste



Software-driven IT assets optimizations



Data-driven sustainability approach and tooling



Partner enablement, certifications and sales programs around sustainability



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

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X-Series Sustainability by Design



	Architectural Power & Lifecycle Optimization	Cooling & Fan Optimization
	 Unified IO and 100G for all servers reduces adapter, cabling, network and storage port needs 	 Zone-based cooling to intelligently
Minimize	 Efficient 54V power distribution to minimize transmission and conversion loss within all system elements 	operate fans where they are needed and not running them at common largest need
energy needs	 Input power monitoring at system level allows a quicker reaction based on real usage to realize 3-4% overall savings 	 Large real estate footprint on server blade modules allows for simpler airflow efficient fan power usage
	Titanium rated PSU	
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

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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 postconsumer 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

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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



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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



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

Dynamic power rebalancing

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

Power Redundancy policy

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

Power profiling policy

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

Power Save Mode

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

Extended Power Capacity

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

Power Allocation (capping) policy

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

Fan speed control policy

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

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

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Intersight Metrics and Monitoring for Servers

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



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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

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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%



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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>

	800-1299	Good
Successfully completed Login VSI test with 318 Knowledgeworker-win 11 sessions. VSImax (system saturati	2000-9999	Bad
Test result review		
320 sessions were configured to be launched in 2880 seconds.		
In total 2 sessions failed during the test:	h fans set	to
O sessions was /wars not successfully launched Balar	iced	
2 launched sessions failed to become active		
 2 launched sessions failed to become active 318 sessions were active during the test 		
 2 launched sessions failed to become active 318 sessions were active during the test 0 sessions got stuck during the test (before VSImax threshold) 		
 2 launched sessions failed to become active 318 sessions were active during the test 0 sessions got stuck during the test (before VSImax threshold) 		

Login VSI Base

Baseline performance of 819 is: Good



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

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



Login VSI Base line indicator

Performance

Good

Bad

PASS

VSI Baseline

VDI Test Power Results

Power Consumption



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SpecInt- Efficiency settings impact on performance and power

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- 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 D	visabled			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
	Default	Acoustic	8	80.9	414	6.3%	8	77	347	6.4%	19.3%	-5.1%
0400V/./22 Cares	Default	Acoustic	16	156	519	12.4%	16	149	445	12.5%	16.6%	-4.7%
Idle Power: 256 Watts	Default	Acoustic	32	297	696	25.1%	32	286	614	25.1%	13.4%	-3.8%
CPU Power (cTDP) -	Default	Acoustic	48	415	815	37.5%	48	404	742	37.5%	9.8%	-2.7%
300 Watts	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%	F	Range r	nost moderniza	ation wo	orkloads 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

4% performance reduction 35W power savings (19%)

	2x64GB Dual Rank DIMM	1X128GB Quad Rank DIMM
System capacity	2	ТВ
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 = <u>6,656W</u>
 - Memory power total 64GB DIMMs = <u>7,168W</u>
- 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

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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

Fibre **Ethernet** Management 00000 00000) 00000 00000 00000 00000 Cisco Unified Massive fabric complexity at scale Non-Standardized Server form factor

Silos of multiple ethernet and SAN fabrics and adapters

X-Series vs Legacy Rack 48 Server comparison:

Legacy Rack:

X-Series:

- 48 BMC Management cables
- 96 DP Ethernet cables
- 96 FC cables
- 384 Optics (4 ethernet, 4 FC)
- 24 Chassis 100G cables
- 48 Chassis Optics



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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:

Total Power Cords





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%



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

L	

4.3x less hardware

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

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





X-Series reduction in yearly greenhouse gas emissions

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

	···· —	
L		

7x less hardware

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

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





X-Series reduction in yearly greenhouse gas emissions

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



UCS-FI-6536

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

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 Meet the Engineer meeting
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Thank you



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- Open the Cisco Events App.
- Click on 'Cisco Live Challenge' in the side menu.
- Click on View Your Badges at the top.









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