



Datacenter e sustainability

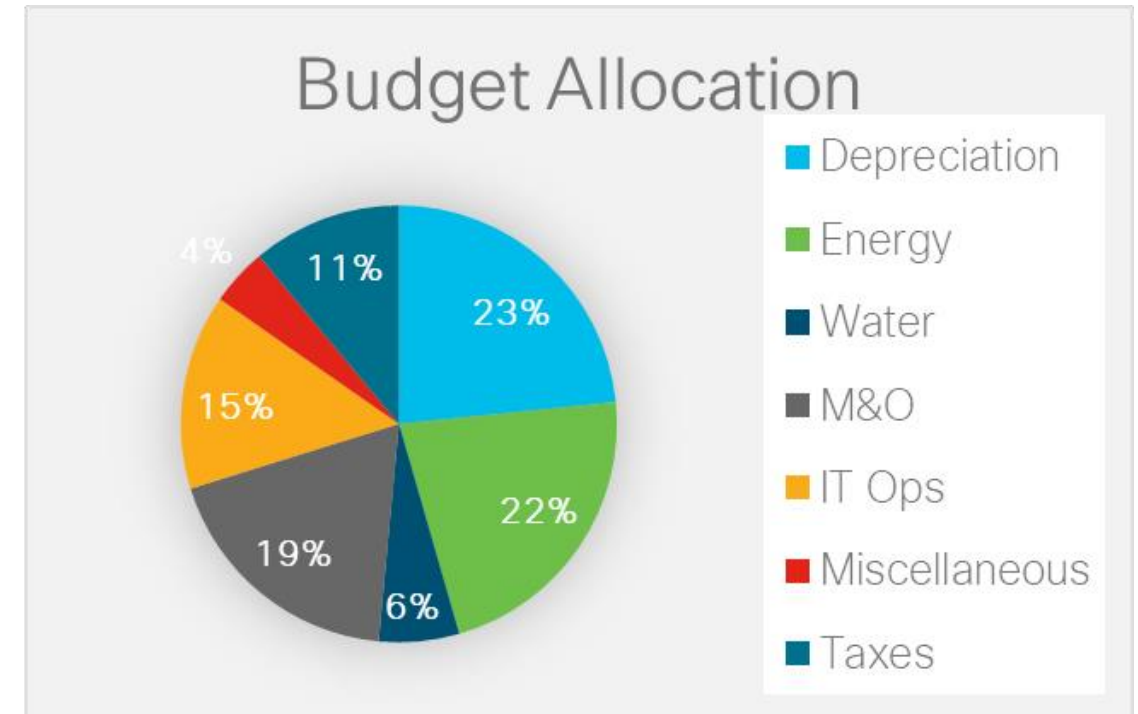
Datacenter e sostenibilita'

Ing. Fausto Vaninetti
Datacenter Technical Solution Architect

Roma, 23 Gennaio 2024

Energy Consumption Now A Key Concern

Energy consumption can represent up to 30% of IT datacenter costs



Numbers vary depending on datacenter location, mixed building vs pure datacenter, year and cost of energy

<https://www.arcserve.com/blog/data-centers-what-are-costs-ownership>

<https://newsroom.cisco.com/c/r/newsroom/en/us/a/y2023/m06/at-cisco-live-a-journey-to-sustainability.html>

The Four Pillars of IT Operational Efficiency

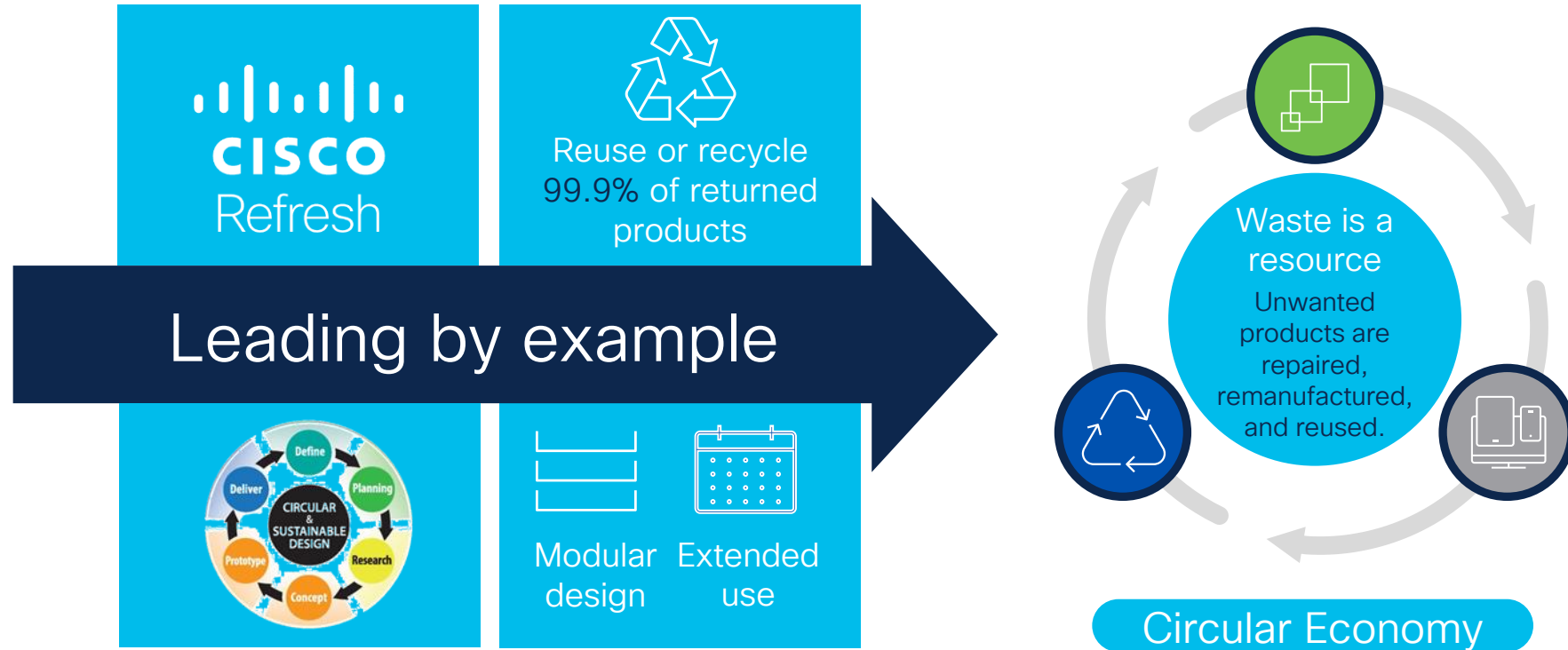
$$IT_{energy_eff} = \frac{IT\ work}{Energy}$$

Key contributors:

- Product energy efficiency
- Product utilization level
- Energy proportionality
- Service uptime

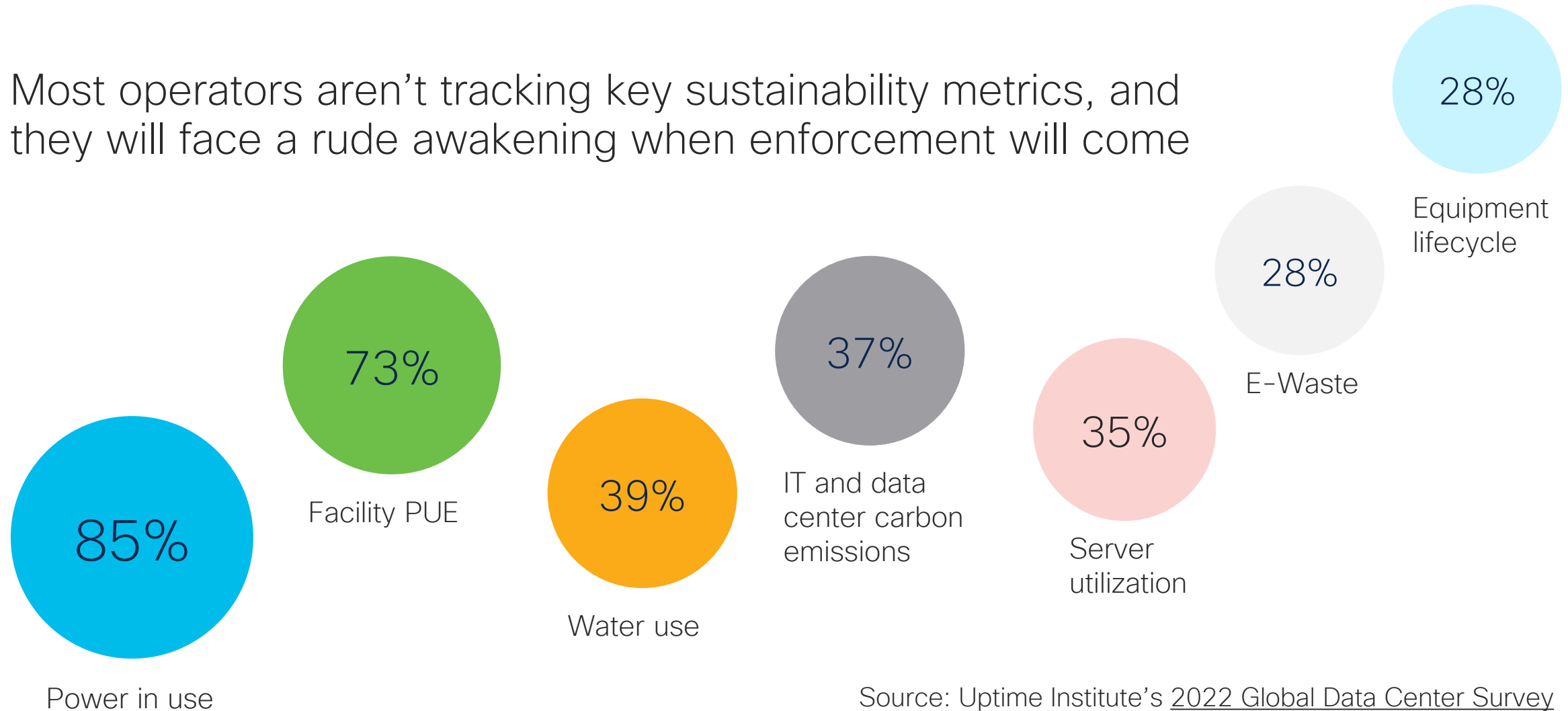


Sustainability Is Not Just Energy Efficiency



A Changing Regulatory Climate

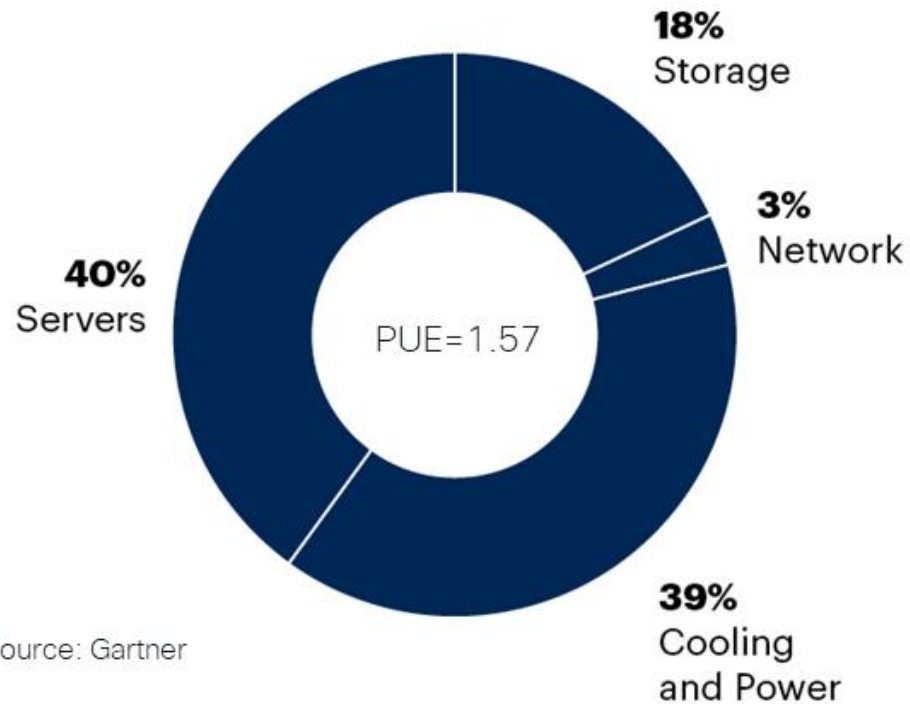
Most operators aren't tracking key sustainability metrics, and they will face a rude awakening when enforcement will come



Source: Uptime Institute's 2022 Global Data Center Survey

Sustainable Computing Makes An Impact

Estimated Data Center Power Use (2022)



- The burden factor – PUE
- Power, materials, weight, upgradability
- Modular computing systems combine energy savings and circular design

<https://www.gartner.com/en/newsroom/press-releases/2022-12-06-how-to-make-the-data-center-eco-friendly>

The Sustainability Benefits of System Modularity

Material Impact in Rack Mount Servers Lifecycle vs. Compute Nodes



- Modular systems use ~**40% less** production raw materials:

- Assume a server lifecycle of 48 months
- Assume 3 cycles for 8 servers
- 24 rack servers require 565 Kg of raw materials
- 24 compute server nodes require 344 Kg of raw materials (infrastructure items unchanged)

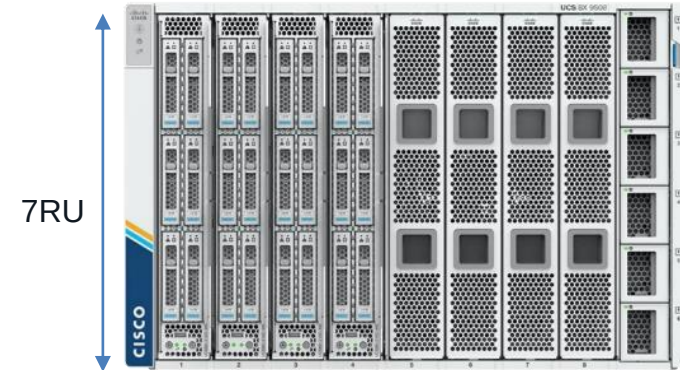


- Server disaggregation helps extend lifetime of modular systems and reduce **up to 66%** the annual contribution from embodied carbon

- Compute, storage, GPU, PMEM, accelerators
- Host virtually any workload
- Adapt to evolving application needs
- Better circularity and repairability



1RU



7RU

Each Server: ~23 Kg*

Total 565 Kg @ 8 servers x 3 lifecycles

Infrastructure: ~ 72 Kg

Each server: ~11 Kg*

Total 344 Kg @ 8 servers x 3 lifecycles

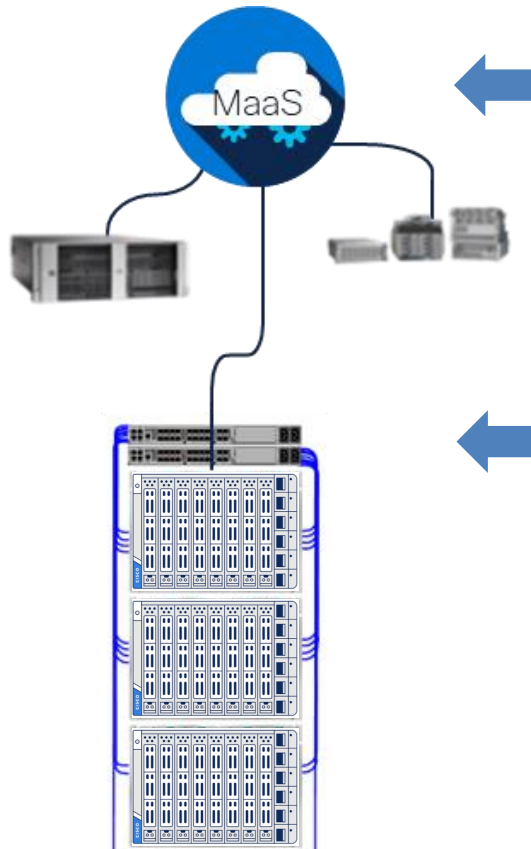
Reduce GHG emissions

Extend lifetime
Reduce raw materials

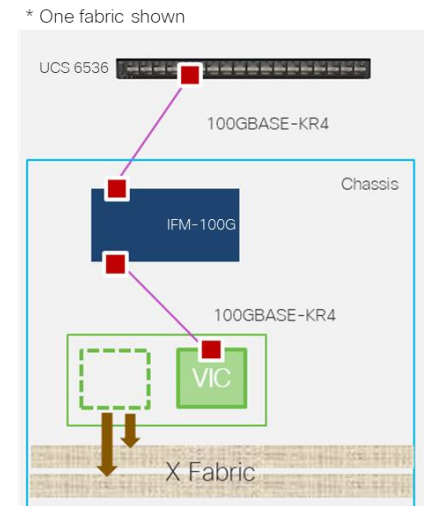
*Server weight maximums from published technical specs

Optimized Architecture

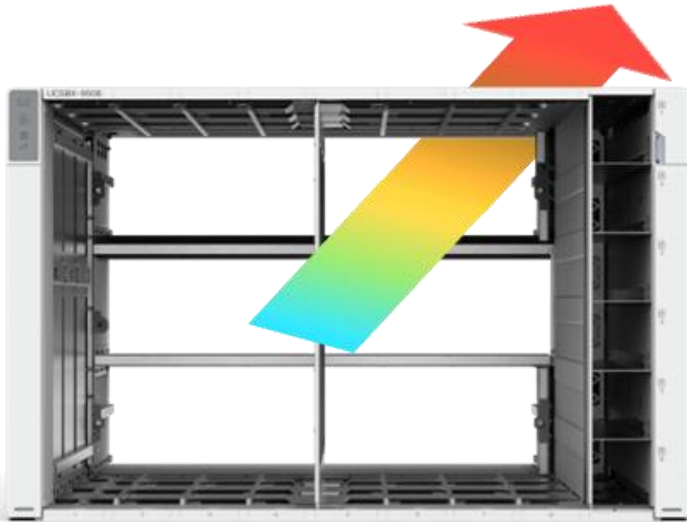
Reducing Materials and Power for a More Sustainable Computing



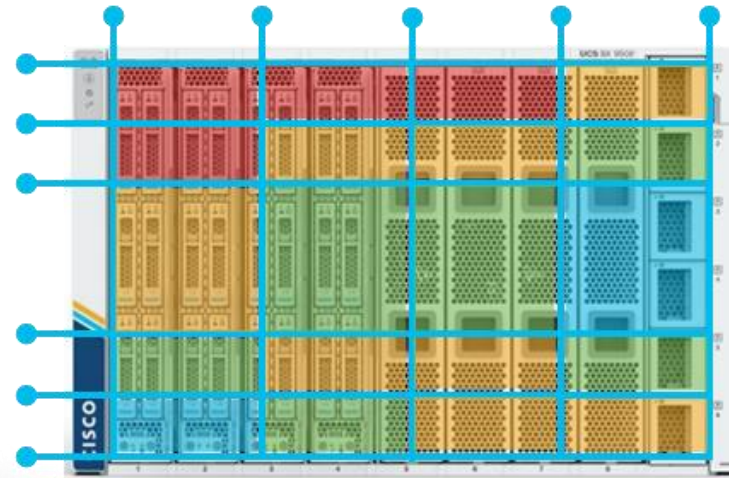
- No management appliances or ring connections, cloud-based global-access management tool
- Single-connect unified fabric allows for data, storage and management traffic consolidation (one switch, one network adapter, one cable)
- Shared switching elements outside of chassis and with great scale (up to 20 chassis)
- 100Gb end-to-end support for next gen fabric requirements, providing excellent bandwidth while reducing connectivity elements



Shared Infrastructure Technologies To achieve higher power efficiency



No midplane obstruction



Zone-based cooling



Optimized power distribution



AIR
COOLED

+30% air cooling
efficiency



WATER
COOLED

Liquid cooling
ready design



200+ component sensor
to feed cooling algorithm



Optimized fan power with
zone-based cooling



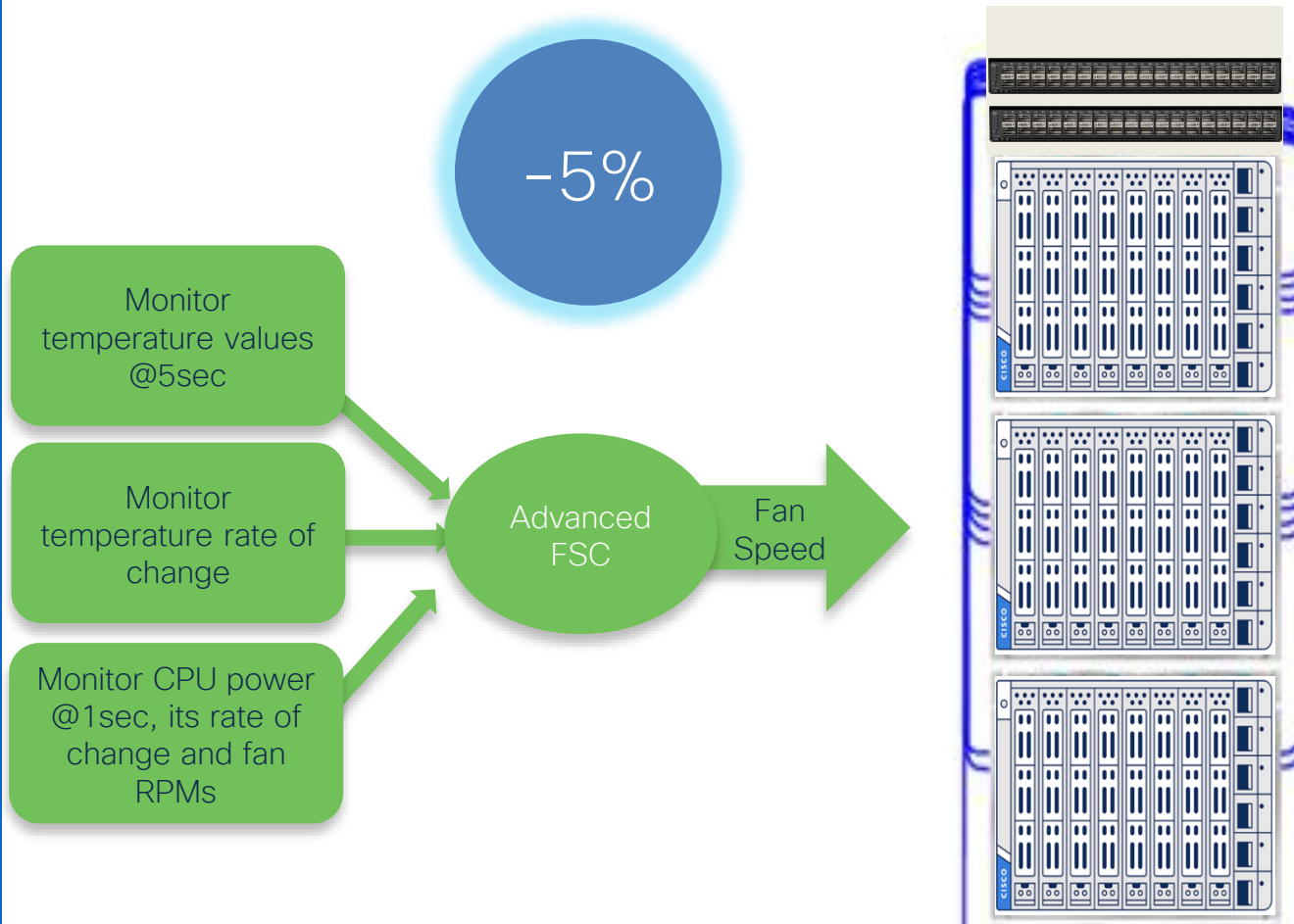
Less and high-efficient
POL voltage regulators



High voltage power
distribution to reduce
power losses, slim wires

<https://blogs.cisco.com/datacenter/ucs-x-series-answers-its-demands-for-a-more-sustainable-data-center>

Advanced Fan Speed Control Environmental Impact Reduction



Advanced FSC provides granular fine tuning of fan speed and saves at least 5%* of system power vs traditional FSC



Hypothetical situation: 20kW rated rack

- Power savings = 1 kW per rack
- Electricity bill savings = \$2,628 / year **
- GHG savings = 4.16 tons of CO₂e / year ***

* Cisco lab testing

** average electricity cost of \$0.3/kWh

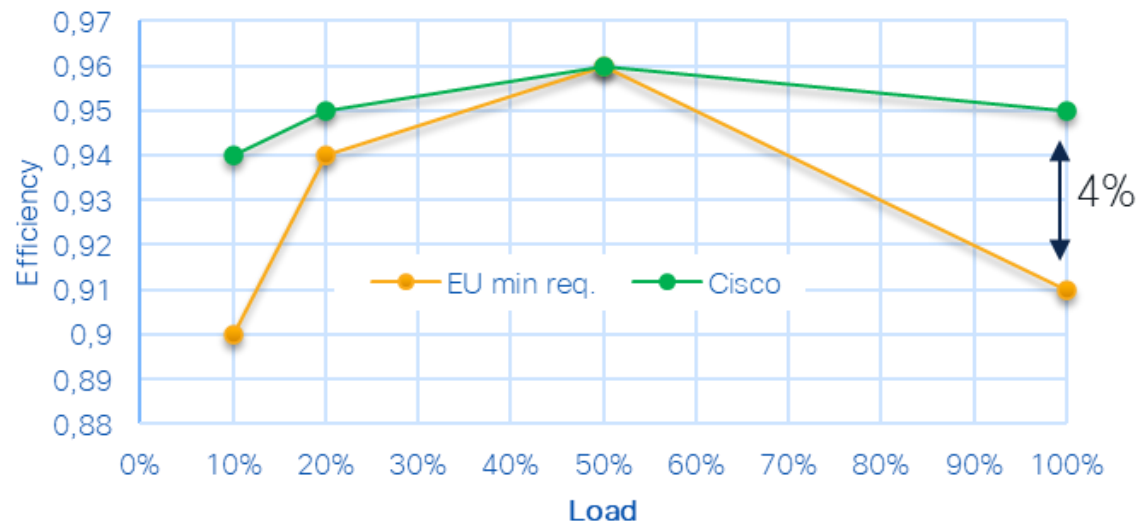
*** average generation of 475 gCO₂e/kWh

80Plus Titanium Certified PSUs

	EU minimum requirements Effective January 2023 (now 2024)				Power Factor
Rated Load	10%	20%	50%	100%	50%
Efficiency	90%	94%	96%	91%	0.95

	Cisco UCS X-Series Platinum 2800W PSU Results				Power Factor
Rated Load	10%	20%	50%	100%	50%
Efficiency*	94%	95%	96%	95%	0.97

*higher values listed of two power supplies offered for UCS X-Series



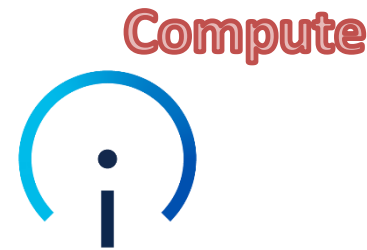
- Cisco PSUs exceed EU min requirements by up to 4%
- Highly efficient PSUs reduce AC to DC conversion loss (wasted heat)
- Extended high-efficiency range fits different chassis occupancy
- PF close to 1 minimizes energy lost in the distribution system and requires smaller wires

<https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R0424#d1e32-56-1>



Simple and Sustainable Operations

Optimal energy control with power policies



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

Power Save Mode

- PSUs can be placed in power saving mode if requested power budget 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

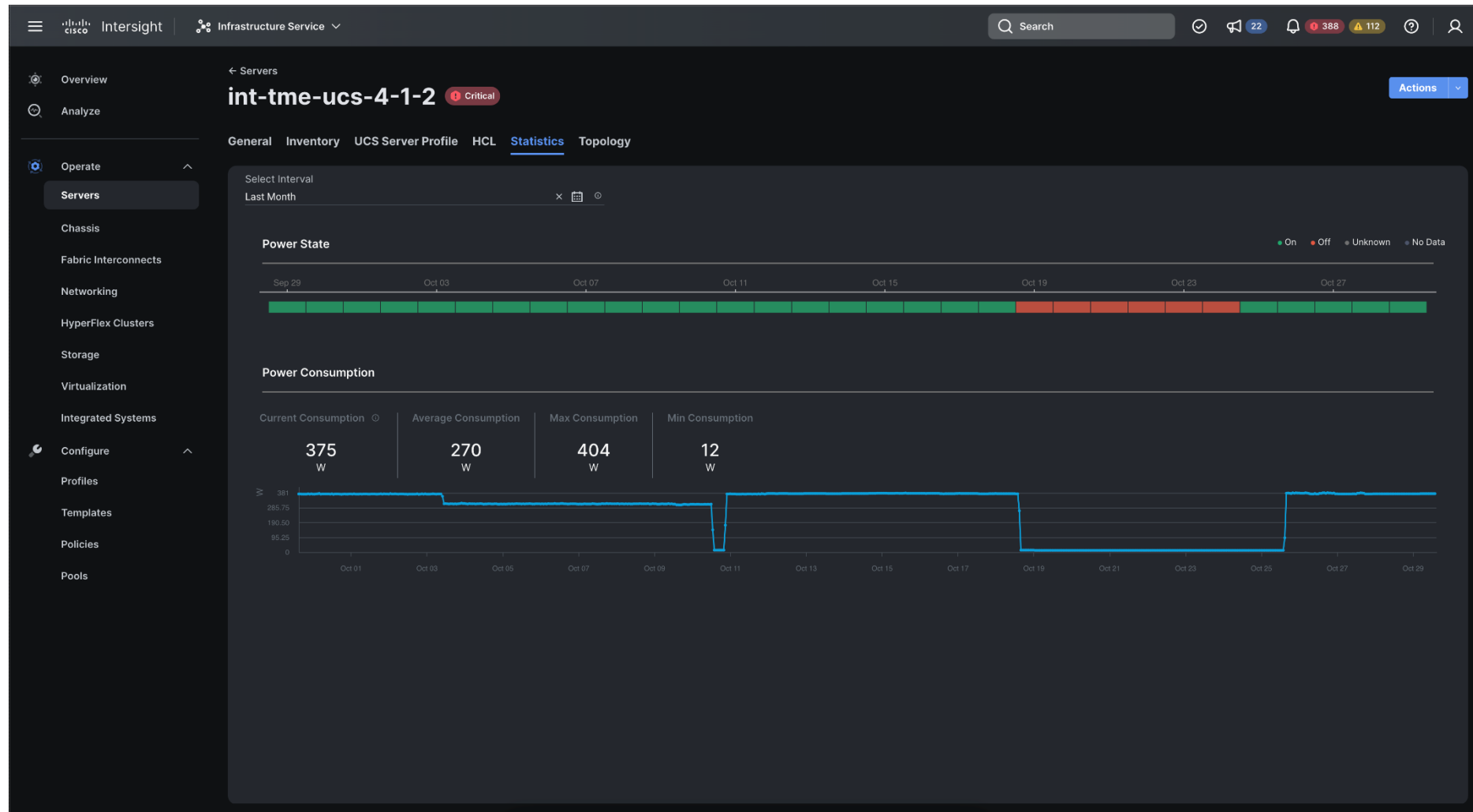
Extended Power Capacity

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

BIOS and OS power policy

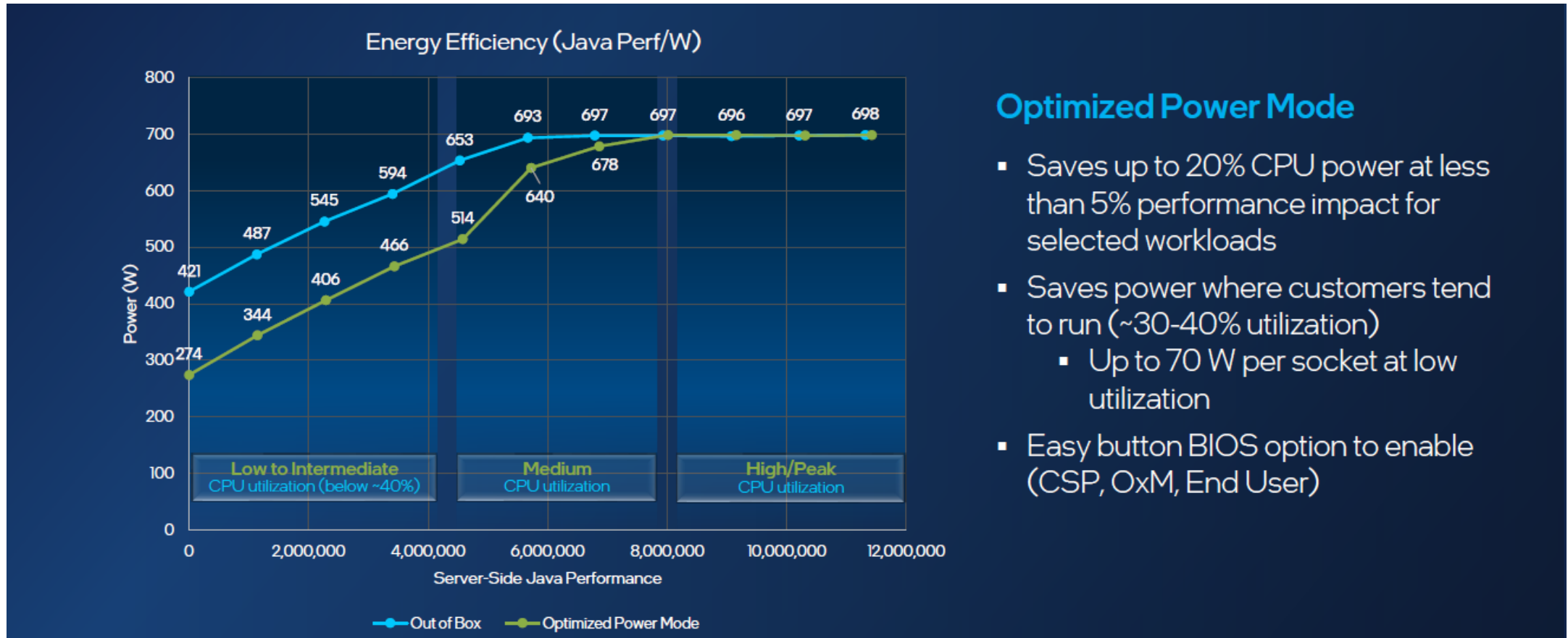
- Use BIOS tokens to adjust power based on app needs
- OS level power recommendations

Visibility & Trending Server Power Utilization



Sustainable Computing with Optimized Power Mode

OPM is a new BIOS-level capability that can be enabled on UCS M7 servers

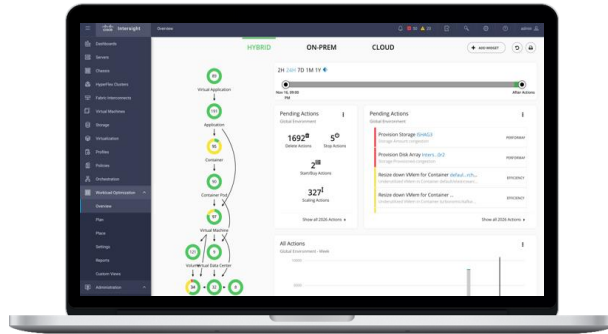


Workload Optimization Tool

Resources right sizing and savings from servers' consolidation

~15-20%*

Average reduction in data center resource utilization

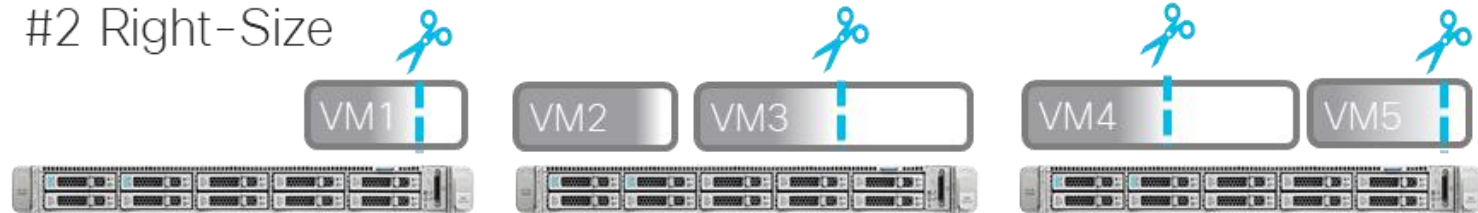


- ✓ Use machine intelligence to simplify application resource management
- ✓ Reduce OPEX and preserve capital by eliminating overprovisioning
- ✓ Adapt quickly and reduce risk with scenario modeling

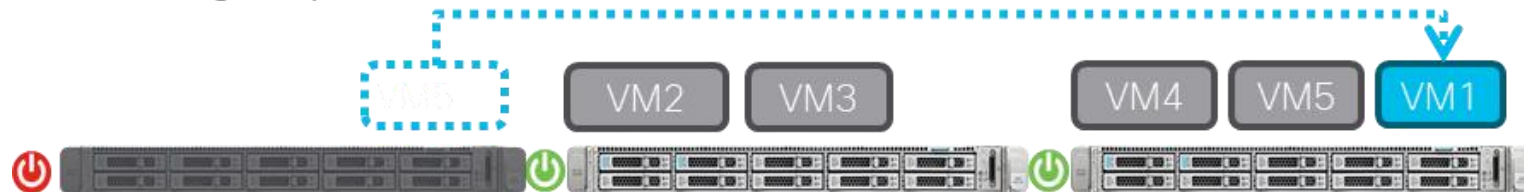
#1 Measure



#2 Right-Size



#3 Regroup & turn-off idle servers



(*) Forrester, The TEI of IWO, Feb 2021

Ing. Fausto Vaninetti

Next vs Old Generation of CPUs

Per CPU: 3x cores, 2x TDP, 7x Performance

Home /

CPU Performance and Spec Information

Disclaimers

- This tool lists only those CPUs which have been published on Spec.org, irrespective of Cisco supporting them.
- SPEC Int numbers are calculated as an average of all server vendors' published numbers and not just Cisco's.
- You may see SPEC Int numbers of CPUs that have not yet been published by Cisco as they may have been published by other server vendors.
- * Not in CCW: CPU not in the list of Cisco supported SKUs.
- ** Only Cisco supported CPUs' TDP value is listed. For other CPUs refer their product page. ex <http://ark.intel.com> for Intel and <https://www.amd.com/> for AMD processors.

[Click for SPEC Conversion: 2006Int_Rate < == > 2017Int_Rate](#)

Industry Standard CPU SPEC Performance Data – Spec.org



Toggle to See All

[export to excel](#)

☐	Vendor	CPU Family	Model	Speed	CPU Cores	Sockets	Total Cores	Threads	2006 CINT	2017 CINT	2006 CINT/Co	2017 CINT/Co	TDP
☐													
☒	Intel	Sapphire R...	Intel Xeon Gold 6448Y	2.1	32	2	64	2	5564	573	86.94	8.95	225
☒	Intel	Haswell	Intel Xeon E5-2660 v3	2.6	10	2	20	10	880	91	44	4.55	105

Next vs Old Generation of CPUs

Consolidation Benefits

64 to 16 server consolidation:

A reduction of total energy consumption by up to **51%** by using the new UCS X-Series platform with 4th Gen Xeon CPUs resulting in:



91,612 kWh savings

reduction in overall
energy per year



62% weight reduction

3.6x fewer hardware components
saving 537 kg of raw material



37 tCO2e

reduction in greenhouse gas
emissions per year

4:1 consolidation, M4 to M7 generation

Intel Xeon SP 4th gen 6448Y CPU, 32 core @2.1GHz, 225W TDP

Intel Xeon E5-2690v3 CPU, 12 core @2.6GHz, 135W TDP

*Source: UCS power calculator and EPA conversions

The SEAL Award

Honoring Sustainability, Environmental Achievement and Leadership

The SEAL Sustainable Product Award

Recognizing innovative and impactful products that are literally “purpose-built” for a sustainable future

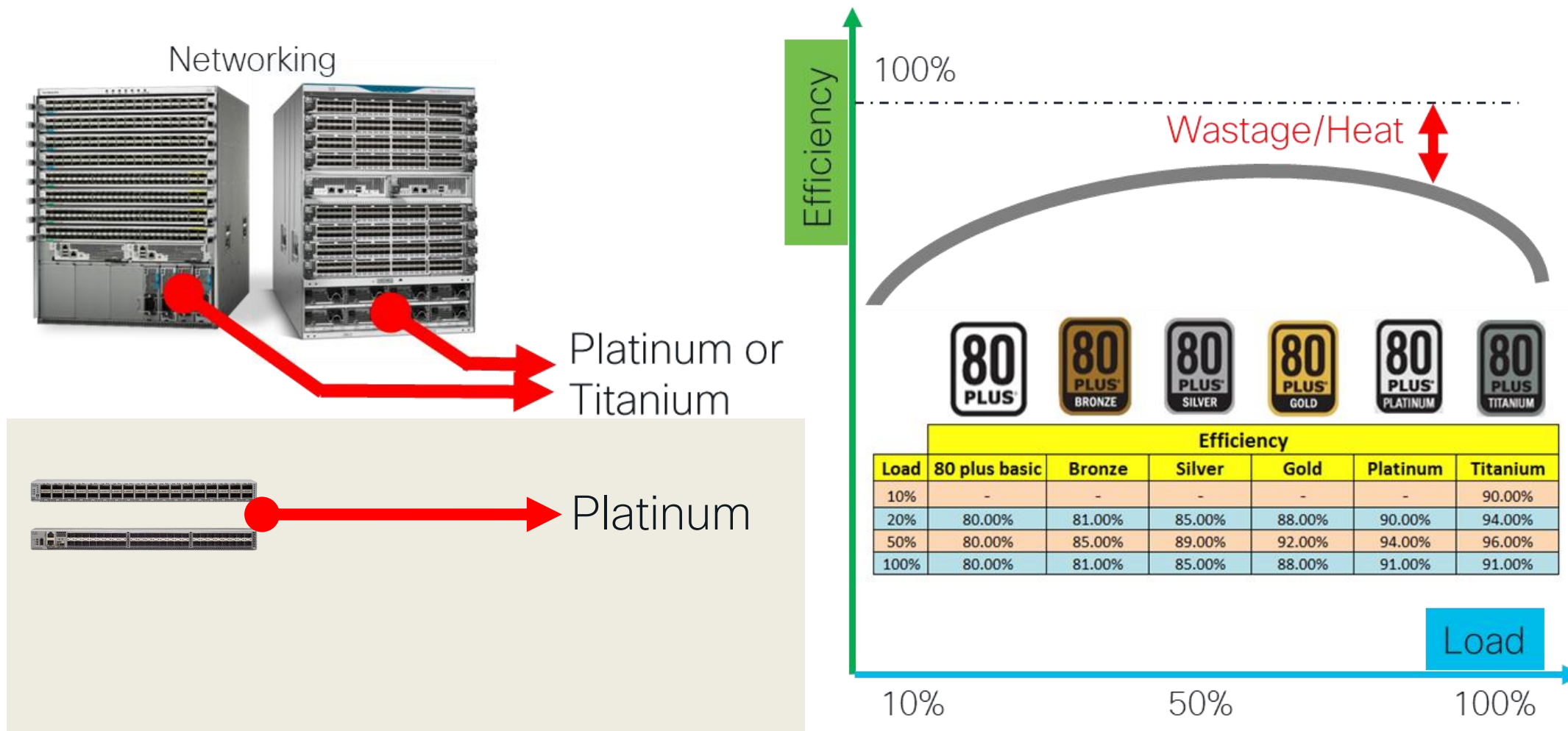
Category winners, computing systems:

- Cisco UCS X-Series (x86)
- IBM z16 (legacy)



<https://sealawards.com/sustainability-award-2023/>

Reducing Heat Generation With Higher Power Supply Efficiency



Data Center Networking

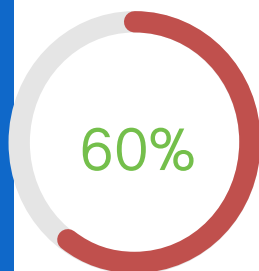
Generational improvement in efficiency

C9336C-FX2 – 36x100GE



2017

9W / 100GE



5W / 100GE

C9332D-GX2B – 32x400GE



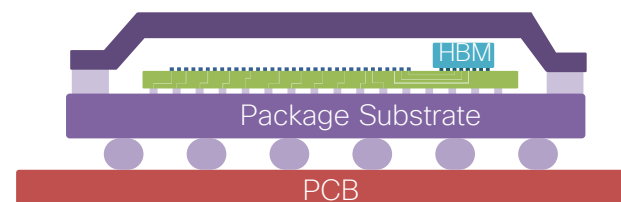
2021



59x

Higher power eff.
(vs Nexus 7010) *

Nexus 9808



Silicon One w/HBM

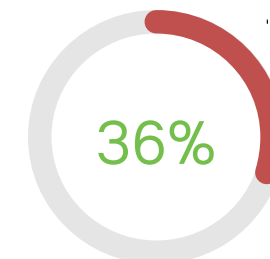


Silicon Photonics



QDD-400G-FR4-S

QDD-4X100G-FR-S



400GE optics vs
4x100GE ports
(port level consumption on
silicon one with FR optics)

(*) [Cisco Sustainable Solutions ebook 2022](#)

Data Driven Sustainable Operations

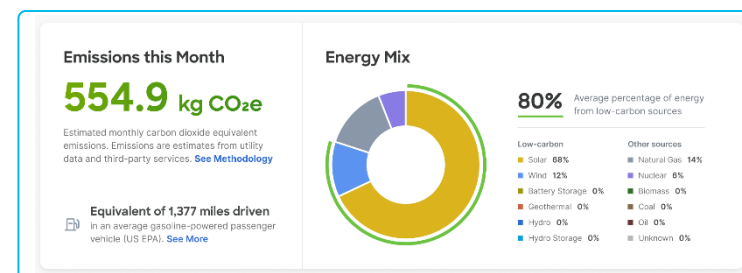
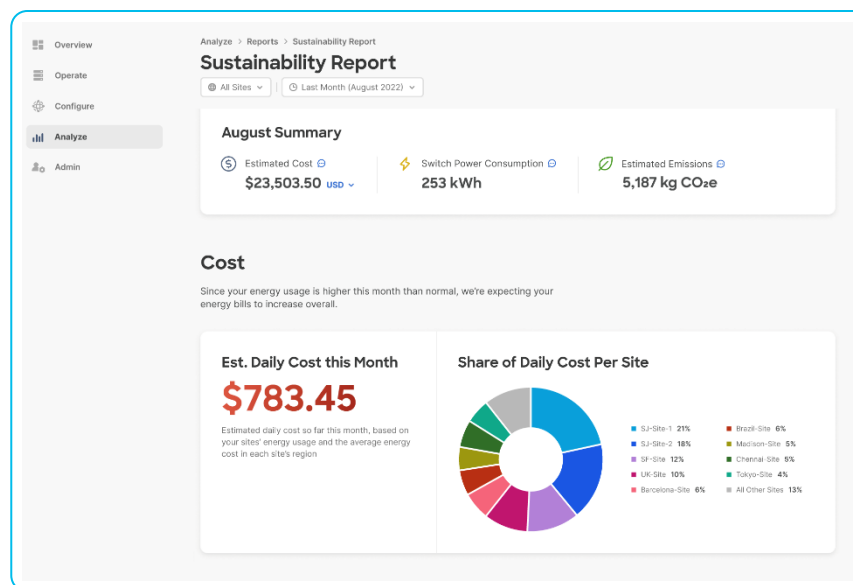
Leverage the power of telemetry and analytics



Analytics

Analyze Sustainability¹

Understand the **carbon footprint** of managed devices
 Learn about the **energy sources** your sites consume
 Get historical views and progress, including **kWh** and **cost**
 Integrate to **Panduit** and **Vertiv** PDUs for increased visibility¹



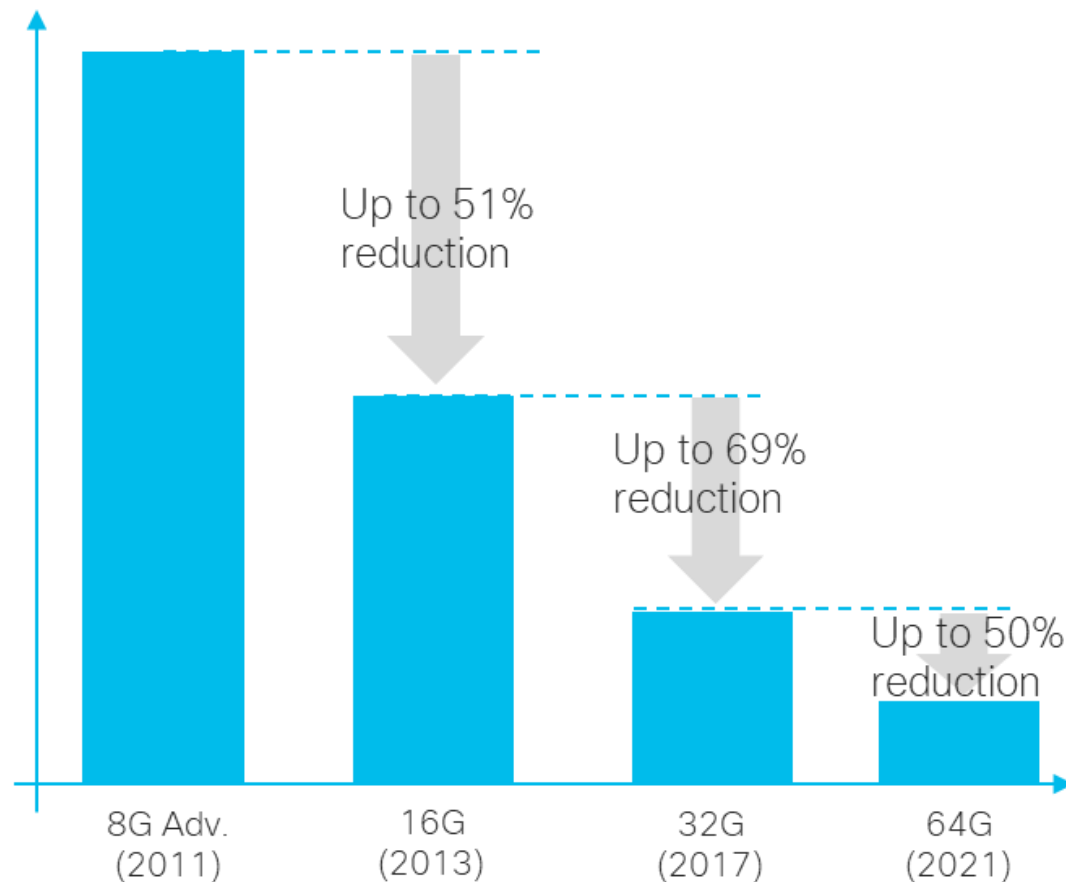
- On device
- Continuous
- Automatic

¹ Panduit, Vertiv integrations expected on Cisco Nexus® Dashboard 1HCY24

Innovation Driving Efficiency Gains Over 10 years

Storage Networking Example

gCO₂e/TB emissions



Reduce CO₂e emissions by approximately 92%* compared to previous solutions

Notable milestones

1. Visualize real-time environmental data
2. Improve ASIC efficiency at each iteration
3. Include energy optimizations by software

*Source: Cisco calculations

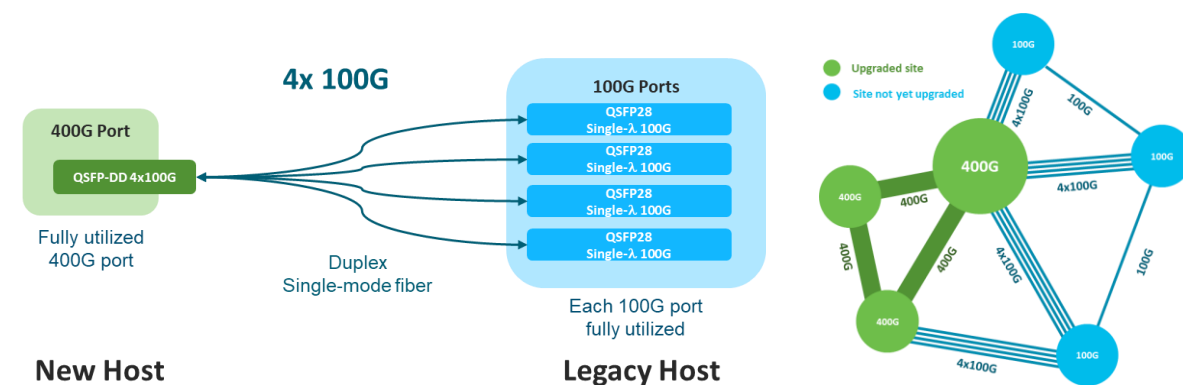
Sustainable Optical Networking

Extended Reach Optics



- Save raw materials of external optical transport solutions, cutting weight by up to 95%
- Cut power consumption by up to 80% in the optical layer by using DCO
- Backward compatibility with existing switches
- Multiple speeds and distances supported

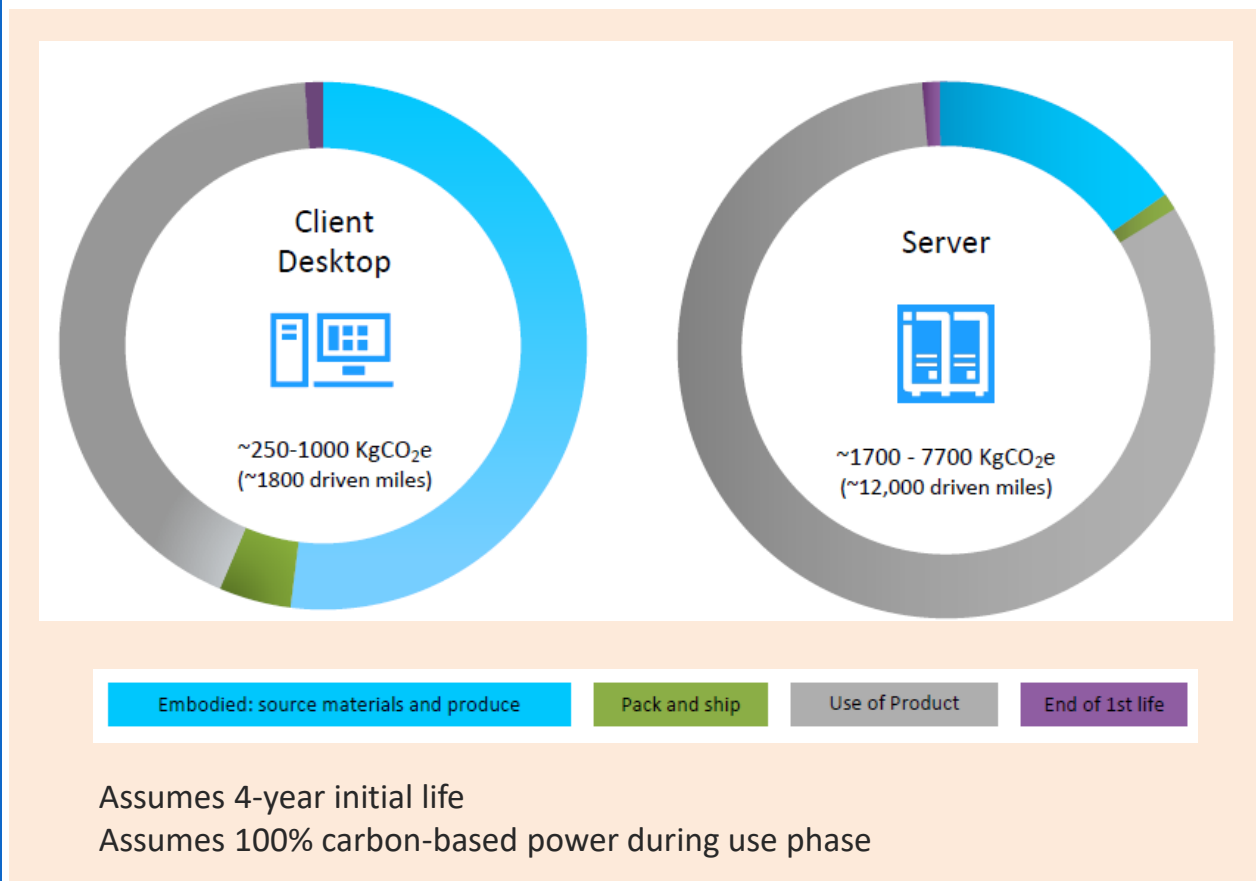
100G Single Lambda and Breakout



- Split high-speed signals with optical breakout cables, patch panels as alternative to breakout cables
- Upgrade your network when needed, reuse of 100G single lambda optics while connecting to 400G ports
- Reuse of lower speed optics inside 400G switches
- Save 6 watts while going 400G vs 4x 100G

GHG Emissions Lifecycle Assessment Using PAIA

LCA models the environmental impacts of products, from cradle to grave



- LCA covers raw materials acquisition and manufacturing, transportation, operation and decommissioning
- Embodied Product Carbon Footprint (PCF) and use phase emissions depend on product itself
- Use phase emissions are heavily impacted by the specific carbon intensity of the grid (see IEA emission factors)
- Products with higher embodied PCF should be refreshed less often

Sustainable Product Design Guidelines



Double down on power efficiency



Compliance and 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



GRAZIE PER L'ATTENZIONE

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