Data Center & Campus Design
New Innovations in Power & Cooling Systems

Denise Lee

VP Engineering Sustainability Office
& Engineering Alliances

cisco Live!

CENGRN-2100

Energy Consumption Continues to Climb

- Data Centers
- Buildings
- Energy Generation
- AI Usage
- Climate Change

Impact of AI in the Data Center

Challenges

Performance Demands

Power Constraints

Cooling Dilemma

Space Efficiency

Network Implications

Investment

Data Center Energy Demand

3X Growth ‘23-’30

150+ Gigawatt Global Data Center Forecast

McKinsey

Data Center Spending

$75B

AI to drive data center spending by 2028

Cushman & Wakefield

Liquid Cooling Growing

33% CAGR

Worldwide market growth from 2024 to 2032

Markets and Markets

Impact of Modernizing Buildings

Challenges

Power Constraints

Space Optimization

Network Implications

Government Regulations

Health & Safety

Investment

Regulatory Pressure

75%

Buildings built prior to 2000 have poor energy efficiency

EU Buildings Directive

CO_2 Building Emission

30%

Operations of buildings account for global emissions

IEA

Skilled Labor Shortage

New Jobs Annually

80,000

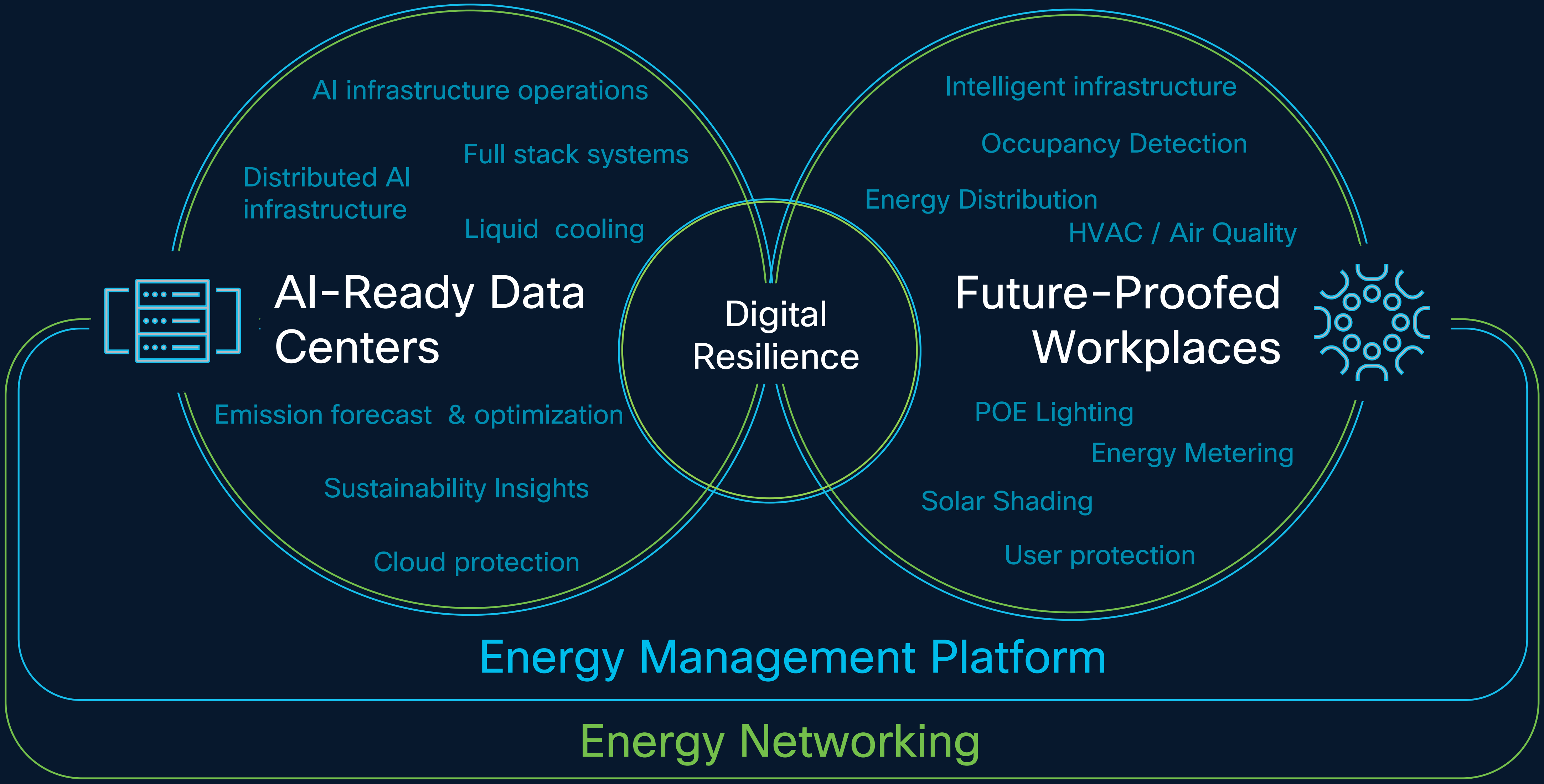
By 2031 demand for skilled electricians will not be met

eeNews

Bringing Energy into Focus

Energy Networking and Liquid Cooling Solutions

Powering and Managing the Network



Advancing Sustainability with Energy Management

Visibility to power telemetry and consistent greenhouse gas (GHG) metrics across global on-premises, cloud, and edge environments

Control use of analytics and insights to drive policy and control

Automate workflows with AI based recommendations and virtual assistant to achieve sustainability goals

ENERGY METRICS: Energy Consumption → GHG Emissions → Carbon Intensity → Energy Mix → Energy Cost

Evolution of Powering the Network

Enhance reliability and support of safe and secure power and data

Class 4 FMP 450vDC

380vDC

90W PoE

AC power systems

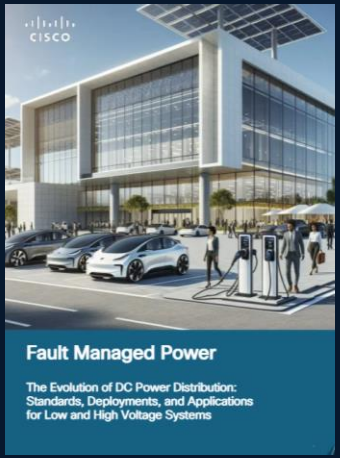
NEW! 2023
National Electrical Code 726

AC power	DC power	FMP power
Alternating current	Direct current	Fault Managed Power

Creating energy networks that connect and distribute energy more simply, safely, securely and sustainably

New Power Distribution Standard: Fault Managed Power

FMP is a 450vDC distribution method that is Smarter, Safer, Cheaper, and Faster to deploy



FMP White Paper

Smarter & Secure

Self-healing

Remote-control & telemetry

In-circuit Data (~10Mbps-1Gbps)

Secure Power

Safer

Touch Safe <450vDC

Ground Safe <450vDC

Arc Safe to 800vDC

Cheaper & Faster

No steel conduit, only structured cabling (~20% less work)

Does not require certified electrician skillset

More efficient to run (10~30% reduction end-to-end loss due to conversion & power-factor)

Cisco is the leading FMP IP owner with 52 issued US Patents, 35 pending

Art of the Possible with FMP

Touch-Safe DC Power up to 450v

Enhanced Fault Detection and Isolation

Improved Energy Efficiency and Reduced Losses

Optimized Energy Storage Integration Preventing Overload

Optimized Energy Flow and Load Balancing

High-Voltage DC and Low-Voltage Power Distribution

Minimized Downtime and Maintenance Costs

Microgrid Support and Distributed Energy Systems

Increased Network Resilience and Reliability

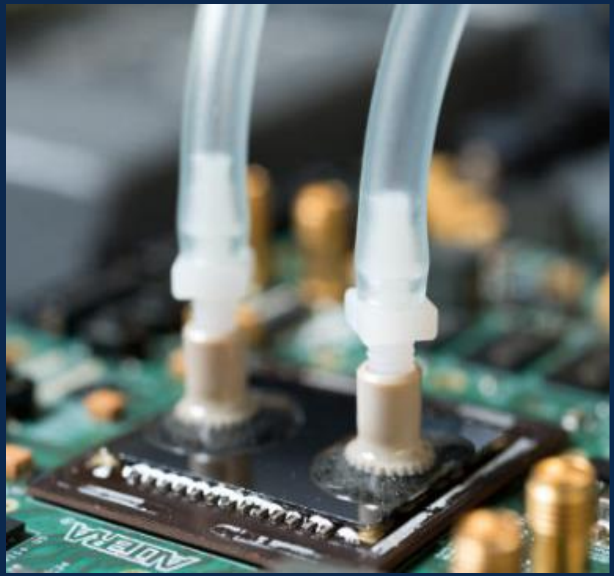
Compliance with Smart Grid and IoT Technologies

Solutions for Liquid Cooling in the Data Center

Integrated, Multi-Vendor Deployment

Rear-Door Heat Exchanger

20-40 kW per rack



Direct to Chip

150 kW per rack

Immersion

250 kW per rack

Helping You

Future Proof Your Investments

IT INFRASTRUCTURE

SIMPLIFIED OPERATIONS

AI-Ready Data Center

FULL STACK SOLUTIONS

DESIGN & BUYING GUIDES

Drivers for Change

AI-Ready Data Center

1

Largest Data Center Expense: Electricity

46% of total spending for enterprise data centers, 60% for SP data centers

Source: [IDC]

2

AI Driving Rack Power Capacities up to 100kW

To offset the emergence of large language model and generative AI applications

Source: [Del Oro]

3

The Need to Manage Power Consumption

Predicting energy demand and adjusting resources reduces downtime to optimize efficiency

Source: [Data Center Dynamics]

AI Data Center Rack Level Integration

Legacy Install

Separate components presents challenges

- Customer Integration
- Inefficient Systems
  - Signal integrity
  - Power loss
  - Thermal cycling
  - Cooling inefficiency
  - Management plane
- Siloed operational processes

32 GPUs / 80Kw

Integrated System

Cisco integrated rack system provides benefits

- Buy as a platform
- Cisco validated
- Best of breed vendor technologies
- Integration based on open standards
- Higher density racks reduce energy cost >50%

64-96 GPUs / ~130Kw

With 400/800v DC to the rack, you will no longer be able to service the rack without an electrician

Transition for Scaling Data Center Cooling

The journey starts where you are

CURRENT

Air Cooling

Existing IT Workloads

Limited to lower density racks

Cannot account for spot problems

8–16 kW / rack

Rear Door Heat Exchanger

Near-term Evolve

Locationally deployed

Liquid CDU to solve hot spot problems

Building solution for DtC

20–40 kW / rack

TRANSITION

Direct-to-Chip (DtC)

Initial High Density

Higher rack density solutions

Scales from Liquid/ Liquid CDU

150 kW / rack

TRANSFORMATIVE

Single-Phase Immersion

3 Year High Density Highest rack density solutions

250 kW / rack

Single-Phase Immersion + DtC

3 Year Single-phase immersion with DtC for extreme thermal density loads

350+ kW / rack

Liquid cooling technologies are highly compatible, and deployment is situational

Enterprise Data Center

(typical 1-5 MW)

76%

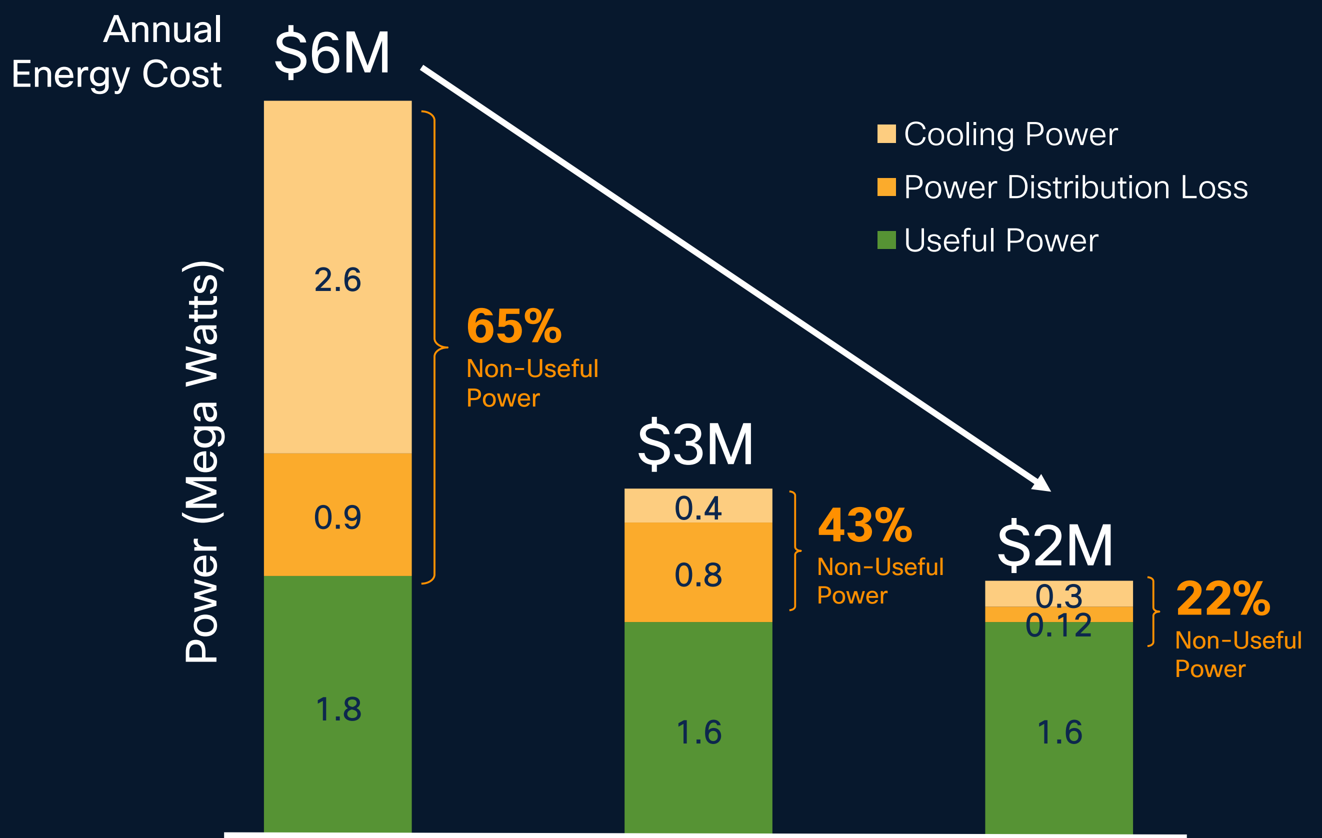
Energy Cost Savings

With FMP + Liquid Cooling

FMP Break-Even < 5 years, power savings alone, without labor and material savings

FMP is 10-16% of IT Kit BOM

Notes:
128 servers (8xB200/B300 GPUs,, Nexus switches + LPO optics, FMP)



	Air Cooled Servers	Liquid Cooled Servers	FMP + Liquid Cooled
# of Racks	45	18	18
kW/ per rack	48 kW	102 kW	102 kW
Total MW	5.4 MW	2.8 MW	1.92 MW

Cisco's Routed Optical Networking

Resilient AI Infrastructure for Optimized Fabrics and Trusted Transport

Cisco's Routed Optical Networking (RON)

Architecture lowers internet costs by reducing equipment and energy consumption

Simplify the Network

By merging routing and optical layers onto a single network with end-to-end automation through Cisco 8000 routers and Silicon One

RON is Cost Reducing

Due to a reduction in energy consumption, cooling, and space requirements

Routed Optical Networking	Impact	
Increased optics speed and a reduced footprint	**5x** Energy reduction	**70%** Space reduction
Chip performance 12-18 month innovation cycles	**2x** Power reduction	**3%** Space reduction
Evolution of cloud enhanced applications	**2x** Memory reduction	**2X** Boot time reduction
Built-in layered end-to-end automation	**70%** Less time to operate	**46%** Transport savings
Service Optimized Power	**57%** Opex savings	**35%** Capex savings

Cisco’s Linear Pluggable Optics

Significantly Reducing Power Consumption in Data Centers

Power Efficiency

LPO optics eliminate the need for digital signal processing (DSP) on both the transmit and receive sides, demonstrating 500w power reduction in a 51.2Tb switch

High Performance

LPO modules rely on advanced ASIC SerDes capabilities to drive linear channels, enabling high-speed data transmission

Interoperability

Cisco is actively working to establish industry-wide specifications, ensuring multi-vendor compatibility

LPO optics use

50% less energy

compared to retimed optics

Energy Networking Before and After

AI-Ready Data Center Systems

BEFORE

- 10% or more in power factor (PF) loss
- 20-40% in AC/DC conversion losses
- 10-20% in transformer & phase balance loss
- 20%+ loss in idle load and power supply units
- 15% loss due to in-chassis fans
- 40-60% energy consumption in cooling

40%*

energy conversion loss
resulting in power inefficiencies
throughout transmission

AFTER

- Reduced transmission losses
- Real-time fault management
- Selective fault isolation in the network
- Dynamic load management
- Automated energy redistribution
- Low-voltage safe and efficient DC distribution
- Optimized for high-voltage DC (HVDC) long-distance power transmission

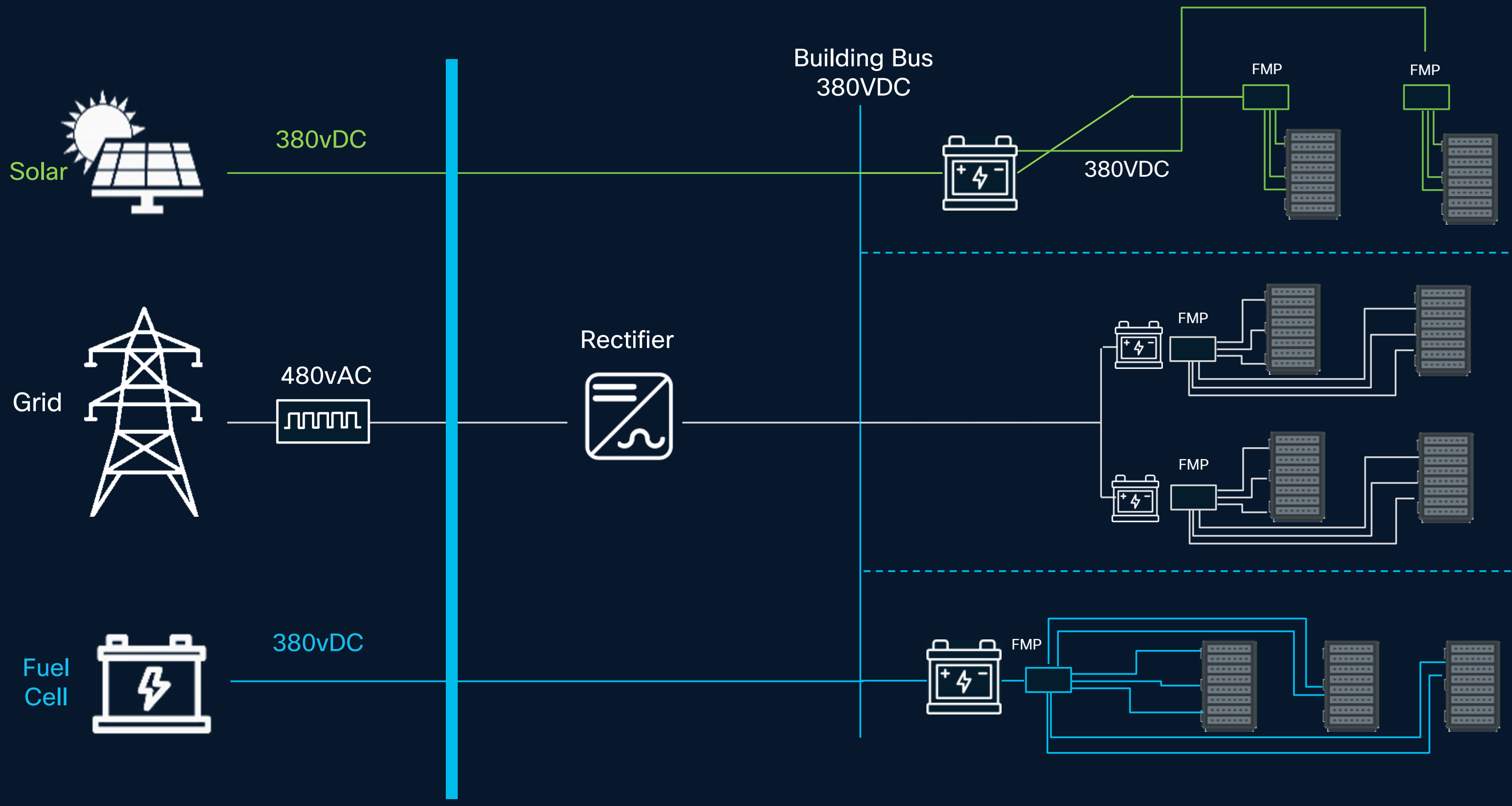
50%*

energy savings gained
operationally more efficient
using liquid cooling and FMP

**Illustrative example: Findings performed in lab environment*

FMP Enabled Data Center

FMP to the rack, FMP in the rack



Scenario 1: Top-of-Rack FMP & Centralized BESS

- 380VDC FMP Power Shelf
- Point-to-Point distribution in rack
- Centralized BESS / backup battery

Scenario 2: Distributed Row-level FMP & BESS

- Co-located 380VDC FMP power-rack mid-row and distributed BESS/ backup battery
- FMP distribution within row

Scenario 3: Centralized FMP and BESS

- 380VDC to Centralized FMP & BESS electrical room
- P2P distribution entire floor
- Small Scale deployments

FMP: Fault Managed Power and
BESS: Battery Energy Storage System

An ecosystem built to deliver more sustainable outcomes in the data center

Liquid Cooling Solutions	DeepCoolAI, VERTIV, GRC Green Revolution Cooling (The Immersion Cooling Authority), Asperitas Immersed Computing
Infrastructure Modernization	HITACHI, NetApp, NUTANIX, PURESTORAGE, Cisco Data Center Networking
Application Modernization	Epic, Microsoft SQL Server, SAP, ORACLE, vmware, NUTANIX
Security, Cyber-Resiliency	COHESITY, Cisco SECURE, NetApp, NUTANIX
Hybrid Cloud, Hybrid Work	COHESITY, citrix, servicenow, RED HAT OPENSHIFT, vmware, NUTANIX
Artificial Intelligence	NVIDIA, PURESTORAGE, NetApp, intel, AMD, NUTANIX


SoFi Stadium
HOLLY
WOOD
PARK

Helping You

Future Proof Your Investments

INTELLIGENT INFRASTRUCTURE

INTEGRATED OPERATIONS

Future Proof Workplaces

COLLABORATION DEVICES

DESIGN & BUYING GUIDES

Drivers for Change

Future-Proof Workplaces

1

Low Voltage and DC Deployments

Highlights PoE as a central strategy for commercial real estate executives

Source: [Deloitte]

2

Commercial Real Estate Loans: $4.7 Trillion

CRE loans (USA) in 2024 up for refinancing in a high interest rate environment

Source: [Markets Insider]

3

Smart buildings worldwide projected to climb

From 45 million in 2024 to 115 million in 2026 as demand grows for energy-efficient buildings

Source: [Smart Energy]

Integrated Solutions and Experiences

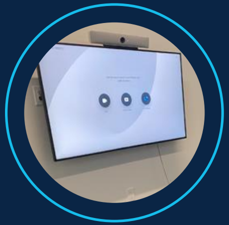
Meraki Cameras
Floor occupancy & tripwire (macro floor plate loading)

Cisco Wi-Fi AP
People count, people's physical location to track their journey through the office

Air Quality
Meraki and 3rd party sensors for CO_2, temperature, humidity, TVOC & PM2.5

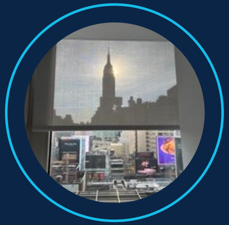
Occupancy
3rd party sensors for people count

BMS Systems
Existing building owner systems for HVAC, fire, access control, and more

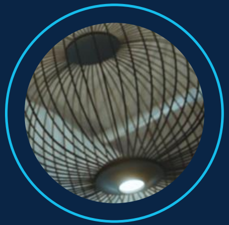


Cisco Room devices
People count, Ambient Noise

Cisco Navigator
Temperature, Humidity & TVOC



Shading
Shading sensors for Lux level to help maximize daylight and manage visual comfort & heat load



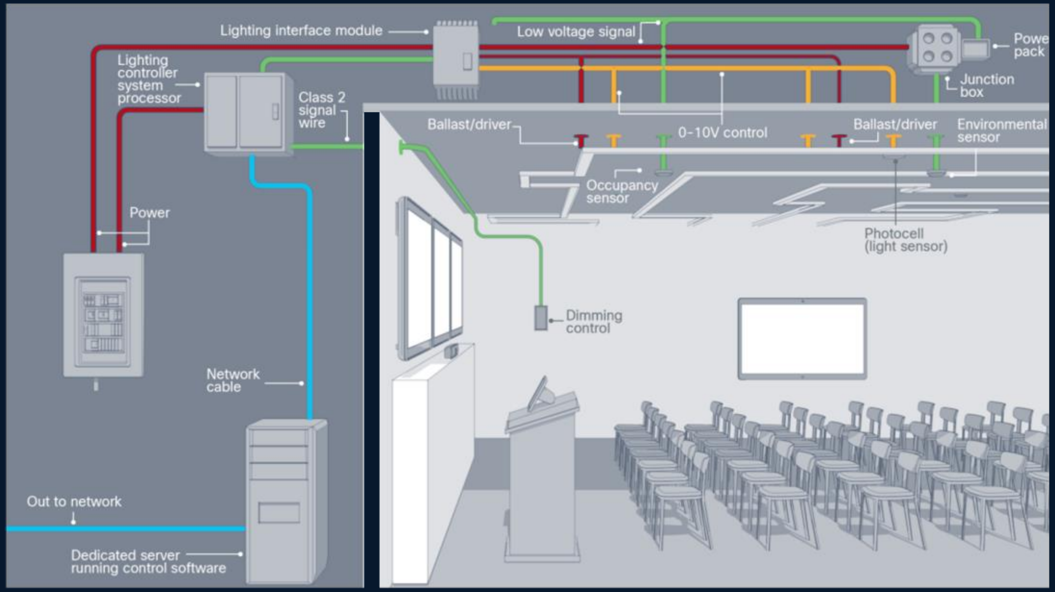
Lighting
Low voltage lighting powered by PoE can be both more efficient and can easily be powered via solar

Energy Metering
Customer owned circuit or submetering systems

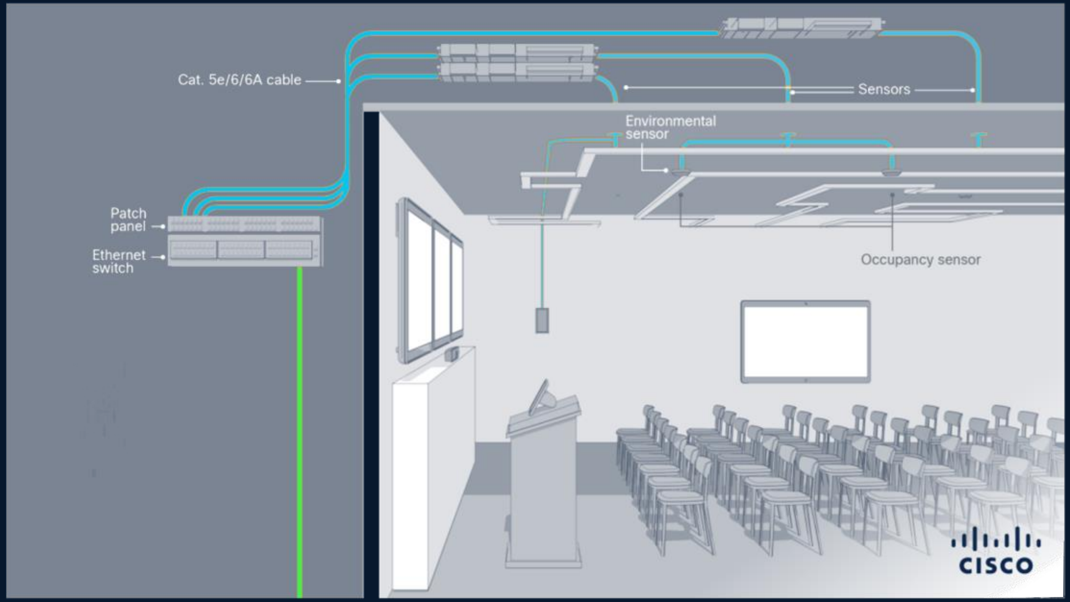
Energy Networking Before and After

Future-Proofed Workspaces

BEFORE



AFTER



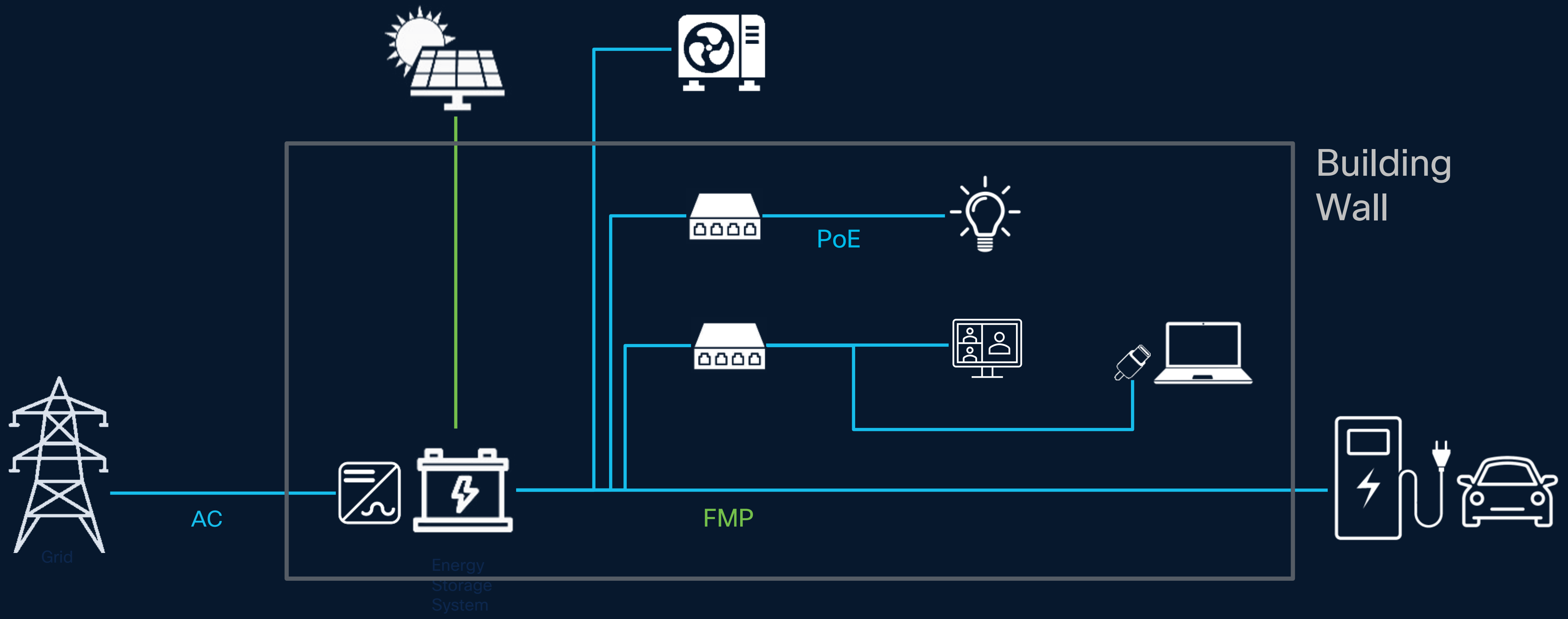
EXAMPLES

Cisco: Penn1 in NY has seen 36% energy savings

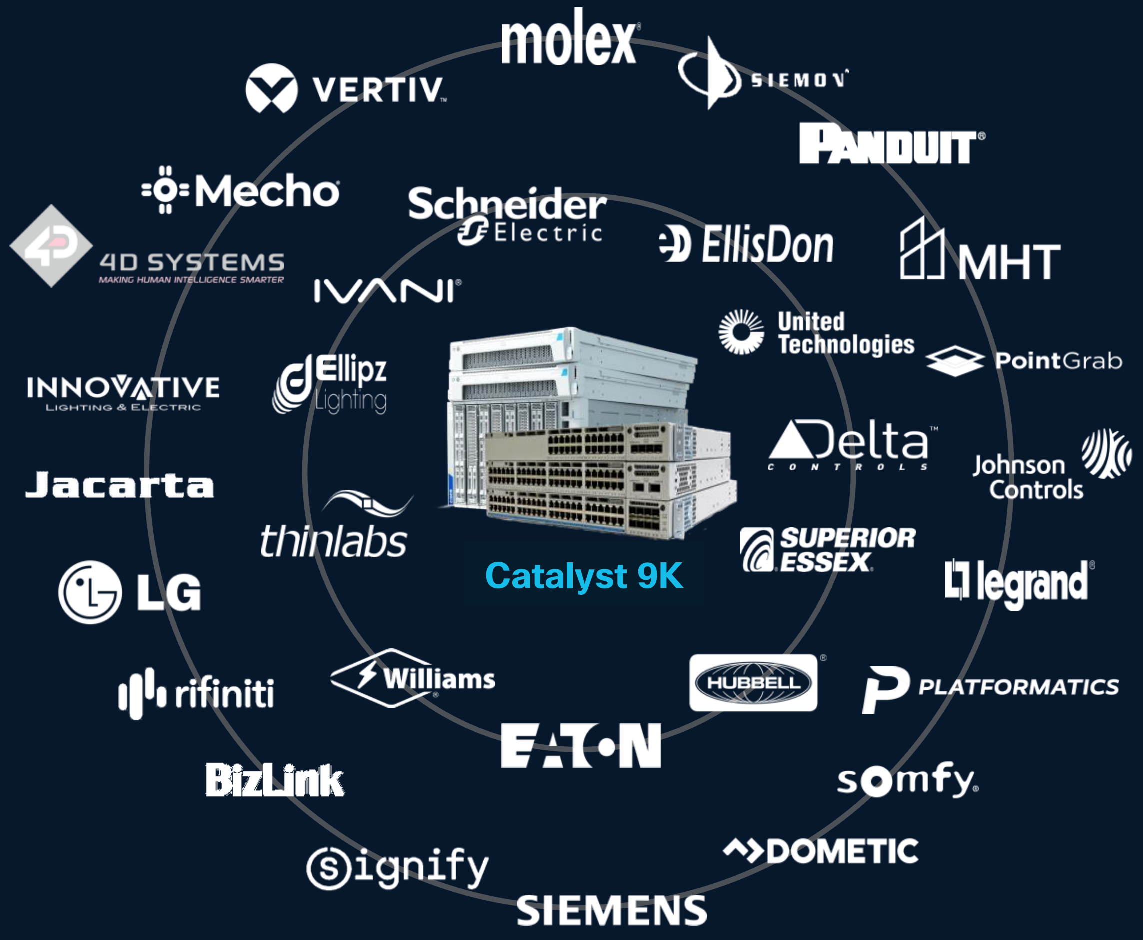
Panduit: 22% capital cost and 78% annual maintenance cost savings seen in 3 buildings + 20 remote locations with PoE switches for security cameras and monitors

FMP + PoE

Completes an End-to-End Safe DC Microgrid



An ecosystem built to deliver more sustainable outcomes in Smart Buildings



Engineering Alliances

Accelerating Technology Innovation Ecosystems

Get More Information Here

Technical Validation for Solutions | Standardization & Scale | Integrates SolutionsPlus

Retrofit for Air-Cooled Data Centers

Options for liquid cooling solutions without data center layout changes

Immersion Cooling for Data Centers

Options to solve data center hot spots or enable new high-efficiency facilities

Touch Safe High-Voltage Power Backhaul

Options to reduce cost (energy, labor, material) while increasing safety in smart buildings

Low-Voltage Last Mile Power Distribution

Using PoE for lighting, signage, and office equipment through last-mile infrastructure

AI-Ready Data Center

VERTIV. GRC DeepCoolAI Asperitas LEVITON

Future-Proof Workplaces

PANDUIT thinlabs MHT Mecho molex

Industry Relationships Driving Progress

Industry Groups

SSI Alliance

IETF

OPEN Compute Project®

ITU

EPRI

EMerge® ALLIANCE

NEMA National Electrical Manufacturers Association

the green grid® get connected to efficient IT

FMP Alliance

PoE Consortium™

Ultra Ethernet Consortium

ETSI

Infrastructure Masons

Smart Building Ecosystem Blueprint

Project 150 Consortium

cisco	Sidara	Schneider Electric	ideal	PARA
Secure, Converged Connectivity Platform	Client, Architect, Consultant, Occupier	MEP Engineering OT & BMS Partner	Secure CNS Systems Integrator	Data Visualization & Digital Consulting

New Innovations

Scale your business, accelerate outcomes and lower costs

- Energy Management – Accelerate outcomes with data insights
- Fault Managed Power - Touch-safe DC power up to 450V
- Cooling Options – Solutions to optimize your AI intensive data center
- Integrated Rack - Fully loaded system with built-in cooling technology
- Validated Design – Accelerating new innovations to market
- Industry Alliances & Standards Bodies – Aligning efforts to drive progress

Learn More Here

Visit the Showcase for related demos & sessions:

- FMP powering the Future-Proof Workplace Zone
- Data center cooling technologies in the AI-Ready Data Center Zone
- Attend interactive education with our data center VR experience in the DevNet Zone
- Participate in Capture the Flag to learn more about FMP certification
- Lightning Sessions

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Earn 100 points per survey completed and compete on the Cisco Live Challenge leaderboard.

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Thank you

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