Huawei Smart & Green Data Center

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Huawei: Leading provider of ICT infrastructure and smart devices

Bring digital to every person, home and organization for a fully connected, intelligent world

Huawei's end-to-end portfolio of products, solutions and services are both competitive and secure. Through open collaboration with ecosystem partners, we create lasting value for our customers, working to empower people, enrich home life, and inspire innovation in organizations of all shapes and sizes.

At Huawei, innovation focuses on customer needs. We invest heavily in basic research, concentrating on technological breakthroughs that drive the world forward.

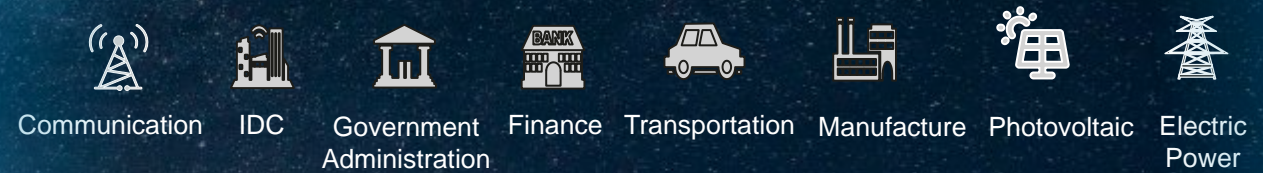| **194.000**	**104.000+**	**170+**	**68+**	**44+**
Employees	R&D employees	Countries and regions	Interbrand's Top 100 Best Global Brands	Fortune Global 500

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Huawei: Leading provider of ICT infrastructure and smart devices

Platform + Ecosystem, Facilitates Industry Success

Communication   IDC   Government Administration   Finance   Transportation   Manufacture   Photovoltaic   Electric Power

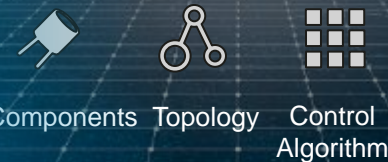Software Platform
Open resources to develop applications

+

Hardware Platform
Huawei Inside, being integrated

+

Ecosystem Partner
Work together for mutual benefits and win-win

Three Core Technologies

Power Electronics
Components   Topology   Control Algorithm

Communication
PLC   IoT

Cloud
Data   Hashrate   Platform Algorithm

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From Green Power Generation to Efficient Power Utilization

Green Power Generation

Efficient Power Utilization

Smart PV	**Site Power Facility**	**Data Center Facility**	**mPower**	**Modular Power**
Generates More Watt in Every PV Plant	Enables each Watt to power more Bits	Enables each Watt to power more HashRate	Longer cruising range per Watt	Serving various industries and enabling efficient power utilization
• Group series inverter • PV controller • Management system for PV plants	• Power supply solutions for telecom and society site • Accommodation & Cooling • Energy Storage System	• Power supply and distribution system • cooling system and mgmt. system for DCs	• Power system • charging system • battery mgmt. system for electric vehicles	• Modular Power Supply Solution for Digital Transformation of Thousands of Industries

Floating solar plant 60MW @Huaibei, Anhui

Solar access in CO rooms @Zhuhai 100% green power

Green power for DC @Qinghai 100% green power

Solar access in campus @Dongguan, 17.5MW, PV + charging

100% green power co-construction

Smart Modular Prefabricated Datacenter 90s video

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Huawei Green Data Center Proposition

Green Construction
Less resource footprint

- Quick TTM@ Prefab Modular DC
- Reduced resource footprint
- High recycling rate

Green Energy Supply
Renewable energy

- Solar powered DC
- Multiple clean energy use
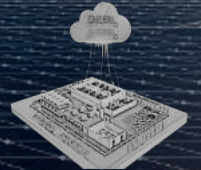- Energy storage +DC

Green Data Center

Efficient Energy Usage
Low PUE&WUE

- Efficient power@simplified and converged solution
- Efficient cooling@freecooling and AI efficiency optimization

Smart Management
Carbon footprint visibility

- Digital Twins
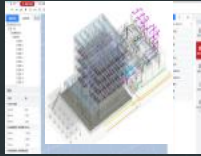- AI-enablement
- Energy Cloud

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Green Data Center – Lifecycle Carbon Management , More than PUE

Reduce Carbon Emission

CO₂ neutral

Visualize Carbon Footprint

Planning	Construction	Operations & Maintenance & Optimization		Recycling
• Digital planning • Modular design	• Less resource • Less waste	• Less PUE&WUE • More renewables	• Digital O&M • Less manpower footprint	• More material recycled • Less waste disposal
		• Automatic optimization • Smart recommendation		
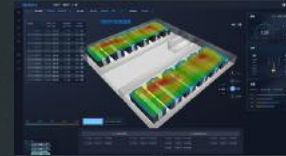
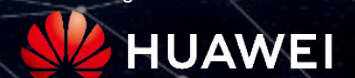| **Facility Deployment**	**DC Operation**	**Demolishing**
• Construction resource consumption • Construction waste	• PUE & WUE & CUE • Resource utilization • Efficiency • O&M carbon footprint	• Recycling rate

Notes: PUE=Power Usage Effectiveness, WUE=Water Usage Effectiveness, CUE=Carbon Usage Effectiveness

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The Journey so far…..

More than 1000 DC sites Build Experience

World's largest DC

UAE A100
1200+ Racks

Largest Carrier building DC
Central Plains Base of China Unicom, Henan，21500 Racks

Largest Edge DC Contract

Philippines TNT 300+ EDC

Highest Altitude DC

China Mobile DC, Lhasa,Tibet, Altitude 3650m, 6600Racks

China Mobile of Shanxi，938 Racks TTM 5M，including building

First promise PUE DC

Southeast Information Park，Fujian 2910 Racks,PUE1.39

Numerous Uptime Tier certification

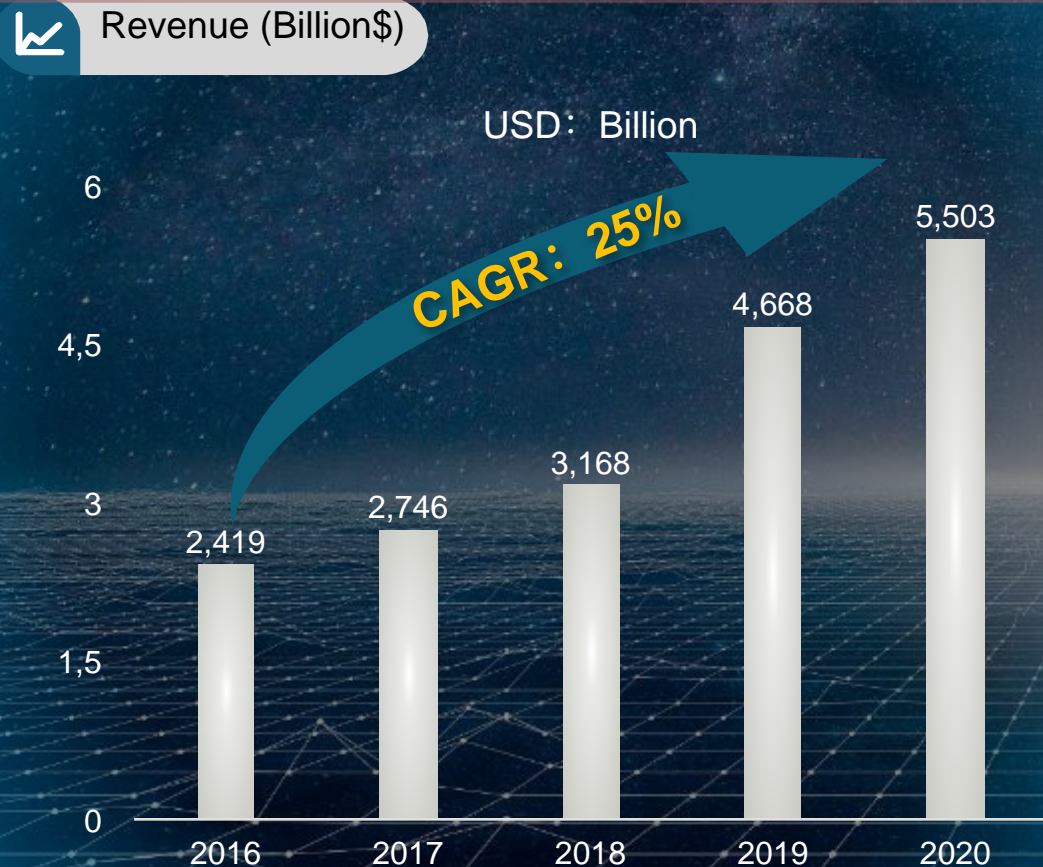**Dubai Airports DXB MDCC**

Nigeria Cloud Exchange Data Center

Batelco Hamala DC

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Continuous and high-speed growth, solutions are widely recognized in the industry

Huawei Digital Power sales revenue

Revenue (Billion$)

USD：Billion

CAGR: 25%

Year	Revenue
2016	2,419
2017	2,746
2018	3,168
2019	4,668
2020	5,503

Huawei Digital Power serves one third of the world's population across more than 170 countries and regions

Smart PV

No. 1 in the global market for six consecutive years. **175GW** smart PV plants Source 1

Data center facility

Prefabricated modular data center solution: No. 1 in the global market for six years. Smart module: No. 1 in the Chinese market for seven years   Source 2

Site power

No. 1 for eight years since 2013. serving **170+** countries and regions   Source 3

mPower

The world's first x-in-1 ePowertrain DriveOne

Embedded power

675+ Million PCS delivered

Source 1:   IHS Markit
Source 2:   Omdia
Source 3:   Frost & Sullivan

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Zero-carbon, Elastic Expansion, Simple Architecture, and AI Enabled are the Main DC Development Trends

Zero Carbon

Carbon neutrality triggers a green revolution. PUE enters 1.0x era, and "zero carbon" DC becomes a reality

Usage of green power: such as **wind and solar energy**, will be widely applied to data centers.
Energy saving and water saving: New technology and new construction mode and AI energy saving technology are applied to data centers.

Elastic Expansion

The infrastructure will be elastic. The first-generation infrastructure matches the second-generation and third-generation IT power evolution

Power density	1st G 4kW/R	2st G 8kW/R	3st G 12kW/R
IT lifecycle	3~5years	3~5 years	3~5years
DC lifecycle	10 ~ 15 years		

Simple Architecture

Converged, prefabricated, system-level, and DC-level simplified architectures will become mainstream applications.

Simplified DC prefabrication

- Prefabrication delivery
- Full modular design: on-demand deployment

Simplified Power System

- Convergence and simplified
- Prefabricated Bus bar

Simplified cooling system

- Air in and water out / Free cooling
- Indirect evaporative cooling

AI Enabled

AI will gradually replace duplication of effort, expert experience, and business decision-making, Autonomous Driving Data Centers are coming

AI energy efficiency

- Energy efficiency diagnosis
- Energy efficiency optimization

AI operation

- AI unattended inspection
- AI Predictive Maintenance

AI management

- AI simulation
- AI service prediction

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Key Driver for Success - Innovation

"0" wait time for rollout

TTM **20** Months —>**6~9** Months

Simple
Reshape Architecture

Prefabrication： TTM20 Months->6~9 Months

Modular: On-demand deployment and phased investment

Elastic architecture: supporting IT evolution

"0" waste of energy

PUE1.45 —> 1.15@Beijing

Green
Reshape Cooling

AI energy saving: PUE1.45 -> 1.15, saving 40% water

Environment-friendly: less construction waste and no noise

"0" manual O&M

O&M costs reduced by **35%**
Resource utilization improved by **20%**

Smart
Reshape O&M

AI-powered, Data Center autonomous driving

AI intelligent inspection and operation

Comprehensive defense of software and hardware: 7 x 24h network security

"0" service interruption

Predictive Maintenance

Reliable
Reshape Power

PowerPOD & SmartLi： ultimate reliability

AI Predictive Maintenance: Zero Service Interruption

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FusionDC: Fully Modular and Prefabricated DC, TTM reduce 50% Green as Design

Challenges

- The construction period of traditional data centers is long, which cannot meet service development requirements.
- In the context of carbon neutrality, building zero-carbon data centers has become a consensus.
- The actual PUE is often higher than the designed PUE.

Prefabricated Modular DC

Full-stack convergence, build the DC you desire

Power Module | Cooling Module | IT module
Stair Module | Corridor Module | Office module

	Traditional Solution	Prefabricated Modular Solution	Benefits
TTM	18 months	6 months	TTM 12 months earlier, resulting in an early revenue of $18 million.
PUE	1.4	1.2	Energy saving by 14% and annual electricity cost saving by $1.25 million
Recycle	< 30%	> 80%	Increases the recycle rate by 50% and reduces carbon emissions by more than 8000 tons.
ROI	8 years	6.8 years	1.2 years in advance
IRR	6%	9.5%	Increase by 3% +

Model: 1500 cabinets@Beijing, 8 kW/cabinet, 2N, 50% load, electricity fee: 0.12 $/kWh, cabinet rental: 1000 $/month

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Modular UPS with SmartLi to Build the Best Power System

3U **100 kW module**

200~**1600kVA** full-capacity coverage

- 1 MW One cabinet
- Intelligent online efficiency: 99.1%
- Redundancy of key components, zero single point of failure
- 5-minute module maintenance

- Battery cell: LFP
- Typical backup time: 300KW@10 min/cabinet
- Fire extinguishing system: Module-level
- Huawei UPS and third-party UPS/HVDC
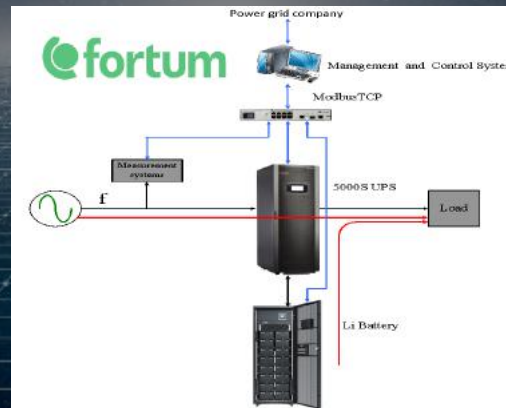

On-demand expansion

Phase 1 → **Phase 2**

Online expansion

UPS   SmartLi   UPS   SmartLi

FFR Function

Power grid company
fortum
Management and Control System
ModbusTCP
Measurement system
5000S UPS
f
Load
Li Battery

More IT Racks, More Revenue

2* （600k UPS+3 VRLA strings）
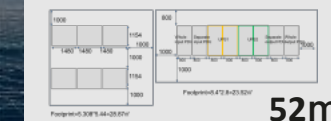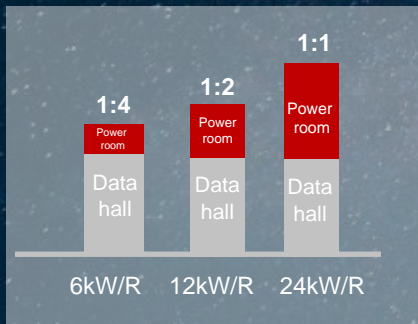
52m²

VS

1200k UPS+ 6 SmartLi cabinet
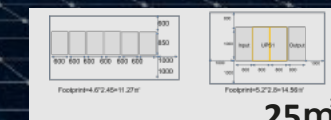
25m²

- Deploy extra 5 IT racks
- 10 years revenue from extra 5 racks:

900*5*12*10=

540,000 EUR

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PowerPoD: Converged Power Supply, Super Efficiency 97.6%, Super Small Footprint reduce 40% Power Room Area

Challenges

Footprint of power room increase very fast

1:4 — 6kW/R
1:2 — 12kW/R
1:1 — 24kW/R

Power room / Data hall

Low load rate, Low Efficiency

- load rate＜40%.
- Power system efficiency＜94%

Low reliability, difficult O & M

- 33% outages are caused by ower system
- low manual O & M efficiency, failure to identify potential risks

Traditional power system & lead-acid battery solution

medium voltage transformer
low voltage distribution

Inputting UPS Output Tributary

Various devices and large area occupied, long term delivery and low efficiency

PowerPOD & SmartLi solution

Full-chain convergence, highest power density, AI-powered, most reliable

|	Traditional solution		Huawei
Installation area	1800 m2	1100 m2	Reduces the area by 40%, deploys additional 200 IT cabinets, and generates more revenue of 3M$ per year.
Delivery Time	2 months	2 weeks	Save 75% time
Efficiency	94%	97.6%	Power cost saving: 0.3M $/ year
Reliability	Large number of dumb devices, high risks	AI enablement	From passive to active prediction (200+ sensor Temperature monitoring, AI low-load temperature rise warning, component life prediction, online switch setting, and sound & image AI recognition)

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EHU: Fastest Delivery in the Industry, Optimal Energy Efficiency @AI

Challenges

- The data center consumes high energy, but the cooling system contribute a high percentage.
- In the context of carbon neutrality, policies have been issued around the world to increase the PUE threshold, and low PUE has become a basic requirement for DC construction.

Power 8% | Other 2% | PUE1.6 | IT 62% | Cooling 28%
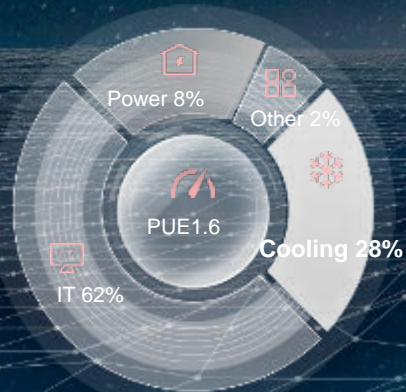
Maximize the use of natural cold sources @AI

Chiller | Cooling Tower | Tank | CRAC | Pump | Plate heat exchanger | DCM

New

Traditional chilled water

- The construction period is long, and the cooling system takes up 66%.
- Four times of heat exchange, low heat exchange efficiency
- Six major components, depending on manual O&M

AHU

- **One box one system, and simplified delivery**
- Heat exchange from chilled water to natural cold source
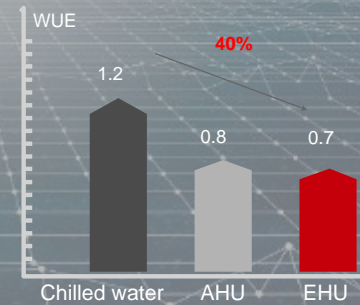- AI Powered, the first commercial AI energy optimization solution

EHU (400kW/260kW)

- Six into one, shortening the delivery time to three months
- Supplied by Lithium battery directly, continuous cooling, zero interruption
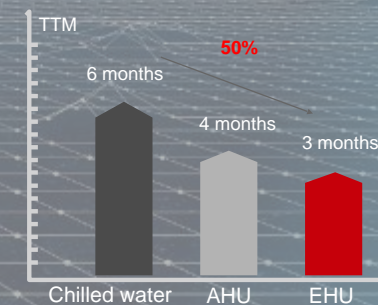- GUE is increased by 3%

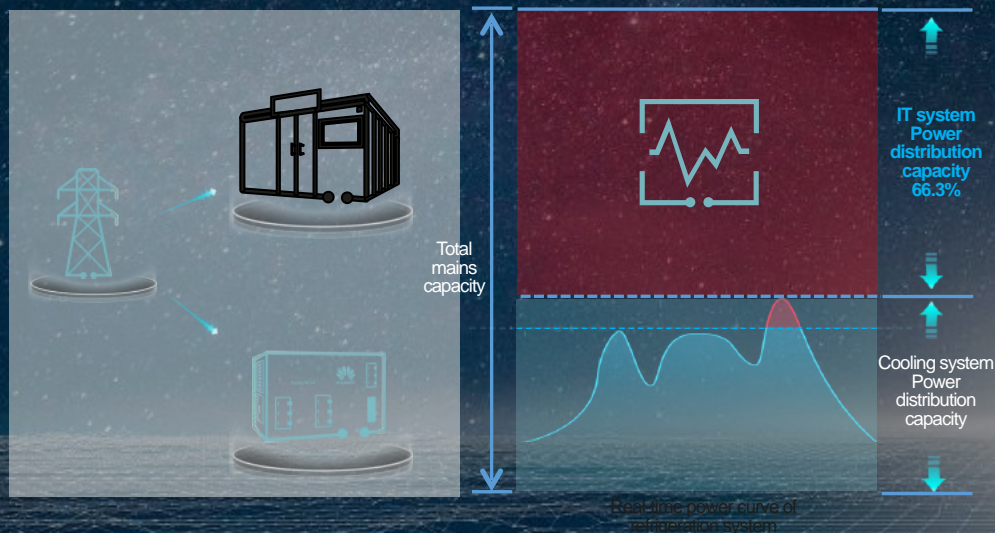Power cost saving: 500k USD/year
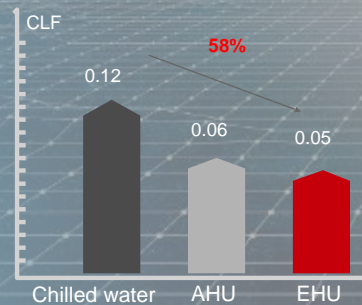
Water cost saving: 20k USD/year

Engineering cost saving: 250k MUSD

CLF — 58%
- Chilled water: 0.12
- AHU: 0.06
- EHU: 0.05

WUE — 40%
- Chilled water: 1.2
- AHU: 0.8
- EHU: 0.7

TTM — 50%
- Chilled water: 6 months
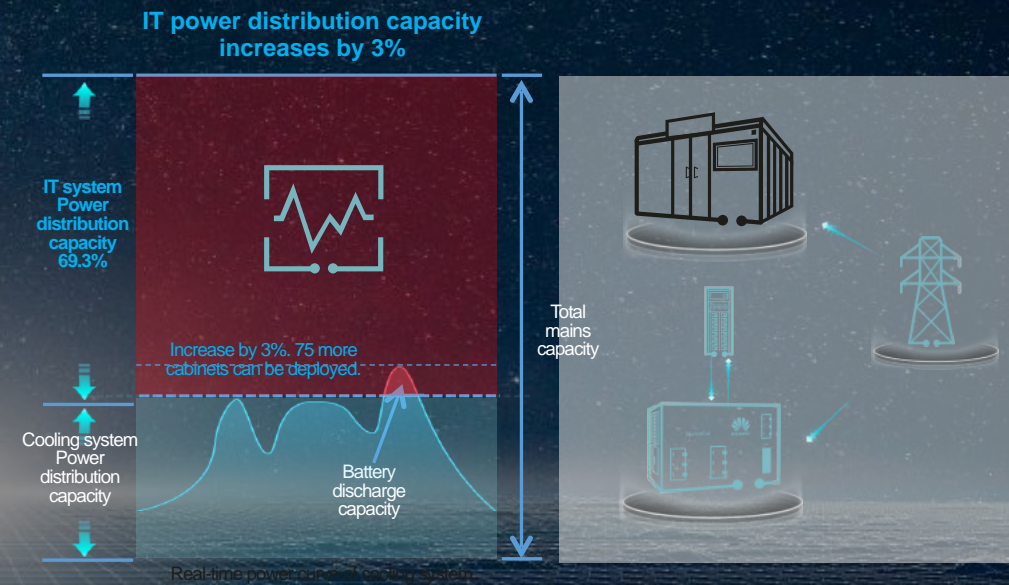- AHU: 4 months
- EHU: 3 months

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EHU: Improves the Data Center Power Utilization Rate by 3% and Increases the revenue by 0.6M $/year

Traditional power supply architecture, cooling peak power restricts IT power capacity

EHU: The energy storage system adjusts the peak cooling power to improve power utilization

IT power distribution capacity increases by 3%

Total mains capacity

IT system Power distribution capacity 66.3%

Cooling system Power distribution capacity

Real-time power curve of refrigeration system

IT system Power distribution capacity 69.3%

Increase by 3%. 75 more cabinets can be deployed.

Cooling system Power distribution capacity

Battery discharge capacity

Real-time power curve of cooling system

Total mains capacity

- The cooling power distribution capacity needs to be reserved based on the peak power of all working conditions.
- The hybrid mode has a high peak power, which restricts the available power capacity of the IT system (GUE 66.3%).

- Peak power regulation through energy storage system, which allows more power capacity to be allocated to IT systems
- The GUE is increased by 3% (from 66.3% to 69.3%), and the revenue is increased by 0.6 MUSD/ year.

Model: 1500 cabinets, 8 kW/cabinet, 50% load rate @ Beijing, 0.12 $/kWh, GUE = Total IT designed power/Total mains capacity

Model: 1500 cabinets, 8 kW/cabinet, 50% load rate @ Beijing, electricity fee 0.12 $/kWh, water fee 0.7 $/kWh...

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AI Energy Optimization： from manual Optimization to Intelligent Cooling, Improve PUE By 8%~15%

Manual Optimization

- Traditional chilled water systems are complex and difficult to optimize
- Manual experience judgment and single-component optimization
- Few manual adjustment parameters, long adjustment period, and difficult to maintain the effect

AI Energy Efficiency Optimization: iCooling

- Support training optimization model in local server
- Deep neural network modeling, model precision > 99.5%, and adjustment accuracy
- Real-time inference based on genetic algorithms, finding the best policy within 1 minute, fast adjustment
- The overall cooling system is adjusted, saving energy by 8% to 15%

Successful Cases

Henan Union Zhongyuan Data Center

- Reduce PUE from 1.54 to 1.35, by 12%
- Saving power cost 800 kUSD per year

Ningxia Mobile Zhongwei Data Center

- Reduce PUE 1.6 to 1.48 (20% load)
- Saving power cost 200 kUSD per year

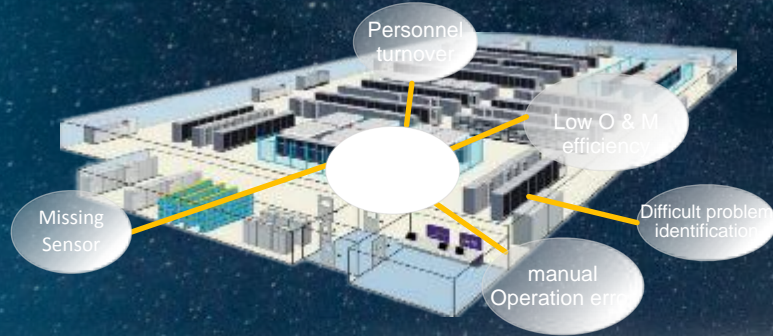### Guangxi Telecom Huangmaoping Data Center

- Reduce PUE from 1.57 to 1.42
- Saving power 2.73 million kWh

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Digital + Intelligent Management, Building A Digital Light-out Factory

O & M labor shortage, low efficiency, and high cost

- 61% of data centers lack qualified O & M engineers.
- High Labor O & M costs, accounting for 5~10% OPEX
- Data center failure rate, up 6% in 2019 from 2018, 80% preventable
- SPC resources low utilization

Labels on diagram: Personnel turnover, Low O & M efficiency, Difficult problem identification, Missing Sensor, manual Operation error

Full Visibility, Manageability， DC autopilot @AI

Intelligent Visualization
Digital foundation

Intelligent O&M
Reduce O& M costs by 35%

Intelligent Operation
resource utilization is improved by 20%

PUE Optimization
PUE↓ 8~15%

System visibility | Large screen report | BIM 3D Visualization | Digital management | AI robot | Asset management | Capacity management | Energy efficiency analysis | Big Data | AI optimization

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Data center facility: simple, green, smart and reliable

Prefabricated modular DC
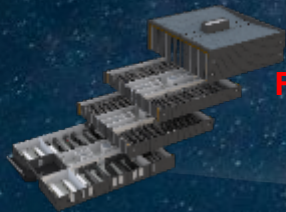
Outdoor data center

From traditional building to Lego-style architecture

One floor for one DC, the delivery consistent with actual design, 1000 racks within 6 months

Smart modular DC

Indoor data center

From modular to intelligent

Any room can be a Data Center, one module for one DC

Smart power

From distributed components to converged power supply

Ultra-high reliability, density and efficiency

Smart cooling

From chilled water to natural cooling sources

Maximizing natural cooling sources @ AI

Smart O&M

From manual O&M to smart O&M

reddot winner 2020

Security and reliability, autonomous driving

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Digital Power: Your Best Partner for a Better, Greener Future

By June 30, 2021, Digital Power has helped customers

generate green power	save power	reduce carbon emissions	equivalent to planting
403.4 billion kWh	**12.4 billion** kWh	**200 million** tons	**270 million** trees