

Huawei Smart & Green Data Center



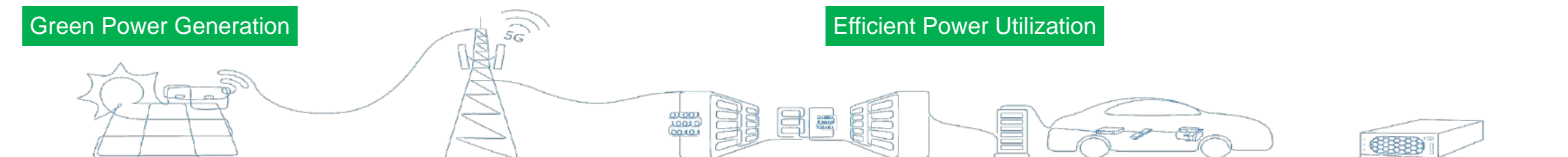
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HUAWEI

From Green Power Generation to Efficient Power Utilization



Green Power Generation

Efficient Power Utilization

Smart PV

Generates More Watt in Every PV Plant

- Group series inverter
- PV controller
- Management system for PV plants

Site Power Facility

Enables each Watt to power more Bits

- Power supply solutions for telecom and society site
- Accommodation & Cooling
- Energy Storage System

Data Center Facility

Enables each Watt to power more HashRate

- Power supply and distribution system
- Cooling system and mgmt. system for DCs

mPower

Longer cruising range per Watt

- Power system
- Charging system
- Battery mgmt. system for electric vehicles

Modular Power

Serving various industries and enabling efficient power utilization

- 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










The Journey so far.....

More than 1000 DC sites Build Experience

<p>World's largest DC</p>		<p>Largest Carrier building DC Central Plains Base of China Unicom, Henan, 21500 Racks</p>	
<p>UAE A100 1200+ Racks</p>			
<p>Largest Edge DC Contract</p>		<p>Highest Altitude DC China Mobile DC, Lhasa, Tibet, Altitude 3650m, 6600Racks</p>	
<p>Philippines TNT 300+ EDC</p>			
<p>China Mobile of Shanxi, 938 Racks TTM 5M, including building</p>		<p>First promise PUE DC Southeast Information Park, Fujian 2910 Racks,PUE1.39</p>	

Numerous Uptime Tier certification

	<p>Dubai Airports DXB MDCC</p>	
		
	<p>Nigeria Cloud Exchange Data Center</p>	
		
	<p>Batelco Hamala DC</p>	
		

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



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



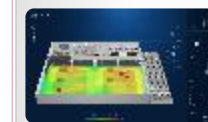
- Energy efficiency diagnosis
- Energy efficiency optimization

AI operation



- AI unattended inspection
- AI Predictive Maintenance

AI management



- AI simulation
- AI service prediction

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

PUE**1.45** → **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 suite of software and hardware: 7 x 24h network security



“0” service interruption

Predictive Maintenance

Reliable
Reshape Power

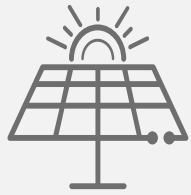
PowerPOD & SmartLi: ultimate reliability

AI Predictive Maintenance: Zero Service Interruption



Green Data Center Requires Green Energy Supply, Green Construction, Efficient Energy Usage, and Smart Management

Green Energy Supply



Green electricity supply

- Overlay PV power generation in data center park
- Use clean energy sources such as wind power, solar power, hydropower and other clean energy sources.

Green Data Center PUE <1.1x



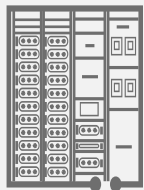
Green Construction



Prefabricated assembled building

- Few wastes generation during construction period
- **Operation PUE = Design PUE**
- Building's recycling rate > 80%, low carbon throughout the lifespan

Efficient Energy Usage



Efficient cooling/power supply

- Maximize the use of natural cold sources
- Shorten power supply links, reduce conversion levels, and improve conversion efficiency.

Smart Management

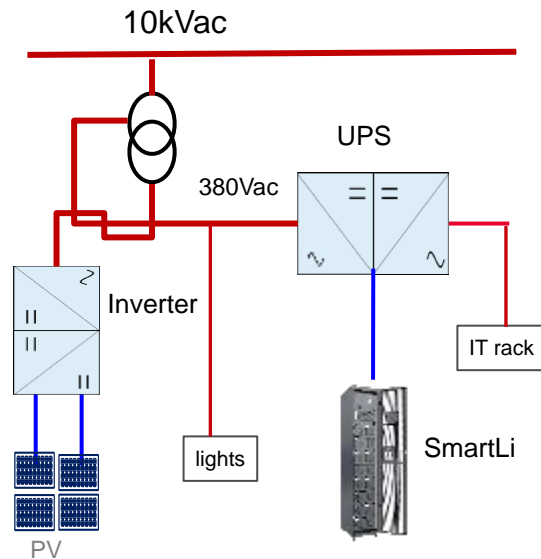


Digital twin, energy cloud system optimization

- Use the BIM technology for planning, construction, and O&M.
- Digital twins, visible and controllable throughout the lifespan
- Digital technologies optimize energy efficiency and reduce carbon emissions.

Green Energy for DC, Support the Sustainable Development Goals

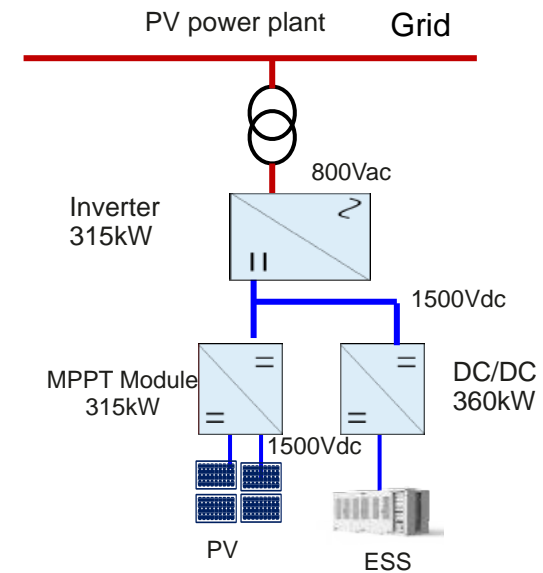
Self-use scheme for PV near-end



- Smart string ESS, One package, one optimization, one cluster, one management
- 30% more power generation
- reducing the LCOS by more than 20%

- Capacity: 0.5MW @ 4500m²
- carbon emission reduction :
4.1k Tons/10 years

PV power plant



Reduce carbon emission
0.8M Tons/10 years

- ±1500V bipolar string, AI plus, comprehensive intelligence
- Reduce LCOE by 7%
- The energy yield is increased by > 2%

Model: 1500 racks, 8kW/Rack, 75% load rate PV plant 4563 m², PV 0.5MW, 1kWh=0.68kg CO₂, Equivalent sunshine time

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



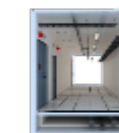
Cooling Module



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% +

High-Density UPS with Intelligent Online Mode to Build the Best Power System

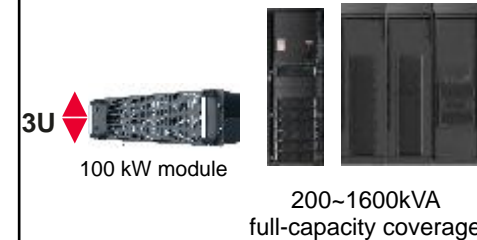
Traditional tower UPS



- Large footprint
- Low efficiency < 94%
- No redundant protection
- Hard to maintain



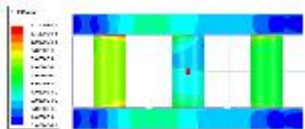
High efficiency modular UPS



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

3 U 100 kVA, Super High Density

Less Footprint



- "Topology pooling" patent, reducing the size by 40%
- Patented magnetic integration reduces the inductance volume by 20%.

Less power consumption

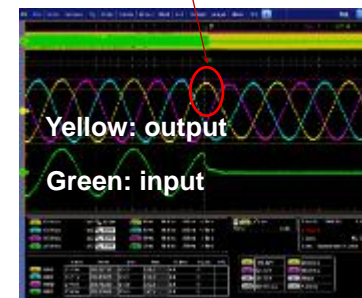
- IGBT: Innovative Low-Loss Technology
- Diode: silicon carbide (SiC) diode
- Inductor: patented magnetic core

Better heat dissipation

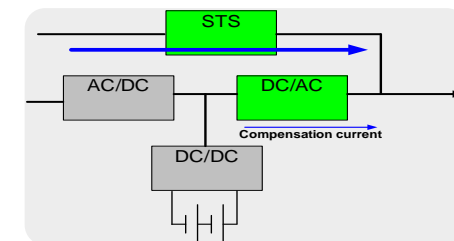
- U-shaped symmetrical architecture
- wide-angle heat dissipation layout,
- innovative heat dissipation capability

Intelligent Online Mode—0ms transfer+99%Efficiency

Intelligent Online Mode: uninterrupted output



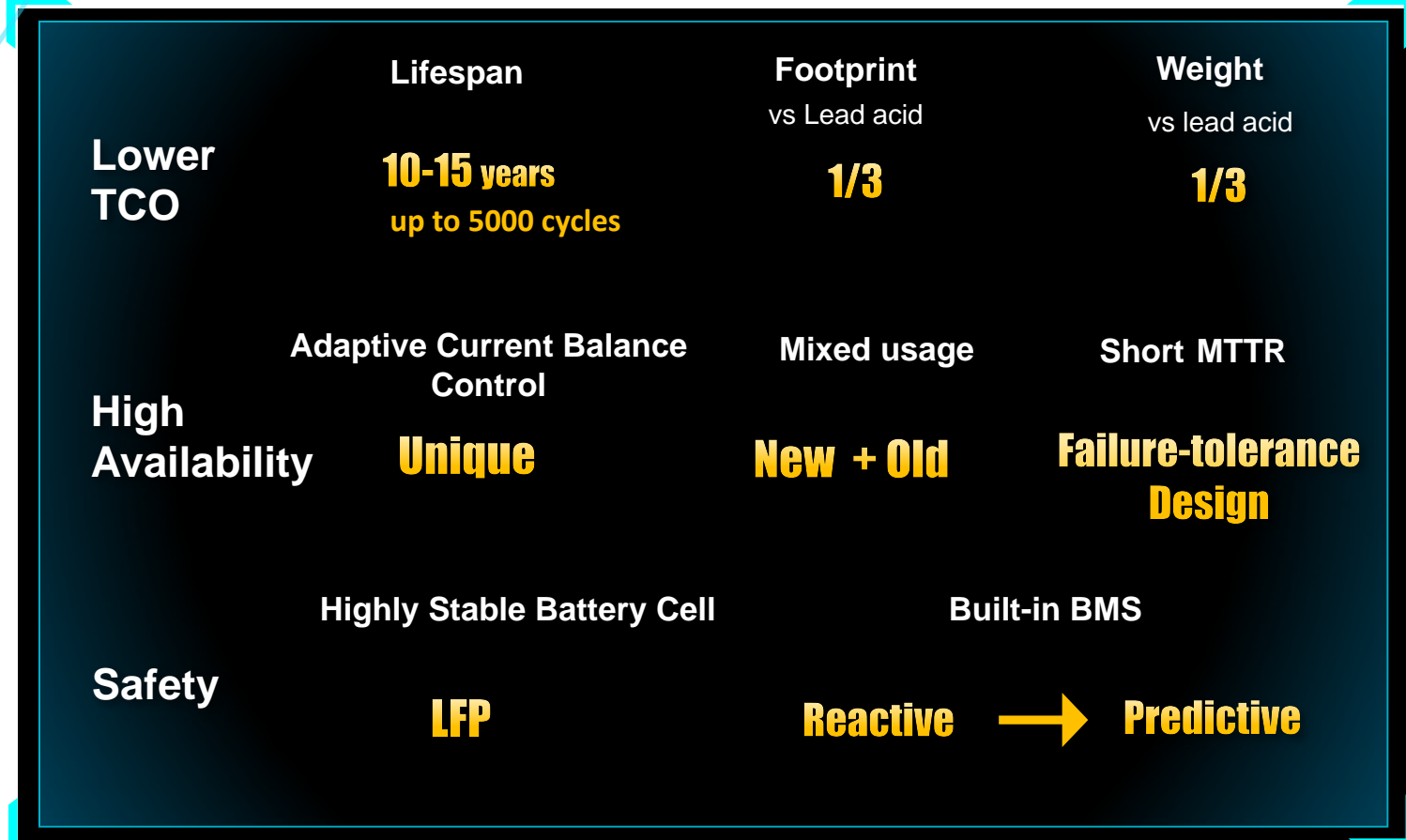
Switching to the inverter mode
0 ms, uninterrupted



With Smartli, Huawei is Leading the Revolution of UPS Battery



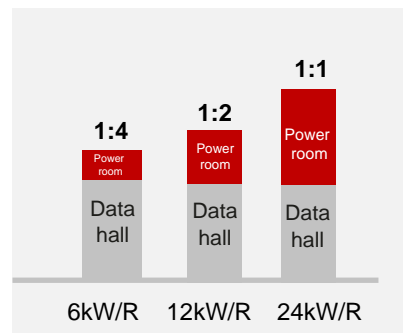
1 cabinet 300kW @10mins



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

Challenges

Footprint of power room increase very fast



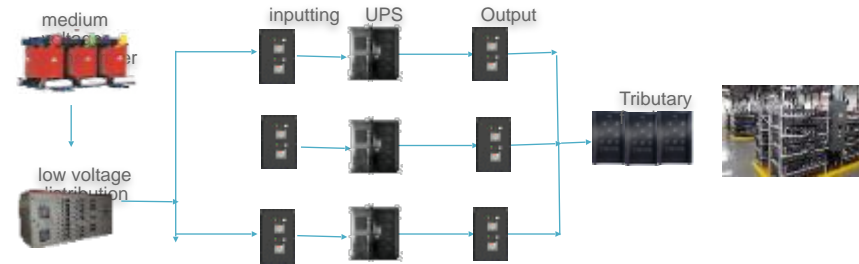
Low load rate, Low Efficiency

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

Low reliability, difficult O & M

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

Traditional power system & lead-acid battery solution



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

Installation area	1800 m ²	1100 m ²
Delivery Time	2 months	2 weeks
Efficiency	94%	97.6%
Reliability	Large number of dumb devices, high risks	AI enablement

Huawei

Reduces the area by 40%, deploys additional 200 IT cabinets, and generates more revenue of 3M\$ per year.

Save 75% time

Power cost saving: 0.3M \$/ year

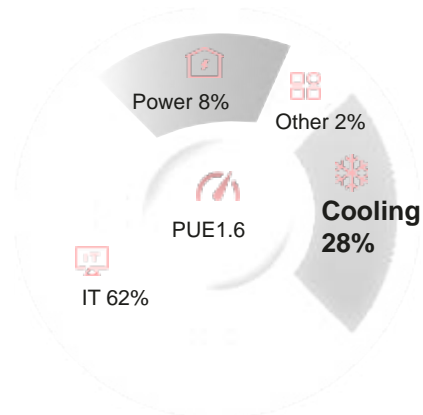
From passive to active prediction (200+ sensor Temperature monitoring, AI low-load temperature rise warning, component life prediction, online switch setting, and sound & image AI recognition)

Model: 1500 racks, IT load 8 kW/R, 2N architecture, load rate 50%, electricity fee 0.12 \$/kWh, water fee 0.5 \$/ton, and rent 1000 \$/month.

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.



Maximize the use of natural cold sources @ AI



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

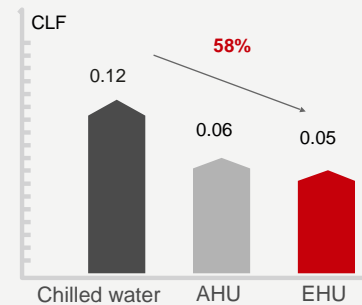
AHU

- 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

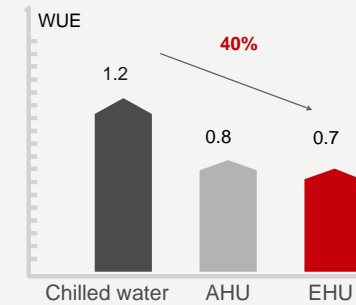
EHU (400kW/260kW)

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

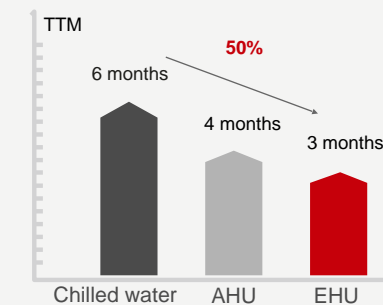
Power cost saving: 500k USD/year



Water cost saving: 20k USD/year



Engineering cost saving: 250k MUSD



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

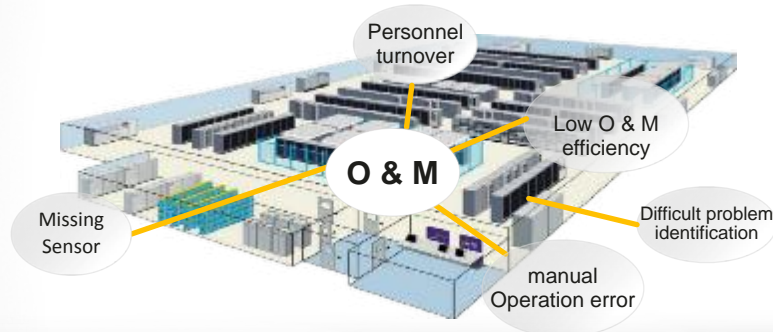
Guangxi Telecom Huangmaoping Data Center



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

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

Full Visibility, Manageability, DC autopilot @AI

Intelligent Visualization

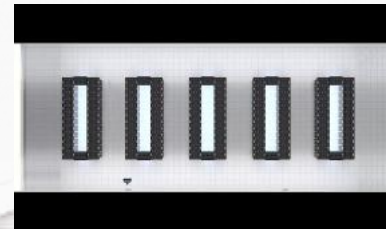
Digital foundation



System visibility Large screen report BIM 3D Visualization

Intelligent O&M

Reduce O& M costs by 35%



Digital management AI robot

Intelligent Operation

Resource utilization is improved by 20%



Asset management Capacity management

PUE Optimization

PUE ↓ 8~15%



Energy efficiency analysis Big Data AI optimization

Huawei Smart DC Maximizing the Value of Data Center Facility

Data Center Model

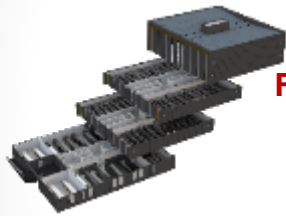


- The overall operation period of the project is 10 years (construction + operation). Geographic location: North China
- The load rate is 50%, the rental rate is 85%, and the rental of a single cabinet is 1000\$/month.
- Electricity fee is 0.15 \$/kWh, capacity fee is 7\$/kVA/month, and water fee is 0.7\$/ton.

Key Parameters	Traditional DC	Huawei Smart DC	Changes
TTM	Construction period > 20 months	Fully prefabricated + fully modularized, 6 months to go to market	TTM reduced 14 months
Amount of racks	1500 IT cabinets, 8 kW/cabinet	More cabinets can be deployed in the same area: 1650 cabinets, 8 kW/cabinet	Add 150 IT cabinets
Initial Investment	Buildings: one-time delivery Three phases deployment	On-demand deployment, on-demand capacity expansion for three phases	16% reduction in initial investment
GUE	66.3%	69.3%	Increases 3% or 0.6M \$/year revenue
OPEX-O&M efficiency	Single-cabinet O&M cost: 35\$/month/cabinet	Single-cabinet O&M cost: 13\$/month/cabinet	O&M costs are reduced by 35%.
IRR	10.00%	15.09%	5.09% improvement
ROI	6.82 years	5.76 years	Reduced by 1.06 years

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



Security and reliability, autonomous driving

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



Conversion note:

Note 1: Conversion coefficient of electricity carbon emissions – 1 kWh electricity is equivalent to 475 g CO₂ (global average).
Source: International Energy Agency (IEA) Global Energy & CO₂ Status Report 2018

Note 2: Lifetime CO₂ absorption of trees (equivalent number of planted trees) – A tree absorbs 18.3 kg of CO₂ a year, and each tree has a 40-year lifespan.
Source: Open data of the North Carolina State University website