2023 Shenzhen Digital Energy White Paper

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Creating a Green Future with Digital Energy

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Development and Reform Commission of Shenzhen Municipality

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Vision

Foreword

Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, we will implement the new strategy of “Four Revolutions and One Cooperation” for energy security development, and accelerate the construction of a new energy system to support the realization of carbon peaking and carbon neutrality goals. In terms of energy, the in-depth integration of the energy revolution and digital technologies is being applied across the board, to the extent that we're embracing a new era of "digital energy". This is of great significance to enhance the core competitiveness of the energy industry and promote the high-quality development of energy.

In recent years, Shenzhen, as a core engine city of Guangdong-Hong Kong-Macao Greater Bay Area (GBA) and a pilot demonstration area of socialism with Chinese characteristics, has thoroughly implemented the innovation-driven development strategy and injected great impetus to the construction of digital government and smart city with pioneering and exemplary standards. In terms of digital energy, we will, combining the global vision with Shenzhen characteristics, align with the global cutting-edge technologies and practices, promote the in-depth integration of digital technologies and the development of energy industry, and unleash the value potential of energy data elements, in an effort to gradually build a green, efficient, flexible, intelligent and sustainable modern energy system.

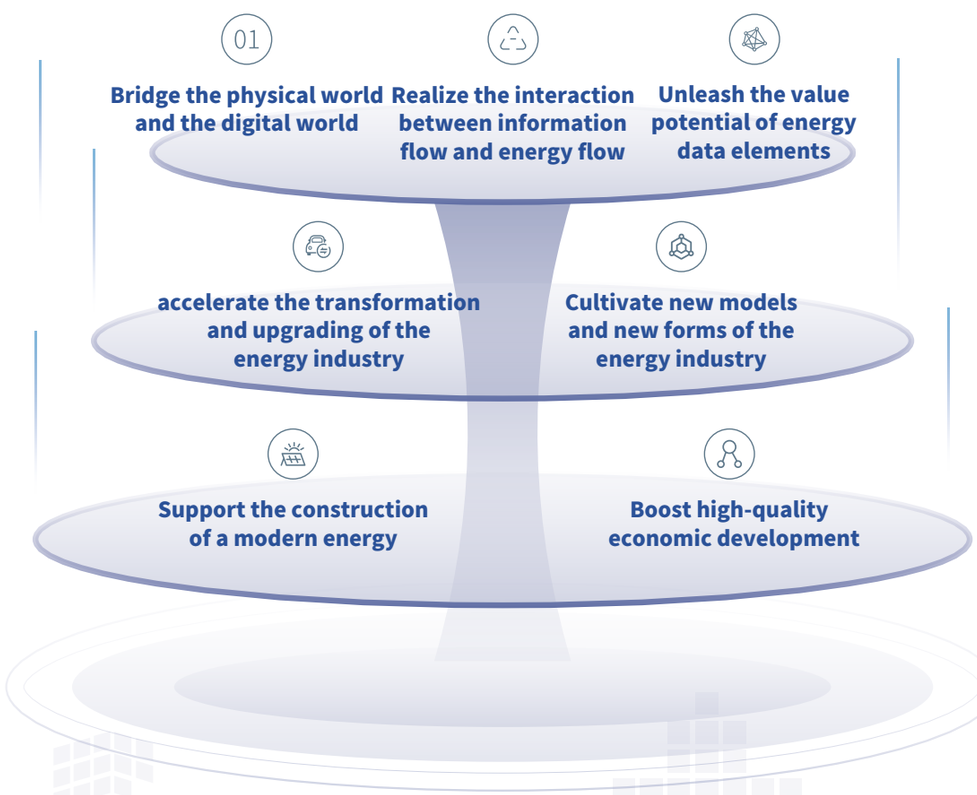
In order to promote the high-quality development of digital energy, this White Paper is prepared by Guangdong Energy Consulting and Planning Research Center and co-edited by Guangdong Electric Power Design Institute Co., Ltd. of China Energy Engineering Group, State High-Tech Industrial Innovation Center, Shenzhen, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, and China Southern Power Grid Energy Development Research Institute Co., Ltd. It starts with the connotation and framework of digital energy, followed by the key technologies and Shenzhen practices in all aspects of energy industry, to explore the impact of the in-depth integration of energy revolution and digital technologies on Shenzhen and even the global development.

Connotation of Digital Energy

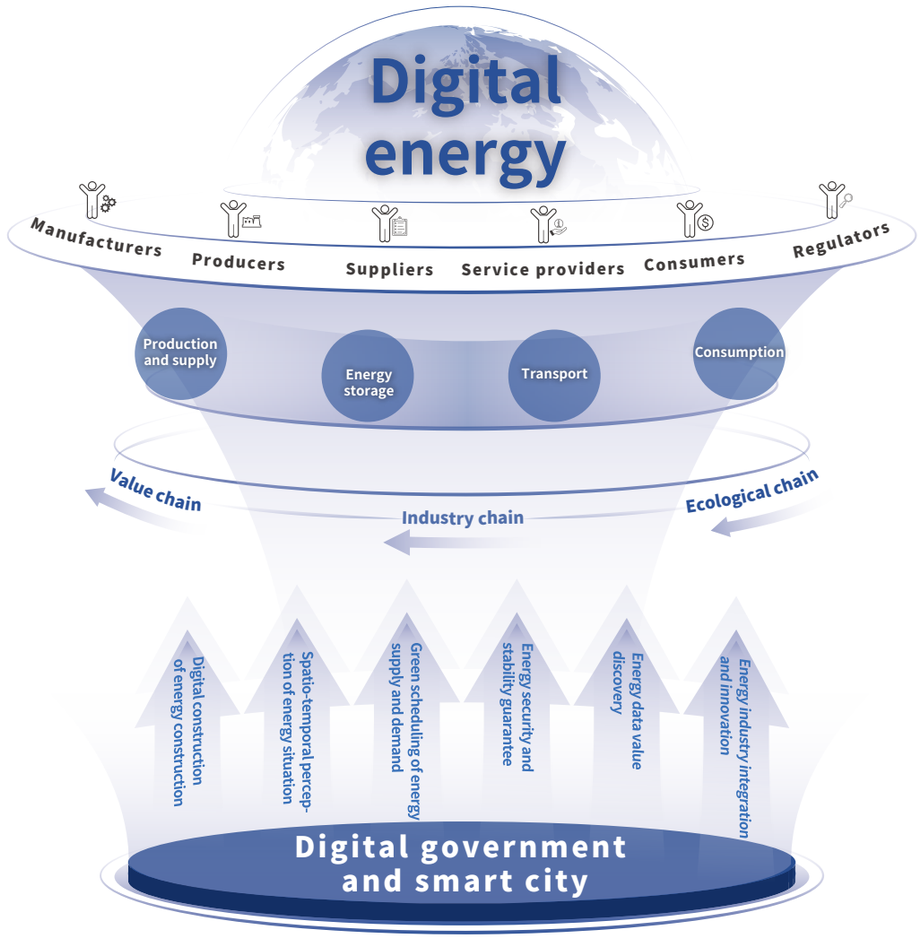
- Three chains
- Six capacities

Connotation of Digital Energy

Digital energy epitomizes the in-depth integration of digital technologies and the energy industry, and is the specific form of energy digitalization and intelligence. Through the IoT connection of energy facilities, big data, AI, and other technologies are used to bridge the physical world and the digital world, and realize the interaction between information flow and energy flow. These efforts are made to unleash the value potential of energy data elements, accelerate the transformation and upgrading of the energy industry, and cultivate new models and new forms of the energy industry to support the construction of a modern energy system and boost high-quality economic development.



Based on the digital government and smart city, digital energy focuses on three chains (value chain, industry chain, and ecological chain), coupled with six capacities (digital construction of energy construction, spatio-temporal perception of energy situation, green scheduling of energy supply and demand, energy security and stability guarantee, energy data value discovery, and energy industry integration and innovation), to cover all aspects of energy production and supply, energy storage, transport, and consumption, and promote the industrial integration, innovation, and extensive connectivity.

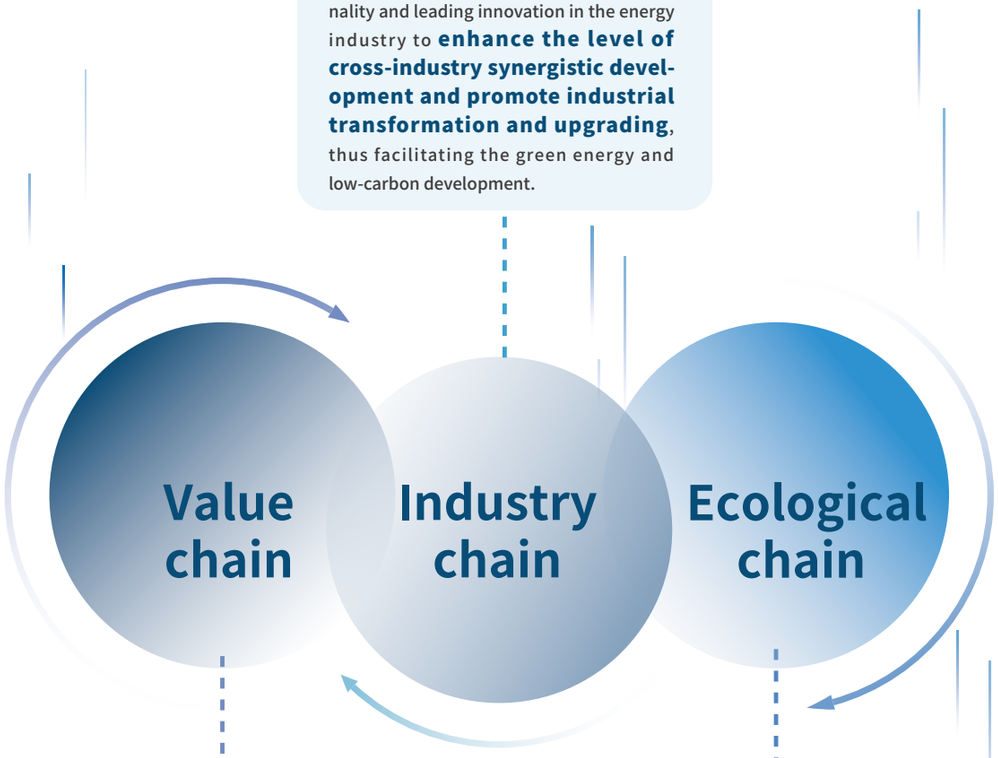


Digital Energy Architecture

Three chains

By focusing on the value chain, industry chain, and ecological chain, digital energy can effectively enhance the overall value of the energy industry and drive industrial integration and upgrading to build a digital energy ecosystem.

Strengthen the application of digital intelligent technologies to promote originality and leading innovation in the energy industry to **enhance the level of cross-industry synergistic development and promote industrial transformation and upgrading**, thus facilitating the green energy and low-carbon development.



Promote the application of digital intelligent technologies in the whole chain and all aspects of the energy industry to **ensure the production safety and supply of energy and enhance the ability to allocate energy resources efficiently**, thus improving the overall value of energy industry.

Promote the full circulation and use of data resources as new production factors to **unleash the value potential of energy data elements and drive the interconnection, interaction, and complementarity of all aspects in the energy network**, so as to promote the healthy and sustainable development of digital energy.

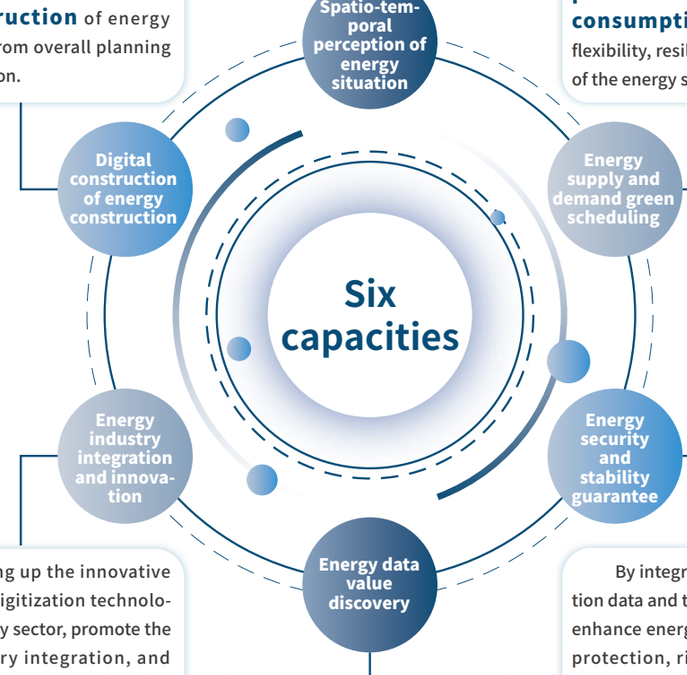
Six capacities

Digital energy is the driving force to lead the transformation of the energy industry and achieve innovation-driven development. The six capacities, including digital construction of energy construction, spatio-temporal perception of the energy situation, green scheduling of energy supply and demand, energy security and stability guarantee, energy data value discovery, and energy industry integration and innovation, can enable the energy industry to seek high-quality development from all aspects.

By connecting with digital twin cities, **comprehensively perceive the energy operation status**, and support scientific decision-making in energy safety supervision, emergency command and production security.

Improve the quality of planning and design, control the efficiency of project construction to guarantee the safety of engineering construction and support the **safe and efficient construction** of energy infrastructure from overall planning to implementation.

By using "data + computing power + algorithm", achieve the **comprehensive energy complementarity and new energy consumption** and enhance the flexibility, resilience and coordination of the energy system.



By speeding up the innovative application of digitization technologies in the energy sector, promote the interdisciplinary integration, and foster **new advantages in the integrated development of digital technologies and the energy industry**.

With the data element market as the core, break down the information barriers between different subjects, **promote the full circulation of energy data resources** and stimulate market creativity and vitality.

By integrating the energy operation data and the city operation trend, enhance energy security monitoring, protection, risk early warning and emergency response capabilities, and **ensure the safety, stability and reliability of energy system**.

02

Digital Energy Development in Shenzhen

- Digital energy development environment
- Digital energy practices in Shenzhen

Shenzhen Government is endeavoring to build "**One Network**" (power charging, storage and discharging network), "**Two Centers**" (virtual power plant management center and data element trading center), "**Three Platforms**" (intelligent energy platform, Shenzhen carbon cloud network platform, and innovative cooperation platform), and promote the application of digital technologies in the "**Four Aspects**" (production, supply, storage, and marketing) of energy, thus exploring the distinctive innovation practices in digital energy.

1 Network

- **Power charging, storage and discharging network**

2 Centers

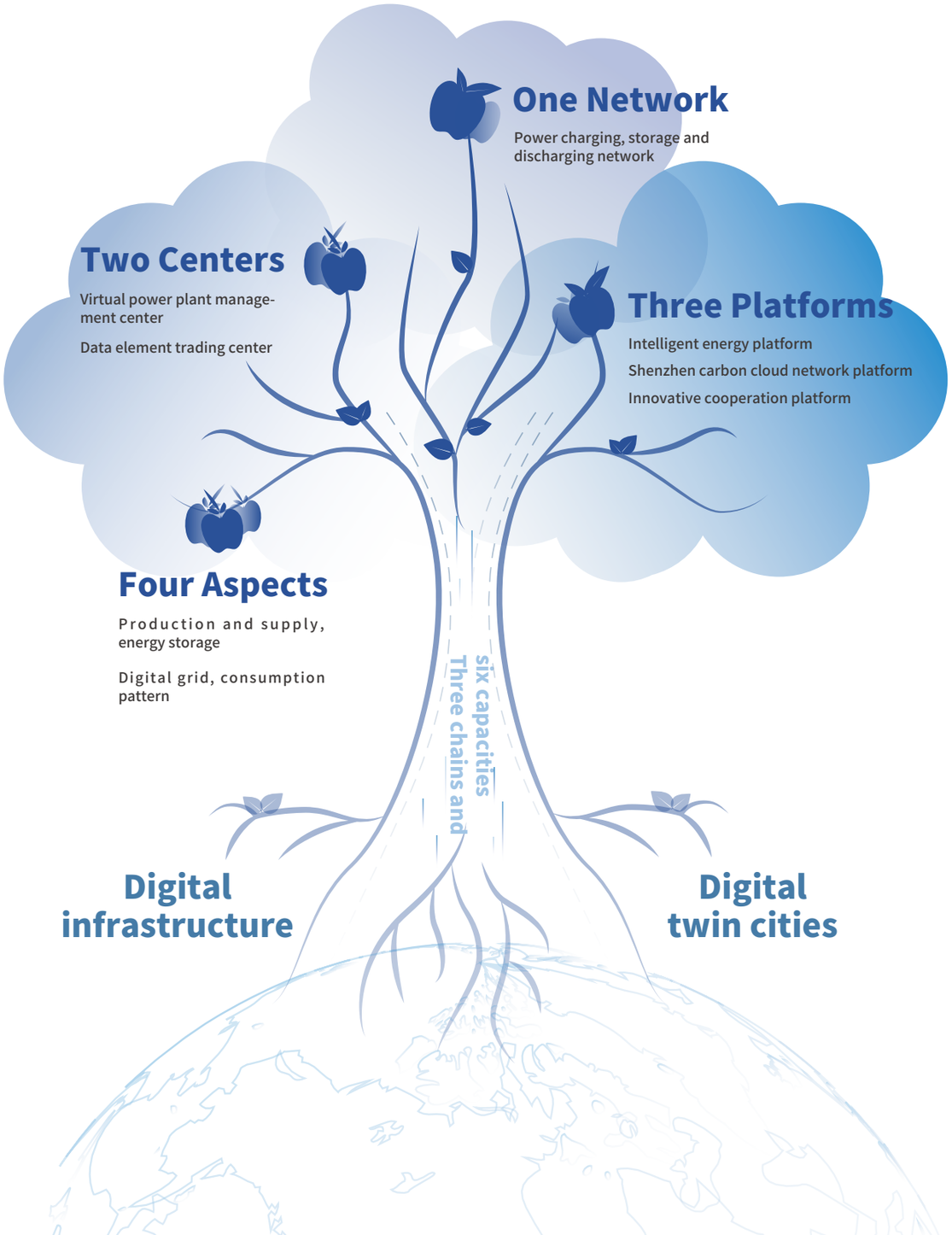
- **Virtual power plant management center**
- **Data element trading center**

3 Platforms

- **Intelligent energy platform**
- **Shenzhen carbon cloud network platform**
- **Innovative cooperation platform**

4 Aspects

- **Production and supply**
- **Energy storage**
- **Digital grid**
- **Consumption pattern**



Digital energy development environment

In recent years, Shenzhen has given full play to the synergy of "dual areas (the GBA and the Shenzhen Pilot Demonstration Area of Socialism with Chinese Characteristics)" driving, "dual areas (Shenzhen Special Economic Zone and Shenzhen Pilot Demonstration Area of Socialism with Chinese Characteristics)" superposition and "dual reforms (piloting comprehensive authorized reform measures and comprehensively deepening the reform and opening-up of the Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone)" demonstration, benchmarked against the world's highest and best practices and vigorously promoted the construction of digital government and smart city characterized by the digital twin. With the pilot demonstration standards, Shenzhen accelerates its efforts to create a new smart city benchmark and "Digital China" city model to drive all-factor digital transformation, empower the digital economy, and build a good environment for the development of digital energy.

Digital infrastructure

As a bellwether in the digital economy, Shenzhen's digital infrastructure is developing rapidly, evidenced by the complete information infrastructure such as mobile communication, optical network, IoT, and data centers.

Digital infrastructure

01 Leading 5G construction nationwide

By the end of 2022, Shenzhen has built a total of **64,500** 5G base stations, with about **37** 5G base stations per 10,000 persons and up to **32** 5G base stations per square kilometer, making it the **first** to achieve **full coverage** of 5G independent networking in the world.

02 Complete optical network construction

Shenzhen has the China (Qianhai) Internet Exchange, a regional international communication gateway, able to carry international communication access services nationwide. It is among the first batch of "**Gigabit Cities**" in China and selected as the "**Comprehensive Pilot City for IPv6 Technology Innovation and Integrated Application**".

03 IoT sensing network beginning to take shape

Take the lead in the city-wide deployment of multi-function smart poles in China and introduce the **first** normative document **in China**, the Measures on Management of Infrastructure for Multi-function Smart Poles in Shenzhen. Shenzhen has built a total of about **19,000** multi-function smart poles, and created innovative application scenarios such as IoV, smart parks, and smart communities.

04 Innovation-oriented computing power facilities

Boast high-performance computing centers such as the **National Supercomputing Center in Shenzhen, Pengcheng Cloud Brain**, and **Tencent Cloud**, demonstrate and drive the development of national computing power with the **government, telecom operators, large Internet companies**, and **independent third parties** as the leading players.

Digital twin cities

By linking "new urban construction" with "new infrastructure", Shenzhen has built a citywide spatio-temporal information platform and digital twin base with BIM modeling as the core, where the physical space of the city is mapped to the digital space, realizing the synchronous operation and interaction between the physical and digital dimensions of the city and solving the complexity and uncertainty of urban planning, design, construction, management, and service.

1 The digital backplane of 2D/3D spaces is used to achieve the dynamic update of data services of basic mapping data in the CIM platform, and share it with the city.

2 A unified city-level spatial service engine is provided to support rapid spatial mapping and positioning capabilities, and thus meet the mapping requirements for applications in urban planning, construction, management, operation and social governance.

3 By integrating with the urban data hubs, spatial data calculation and analysis capabilities and 2D/3D space comprehensive query are provided to support spatial calculation and analysis applications in all authorities.

Digital energy practices in Shenzhen

Power charging, storage and discharging network

At present, Shenzhen is vigorously promoting the construction of "power charging, storage and discharging network". Based on the digital twin cities, Shenzhen has leveraged its flexible charging and discharging resources such as charging and switching stations, energy storage facilities, communication base stations, and charging cabinets, and focused on Vehicle to Grid (V2G), AI, and big data analysis technologies, to realize the application of new models and new formats including Vehicle Grid Integration (VGI), SuperCharge, flexible charging, and shared energy storage. While the public has access to efficient and convenient energy services, the construction and operation conditions of charging facilities can be monitored in real time to improve urban energy security and resilience, thus promoting the integration of generation, grid, load, and storage and the complementary development of multiple energy sources.

As of June 2023, Shenzhen's "One Network Platform (1.0)" has access to 170,000 charging piles, 5,100 5G energy storage base stations, 6,000 charging and switching cabinet for electric bicycles, 1,200 PV stations, 15 energy storage demonstration stations, 13 V2G stations, etc.

V2G demonstration stations
13

Charging and switching cabinet for electric bicycles
6000

PV stations available
1200

5G base stations for energy storage
5100

Energy storage demonstration stations
15

Charging piles available
170,000

Virtual power plant management center

In August 2022, Shenzhen established the first virtual power plant management center in China, in an effort to support the flexible scheduling of distributed resources citywide, realize the accurate peak cut of grid, and increase our capacity to absorb new energy. Thanks to the advanced communication technologies of "Internet, 5G, and Intelligent Gateway", the interface between the grid scheduling system and the aggregator platform is opened to enable the two-way communication between the grid dispatching system and the user-side adjustable resources. With the 5G dedicated network slicing technology, the virtual power plant is able to break the technical bottleneck in participating in grid frequency modulation.

As of June 2023, Shenzhen Virtual Power Plant (VPP) Management Center has accessed to load aggregators such as distributed energy storage, data centers, charging stations, and subways; the VPP has realized more than 1.5 million kW of grid-connected capacity, and achieved the maximum adjustable load capacity of over 300,000 kW. This has effectively improved the reliability and stability of power supply in Shenzhen, and promoted the construction of a new power system with efficient integration of generation, grid, load, and storage.

Cumulative grid-connected capacity
1,500,000kWh

Maximum adjustable load capacity
300,000kWh

Data element trading center

In the development practice of national strategy for digital economy, Shenzhen has given full play to its leading and exemplary role, and actively explored the path of market-oriented allocation of data elements, data trading, and data value discovery. In November 2022, the Shenzhen Data Exchange was officially inaugurated, with the goal of building a national data trading center. So far, it has brought together a large number of data resources and market players, leading the country on a transaction scale. By the end of June 2023, a total of 812 data transactions had been registered and filed, involving 127 types of application scenarios such as energy, Fintech, digital marketing, and public services, with a cumulative transaction amount of RMB 2.8 billion.

In terms of energy data trading, the Shenzhen Data Exchange has made the energy big data product of "Power Supply Bureau - Power Credit Indicators" available online. The energy data and credit information are fused to support the credit information services to carry out post-loan early warning, bogus company identification, credit anti-fraud, credit extension assistance, and other service applications. Shenzhen has taken the lead in realizing the compliance transaction of power data products from "P2P" to "exchange mode" in China, and explored a new path for mining the value potential of energy data elements.

Intelligent energy platform

In order to timely examine the situation of energy supply and demand, formulate scientific energy policies, prepare energy strategic planning and industrial layout, and strengthen the government's delicacy management for energy, Shenzhen is exerting its efforts to build a smart energy management platform. A modern energy regulatory network system covering the entire chain of energy production, transportation, storage, and consumption has been established around energy varieties such as electricity, coal, oil, natural gas, and new energy, as well as energy supply security, energy infrastructure, and energy construction projects, in an effort to improve the level of delicacy management and modern governance in the energy sector.

- Tamp energy supply security and support the perfection of the production, supply, storage, and marketing system
- Strengthen the energy security to ensure the safe operation of energy infrastructure
- trengthen the overall planning for energy projects and facilitate their orderly construction
- Improve the ability to match energy and resources and make a good layout of energy infrastructure

Shenzhen carbon cloud network platform

Shenzhen has actively implemented the strategy of carbon peaking and carbon neutrality to promote the construction of a comprehensive management and service platform focusing on carbon peaking and carbon neutrality, by which our efforts are planned and coordinated to achieve the carbon peaking and carbon neutrality goals. This is taken as an effective means to support the monitoring analysis, decision support, and command and dispatching of carbon emissions citywide, thus achieving the overall deployment of carbon peaking and carbon neutrality.

- Build a data base for carbon emission, and realize the monitoring of carbon emissions in energy, industry, construction, transportation, and other fields.
- Carry out green industry certification and evaluation, promote effective connection among government, industry, and capital, and advance the development of green industries.
- Master the implementation of carbon peaking and carbon neutrality, guide industry authorities to practice energy conservation and carbon reduction in an orderly manner, and realize the command and dispatching of the citywide carbon peaking and carbon neutrality.
- Monitor energy consumption in real time, practice the dual control system of total energy consumption and energy intensity, and exercise oversight over energy conservation, thus enabling enterprises to save energy, reduce costs and increase efficiency.

Innovative cooperation platform

Shenzhen is deeply implementing the innovation-driven development strategy, actively building a platform for innovation cooperation and exchange, and efficiently pooling domestic and foreign innovation resources for the sake of innovation cooperation among all stakeholders, in an effort to build a world-class innovation platform.

The International Digital Energy Expo 2023, opened in Shenzhen, focuses on cutting-edge technologies and Shenzhen practices in the field of global digital energy, links the upstream and downstream ecosystems of the energy industry chain, and brings together talent, information, and technology. In this way, an effective bridge is built to connect supply and demand parties, make good use of both domestic and international markets and resources, and help enterprises expand their market.

Shenzhen International Low-Carbon City Forum, as the only forum guided by the National Development and Reform Commission in the green and low-carbon development, has attracted more than 10,000 guests from more than 60 countries and regions. Since 2013, the Forum has been successfully held for 10 successive years. It offers experience exchange and interactive display around themes such as low-carbon transition paths and innovative applications of green and low-carbon technologies. P2P links between projects, capital, and industrial entities are available to provide practical application opportunities for low-carbon technologies.

In order to promote the development of the digital energy industry, Shenzhen has continuously laid a solid foundation for scientific and technological innovation, created a series of important platforms for gathering innovative talent and producing innovative results, and built **139** innovation carriers in the energy sector to facilitate the in-depth integration of industry, universities and research institutes.

Production, supply, storage, and marketing applications of digital energy

Around the connotation of digital energy and the architecture of "three chains and six capacities", digital technologies have been widely applied in various links of energy production, supply, storage, transportation, and consumption in Shenzhen. With the gradual expansion of application scenarios and the iterative update of digital technology, Shenzhen has constantly made new progress in such aspects as reconstructing a safe and efficient energy production and supply system, building a world-class energy storage industry center, constructing the key carrier of new power system and fostering a new model of intensive energy consumption.

Production and supply

Digital intelligent technologies are increasingly being applied to the efficient development and utilization of fossil fuels such as coal, oil, and gas, as well as non-fossil energy such as wind, solar, and nuclear energy, promoting the improvement of energy production efficiency and the level of energy supply security. Shenzhen Energy Group, for example, has deployed systems such as smart construction site, project management, smart power plant, centralized monitoring of new energy, and smart gas. It manages **over 160** power plants (stations) and **over 3,200 kilometers** of gas pipelines by digital means, which has significantly improved labor productivity and management efficiency.

Energy storage

Committed to the construction of "Four Centers (i.e., Advanced Energy Storage Headquarters R&D Center, New High-end Intelligent Manufacturing Center for Energy Storage, Multi-scenario Demonstration and Verification Center, and Global Supply Center for High-quality Energy Storage Products and Solutions)", Shenzhen makes best efforts to accelerate the building of a world-class new industry center for energy storage worth RMB one trillion. At present, the city houses **more than 7,000** energy storage enterprises, including BYD, Huawei Digital Power, Sunwoda, CLOU Electronics, Senior, Capchem, BTR, and Dynanonic. In 2022, the output value of the energy storage industry reached **RMB 267 billion**, with the world-leading industry level, and digital intelligent key technologies covered the whole industrial chain of energy storage.

Power grid

With Shenzhen Power Supply Bureau as the main body, a digital grid is built covering "transmission, substation, distribution, and consumption". In terms of power transmission, Shenzhen has achieved full 3D digital coverage of **over 5,000 kilometers** of transmission lines, and **100%** coverage of UAV inspection. In terms of power transformation, Shenzhen has achieved **100%** unattended and remote operation in substations. In terms of power distribution, Shenzhen has built a self-healing smart distribution network with the highest degree of automation in China. In terms of power utilization services, Shenzhen has achieved full business acceptance for customers in online business halls and an electronic settlement rate of electricity bills of **100%**.

Energy consumption

Shenzhen has achieved fruitful results in exploring energy conservation, efficiency improvement, and low-carbon development in key areas of energy use such as industry, building, and transportation with digital technology. The energy efficiency levels citywide have ranked among the top in the country for years. The energy consumption per unit of GDP in Shenzhen is about **1/3** of the national average level, making it the city with the lowest energy consumption per unit of GDP in China.

Reconstructing a Safe and Efficient Energy Production and Supply System

- Energy exploitation
- Conventional thermal power generation
- Nuclear power generation
- Solar power generation
- Wind power generation

03

Energy is the driving force OF urban development and the fundamental guarantee for high-quality economic and social development. Shenzhen has formed a diversified energy supply pattern of electricity, oil, and natural gas, and the application of digital technologies will keep improving the energy supply security and energy production efficiency. In recent years, a large number of digital energy leading enterprises (in the fields of fossil energy exploitation, traditional thermal power, nuclear power, and new energy power generation) in Shenzhen have carried out leading practices in digital energy, and promoted the digital and intelligent development on the energy supply side.

Energy exploitation

In the field of energy exploitation, 5G, AI, big data, and other technologies are used to realize the digitized and unmanned production of oil, natural gas, and coal, thus enhancing the level of intelligent exploitation of fossil fuels, ensuring the safe production of energy, and promoting cost reduction and efficiency increase in the energy exploitation industry.

Key technologies

1 Intelligent exploitation technology for coal mine

The intelligent exploitation of coal mines is the in-depth integration of new-generation information technologies such as 5G, AI, big data, IoT, and cloud computing with the coal mine production process to realize self-planning, self-perception, self-decision-making, and self-operation in coal mine design, digging, mining, transportation, and other links, thus keeping the coal mine production remotely controlled, intelligent and unmanned for higher production efficiency and economic benefits.

2 Digital technology for oil and gas exploration and development

The digital technology for oil and gas exploration and development maps the physical space of oil and gas exploration and development to virtual digital space by mining oilfield exploration data resources. In this way, a series of functions are achieved, including oil and gas field exploration and development and equipment status management, field visualization operations, online guidance from off-site experts, and on-site risk identification and early warning, thus enhancing the equipment status perception and emergency management capabilities for oil and gas exploration.

3 Digital operation technology for LNG terminals

The digital operation technology for LNG terminals applies advanced digital means such as big data, 5G, IoT, and BeiDou positioning in the operation and management of LNG terminals. Through the IoT access of the intelligent terminal of the LNG sites, the real-time acquisition and big data analysis of personnel location, safety operation information, 5G robot patrol data, and field operation videos are supported to effectively improve the safety, reliability, and operational efficiency of the LNG terminals.

4 Digital safety management technology for gas pipe network

The digital safety management technology for gas pipe networks realizes automatic acquisition, massive data transmission, and fast big data analysis of city gas network data by virtue of computers, communication networks, automatic control, AI, and other technologies, so as to support the real-time monitoring of the production safety status of gas pipe networks and timely fault location, and achieving digital safety management of pipelines.

Advanced practices

HUAWEI Coal Mine Legion: "Intelligent Mine Joint Solution"

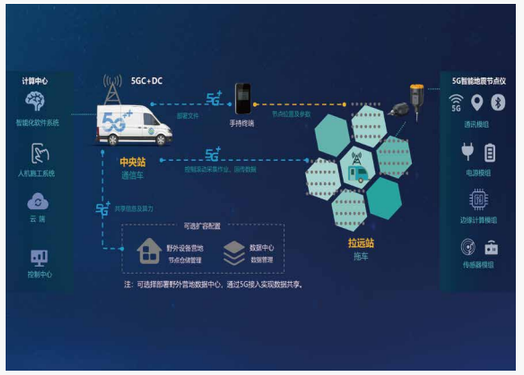
Key technologies

Through advanced technologies such as 5G, AI, and Kunpeng Cloud, an overall intelligent mine architecture of "3*1+N+5" (one network, one cloud, one platform, N applications, and five centers) has been formed, achieving goals such as undermanned mining, intelligent transportation, unmanned operation, unmanned driving, and intelligent control.

Results

Shaanxi Coal Group Hongliulin Mining achieved an 18% reduction in workforce and a 30% increase in production per shift by using this solution.

ZTE: Large-scale Field "5G Intelligent Oil and Gas Exploration System"



Key technologies

The oil and gas exploration system uses 5G transmission to "cut off" the node instrument, which can achieve data acquisition while processing, significantly reduce the exploration cycle, and improve exploration efficiency.

Results

There is no need to lay survey lines at the field exploration site, the amount of labor has been reduced by 70%, and the cost of equipment for a single node can be saved by RMB 3,000. Based on the average 100,000 nodes of a single exploration project, the equipment cost can be saved by RMB 300 million and the labor cost by about RMB 20 million.

Advanced practices

China Mobile Group Guangdong Company Limited: LNG Park, Dapeng New Area

Key technologies

The digital construction and operation technology for LNG terminals, and the 5G dual-domain private network scheme are used to achieve applications such as safe operation management, real-time monitoring, and 5G robot station patrol.

Results

In the first year of operation, the plant patrol efficiency was increased by 70%, the accident rate was reduced by 50%, the labor intensity of employees was reduced significantly, and the personnel demand was reduced by 30%.

Shenzhen Gas Corporation Ltd.: "5G+ Smart Gas" Solution

Key technologies

Domestic intelligent security PLC and RTU, integrated safety communication module, and other core control equipment are self-developed, and an integrity management system for urban gas pipelines is established to achieve the digital twin of gas and grasp the spatial distribution and safety status of key gas facilities in real time.

Results

"5G information flow" supports the safe and efficient operation of "gas energy flow, so that the production efficiency is increased by about 50%, achieving digitally empowered public safety in megacities.

Conventional thermal power generation

In the field of conventional thermal power, digital technologies are used to improve the productivity and quality of power plants and realize lean management from the aspects of infrastructure project management, unit operation monitoring, intelligent O&M management, remote operation execution, and production safety management.

Key technologies

1 Intelligent operation and inspection integration technology for power plants

The intelligent operation and inspection integration technology for power plants realize intelligent inventory monitoring, intelligent early warning and diagnosis, and intelligent patrol through digital means such as IoT, big data, and AI. After the status information of power plant equipment is collected and aggregated automatically, diagnostic models are used to analyze the health status of equipment, and data are essential in key links such as power plant operation, overhaul, and maintenance to reduce operational intensity, improve work efficiency, and ensure safe production and highly reliable operation of the unit.

2 Overhaul isolation and control technology for power plants

The overhaul isolation and control technology for power plants uses upper computer software systems, smart keys, and hardware equipment to intelligently control ticket reception, hazardous point management, safety measure arrangement, maintenance personnel control, and hazard source isolation during the power plant work ticket process, prevent the unexpected energy release accidents during the overhaul process, ensure the safe execution of maintenance operations, and improve the safety level of power plant maintenance.

3 Low-code and digital and intelligent middleground technology for smart power plants

The low-code and digital and intelligent middle-ground technology for smart power plants based on cloud-edge collaboration can provide visual low-code modeling services, such as equipment digital image modeling, visual index modeling, system equipment diagnosis and early warning model, and system equipment component simulation operation, allowing power plant users to carry out index analysis, operation early warning, diagnostic analysis, simulation, and other business applications conveniently.

4 AI control technology for waste incinerator

The AI control technology for waste incinerator digitizes the flame pattern in the waste incinerator through image recognition to form real-time temperature field data, quickly diagnose combustion conditions such as deviant combustion, starving, backward movement of firing line, and smog anomaly, and realize the quantitative analysis of combustion conditions in the incinerator. In the incineration process, AI algorithm, massive operation data, and cumbersome manual control command logic are organically combined to establish a core control algorithm library, thus forming a combustion control system with AI.

Advanced practices

Smart Waste Incineration Power Plant: "Guangming Energy Eco-Park Project"

Key technologies

The intelligent combustion control, intelligent patrol, and other key technologies of SE Environment Co., Ltd. and SE Intelligent Energy Technology Co., Ltd. are used to achieve intelligent incineration, intelligent monitoring, intelligent inventory monitoring, intelligent equipment diagnosis, and maintenance.

Results

Rich data analysis and visual service capabilities are provided to improve the environmental protection capacity.

SE Smart Energy Technology Co., Ltd.: Guangdong Heyuan Power Plant Intelligent Power Plant Platform

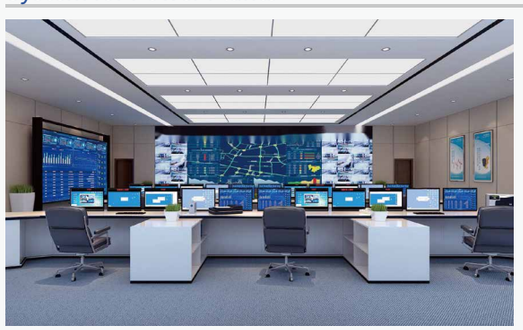
Key technologies

Both the low-code and digital and intelligent middle-ground technology for smart power plants based on cloud-edge collaboration and intelligent operation and inspection integration technology for power plants are employed.

Results

More than 100 early warning models with an accuracy rate of over 90% are constructed to avoid unplanned downtime at least once per year, reduce 3 inspectors per year, and create economic benefits of RMB 2.1-3.9 million per year.

Changyuan Technology Group Ltd.: Overhaul Isolation and Control System for Power Plants



Key technologies

The upper computer software system, intelligent key, and hardware devices are coordinated for intelligent control.

Results

The system has been put into use at SDIC Panjiang Electric Power Co., Ltd., covering 7 specialties throughout the plant. It is seamlessly integrated with the centralized control system to achieve unified scheduling of operation and inspection, ensuring the safety of operations during maintenance.

Huawei Technologies Co., Ltd.: Ningzhou Marina Bay Smart Power Plant

Key technologies

Six applications, including smart construction, smart security, smart operation, smart maintenance, smart operation, and smart plant, are constructed.

Results

The smart power plant operation goals of no safety accidents, unattended operation, unmanned patrol, and low-carbon emission reduction are gradually achieved.

Nuclear power generation

In the field of nuclear power, virtual reality, human-computer interaction (HCI), intelligent terminals, and other technologies are used to realize the digital management of the whole life cycle covering design, construction, and operation, thus enhancing the digital construction capacity of nuclear power and the capacity to operate nuclear power safely.

Key technologies

1 Intelligent construction technology for nuclear power project

Supported by virtual reality, computer networking, rapid prototyping, multivariate databases, and other technologies, the intelligent construction technology for nuclear power projects analyzes, plans, and recombines the product information, process information, and resource information of nuclear power equipment, and maps each construction link of nuclear power project to virtual digital space, achieving the applications such as whole process management, field visualization operations, employee training and online guidance from off-site experts, and real-time control of engineering construction and improving the work efficiency and quality of nuclear power project construction.

2 Digital instrument control technology for nuclear power

Based on computer and network communication, by introducing database, HCI, intelligent terminal, and other technologies, the digital instrument control technology for nuclear power constructs a four-layer digital instrument control system of the site control layer, process control layer, operation control layer, and management layer, converts electronic information in the operation of nuclear power equipment into digital information, and processes it efficiently at different layers, in order to realize the decentralized control and centralized operation and management of the operation of nuclear power equipment, and improve the safety, stability, and economy of the operation of nuclear power plants.

3 Digital protection technology for nuclear power plant reactor

The digital protection technology for nuclear power plant reactors enables the logic processing and protection control of the reactor protection device by using MPU. With high-speed computing power, the digital protection system for nuclear power plant reactors constructed by this technology can realize real-time calculation of the DNBR (departure from nucleate boiling ratio) and LPD (linear power density) of the reactor core, directly protecting the core parameters that ultimately endanger the safety of the reactor core, and improve the output and availability of nuclear power plant reactors.

Advanced practices

China General Nuclear Power Corporation (CGN): Shenzhen Daya Bay Nuclear Power Plant Project

Key technologies

The intelligent construction technology for nuclear power projects, digital instrument control technology for nuclear power plants, and digital protection technology for nuclear power plant reactors are synchronized to achieve the replacement simulation and intelligent management operation of key equipment in nuclear power plants.

Results

The Project boasts 100% coverage of digital R&D and design, 100% popularization of digital R&D tools, and 100% digital control rate of key procedures. Upon completion, it is the first large-scale commercial nuclear power plant in the Chinese mainland.

CGN: Shenzhen Ling Ao Nuclear Power Plant Project (Phase II)

Key technologies

The Project adopts digital instrument control technology for nuclear power and replaces the traditional analog master control room with a digitally advanced one.

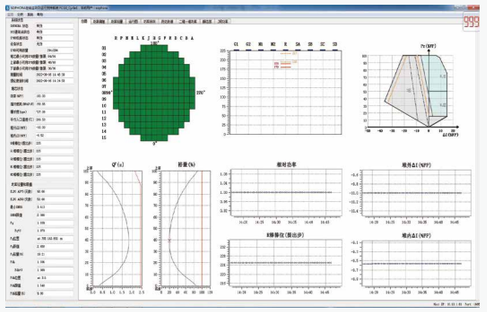
Results

The Project has built a demonstration power plant of CPR1000 reactor type, which adopts a new self-developed digital operation program for nuclear power plants, realizing the digital operation of the nuclear power plant.

CGN: Digital Twin Online Monitoring System for Nuclear Reactor Core

Key technologies

By combining the 3D numerical simulation technology of the core and the collection of internal and external measurement signals of the reactor, the system enables high-resolution and high-precision real-time monitoring of core parameters and accurate analysis and prediction of core status data.



Results

The system can greatly improve the operation level, safety, and economical efficiency of the unit, and is applied in 42% of China's commercial nuclear power units in operation, which effectively promotes the quality improvement of nuclear power operation in China.

Solar power generation

In the PV field, digital and intelligent technologies are used to enhance the level of distributed solar energy utilization, and promote cost reduction, emission reduction, and efficiency increase in solar power generation, better advancing the development of the PV industry.

Key technologies

1 Intelligent and highly reliable PV inverter technology

By integrating IoT, big data, AI, and other technologies, the intelligent and highly reliable PV inverter technology speeds up the upgrade of PV inverter chip technology, CPU processing speed, and PWM resolution to greatly reduce the inductance loss of PV inverter. The AFCI technology integrating AI and IoT is adopted for PV inverters, effectively preventing arc hazards and locating arc faults.

2 Automatic tracking technology of solar energy

The automatic tracking technology of solar energy accurately calculates the solar azimuth and solar altitude according to apparent motion trail combined with the position information of PV power generation module through the SCM or big data platform, and controls the postures of solar panel accurately and timely, tracks the solar angle effectively, and improve the efficiency of solar panels by automatic sensing terminals and automatic control devices.

3 Intelligent operation and maintenance technology for PV power generation

The intelligent operation and maintenance (O&M) technology for PV power generation carries out operation monitoring, intelligent diagnosis, efficient scheduling, and unmanned patrol for photovoltaic power stations by comprehensively utilizing IoT, big data, artificial intelligence, and other means, achieving intelligent security and O&M of photovoltaic power plants.

Advanced practices

Huawei Digital Power Technology Co., Ltd.: Inverter Capable of Intelligent Detection of DC Arc

Key technologies

Based on intelligent and highly reliable PV inverter technology, the AFCI technology integrating AI and IoT is employed to achieve the PV performance level of "L4" in CGC/ CGC/GF 175:2020.

Results

In rooftop PV systems with complex environments, the inverter can prevent arc hazards effectively. In combination with the application of component-level electronics in the system, arc faults can be located accurately.

Huawei Digital Power Technology Co., Ltd.: Ningxia Agriculture & Solar Complementary Project

Key technologies

The solar flat single-axis tracking technology is adopted to improve power generation efficiency, and intelligent O&M technology of PV power generation is used to improve the level of security services and management efficiency and reduce O&M costs.

Results

Compared with conventional power plants, the power generation capacity has increased by more than 2%, the O&M efficiency increased by more than 50%. It is an attempt to explore the new business model of generating power on PV panels and herding sheep under PV panels.

Huawei Digital Power Technology Co., Ltd.: Wind, Solar, and Water Renewable Energy Base in Gonghe County, Qinghai

Key technologies

Gonghe County, Qinghai has built the world's largest wind, solar, and water renewable energy base, where Huawei's intelligent O&M technology of PV power generation is employed to realize single-string component management for more than 7 million PV modules.

Results

Compared with conventional power plants, the power generation capacity has increased by more than 2%, the O&M efficiency increased by more than 50%. It is an attempt to explore the new business model of generating power on PV panels and herding sheep under PV panels.

Wind power generation

In the field of wind power, digital technology is used to achieve the interactive integration of "human, computer, network and things", so that the perception, O&M, control, and decision-making capabilities of wind farm stations can be improved to maximize the comprehensive benefits of wind farms.

Key technologies

1 Intelligent patrol technology of offshore wind power

Intelligent patrol technology of offshore wind power, equipped with intelligent monitoring devices and intelligent patrol robots, integrates AI and big data technologies to realize intelligent identification, monitoring, patrol, and status analysis of equipment in offshore wind power plants. This technology can complete the control loop of real-time data acquisition, real-time information transmission, intelligent analysis and early warning, and rapid decision feedback in all weather conditions during patrol, and provide data support for accident tracing, thus strengthening the management capabilities of power equipment.

2 Digital and intelligent centralized control O&M technology for wind farms

The digital and intelligent centralized control O&M technology for wind farms conducts integrated collaborative collection, centralized processing, and intelligent application of multi-source heterogeneous data of wind farms by applying IoT, big data, communication, and other technologies, realizes real-time monitoring and fault diagnosis of equipment, and supports the networking, transparency and intelligence of operation and inspection. By accumulating operational data, this technology helps to anticipate potential problems, assist in optimizing the O&M plans, improve the reliability and life of equipment, and support the large-scale expansion and operation of offshore wind farms.

3 Intelligent O&M and scheduling technology for offshore wind farms

The intelligent O&M and scheduling technology for offshore wind farms automatically calculate to gain the O&M ship personnel scheduling plan with optimal economical efficiency of O&M based on AI algorithm by taking use of the information integration capabilities and computing power advantages of big data centers in full consideration of meteorological and hydrological forecast information, the list of tasks to be repaired, O&M resources information available, so that the O&M efficiency can be significantly improved, the O&M cost reduced to enhance the overall economic benefits of offshore wind farms.

Advanced practices

China Energy Engineering Group Guangdong Electric Power Design Institute Co., Ltd. (GEDI): Guangdong Offshore Wind Power Big Data Center

Key technologies

Approved and established by the Development and Reform Commission of Guangdong Province, the Center has collected the whole life cycle data of offshore wind farms in the province, covering the planning, construction, and operation period, and carried out data mining.

Results

It realizes the meteorological and hydrological forecast and early warning, smart construction site, intelligent scheduling, wind turbine equipment early warning, wind turbine power prediction, and intelligent O&M decision-making.

Shenzhen Energy Group: Centralized Control Center of the Wind Farm

Key technologies

The digital and intelligent centralized control O&M technology for wind farms is combined with the thinking mode of big data machine learning to carry out the early warning and investigation of hidden dangers, by making use of the precipitated wind turbine operation data and big data algorithms.

Results

It has accessed the production and operation data of all wind farms and sub-stations in 14 provinces, realizing remote centralized monitoring, on-site less manned operation, regional maintenance, and unified, standardized management. In this way, it can save 15-20% of equipment maintenance costs per site, up to RMB 1 million per year.

YOUIBOT Robotics Co., Ltd.: Intelligent Wheeled Patrol Robot for Offshore Wind Farms

Key technologies

The intelligent patrol technology for offshore wind farms is utilized to realize visual identity, remote control of environmental monitoring, and intelligent scheduling.

Results

The product has officially been put into use at an offshore wind farm booster station in Guangdong, in charge of equipment patrol, image information transmission, and status evaluation. The robot achieves 7/24 high-frequency, unmanned patrol and O&M, reduces over 98% of manual patrol, and achieves cost reduction and efficiency improvement.

04

Building a World-class Energy Storage Industry Center

- Power-side energy storage
- Grid-side energy storage
- User-side energy storage

The development of energy storage industry in Shenzhen ranks among the top in the world, with complete industrial chains. At present, the key links such as battery materials, precision parts, current collectors, battery management system (BMS), energy management system (EMS), and power conversion system (PCS) have been fully planned in Shenzhen. Shenzhen has configured energy storage systems in multiple scenarios on the power side, grid side and user side to promote the development of renewable energy, ensure the safe and stable operation of the power grid, and enhance the efficiency and reliability of energy use by users. At present, Shenzhen has gathered three major enterprises of energy storage ecosystem, a series of leading enterprises of household storage, as well as a number of SRDI enterprises, to constantly optimize the industrial pattern.

Building a World-class Energy Storage Industry Center

Key technologies

1 BMS technology for delicacy battery management

The BMS technology for delicacy battery management solves the battery capacity fading, consistency deviation, capacity mismatch, and other problems in centralized systems through the intelligent string solution of "pack-specific optimization" and "one cluster-specific management", thus improving energy storage capacity and operation efficiency.

2 Safety early warning technology for electrochemical energy storage system

Based on the operation status and performance data of the electrochemical energy storage system, the safety early warning technology for the electrochemical energy storage system can realize the early warning and monitoring of the safety of the electrochemical energy storage system through big data analysis, modeling, AI prediction, and other means. Compared with the conventional BMS management system, it can realize short circuit diagnosis, voltage anomaly diagnosis, temperature anomaly diagnosis, and AI active safety warning function in the cloud, so as to improve the operational safety of the energy storage system.

3 Multi-tier protection technology for electrochemical energy storage system

The multi-tier protection technology for electrochemical energy storage system mainly achieves hierarchical protection for typical electrical faults (e.g., overcurrent, overvoltage, and short circuit), fault isolation, and anti-reverse connection protection at the pack and cluster levels through sensing detection, on-off control, distribution technique, and power conversion, enabling multi-tier safety protection from the cell, pack, battery cluster to the system, improving system robustness, and achieving safe and preventable energy storage.

4 Network-based energy storage technology for active support of power grid

The Grid Forming Battery Energy Storage System (GFM-BESS) simulates the operating principle of synchro and can play the role of a voltage source, achieving equivalent effects to the synchro. Compared with existing current source transducers, it has the characteristics of fast response speed, strong overload capacity, and better support for voltage and frequency.

Advanced practices

Power-side energy storage

The power-side energy storage is mainly grid-connected energy storage for renewable energy and energy storage of thermal power with frequency modulation. By configuring energy storage systems for renewable energy sources such as wind and solar energy, smooth control of renewable energy generation is achieved to reduce the impact of fluctuating power grid connections on the power grid, and improve the utilization rate of renewable energy and the safety of grid operation. Thermal power with frequency modulation takes advantage of the fast response of energy storage equipment to help conventional thermal power plants adjust the frequency of the power grid when the grid load changes significantly, thereby ensuring stable and safe operation of the grid frequency.

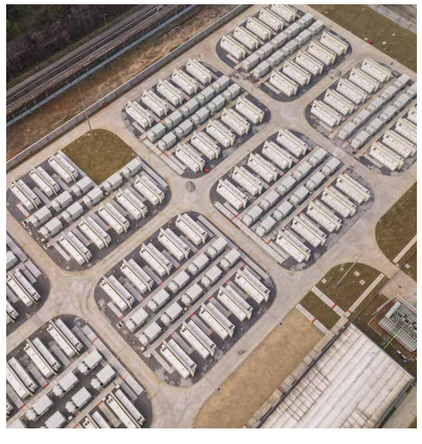
CLOU Electronics: Energy Storage Project of Guangdong Haifeng Xiaomo Power Plant

Key technologies

The Project applies the group control management technology and EMS system self-developed by CLOU Electronics, and realizes the functions of millisecond-level wide-area direct control of the energy storage system, virtual synchro, peak load regulation, and black start. The frequency modulation performance kp index has been greatly increased from 0.8 to 2.4.

Results

Upon completion, it's the largest energy storage and 100MW unit frequency modulation project in China, and also one of the first eight technology innovation (energy storage) pilot demonstration projects of the National Energy Administration.



BYD Company Limited: Datang Huayin Leiyang Electrochemical Energy Storage Power Plant Project

Key technologies

The installed capacity is 200MW/400MWh, and BYD Cube T28 energy storage products and related technologies are used to achieve the goal that the maximum temperature difference of the battery can be controlled within 5 ° C, as well as the functions of grid peak regulation and black start.

Results

This Project is a global design benchmark for electrochemical energy storage power plants, and also a key project for the National Energy Administration to address the peak loads in winter/summer, providing strong support for the local grid to build a large-scale friendly interactive system of generation, grid, load, and storage.

Advanced practices

Grid-side energy storage

Grid-side energy storage can mainly relieve the pressure of grid regulation and smooth grid fluctuations. Meanwhile, the output power of the energy storage system has a high matching degree with AGC (Automatic Generation Control) instructions, which can provide faster and more accurate frequency regulation services for the grid, ensuring safe and stable operation of the grid.

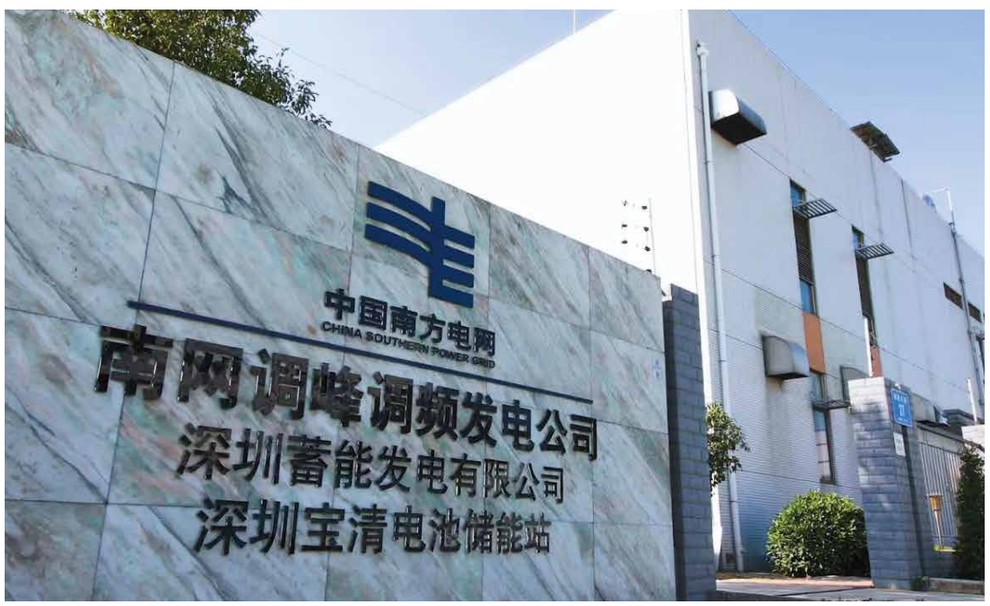
China Southern Power Grid Peak Shaving and Frequency Modulation Power Generation Co., Ltd.: Shenzhen Baoqing Battery Energy Storage Station

Key technologies

Two technical routes of lithium iron phosphate (LIP) battery and lithium-titanate battery are adopted, with a total capacity of grid-connected scheduling energy storage system of 10MW/22MWh.

Results

China Southern Power Grid has obtained 45 authorized invention patents, prepared 2 IEEE international standards, 8 national standards, 8 industrial standards, and 2 group standards, and set up the China Southern Power Grid Joint Laboratory for Advanced Energy Storage Technology with several enterprises.



User-side energy storage

The user-side energy storage is mainly to improve the reliability of user electricity and reduce electricity costs. With the increasing degree of electrification in energy-use areas of terminals such as transportation, industry, and construction, the load characteristics of power systems will be more complex and diversified. The energy storage system provided on the user side can smooth the load fluctuation and improve the power quality. Industrial and commercial users can use the energy storage system to charge at low electricity prices and discharge at high electricity prices to achieve peak-valley price arbitrage and reduce the cost of electricity for enterprises.

Huawei Digital Power Technology Co., Ltd.: Jiangsu Changzhou Centuray Energy Storage Project

Key technologies

Huawei digital energy technology products are equipped, such as intelligent string energy storage system, intelligent energy storage controller, intelligent subarray controller, and distributed temperature control technology.

Results

With "pack-specific optimization" and "cluster-specific management", the discharge capacity is increased by 15%, the O&M costs decreased by 50%, and the modular design achieves a system availability of 99.9%, supporting 15-year stable operation of the energy storage system.

Shenzhen Sunwoda Energy Technology Co., Ltd.: User-side Energy Storage Project

Key technologies

With all-in-one mode, the air-cooled 1MWh container products of Sunwoda realize multi-level safety protection of the energy storage system and improve system robustness by sensing detection, on-off control, distribution technique, and power conversion.

Results

It is applied to peak shaving on the user side, solving the problem of off-grid load support after power rationing, thus reducing the cost of electricity for users, and improving the reliability of power supply.

05

Constructing the Key Carrier of New Power System

- Power transmission digitization
- Power transformation digitization
- Distribution network digitization
- Intelligent scheduling and intelligent O&M

The digital grid is the key carrier for constructing a new power system. In recent years, Shenzhen has actively built a safe, reliable, green, efficient and intelligent modern urban power grid that is compatible with high-quality development, with a number of landmark achievements in building a world-class smart grid: first, a digital power transmission system of "video + UAV + AI" to achieve "three 100% coverage" of digital power transmission; second, a digital substation with "5G + intelligent patrol" to enable 100% intelligence in patrol, operation and safety control; third, a digital distribution network demonstration of "operation and regulation synergy" to take the lead in building 7 high-quality power supply leading areas; fourth, an intelligent, efficient, flexible and interactive regulation system that adapts to the new power system.

Power transmission digitization

Based on the IoT platform, the digital power transmission achieves intelligent route planning and UAV remote autopilot by using new technologies such as WAPI, BeiDou positioning, intelligent offset correction, and mission route, and enables comprehensive monitoring and data acquisition of lines, panoramic information fusion of transmission, global intelligent decision-making through transmission sensing terminals, communication terminals, and transmission smart gateways, so as to improve the O&M efficiency of transmission lines.

By the end of 2022, Shenzhen had included more than 5,000 kilometers of transmission lines, about 7,000 towers, and 7 underground transmission tunnels into the 3D digital channel system, with smart cameras equipped on more than 4,000 transmission towers, and 100% coverage of UAV patrol to transmission lines, so that the efficiency of equipment patrol has been increased by more than 3 times.

Key technologies

1 Intelligent sensing platform for transmission line disasters

By using 3D point cloud data and the multi-spectral radar scan data, the intelligent sensing platform for transmission line disasters has, combined with typical environments and the growth cycle prediction model of tree species, realized the intelligent prediction of hidden dangers of tree barriers in the transmission line corridor area. Based on meteorological information such as temperature, wind speed, rainfall, and line hazard information, the line icing, typhoons, and geological disasters are early warned and predicted to guide differentiated treatment during and after disasters.

2 Intelligent patrol of transmission lines

Based on smart sensing technologies such as UAV, tunnel patrol robots, online monitoring devices, and mobile terminals, the intelligent patrol of transmission lines achieves automatic collection of information on equipment bodies, channel environments, and tunnel ancillary facilities. It promotes the shift from manual analysis of transmission line data to intelligent identification of defects, meets applications of centralized terminal control, automatic anomaly identification and push, and patrol process tracing, and realizes intelligent identification of defects and hidden dangers and quasi-unmanned patrol.

3 Intelligence operation of transmission lines

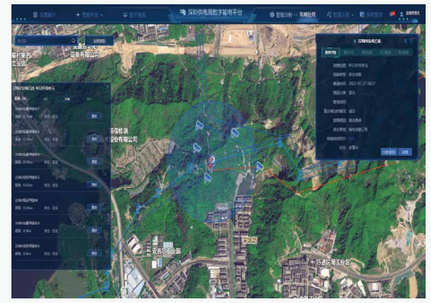
Based on the 3D laser point cloud database of transmission lines and BeiDou high-precision positioning services, the intelligence operation of transmission lines builds various types of UAV autopilot route libraries to achieve the full coverage of multi-rotor UAV autopilot and the collaborative operation applications of UAV clustering. The laser and UAV obstacle-clearing devices allow intelligent robots to perform line cleaning, repair, and other hot-line tasks, enabling remote control of cable tunnel access control, wind turbines, water pumps, lighting, and fire protection facilities, to ease the work pressure of power patrol personnel.

Advanced practices

Shenzhen Power Supply Bureau: CSG Artificial Intelligence Platform Intelligent Power Transmission Platform

Key technologies

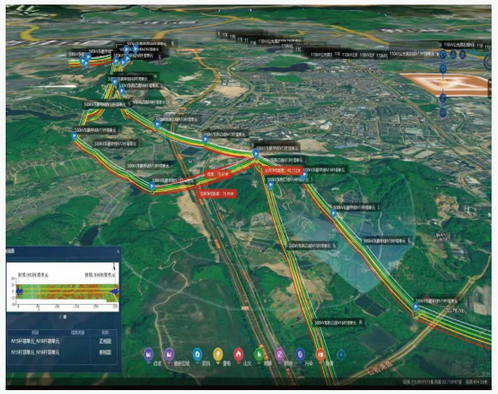
By integrating algorithms such as green film and pollution flashover self-developed by Shenzhen Power Supply Bureau, the digital technology is used to integrate and dispatch multi-source data such as electrical, hidden dangers, defects, lightning, fault location, microclimate, and grounding circulation, and construct a panoramic analysis of trip causes.



Results

Intelligent image identification and early warning are linked with video patrol operations to achieve the rapid location of line faults, automatic export of preliminary analysis reports, and automatic sending of SMS, support field troubleshooting, and increase fault locating efficiency by more than 50%.

Shenzhen Power Supply Bureau: Intelligent Patrol Applications for Transmission Lines



Key technologies

AI algorithms are used to automatically identify hidden dangers and defects in transmission lines, to achieve comprehensive coverage of video intelligent monitoring, and to create large-scale intelligent applications of digital transmission.

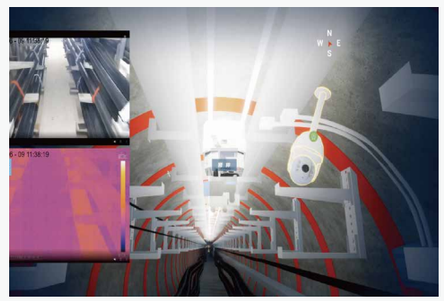
Results

100% coverage of unmanned aerial vehicle inspections on transmission lines is achieved, unmanned aerial vehicles are integrated with intelligent identification algorithms, and refined and scale applications are created for transmission inspection. The defect detection capability has increased by 2.8 times, and the trip rate has decreased by 50%. Overall, the comprehensive efficiency has improved by 11 times compared to traditional methods.

Shenzhen Power Supply Bureau: Transmission Underground Tunnel 3D Modeling

Key technologies

By utilizing the intelligent patrol technology of the underground pipe gallery, 5G intelligent AI cameras are installed with the help of smart poles so that intelligent patrol is realized, and remote control of the guide rail robot is supported to conduct mobile patrol in the tunnel.



Results

The intelligent monitoring capability and level of pipe galleries are improved, and unmanned and intelligent management of underground pipe galleries are preliminarily achieved for 7 cable tunnels in Shenzhen. The entire patrol process has been transformed from a 24-hour manual operation to a 2-hour intelligent inspection, resulting in a 12-fold increase in efficiency.

Power transformation digitization

Based on photovoltaic technologies, information technology, and network communication technology, power transformation digitization realizes the digitization of all information acquisition, transmission, processing, and output processes of substations, the standardization of system information modeling, data exchange, and networked control operations. As of the end of 2022, the city has completed the intelligent transformation of video monitoring in 93 substations, and explored the implementation of the "unattended and remote operation" mode in 265 substations, which has increased the operation and maintenance efficiency by 2.7 times and the operational efficiency by 50%.

Key technologies

1 Unmanned patrol of substations

The unmanned patrol of the substation is based on intelligent sensors, cameras, robots, drones, and other terminals. It builds an unmanned patrol system for the substation, which conducts unmanned patrols on the appearance, meters, defects, and internal and external abnormalities of equipment. By utilizing big data analysis and artificial intelligence technology, terminals are centrally controlled, abnormal results are automatically identified and pushed, the patrol process is traced, and the historical inspection information is obtained, etc., ultimately achieving a 100% replacement rate for daily inspections and the goal of unmanned intelligent machine inspections on site.

2 Digital operation of power transformation

Digital operation of power transformation utilizes intelligent gateways, digital terminal devices in substations, and artificial intelligence algorithms to construct a holographic model of the substation. This enables panoramic monitoring of equipment, facilities, environment, personnel, and vehicles within the substation, thereby improving the efficiency and quality of control and management and the level of support for daily substation operations.

Advanced practices

Shenzhen Power Supply Bureau: 500kV Pengcheng Substation, the First Global Digital Substation

Key technologies

Pengcheng Substation adopts digital twin BIM to perform fine-grained modeling of equipment and components. It collaborates with mobile operators to build the world's first 5G base station within the station, providing high-speed and low-latency 5G communication for all 1,103 intelligent IoT devices in the entire station.

Results

The substation has deployed 6,758 video terminals, 50 sets of 5G CPE, and 26 sets of intelligent patrol robots. It has independently developed 10 different program algorithms to achieve comprehensive intelligent surveillance, operation, and safety control. Compared to traditional manual inspections, the efficiency of intelligent surveillance has been increased by approximately 2.7 times.

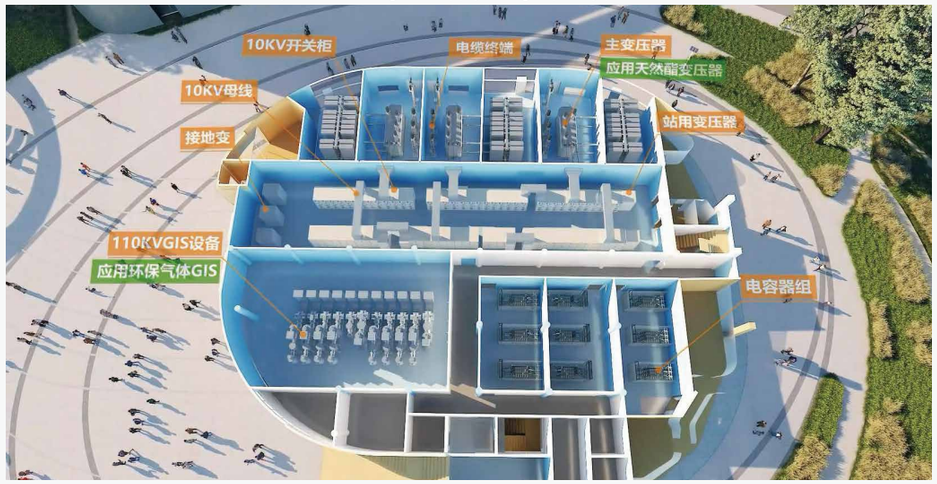
Shenzhen Power Supply Bureau: 110kV Houhaisan National Zero Carbon Intelligent Popular Science Substation

Key technologies

The substation has built a digital twin intelligent operation and maintenance system, creating an intelligent substation with features such as digital modeling, holographic perception, ubiquitous connectivity, autonomous early warning, and efficient interaction.

Results

It achieves functions such as panoramic monitoring of equipment information, real-time perception of status, autonomous implementation of patrols, and automatic health diagnosis, enhancing the substation's risk prevention and control capability and lean operation and maintenance capability, which further improves the reliability of power supply in the "Around Shenzhen Bay" area leading the supply of high-quality power.



Distribution network digitization

By leveraging digital technologies such as sensors, IoT, cloud computing, and software, distribution network digitization enables transparent monitoring of equipment and operational status, supporting intelligent operation, intelligent services, and intelligent operations of the distribution network.

As of the end of 2022, Shenzhen has built the most advanced self-healing intelligent power distribution network in the country. It has pioneered the development of a "digital & intelligent brain" for distribution network grid planning and completed over 4,300 intelligent distribution room renovations, achieving a 60-fold increase in planning efficiency and a 99% accuracy rate in fault diagnosis.

Key technologies

1 Intelligent power distribution room

intelligent distribution rooms utilize AI computing, edge computing, cloud-based algorithm models, and other technologies to achieve comprehensive awareness, fault analysis, operational analysis, and device coordination at distribution sites. It replaces manual inspections with intelligent patrols, enabling unmanned or reduced manpower operations, enhancing lean management, and improving the quality and efficiency of operation and maintenance.

2 Self-healing intelligent power distribution network

The self-healing intelligent power distribution network utilizes the precise timing service, piping, and slicing technology unique to 5G communication to quickly and accurately isolate distribution network faults, which can significantly reduce the outage time of users and improve the reliability of power supply. It can be widely applied in the electricity grid of large and medium-sized cities with 5G signal coverage, achieving precise isolation and localization of 10kV feeder line faults, greatly improving the efficiency of distribution network fault isolation.

3 Digital twin grid

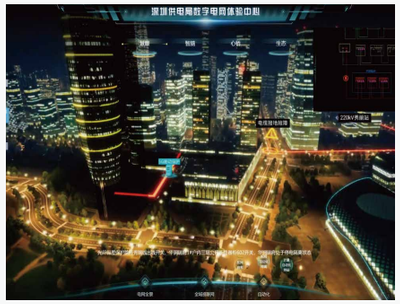
Digital Twin Grid applies digital twin technology to create a three-dimensional and digitized representation of the real power grid. It enables the mapping of all elements of the physical power grid, achieving full cycle, all-round, and full process digital control from distribution network planning and construction to later inspection and fault handling.

Advanced practices

Shenzhen Power Supply Bureau: High-quality and Self-healing Power Distribution Network

Key technologies

By utilizing digital planning systems, high-stability, low-latency fiber-optic private networks, power distribution automation, and other technologies, it enhances the self-healing effectiveness of distribution networks, enables rapid generation and execution of automatic power restoration strategies, provides early warning for automatic switch anomalies, and facilitates proactive operation and maintenance.



Results

The coverage rate of self-healing for the entire city's power grid has reached 100%, and the recovery time for power outages has been reduced from "hours" to "seconds", with over 70% of affected users achieving second-level recovery.

Shenzhen Power Supply Bureau: Grid Planning System for Distribution Network

Key technologies

The multi-dimensional data such as distribution network structure, operation, operation and maintenance, equipment, and intelligence are analyzed and calculated by means of digital twins, big data analysis, wiring pattern recognition, planning simulation calculation, and other technical means.

Results

A "map" of the distribution network planning domain was constructed to achieve the integration and visualization of basic data for distribution network planning. The efficiency of problem discovery and handling was significantly improved, with a fault diagnosis accuracy of 99% and a 60-fold increase in planning efficiency.

Shenzhen Power Supply Bureau: Intelligent Patrol of Power Distribution

Key technologies

By integrating online monitoring data, real-time synchronized automation data at the second level, and AI-based video perception technology, an intelligent patrol system for distribution rooms is established.

Results

It can efficiently and automatically model all 16,000 intelligent distribution rooms in the city at a low cost, transforming the traditional operation and maintenance mode of distribution rooms from passive to proactive, providing valuable experience for the further development of digital applications in the power distribution network.

Intelligent scheduling and intelligent O&M

Intelligent scheduling adopts artificial intelligence technology for power prediction, real-time control, scheduling and regulation of terminal control, active distribution networks, and load regulation. Intelligent operation and maintenance utilizes advanced information technology, communication technology, and automatic control technology to real-time monitor, diagnose, control, and optimize the power system.

By the end of 2022, Shenzhen had built the first set of main and distribution network integrated scheduling automation systems of megacity in China, achieving an efficiency improvement of nearly 90% in scheduling and becoming one of the largest self-healing operation units in China.

Key technologies

1 The cloud-edge integrated intelligent scheduling operation platform

The cloud-edge integrated intelligent scheduling operation platform enhances the level of artificial intelligence in power dispatch, realizing functions such as power dispatch prediction, graph model, and intelligent control decision-making. It constructs a new cloud-edge fusion format of coordinated operation between "cloud brain + edge nodes", achieving panoramic modeling, comprehensive perception, intelligent prediction, global optimization, coordinated control, and market-oriented operation of the power grid's generation, transmission, loading, and storage.

2 Power intelligent operation

The intelligent power operation promotes the implementation of technologies such as identity recognition and behavior recognition by utilizing smart wearable devices with functions such as voice recognition, precise positioning, data collection, image recognition, and remote interaction to manage the qualifications of personnel engaged in power operations, as well as the recognition and early warning of safety and behaviors in work areas and processes, enhancing power operation safety and improving production efficiency.

Advanced practices

Shenzhen Power Supply Bureau: Overhead Contact System (OCS), a main and distribution network integrated scheduling automation system

Key technologies

It is the first practical application of an OCS system in a large city in China, enabling comprehensive and integrated monitoring of the entire power grid from generation, transmission, transformation, and distribution, as well as a panoramic view of the power grid.

Results

The power grid dispatch has enabled one-click control from the highest voltage level of 500 kV substations to the "doorstep" of users and achieved fault location, isolation, and automatic power restoration at the second level in the distribution network. The time for fault restoration has been reduced from 2.5 hours to within 2 minutes.

06

Fostering new patterns for the intensification of energy consumption

- Green and Low-carbon New Data Center
- Virtual Power Plant with Friendly Interaction between Generation, Transmission, Loading, and Storage
- Smart park with multi-energy complementary and integrated optimization
- Efficient and Low-carbon Building Energy System
- Charging network with parking and charging integration and fast charging

Shenzhen actively expands the application scenarios of digital energy technology on the energy consumption side. In the industrial sector, it actively promotes the participation of virtual power plants in demand response, with a focus on accelerating the integration and optimization of green and low-carbon data centers and multi-energy complementary systems in intelligent park construction. In the construction sector, shenzhen explores the construction of intlligent buildings and applies suitable efficient energy equipment and systems, as well as technologies such as intelligent building control, to achieve a new building energy application system that interacts harmoniously with the city's energy system. In the transportation sector, the focus is on the construction of electric vehicle charging facilities and the establishment of a digital energy supply network, which includes creating digital connections between gas stations, charging stations, and vehicle owners, in order to build a city-wide green and low-carbon transportation network.

New green and low-carbon data center

The new green and low-carbon data center is a new type of infrastructure that is based on the application of information technologies such as 5G, industrial internet, cloud computing, and artificial intelligence and supported by green and low-carbon energy technologies such as efficient system integration, efficient refrigeration/cooling, efficient IT, and efficient power supply and distribution technologies. It aims to empower various industries by aggregating, storing, and managing diverse data resources.

Key technologies

1 Efficient system integration

Efficient system integration can provide optimal system integration deployment plans. Among them, prefabricated micro-module technology allows for the integration of core components such as rack systems and power supply and distribution systems, improving deployment efficiency through modular construction. Software-defined data center technology can build virtual resource pools relying on x86 servers, thereby increasing the utilization of IT resources. The solution for micro-liquid cooling data centers integrates efficient cooling facilities such as micro-liquid cooling cabinets, secondary cooling equipment, and heat exchangers to achieve spatial intensification and rapid deployment of systems.

2 Efficient refrigeration/cooling

Efficient refrigeration/cooling is used to cool and dissipate heat from IT equipment. The Fan Wall Chilled Water Cooling Solution, fluorine pump natural cooling technology, and fluorine pump multi-link circulating natural cooling technology enhance the energy efficiency of the data center through mechanical refrigeration or natural cooling methods. The data center energy consumption monitoring and intelligent operation management system, as well as the precision air conditioning variable speed energy-saving control cabinet, optimize the data center's energy efficiency by calculating and analyzing real-time data and implementing optimal control.

3 Efficient IT

The technology of efficient IT products provides the data center with efficient and energy-saving computing power and data storage capabilities. The liquid-cooled servers with cold plate technology ensure efficient heat transfer for the chips. The long-term, high-capacity optical disc storage technology utilizes a high-density jukebox to achieve cost-effective storage. The data center infrastructure management system (DCIM) enhances operation and maintenance efficiency and resource utilization through digital visualization, automated operation and maintenance, intelligent operations, and AI energy-saving features. A security defense system is implemented throughout the product lifecycle to ensure uninterrupted business operations and independent control.

4 Efficient power supply and distribution

Efficient power distribution provides uninterrupted power supply protection for the data center. Integrated power modules and modular uninterruptible power supply (UPS) technology enable the deployment of functional units in a unified manner. The "lithium battery + high-voltage direct current" technology ensures integrated backup to safeguard the information processing and the power supply for communication equipment. The intelligent distribution monitoring and management system enables intelligent management of the power distribution infrastructure in data centers, improving overall system efficiency and energy savings.

Advanced practices

Vertiv Group Corp.: Shenzhen Ping An Bank Data Center

Key technologies

It incorporates various green and energy-efficient devices, such as the Vertiv 2500kVA SCB13 energy-saving dry-type transformer, Vertiv PEX4S all-variable speed fluorine pump air conditioning, and Vertiv EXL uninterruptible power supply system.

Results

The first-ever energy-saving review and acceptance of an ultra-low PUE1.25 in China was successfully conducted in a high-heat and humid climate, setting a benchmark for the green construction of highly reliable bank data centers nationwide.

Huawei Digital Power Technologies Co., Ltd.: Three Gorges Dongyuemiao Data Center

Key technologies

It utilizes Huawei's technology of "steel structure + prefabricated modular", high-density intelligent power modules, intelligent lithium batteries, high-temperature fan walls, the intelligent management system DCIM, and iCooling@AI energy efficiency optimization, offering full-stack solutions for the data center.

Results

The first large-scale green zero-carbon data center in the domestic power industry has been completed and selected as a typical case in the 2021 National New Data Center. It has improved cooling efficiency by 15% compared to traditional solutions, with a Power Usage Effectiveness (PUE) reduced to 1.25.

ZTE: Guangdong Internet Cloud Data Center

Key technologies

It applies ZTE's prefabricated solution, as well as technologies such as HVDC and indirect evaporative cooling air conditioning, to achieve green energy savings.

Results

This data center has been selected in the "National Guidelines and Cases for Energy-saving Technology Application in the Field of Information Technology (2022 Edition)", with a PUE of 1.25 and an average power consumption of 7.20 kW. Compared to traditional air-cooled electricity, it saves 1702 kWh/year.

Advanced practices

Vertiv Group Corp.:China Unicom Sanlong Bay Intelligent Computing Center

Key technologies

It adopts a green construction plan based on BIM and CFD, integrating cutting-edge and efficient energy-saving technologies, such as intelligent hibernation modular UPS, intelligent multi-link full-variable speed natural evaporation refrigeration fluorine pump air conditioning system, comprehensive energy consumption monitoring of the building, and intelligent operation and maintenance management system.

Results

The capacity is increased by about 3.5% in the number of cabinets, and the PUE value with low load and high efficiency is less than 1.3.

Huawei Digital Power Technologies Co., Ltd.: European Cross-border Colo Operator K2

Key technologies

Huawei's indirect evaporative cooling solution (EHU) and innovative technology of one box and one system are adopted.

Results

Natural cooling has been achieved throughout the year, with a designed PUE as low as 1.15, saving 14 million kWh of electricity annually, equivalent to a 10-year reduction of 66,000 tons of carbon emissions.

Virtual power plant with friendly interaction of source, grid, load, and storage

The virtual power plant is an integrated system of power source, grid, load, and storage that achieves multi-subject, multi-level coordination and interaction and can serve as a special power plant to participate in grid dispatching or power market transactions when necessary by leveraging advanced communication technology and software architecture, applying technologies such as resource aggregation and optimal regulation, intelligent operation and coordinated dispatching, intelligent measurement and information communication, and terminal energy management, and aggregating distributed resources.

Key technologies

1 Resource aggregation and optimal regulation

Resource aggregation and optimal regulation realize the response to the grid demand command by aggregating the external characteristics of adjustable resources, and at the same time, it also conducts optimal regulation towards distributed resources based on market price signals and system operating conditions through measures such as the internal signing of direct control agreements and market incentive mechanisms, in order to achieve the optimal comprehensive benefits within the virtual power plant.

2 Intelligent operation and cooperative scheduling

Intelligent operation and cooperative scheduling forms a control scheme library for the power grid's control objectives, automatically generates control commands according to the actual operating conditions, and construct a multi-objective scheduling decision optimization model. It adopts intelligent algorithms such as genetic algorithms, simulated annealing, and neural networks to solve the operation and scheduling strategies of the virtual power plant in different time scales. This ensures real-time or near-real-time control of distributed resources, guaranteeing the stable operation of virtual power plants and the ability to respond to changing demand in a timely and continuous manner.

3 Intelligent measurement and information communication

By leveraging 5G customized DNN and network slicing capabilities, the technology of intelligent measurement and information communication builds a resilient network for virtual power plants, meets the demands of hierarchical zoning resource scheduling, and enables comprehensive management of wide-area resources. Therefore, the aggregation and control of adjustable loads, power storage stations, charging (swapping) stations, communication base stations, and other distributed resources can be realized.

4 Terminal energy management

The technology of terminal energy management establishes power constraints for terminals to ensure the reliability of the power supply from adjustable resources. It aims to output the optimal target response power for terminals based on comprehensive production efficiency in operational planning, and also tracks and controls real-time adjustment deviations for closed-loop power control to meet the requirements of the grid regulation performance.

Advanced practices

Shenzhen Power Supply Bureau: Virtual Power Plant Operation Management Platform

Key technologies

This platform utilizes 5G+ intelligent gateway technology to solve the security and defense challenges of accessing and scheduling massive load-side resources, ensuring the observability, measurability, and controllability of user-adjustable resources throughout the entire time period.

Results

It is the first network-ground-integrated virtual power plant management platform in China. It is currently the platform with the highest data collection density, the most comprehensive access to load types, the largest scale, the most directly controlled resources, and the widest range of application scenarios for virtual power plants.

Smart park with multi-energy complementary and integrated optimization

Representing the embodiment of the "two integrations" and the model of "Internet +", the smart park multi-energy complementary and integrated optimization realizes multiple benefits such as cascaded energy utilization, comprehensive energy efficiency improvement, energy structure optimization, and efficient utilization of local resources through technologies such as multi-energy coordinated scheduling, microgrid management, and smart energy management.

Key technologies

1 Multi-energy coordinated scheduling

Multi-energy coordinated scheduling is based on the intelligent energy system in the park as the core of energy scheduling, using the model of "Internet +" to integrate combined cooling, heating and power (CCHP), energy storage, smart microgrids, and non-fossil energy generation facilities in the park. It realizes the complementary and mutual support, clean production, and consumption on the spot among heterogeneous energy sources, effectively improves energy utilization efficiency, achieves optimal allocation of resources, and forms a green and shared closed-loop flow system.

2 Microgrid management technology

Microgrid management is the use of a microgrid energy management system to optimize the distribution and balance of distributed energy resources, establishing an integrated network of "source-grid-load-storage" to enable self-management, scheduling, and allocation of energy within the microgrid. Microgrid management allows users to autonomously control their electricity demand, while also enabling power suppliers to schedule and manage the "grid-microgrid" interaction through the microgrid energy system, enhancing the flexibility and reliability of the microgrid.

3 Intelligent energy management technology

Intelligent energy management involves the Intelligent management of energy within a park or campus through a smart energy management system. The intelligent energy management system consists of an edge layer and an energy management platform. Specifically, the edge control layer enables real-time perception and control of energy facilities, with a response time of seconds or even milliseconds. By comprehensively understanding the energy production and usage situation within the park, the energy management platform achieves comprehensive management of energy in the areas of production, transmission, storage, and consumption.

Advanced practices

Shenzhen Sunwoda Energy Technology Co., Ltd.: Huizhou Sunwoda Industrial Park

Key technologies

The park adopts a multi-energy complementary distributed energy system, including mains electricity, photovoltaics, gas power generation, and energy storage, and fully taps into the controllable potential of load devices such as aging batteries, air compressors, and air conditioning units, achieving coordination and complementarity between the energy supply and the energy demand.

Results

After being put into operation, the comprehensive energy utilization efficiency of the park has increased to 88.34%, the peak-to-valley difference in electricity consumption has decreased by 29.4%, the comprehensive energy cost has reduced by 8.17%, and the carbon emissions have been reduced by approximately 9,574 (t) per year.

Huawei Digital Power Technologies Co., Ltd.: AntoHill Near-Zero Carbon Campus

Key technologies

The campus utilizes building-integrated PV, AC/DC microgrid architecture, intelligent energy management, and advanced solar, storage, and charging systems.

Results

It has been honored with the "Carbon Neutrality Green Dot Pioneer Award", the world's first highest award for carbon-neutral parks, the "Carbon Pioneer" of Shenzhen, and other awards. After being put into operation, the park generates 1.5 million kWh of photovoltaic green power annually, and reduces carbon emissions by over 60%. The utilization rate of renewable energy exceeds 25%, and the energy consumption per unit area is reduced by 50% compared to the energy consumption standards for commercial buildings in Shenzhen.

Huawei Digital Power Technologies Co., Ltd.: The Low Carbon Demonstration Park of Office Building in Futian District

Key technologies

The park adopts key technologies such as Huawei's multi-energy coordinated scheduling and intelligent energy management to achieve intelligent energy management of the park, including smart photovoltaics, smart energy storage, VPP scheduling, flexible capacity enhancement, smart temperature control, smart lighting, and smart charging.

Results

After being put into operation, the annual production of photovoltaic green electricity is approximately 3.2 million kWh, with a power saving rate of 53% and a carbon emission reduction of over 53%. The utilization rate of renewable energy exceeds 48%.

Huawei Digital Power Technologies Co., Ltd.: Shenzhen Longgang International Low-carbon City

Key technologies

It adopts Huawei's smart photovoltaic and energy storage + energy management cloud-integrated solution, with the installation of 1.1MW photovoltaic and 2MWh energy storage, and the deployment of a comprehensive smart park management system.

Results

After being put into use, it produces 1.27 million kWh of green electricity per year, reducing carbon emissions by 606 tons, and the park's electricity consumption is basically self-sufficient.

Vertiv Group Corp.: Jiangmen Factory Park Integrated Energy Project

Key technologies

It adopts Vertiv's multi-energy coordinated scheduling technology, and automatically completes energy scheduling by utilizing the energy management system to synthesize local electricity prices, factory load curves, and photovoltaic generation curves, creating economic value for the owner by load shifting.

Results

Its annual direct savings in electricity costs of more than RMB 600,000, the consumption of self-provided photovoltaic system power generation reaches 100%, while the annual carbon dioxide emissions can be reduced to about 2,400 tons.

Efficient and low-carbon building energy system

The efficient and low-carbon building energy system is a new type of building energy application system based on the core concept of full lifecycle optimization design and smart operation. By combining climate and building scene characteristics, and applying technologies such as efficient energy equipment and system, smart building control, etc., according to local conditions, it achieves energy-intensive utilization, full consumption of renewable energy, and friendly interaction between buildings and urban energy systems.

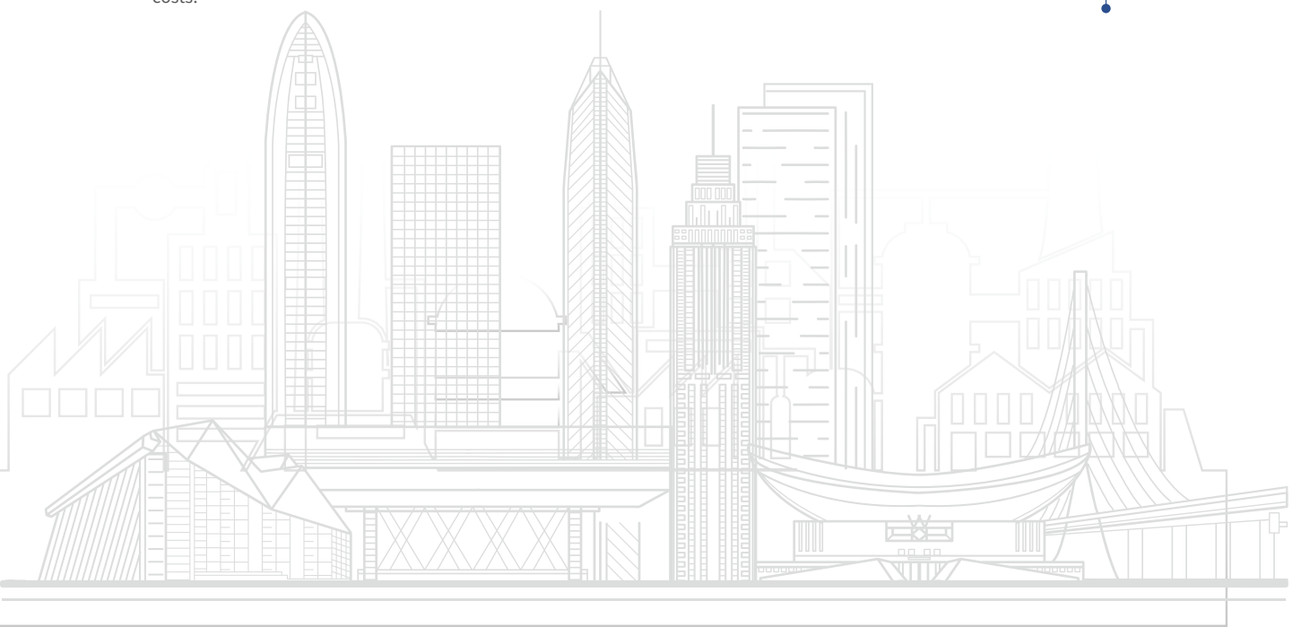
Key technologies

1 Efficient energy equipment and system

The building energy equipment and system achieves the reduction in building energy consumption through sustained improvements in energy efficiency. It utilizes proactive technologies such as high-efficiency variable speed air conditioning systems that adapt to load demands, lighting systems based on visual comfort, and electrical system measures with advanced control technology, which maximizes the efficiency of energy equipment and systems, providing a healthy and comfortable indoor environment with minimal energy consumption.

2 Smart building control

Based on the comprehensive perception and interconnection of people, machines, things, and events, the smart building control system predicts human behavior and preferences by dynamically monitoring energy equipment and systems and real-time sensing of indoor environmental conditions, and provides customized energy services and optimized operational strategies based on these predictions, which effectively reduces energy consumption and operating costs.



Advanced practices

Shenzhen Institute of Building Research Co., Ltd.: IBR Future Complex

Key technologies

It adopts "photovoltaic, energy storage, direct current and flexibility (PEDF)", a new type of electrical distribution system, enables "flexible" adjustment of the building's electrical load, applies an intelligent group control system combining strong and weak electricity, and utilizes comprehensive net-zero energy building technologies.

Results

The complex is the first full DC building in the world to come out of the laboratory and apply these technologies on a large scale. Compared to similar office buildings in Shenzhen, it has an average annual energy consumption level that is 46.6% lower and a yearly carbon emission reduction of 1,675 tons.

Chinese Academy of Sciences Holdings Co., Ltd.: China Overseas Building Project

Key technologies

This project incorporates various technologies such as natural ventilation and daylighting in the atrium, high-performance building envelope, heat recovery from fresh air and waste heat, efficient machine rooms, active chilled beams, efficient lighting, efficient elevators, and rooftop photovoltaics to explore the engineering approaches for nearly zero-carbon buildings.

Results

It achieves an annual overall energy efficiency rate of 61%, an energy efficiency rate of 59%, a renewable energy utilization rate of 12%, and reduces carbon emissions by 1642.3 tons. This project has been awarded the national standard for near-zero energy consumption building design in 2021.

Advanced practices

Shenzhen Dameisha Vanke Center: Pilot Project of Near-Zero Carbon Emission Building

Key technologies

The project is being constructed by China Construction Design International (CCDI) and Shenzhen Wonderland-time Green Building Technology Co., Ltd. It incorporates renewable energy utilization measures, utilizes intelligent management control systems, and resource recycling technologies, and combines cloud-edge energy management systems comprehensively to enable the intelligent operation and maintenance of electrical equipment and allow for the monitoring, disclosure, and analysis of energy consumption data, optimizing the absorption rate of photovoltaic power generation.

Results

Through measures such as the hosting of demand electricity fees, the project achieves 100% green electricity supply during operation, resulting in near-zero carbon emissions.

China Construction Science & Technology Group Co., Ltd.: CCTC Green Industrial Park

Key technologies

The project utilizes solar photovoltaics, energy storage, and a flexible power management system to supply electricity to the 8 office areas and the 2,500 square meters of the building. Through a flexible energy management system and advanced AI technology, the building's energy usage can be automatically regulated and optimized.

Results

The project saves more than 100,000 kWh of electricity annually, improves energy efficiency by over 30%, saves approximately 33.34 tons of standard coal per year, and reduces carbon emissions by over 47%.

Charging network with parking and charging integration and fast charging

The electric vehicle charging network revolves around the application of technologies such as liquid-cooled supercharging, charging module's splitting and overmatching, integrated solar, storage and charging, and vehicle-to-grid (V2G) technology. By providing charging and swapping services such as "one kilometer of battery life only needs one second of charging", "integrated parking and charging", and "fast charging", it ensures the integration infrastructure for the promotion and application of electric vehicle and the energy conservation and carbon reduction in the transportation field.

Key technologies

1 Liquid-cooled supercharging

Liquid-cooled supercharging utilizes a dedicated liquid circulation channel to transfer heat, enabling rapid heat dissipation and achieving ultra-fast charging. At the same time, through innovative intelligent switching matrix and power pooling scheduling technology, the power utilization rate of power grid transformers can be significantly improved, thereby reducing the waste of power resources.

2 Charging module's splitting and overmatching

The charging module's splitting and overmatching based on digital algorithms is to calculate the overmatching power coefficient that matches the power capacity of the front stage and the charging power demand of the rear stage vehicles through precise digital simulation technology, and to schedule multi-charging modules through ultra-fast power distribution. This enables more electric vehicles to be serviced and effectively improves the utilization of modules and power under the same power capacity.

3 Integrated solar, storage, and charging station

The DC bus architecture places the AC/DC converter upfront at the grid connection side, and the converter outputs stable DC voltage at the back end to form a small DC power grid. The charging stations, photovoltaics, energy storage, and other DC power sources or loads in the station all share the DC bus, allowing for efficient energy dispatch.

4 Vehicle to Grid (V2G)

V2G considers electric vehicles as flexible and schedulable mobile energy storage units that interact with the power grid to exchange energy and information. By utilizing the energy storage characteristics of electric vehicles, it achieves interaction between the power generation and the load, smooths out electricity peak and valley, stabilizes fluctuations in new energy sources, and increases the proportion of clean charging.

Advanced practices

Huawei: New Charging Network Solution of Full-liquid-cooled Supercharging Architecture

Key technologies

It innovatively adopts full-liquid-cooled supercharging and charging module's splitting and overmatching based on digital algorithms. It achieves the charging experience of "one kilometer of battery life only needs one second of charging" with high-power and quick charging.

Results

It achieves a 1%+ increase in system efficiency through self-developed topology, liquid cooling, and intelligent optimization. Ultimately, a 40% reduction of TCO was achieved in the total lifecycle.

Shenzhen Power Supply Bureau: Digital Grid Experience Center and V2G Interactive Demonstration Station

Key technologies

The demonstration station has implemented V2G technology and intelligent operation and maintenance technology based on AI and big data analysis, reducing electricity consumption by 100 kilowatt-hours within 1 hour and effectively achieving peak-load shifting of charging load.

Results

Currently, more than 120 electric vehicle charging stations can be adjusted, with an adjusting capacity exceeding 7.1 megawatts, providing a new sustainable development path for deep interaction between power supply and demand in the new power system.

Huawei Digital Power Technologies Co., Ltd.: Yongtai Digital Energy's Solar, Storage, and Charging Station

Key technologies

The charging station mainly focuses on the integration of solar, storage, and charging and liquid-cooled supercharging, carrying out ultra-fast charging and battery swapping businesses. By integrating photovoltaic, distributed energy storage system, and liquid-cooled supercharging pile, the integrated solar, storage, and charging station achieves coordinated operation of "source, grid, load, and storage".

Results

It is the world's first new energy vehicle charging and swapping station that supports liquid-cooled supercharging architecture, achieving a range of 500 kilometers on a 10-minute charging.

Vision

Since the 18th National Congress of the Communist Party of China, Shenzhen has been vigorously promoting the high-quality development of digital energy while implementing the new energy security strategy of "Four Revolutions and One Cooperation". It has introduced new development concepts, element organization methods, and market rules unique to the digital era into the existing energy system. By making data the core production factor and using digital technology as the driving force, it empowers the innovation and development of the energy industry, thereby supporting high-quality economic development.

Creating a Green Future with Digital Energy! Shenzhen will continue to fully demonstrate its new responsibilities and achievements as a Pilot Demonstration Zone of Socialism with Chinese Characteristics and to promote the in-depth integration of digital technology and the energy industry by benchmarking world-class and domestic leaders. It will extensively explore innovative application scenarios of digital technology in areas such as energy development and utilization, energy storage configuration, construction of new power systems, and energy consumption. Shenzhen is committed to building a green, efficient, flexible, intelligent, and sustainable modern energy system, and creating a highland for high-quality development of energy. It will promote the construction of an intelligent, digital and efficient intelligent city, continuously consolidate the digital base for high-quality development of economy, explore the promotion of the data trading market, enhance the comprehensive management capacity of energy digitization, strengthen international cooperation and the integration of scientific and technological innovation practices of industry, academia and research, and vigorously optimize the environment for the development of digital energy, so as to inject new kinetic energy for the development of the industry and speed up to build a global digital energy pioneer city.

Looking forward to the future, Shenzhen will make more efforts in whole chain and whole ecocycle to construct a globally leading innovation ecosystem and support system of digital energy, create multi-field international digital energy industry empowerment center, and endeavor to create new glory during the new journey to comprehensively build a great modern socialist country