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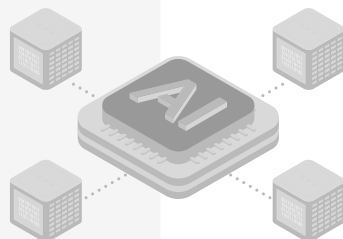
2023 / 43

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**DIGITALIZATION
HAS CHANGED
OUR LIVES AGAIN**



Editor's words



DIGITAL AND SMART CHANGES MAKE THINGS BETTER

One day, my son, a grade 1 student in the senior high school, talked about ChatGPT with me at dinner. It makes me realize that this chatbot has gone viral now. He has fully devoted himself to the schoolwork, and seldom mentions other things to me since high school. Surprisingly, he now wants to talk with me about this chatbot that has swept his class, and even asks me to chat with it together.

According to Report on the Development of China's Digital Economy (2022) by CAICT, the value of China's digital economy reached CNY 45.5 trillion in 2021, accounting for 39.8 percent of the country's GDP.

To fully implement the national 14th "Five-Year Plan" and Three-Year Action Plan for the Digital Transformation of the Manufacturing Industry (2021-2023), Shanghai issued the Shanghai Municipal Implementation Plan for the Digital Transformation of the Manufacturing Industry in October, 2022. With the deep integration of information technology and manufacturing as the central idea, it develops a "four-in-one" system for manufacturers to achieve digitalization with the four elements of the platform based on "chain-chiefs", smart factories, super application scenarios and innovation ecosystem, and will greatly improve the influence of "Made-in-Shanghai" brands and boost the high-quality development of the real economy. By 2025, it will implement digital diagnosis for all major manufacturing enterprises, build 10 demonstration zones, 200 exemplary smart factories and 30 Industrial Internet platforms, help 40 companies grow into "industry-empowered chain chiefs", and develop 50 super application scenarios for digital transformation.

The tide of digitalization pushes Shanghai Electric to proceed with high-quality development through the synergy of "smart energy and intelligent manufacturing", the two drivers of "industry intelligentization and service industrialization" and the interaction between "the Internet of Energy and Industrial Internet". At present, Shanghai Electric's subsidiaries in all sectors are actively exploring how to become more digitalized and empower their high-quality development with digital technologies.

As the chapter Great Learning of the Book of Rites advises, "If one can make things better for one day, he should make them better every day." Let's always seek new changes and embrace the new era for a digital Shanghai Electric.

Shanghai Electric Group Co., Ltd.
Shanghai Electric Editorial Board

Honorary Director

Leng weiqing

Honorary Deputy Director

Liu Ping Zhu Zhaokai

Director

Xin jian

Planner

Shen Jin

Editor-in-Chief

Tu Min

Add 2748 Pudong Dadao, Shanghai

Zip 200136

Tel 8621-20605605

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NEWS OVERVIEW

Shanghai Electric Wins Three WIPO-CNIPA Awards for Chinese Outstanding Patented Inventions and Industrial Designs

Recently, the Chinese Workers' Technical Association announced the winners of the 2022 WIPO-CNIPA Awards for Chinese Outstanding Patented Inventions, and three patents of Shanghai Electric recommended by the Shanghai Municipal Mechanical Labor Union won a first prize, a second prize and a third prize. The double-reheat CT boiler developed by Shanghai Boiler Works won the first prize. The patented technology adopts an original juxtaposition of multiple high-temperature heating surfaces, which cleverly solves the contradiction between heat transfer requirements and layout. It also features a flexible flue gas-steam temperature regulation system and a new steel truss structure. As the core technology of double-reheat boilers, it has been applied to the world's first 1000MW ultra-supercritical double-reheat boiler, the Double-Reheat demonstration project for the expansion of Guodian Taizhou Coal-fired Power Plant, whose capacity and comprehensive parameters were once among the best in the world. Shanghai Mitsubishi Elevator won the second prize for "a safety sensor for passenger cabins and its implementation". "A gasifier throat and its applications in biomass gasifiers" designed by the Shanghai Electric Group Central Academe won the third prize.



Double-reheat CT boiler

Shanghai Boiler Works Co., Ltd.



Safety sensor for passenger cabins and its implementation

Shanghai Mitsubishi Elevator



Gasifier throat and its applications in biomass gasifiers

Shanghai Electric Group Co., Ltd. Central Academe

Hualong I (HPR1000) Unit 3 of the Fangchenggang Nuclear Power Plant in Guangxi Is Connected to the Grid for Commercial Operation

At 20:29 on January 10, 2023, Unit 3 of the Fangchenggang nuclear power plant majorly owned by the China General Nuclear Power Corporation in Guangxi Zhuang Autonomous Region was connected to the grid for the first time as the first Hualong I reactor in Western China, signaling that the unit was capable of power generation and moved closer to the goal of commercial operation.

The plant is designed to have 6 units of 1000MW reactors which are estimated to produce 48 billion kWh of clean electricity every year after being completed, cutting the use of standard coal by 14.39 million tons and CO₂ emission by 39.74 million tons in comparison with a coal-fired power plant of the same capacity. The two units of phase I has been put into commercial operation in 2016 and produced over 100 billion kWh of power accumulatively to the grid, and Unit 3 and Unit 4 of phase II are under construction as scheduled which are the Hualong I model adopting China's 3rd-generation nuclear power technologies. Shanghai Electric Power Generation Group is the contractor and supplier of steam turbine generators installed in both phase I & II.





Unit 5 of Shidongkou Power Plant Starts Supplying Electricity

Unit 5 of Huaneng Shanghai Shidongkou First Power Plant 2x650MW capacity replacement project, constructed by Shanghai Electric Power Generation Group, passed the 168-hour full-load test run with excellent technical indicators, marking its upcoming commercial operation. It is the first capacity replacement project in China, a key energy project under Shanghai's 14th Five-Year Plan and a major construction project for the city. Shanghai Electric Power Generation Group provided a full set of main and auxiliary equipment for the project, including a 650MW ultra-supercritical double-reheat condensing steam turbine (single shaft, five-cylinder four-exhaust) with high efficiency, and major auxiliary equipment motors such as induced draft fan motor, primary fan motor, supply fan motor, circulating water pump motor and condensate pump motor. In addition, the project adopts deep peak regulation with a minimum load for stable combustion of 20%, enabling efficiency of 80% in peak regulation. By making full use of the project site, the project team has created a demonstration project with great profitability, leading environmental performance, advanced technology, intelligent efficiency, and sufficient utilization of existing resources, based on relevant principles.

Shanghai Electric Digital Technology's Achievement Selected as "Excellent IIoT APP Solution"

The Ministry of Industry and Information Technology (MIIT) recently announced the "2022 Excellent IIoT APP Solutions", which included the Supply Chain Collaboration App for Advanced Equipment Manufacturers by Shanghai Electric Digital Technology. Leveraging Shanghai Electric's proven ability in advanced equipment manufacturing, "Shanghe" smart supply chain platform is designed to enable smooth collaborations of the whole supply chain. It will facilitate the digital transformation and upgrade of supply chain of the manufacturing industry, provide key supply chain services to manufacturing technology, and enhance the digital and intelligent capability of advanced manufacturing enterprises, to help them improve development quality, reduce cost and increase efficiency. The platform will be fully integrated with the SEunicloud IIoT platform to expand service offerings and create more IIoT-based smart supply chains in areas such as industrial chain collaboration and after-sales service.

Shanghai Electric's Two Projects in Malaysia Start Power Supply

Recently, the Marudi Junction – Bunut 275kV Transmission Line Project and Bunut 275 kV substation contracted by Shanghai Electric Power Transmission & Distribution Engineering have started supplying electricity. With strict local policies on environmental protection, the project team ensured that the environment and vegetation were not damaged with green project design, gaining recognition from the owner and winning several gold and silver awards for environmental protection from the Department of Environment, Sarawak and Sarawak Energy. After being put into operation, the two projects comprehensively improved the reliability of power supply in the northeastern region of Sarawak, Malaysia, solved the bottleneck in industrial development due to the lack of electricity for many years, and opened the channel of power transmission from Sarawak to Sabah, which won the high appreciation of the project owner, Sarawak Energy.

Block C of Phase V of the PV Project in Dubai Connected to Power

On February 1, local time, Block C of the 900MW Phase V PV project in Dubai was connected to power successfully as a major project milestone. Its timely completion received unanimous praise from the owner and the local grid company. The project is divided into three blocks (A/B/C and each 300MW). Block A is temporarily handed over on November 9, 2021, and Phase B enters commercial operation on October 10, 2022.



Shanghai Electric's Thar Project Awarded Outstanding Chinese Enterprise for Promotional Practices

Recently, the Chinese Embassy in Pakistan held a ceremony to recognize the promotional practices of Chinese enterprises in Pakistan in 2022. Shanghai Electric's Thar Coal Block-I Power Generation Company and China CEFC Energy Company were selected from hundreds of Chinese enterprises in Pakistan as Outstanding Chinese Enterprises for Promotional Practices. Thar power plant received the award for the first time, while CEFC Energy received its first award in 2022 and this is its second award. Both companies will keep their good work in project construction to further improve local people's livelihood and boost the high-quality development of the China-Pakistan Economic Corridor project.



2022 China's Top Overseas Power Project Contractors Released

The China Chamber of Commerce for Import and Export of Machinery and Electronic Products (CCCME) announced the "2022 China's Top Overseas Power Project Contractors". Shanghai Electric ranked 13th with 20 newly signed projects, including major maintenance of Wassit Power Plant in Iraq and the Parau PV project in Romania. In particular, the group's thermal power and wind power projects ranked 7th and 8th respectively, while its power transmission projects ranked 9th, up 2 places from last year. its solar power (PV) projects ranked 14th; and its new energy projects ranked 15th, up 5 places from last year. In 2022, Chinese enterprises reportedly entered into 517 contracts for overseas power projects, with a total contract value of \$33.993 billion and a total installed capacity of 33.5 GW.



East-West Passage across Pudong Opened to Traffic with Assistance from Shanghai Electric

Recently, East-West Passage across Pudong, built with the participation of Shanghai Electric Automation D&R Institute, was opened to traffic to further enhance the functions of the rapid transit system in Shanghai. The positive spillover effects of Lujiazui CBD are enhanced to facilitate the development of the Lujiazui Finance and Trade Zone and the “Golden Central Development Belt”. The project contains nine parts, including the East-West Passage and the auxiliary rooms (including the tunnel central control room and the central equipment room), and the integrated monitoring system including the central control system.

Shanghai Electric ZTC Technology Assists the World’s Largest Natural Gas Treatment FPSO Platform in Its Sea Trial

The N999 Tortue FPSO platform, the world’s largest natural gas treatment FPSO platform designed and manufactured by COSCO Shipping (Qidong) Offshore successfully made its sea trial after a number of commissioning sessions. All communication cables onboard were supplied by Shanghai Electric ZTC Technology (Suzhou). It is the second international collaboration between Shanghai Electric ZTC Technology and world-renowned shipping companies after the FPSO Almirante Barroso MV32 project last year. In recent years, Shanghai Electric ZTC Technology has insisted on developing new technologies and products to satisfy customer needs. It has brought in cutting-edge manufacturing equipment and participated in many naval projects at home and abroad with its excellent product performance and complete classification society certifications.



Shanghai Electric-SPX Obtains Orders for Air-Cooling Equipment from CSP Market

Shanghai Electric-SPX Engineering & Technologies recently won consecutive orders for air-cooling equipment from Yumen CSP project and Zhabuye CSP Project in Tibet. So far, the company has won all the air-cooling equipment bids in the domestic CSP market over the past year, strengthening Shanghai Electric’s market presence.

In the past two years, the company has won many orders for air-cooling equipment from CSP projects such as Yumen Xinneng, CSIC, Haixi Mongolian and Tibetan Autonomous Prefecture, Akesai, and Cosin Solar Jinta.

Green Medal! Sustainable Development Achievements of Shanghai Electric Make the Forbes List





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At the 2023 Forbes China Sustainable Development Summit held in Shanghai on March 7, Shanghai Electric won the Best Case Award for the “2022 Industrial Sustainability in China: Exploration and Practice” white paper, and made the list of “2022 Forbes China Top 50 Sustainable Development Industrial Enterprises” for its long-term investment and excellent performance in the high-end, green and intelligent development of industrial manufacturing.

As one of the largest energy equipment manufacturers in China, Shanghai Electric has taken the national “carbon peaking and carbon neutrality” goals and comprehensive green transformation as its mission with “energy substitution, energy efficiency improvement, optimal resource utilization” as its three major paths. It has contributed electric wisdom to “safe decarbonization” through constant upgrade of technology and products. Shanghai Electric actively conducts exploration and practice of sustainable development in terms of green manufacturing, intelligent manufacturing, construction of green supply chain, clean energy, energy conservation and emission reduction, social responsibility, and so on. In the future, Shanghai Electric will continue to promote green development, strengthen the research and development of green technologies, seek innovation and progress, and strive for safe decarbonization and the harmony between human and nature.

This award aims to recognize the green manufacturers with excellent influence and power nationwide, set a new benchmark in the industry, explore the new model of green and low-carbon transformation, and assist industrial manufacturers in achieving the goal of carbon neutrality. Only the industrial enterprises with a history over 10 years, an annual operating income exceeding CNY 100 billion, and the research and development investment growing by about 50% year on year were selected. **D**



Hunutlu Thermal Power Plant Ensured Sufficient Power Supply for Anti-quake Relief Work in Türkiye

The recent major earthquake in southern Türkiye has attracted global concern. The region experienced two strong-magnitude earthquakes in one day, followed by several aftershocks, resulting in substantial loss of life and property. However, the Hunutlu thermal power plant, a China-backed coal-fired power plant located only 90 kilometers from the epicenter of the earthquake, has been generating electricity at full power to ensure sufficient power supply for the anti-quake relief work in the country. Shanghai Electric was engaged in the construction of the power station. Designers from the group have adopted spring vibration isolators for Eurocode 8 in the design of the generators, ensuring that the power plant's equipment is safe in major earthquakes.

A magnitude 7.8 earthquake struck the southern Turkish province of Kahramanmaraş at 04:17 am local time on February 6, followed by another magnitude 7.6 earthquake at 13:24. After the two deadly quakes and scores of violent aftershocks, three power

plants (a foreign-owned coal-fired power plant, a domestic coal-fired plant and a hydro power plant) near Adana province, where the Hunutlu thermal power plant is located, have been severely damaged and shut down. As electricity consumption rises in winter, the situation in the affected areas is even more critical.

The Hunutlu thermal power plant is the largest direct China-backed project in Türkiye since the establishment of diplomatic ties between the two countries, representing the cooperation between China's Belt and Road Initiative and Türkiye's Middle Corridor Initiative. Located on the Yumurtalik Beach adjacent to the Mediterranean Sea, Adana Province, the plant is equipped with two 660MW ultra-supercritical generators and flue-gas desulphurization (FGD) and SCR systems. The steam turbines, generators, auxiliary equipment and other key equipment of the power plant are all manufactured and installed by Shanghai Electric. **D**

The first EW8.X-230 offshore turbine based on the Poseidon platform was rolled off the production line of Shanghai Electric's Putian manufacturing facility, marking a milestone in China's offshore wind power moving towards grid parity.

The first EW8.5-230, a next-gen semi-direct-drive turbine based on the Poseidon platform, has been hoisted into place at Bozhong B Offshore Wind Farm of Shandong Energy Group. With the Shanghai Electric's largest installed rotor with a diameter of 230m, it leads China's wind power into a new era.

47 semi-direct-drive EW8.5-230 turbines based on the Poseidon platform at the Bozhong Offshore Wind Farm have been connected to the grid, making it the commercial wind farm with the largest rotor diameter in the Shanghai Electric.

June 10, 2022

September 8, 2022

December 30, 2022

TOP10

Shanghai Electric's Poseidon-based Turbine Ranked among the Top 10 Turbines of 2022



Windpower Monthly, a prestigious magazine in the wind power sector, announced its Turbines of the Year 2022 list recently.

Shanghai Electric's EW8.5-230 wind turbine based on the Poseidon platform has been selected as one of the Top 10 turbines, signifying another victory for the turbine after it was named one of the "Best 10 Innovations" in the China's top 50 wind power enterprises list in September.

With a 230-meter diameter, the turbine rotor has a swept area that equals 5.8 football fields. With an annual average wind speed of 7.5 m/s, it can generate electricity up to 28 million kWh per year, which can satisfy the demand for electricity of 14,500 households, equivalent to reducing coal consumption by nearly 10,000 tons and

CO₂ emission by 24,000 tons. It's a next-gen turbine with semi-direct drive designed by Shanghai Electric based on its many years of experience in offshore wind for China's sea areas with low-to-medium wind speeds. Its rotor diameter is the largest among those of commercial turbines in the world, which will lead China's wind power into the "era of big rotor".

The Poseidon-based turbine adopts a highly integrated next-gen semi-direct drive chain that reduces both the construction cost of onshore wind farms and the kilowatt-hour cost across the life cycle of wind farms. Focusing on "technology-driven innovative solutions", Shanghai Electric will insist on promoting continuous innovation in technology and products to lead China's wind power. **D**



Shanghai Electric Scores another New Achievement in Green Transition

On January 5, the sub-forum themed on China's ESG Practices and Development of the 4th Forum for Credit System Construction of Chinese Cities was held in Beijing. Shanghai Electric was awarded the Credit 100 Jinlan Award for Best Carbon Peaking & Carbon Neutrality Practice for its excellence in green transition.

It is not the only ESG award that Shanghai Electric has received recently. On December 20, 2022, Shanghai Electric was selected for the "CSR of Local SOEs: Pioneer 100 Index (2022)" published by State-owned Assets Supervision and Administration Commission of the State Council which brings together the best CSR practices of the year. Shanghai Electric has been selected for its active exploration and outstanding achievements in CSR.

Shanghai Electric has always regarded CSR as an integral part of its high-quality development. An early adopter of ESG disclosure in China, Shanghai Electric has released ESG reports for six consecutive years. With its thorough and informative ESG report and excellent performance in ESG, Shanghai Electric was honored with the "ESG Practice of the Year Award" by Shanghai Press Group and Jiemian News on September 8, 2022. Afterwards, the company was named "Zero Carbon Future Leader of the Year" at the Cloud Summit of the Jiemian Creative Industry Forum on October 24. Shanghai Electric was awarded for its important contributions in exploring the path towards safe decarbonization and promoting low-carbon energy transition by new technologies and applying various energy-saving innovations in power generation, thermal power transformation flexibility, power transmission and distribution, rail transit, intelligent buildings and many other fields.

As one of the largest energy equipment manufacturers in China, Shanghai Electric has taken the national carbon peaking and carbon neutrality goals and comprehensive green transition as its mission with "energy substitution, energy efficiency

improvement, optimal resource utilization" as its three major paths. The company has contributed to "safe decarbonization" through a constant upgrade of technology and products.

For alternative energy resources, Shanghai Electric pursues cogeneration practices that integrate thermal energy and new energy, vigorously promotes technological innovation and industrial planning for the integrated development of "wind, solar, storage and hydrogen", and strives to increase the consumptive efficiency of renewable energy, so as to promote energy transition and establish a green power system. To improve energy efficiency, the company implements the "Energy Saving First" strategy and provides energy-efficient products and services for many industries through technological innovation. In terms of resource utilization, Shanghai Electric has capabilities in core process planning and system and equipment manufacturing for flue gas treatment, water treatment, solid waste treatment, and carbon capture and utilization, which can greatly promote the recycling of energy resources. For pollutant management, Shanghai Electric has established a sound and permanent mechanism for clean production to enhance the green development of enterprises.

It is worth noting that MSCI, a renowned international index provider, upgraded Shanghai Electric's ESG rating from BBB to A, an upgrade for the second consecutive year, which reflects the continuous improvement of Shanghai Electric's ESG governance and disclosure, as well as the capital market's full recognition of its value in the long term. Shanghai Electric will boost its R&D advantages through technological innovation and lead the low-carbon development of the electrical industry. We will actively shoulder the responsibility to realize the national carbon peaking and carbon neutrality goals, firmly pursue high-quality development, and further promote the implementation of China's sustainable development strategy. **D**

Shanghai Electric's Flexible Bearing System for PV Earns Order Worth 100 Million Yuan

In January, Shanghai Electric Power Generation Equipment Co., Ltd. Generator Plant (hereinafter "Shanghai Generator Plant") won the bid of the flexible bearing system for 250MW PV modules in Area A of Huayuan Power's Derun 500 MW fishery-PV complementary smart energy project at Huanghua City, Hebei Province. The project marks Shanghai Generator Plant's first PV order whose value exceeds 100 million yuan, demonstrating that the flexible bearing system developed by the company is recognized by the market shortly after its launch.

With a total contract value of 2.5 billion yuan, the project will adopt a fishery-PV

complementary power generation model to build a salt pond-based PV plant. The project can also support recreation and tourism businesses by acting as a landmark on the route, which will drive the development of fishery, energy and tourism concurrently. The power plant is designed to yield 500 million kWh of electricity every year with an installed capacity of 500MW. As a signature flexible bearing system project in China, it represents an important step forward for the PV bearing system sector, especially it enables the flexible system to be applied in much more scenarios and reinforces the diversified development of the PV bearing system sector. **D**



The First Turbine of Yangpu Shenergy - Shanghai Electric Wind Power Zero-carbon Project Rolled off the Production Line

On January 10, the launching ceremony for the first turbine produced in Yangpu Shenergy - Shanghai Electric Wind Power Zero-carbon Energy Equipment Industry Project was held in Yangpu Economic Development Zone, Danzhou, Province of Hainan. The project is among the first batch of construction projects commenced in Hainan Free Trade Port on January 6, 2022. After a year, the first main wind turbine equipment produced in Yangpu Economic Development Zone rolled off the production line.

At the end of 2021, the Department of Industry and Information Technology of Hainan Province issued the Development Plan of Wind Power Equipment Industry in Hainan Province (2022-2025), which proposed that the province would form a wind power equipment industry cluster consisting of "one park and two bases", namely, Western Offshore Wind Power Industrial Park, Yangpu and Dongfang Offshore Wind Power Equipment Manufacturing Bases. Offshore wind power supporting projects are launched in Yangpu to raise the proportion of installed clean energy capacity and boost high-quality development.

Based on the local plans and aiming at collaborative development, Shanghai Electric gives full play to its leading role in uniting upstream and downstream enterprises to extend the industrial chain and form an industrial cluster to boost the diversified development of the offshore wind power industry in Yangpu. The Yangpu Shenergy - Shanghai Electric Wind Power Zero-carbon Project will be equipped with a production line of 8 to 15 megawatts for offshore wind turbines with an annual production capacity of 150 to 200 units.

It is of great importance to developing offshore wind power for the achievement of the national carbon peaking and carbon neutrality goals in Hainan. Leveraging the wind resources in the province, Shanghai Electric will promote the construction of the second phase of the Yangpu project, which covers the manufacturing of ultra-long wind turbine blades, gearbox, inverter and generator, and the construction of offshore wind O&M port, so as to build a 10-billion-yuan new energy equipment manufacturing base for regional markets in Hainan, Guangxi and Southeast Asia, and provide full support to Hainan in building a 100-billion-yuan wind power industrial cluster.

Shanghai Electric will give full play to its comprehensive

advantages in advanced equipment manufacturing to help Hainan in the integrated development of wind power, wind turbines and applications. The company will strive to strengthen supply chain cooperation, enhance the competitiveness of the industry, and promote the construction of the offshore wind industrial chain. Shanghai Electric will work with its partners on green hydrogen manufacturing, desalination, redox flow batteries, zero-carbon plants, smart grid, smart transportation and digital urban governance to help Hainan build a new power system and a clean, safe and efficient energy system featuring renewable energy and the integration of "source, grid, load and storage". The company will also help Hainan to build the Western Offshore Wind Power Industrial Park, the 100-billion-yuan wind power industrial cluster, the national ecological civilization pilot zone, and an eco-friendly, green and low-carbon free trade port. **D**





Shanghai Electric Contributes to Yangtze- to-Huaihe Water Diversion Project that Starts Trial Operation Recently

Recently, Yangtze-to-Huaihe Water Diversion Project, a mega water project to divert water from the Yangtze, China's longest river, to the Huaihe River ("No.1 Infrastructure Project" of Anhui Province), announced its trial operation on the shore of Chaohu Lake. Shanghai Electric participated in the construction of 12 pumping stations, and provided a total of 60 large and medium-sized motors, with the total contract amount accounting for more than 95% of the total investment in the project's motors and equipment.

Connecting the Yangtze River and Huaihe River, the project is a cross-basin and cross-province strategic project for water resources allocation and comprehensive utilization, and one of the 172 major water conservation and supply projects named by the State Council. Since winning the tender for Zhuji Pumping Station in 2018, the management of Shanghai Electric Machinery has led a project team composed of backbone staff to carry out lifecycle project management with the aim of delivering a high-quality project. Against all adversity and challenges such as COVID-19, the team members strictly controlled the important milestones of the project, and steadily

promoted the project process with excellent manufacturing capability, rigorous quality assurance, and perfect after-sales service to ensure its trial operation was on schedule.

It is noteworthy that the design of the Shushan Pumping Station is very demanding, as it is the largest pumping station in the project and the largest mixed-flow pumping station in Asia. The technical team designed a set of electromagnetic solutions with high performance parameters with a domestic-leading electromagnetic analysis platform. During project execution, they conducted 3D rigid strength analysis, modal analysis of key components and ventilation analysis of the motor, working hard to improve its quality and enabling the key performance parameters on vibration control, noise reduction and efficiency of the pumping station much higher than the requirements of the bidding documents.

Shanghai Electric has been deeply involved in many national key livelihood projects, including the Dongjiang-Shenzhen Water Supply Project, the South-to-North Water Diversion Project, the Pearl River Delta Water Supply Project, and the Yangtze-to-Huaihe Water Diversion Project, fully demonstrating its strong technological strength and leading status in the water conservancy industry. Shanghai Electric will provide its clients with next-gen intelligent motors that are safer, better and more reliable through new technologies and tools such as intelligent design, digital delivery and intelligent O&M to assist them in building high-quality projects. **D**

ANOTHER SURPRISE FROM DIGITALIZATION!



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Digitalization surprised us again.



“SHANGHAI ELECTRIC MODEL” EMPOWERS THE INDUSTRY’S TRANSITION TO GREEN AND LOW-CARBON DEVELOPMENT

According to Report on the Development of China’s Digital Economy (2022) by CAICT, the value of China’s digital economy reached CNY 45.5 trillion in 2021, accounting for 39.8% of the country’s GDP.

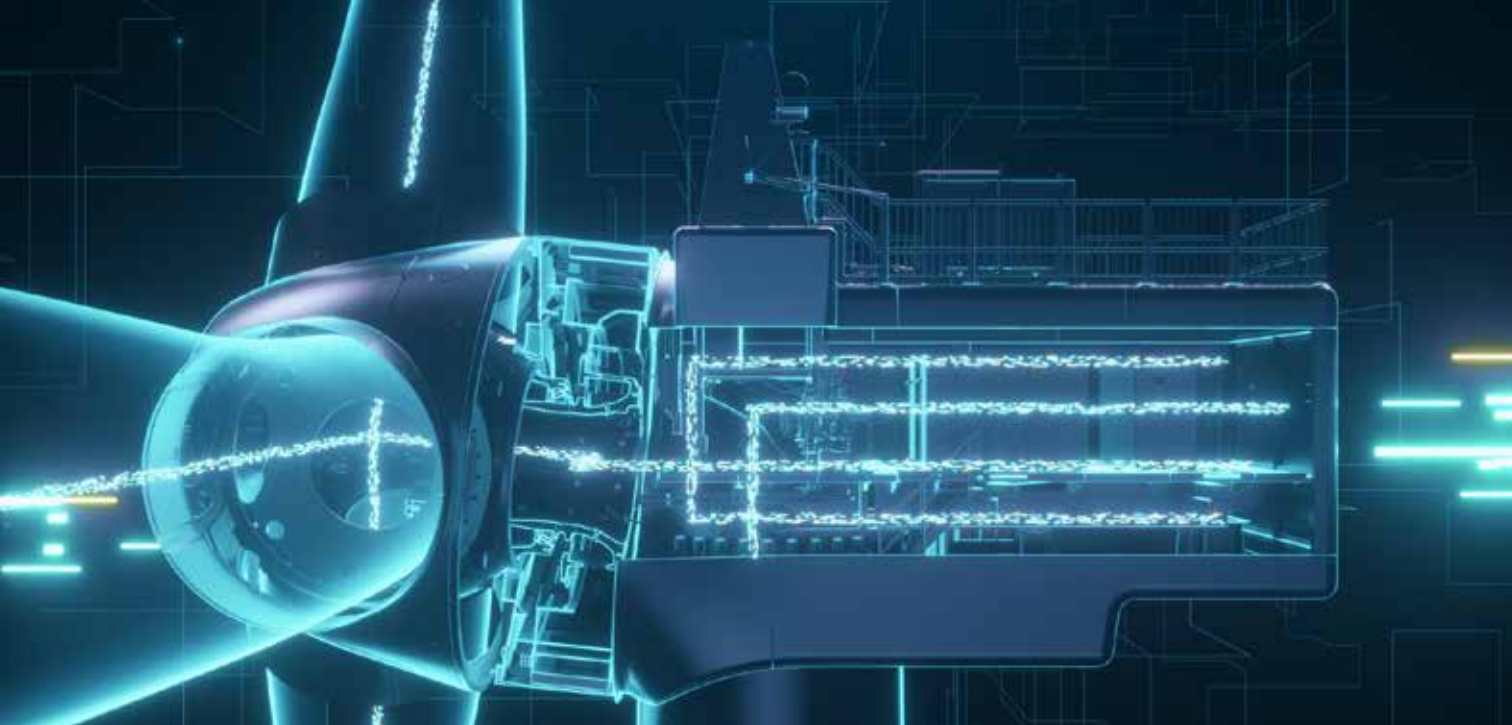
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The tide of digitalization pushes Shanghai Electric to proceed with high-quality development through the synergy of “smart energy and intelligent manufacturing”, the two drivers of “industry intelligentization and service industrialization” and the interaction between “the Internet of Energy and Industrial Internet”. At present, Shanghai Electric’s subsidiaries in all sectors are actively exploring how to become more digitalized and empower their high-quality development with digital

CHALLENGES IN DIGITAL TRANSFORMATION

Creating numerous opportunities and challenges, digital transformation has become unavoidable for organizations looking to remain competitive in a fast-changing world. At the end of last year, Shanghai Electric released the Shanghai Electric White Paper on Digital Transformation, which analyzes and summarizes the scenarios, tools and cases where digitalization empowers manufacturing enterprises. The White Paper pointed out: The ability to acquire, process, transmit and predict information within a reasonable span of time is one of the decisive factors for the survival of inter-species and intra-species individuals and groups.

There is no need to talk about the need for digitalization, but to focus on how to realize it when all information can be described, transmitted and calculated by digital technology; everything around us can be recorded, calculated and even predicted by such technology, and a mobile phone next to us can perform more calculations in one second than a person working tirelessly for over 800,000 years without rest.



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The world's major economies, including China, and the city of Shanghai, have all put forward plans and timetables for digital transformation, especially for the manufacturing industry.

Such industry-wide effort is bringing pressure as Shanghai Electric transitions to full intelligent digitalization.

According to Deloitte statistics, the average proportion of digital investment to sales revenue of major multinational companies is 2%, with some of them reaching 4%. Leading companies are investing more in digital technology. The digital transformation of global leading manufacturers such as Siemens and Schneider has covered the dimensions of business restructuring and organizational

management reform. They are building new technical barriers and competitive advantages through digital technology in terms of concepts, methods, standards and software to grasp the future of industry.

Tech giants have many successful practices of digital transformation for individual customers, but for enterprise customers, their digital business is not smooth, because there are a lot of "chasms" and "shafts" in manufacturing industry due to complex organizational structures and processes. However, tech companies have never given up on penetrating into the industrial sector.

The above-mentioned reasons make it more difficult for manufacturing companies to escape from the valley of the "smile curve", leaving them with a window of opportunity for digital transformation that will not exist for long. In response to the opportunities and challenges, nearly two-thirds of the Chinese central state-owned enterprises have set up technology companies to serve their digital strategies.



SHANGHAI ELECTRIC'S DIGITAL TRANSFORMATION MODEL

Shanghai Electric believes that there is no universal solution for digital transformation of enterprises. It can neither be achieved very quickly, nor should it be treated as a blind investment. Based on the key pain points, they should take the major application scenarios as the breakthrough points, and then gradually develop to complete the digital transformation.

The first task of digital transformation is to answer two questions through a comprehensive review before launching the transformation: what issues to address with digital transformation? and how is the digital footing of the enterprise? It can be regarded as a self-examination that enterprises must carry

out before launching the transformation. The process includes three aspects. First, assess the health condition of the enterprise, including business operations, financial condition, personnel structure, innovation and R&D. Second, assess the digital footing of the enterprise, mainly about the existing digital capabilities of the enterprise, including the IT architecture, hardware and equipment, software and systems, database and storage and integration condition, IT talent reserves and their areas of expertise. Third, identify the enterprise's needs for digital transformation, which should cover processes and departments such as R&D, testing, production, marketing, sales, personnel, workplace,



procurement, customer service, operation and maintenance. After overall analysis, the enterprise can spotlights segments to clarify its key needs and orientation to avoid blind transformation.

Digital transformation in large enterprises is usually a systematic top-down reform. Such companies should start off with a master plan and comprehensive digital deployment after sorting out their business processes (either by themselves or a consulting agency) with an aim to reduce information silos and enable leap-forward improvements. As digital transformation progresses, they should keep adapting and updating to continuously expand digital capabilities based on requirements. Most SMEs do not have sufficient manpower, financial resources and technology for a thorough transformation, although they can realize the benefits and importance of digitalization. Successful digital transformation of SMEs often starts with the business that requires urgent improvement. Such companies can use digital tools to satisfy their needs and address pain points in a targeted manner for revenue growth, cost reduction and efficiency improvement.

Digital technologies and tools allow the quantification of business and the "collaboration" among departments and units in the enterprise, which changes the traditional organizational structure and eliminates "data silos". In companies with successful digital transformation, the end-to-end process greatly reduces the redundancy of work. Digitization tools offer visualized data, enabling data-driven business, standardized workflow and task visualization, and continuous accumulation of data assets.

The White Paper on Digital Transformation released by Shanghai Electric in last year presented a digital transformation model for equipment manufacturing industry in line with the characteristics of Shanghai Electric, covering 34 digital scenarios in 8 categories and 23 cases in 7 types, ranging from digital transformation planning to intelligent manufacturing, while summarizing 51 digital products in 5 classes, including platforms, software and other digital tool series. The White Paper will serve as a tool for digitization workforce and business leaders at all levels to help industries attain better development.

SHANGHAI ELECTRIC'S AWARDS IN DIGITAL TRANSFORMATION

Shanghai Electric Group won the Zhan Lu Award at 2020 WAIC Industrial Intelligence Summit

Shanghai Electric's SEunicloud won the 2021 Industrial Internet Golden Purple Bamboo Award

SEunicloud platform was included in the third batch of model platforms in service manufacturing by Ministry of Industry and Information Technology

Shanghai Electric's SEunicloud was named one of the 2020 Top 12 industrial Internet platforms in Yangtze River Delta

Shanghai Highly Group won 2022 China Light Industry Digital Transformation Outstanding Company Award

Highly Electrical Appliances was selected as a 2021 Industrial Internet Pilot Demonstration Project by Ministry of Industry and Information Technology

Shanghai Electric Wind Power was selected into China Digital Transformation Top 50 List

Shanghai Electric Nuclear Power Equipment Corporation was selected as a pilot demonstration company in manufacturing "innovation and entrepreneurship"

Turbine Plant was included in the first batch of intelligent manufacturing demonstration factories (20 in total) by Ministry of Industry and Information Technology

Shanghai Boiler Works won the Digital Innovation Potential Award in the SASACS SOE Digital Transformation and Innovation Competition.

Shanghai Electric Machinery won the Digital Innovation Pioneer Award in the SASACS SOE Digital Transformation and Innovation Competition

Shanghai Electric Digital Technology's Achievement Won the Excellent Industrial Internet Solution Award

Shanghai Electric Group, Highly Group, Digital Technology, etc. were selected for special projects in industrial Internet or industrial high-quality development

SHANGHAI ELECTRIC CREATES A NEW MODEL OF GREEN AND LOW- CARBON SERVICES



ELECTRIC SHANGHAI

Carbon Peak and Carbon Neutral seem like climate and environmental issues, but in fact they are issues of development transformation. As the main source of carbon emissions, energy is also an important basis for economic and social development. The dual-carbon target has put forward higher requirements for the development of China's energy system. Shanghai Electric actively responds to the national dual-carbon target, actively undertakes the mission of the times, and focuses on the transformation to green, low-carbon and digital development. With a vision in key areas, while continuously optimizing the industrial structure, it actively creates a new model of green and low-

carbon services.

With rich technical heritage and based on the digital base of SEunicloud, the "energy-carbon control platform" becomes a calling card of Shanghai Electric. It turns the industrial experience into a mature digital algorithm model and uses digital application components as a carrier to meet the general and individual green and low-carbon needs of different customers, providing high-quality butler services for customers in parks, factories, warehouses and schools.

It functions with carbon control as the goal and energy control as the means, planning as the guide and operation as the focus, software as the carrier and mechanism as the core. The "energy-carbon control platform" built by Shanghai



Electric not only serves the needs of operation and maintenance and market trading in the operation stage, but also meets the needs of planning, design and equipment selection in the planning and construction stage. It orients towards the whole life cycle of planning, construction and operation, deeply integrating equipment technology and information technology to build a new model of green and low-carbon service for Shanghai Electric.

Last year, this new model, which combines technological innovation and model innovation, was deployed in Shanghai and Hebei.

As a digital city-industry integration project that was implemented after Shanghai's "five new towns" plan was finalized, "Digital

ELECTRIC SHANGHAI



energy architecture for "Digital Jianghai", making it Shanghai's first urban green and low-carbon pilot zone.

As a powerful driver of a green supply chain for power materials, State Grid Jibei plays a leading role in demonstrating and leading the industry. Based on "energy transformation and green development" concept, it innovatively proposes to build a zero-carbon storage system with "zero-carbon warehouse" as its core, in order to build a benchmark demonstration project of zero-carbon warehouse of State Grid Jibei. Together with relevant units, Shanghai Electric Digital Technology gives full play to the concept and advantages of the "energy-carbon control platform", which is a powerful solution to the customer's pain points, and provides

preliminary planning, consultation and digital upgrade services for the zero-carbon transformation of power supply warehouses in the relevant regional power supply bureaus.

In the future, under the guidance of the national strategy of "Carbon Neutral and Carbon Peak", Shanghai Electric will continue technological innovation and model innovation, address the main challenge of energy and industrial carbon emission reduction, integrate and build "energy and carbon" digital aggregation system, and delve into the green and low-carbon industry. It will continue to iterate the SEunicloud energy-carbon control platform, continuously improve its green and low-carbon service capability, and empower the industry in the green and low-carbon transformation journey.





“DIGITAL JIANGHAI” INTEGRAL ENERGY CONSTRUCTION PLAN

The “Digital Jianghai” project is located in the northeast of the core area of Fengxian District, with an area of 137 hectares and a building area of 2.55 million m². As the first project in Fengxian District, one of the five New City areas, it is built around the digital era, laying out elements such as digital industry manufacturing and services. The aim is to build the first international digital industry district with city-wide influence, characterized by industry-city integration, complete functions, balanced industry and housing, livable environment,

convenient transportation, and efficient governance, and the first green and low-carbon pilot area in Shanghai.

Three core issues need to be addressed in the planning and design: First, in developing integral energy, how to demonstrate the highlights of the project according to local conditions while meeting the general requirements of green and low-carbon development? Second, how does the integral energy system respond to users’ flexible demand of energy in the future? Third, how to balance the low cost and operability of the plan?

Shanghai Electric Central Academe, Électricité de France, and Shanghai Electric Digital Technology set up the guideline of “greenness

and efficiency, flexible openness, and digital empowerment”, the “1+5+X” overall energy structure, and the goals of >2% renewable energy ratio and 23,000 tons of CO2 emission cut.

In terms of greenness and efficiency, the green power core of the industrial park will be the PV building roofs and the solar-storage-charge integrated carport, with a PV capacity of 7.5MWp. Meanwhile, the waste heat steam of the adjacent thermal power plants and the efficient and flexible air source heat pump will be fully utilized to meet the heating and cooling needs of the buildings;

In terms of flexible openness, the plan features collaborative interactive systems such as the user-side AC-DC hybrid flexible distribution network and smart micro-grid groups to make the power distribution system more flexible and active. The project is equipped with 21 sets of 250kW/1.5MWh liquid flow energy storage batteries, 1917 sets of charging piles (including 580 sets of 60kW DC fast charging, some with V2G functions). Meanwhile, in the project core area, a PEDF will be built to achieve open access and two-way interaction of diversified loads;

In terms of digital empowerment, by building an energy-carbon dual-control platform and relying on a unified energy digital base, all links of source, grid, load and storage of the industrial park will be connected to achieve comprehensive monitoring, accurate measurement, and high-level control. Sixteen types of business scenarios are imagined, including virtual power plant clusters, energy operation and maintenance joint centers, energy-carbon one-stop access, and energy-carbon dual-control map. With effective concentration of a large number of adjustable resources to support real-time dynamic response, the industrial park will be capable of excellent energy perception, smart decision-making and fast execution.



The digital and green trends have become two major factors driving the global socioeconomic transformation and are changing the human society profoundly. The dual-carbon policy will be the strategic direction of China’s 14th “Five-Year Plan” period and beyond, and the coordinated digital and green transformation is the key to realizing this goal.

China Academy of Information and Communications Technology predicts that digitalization’s contribution to decarbonization will be around 12% to 22%. We should go green and go digital at the same time, with the former driving the latter, and the latter facilitating the former. More efforts should be invested in developing green digital technologies and fostering a new green digital ecosystem.

As one of the leading enterprises in China’s equipment manufacturing industry, Shanghai Electric has drawn up a blueprint for digitalization, which will transform from lean manufacturing and intelligent manufacturing to services, ultimately forming a digital industrial group of companies. Quantifiable, traceable, predictable and retainable, it will empower each business chain through digital means, and cultivate core competencies characterized by high quality, high efficiency and low cost.

Dense roots give rise to fruitfulness, and sufficient lamp oil creates brilliant light. There will be more wonders about the Internet and its integration with the real economy, and there are many efforts to be made for the digitalization of Shanghai Electric. For Shanghai Electric, the path to digitalization will open wider. **D**

ZHANG LEI

STICK TO
ORIGINAL
ASPIRATION
AND MISSION
EMBARKING
ON A JOURNEY
OF CHANGE

Zhang Lei

Holder of Shanghai Municipal May 1st
Labor Medal from Shanghai Electric Power
Transmission & Distribution Engineering





"Somehow, 14 years." Zhang Lei, born in 1978, has 14 years of experience in overseas projects. He has been to Sri Lanka and Pakistan. His unpretentious account is always full of trivial details, but I repeatedly learned "responsibility" and "persistence" from it.

When he was sent abroad at the age of 30, did he anticipate that he would stay there for 14 years? What has motivated him to grow into a holder of Shanghai Municipal May 1st Labor Medal? What kind of belief and sense of mission does he harbor?

Let's listen to Zhang Lei's story.

I WANT TO BROADEN MY HORIZONS IN SUCH A WONDERFUL WORLD

Many people think that Shanghainese can't bear hardships. As a native of Shanghai, Zhang Lei graduated from Shanghai University of Electric Power with a degree in electrical automation. Before joining Shanghai Electric, he already had 8 years of experience in power industry, responsible for the commissioning of substations and general contracting of equipment of Shanghai Metro. In 2008, he joined Shanghai Electric Power Transmission & Distribution Engineering Co., Ltd., and had the opportunity to be responsible for the management of the substation construction in a supporting project of 1X300MW power station in Sri Lanka. He was 30 years old and full of ambition. He said, "I want to broaden my horizons in such a wonderful world."

Upon arrival at the airport in Colombo, Sri Lanka, Zhang Lei was curious about the country while feeling a little disappointed when he looked outside the plane window. From the bustling Shanghai to the island country with poor lighting, his first thought was that Sri Lanka needs to vigorously develop its power system.

However, he was shocked by the high temperature in Sri Lanka, in addition to the notorious "dengue fever", "LTTE" and "civil war".

The summer sun was blazing in Sri Lanka, and his body temperature exceeded 40 °C. Although the dormitory was air-conditioned, there were frequent power outages, sometimes two or three times a night. With no windows in the bedroom, the whole room was like a steamer, and project members woke up frequently in the night. In the heat wave, they sat in the courtyard, looking at the dark city, talking about interesting things or prospects for the future. Zhang Lei always said that he hoped the project would be completed sooner, so that the power would not be out in summer.

They were not halted back by the adversities. Zhang Lei learned that the 1X300MW auxiliary project for Puttalam power station, representing China's assistance to Sri Lanka, has the largest installed capacity in the country at that time. After being connected to the grid, it will cover about one-third of Sri Lanka's electricity consumption and ensure residential communities and enterprises enjoy a stable power supply. He felt proud to be able to join such a meaningful project as a Chinese. A seed called the sense of mission has quietly taken root in this young man's heart.



LEARNING ENGLISH PAINSTAKINGLY

English was the first challenge that Zhang Lei encountered. The project owner is CEB, a local power company. When the owner asked his questions, Zhang Lei was often unable to express himself accurately, realizing that his English skills were too poor for such a professional project.

"I will not be the weak link that makes the owner doubt our ability." He was determined to make up for his shortcomings. In the first two months, he and his colleagues investigated more than 280 towers on foot under the scorching sun to get first-hand information. They drank coconut juice when they were thirsty, ate bread when they were hungry, and painstakingly completed the survey of more than 100 kilometers. At night, he studied professional vocabulary in English while others were sleeping. Even when the power was out, he kept studying with a flashlight. By translating electrical construction standards, he mastered professional English vocabulary in the field of electricity. Meanwhile, he talked with

the locals in English whenever he had the chance, and his spoken language became increasingly fluent.

After seven years in Sri Lanka, Zhang Lei left the country. He saw from the plane that scattered power facilities firmly rooted in the land of the Pearl of the Indian Ocean, and myriad twinkling lights are like an ocean. He said, "I feel reluctant to leave the country. We had a hard beginning, but after all our efforts, we helped the country improve its power system. The lights represent our sweat, and the Chinese technology and standards brought by us." Zhang Lei will always miss this beautiful country. Those dewdrops condensed in the dark night will eventually greet the morning light, watering his sense of mission to grow and prosper.

JUST CAN'T LEAVE

Sense of mission is a too big phrase for Zhang Lei, and he prefers "responsibility". He spent another 7 years in Pakistan, taking on more responsibilities that made it impossible for him to just walk away.

In May 2015, three months after the completion of the project in Sri Lanka, Zhang Lei was appointed as an on-site project manager for the TP-1000 Power Grid Upgrade project in Karachi, Pakistan. The challenge of the project was the lack of sufficient primary data. Meanwhile, the private land ownership in the country caused problems in land use for the construction and renewal of the 15 high-voltage lines of the project.

Zhang Lei was deeply impressed by a double-circuit buried cable with a total length of about 12 kilometers and a diameter of 2,500 mm². As the cable crosses the entire downtown of Karachi, as many as six main traffic roads need to be excavated, involving numerous government departments and private landowners, which will greatly affect the mobility and daily life of the local people. The Karachi branch of a well-known company, leading a consortium as Party A, and the owner, Karachi Power Company, both thought that this was an impossible task.

However, with the help of PowerChina Hubei Electric Engineering's technology, Zhang Lei and his team found a feasible path that had the lowest cost and least impact on the lives of local people after surveying the region repeatedly and cutting through complexity based on the social information provided by the local subcontractors. During

the peak time for construction, he was stationed at the project site and worked until 11:00 pm every day, solving many problems in a timely manner. He often ate chicken biryani with Pakistani workers on the construction site. The cable was put into operation smoothly in February 2019, running well since then.

In the seven years in Pakistan, Zhang Lei and his team encountered numerous obstacles and solved countless problems. Besides their daunting tasks, there were poor local security, threats from terrorist attacks, and sporadic covid-19 resurgences. Zhang Lei always stick to his "responsibilities" despite all adversities. He set a principle for himself, that is, he would not leave the project site as long as there are unsolved problems. He believed that it was his duty. He believed that only if he was there, he could fulfill his responsibility to the fullest.

He had done a lot for the country during his seven years in Pakistan. When a flood ravaged Karachi, he led his team to donate money and supplies. When COVID-19 hit the country severely, he shared epidemic prevention supplies with the owner of the project. He also provided project management lessons to local employees. On January 23, 2020, Zhang Lei had just finished his vacation and returned to the project site in Karachi. After learning about the COVID-19 resurgence situation, he sent his colleagues in the project department to return to China, even though the project was still in the peak time of construction, and he himself stayed in Karachi for 24 months. Fortunately, no one on the project site contracted the novel coronavirus under his leadership.



ALWAYS ON THE ROAD

In his 14 years abroad, he gave up many opportunities to go back to China in consideration of the urgency of the project construction. He only reunited with his family during a few Chinese New Year holidays. "I wasn't able to be there for my family. However, I have tried every minute of the 14 years to make some part of the world a better and brighter place. When the project was put into operation, we gave hope to more people. I feel very satisfied." Zhang Lei is a wise man, he knows that he can't have his cake and eat it.

"In a society full of temptations, we must know what we really want and stay true to our original aspiration. Lofty ideals are priceless. What I get is just what I aspire to. I don't care that my salary is lower than others, I have more business trips or my home is far from my office. At Shanghai Electric, I can utilize my knowledge and skills towards the same goal shared with my teammates and see personal development day by day. Why would I leave such a warm and encouraging family?" He returned to China in 2022 and joined the challenging Shigang project.

On August 3, 2022, he was assigned to be responsible for the equipment installation and construction management of Shigang Jingcheng 220kV power transmission project in Yingkou. He embarked on this new journey. Compared with projects in foreign countries, the requirements of domestic power transmission projects are more stringent, and the process procedures are more complicated. "I'll be fully dedicated to my work no matter how challenging it is." With the same sense of responsibility, he sought advice from others and solved a lot of technical problems based on his 20 years of work experience. He properly handled the relationship between the owner, the constructor and the equipment suppliers, pouring all his efforts into the project for timely delivery.

As Zhang Lei is on his new journey, other engineers are also on the road. From the auxiliary project for Puttalam 1×300MW power plant in Sri Lanka, TP-1000 project in Pakistan, to Shigang Jingcheng 220kV power transmission project, he has grown from a professional technician to a key project manager. His experience demonstrates how an ordinary person becomes extraordinary.

Zhang Lei has seen many hardships, frustrations and "impossibilities", but he has defied the odds with his faith and sense of mission, which enables him to uphold his original aspiration and honesty at work against such a fast-changing era, and warm others with his energy. **D**

MATERIALS SCIENCE TO PROMOTE NEW DEVELOPMENT CARBON FIBER TO GAIN SIGNIFICANT DEMAND IN WIND POWER

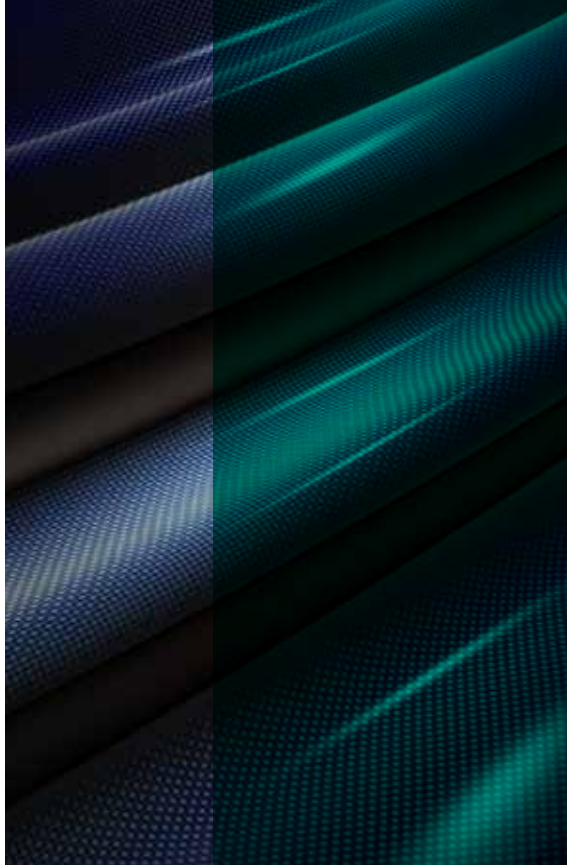
By Zhang Zhiyang

Lithium has driven electrochemical energy storage to higher energy density, which enables longer lasting smart phones and increased EV range. Featuring high safety performance, Lithium iron phosphate batteries have been used in the power cell industry after their energy density was enhanced. Silicon-based energy solutions are gaining ground to replace fossil energy, while hydrogen-based energy is also emerging as a trend for zero-carbon solutions. The development of technology is increasingly dependent on the elements at the front of the periodic table, and national development is also more reliant on related resources.

CITIC's report shows that the carbon fiber industry index recently reached a historical high since 2022. On August 2, the sector's index hit a recent high of 6316.11 points, representing an increase of nearly 16% compared to that in mid-July.

The counter-trend strength of the carbon fiber sector results from the market's expectation of an upcoming demand release in the downstream market, and the key event that led investors to such a judgment was some news about the expiration of a patent on carbon fiber.

More than two decades ago, Vestas, a global wind power giant, solved the technological problem in the application of carbon fiber sheets on wind turbine blades through its patented technology. Afterwards, the company introduced pultruded carbon sheets to the wind power industry. On July 19, 2002, Vestas applied to the China National Intellectual Property Administration (CNIPA), the European Patent Office (EPO) and the World Intellectual Property Office (WIPO) for a patent related to wind turbine blades featuring carbon fiber, with a protection duration of 20 years. The patent expired on July 19, 2022. A number of securities and investment institutions believed that after the lifting of the patent restrictions, domestic wind turbine blade manufacturers would be able to roll out blades with carbon fiber, allowing the penetration rate of the material to increase in the wind power sector. The Westerners gained many colonies through ships and cannons in the Age of Great Exploration, but after World War II, they used "shields" to win rich profits for nearly 80 years. The third industrial revolution opened the era of patents, which focused on forward-looking strategic deployment. Countries, through such an advanced cognition, will be 30 years ahead of the world. The development of modern economy depends on "cognition". In the future, whether it is an economic war or technological war, whether it is a cold war or a hot war, it is a "cognitive war".



01

INCREMENTAL MARKET OPENING?

How can the lifting of a patent protection lead to a big change in the carbon fiber sector? The answer is obvious: investors are attracted by the potentially incremental market. According to a research report by China Securities, carbon fiber is a high-performance material with carbon main chain formed by the cracking and carbonization of organic fibers (filaments) such as polyacrylonitrile and asphalt under high temperature, which possesses excellent properties such as light weight, high strength, high modulus, electrical conductivity, thermal conductivity, corrosion resistance, fatigue resistance, high temperature resistance, and small expansion coefficient.

It has the highest specific strength and modulus among the high-performance fibers in mass production.

The rising demand for carbon fiber in wind turbine blades is underpinned by the growing blade length and the steadily developing wind power market.

Data from the Chinese Wind Energy Association (CWEA) of the China Renewable Energy Society show that in 2021, China's installed wind power reached a record high, with new installed capacity reaching 55.92 million kilowatts, up 2.7% year-on-year. In particular, the installed capacity of onshore wind power increased by 41.44 million kilowatts; the installed capacity of offshore wind power increased by 14.48 million kilowatts, up 276.59% year-on-year. With its excellent performance, carbon fiber is extensively adopted in aerospace, wind power blades, sports and leisure, transportation, construction and other fields. It is worth mentioning that the demand for carbon fiber in the downstream markets is dominated by wind turbine blades.

According to data from the Global Wind Energy Council (GWEC), from 2015 to 2021, the demand for carbon fiber in the global wind power market climbed year by year, from 18,000 tons to 33,000 tons. In 2021, the demand for carbon fiber from wind power accounted for 30% of the total global demand. BAIIINFO data show that in 2022, wind turbine blades become the largest downstream market for carbon fiber in China, accounting for 35% of the total domestic demand.

At the same time, wind turbines are getting bigger. In 2021, the average capacity of newly installed wind turbines in China reached 3,514 kilowatts, up 31.7% year-on-year, with the average capacity of onshore wind turbines up 20.7% and offshore wind turbines up 13.9%.

Along with the increase in turbine capacity, the length of blades is also getting longer. According to China Securities' report, in 2014, 88% of new turbines installed worldwide had diameters of rotor blades less than 110 m, while in 2019, the proportion of rotor blades with diameters of 110 m or more reached 86.5%. In 2020, the rotor blades of mainstream models reached 131 to 150 meters in diameter. As offshore wind turbines become larger and larger, big and light blades become an inevitable trend. With its high specific strength and modulus, carbon fiber can ensure blade strength while reducing its weight, enabling a larger swept area and lower load, thereby improving the turbine's power generation efficiency. Carbon fiber is a more desirable material for blades than glass fiber. Therefore, the capital market has generally expected that the penetration of carbon fiber in the wind turbine blade market would grow after its patent expired.

02

COST-EFFECTIVENESS CONSIDERATIONS

When the carbon fiber wind turbine blade is still under patent protection, the industry has already looked forward to the growth of carbon fiber demand. However, the high cost is still the biggest obstacle to the massive application of carbon fiber in wind turbine blades. Research shows that the cost of carbon fiber filament for wind turbines is 120,000 yuan/ton, and the cost of the finished fabric rises to 180,000 yuan/ton, which is 12 times the price of glass fiber fabric.

It is difficult for enterprises to gain revenue when the cost is too high. It is estimated that if carbon fiber is adopted to make the main beam of the blades instead of fiberglass uniaxial cloth, it can effectively reduce the weight of blades by 20%, but the cost will rise by 82%.

This means that, although carbon fiber has been freed from the shackles of patent protection, we still need to overcome many difficulties to realize its massive application in a short term. Furthermore, as the state no longer subsidizes the wind power industry, and offshore wind is still far from parity, the large-scale use of carbon fiber is more inconceivable. As we know, blades are core components of wind turbines, and their costs account for 20% of the total turbine cost, and the material accounts for more than 80% of the cost of the blades.

Prices of wind turbines have been falling since the end of 2020. At present, the price of onshore wind turbines has dropped to 2,500 yuan/kW, and offshore wind turbine has fallen below 4,000 yuan/kW, representing a major plunge compared to the historical high. The demand for cost reduction is bound to be spread along the industrial chain to the upstream blade production.

Glass fiber is still the main material of turbine blades due to cost management concerns. Through technological evolution, glass fiber can also meet the requirements of large wind turbines. Low-speed wind farms are often developed close to load centers, where resources change from impossible to irreversible. The low cost and low loss in glass fiber technology development can provide a boost to the development of new materials, and the reduction in marginal cost resulting from the massive application of the material will nurture the emergence of new markets. **D**

BLOOMING FLOWERS IN OUR HEARTS

As the poem goes, “The rosy clouds are reflected in the water under the Tianjin Bridge, and the weeping willow branches sway gently in the breeze.” I pushed open the window and took a deep breath. As I looked out, the beautiful spring scenery came into my eyes, filling my heart with joy.

After a long cold winter, we all crave warmth and hope to be embraced by the pleasant spring breeze. We want to bend down and listen to the sound of blooming.

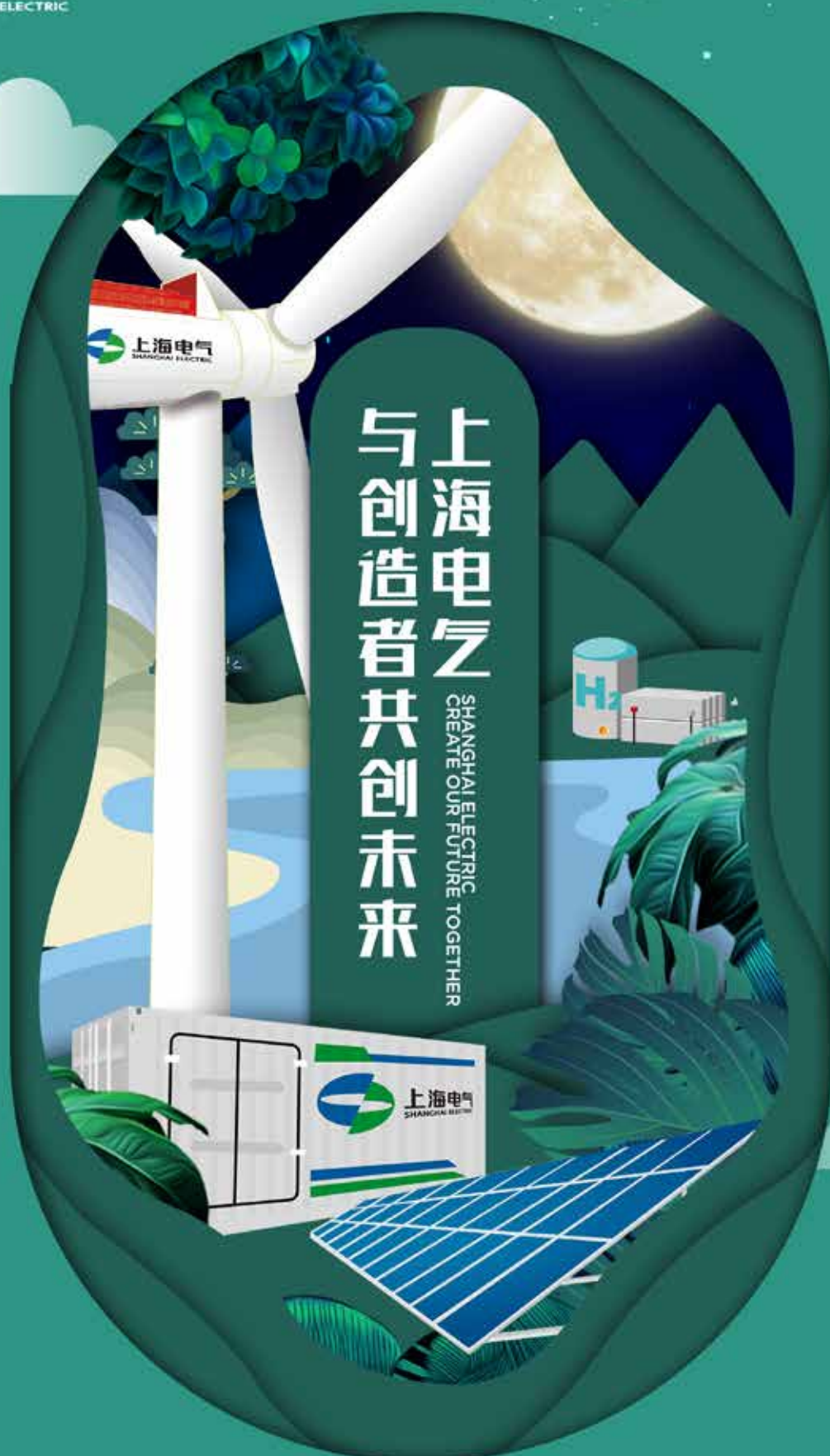
When night falls, the myriad twinkling lights pierce through the darkness, creating a spectacular night view. The lights illuminate the city as if it were daytime.

When we look up at the starry sky, we’ll be stunned by its depth and vastness, which contains unfathomable truths for us to pursue. The starry sky is so free and tranquil that we cannot help but admire its immensity.

We are so small in the face of nature, but at the same time, we can create miracles by using the gifts of nature. There are beautiful flowers blooming in the hearts of Shanghai Electric’s employees, namely, sustainable solar energy, gracious wind power, potentially limitless biomass energy, and awesome nuclear energy and hydrogen energy storage, the rising stars of energy solutions.

As the world faces an energy problem, most countries believe that new energy will provide a safer future for us, and China is no exception. Guided by the national carbon peaking and carbon neutrality goals, Shanghai Electric has launched pioneering strategies in solar energy, wind power, biomass energy, nuclear energy and energy storage, making great strides forward in a multi-pronged approach.

Life is short, and time just flies by. In this long-awaited spring, we send an invitation letter to the world: let’s forge ahead in the world of new energy! Let’s pioneer the future together! **D**



与上海电气
创造者共创未来

SHANGHAI ELECTRIC
CREATE OUR FUTURE TOGETHER