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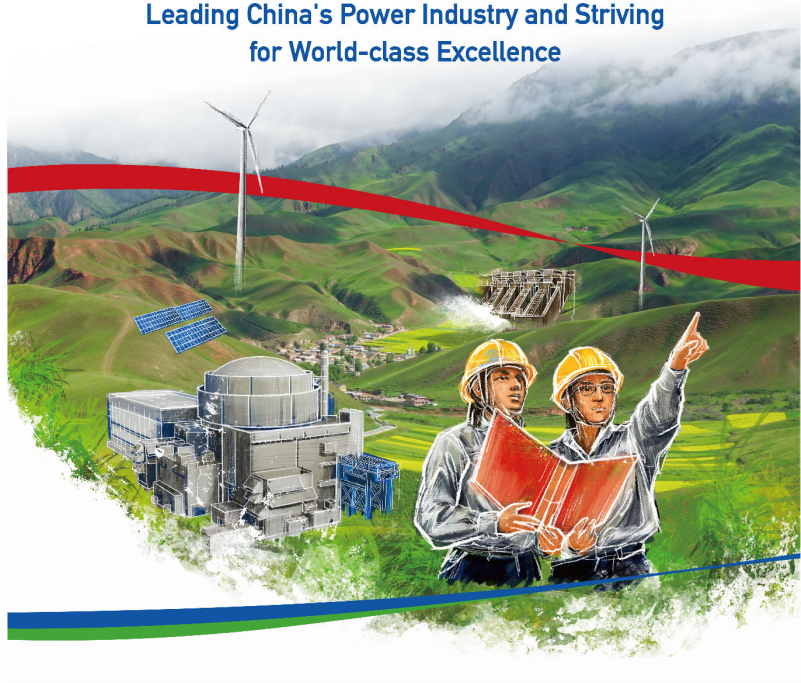
 中国华能集团有限公司  
CHINA HUANENG GROUP CO., LTD.

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CHINA HUANENG GROUP CO., LTD.

2022

Environmental, Social and Governance Report

Leading China's Power Industry and Striving  
for World-class Excellence



This report, the 17<sup>th</sup> consecutive sustainability report released to the public by CHNG since 2006, is the first special report named as "Environmental, Social and Governance (ESG) Report". Based on the principles of objectivity, standardization, and comprehensiveness, this report fully incorporates the latest policies and corporate strategy, and delves into the ESG concept embedded in its "three-color" culture, internalized in its main business, and coexisting with its development goals. Besides, this report explores an ESG management and practice system with "CHNG characteristics", systematically sorts out and truthfully discloses information concerning its fulfillment of ESG indicators with "CHNG characteristics", demonstrates corporate responsibility, and shapes a good image of corporate citizen that pushes the higher-quality and more sustainable corporate development.



The logo of China Huaneng Group consists of the deformation of letters "H" and "N". "H" and "N" are the first letters of Chinese phonetic transcription of "Huaneng", and the meaning of the combination is: contributing energy and adding power for national rejuvenation while creating happiness. Letter "H" adopts a bold font, which is powerful and vigorous, presenting a visual image of safety, reliability and steadiness; letter "N" connects letter "H" with three rays to form a lightning font, symbolizing perpetual and unlimited power; and dark blue is chosen as the base color, demonstrating solemnness, rigor, serenity and harmony, as well as broad-mindedness and lofty ambition. The shape of the letters resembles mountain peaks, emitting a grand atmosphere; the composition of the logo is neat and orderly, giving a sense of solemnness; and the superposition effect is concise and lively, full of vitality, exhibiting the sacred mission and demeanor of Huaneng as a key state-owned backbone enterprise.

## About this Report

### Reporting Period

January 1, 2022 to December 31, 2022. Some of the contents go beyond the above range.

### Reporting Cycle

This report is an annual report released to the public in the third quarter of each year.

### Main Contents

This report discloses CHNG's policies, practices and performance in 2022 in main business, environmental, social and governance aspects. Its relevant basic source materials are all drawn from relevant company documents, statements and grassroots enterprises.

### Compilation Basis

*The 2030 Agenda for Sustainable Development* by the United Nations  
*The Ten Principles of the UN Global Compact* by the United Nations  
*Unified Standard for the Sustainability Reporting* from the Global Reporting Initiative (GRI)  
*Environmental, Social and Governance (ESG) Reporting Guidelines* issued by Hong Kong Exchanges and Clearing Limited  
*ISO26000: Guidance on Social Responsibility (2010)* issued by the International Organization for Standardization  
*Guidelines on Social Responsibility (GB/T36000-2015)* issued by the Standardization Administration of the People's Republic of China  
*Reference-Index System for ESG-Special Reports of Listed Companies Controlled by Central SOEs* issued by State-owned Assets Supervision and Administration Commission

### Title Description

For convenience of expression, in this report, "CHNG", "Huaneng Group", "Huaneng", "the Company" and "We" refer to "China Huaneng Group Co., Ltd.".

### Online Access to the Report

The Report is available in Chinese and English. The video version is also available. The Chinese version and the video version are released at the same time. Please visit our website at <https://www.chng.com.cn>, or call 010-63287171 to request for the Report.  
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The 20<sup>th</sup> National Congress of the Communist Party of China is a meeting of great importance. It takes place at a critical time as the entire Party and the Chinese people of all ethnic groups embark on a new journey to build China into a modern socialist country in all respects and advance toward the Second Centenary Goal. The decisions, deployments, and achievements made at the national congress will undoubtedly play a very important guidance and assurance role in building a modern socialist country in all respects, advancing the great rejuvenation of the Chinese nation on all fronts, and striving for the new success of socialism with Chinese characteristics.

Study, publicity, and implementation of the guiding principles of the 20<sup>th</sup> National Congress of the Communist Party of China were our primary political task. A wave of study, publicity, and implementation has been sparked rapidly. Party organizations at all levels were organized to listen to or watch the 20<sup>th</sup> National Congress of the Communist Party of China. Members of the Party Leading Group took the lead in study based on the actual situation, and guided Party members and officials to hold high the great banner of socialism with Chinese characteristics. Moreover, by deeply studying and understanding the guiding principles of the 20<sup>th</sup> National Congress, forging ahead with fortitude, working perseveringly and diligently, China Huaneng promoted its high-quality development driven by the guiding principles of the 20<sup>th</sup> National Congress of the Communist Party of China, and strived to be the first to build a world-class company with global competitiveness in the industry, showcasing Huaneng's responsibility and making contribution on the journey to build a modern socialist country in all respects and advance the great rejuvenation of the Chinese nation on all fronts.

## Party Organizations at All Levels Listened to or Watched the 20<sup>th</sup> National Congress of the Communist Party of China



- ① Members of the management team of the Group, and representatives of Party members and officials from various departments of the headquarters and units directly affiliated to the Group
- ② Members of the management team and department heads of Huaneng Power International, Inc.
- ③ Maintenance staff of Zhuribe Central Station of Huaneng Renewables Corporation Limited
- ④ Frontline employees of Changjiang Nuclear Power Project
- ⑤ "Raining 10" Ship employees of Raining Shipping
- ⑥ Production frontline employees of Gansu Company
- ⑦ Officials and workers of Lower Sesan II Hydropower Station
- ⑧ Officials and workers of Pakistan Sahwal Power Station



# CHNG in High Quality Development

The 20th National Congress of the Communist Party of China has pointed out the direction and established the action guidelines for us to plan and promote high-quality development. We need to plan, reflect, and drive the Company's work within the overall interests of the Party and the country.

Standing at a new starting point, we must rely on tenacious efforts to open up a new field for Huaneng's cause. Adhering to integrity, innovation, and unity, comprehensively embarking on a new journey of leading China's power industry and striving for world-class excellence, are the company's strategic choice to adapt to the new situation, shape new advantages, and achieve new leadership position.

— Speech by Wen Shugang, Chairman of Huaneng, at the 2023 Working Conference

## Guided by the "366" Strategy

### Strategic Vision

Leading China's Power Industry and Striving for World-class Excellence

### Basic Path

Deepen Reform for Better Quality. Deepen Reform for Higher Efficiency. Deepen Reform for Stronger Impetus

### Development Strategy

Focusing on the "3 Guidances", Ensuring the "6 Persist-ins", and Realizing the "6 New Leaderships"

### "3 Guidances" as the Overall Requirements

#### One Development Goal:

Accelerate the Building of a World-class Enterprise

#### One Development Theme:

Step up Efforts to Advance High-quality Development

#### One Development Direction:

Vigorously Accelerate Green and Low-carbon Transition

### "6 Persist-ins" as the Strategic Direction

Persist in Green Development  
Persist in Enterprise Reform  
Persist in Value Creation  
Persist in Risk Prevention and Control  
Persist in Sci-tech Innovation  
Persist in Party Building as the Guiding Force

### "6 New Leaderships" as the Strategic Task

New Leadership in Sci-tech Innovation  
New Leadership in International Development  
New Leadership in Green Transition  
New Leadership in Corporate Governance  
New Leadership in Efficiency and Effectiveness  
New Leadership in Party Building Quality

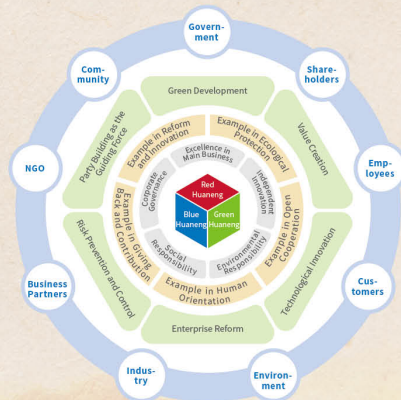
## Driven by the Three-color Culture

A "red" company that serves national strategy, safeguards energy security, and serves the need of socialism with Chinese characteristics

A "green" company that facilitates energy revolution, protects the environment, and supplies clean energy to ensure a better life for the people

A "blue" company that participates in global energy governance, serves the Belt and Road Initiative, and contributes to building a community with a shared future for mankind

## ESG System with Huaneng Characteristics



Persisting in serving national interests and development strategies  
Serving as an example in promoting economic and social development in all respects

Persisting in scientific development and technological innovation  
Serving as an example in building a resources-conserving and environmentally friendly society

Persisting in pursuing enterprise value in a rational way  
Serving as an example in promoting harmonious progress of both the enterprise and society  
Persisting in the principle of relying on employees and working with the public to develop the enterprise  
Serving as an example in putting people first and sharing benefits

Persisting in giving back to society and benefiting the people  
Serving as an example in practicing social ethics

## Board of Directors



**Wen Shugang**  
Chairman of the  
Board of Directors



**Deng Jianling**  
Board Director and  
President



**Zhang Wenfeng**  
Board Director



**Xu Ping**  
External Board  
Director



**Zhu Yuanchao**  
External Board  
Director



**Zou Zhengping**  
External Board  
Director



**Liu Yuezhen**  
External Board  
Director



**Yan Xiaopeng**  
Employee Director

## Management Team



**Wen Shugang**  
Chairman of the  
Board of Directors



**Deng Jianling**  
Board Director and  
President



**Zhang Wenfeng**  
Board Director



**Fan Qixiang**  
Vice President



**Wang Yihua**  
Chief Financial Officer



**Wang Wenzong**  
Vice President



**Wang Limin**  
Chief Compliance Officer



**Li Xiangliang**  
Vice President



**Zhang Tao**  
Vice President



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# Message from the Chairman



Chairman of the Board of Directors: Wen Shugang

In 2022, a significant year in the history of the Party and the country, the 20<sup>th</sup> National Congress of the Communist Party of China was successfully held to plan the great cause of national rejuvenation, create a blueprint for a powerful country, which has provided scientific guidance for promoting high-quality development of enterprises. The year of 2022 is also an extraordinary year in the development history of Huaneng Group. The Company focused on the overall situation of the Party and the country, and deeply understood the corporate mission and responsibility in the new era and on the new journey. Various undertakings for building a world-class enterprise have achieved vigorous development and significant progress in the year.

In response to the complex and severe situation of the overlapping of changes unseen in a century and the pandemic, as well as the deep adjustment of global political landscape and energy supply and demand pattern, CHNG has taken the initiative and overcome difficulties under the strong leadership of the Party Central Committee with Comrade Xi Jinping at the core, demonstrating the fearless and enterprising spirit to move forward. Study, publicity, and implementation of the guiding principles of the 20<sup>th</sup> National Congress of the Party are always CHNG's primary political task. CHNG continuously strengthens ideological and political guidance, and guides the Party members and officials to deepen their understanding and take practical actions; as a pacesetter in the power generation industry, CHNG has successfully completed the energy security tasks during important periods, hitting historical highs in power generation and heating capacity, and functioning as a pillar and stabilizer; according to the national strategic demand, we, with the pioneering spirit, continuously lead the industry's progress. CHNG has achieved new breakthroughs in core technologies in key fields, significantly enhancing the vitality of technological innovation.

**Contributing Huaneng Wisdom for Green and Low-Carbon Transition.** Pursuant to the national carbon peaking and carbon neutrality goals, CHNG actively promoted energy structure adjustment, and the clean energy sector became the primary source of profit and key supports. The approved renewable energy has exceeded 70,000 MW, and nearly 13,000 MW have been put into production, setting a record high; CHNG continuously improved the development of conventional energy, increased efforts to upgrade and renovate environmental protection equipment, and reduced resource and energy consumption, with an aim to resolutely tackle pollution prevention and control. The main energy consumption indicators and pollutant emission performance were leading in the industry, and the carbon dioxide emission intensity per kWh of electricity generation has decreased by 1.89% year-on-year; moreover, adhering to the concept of "Developing While Protecting, Protecting while Developing", CHNG has firmly established the awareness of ecological red line, creating a batch of green power projects that coexist harmoniously with the environment. **Providing Huaneng Solution for Building a Harmonious Society.** CHNG attached great importance to the health and safety of its employees, organized high-quality labor competitions and vocational skills competitions, cultivated multiple "Craftsmen of Huaneng" and "Craftsmen of the Nation", and continued to carry out safety education and training as well as "double-improvement" activities of safety management to ensure overall safety in various fields; while supporting its own business in becoming stronger and better, CHNG actively played a leading role, and opened up cooperation with governments, enterprises, and overseas institutions in a wider range of areas to support the national major regional strategies. Its targeted assistance work has received the highest evaluation in the national assessment for six consecutive years, making contributions to industry development, local development, and international development. **Offering Huaneng Strength for Modern Corporate Governance.** CHNG has established and improved the modern enterprise system with Chinese characteristics, strengthened the level of corporate governance according to law, continuously improved the market-oriented operation mechanism, and further enhanced the vitality of the enterprise. The three-year action of state-owned enterprise reform has achieved high-quality results. In this way, CHNG fully completed the key tasks of benchmarking first-class management, and won 35 national awards for management innovation achievements; with the continuous growth of the operating performance in adversity, the operating revenue was RMB 424.5 billion yuan, a year-on-year increase of 10%, and the total profit was RMB 22.7 billion yuan, a year-on-year increase of 71%, indicating new breakthrough in maintenance and appreciation of state-owned assets.

We forge ahead to write a new chapter in the new era. The year 2023 marks the start of the full implementation of the guiding principles of the 20<sup>th</sup> National Congress of the Party. It is a significant transitional year during the 14<sup>th</sup> Five-Year Plan period, and for Huaneng to embark on a new journey to lead China's power industry and strive for world-class excellence. Therefore, it is of great significance to do well in all aspects of work. CHNG will adhere to the guidance of Xi Jinping's Thought on Socialism with Chinese Characteristics for a New Era, comprehensively implement the guiding principles of the 20<sup>th</sup> National Congress of the Communist Party of China, work hard with a sense of responsibility and ensure the completion of the tasks with high standards and high quality, so as to build a world-class enterprise with global competitiveness.

Great truths are always simple, and actions speak louder than words. In the future, CHNG will unite more closely around the leadership of the Party Central Committee with Comrade Xi Jinping at its core, and comprehensively grasp the new demands in the new era and on a new journey. Moreover, by taking high-quality development as the primary task, supply-side structural reform as the main line, reform and innovation as the fundamental driving force, and high-quality party building as the guarantee, CHNG will make every effort to lead China's power industry and strive for world-class excellence, and make new and greater contributions to building China into a modern socialist country in all respects!



## Promoting the Commercialization of Scientific and Technological Achievements

CHNG vigorously advanced the implementation of innovative technologies, sped up the promotion and application of independently controllable technologies, made further headway in the commercialization of scientific and technological achievements, and effectively leverage its own advantages to lead the technological progress of the power industry.

- Promoted and applied Huaneng Ruwuo DCS system in 13 thermal power units, 5 hydroelectric units and utility systems, and renovated 8 thermal power units throughout the year
- Completed and put Ruijin Power Plant Phase II Project into operation as China's first large-scale smart power plant using the homemade control and information system (DCS/DEH/SIS)
- Built Huaneng Zhejiang Virtual Power Plant into the first virtual power plant in China, directly dispatched by the grid and participating in real-time response regulation, and won the **First Prize of Smart Industry in the 5G Application Competition** organized by the Ministry of Industry and Information Technology
- Accelerated the localized application, improvement and upgrading of homemade wind power PLCs, with a total of more than 100 units transformed and replaced
- Started construction of the first set of 135 MW validation project for COAP at Linyi Power Plant, which was the first in the world and original from Huaneng
- Built Huaneng Energy Storage Power Station, the world's first 100 MW-class energy storage power station under decentralized control, with the efficiency of refined and decentralized intelligent control technology for electrochemical energy storage up to 87.8%, at the international leading level
- Developed and put into service the world's first 2.7 MW tandem dual-wind turbine unit
- Huating Coal Industry's 200 thousand tons/year Polypropylene Technology Demonstration Project succeeded in one-step charging
- Developed internationally-leading intelligent key vibrofloatation equipment with independent intellectual property rights for deep overburden of hydropower, and applied it in Yingliangbao Hydropower Station
- Built the first 5 MW-class supercapacitor hybrid frequency modulation demonstration project in China, significantly improving the flexible regulation ability and power generation efficiency of units
- Successfully put into operation the world's first coal power coupled molten-salt heat storage demonstration project
- Applied the "Intelligent Monitoring System for Photovoltaic Power Stations" in Dezhou Dingzhuang Floating Photovoltaic Power Station
- Promoted and applied the 100% domestically-made core packaging for water-feeding pumps of GW-level units in Dalat Phase V and Zhengning Phase II

### The Company Achieving the Localization of the "Brain" of Hydropower Stations



The core control system of hydropower units deemed as the "brain" of hydropower stations relies on imported key components for a long time. In order to overcome this "bottleneck", CHNG established a technical team to fully meet the advanced hydroelectric application needs of "remote centralized control and unmanned duty" in China. Extensive adaptation, comparison, and R&D work have been carried out in terms of the software and hardware of the hydroelectric core control system, with a total of 34 major innovations, of which 17 have filled the domestic gap. CHNG has successfully developed the Huaneng Ruwuo Hydroelectric Core Control System. This marks for the first time that the software and hardware of the core control system for large hydropower stations in China have achieved 100% localization, with a fully autonomous and controllable "domestic brain".

In November 2022, Xiaowan Hydropower Station successfully put into operation the Huaneng Ruwuo Hydropower Core Control System, and completed the localization transformation of four major control systems: computer monitoring system, governor, excitation system, and relay protection equipment. Thus, CHNG became the only power enterprise in China to master the key technologies of the four core control systems of hydropower units.



Scan the QR code to watch CCTV report on Localization of Core Control System of Hydropower Units for the First Time

## Focusing on Building a Research Platform

With a focus on the national scientific and technological innovation development strategy, CHNG participated in the construction of Huanrou Laboratory, and took the lead in undertaking 2 major special research tasks. The "Efficient and Flexible Coal Power and CCUS National Key Laboratory" led by CHNG was listed into the first batch of 20 "National Key Laboratories". The Renewable Energy Grid Simulation Center, the Artificial Intelligence and Big Data Laboratory, and the Advanced Photovoltaic Technology Research and Development Laboratory were built, and the Energy Storage Laboratory was officially put into operation. CHNG deepened the collaborative innovation and integrated development between upstream and downstream enterprises, universities, research institutions and consumers, and took the lead in establishing a network security technology innovation alliance for power infrastructure.

Based on domestic independent and controllable development, CHNG has initially established a renewable energy intelligent operation and maintenance platform integrating "group-level company-plants". Through comprehensive and full-chain digital intelligent information management of the renewable energy industry, 75 application functions have been launched, connecting 484 renewable energy plants with a total of 44.95 GW. It has basically achieved full connection and has become the data platform system with the largest installed scale of renewable energy plants in China and the highest number of points.

## Persisting in Stimulating Staff Innovation

CHNG furthered the "Mass Entrepreneurship and Innovation", guided the employees to carry out technological innovation according to needs and applications. Throughout this year, 419 Crowd Innovation Projects were established and 639 employees' technological innovation achievements were collected, which continuously stimulated employees' innovation potential and vitality.

CHNG formulated the *Management Measures for the Promotion and Transformation of Employees' Technological Innovation Achievements*, held a press conference on employees' technological innovation achievements and a signing ceremony for achievement transformation on which a total of 15 promotion and transformation achievements were signed, and participated in the First Innovation Exchange Conference for Craftsmen of the Nation organized by National Federation of Trade Unions to showcase 19 achievements and the deeds of 10 Craftsmen of the Nation.

The management of innovation studios have been improved, and 81 innovation studios were evaluated, which were generally in good operating condition; the development of innovation studios for maker and craftsmen was propelled, and 20 Huaneng makers and 44 Huaneng craftsmen were selected and commended; the members of innovation studio Alliances have increased to 153, and 242 key research (transformation) projects and activities of such alliances have been reviewed and released throughout the year. Moreover, training courses on alliance innovation methods have been organized to promote collaborative research and talent cultivation.

In 2022, 90 achievements of the Company were awarded the **National Technical Achievement Award for Electric Power Employees**, and 56 achievements were awarded the title of **National Technical Innovation Achievements of Excellent Employees in Energy Chemical and Geological Sectors**. The number and quality of award-winning achievements maintained industry-leading position; 5 achievements were awarded the title of **Technological Innovation Achievements of Employees by the China Workers' Technical Association**; 15 achievements were awarded the title of **Excellent Projects for Innovation and Efficiency Creation in Power Enterprise Teams**, and 1 entity was awarded the title of **Demonstration Entity of Power Enterprise Team Building**.





# Contributing Huaneng Wisdom for Green and Low-Carbon Transition

6



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# ESG

## Directional Navigation

Nature provides the basic conditions for human survival and development. Respecting, adapting to, and protecting nature is essential for building China into a modern socialist country in all respects. We must uphold and act on the principle that tural waters and lush mountains are invaluable assets, and we must remember to maintain harmony between humanity and nature when planning our development. We will advance the Beautiful China Initiative and take a holistic and systematic approach to the conservation and improvement of mountains, waters, forests, farmlands, lakes, grasslands, and deserts. We will carry out coordinated industrial restructuring, pollution control, ecological conservation, and climate response, and we will promote concerted efforts to cut carbon emissions, reduce pollution, expand green development, and pursue economic growth. We will prioritize ecological protection, conserve resources and use them efficiently, and pursue green and low-carbon development.

—Report to the 20<sup>th</sup> National Congress of the Communist Party of China by Xi Jinping

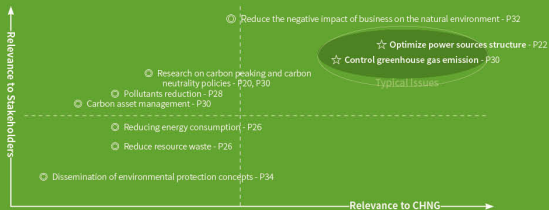
## Hands-on Practice

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# Environmental

## WHAT Identification of Core Environmental Issues



## WHY Background Analysis of Typical Issues

More than 130 countries around the world have clarified the timeline for carbon neutrality, and promoting carbon peaking and carbon neutrality has become a universal consensus in the international community.

The proposal of the carbon peaking and carbon neutrality goals by the Party Central Committee with Comrade Xi Jinping as the core is a solemn commitment of China to the international community. According to the Report to the 20<sup>th</sup> National Congress of the Party, we need to work actively and prudently toward the goals of reaching peak carbon emissions and carbon neutrality, thoroughly advance the energy revolution, and speed up the planning and development of a new energy system to ensure energy security.

Under the guidance of carbon peaking and carbon neutrality goals, the national "1+N" policy system for carbon peaking and carbon neutrality" is constantly improving, and various provinces, regions, and industries have introduced carbon peaking plans. The total carbon emissions generated by energy combustion in China account for nearly 90%, with the emissions by the electricity industry accounting for about 40% of the energy industry's emissions. This shows that to achieve the carbon peaking and carbon neutrality goals, energy is the main battle position, electricity is the main battlefield, and coal-fired power is the main force.

CHNG is benchmarking 14 energy companies of the same type globally, and the green indicators urgently need to be improved. The industrial structure is mainly based on coal-fired power, and the installed capacity proportion of clean energy is still lower than the industry average. Some regional and industrial companies have not yet broken away from traditional path, and little impetus and few methods to develop clean energy have become the biggest weakness restricting the high-quality development of enterprises.

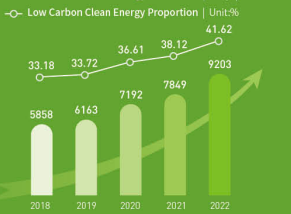
## HOW Management and Response to Typical Issues

Guided by the carbon peaking and carbon neutrality goals, based on the guiding document on the country's work to achieve carbon peaking and carbon neutrality goals, the Action Plan for Carbon Dioxide Peaking Before 2030, and the Guidelines for Preparation of the Carbon Peaking Plan of Central SOEs formulated by the State-owned Assets Supervision and Administration Commission, CHNG resolutely implemented the new energy security strategy and formulated its *Action Plan for Carbon Dioxide Peaking* to accelerate green-oriented transition, according to the development goals and strategic layout of the 14<sup>th</sup> Five-Year Plan, in combination with the industrial structure.

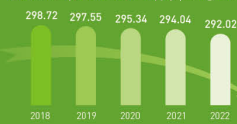
The Theoretical Learning Group under our Party Leading Group focused on studying issues related to carbon peaking and carbon neutrality, and made arrangements and deployments for relevant work according to the Company's *Action Plan for Carbon Dioxide Peaking*. CHNG should move faster to build a new pattern of high-quality development, adhere to increment with clean energy as the main focus, and strive to create the "three major pillars" including renewable energy, nuclear power and hydropower, ensuring that by 2025, the additional installed capacity of renewable energy will exceed 80 GW, and the installed capacity proportion of clean energy will exceed 50%. We need to vigorously promote the development of low-carbon and zero-carbon energy technologies, promote the application of low-cost carbon capture and sequestration technologies, and make effective use of technological innovation to help us become the pioneer and model in achieving carbon peaking and carbon neutrality.

## PERFORMANCE Huaneng Intelligence

■ Low Carbon Clean Energy Installed Capacity | Unit:10 MW



■ Coal Consumption for Power Supply | Unit:g/kWh



■ Auxiliary Power Ratio | Unit:%



■ Greenhouse Gas Emission Intensity | Unit:g/kWh



## PRACTICE Huaneng Intelligence

Electricity generation of Large-Scale Wind-Solar-Hydro-Storage Multi-Energy Complementary Energy Base Exceeded Trillion Kilowatt Hours.

The first batch of 7GW peak-shaving coal-fired power and supporting renewable energy projects in the Eastern Gansu Energy Base were under construction, and the second batch of 2.78GW renewable energy projects were approved.

The three hydro-wind-solar multi-energy complementary clean energy bases respectively located at the Tibet Section of Lancang River, Yunnan Section of Lancang River and Yajiang Middle Reaches were included in the national "14<sup>th</sup> Five-Year" power development plan and renewable energy development plan.

Two reactors of Shidao Bay High Temperature Gas Cooled Reactor Demonstration Project were brought into full-load power operation, and the PWR Project Phase I was available for approval.

Changjiang Nuclear Power Project Phase II was constructed in a safe and orderly manner, and the installation of Unit 3 nuclear island was started 46 days ahead of schedule, achieving the on-schedule completion of annual secondary milestone.

Jiangsu Jintan Salt-cavern Compressed Air Energy Storage National Demonstration Project was officially put into operation as the world's first large-scale non-supplementary combustion compressed air energy storage power plant.

## PRIZE Huaneng Intelligence

The Company won the title of "Leading Enterprise in China's Industrial Carbon Peaking" awarded by China Federation of Industrial Economics for its outstanding practices and contributions in promoting green and low-carbon transformation.

The Company's theoretical article titled *Demonstrating the Responsibility of a Central SOE in Advancing Carbon Peaking & Carbon Neutrality* won the award of "Outstanding Theoretical Research Achievement in Learning and Faithfully Implementing General Secretary Xi Jinping's Important Statements on Developing the State-owned Economy" granted by State-owned Assets Supervision and Administration Commission of the State Council.

The pre-carbonization integrated machine developed by the Company was identified by the Chinese Society for Electrical Engineering as an internationally leading technology, and related technologies were included in the List of Leading Technologies of "INNOVATION CHINA" in the green and low-carbon field.

The "Key Technology of Systematic Ecological Restoration in Open-pit Mining in Extreme Cold Grassland Area" of Yimim Open-pit Mine was listed as the "Advanced and Applicable Technology for Mineral Resource Conservation and Comprehensive Utilization" by the Ministry of Natural Resources.

Miaowei Power Station was awarded the title of "National Soil and Water Conservation Demonstration Project" by the Ministry of Water Resources.

## Optimizing Power Sources Structure

The Company actively served the national energy policy, and by promoting the Carbon Peaking & Carbon Neutrality goals and energy security, developed a medium- and long-term "3411" energy development framework focusing on building a new power system and a new energy system, continuously improved the energy security guarantee capabilities and advanced green and low-carbon transformation. The Company used renewable energy, nuclear power and hydropower as three major pillars for transformation, and promoted the construction of clean energy bases as the development path to boost the upgrading and adjustment of energy structures. In 2022, the Company's low-carbon clean energy accounted for 41.62%, an increase of 3.5% year-on-year, and its power generation set a new record, becoming the main source of profit and a key support.

### Medium- and Long-Term "3411" Energy Development Framework of the Company

**3** The "Three Major Pillars" (renewable energy, nuclear power and hydropower) and the optimized development of coal-fired power

**1** "Ten Major Bases" with multi-energy complementarity from east to west and from north to south were basically completed

**1** A decentralized and distributed contiguous development belt was basically completed

**4** "Four Development Models", namely the integration of wind, solar and energy storage combined with environmental treatment in northern China, the integration of wind, nuclear power, gas and energy storage combined with comprehensive energy services along the eastern coast, and the integration of distributed scenarios for wind, solar, load and energy storage in mid-eastern China, gradually entered the mature stage

The Company adhered to optimizing its main business and strictly controlled investment in other businesses. Throughout the year, it invested RMB 104.4 billion yuan in the infrastructure in the power industry, including RMB 98.1 billion yuan in low-carbon and clean energy field, accounting for 94%, an increase of 5% year-on-year. The Company continuously increased effective investment in three pillar areas, i.e. renewable energy, nuclear power and hydropower, to ensure an incremental investment with good economic benefits. In 2022, the Company invested RMB 81 billion yuan in wind power and photovoltaic projects, an increase of RMB 28 billion yuan year-on-year; RMB 8.2 billion yuan in nuclear power projects, an increase of RMB 2.6 billion yuan year-on-year; and RMB 7 billion yuan in hydropower projects, an increase of RMB 1.1 billion yuan year-on-year.

### Electricity Generation of Large-Scale Wind-Solar-Hydro-Storage Multi-Energy Complementary Energy Base Exceeded Trillion Kilowatt Hours



Case

As the main power source of the national "West-to-East Electricity Transmission" project, Huaneng Lancang River wind-solar-hydro-energy storage multi-energy complementary energy base had a total installed capacity of over 24GW, including 22.96GW of hydropower, making it an example of the world's longest and most complete whole basin development. This base successively built 10 large and medium-sized cascade hydropower stations, including Xiaowan and Nuozhadu, and developed 15 wind and PV projects, continuously delivering clean energy to the Guangdong-Hong Kong-Macao Greater Bay Area. At 20:18 on October 25, 2022, the total power generation of the base exceeded 1,000,000GWh, equivalent to reducing about 310 million tons of standard coal consumption and about 780 million tons of carbon dioxide emissions.



Scan the QR code to watch CCTV report titled *The Power Generation of the Multi-Energy Complementary Base in the Yunnan Section of Lancang River Exceeded 1,000,000GWh*

### Striving to Vigorously Develop Renewable Energy

Renewable Energy Installed Capacity Exceeded

50 GW

The development of the Company's renewable energy sector reached a record high, with an approved capacity of 70.82GW throughout the year, including 23.98GW which commenced construction and 12.95GW which was put into operation, leading the industry in aspect of scale. In 2022, renewable energy installed capacity of the Company exceeded 50GW, accounting for 23.19%, an increase of 4.59% year-on-year, and the resulted profit reached RMB 15.595 billion yuan, an increase of 11.37% year-on-year, making it the largest contributor to the Company's total profit and leading the industry in terms of the profitability per kilowatt in the wind and PV power fields.

The Company focused on deserts and Gobi areas, upheld the synergy of wind and solar resources, regulation capacity and transmission channels, and strove to promote the implementation of large-scale wind and solar power bases with intensive management and competitiveness.

- The development right for 12GW renewable energy in Southern Ordos of Kubuqi Desert was obtained
- The first batch of 2GW peak-shaving coal-fired power and supporting renewable energy projects in the Eastern Gansu Energy Base were under construction, and the second batch of 2.78GW renewable energy projects were approved





## Collaborative Development of Offshore and Onshore Wind Power

### Offshore Wind Power

The Company focused on building a "centralized and contiguous" offshore wind power development zone integrating investment, construction, operation and maintenance. Projects in the north of Shandong Peninsula and Lingao County in Hainan have been approved, and projects located in Lemen of Shantou City and Cangnan of Zhejiang have commenced construction smoothly. In 2022, the Company's annual investment in offshore wind power project was over RMB 6 billion yuan; the combined offshore wind power capacity including those approved, under construction and operational was 9.32GW, ranking among the best in the industry.

### Onshore Wind Power

RMB 4.1 billion yuan was invested in Shanguo GW-level Wind Power Base throughout the year. The first batch of 1,200MW units were connected to the grid, and the complete key technology for the design and construction of large turbine onshore wind farms achieved breakthrough. 4MW or above large capacity wind turbines were applied in all the GW-level wind power bases for the first time.



## Simultaneous Construction of Centralized and Distributed PV Power Projects

### Centralized PV Power

Yajiang Company's three PV projects for power supply guarantee were fully connected to the grid for power generation, so that the Company achieved the breakthrough of renewable energy project in Tibet region.

### Distributed PV Power

The Company upheld the centralized and efficient contiguous development of distributed rooftop PV projects throughout the county, actively explored the development and operation management models of distributed PV projects, and created a customized and standardized model for "small, scattered and disorderly" distributed development status.



## Actively Developing Hydropower

The Company's hydropower sector made solid progress, with a profit of RMB 9.2 billion yuan throughout the year, an increase of 18.3% year-on-year, leading the industry in benchmarking the profitability per kilowatt. The three hydro-wind-solar multi-energy complementary bases respectively located at the Tibet Section of Lancang River, Yunnan Section of Lancang River and Yajiang Middle Reaches were included in the national "14th Five-Year" power development plan and renewable energy development plan.

- Rumei Hydropower Station and Gushui Hydropower Station were included in the national list of major hydropower projects that would accelerate development.
- The key parts (i.e. diversion tunnel and hub of the plant area) of Huangliangbao Hydropower Station were under construction as planned in an orderly manner.
- The Toba Hydropower Project made solid progress according to national deployment.
- The agent-construction contract for the Aoku Project in Xinjiang was executed and its construction was commenced.
- Jiexu Hydropower Station was approved and its construction was commenced.
- The preparations for Banda and Guxue Hydropower Projects were started.



## Developing Nuclear Power in a Safe and Orderly Manner

The Company's nuclear power sector was strengthened continuously. The Company advanced the construction of three coastal nuclear power bases respectively located at Shidao Bay (Shandong), Changjiang in Hainan and Kapu in Fujian, and made solid progress in cascade development with regard to demonstration, construction, commencement and reserve of nuclear power projects.

In 2022, three projects of the Company won the **Scientific and Technological Progress Award of China Nuclear Energy Association**, the first prize for the Research and Engineering Application of Manufacture Technology of High Temperature Gas Cooled Reactor Steam Generator, and the third prize for the Development of Helium Mass Spectrometric Leak Detection System for Heat Exchanger Tubes of High Temperature Gas Cooled Reactors and for the Research and Development of Nuclear Power Industrial Control Network Security Protection System. The "Maintenance Technology Research of Control Rod System for High Temperature Gas Cooled Reactor Demonstration Project" won the **"Golden Apple Award"** in the technical achievement category granted by China Electricity Technology Market Association.

- Two reactors of Shidao Bay High Temperature Gas Cooled Reactor Demonstration Project were brought into initial full power operation, and the PWR Project Phase I was available for approval.
- Changjiang Nuclear Power Project Phase II was constructed in a safe and orderly manner, and the installation of Unit 3 nuclear island was started 46 days ahead of schedule, achieving the on-schedule completion of annual secondary milestone.
- Xiapu PWR Project obtained the "Permit" for the four units, leading to the successful commencement of feasibility study stage.