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## Sustainable Energy Supply

It is CNPC's responsibility and mission to meet energy challenges and satisfy the ever increasing demand for low-carbon clean energy. To this end, we have enhanced technological innovation, laid a solid resource basis, continued to increase our efficiency in hydrocarbon development and utilization, and raised the proportion of clean energy such as natural gas in our energy supply, in order to make contributions to the construction of a stable, safe, clean and economical energy supply system and the prosperity of human society.

### SDGs



## Energy and Future

### Opportunities and Challenges

**Continuous growth in energy demand.** The world population is projected to reach more than 9 billion by 2050 according to the United Nations' *World Population Prospects*. Population growth, together with urbanization in developing countries and industrialization, will continue to drive the growth of global energy demand and consumption.

**Equal access to energy.** Over 1.2 billion people in the world still do not have access to affordable modern energy, losing the opportunity for equal development. Helping this group of people have equal access to energy is an important part of achieving the Sustainable Development Goals (SDGs) of the United Nations.

**Low-carbon transition below 2°C.** Climate change has become a major issue affecting the destiny of the world and all mankind. The Paris Climate Conference has set the goal of limiting global warming below 2 °C by the end of the century, and that the future lies in low carbon and low energy intensity development. Nevertheless, fossil fuels will remain the major source of energy for decades to come, and will continue to dominate the energy market for a long time in the future.

**Construction of a high-quality energy system.** China's economy has entered a stage of high-quality development. Guided by the new energy security strategy centered on "four revolutions and one cooperation", the Chinese government is actively promoting energy revolution and accelerating the construction of a modern energy system that is clean, low-carbon, safe and efficient, in order to realize high-quality development of the energy system.

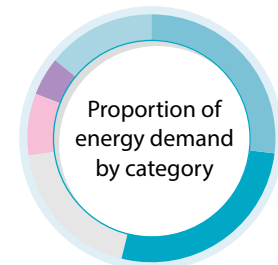
### Strategic Response

The world is undergoing a profound and rapid energy transition towards a cleaner, more efficient and diversified energy structure. The oil and gas industry shoulders an important responsibility in meeting global energy challenges. As a major player in the industry, CNPC has been actively cooperating with the government and companies along the value chain, and strives to provide clean, low-carbon and affordable energy while meeting future energy demand, in an effort to jointly build a sustainable energy future.

**We will vigorously develop natural gas to enhance the supply capacity of clean energy.** With natural gas as the strategic core for green development, we will devote great efforts to the innovation, application and promotion of the clean and efficient utilization technology of natural gas. We will increase imports of pipeline natural gas (PNG) and LNG overseas while improving our production capacity to secure the natural gas supplies needed by society, thereby providing a strong support to the optimization of China's energy structure and the construction of a beautiful China. The share of natural gas in domestic oil and gas equivalent production is expected to reach approximately 50% by 2020 and will continue to rise thereafter.

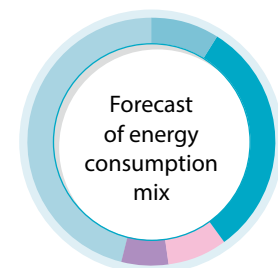
**We will develop new energy and promote low-carbon transition.** We take the development of new energy as a new driver for promoting low-carbon transition and have already put it into practice in fields like geothermal energy and biofuels. We initiated the development and utilization of geothermal resources in North China, Liaohu and Xinjiang domestically and in Kenya internationally. We built gasoline-hydrogen refueling stations in cooperation with Haipoer Hydrogen Technology Company, and used solar power at service stations in Beijing. We also continue to explore biofuel technologies.

In the future, we will intensify our efforts in the field of new energy. First, we will continue to support large-scale development of geothermal resources and promote the utilization of waste heat from produced water in oil producing areas. Second, we will strengthen support for the research and application of biomass energy. Third, we will study and deploy the whole industry chain of hydrogen energy. Fourth, we will promote clean energy development and utilization by fully leveraging on local conditions.



Forecast of global primary energy demand by category by 2050 \*

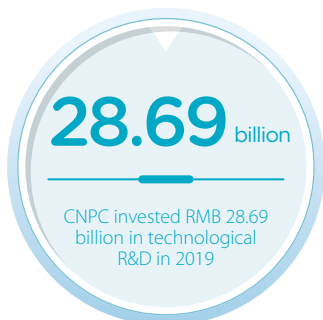
Oil	27%
Natural gas	27%
Coal	19%
Hydroelectric power	8%
Nuclear power	5%
Other renewable energy sources (including wind power and photovoltaics)	14%



Forecast of global energy consumption mix by 2050 \*

Oil	9%
Natural gas	31%
Hydroelectric power	8%
Nuclear power	6%
Other renewable energy sources (including wind power and photovoltaics)	46%

\* Data source: *World and China Energy Outlook 2050* by CNPC Economics & Technology Research Institute



## Technology and Innovation

Advanced and applicable energy technology enables us to provide more and cleaner energy, and address global issues such as equal access to energy, climate change and enhancement of energy utilization efficiency. In 2019, we speeded up technological innovation to promote high-quality development.




### Innovation Platforms

CNPC relies on 82 research institutions and departments, including 75 at subsidiary-level. The Company also has 20 national R&D centers and 55 Group-level key laboratories and experimental bases, covering the upstream, midstream and downstream sectors and supporting and leading the Company's sustainable development efforts.

CNPC maintains a two-level (national-level and provincial/industry-level) skills cultivation platform and has a powerful group of 22 academicians, 23 scholars from the national "Hundred, Thousand and Ten Thousand Talents Program", 4,231 two-level technical and skilled experts, and 31,000 researchers.

### Technological Achievements

Guided by national science and technology major projects in oil and gas, and centered on the Company's science and technology major projects, CNPC intensified efforts in technological innovation and formed a batch of innovative theories and new technologies/new products with proprietary intellectual property rights.

Objective	Measures
 <p><b>Increase both reserves and production under complex geological conditions</b></p>	<ul style="list-style-type: none"> <li>• Continue to deepen knowledge of ancient carbonate rock reservoir formation and deep zone exploration</li> <li>• Continue to improve technologies such as development of unconventional, deep and ultra-deep and complex-structure reservoirs</li> </ul>
 <p><b>Promote green production and low-carbon development</b></p>	<ul style="list-style-type: none"> <li>• Promote national Science and Technology Major Project: key technology for environmental detection and protection for the development of unconventional hydrocarbons including shale gas;</li> <li>• Implement CNPC-level R&amp;D Projects: CNPC research and application of key technology for low-carbon and clean production; refining energy system optimization, upgrading and application;</li> <li>• Carry out CNPC's major field tests: demonstration project of harmless treatment and recycling of drilling waste;</li> <li>• Strengthen research on basic, forward-looking and generic technologies to sustain development momentum: research and promotion of key HSE technologies</li> </ul>
 <p><b>Improve energy efficiency, reduce costs and ensure energy security</b></p>	<ul style="list-style-type: none"> <li>• Integrate information technology into the oil and gas industry</li> <li>• Integrate technologies such as "cloud computing, big data, and internet of things" into the whole process of the company's production and operation</li> </ul>

### 2019 National science and technology awards

CNPC was awarded **one** first prize of National Science and Technology Progress for a project led by CNPC, and also, **one** China Patent Gold Award and **one** China Patent Silver Award. CNPC took the lead in formulating **7** sets of international standards



### Major and core supporting technologies with international competitiveness

CNPC has formed **20** core supporting technologies and made breakthroughs in more than **20** key technologies including major equipment and software

## 600

 million tons

CNPC's newly-added proven oil in place exceeded 600 million tons for the 14<sup>th</sup> consecutive year

## 400

 billion cubic meters

Newly-added proven gas in place exceeded 400 billion cubic meters for the 13<sup>th</sup> consecutive year

## Information Technology

CNPC integrates information technology into production and operations by promoting the formation of digital oilfields, smart refineries, smart pipelines and smart service stations. Also, CNPC has introduced information systems into professional fields. Typically, CNPC has built-in IoT systems within oil and gas production, engineering technology, refining and chemicals, and equipment manufacturing, to improve the integration of automatic data collection, remote monitoring, and production & operations decision-making.

### Progress

- Discovered the billion-ton Qingcheng Oilfield in the Ordos Basin
- Proved additional original shale gas in-place of 740.971 billion cubic meters in the Changning-Weiyuan and Taiyang blocks, adding up to a total of 1.06 trillion cubic meters across the Sichuan Basin, and forming a giant TCM-level shale gas region in the southern Sichuan Basin
- Obtained high-yield commercial oil flow in the southern margin of the Junggar Basin, showing the probability to discover large-scale blocks for reserves and production growth
- Discovered new gas-containing structure in Kuqa of the Tarim Basin, which is expected to form a new billion-ton-level gas region
- Heavy crude oily sludge processing and comprehensive utilization technique: helping treat 103,000 tons of heavy crude oily sludge at the Liaohe Oilfield
- Waste gas processing technique for refining and chemical enterprises: applied in Qingyang Petrochemical and Dushanzi Petrochemical to reduce emissions and improve efficiency
- VOCs emissions control and utilization technique: widely applied at Jilin Petrochemical and other companies as pilot projects, helping reduce 4,000 tons/year of VOCs emission, recycle 1,154 tons/year of resources and achieve RMB 11 million/year of economic benefits
- Digital oilfield: It was configured with the Dream Cloud platform covering exploration and development, collaborative research, operation management and other businesses.
- Intelligent refinery: Its operational management control and analysis decision-making capabilities were consistently improved.
- Intelligent pipeline: It is characterized by comprehensive and unified data, perceptual interaction and visualization, system integration and interconnection, precise matching of supply and demand, intelligent and efficient operation, and predictive analytics for early warnings.
- Smart sales: It facilitated the cross-border integration of "service + commodity + Internet + finance".
- Engineering technology: A service platform with real-time data sharing, multispecialty cooperation and overall coordination was built.
- Engineering construction: Life-cycle integrated management and control was promoted for project management.
- International trade: The Pioneer Trade Management System covered the whole trading process.

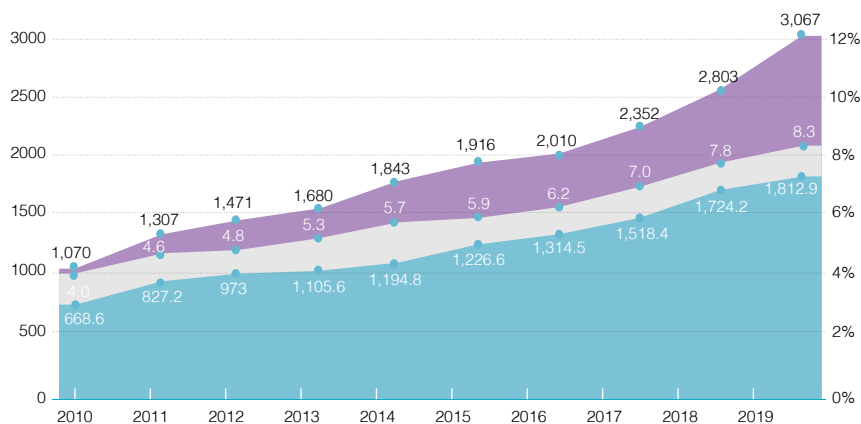
## Clean Energy

In order to secure sustainable supply of clean energy in the future, we have been vigorously developing our natural gas business, continuously enhancing the quality of our oil products and exploring new energy development opportunities to meet market demand for clean and high-quality energy.

### Natural Gas

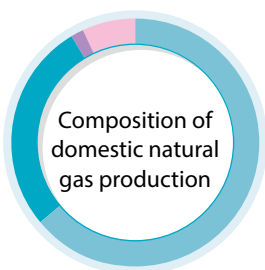
Taking natural gas as a strategic and growing business, CNPC keeps strengthening natural gas exploration and development, developing conventional natural gas and unconventional gas such as tight gas, shale gas and coalbed methane, and importing overseas natural gas to build a diversified energy supply system. By the end of 2019, CNPC's natural gas production capacity was 122.34 billion cubic meters.

#### "Green Power" Optimizing Energy Structure



- Proportion of natural gas in China's primary energy consumption mix (%)
- CNPC's domestic natural gas supply (x10<sup>8</sup> m<sup>3</sup>)
- China's natural gas consumption (x10<sup>8</sup> m<sup>3</sup>)

(Data source: *Energy Statistics* by CNPC's Economics & Technology Research Institute)



#### Composition of domestic natural gas production in 2019

conventional gas	63.7%
tight gas	27.8%
CBM	1.7%
shale gas	6.8%

In 2019, CNPC produced 150.3 billion cubic meters of natural gas, including 118.8 billion cubic meters domestically, a 8.6% year-on-year increase, and accounting for 69.9% of the China's total production. CNPC increased PNG and LNG imports while working to increase its production capacity. CNPC supplied 181.29 billion cubic meters of natural gas, a 5.1% increase over the previous year, providing strong support to the optimization of China's energy mix and the construction of a beautiful China.

61.9%

CNPC's domestic natural gas market share

69.9%

CNPC's share of domestic natural gas production

48.2%

Gas mix in CNPC's domestic production of oil and gas equivalent



## Unconventional natural gas



### Shale gas

- The Changning-Weiyuan and Zhaotong national shale gas demonstration zones produced 7.771 billion cubic meters of gas in 2019.
- The southern Sichuan Basin produced 8.03 billion cubic meters of shale gas in 2019, an year-on-year increase of 88.4%.



### Coalbed methane

- The Qinnan and Edong coalbed methane industrial bases contributed an annual production capacity of 2.2 billion cubic meters.
- CBM production was 2.07 billion cubic meters, in 2019.

## Case Study

### High-quality Construction of China-Russia East Natural Gas Pipeline

The China-Russia East Natural Gas Pipeline was invested and constructed by PetroChina Pipeline Co., Ltd. It crosses 9 provinces from Heihe City in Heilongjiang Province in the north to Shanghai in the south. This 3,371 km pipeline consists of three sections: Heihe-Changling, Changling-Yongqing and Yongqing-Shanghai. The Heihe-Changling section was completed on October 16, 2019 and was came online on December 2<sup>nd</sup> of the same year.

#### • Clean energy supply

Once it is fully operational, the China-Russia East Natural Gas Pipeline is expected to deliver 38 billion cubic meters annually by 2025. The pipeline will transport gas from Russia, through nine provinces (municipalities and autonomous regions) within China, to Northeast China, the Beijing-Tianjin-Hebei region and the Yangtze River Delta, thereby contributing clean and high-quality energy to building a "Beautiful China".

#### • Optimize regional gas consumption structure

The northern section connects with existing gas pipelines network such as the Harbin-Shenyang Gas Pipeline and the Qinhuangdao-Shenyang Gas Pipeline. As a result, the regional gas consumption structure can be further optimized to form multiple supply channels, which is of great significance to ensure clean energy supply.

## Utilization of Natural Gas and Alternative Fuels

We actively promote the comprehensive utilization of natural gas in city gas, industrial fuels, natural gas power generation, chemical feedstock and vehicle fuels. In 2019, we vigorously promoted coal-to-gas projects and supported related projects in the Beijing-Tianjin-Hebei region, the Yangtze River Delta and the Pearl River Delta.

## Case Study

## Promoting Natural Gas Utilization

Accelerating the development and utilization of natural gas is a realistic choice to win the Battle for Blue Skies and the battle against pollution. CNPC actively promotes the healthy development of the natural gas industry and effectively guarantees the stable supply of natural gas to contribute clean and efficient energy to social and economic development and ecological civilization construction.


 Beijing-Tianjin-Hebei region

The Beijing-Tianjin-Hebei region is a key target for the prevention and control of air pollution. CNPC has actively implemented its three-year action plan to win the Battle for Blue Skies and strengthened cooperation with local governments to guarantee the stable supply of natural gas. CNPC pushed forward the "coal to gas" program, connecting gas to 136,124 households in 233 villages of 25 towns under 2 counties in Xiongan New Area within five months. Through overall coordination, 920 million cubic meters of natural gas were supplied for the "coal to gas" program in the past winter. In 2019, CNPC supplied a total of 36.15 billion cubic meters of natural gas to the Beijing-Tianjin-Hebei region.

The Yangtze River Delta is economically developed with great energy demand. CNPC made full use of its strengths to support the natural gas power generation, coal-to-gas project, vehicles and ships and other sectors. CNPC supplied a total of 33.9 billion cubic meters of natural gas to the Yangtze River Delta in 2019. The supply quantity is expected to reach 54.2 billion cubic meters by the end of the 14<sup>th</sup> Five-year Plan; accordingly, it is estimated to replace 72.09 million tons of standard coal and reduce 76.98 million tons of CO<sub>2</sub> emissions and 1.38 million tons of SO<sub>2</sub> emission.

## Yangtze River Delta

## Pearl River Delta

The Pearl River Delta is the most economically active area of China. In combination with the 13<sup>th</sup> Five-year Energy Plan of Guangdong Province and the energy plan of Guangdong-Hong Kong-Macao Greater Bay Area, CNPC increases natural gas supply to help build a green and clean energy system and facilitate the building of a beautiful Guangdong. In 2019, CNPC supplied a total of 4.6 billion cubic meters of natural gas to Guangdong. The supply quantity is expected to reach 23.4 billion cubic meters by the end of the 14<sup>th</sup> Five-year Plan; accordingly, it is estimated to replace 31.12 million tons of standard coal and reduce 33.23 million tons of CO<sub>2</sub> emission and 520,000 tons of SO<sub>2</sub> emission.

### Case Study Promoting "Coal-to-gas" in Xiong'an New Area

In 2019, the rural clean heating renovation project was promoted in Xiong'an New Area. CNPC undertook the "coal-to-gas" project benefiting about 590,000 residents in the area, accounting for 88% of the total workload under the renovation project. By the end of 2019, Xiong'an New Area entered the "gas era".

"Gas is much better! We can use it for heating, cooking and bathing. The heating can be set automatically at a constant temperature, liberating us from adding coal at midnight. Gas is more convenient, cleaner, and greener! After deducting the subsidies, the cost is more or less the same as that for using coal. Thank you!"

—— A villager in Xuzhuang Village in Xiongxian County of Xiong'an New Area



### CNPC's Measures to Secure Market Supply During Special Periods in 2019

Agricultural production	Spring plowing, summer planting, summer harvest, summer field management and autumn harvest	<ul style="list-style-type: none"> <li>• Surveyed oil demand, developed plans to secure supply, and opened green channels</li> <li>• Scheduled resources availability, and coordinated distribution of fuel in advance</li> </ul>
	2019 Changning "6.17" Earthquake in Sichuan	<ul style="list-style-type: none"> <li>• Started an emergency plan</li> <li>• Speeded up resource raising. The first batch of 15 emergency tank trucks fully loaded with 400 tons of oil products arrived all through the night</li> <li>• Opened green channels for emergency rescue</li> </ul>
Natural disasters	Extraordinary rainstorm geological disaster in Wenchuan	<ul style="list-style-type: none"> <li>• Opened special channels for disaster relief</li> <li>• Spared no effort to ensure adequate oil supply for disaster relief</li> </ul>
	Droughts in provinces and regions at the middle and lowers reaches of Yangtze River	<ul style="list-style-type: none"> <li>• In the same month, supplied 1.05 million tons of gasoline and diesel oil for provinces severely affected by the disaster including Hubei, Hunan, Jiangxi, Anhui, Fujian and Henan</li> </ul>
Major national events	NPC and CPPCC (March 1–20)	<ul style="list-style-type: none"> <li>• Distributed resources in advance. Total resource quantity distributed by railways to Beijing direction in March was 119,300 tons</li> <li>• Arranged inventory properly to ensure more than 140,000 tons of oil product resources available</li> <li>• Guaranteed secondary distribution. Totally 64,000 tons of gasoline and diesel were delivered during the Two Sessions</li> <li>• Built the emergency guarantee mechanism based on North China Petrochemical and Dagang Petrochemical and supplemented by Liaoyang Petrochemical</li> </ul>
	Bo'ao Forum for Asia Annual Conference (March 26-29)	<ul style="list-style-type: none"> <li>• Planned in advance to guarantee dedicated resource supply</li> <li>• Transferred in 146,500 tons of refined oil products in the first quarter, a year-on-year increase of 28,100 tons</li> </ul>
	Conference on Dialogue of Asian Civilizations (May 15)	<ul style="list-style-type: none"> <li>• Allocated and transported resources to the directions of Northeast and North China in advance, with 38,000 tons of resources supplied for Beijing and 46,000 tons of gasoline and diesel stored in Beijing area</li> <li>• Made a resource supply guarantee plan and activated an emergency supply guarantee mechanism for major events</li> </ul>
	Annual Meeting of the New Champions in Dalian (July 1-3)	<ul style="list-style-type: none"> <li>• Conducted survey on oil demand and made a supply guarantee plan</li> <li>• Gave priority to the supply of aviation fuel</li> </ul>
	70 <sup>th</sup> Anniversary of the Founding of the People's Republic of China	<ul style="list-style-type: none"> <li>• Strengthened the arrangement of production, transportation and marketing. From September 18-30, 4.126 million tons of oil products were delivered, corresponding to a daily average 30,000 tons more than that from September 1-17</li> <li>• Guaranteed the supply to key areas. From September 12, CNPC's oil depots have kept full load, including 23,200 tons of gasoline and 27,500 tons of diesel</li> <li>• Guaranteed resource transportation, with the monthly volume by railway not less than 3.7 million tons</li> </ul>



## Upgrading of Refined Products

We promote the optimization of the energy consumption mix through upgrading quality of energy products. In 2019, we invested RMB 1.76 billion in equipment replacement and technical transformation and fully supplied National VI gasoline and diesel. In 2019, we supplied 119.594 million tons of National VI gasoline and diesel to the domestic market, accounting for 36.3% of the domestic market share.

## New Energy

With an eye on the future, we continued to promote the development and utilization of renewable energy including geothermal energy and biofuels. In 2019, CNPC continued to expand its new energy business, such as geothermal energy, solar energy, biofuels, and charging and battery swap stations.



CNPC built a large-scale distributed photovoltaic power station at the Jilin Oilfield, with a maximum daily generating capacity of 100,000 KWh and annual generating capacity of 22.5 million KWh.

Compared with coal-fired power plants with the same capacity, the PV power station can reduce 18,700 tons of CO<sub>2</sub> emissions, 1.425 million tons of SO<sub>2</sub> emissions and 48 tons of NO<sub>2</sub> emissions.



CNPC developed geothermal energy at the Jidong Oilfield, enabling a heat supply immediately after the geothermal project was put into practice. The project supports the heating demand of 2.3 million square meters in Caofeidian New Town.

Compared to coal-fired heating, geothermal energy is cleaner and can be reused without causing water pollution.

## Energy Cooperation

International energy problems can't be solved without cooperation. Upholding the principle of "mutually beneficial cooperation for common development", we give play to our advantages in integrated businesses, capital, technology and managerial expertise, and cooperate with host governments and partners to address local energy challenges, in order to meet local energy demand and maintain regional energy security.

### International Energy Cooperation

In response to the complex and volatile world situation, we worked hand in hand with the government of the host countries and our partners to guarantee the stable operation of cooperation projects. Leveraging our advantages in integrated businesses, we carried out all-round cooperation in such areas as upstream, downstream, trade and marketing, and technical support. Therefore, we have achieved cooperation throughout our industry chain and value chain. In 2019, CNPC produced 182.21 million tons of oil and gas equivalent overseas, with CNPC equity production of 104.363 million tons, up 6.3% year on year. CNPC made contributions to meeting energy demand in host countries and supporting local economic development.

## Case Study

## CNPC and the Belt and Road

CNPC is involved in the operation and management of 53 oil and gas cooperation projects in 20 countries along the Belt and Road, and 7 of the 9 overseas large-scale oil and gas projects with production capacity of 10 million tons are along the Belt and Road. In 2019, CNPC's overseas oil and gas equity production was 87.06 million tons, up 11% year on year and accounting for 83% of total overseas oil and gas equity production.



## E&P Joint Ventures in China

We continue to make steady progress in cooperation with international partners in developing oil and gas resources in China. While deepening cooperation in conventional areas, we reinforced cooperation with IOCs in shale gas and other unconventional resources. Projects including the South Sulige Project and Chuazhong Project were making steady progress. Our domestic oil and gas production equivalent in cooperation with international partners amounted to 10.71 million tons in 2019.

## International Trade

Supported by our overseas operation hubs and trade networks, we conduct international trading in over 80 countries/regions around the world, constantly improving our resource deployment capability. In 2019, we reported 540 million tons of international trading volume, and witnessed further improvements in both scale and operational quality.

