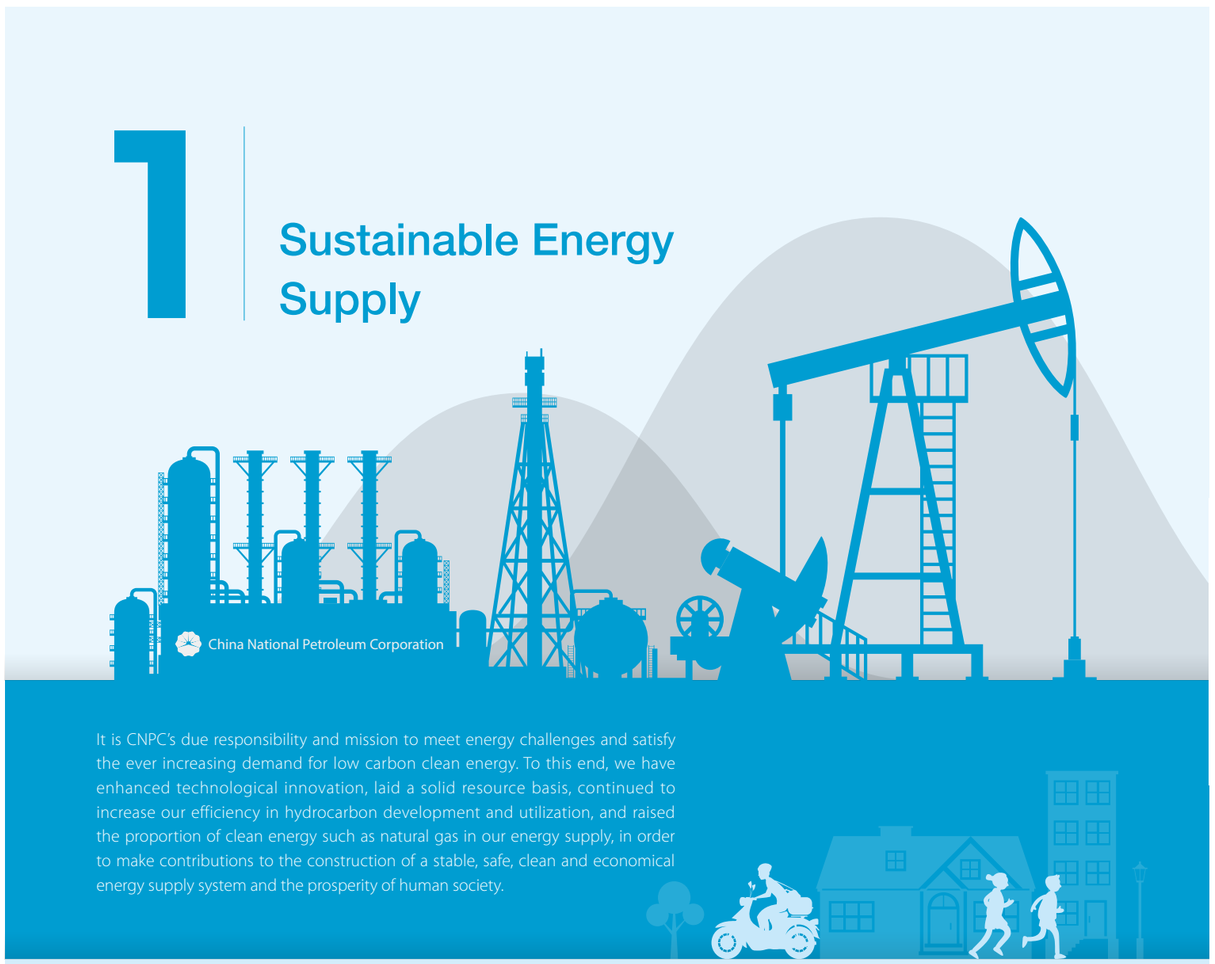
1 Sustainable Energy Supply



It is CNPC's due 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 the Future

Opportunities and Challenges

Continuous growth in energy demand. The world population is projected to reach more than 9 billion in 2050 by 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.

The trend of energy transition. Energy transition is a prominent feature of global energy development. Developing clean and low-carbon energy has become a consensus shared by governments, different industries and the society. Nevertheless, fossil fuels will remain the main source of energy for decades to come, and will continue to dominate the energy market for a long time in the future.

Inevitable transition to clean and low-carbon development. Climate change has become a major issue affecting the destiny of the whole world and all mankind. The Paris Climate Conference has set the goal of limiting global warming below 2℃ by the end of the century, and that the future lies in low carbon and low energy intensity development.

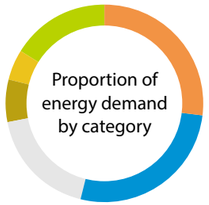
The pivotal role of natural gas. Natural gas is the only low-carbon and clean energy in fossil energy. Accessible, affordable and sustainable, it has become the fastest growing fossil energy and is expected to reach 30% in primary energy consumption by 2050.

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.

The consensus of global cooperation. The energy transition featuring low carbon and carbon-free development calls for all-round international exchanges and cooperation in advanced technology, management concept, and knowledge and experience. A wide range of global energy cooperation will help countries jointly cope with new energy security risks.

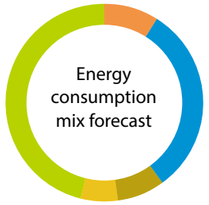
We

- support the UN's goal of "Ensuring access to affordable, reliable, sustainable and modern energy for all"
- actively respond to the Chinese government's "13th Five-year Plan for Energy Development" and intensify our efforts to promote the energy revolution



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: *Energy Outlook 2050* by CNPC Economics & Technology Research Institute

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 important responsibility in meeting global energy challenges. As a major player in the industry, CNPC has been actively cooperating with the government and companies in the industry 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.

Oil and gas will remain the world's primary energy source for a long time to come. In the short to medium term, the Company will still focus on oil and gas business, while strengthening restructuring of oil and gas operations. First, we will increase the share of domestic natural gas production, and expect to see the ratio of our domestic oil and gas production equivalent reach 1:1 by 2020, enabling more low-carbon energy supply. Second, we will increase the share of overseas oil and gas production. By 2020, the share of our overseas oil and gas equity production will rise to over one third of the company's total. Third, we will strengthen the development of unconventional resources, especially shale oil and gas and tight oil and gas.

While intensifying our efforts in restructuring oil and gas operations, we will actively deploy new business. First, we will steadily promote fuel ethanol business; second, promote the use of associated resources such as geothermal energy; third, make greater efforts in the research of new energy business, so as to lay a solid foundation for future planning and development.

Technology and Innovation

Advanced and applicable energy technology enables us to provide more and cleaner energy, and address global issues such as climate change and enhancement of energy utilization efficiency.

Thanks to theoretical innovation and technological breakthroughs, CNPC increases efficiency in the development and utilization of existing resources, explores new areas of energy development, and develops green production technology to provide energy for society in a more responsible way.

Technological innovation system and talent team building in 2018

27,698 million RMB
Investment in technological research and development: 27,698 million RMB

54
Key laboratories and experiment bases

303
Senior technical experts

30,000
Researchers

CNPC Innovative Technologies Winning National Awards in 2018

Technology	Award
Theory and technology for conglomerate exploration in sag area and the discovery of the 1 billion-ton-grade giant Mahu Oilfield	First-prize of National Science and Technology Progress Award
Key technology for oil and gas pipeline system integrity and its industrial application	Second-prize of National Technical Invention Award

Objective	Measures	Progress
Increase both reserves and production under complex geological conditions	• Continue to deepen the theories on ancient carbonate rock reservoir formation and deep zone exploration • Continue to improve technologies such as development of unconventional, deep and ultra-deep and complex-structure reservoirs	• Discovered a 1 billion-ton-grade giant uncompartmentalized conglomerate oilfield in Mahu, Xinjiang • Discovered 100-bcm-grade condensate gas reservoirs in Tarim (Well Zhongqiu No. 1) • Drilled a high-yield volcanic rock industrial gas well in the Sichuan Basin • Obtained high-yield commercial oil flow in the southern margin of the Junggar Basin, showing probability to discover large-scale blocks for reserves and production growth • Formulated the domestic exploration and production development plan from 2019 to 2025
Improve energy efficiency, reduce costs and ensure energy security	• Integrate information technology into the oil and gas industry • Integrate technologies such as "cloud computing, big data, and internet of things" into the whole process of the company's production and operation	• Digital Oilfield: Changqing Oilfield realized unmanned operation in gas gathering stations and used drones to patrol wells • Intelligent Refinery: gradual transformed production control mode from automatic control to intelligent control • Intelligent Pipeline: took the Eastern Route of Russia-China Gas Pipeline as a pilot project to construct intelligent pipelines featuring comprehensive and unified data, interaction and visualization for perception, system integration and interconnection, accurately matched supply, intelligent and efficient operation, and controllable forecast and warning • Intelligent Service Station: introduced new mode of "Service Station + Internet + N"
Promote green, low-carbon development	• National Science and Technology Major Project: key technology for environmental detection and protection for the development of shale gas and other unconventional oil and gas • CNPC-level R&D Projects: CNPC research and application of key technology for low-carbon and clean production; refining energy system optimization, upgrading and application • CNPC's major field tests: demonstration project of harmless treatment and recycling of drilling waste • Strengthen research on basic, forward-looking and generic technologies to sustain development momentum: research and promotion of key HSE technologies	• Provided complete sets of environmental protection technologies to support the green and sustainable development of the unconventional oil and gas industry in terms of policy and standard systems, environmental risk assessment and monitoring, and pollution prevention technology and equipment • Focused on pollution prevention and treatment and waste recycling, accelerated the application and promotion of low-carbon technologies and the development of low-cost technologies, and provided technical support for the Company to promote low-carbon, green development • Systematically addressed major issues for clean production and pollution prevention and treatment at the source and throughout the process during oil and gas drilling and downhole operation • Organized basic and advanced research on seven disruptive, leapfrogging technologies such as site pollution prevention and control and remediation, to support the green, low-carbon and sustainable development of the Company • Successfully developed and was capable of supplying National VI standard gasoline and diesel • Continued to lower indicators such as comprehensive energy consumption for refining and ethylene combustion energy consumption

600 million tons

In 2018, CNPC's newly-added proven oil in place exceeded 600 million tons for the 13th consecutive year

1 billion tons

Total proven oil and gas reserves exceeded 1 billion tons

400 billion cubic meters

Newly-added proven gas in place exceeded 400 billion cubic meters for the 12th consecutive year

188.16 million tons

CNPC's total oil and gas production reached 188.16 million tons of oil equivalent

Case Study

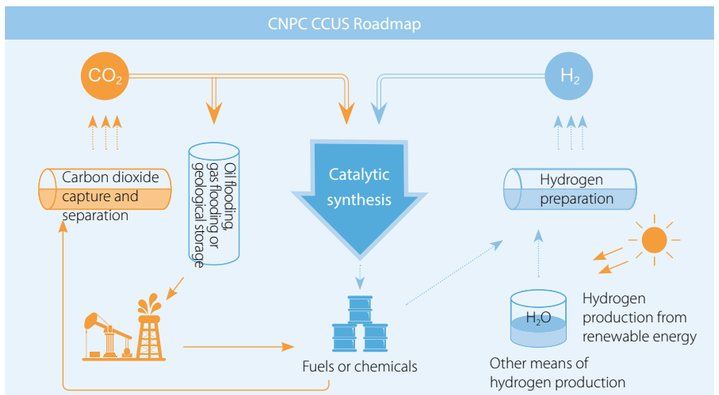
Promoting Green Development through CCUS

In the face of global energy transition and climate change, we work with energy companies at home and abroad for solutions to the crisis. In 2018, we explored ways to improve energy efficiency, worked on the mode for the most-efficient utilization of natural gas, and studied the commercialization of carbon capture, utilization and storage (CCUS) technology, so as to jointly promote the energy industry to make contributions to addressing climate change.

Promoting CCUS projects. We conducted research on important carbon emissions reduction technologies, such as carbon dioxide flooding and sequestration, assessment of carbon sequestration potential in saline aquifers and reservoirs, and capture of carbon dioxide from flue gas in self-provided power plants. In Jilin Oilfield, we completed China's first full-industry-chain CCUS base covering carbon dioxide separation, capture and oil displacement. We entered into a memorandum of understanding on technology and R&D cooperation with GE, further enhancing our cooperation in such fields as carbon dioxide capture, storage and utilization, and low-carbon and environmental protection technologies.

Advancing the operation of CTSA-CCUS. Under the guidance of the Ministry of Science and Technology and in partnership with enterprises, universities and research institutes with strong R&D capabilities in CCUS, we established the China Technology Strategic Alliance for CO_2 Capture, Utilization and Storage Technology Innovation (CTSA-CCUS) to lead the progress of CCUS technology in China.

We have built a scientific and technological research system centering on major special projects, and deployed one national oil and gas special project, one CNPC-level R&D project, one major field test and one forward-looking and generic technology project. We also carried out environmental technology system research, so as to provide strong support for the green, low-carbon and sustainable development of the Company.



By the end of 2018, Jilin Oilfield applied CCS-EOR technology to store 1.385 million tons of carbon dioxide, with a storage rate of over 93% and a recovery rate over 20% higher than that of water flooding.

Clean Energy

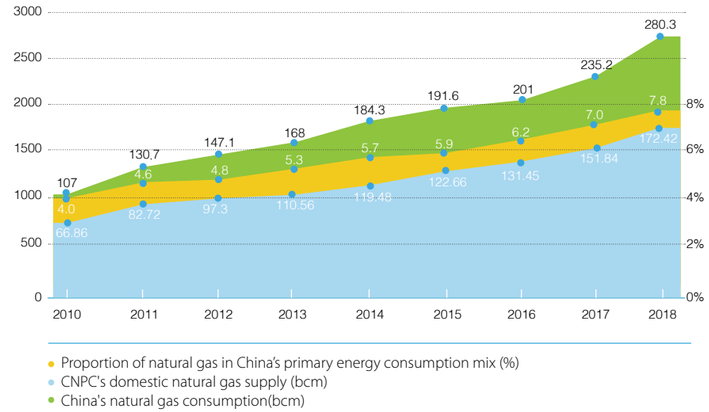
In order to secure sustainable supply of clean energy in the future, we have been vigorously developing natural gas business, continuously enhancing the quality of oil products and exploring new energy development to meet market demand for clean and high-quality energy.

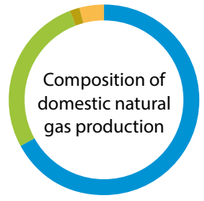
Natural Gas

CNPC deems natural gas exploration and development as a strategic and growth-oriented project, keeps accelerating the construction of transnational natural gas pipelines and domestic natural gas pipeline network, promotes the development of conventional natural gas and unconventional gas such as tight gas, shale gas and coalbed methane, and imports overseas natural gas to build a diversified energy supply system.

"Green Power" Optimizing Energy Structure

(Data source: *Energy Statistic Data* by CNPC Economics & Technology Research Institute)

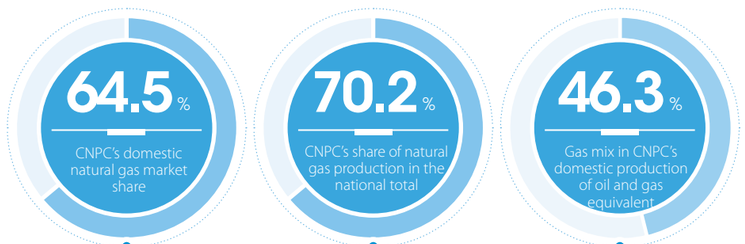




Composition of domestic natural gas production in 2018

conventional gas	67.30%
tight gas	27.03%
CBM	1.77%
shale gas	3.90%

In 2018, the Company produced 138.02 billion cubic meters of natural gas, including domestic production of 109.37 billion cubic meters, up by 5.9% year-on-year and accounting for 70.2% of the national total. CNPC increased the import of natural gas from overseas pipelines and LNG while working to increase its production capacity. We supplied 172.42 billion cubic meters of natural gas to the society, an increase of 13.6% over the previous year, providing a strong support for the optimization of China's energy structure and the construction of a beautiful China.



Production Capacity

By the end of 2018, the Company's natural gas production capacity was 110.6 billion cubic meters.

Unconventional natural gas

Shale gas

- Prepared CNPC's *Special Plan for Shale Gas Development 2021-2030*
- An annual gas production capacity of 6.6 billion cubic meters in southern Sichuan, including 4.264 billion cubic meters of gas production from state-level shale gas demonstration zones at Changning-Weiyuan and Zhaotong; and daily production of 20 million cubic meters to ensure supply in winter
- Made significant progress in deep shale gas evaluation in western Chongqing

Coalbed methane

- Completed two coalbed methane industrial bases in Qinnan and Edong, with annual production capacity of 2.2 billion cubic meters
- Added 52.4 billion cubic meters of proven CMB reserves, and produced 1.934 billion cubic meters of coalbed methane

Case Study CNPC Helps Beijing-Tianjin-Hebei Win Battle for Blue Skies

CNPC actively cooperates with the governments of Beijing, Tianjin and Hebei and companies in the industry to increase natural gas supply, and promote natural gas pipeline network construction and "coal-to-gas" projects, so as to fully meet the need for clean energy in the Beijing-Tianjin-Hebei region and improve the regional atmospheric quality.

Clean energy supply

- As of late 2018, the first, second and third Shaanxi-Beijing Gas Pipelines had delivered a total of 205.6 billion cubic meters of natural gas to the Beijing-Tianjin-Hebei region. The combustion value of which equaled to CO_2 emission reduction of 292 million tons, SO_2 emission reduction of 4,523,100 tons, smoke dust reduction of 186 million tons
- All the refining and chemical enterprises have completed National VI standard oil product upgrade, supplying National VI oil products to the "2+26" cities in the Beijing-Tianjin-Hebei region and surrounding areas in advance

Pollution control

- All subsidiaries achieved "zero coal consumption" in "2+26" cities in the Beijing-Tianjin-Hebei region
- Low-nitrogen transformation of gas boilers in Beijing
- Oil and gas recovery operation in our service stations and VOC control in refining and chemical enterprises improved comprehensively, and the oil and gas emission concentration of service stations (depots) met relevant standards and requirements
- Automatic monitoring facilities were installed at all elevated emission sources and were connected with the network of the local government
- According to the Air Quality Report 2018 issued by the Ministry of Environmental Protection, days with good or excellent air quality in 2018 in the Beijing-Tianjin-Hebei region and neighboring cities increased by 1.2% year-on-year, while the PM2.5 concentration decreased by 11.8% year-on-year

Pipeline Construction

By the end of 2018, CNPC operated 54,270 kilometers of natural gas pipelines, forming a gas network covering 30 provinces (municipalities and autonomous regions) and Hong Kong SAR in China, benefiting more than 500 million people.

Case Study Promoting Interconnection of Domestic Pipeline Network

We work to promote the interconnection of our natural gas pipeline networks. As of late 2018, we had completed 24 major national interconnection projects including the "Tianjin-Beijing Corridor" and the "Northeast China-Qinshen (Qinhuangdao-Shenyang)-Beijing Pipeline", further enhancing our natural gas resource allocation capacity and flexibility.

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 2018, the Company vigorously promoted coal-to-gas projects, and achieved full coverage of "coal to gas" in Bazhou, Zhuozhou, Baoding, Qinhuangdao, Tangshan and Hengshui of Hebei province.

CNPC's Measures to Secure Market Supply during Special Periods in 2018

Agricultural production

During spring plowing, summer planting, summer harvesting and summer field management

we

- Surveyed oil demand, developed plans to secure supply, and opened green channels
- Scheduled resources availability, and coordinated distribution of fuel in advance

Natural disasters

In response to heavy snowfalls in the three provinces in Northeast China, torrential rains in Minxian County, Dingxi, Gansu province, earthquakes in Jiuquan of Gansu province and Tonghai in Yuxi of Yunnan province, and landslide resulting in barrier lake in Jinsha River, Tibet

we

- Started an emergency plan to secure oil supply
- Opened green channels to secure oil supply for disaster relief
- Ensured adequate oil supply for disaster relief

Major national events

During the Forum on China-Africa Cooperation (FOCAC) in Beijing and Shanghai Cooperation Organization (SCO) Summit in Qingdao

we

- Planned in advance and carefully organized oil supply
- Guaranteed stable supply of resources

Upgrading of Refined Products

We promote the optimization of the energy consumption mix through upgrading quality of energy products. In 2018, we invested more than RMB 3.4 billion in building a batch of refined oil quality upgrading projects, and all of our refining and chemical enterprises completed oil product quality upgrading to National VI standard. In 2018, we supplied 117.358 million tons of refined oil (gasoline and diesel) to the domestic market, accounting for 36.1% of the domestic market share.

	We actively respond to
	Three-Year Action Plan to Win Battle for Blue Skies
	Work Plan for the Acceleration of the Quality Upgrading of Refined Oil

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 2018, CNPC continued to expand its new energy business, such as geothermal energy, solar energy, biofuels, and charging and battery swap stations.

Fuel ethanol

600,000 tons every year

CNPC's subsidiary Jilin Fuel Ethanol Company is capable of producing 600,000 tons fuel ethanol

1.8 million tons every year

CNPC's subsidiary Jilin Fuel Ethanol Company is processing over 1.8 million tons of corn every year

Geothermal energy

480 million RMB

The Company invested RMB 480 million in 2018

5

CNPC orderly carried out five projects, namely, geothermal heating in Caofeidian New Town, geothermal heating of Petroleum New City of Huabei Oilfield (Phase I), utilization of waste heat from produced water in Daqing Oilfield, utilization of waste heat from produced water in Huabei Oilfield, and utilization of waste heat from produced water in Jidong Oilfield

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.

34

CNPC operates in 34 countries and regions

92

CNPC operates 92 oil and gas projects globally

77

CNPC provides technical service and engineering construction for 77 countries and regions

International Energy Cooperation

In response to low oil prices and regional turmoil, we worked hand in hand with the government of the host countries and our partners to guarantee the stable operation of cooperation projects. Leveraging China's Belt and Road Initiative, we entered into a number of cooperation agreements with companies in Central Asia, Middle East and some other regions, and 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 2018, CNPC produced 172.39 million tons of oil and gas equivalent overseas, with CNPC equity production of 98.18 million tons, up 10.2% year-on-year. The Company made due contributions to meeting energy demand in host countries and supporting local economic development.

Joint E&P 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. The South Sulige Project was in steady progress, with an annual gas output of more than 2.24 billion cubic meters. The Chuanzhong Project in Sichuan Province increased its daily gas collection and transportation from 800,000 cubic meters to 1.2 million cubic meters, further securing gas supply in winter. Our domestic oil and gas production equivalent in cooperation with international partners amounted to 10.118 million tons in 2018.

International Trade

Supported by our overseas operation hubs and trade networks, we conduct international trading through cooperation and joint ventures in over 80 countries and regions around the world, constantly improving our resource deployment capability. In 2018, we reported 480 million tons of international trading volume, and witnessed further improvements in both scale and operational quality.