

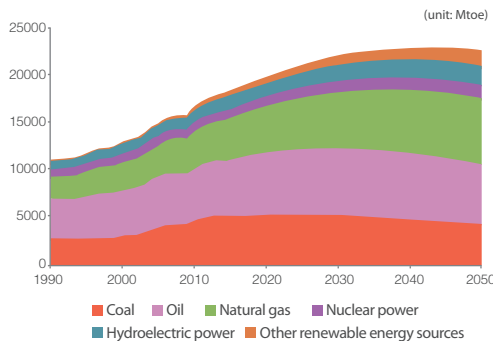
Sustainable Energy Supply

- ☑ Energy and Future Development
- ☑ Technological and Managerial Innovation
- ☑ Clean Energy
- ☑ Energy Cooperation

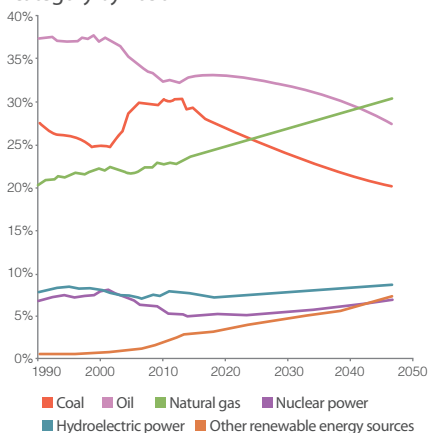
It is CNPC's due responsibility and mission to meet energy challenges and satisfy the ever increasing demand for low carbon clean energy. To this end, we have enhanced technological innovation, laid a solid resource basis, continued to increase our efficiency in hydrocarbon development and utilization, 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.

Energy and Future

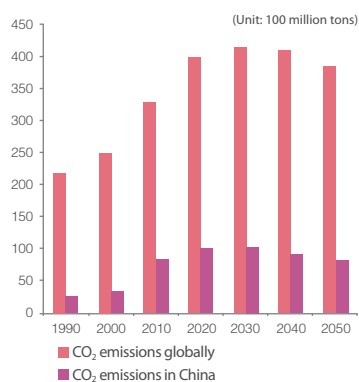
Forecast of global primary energy demand by 2050 *



Forecast of global primary energy demand by category by 2050 *



Forecast of global and China's energy-related CO₂ emissions by 2050 *



*Data source: 2016 Energy Statistical Data of CNPC Economics & Technology Research Institute

Energy Challenges

Energy demand continues to increase.

Revenue and population growth, and the urbanization and industrialization of developing countries are driving forces of growing energy demand. Although there are still uncertainties in global GDP growth, the world certainly requires more energy to ensure global economic prosperity and development in the future.

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 to obtain energy is an important part of the target of realizing the United Nations' goal of sustainable development.

Energy structure keeps changing. Despite the accelerated energy structural transition to clean and low-carbon development, fossil fuels remain the major source powering global economic growth, whereas non-fossil fuels are expected to grow at a rapid speed. Oil accounts for a fairly stable share of primary energy consumption mix, and natural gas has become and is becoming the fastest growing fossil fuel, and is expected to reach 8.3~10% of primary energy consumption mix by 2020.

China's economy enters into "new normal".

China's economy is moving forward steadily at a reasonable speed with improved quality and efficiency. But there is a serious conflict between overcapacity and upgraded demand structure, with slow growth of domestic oil demand and ample natural gas supply.

Providing Clean, Low-carbon and Affordable Energy

The world is undergoing a profound and rapid energy transition towards a cleaner, more efficient and diversified energy structure. 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

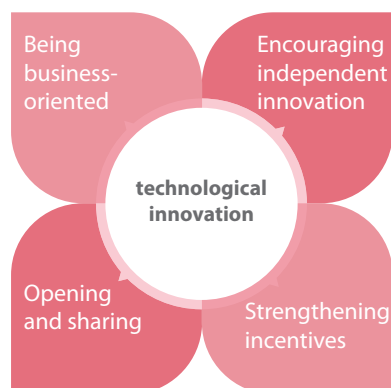
companies in the industry chain, and strives to provide clean, low-carbon and affordable energy while meeting future energy demand, in an effort to jointly build a sustainable energy future.

We implement the development concept of innovation, harmonization, green, openness and sharing, actively improve ways of energy production, strengthen technological and management innovation, and constantly consolidate our resource basis. With the aim of future sustainable energy supply, we accelerate the development of natural gas, explore unconventional energy, deploy new energy development, and supply more clean energy. In addition, we expand international cooperation, optimize global business layout, and strive to become a major supplier to provide energy in a more environmentally responsible way to drive the socio-economic development.

We support the UN's goal of "Ensuring access to affordable, reliable, sustainable and modern energy for all":

- ✦ Ensuring an affordable and reliable modern energy service to all by 2030.
- ✦ Substantially increasing the proportion of renewable energy in the global energy structure by 2030.
- ✦ Doubling the global energy efficiency improvement rate by 2030.
- ✦ Strengthening international cooperation, promoting research and technologies for obtaining clean energy, including renewable energy and energy efficiency as well as technologies for advanced and cleaner fossil fuels, and encouraging investment in energy infrastructure and clean energy technologies by 2030.
- ✦ Increasing infrastructure construction and upgrading technologies to provide all people with a sustainable modern energy service by referring to the support plan of developing countries, especially least developed countries, small island developing states and landlocked developing countries by 2030.

Technological and Managerial Innovation



Advanced and applicable technology and effective management innovation enable us to provide better energy solutions, address climate change, improve energy utilization efficiency, and mitigate hedge against the economic risk of low oil prices.

Building Energy Future with Science and Technology

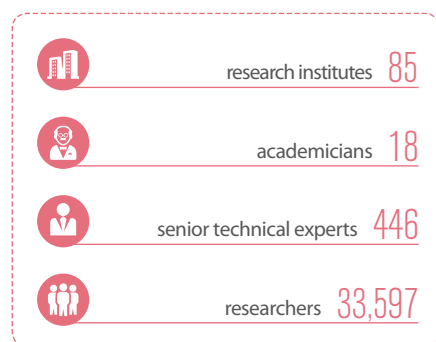
Technological innovation is the driving force for us to keep overcoming challenges. The remaining proven recoverable reserves are now mainly low permeability and lithologic reservoirs, whereas new discoveries are deteriorating in grade and difficult to recover. The overall exploration & development environment is getting more complex. Thanks to continuous technological breakthroughs, CNPC increases enhances the recovery of existing resources, explores new areas of energy development through cutting-edge technologies, and develops green production technology to provide energy for society in a more responsible way (see P28 Responsible Operation for more information).

In 2016, CNPC focused on removing technological obstacles to sustainable development and actively promoted R&D of cutting-edge technologies. This provided theoretical and technological support for our major strategic projects, including the steady development of Daqing Oilfield, stable production of Changqing Oilfield, rapid growth of new businesses such as tight oil and gas and shale gas, and increased overseas production and business scope, refinery restructuring and product quality upgrading.

CNPC headquarters spending on R&D in 2016

4.95 billion

Technological innovation platform and talent development



Key Laboratories and Experiment Bases

National-level Laboratories and Research Centers

- National key laboratory for petroleum and petrochemical pollutants control and treatment
- National engineering and research center for CBM development and utilization
- National energy experiment center for shale gas research and development
- National energy R&D center for LNG technologies
- National energy R&D center for tight oil and gas

CNPC Key Laboratories/ Experiment Bases

- Pilot test base for CBM production
- Experiment base for carbon dioxide flooding and storage
- Key laboratory for clean fuels
- Key laboratory for natural gas quality control and energy metering

Major Technical Achievements

Major core supporting technologies

- Tight gas exploration and development technology
- High-rank CBM exploration and development technology
- Carbon Capture, Utilization and Storage Technology (CCUS)
- Key low-carbon technologies
- Technology package on clean gasoline/diesel production meeting National V standards
- Technology package on 20,000 tons/a Hexene-1 and new products of medical polyolefin production
- Refinery energy system optimization technology
- Construction and operation technology for large-scale gas liquefaction and receiving terminals

Major technological breakthroughs and leading reserve technology

- Shale gas exploration and development technology under depth of 3,500m
- Green and low-carbon oil refining process technology
- New technology on aviation biofuel production
- Logging interpretation evaluation technology for unconventional oil and gas
- Third-generation large volume gas pipeline engineering technology
- 270,000m³ full capacity LNG tank building technology

Technological innovation created more than 100 billion yuan during our “12th Five-Year Plan” period.

In 2016, CNPC pushed forward technological innovations

- ▣ Scored 12 major landmark achievements
- ▣ Achieved significant progress in 24 major equipments, products and softwares
- ▣ Applied 5,017 patent in 2016
- ▣ Won two Second-prize of National Science and Technology Progress Award

In 2016, CNPC's newly-added proven oil in place exceeded 600 million tons for the 11th consecutive year, and newly-added proven gas in place exceeded 400 billion cubic meters for the 10th consecutive year, with the total of proven oil and gas reserves exceeding 1 billion tons for the 10th consecutive year. Daqing Oilfield's complex chemical flooding and fine water flooding technologies provided strong support for the sustainable development of the oilfield, improving its recovery ratio by over 18% and 1%~3% respectively. Changqing Oilfield focused on increasing single well output, enhancing recovery ratio and cutting development costs, kept debottlenecking and enabled over 50 million tons production of oil and gas equivalent for the fourth consecutive year in 2016. CNPC's total oil and gas production reached 183.63 million tons of oil equivalent in 2016. In addition, CNPC is capable of supplying National-V gasoline and diesel, and its comprehensive energy consumption for oil refining and ethylene combustion dropped continuously.

CNPC Innovative Technologies Winning National Awards in 2016

Technology	Award
Paleo carbonate exploration theory and technology innovation, and discovery of the giant Anyue gas field	Second-prize of National Science and Technology Progress Award
Large-scale ethane process technology package, key equipment and industrial application	Second-prize of National Science and Technology Progress Award
Special drilling liquid for complex well and industrial application	Second-prize of National Technical Invention Award
Quantitative calculating method of oil saturation in fractured reservoirs	Gold Medal of China Patent Award



Increase Profits through Managerial Innovation

In face of low oil prices and the “new normal” of economic development, CNPC endeavored to increase profits through managerial innovation. New breakthroughs were made in the reorganization of the management system and business as well as key innovation reforms. Functions at all levels were specified and part of the departmental functions at the headquarters were straightened out. We strengthened our natural gas sales network by setting up five regional natural gas marketing companies. The newly established China Petroleum Engineering Company Limited and CNPC Capital Company Limited went public successfully. In addition, we constantly optimized our production and business layout, took measures to increase efficiency and profit and cut cost and expenditure, and special efforts were made in loss-making subsidiaries to improve their performance. We continued to push forward supply-side structural reform, strengthen reform and management, and improve development quality and efficiency. In 2016, operational costs per unit of oil and gas, processing charges for each ton of oil and marketing cost for per ton oil dropped by 10.1%, 0.4% and 3.6% respectively.

Clean Energy

In order to secure future sustainable supply of clean energy, we vigorously develop natural gas business, explore new energy development and continuously enhance the quality of oil products to meet market demand for clean and high-quality energy.



As the energy consumption mix is getting more diversified with lower carbon emissions, did CNPC make any adjustment in traditional oil and gas and new energy development?

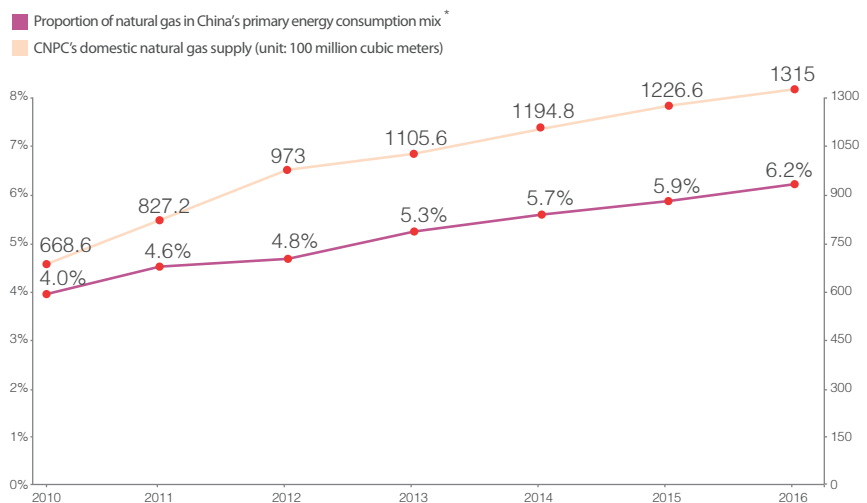
Fossil fuels will continue to play the main role in energy consumption before 2030. In China, as energy consumption growth slows down, and energy structure keeps optimizing, we are going to enter a new stage where overcapacity in traditional energy coexists with the rapid growth of clean and low-carbon energy. Against this backdrop, CNPC will stabilize oil production and increase the output of natural gas focusing on development quality and efficiency. Meanwhile, we will push forward the development of new energy, and explore associated resources in oil and gas basins including geothermal and natural gas hydrate.



Natural Gas

CNPC intensifies natural gas exploration and development as a strategic and growth-oriented project, accelerates 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 resources to build a diversified energy supply system.

The rise of "Green Power" in energy supply has optimized China's energy structure and met people's need for clean energy.



^{*}Data source: Energy Statistical Data of CNPC Economics & Technology Research Institute

Domestic natural gas market share in 2016

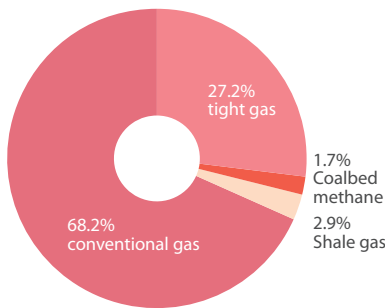
68.4%

Domestic natural gas production share in the national total in 2016

73.2%

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

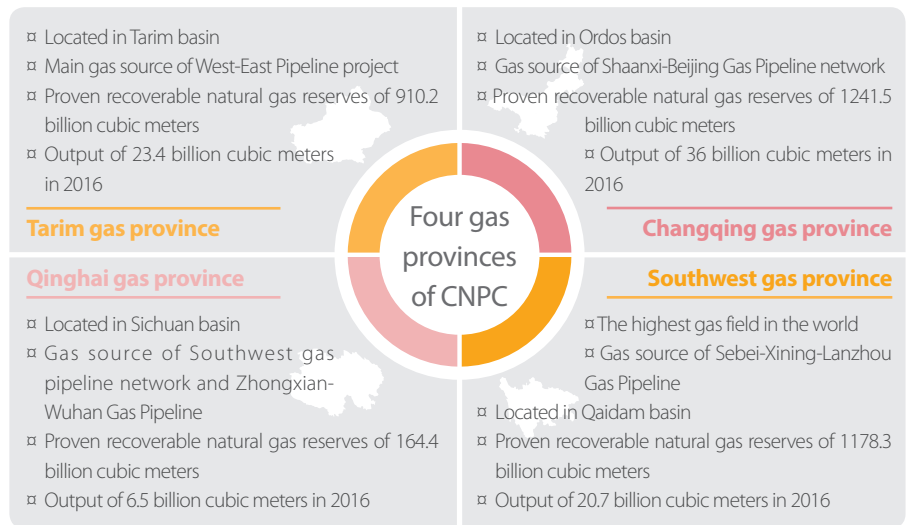
42.6%



CNPC's domestic gas production

Natural Gas

We constantly strengthen exploration in our four gas provinces in China. In 2016, newly constructed natural gas production capacity reached 10.94 billion cubic meters.



Tight gas

We set up the National Energy R&D Center for Tight Oil and Gas to improve tight gas development efficiency.

Coalbed methane

We accelerated construction of coalbed methane production bases, promoted scale development, and set up the most advanced CBM lab in China. Baode gas field, the largest middle and low rank coalbed methane field in China, was put into operation. Two coalbed methane production bases in Qinsui and Edong realized reserve growth and large-scale development.

Shale gas

CNPC chose favorable development zones and formed six major technology series with platform horizontal well fracturing as the core technology and matching domestically-produced toolkits, realizing large-scale production and efficient development. By the end of 2016, two state-level shale gas demonstration zones at Changning-Weiyuan and Zhaotong achieved production capacity of 3 billion cubic meters.

Pipeline Construction

In 2016, the fourth Shaanxi-Beijing Gas Pipeline started construction, and the eastern section of Third West-East Pipeline and its Guigang-Yulin and Jintan-Liyang branches were put into operation. This will greatly improve our resource distribution and market supply capabilities in Beijing, Fujian, Guangxi and Jiangsu. By the end of 2016, CNPC operated 52,000 kilometers of natural gas pipelines, covering 30 provinces (municipalities and autonomous regions) and Hong Kong SAR in China and benefiting more than 500 million people.

We accelerated transnational natural gas pipeline construction, explored natural gas importing channels and improved natural gas supply capability.

- ▣ The testing section of the Eastern Route of Russia-China Gas Pipeline started construction with 3,405km of newly built pipelines. Annual designed capacity is 38 bcm/a.
- ▣ The line A, line B and line C of Central Asia Gas Pipeline has a annual transmission capacity of 50 bcm/a and the length of single line is 1,833km.
- ▣ The Myanmar-China Gas Pipeline has a capacity of 12 bcm/a and a total length of 2,546km.

CASE

West-East Gas Pipeline Project Delivering Clean Energy and Facilitating Low-carbon Transition

In December 2016, the eastern section of the Third West-East Pipeline (Line Three) was fed with gas. Line Three is another pipeline running from west to east in China and linked to the Central Asia Gas Pipeline after Line Two. The eastern section of Line Three will help Eastern China realize low-carbon transition and turn resource advantages in Central Asia and Western China into economic and environmental advantages.

The West-East Pipeline network will be able to deliver 77 billion cubic meters of natural gas annually upon completion, accounting for 37% of China's total natural gas consumption in 2016, replacing 160 million tons of standard coal and reducing CO₂ and SO₂ emissions by 290 million tons and 1.97 million respectively.

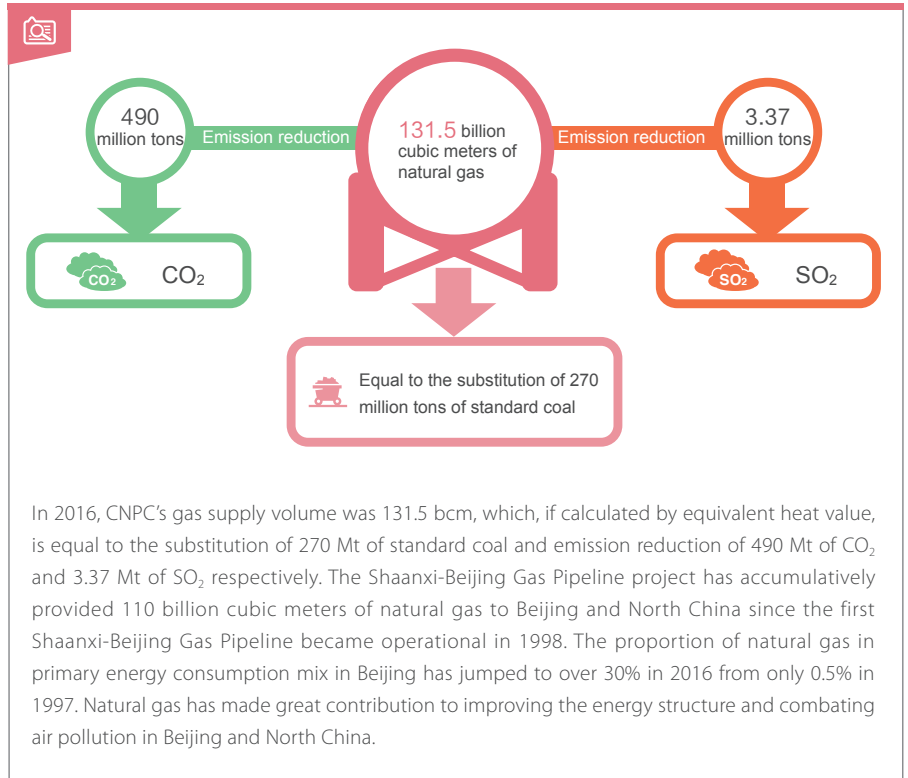
The sketch map of the West-East Gas Pipeline



The First West-East Gas Pipeline	Completed in 2004	Transmission capacity: 17 bcm/a
The Second West-East Gas Pipeline	Completed in 2012	Transmission capacity: 30 bcm/a
The Third West-East Gas Pipeline	The western section was completed in 2014, the eastern section was completed in 2016, and the Zhongwei-Ji'an section is under construction	Transmission capacity: 30 bcm/a

Natural gas utilization and substitution for other fuels

CNPC has actively expanded the utilization of natural gas in areas such as city gas, gas-fired power generation, public transportation, shipping, etc. CNPC actively promoted “coal-to-gas” projects in Beijing, Tianjin, Hebei, Shandong and Southwest China, in an effort to improve local air quality.



Serving the G20 Summit

CNPC's measures to ensure market supply during special periods in 2016

Natural gas supply in winter	Serving busy farming season	Supporting major national activities
<ul style="list-style-type: none"> ▣ Drafted purchase and sales plan in advance and drafted natural gas supply plan ▣ Communicated with local governments and users to arrange gas supply in advance ▣ Coordinated with domestic counterparts on resource swap in advance ▣ Increased domestic gas production and gas supply from Central Asia ▣ Paid attention to spot LNG resource purchases ▣ Accelerated construction of the Baodi-Xianghe-Xiji Pipeline and the third Yongqing-Dagang Pipeline to ensure supply in winter ▣ Closely followed market dynamics to improve demand-side management 	<ul style="list-style-type: none"> ▣ Contacted related departments to better understand the general situation of oil demand in the agriculture sector ▣ Stored diesel in advance ▣ Coordinated railway and pipeline delivery capacity to increase supply to regions with busy agricultural activities ▣ Provided quality services 	<ul style="list-style-type: none"> ▣ Drafted supply plan for Zhejiang and Jiangsu during the G20 Summit ▣ Set up emergency group to ensure supply for the G20 Summit, and followed overall refined product supply dynamics

New Energy

With an eye on the future, we promoted the development of renewable energy including geothermal energy and solar energy, to play a positive role in implementing the nation's new energy strategy and improving China's energy structure.

Geothermal energy

CNPC completed a demonstration study on middle and deep layer geothermal resource evaluation and development, and carried out research on middle and low temperature geothermal power generation, oilfield waste water residue heat utilization, ground water recharge, and high temperature geothermal drilling. Huabei Oilfield participated in the research for the 863 project on middle and low temperature geothermal power generation, and passed acceptance checks.

Biomass energy

CNPC's ethanol gasoline realized large-scale supply in northeast China. We made breakthroughs in the industrial development of aviation biofuel by refining aviation biofuel from Jatropha fruit and passed test flights. Compared with traditional aviation kerosene, this fuel can reduce greenhouse gases by 50%~90% within its lifecycle and has become an ideal alternative to fossil fuels.

Upgrading of Refined Products



We strive to provide cleaner and more efficient refined products and optimize the energy consumption mix by increasing investment, accelerating R&D and application of new technologies, and upgrading gasoline and diesel quality. By the end of 2016, CNPC completed all of its National V gasoline and diesel upgrading projects and commenced production as scheduled.

41.2%

2016

In 2016, 41.2% of CNPC's domestic gasoline supply met the National V standard

20.2%

2016

In 2016, 20.2% of CNPC's domestic diesel supply met the National V standard

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 the local energy challenges, in order to meet local energy demands and maintain regional energy security.

By the end of 2016

CNPC operated in

35 countries and regions

CNPC operated

91 projects

CNPC provides technical service and engineering construction for

71 countries and for regions

International Energy Cooperation

Despite low oil prices and regional turmoil, CNPC guaranteed the stable operation of cooperation projects. In 2016, CNPC produced 146.32 million tons of oil and gas equivalent overseas, with CNPC equity production of 76.01 million tons, up 5.5% year-on-year. The Company made due contributions to meeting energy demand in host countries and supporting local economic development.

Middle East

- ▣ The North Azadegan project in Iran went into production.
- ▣ The Rumaila project in Iraq realized production of 3 billion barrels since start of operation in 2010, resulting in an oil revenue of USD 200 billion for the country.

Africa

- ▣ Reserves of our projects in Chad increased by 28 times in the recent five years, with an annual growth rate of 96%.
- ▣ Our integrated cooperation with Niger in the upstream, midstream and downstream sectors helped the country build a complete modern oil industry system. The cooperation projects not only met local energy demand, but also achieved exports of refined products in 2016.

Central Asia

- ▣ The Amu Darya project in Turkmenistan focused on natural gas exploration and production, with total natural gas output in 2016 of 13.13 billion cubic meters. The project created 22,000 jobs and invested over USD 3 million in public welfare undertakings.
- ▣ Since its construction completion, the Central Asia Gas Pipeline has transmitted 172.4 billion cubic meters of natural gas, having turned local resource advantages into economic advantages and met the energy demand from the market along the pipeline. In 2016, the project created more than 1,800 jobs in Kazakhstan and Uzbekistan.
- ▣ Seven upstream projects in Kazakhstan produced 18.79 million tons of crude oil and 8.35 billion cubic meters of natural gas in 2016. Investment in public welfare undertakings reached USD 29.69 million.



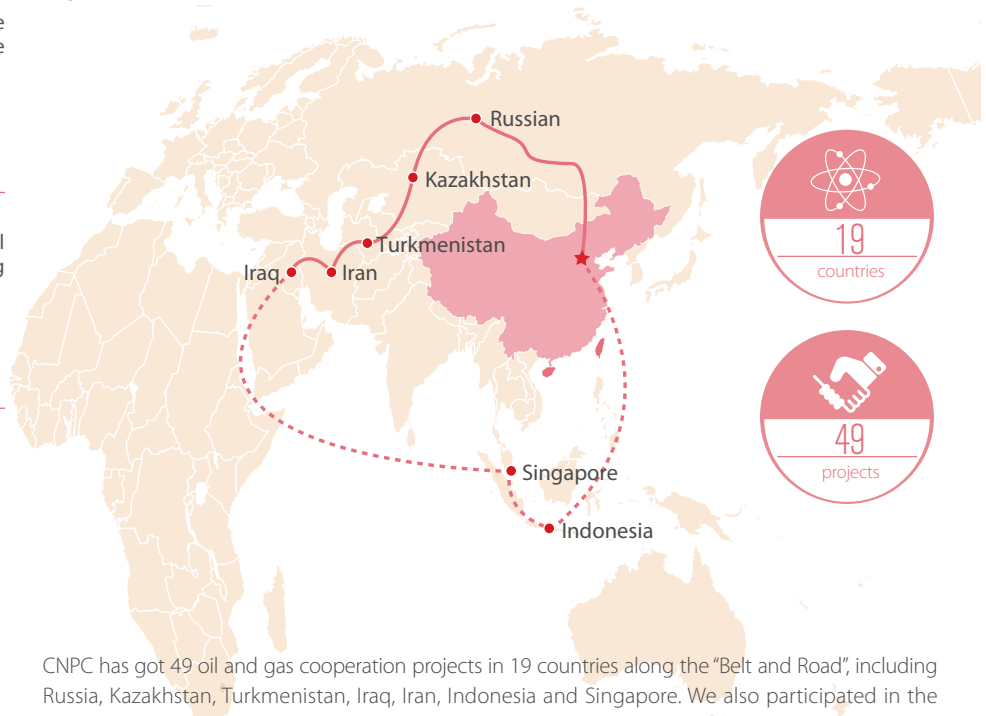
CNPC in "Belt and Road" region

CNPC imported 48.12 million tons of oil from the "Belt and Road" regions, accounting for 64% of the Company's total oil imports respectively

64 %

CNPC imported 42.5 billion cubic meters of natural gas from the "Belt and Road" region, accounting for 95% of the Company's total gas imports

95 %



CNPC has got 49 oil and gas cooperation projects in 19 countries along the "Belt and Road", including Russia, Kazakhstan, Turkmenistan, Iraq, Iran, Indonesia and Singapore. We also participated in the construction and operation of pipelines such as Central Asia Gas Pipeline.

In 2016, CNPC imported 48.12 million tons of oil and 42.5 billion cubic meters of natural gas from the "Belt and Road" region, accounting for 64% and 95% of the Company's total imports respectively.



Hope Oilfield in Kazakhstan



Halfaya project in Iraq

The North Azadegan project in Iran



Joint E&P in China

We continue to make steady progress on 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. In 2016, we entered into a production sharing contract with BP for the Neijiang-Dazu shale gas block of Sichuan Basin. The LuoJiazhai High-sulfur Gas Field of Chuandongbei Gas Project jointly developed by CNPC and Chevron was put into operation, which will increase gas supply to regions including Sichuan and Chongqing. The Changbei Project in Changqing Oilfield in cooperation with Shell maintained stable production. Our domestic oil and gas production equivalent in cooperation with international partners amounted to 9.13 million tons.

Major Joint E&P Projects in China in 2016

Project	Partner	Progress
Zhaodong crude oil project	New XCL Roc Oil (Bohai) Company	Maintained stable production
Changbei natural gas project	Shell	Maintained stable production
Chuandongbei natural gas project	Chevron	LuoJiazhai high sulfur gas field went into production
South Sulige natural gas project	Total	Maintained stable production

International Marketing

Supported by our overseas operation hubs and trade networks, we conduct international trading through cooperation and joint ventures in 80 countries and regions around the world, further improving our resource deployment capability. In 2016, we reported 450 million tons of international marketing volume, and witnessed improvements in both trade scale and operational quality.

