Annual Business Review

Targeting at market orientation and economic returns, the company continued to optimize production organization and resource allocation, promote an integrated and coordinated operation on oil and gas production, refining, chemicals, marketing and trade activities, and improve internationalized business operation and service market competitiveness.

Exploration and Production

633.16 mmt

Newly proven oil in place (Domestic)

584.6 bcm

Newly proven gas in place (Domestic)

In 2018, focused on economically recoverable reserves and profitable output, the company embarked on a series of E&P initiatives, including the Domestic E&P Business Acceleration Program 2018-2025, the Natural Gas Business Development Plan 2018-2030 and the Shale Gas Development Plan 2020-2035. Our E&P business showed good prospect as a whole, as a result of corporate reform and technological innovation, well-planed E&P activities, favorable outcomes in unconventional resources E&P as well as active engagement in foreign cooperation in China.

Exploration

The company's exploration efforts in 2018 have proved fruitful. Focusing on risk exploration, we made more investments and efforts in new areas and new fields, leading to new discoveries at multiple basins, strata and spots. Meanwhile, a cost-effective and fine exploration approach was adopted in mature areas, increasing the ratio of high-quality, large-scale, uncompartmentalized reserves that are more developable and upgradable. Unconventional resources have taken a larger share in the newly added reserves and gradually become an important alternative source of reserve expansion. The full-year increment to proven oil in place and gas in place are 633.16 million tons and 584.6 billion cubic meters respectively.

Reserves and operating data (Domestic)

	2016	2017	2018
Newly proven oil in place (mmt)	649.29	659.45	**633.16**
Newly proven gas in place (bcm)	541.9	569.8	**584.6**
2D seismic (kilometers)	24,885	26,813	**18,182**
3D seismic (square kilometers)	8,764	7,843	**12,570**
Exploration wells	1,656	1,774	**1,803**
Preliminary prospecting wells	865	986	**997**
Appraisal wells	791	788	**806**

Crude Production

With an emphasis on both ramping up production in new fields and stabilizing production in mature fields, the company produced 101.02 million tons of crude oil in 2018. Production ramp-up projects at Xinjiang Oilfield (Mahu and Jimsar) and Dagang Oilfield have made major headway, thanks to reinforced measures for low cost development, new capacity management and process control, etc. We continued to deepen refined reservoir interpretation, pilot development, waterflooding campaign and dormant well restoration and extend the use of horizontal wells, cluster wells and factory processes, keeping the natural decline rate below 11.5%. The digital oilfield initiative has proceeded at a fast pace with Internet-of-Things technologies being widely used over the past six years. Digital oilfield systems have been deployed in a number of oilfields including Changqing, Southwest and Dagang, etc.

101.02 mmt

Crude production (Domestic)

109.4 bcm

Natural gas production (Domestic)

Stable Production of Mature Fields

The Stable Production Program continued to address challenges faced by mature oilfields, with measures taken to enhance recovery factor, mitigate decline rate and improve water flooding efficiency. In 2018, fine reservoir interpretation for continental sedimentary sandstone was carried out in support of production growth in mature fields. Based on secondary and tertiary ("2+3") recovery techniques, "2+3" EOR models have been developed for four main types of reservoirs to facilitate sustained and effective transformation in mature fields. Water flooding management efforts have helped keep water injection effectiveness at a high level and further reduced the natural decline and composite decline rates. Improvements in utilization of oil wells, gas wells and water wells have been achieved through enhanced measures on restoring dormant wells.

Field Tests of Key Development Technologies

A range of pilot testing activities have delivered new results. Gas-assisted gravity miscible drive process has been tested successfully at the Donghetang field in Tarim Basin and expected to increase the recovery factor by 29%. Air injection/fire flooding techniques have contributed to

Major discoveries

Risk exploration

- Risk exploration in Tarim Basin achieved big breakthrough that a new gas-bearing structural belt in Qiulitage was found
- High yield oil and gas flows were obtained at a number of exploratory wells in Bayan-Hetao Basin
- Significant progress was made in natural gas exploration in Sichuan Basin, include the identification of new gas-bearing volcanic strata in the western part and high yield gas flows from exploratory wells in the eastern part
- Lithologic reservoirs are identified in the Shawan Sag, Junggar Basin

Exploration achievements

- We newly proved 220 million tons of oil in place in the Ordos Basin and 170 billion cubic meters of gas in place in Jingbian and Shenmu-Qingjian areas
- New progress was achieved in exploring the Manan Slope in Junggar Basin, identifying six uncompartmentalized blocks with newly proven oil in place of 130 million tons
- Discoveries at the Kelasu tectonic belt in Tarim Basin add more than 150 billion cubic meters of proven gas in place
- A number of large-scale oil and gas plays were identified in the Sichuan, Qaidam, Songliao and Bohai Bay basins

The era of "Cloud" for upstream operations

Aiming at "integration and sharing", the company has developed a collaborative research environment featuring unified data pool and unified PaaS cloud platform. The E&P Dream Cloud 1.0 platform was formally launched in November 2018. As CNPC's first intelligent information sharing platform for its core operations, it is intended to bolster connectivity for data, technology and research in upstream activities and promote the intellectualization of E&P.

an annual output of more than 300,000 tons from heavy oil reservoirs. Demonstration projects at Changqing and Qinghai oilfields have marked the commercial testing of oxygen-reduced air drive techniques. Jilin Oilfield's tight-spacing CO2 miscible flooding tests have helped oil recovery reach 20%. At Liaohe, Xinjiang and Dagang oilfields, surfactant-polymer flooding tests have increased the recovery factor by 19, 18 and 16.5 percentage points respectively. Leveraging technological breakthrough in heavy oil fire flooding with air injection and tail gas treatment, Xinjiang Oilfield's commercial tests for fire flooding and pilot tests for tail gas reinjection have buried 126 million cubic meters of tail gas and reduced 75.22 million cubic meters of CO2 emissions on an annual basis, leading to a significant cut in the cost for tail gas treatment.

Natural Gas Production

In 2018, the company's natural gas output hit an all-time new high of 109.4 billion cubic meters. Our four major gas provinces, i.e. Changqing, Tarim, Southwest and Qinghai, have seen steady growth in natural gas production, as a result of reinforced measures for operations management, dynamic monitoring & analysis, wintertime scheduling, and enhanced gas recovery in mature fields. Capacity building in key projects in the Sichuan Basin (shale gas) and Tarim Basin (Kuche sag) has made headway. Natural gas output from smaller gas-producing fields like Daqing and Jilin was elevated to a higher level, making these fields an important alternative source of supply.

Underground Gas Storages

To cope with regional and seasonal imbalances in the domestic natural gas market and ensure market supply, we further tapped the potential of 10 existing storages with the total working gas capacity amounting to 9 billion cubic meters in 2018. The company also plans to build 10 new underground gas storages, preliminary evaluation and pilot testing are now under way.

Unconventional Hydrocarbon and New Energy

E&P of unconventional hydrocarbon and new energy development have proceeded progressively and achieved some positive results.

E&P of Unconventional Hydrocarbon

The company's exploration efforts in unconventional hydrocarbon such as shale oil and gas, tight oil and gas and CBM delivered important results in 2018. Unconventional hydrocarbon, as an important alternative source of energy, are accounting for an increasingly larger share in our newly added proven reserves. The construction of unconventional hydrocarbon projects has gathered pace. A number of important producing blocks and pilot testing bases have taken shape as unconventional oil and gas production continues to grow.

Shale oil & gas: Major discoveries in the Ordos and Bohai Bay basins have pushed proven reserves of shale oil to a new high. Shale oil is becoming one of the realistic sources of the company's domestic crude production growth. Shale gas exploration breakthroughs in the southern part of the Sichuan Basin provide a meaningful example for mining shale gas from depths of over 4,000 meters. Shale gas production capacity in two national demonstration projects in Changning-Weiyuan and Zhaotong has moved up steadily over the years, thanks to an integrated approach to geologic engineering, growing output per well and improved construction efficiency. We produced 4.26 billion cubic meters of shale gas in 2018, jumping 41.2% year-on-year.

Tight oil & gas: Focused on the Ordos, Junggar, Sichuan and Songliao basins, E&P efforts in tight formations have contributed to large-scale recovery of tight oil and gas resources. In Ordos Basin, tight oil and gas resources are becoming an essential driver of reserve additions and production is rising steadily. In Junggar Basin, tight oil production capacity is growing rapidly on a large scale across the Jimsar Sag. In Sichuan Basin, R&D of extraction techniques has picked up pace in the Jinhua-Zhongtaishan tight gas pilot area. In Songliao Basin, tight oil demonstration projects operated by Daqing Oilfield in the Longxi region are testing new tight oil production solutions.

CBM: As CBM exploration extends into new regions, high-quality coal formations with a thickness of more than 40 meters have been revealed in the Santanghu Basin, Xinjiang. As two major CBM producing fields, Qinshui (Shanxi) and Edong (Shaanxi) have seen a shift in development to enable gas recovery and steady growth in gas output. A breakthrough has been made in addressing technological bottlenecks and boosted gas production remarkably for mature fields in Qinshui Basin. International cooperation projects have posted high output, as gas production of Baode field remains stable at high levels and integrated management measures implemented at Hancheng field show results. The company produced 1.93 billion cubic meters of CBM for the full year.

New Energy

Striving to provide more high-quality, clean and low-carbon energy products to the society, the company has been pushing ahead with its new energy development plans and deployed a series of new energy projects closely related to its core operations. Areas of focus include geothermal energy, gas hydrate, biomass, energy storage, hydrogen fuel and uranium. A "green" growth pattern based on core oil and gas operations and a mix of alternative and renewable sources of energy is taking shape. Meanwhile, "green financing" in the form of "green loans" and "green funds" have been launched to facilitate the transformation to a "greener" growth model.

Geothermal energy: The company has been actively promoting the development and utilization of geothermal energy and supporting relative research efforts. We fund demonstration projects in the Huabei, Daqing, Liaohe and Jidong oilfields. So far, a number of geothermal projects have been completed and put into operation, leveraging the geophysical prospecting, well drilling and completion technologies for the evaluation and development of geothermal resources. Huabei Oilfield has started exploratory drilling of the first geothermal well in Xiong'an, Hebei province.

Joint E&P in China

The company has been working with international partners including Shell and Total in E&P activities in China around low-permeability reservoirs, heavy oil, shallow-water reservoirs, sour gas, high-temperature and high-pressure gas reservoirs, CBM and shale gas, etc.

The company's foreign cooperation E&P projects have made new breakthroughs. These projects produced for the first time more than 10 million tons of oil equivalent for the full year, i.e. 10.12 million tons, including 2.39 million tons of crude oil and 9.7 billion cubic meters of natural gas. As of 2018, the company had 34 joint E&P projects in operation.

The company stepped up collaborative efforts and delivered a series of E&P achievements in 2018. The Changbei Project at Changqing Oilfield, with Shell as our partner, has completed the first bilateral horizontal well, with an initial daily output of 700,000 cubic meters. The Sulige South Project, with Total as our partner, has accelerated production ramp-up and achieved a sustained drop in costs while posting increases in its national gas output. The newly installed gathering station Su'nan-C3 has added 4 million cubic meters to the amount of natural gas processed on a daily basis. The Zhaodong Oil Project, with New XCL-China and Australia's ROC Oil as our partners, is set to drill at least 24 wells within two years under an extension agreement to stabilize Dagang Oilfield's crude oil production.

Natural Gas and Pipelines

With a focus on strengthening the connectivity and coordination of production, transportation, marketing, storage and trade activities, the company's natural gas and pipeline operations stabilized supply and achieved double-digit sales growth in 2018, thanks to the progress made in pipeline network optimization, intelligent pipeline system, pipeline connectivity projects and natural gas marketing network improvement.

Oil and Gas Pipelines

The company pushed ahead with its pipeline network optimization in 2018. Our crude transportation volume hit a new historical high through reinforced planning management on crude pipelines. The refined products pipelines have been upgraded to meet the demand for transporting National VI fuel oil. As to the natural gas pipelines, we enhanced flow allocation and inventory management to meet increased wintertime demand, ensuring adequate and stable supply.

By the end of 2018, CNPC-operated pipelines in China totaled 86,734 kilometers, including 20,736 kilometers for crude oil, 54,270 kilometers for natural gas, and 11,728 kilometers for refined products, accounting for 69.9%, 75.2% and 42.8% of the nation's total respectively.

Key Pipeline Projects

The company's key pipeline projects gathered pace and made significant headway in 2018. A number of key projects aimed at strengthening gas pipeline connectivity went on stream. The Jinzhou-Zhengzhou Refined Products Pipeline (trunk line) was completed; the Qinzhou-Nanning-Liuzhou Refined Products Pipeline, Kunming Branch of the Yunnan Refined Products Pipeline and Fushun-Jinzhou Refined Products Pipeline became operational; the Russia-China Gas Pipeline (Eastern Route) proceeded smoothly; and the Fujian-Guangdong Branch of the Third West-East Gas Pipeline started construction.

Natural Gas Pipeline Connectivity Projects

In view of bolstering the value chain of our natural gas operations, we proceeded with the gas pipeline connectivity projects, as well as underground gas storages and LNG terminals, to build a gas pipeline network that is well planned, wide-reaching, highly integrated, safe and efficient. We worked with Sinopec and CNOOC on 24 pipeline connectivity projects. These projects are designed to tackle connectivity issues in natural gas transportation and scheduling and optimize national and regional pipeline systems, in a bid to boost natural gas supply.

69.9%

Crude pipeline mileage in the nation's total

75.2%

Natural gas pipeline mileage in the nation's total

National VI-compliant pipeline upgrading

Under the national standards for motor vehicle gasolines and diesel fuels, National VI-compliant products have been available in the domestic market since January 1, 2019. National VI standards impose more rigorous sulfur content requirements, as compared with National V, in a bid to further reduce pollutant emissions.

Pipeline upgrading is a prerequisite for the implementation of the new fuel regulations. Necessary upgrades and replacements were made efficiently, thanks to coordinated efforts among member companies. The Lanzhou-Zhengzhou-Changsha, Lanzhou-Chengdu-Chongqing, and Yunnan refined products pipelines have been revamped. By the end of 2018, all of the company's refined products pipelines had been ready for delivering National VI-compliant gasolines and diesel fuels to the market.

Qinzhou-Nanning-Liuzhou Refined Products Pipeline

Located in Guangxi, the pipeline runs 363 kilometers to deliver refined products from Guangxi Petrochemical to Liuzhou Oil Depot. The pipeline was put into operation in August 2018 with a design capacity of 5 million tons per year. It will enable better energy security for Guangxi's economic development by improving the energy mix and refined products deliverability in the region.

Fushun-Jinzhou Refined Products Pipeline

The pipeline is designed to link four large refineries in Northeast China, i.e. Fushun Petrochemical, Liaoyang Petrochemical, Liaohe Petrochemical and Jinzhou Petrochemical. The pipeline runs 431 kilometers with a design capacity between 3 million and 7.5 million tons per year. Becoming operational in September 2018, the pipeline, together with the Jinzhou-Zhengzhou Pipeline and the Lanzhou-Zhengzhou-Changsha Pipeline, will create an important refined products pipeline network in China.

Natural Gas Sales

There was a surge in natural gas consumption in 2018, as a result of China's heightened air pollution control, growing demand from natural gas-fueled power generation, headway made in implementing the "Natural Gas as An Alternative to Coal" Initiative and "2+26 Cities" Clean Winter Heating Initiative. Leveraging these opportunities, we worked proactively with our clients in optimizing sales planning and resources allocation and managed to increase the supply of pipeline gas and imported LNG in response to market demand. In 2018, we sold 172.4 billion cubic meters of natural gas in China, up 13.6% year-on-year.

We continued to explore the market and expand our distribution network to optimize the overall value chain, effectively ensure smooth sales channel and enable integrated marketing throughout the upstream and downstream sectors. By the end of 2018, our gas distribution network covered 32 provinces, municipalities and autonomous regions and maintained a leading position in the northern, southwestern, northwestern, central and northeastern parts of China, while gaining a larger presence in the eastern and southern markets. We secured a total of 275 new clients in 2018, adding 2.1 billion cubic meters of natural gas sales.

In 2018, our end-user markets of natural gas grew rapidly, registering gas sales of 24.6 billion cubic meters, up 14.5% year-on-year. By the end of 2018, we owned and operated 445 CNG filling stations, 393 LNG filling stations and 411 LNG refueling points, ranking top in terms of the number of CNG and LNG filling stations in China.

Liquefied Natural Gas (LNG)

The company stepped up to strengthen its natural gas peak-shaving capability. Based on a holistic approach to LNG operation planning, we built new LNG facilities and expanded existing ones to create an offshore natural gas resource hub. Shenzhen LNG peak-shaving station, Tangshan and Jiangsu LNG Terminal expansion project were under construction. These peak-shaving systems have helped us ensure ample gas supply during peak consumption periods. In 2018, our three LNG terminals in Jiangsu, Dalian and Tangshan unloaded 15.13 million tons of LNG, up 45% from a year earlier.

The installed capacities of our 21 LNG plants in Hubei, Sichuan and Shaanxi, etc. amounted to 22.9 million cubic meters per day, accounting for approx. one-fifth of China's total LNG capacity. We processed 1.06 million tons of LNG for the full year, up 16.9% year-on-year.

Refining and Chemicals

As the company continued to optimize production management and operational benchmarking and speed up upgrade and transformation, our refining and chemicals business remained a major source of earnings in 2018, with new headway in key projects and ongoing improvement in product mix.

Resource allocation was further optimized and earning estimation was conducted for each product category based on market demand and facility conditions, to ensure high-utilization rate of the company's integrated refining-petrochemical complexes and high-performing refining facilities. In 2018, we processed 162.36 million tons of crude oil, and produced 112.91 million tons of refined products and 5.57 million tons of ethylene in China.

New progress was made in the restructuring of refining operations, with 14 key technical and economic indicators being improved. The diesel-gasoline ratio dropped by 0.09 unit from a year earlier. High-value products accounted for 66.6% in our refined product portfolio, with a 12-million-ton increase in jet fuel and a 225,000-ton decline in heavy-components oil products.

162.36 mmt

Crude runs (Domestic)

112.91 mmt

Refined products output (Domestic)

Construction and Operation of Large Refining & Petrochemical Bases

In 2018, we continued a refined approach to operational management, strengthened production control and process optimization, and improved profit-gaining capability, with 99.66% of our refining and chemical facilities maintaining steady running.

Refining and chemicals operating data (Domestic)

	2016	2017	2018
Crude runs (mmt)	147.09	152.45	162.36
Utilization rate of refining units (%)	80.9	80.8	83.1
Refined products output (mmt)	99.32	103.51	112.91
Gasoline	37.97	40.98	45.90
Kerosene	9.32	10.18	12.54
Diesel	52.03	52.35	54.46
Lub oil output (mmt)	1.16	1.64	1.60
Ethylene output (mmt)	5.59	5.76	5.57
Synthetic resin output (mmt)	9.20	9.40	9.17
Synthetic fiber output (mmt)	0.06	0.06	0.05
Synthetic rubber output (mmt)	0.76	0.81	0.87
Urea output (mmt)	1.90	1.44	0.83
Synthetic ammonia output (mmt)	1.53	1.36	1.05

We launched a number of key projects under the company's transformation and upgrading initiatives for refining and chemicals operations and won significant progress. Liaoyang Petrochemical's revamp and expansion project for Russian crude processing went on stream; Huabei Petrochemical's 10 Mt/a upgrading project was completed; an integration project kicked off at Guangdong Petrochemical; refining plant restructuring project started at Daqing Petrochemical; ethylene unit optimization and renovation started at Dushanzi Petrochemical and Lanzhou Petrochemical respectively. Alkylation projects advanced at an accelerated pace, with seven units being operational at Daqing Petrochemical, Harbin Petrochemical and Lanzhou Petrochemical, etc.

Liaoyang Petrochemical's Revamp and Expansion Project for Russian Crude Processing

On the basis of its existing 9 Mt/a capacity, Liaoyang Petrochemical revamped five existing units and newly built 11 instillations for residual hydrogenation and catalytic cracking to ensure the highly efficient use of Russian crude oil. The project became operational in September 2018 with a capacity to produce 2.6 million tons of gasoline and 3.3 million tons of diesel fuels per year. The project has contributed to a diesel-gasoline ratio down to 1.27, which can be further reduced to 1.06 by an increase in jet fuel output, and achieved a 570,000-ton increase in aromatic hydrocarbon production, with the technical indicators and energy efficiency further improved.

Upgrading of Refined Products

We complied and released the *Guidelines for the Conversion to National VI-Compliant Vehicle Fuels* in accordance with the national and local regulatory requirements, in a bid to bolster efforts in product mix restructuring and quality improvement. As of 2018, all of our refineries had been revamped and ready to produce National VI-compliant products.

Development of New Chemicals

We sped up R&D of new chemical products and kept enhancing market competitiveness. We launched 81 new types of product with a total output of 970,000 tons and sold 29.01 million tons of chemical products for the full year. R&D advances include the development of ultra-high fluidity polypropylene, certification of PE100 and PE-RT pipe materials, and long-cycle production of medium-MFR impact-resistant and low-MFR co-polymerized polypropylene.

Liaoyang Petrochemical's revamp and expansion project for Russian crude processing

Marketing and Sales

Watching market changes closely, the company continued to sharpen its marketing and sales strategies and boost profitability and market competitiveness in 2018 through coordinated planning for production and distribution and integrated marketing for oil products, fuel cards, non-fuel business, lubricants and natural gas.

Refined Products

The 2018 domestic refined product market has become increasingly competitive due to oversupply, the trend of clean energy consumption and a diverse mix of industry players. Based on a proactive, and sophisticated approach to product distribution, we heightened efforts in regional marketing, furthered integration of retailing and wholesale operations and innovated forms of sales promotion, achieving full-year sales of 117.36 million tons, up 2.8% year-on-year.

We pushed ahead with quality upgrading initiative in order to deliver cleaner and premium oil products. By the end of 2018, all of our oil depots and service stations had been revamped to ensure the supply of National VI-compliant oil products.

Service Station 3.0

As the Internet big data and cloud computing technologies evolve rapidly, we are pushing ahead with the Service Station 3.0 initiative which is aimed at creating the "People + Car + Lifestyle" ecosystem based on the concept of "Service station + Internet + N".

Marketing Network

We stepped up efforts in distribution network restructuring and quality improvement, with a focus on areas neighboring refineries, downtown areas, areas along highways and tourist destinations, serving and guaranteeing high quality development of refined oil sales. Among a total of 506 newly built service stations, 445 became operational, adding 2.92 million tons to our retailing capacity. By the end of 2018, we had 21,783 service stations in operation across the country.

Smart technologies-enabled, an "Internet +" approach to marketing is adopted to create the "People + Car + Lifestyle" ecosystem. Online shopping and payment options have been made available through our 95504.net, WeChat official account and retail apps to bolster marketing and sales in a holistic "Online + Offline" manner. Joint marketing campaigns with SAIC Motor, JD.com, China Bank of Communications and other partners continued to gain traction and forge the service stations from the oil sales platform into the comprehensive marketing platform.

Non-fuel Business

The company's non-fuel business is centered on a targeted, professional and refined approach to the management of convenience stores. We enhanced development and marketing efforts for the own-brand offerings and boosted the competitiveness of flagship products. We launched our own premium brand "uSmile Premium+" in 2018. Meanwhile, we actively tapped into car services and imported products and worked with KFC and McDonald in launching drive-through restaurants in Heibei and Heilongjiang, etc. In addition, our diversification efforts in advertisement, packaging, insurance and e-commerce were gathering pace. The company's non-fuel business has generated RMB 23.1 billion in revenue for the full year, up 24% year-on-year.

Lube Oil and Miscellaneous Refined Products

Leveraging its R&D, production and distribution capabilities, the company sold 1.63 million tons of lubricants for the full year. All eight lubricant categories, especially high-value products such as automotive lubricants and industrial fluids, posted remarkable growth in sales. In particular, sales from automotive lubricants and industrial fluids jumped by 14% and 11% respectively year-on-year. Meanwhile, new technology development efforts in converter transformer and gas engine lubricants have made progress.

In 2018, we sold 32.94 million tons of miscellaneous refined products for the full year, with sales of waterproofing film and naphtha products hitting all-time highs. In particular, we continued to top the domestic market as China's largest asphalt supplier.

Overseas Oil and Gas Operations

Adhering to a prudent approach to overseas operation, the company continued to push ahead with international collaboration along the Belt and Road route and strengthen the management of its global operation in 2018, with a focus on optimizing investment structure and regional footprint. The company's overseas operation has seen major breakthroughs, including oil and gas discoveries, commissioning of key projects and remarkable growth in overseas earnings. So far, the company has made oil and gas investment in 34 countries around the world.

75.35 mmt

CNPC's share in overseas crude production

28.7 bcm

CNPC's share in overseas natural gas production

Oil and Gas Exploration

The company's overseas exploration activities were centered on large-scale, high-quality and readily producible reserves, leading to achievements in a number of key zones. These activities resulted in newly added equity recoverable reserves of 33.16 million tons of oil equivalent, including 18.03 million tons of crude oil and 19 billion cubic meters of natural gas.

Libra project in Brazil

Layout of overseas oil and gas operations

- **Central Asia – Russia:** Building a core oil and gas cooperation zone under the Belt and Road Initiative
- **Middle East:** Building a high-end cooperation zone that gives full play to our comprehensive and integrated advantage
- **Africa:** Building a most influential cooperation zone for the development of conventional oil and gas resources
- **Americas:** Building a unique cooperation zone for the development of unconventional and deepwater oil and gas resources
- **Asia-Pacific:** Building an important cooperation zone for natural gas and integrated projects

Major breakthroughs were made in offshore exploration. The appraisal wells drilled in the northwestern part of the Libra project in Brazil encountered pay zones with a net thickness of 310 meters, identifying proven oil in place of 1.6 billion tons. Deepwater exploration in Myanmar was succeed, marking the first biogenic gas play discovered in the block.

Important discoveries were made in onshore risk exploration. Two productive buried-hill reservoirs were identified in the Bongor Basin, Chad, adding to the existing discoveries in this basement rock – buried hill complex. Two exploratory wells in Block 1 of the Abu Dhabi Onshore-Offshore Project proved successful, opening up good prospects of commercial development and further exploration. The exploratory wells at the Yamal project in Russia produced high-yield gas flows after a fracturing process, indicating great potential of reserve replacement. In Uzbekistan, Well M-15 was completed in spite of challenges from high temperature, high pressure, high density, high sulfur-content and ultra-deep drilling, obtaining good oil and gas shows during the formation test.

Targeted exploration in mature plays, such as the Andes Block T in Ecuador, Pre-Caspian Central Block in Kazakhstan, Block 3/7 in South Sudan and Block 6 in Sudan, has shown significant progress.

Oil and Gas Production

In 2018, based on a cost-efficient strategy to overseas operation, the company achieved robust growth in oil and gas production by stepping up field management and streamlining processes to ensure smooth running of production facilities; deploying new EOR techniques, boosting per-well capacity, reducing decline rates and unleashing the potential to stabilize production in mature fields; and enhancing reservoir interpretation, optimizing well location and speeding up drilling to bring new wells into operation and build up production capacity. The full-year operating production reached 172.39 million tons of oil equivalent, in which CNPC's share was 98.18 million tons, up 10.2% year-on-year. In particular, the operating and equity production of crude oil were 144.63 million tons and 75.35 million tons respectively; and those of natural gas were 34.8 billion cubic meters and 28.7 billion cubic meters respectively.

Central Asia-Russia: Focusing on natural gas capacity expansion, the company has made great headway in bringing its natural gas production to higher level. In Turkmenistan, the EGR Project at the Saman-Depe Gas Field was completed. In Uzbekistan, the Sigit and East Alat gas fields in Karakul Block went on stream, marking the completion of the capacity building project. In Russia, the second and third LNG trains of the Yamal Project were launched, boosting the project's annual capacity to 16.5 million tons; the construction for the fourth train was started. In addition, the construction of Asia Steel Pipe Co., Ltd., the company's investment in Kazakhstan, was well underway.

Middle East: Under a diversification strategy, CNPC International Middle East continued to optimize asset structure and bolster robust growth in oil and gas operation by leveraging a multi-level, flexible innovation and cooperation mechanism. The offshore Bu Haseer Oilfield in Abu Dhabi, UAE became operational one year after its construction. The newly-signed Abu Dhabi Offshore Project started to produce oil. The Halfaya Oilfield Phase III (CPF3) project became operational, bringing a 200,000 bbl/d addition to processing capacity and boosting the field's total annual capacity to 20 million tons; a power station and water injection pipelines were put into operation at the Rumaila Oilfield, with other upgrades and ramp-ups proceeding as planned.

Latin America: CNPC International Latin America managed to stabilize production operation and achieve an upturn in crude output amidst the social complexities in host countries. The company continued to improve its unconventional resource development and deepwater project management capabilities while pushing ahead with the deepwater project in Brazil and the extra-heavy oil project in Venezuela, in a bid to create overseas demonstration zones for cooperation in the development of unconventional and deepwater resources. In Brazil, the Libra project successfully completed offshore oil lifting operation, generating returns on the company's first ultra-deepwater investment; a floating production storage and offloading (FPSO) unit was constructed as planned in the Mero block. In Venezuela, the 165,000 bbl/d expansion (Phase I) of the MPE3 project saw the completion and commissioning of the main facilities.

Africa: In Sudan and South Sudan, CNPC International Nile exceeded production targets for the year, by strengthening oilfield management, improving well stimulation measures and increasing profit-generating output. The company managed to put the Block 1/2/4 in South Sudan back into production with a daily capacity of 22,000 barrels. The Raphia FPF and second Daniela CPF facilities for the Chad Project Phase 2.2 became operational. In Mozambique, the Coral Gas Field (Phase I) works for a LNG project proceeded smoothly as planned.

Asia-Pacific: The Arrow PTL project in Australia completed a revamp of the Daandine central gas processing plant and was put it into operation. Our projects in Indonesia and Canada streamlined reservoir management and took a range of measures to unleash potential, improve quality and boost efficiency.

Pipeline Construction and Operation

With a focus on operation management, coordination and hazard control, the company's overseas long-distance pipelines, including the Central Asia-China Gas Pipeline, Myanmar-China Oil and Gas Pipeline and Kazakhstan-China Crude Pipeline, etc., remained safe and stable operation, delivering 33.11 million tons of crude oil and 53.5 billion cubic meters of natural gas throughout the year. By the end of 2018, CNPC operated overseas oil and gas pipelines totaled 16,500 kilometers, including 8,597 kilometers for crude oil and 7,903 kilometers for natural gas.

New achievements were made in overseas pipeline construction. The Second Russia-China Crude Pipeline became commercially operational; the Central Asia-China Gas Pipeline-Line D project and the Kazakhstan-China Crude Pipeline (Northwest) revamp project were under construction as planned; the Chad Crude Pipeline expansion project was completed and went on stream.

Refining and Chemicals

The company's overseas refineries achieved safe and steady operations in 2018 and processed 45 million tons of crude throughout the year. In Kazakhstan, the Shymkent Refinery renovation project Phase II was completed, with major improvements in crude processing degree and light oil yield. Our joint venture refinery in Chad adjusted its product mix in response to market demand and achieved balance between production and distribution. Our joint venture refinery in Niger saw some best economic and technical indicators of all time, thanks to optimized production planning and process running. Our joint venture refineries in Sudan, UK and France were operating smoothly after timely and quality overhauling.

Renovation of the Shymkent Refinery

The Shymkent Refinery renovation project Phase II in Kazakhstan was completed and went on stream. As one of Kazakhstan's top three refineries, the Shymkent Refinery is jointly operated by CNPC and KazMunaiGas. Started in 2014, the renovation project comprises of two phases: Phase I was made operational at the end of June 2017; Phase II went on stream in September 2018. The revamping efforts have turned the Shymkent Refinery into a state-of-the-art, eco-friendly refinery with significantly improved processing capabilities. In particular, the light oil yield has increased from 56% to 80% and oil products are compliant with the Euro IV and Euro V standards as well as the local regulations for clean fuels, playing an important role in promoting eco-friendliness and securing oil products supply.

Project Cooperation and Development

In 2018, the company has been actively engaged in international cooperation and new project development through international platforms such as the SCO Qingdao Summit and FOCAC Beijing Summit. The Abu Dhabi Offshore Project was successfully delivered; a production sharing contract on the Peroba deepwater block in Brazil was signed; and agreements on oil contract extension & deepening oil and gas cooperation between China and Kazakhstan were inked.

We entered into cooperation agreements and MOUs with a number of governments and energy companies to bolster international oil and gas cooperation in a wider scope and at a deeper level. In Russia, we inked a cooperation agreement on upstream projects with Rosneft, and reached into a technical cooperation agreement and a cooperation framework agreement on the Sutor Minsk Oilfield with Gazprom. In Latin America, we signed MOUs on natural gas development with Venezuelan counterparts, and an integrated project business model agreement with Petrobras. MOUs for strategic partnership with our partners, e.g. Equinor, were nailed down.

International Trade

In 2018, our trading activities in more than 80 countries and regions around the world maintained a focus on resource allocation and global deployment and achieved steady and robust results in trading and shipping of crude oil, refined products, natural gas and chemicals. Our three international operation hubs in Singapore, London and New York continued to improve operation management and enjoyed an increased presence in the international markets. We reported trading volume of 480 million tons, worth USD 236.7 billion, up 2.5% and 28.4% year-on-year respectively, with sales revenue standing for the first time above RMB 1 trillion, up 20% from a year earlier.

Crude oil trading amounted to 260 million tons for the full year, up 1.9% year-on-year. Leveraging our trading expertise and a global distribution network, we continued to boost the sales of overseas equity oil through a holistic approach to planning, market development, storage & transportation and distribution. Crude oil purchases have remained safe and stable, leveraging improved capabilities for the transportation of crude oil as well as the construction and operation of oil terminals and oil depots. After the debut of yuan-denominated crude oil futures contract in 2018, we have been actively engaging in oil-futures trading processes at Shanghai Futures Exchange, covering registration, buying and selling of warehouse receipts.

Refined product exports expanded for the first time into the Canada and US markets and long-term supply contracts were signed with clients in Australia, Japan, Vietnam, Mexico and the Middle East. We continued to tap into the retail market of refined products, with a steadily rising market share. Our full-year refined product exports hit the all-time high of 15.89 million tons in 2018.

The trade volume of natural gas reached 130.6 billion cubic meters, up 7% year-on-year. Further progress was made in the negotiations over the Central Asia-China Russia-China, Myanmar-China and LNG projects, etc. Long-term agreements were signed with KazTransGaz, Cheniere Energy and Qatargas, in a bid to ensure a secure supply of natural gas in the domestic market. We were gradually shifting from a natural gas importer to an exporter, with steady growth in trade volume in Japanese and Korean markets and a successful entry into markets in Southwest Europe, South America and South Asia, etc.

Consolidating resources and markets at home and abroad, we expanded imports and exports in chemical products, e.g. polyolefin, methanol and polypropylene, etc. Meanwhile, more lucrative items such as raw materials for polyester fibers, alcohol ether and carbon products generated good results.

Our freight shipping operations have refocused on a global network, optimized service offering and collaborative efforts to ensure continuous improvement in service capabilities and operational efficiency. We have partnered with 34 oil tanker and bulk carrier owners worldwide and deepened business ties with domestic shipping companies, including COSCO and China Merchants Group.

Overseas Operation Hubs

Our three overseas operation hubs in Singapore, London and New York are showing progress in bolstering operational efficiency and market presence.

The Asian operation hub has proceeded with a fine-tuning strategy of its crude oil sales by introducing the concept of "crude oil supermarket" and offering "one-stop" solutions for end users. We gained a 20%+ share in emerging markets such as Sri Lanka and Myanmar, leveraging a targeted approach to credit extension and tailored schedules for time charter and gasoline-diesel LTL shipping. As a new breakthrough in natural gas trading, LNG resale to Japan, Korea, Thailand, Singapore, India and Pakistan amounted to 5.02 million tons, heralding a "boom in both oil and gas trading".

The European operation hub continued to sell equity oil from Kazakhstan, Sudan, and Chad and spot LNG from Russia's Yamal plant. The long-term sales contracts for crude oil from Nigeria and Chad provided a solid foundation for developing the African market. The operation hub traded 700,000 tons of biodiesel for the full year, ranking among the top 3 biodiesel suppliers in Europe.

The American operation hub has experienced fast-paced growth. The development of logistics routes linking the heavy oil project in Canada with the US market and the international markets contributed to a timely response to discount volatility and a significant revenue increase from Canadian crude oil in 2018. Natural gas sales expanded as a result of cross-region collaboration. The operation hub began to sell LNG cargos to the Latin American markets. The equity delivery document and a shareholder agreement with Brazil's TT Work were signed to acquire a 30% stake in the company. The refined product marketing network is taking shape in Latin America.

Services Business

Leveraging its integrated capabilities and expertise, the company kept optimizing market layout and improving service quality. Its competences and operating results in oilfield services, engineering and construction, equipment manufacturing and financial services continued to improve in 2018.

Oilfield Services

The company's oilfield services arm proceeded with its reform and restructuring initiatives in 2018 with a focus on the optimization of top-level design, streamlining of business processes and innovation of service offering. Domestically, we managed to achieve continuous improvement in quality, efficiency and earnings amidst a surge of workload by rationally deploying deep-well drilling rigs, fracturing units and coiled tubing units, boosting drilling and fracturing operations in winter months and introducing new techniques. Overseas, market development efforts were fruitful. In particular, the value of service contracts signed in traditional markets such as Algeria, Niger and Pakistan was doubled; and bids were awarded for a number of major geophysical prospecting and drilling projects in UAE, Saudi Arabia and Kuwait. By the end of 2018, the company had 8,176 service crews, offering geophysical prospecting, drilling, well logging, mud logging, downhole operation and offshore engineering services in 53 countries around the world.

Geophysical prospecting: Targeting technical bottlenecks in oil and gas exploration, we have pushed ahead with R&D efforts in velocity modeling and shear-wave data acquisition and facilitated the adoption of broadband wide-azimuth, high-density seismic techniques, GeoEast data processing and interpretation solution, and EV56 high-precision vibroseis. These technological advancements have contributed to major discoveries in Qiulitage (Tarim), Mahu (Xinjiang) and Sulige (Changqing). Project management capabilities have been bolstered by optimized technical solutions, improved project coordination and wider adoption of digital seismic system and drones. The Shehong-Yanting 3D Seismic Acquisition Project in China and the deep-sea OBN Project in Indonesia were completed in a timely and efficient manner. In 2018, we deployed a total of 164 seismic crews, acquiring data of 105,739 kilometers of 2D lines and 76,702 square kilometers of 3D profiles, marking 8.5% and 8.6% of average efficiency increase on a daily basis for 2D and 3D seismic data acquisition respectively.

Drilling: The rate of penetration was increased by 5% as a whole, with impressive growth in the numbers of horizontal wells and deep wells as well as the amount of drilling footage, by optimizing drilling parameters and using aggressive drilling techniques. In particular, Well 202H13-6 in the Weiyuan Block set a drill time record of 27.6 days; Daqing Drilling

Engineering Company used hydraulic rotary percussion tools for the drilling of 21 wells, achieving a 129% increase in the average penetration rate. A number of difficult wells have been drilled successfully. In Tarim Basin, Well Keshen-21 was completed at a depth of 8,098 meters; in Sichuan Basin, Well Wutan-1 created a fresh record of 8,060 meters for risk drilling in the Sichuan-Chongqing region; in Uzbekistan, 23 technical troubles were solved when drilling Well M-15 and resulted in 8 proprietary techniques. In 2018, we deployed 1,183 drilling crews to spud 11,385 wells and completed 11,264 wells, with a total footage of 25.71 million meters. In particular, 816 wells are deeper than 4,000 meters, up 25.9% from a year earlier; 931 horizontal wells were drilled, up 22.2% year-on-year.

Well logging and mud logging: A range of state-of-the-art logging technologies have been developed and deployed. EILog and LEAP800 logging systems have continued to improve. R&D achievements in such as Azimuthal gamma imaging while drilling and array induction imaging logging techniques have been put into use. New techniques and procedures for express logging were widely used to boost logging efficiency. In particular, the "Logging Kit" approach increased the logging efficiency for vertical wells by 48% on average; the express logging and through-pipe memorized logging techniques for horizontal wells made the logging process 30% and 60% more efficient respectively. In 2018, we deployed 817 well logging crews to complete 106,963 well-times of logging in 19 countries and 1,035 mud logging crews to complete mud logging at 14,256 well.

Downhole operation: R&D and deployment of improved downhole techniques and practices such as SRV fracturing for horizontal wells and multi-stage fracturing with dissolvable bridge plug contributed to a 23% increase in conventional fracturing and a 32% rise in factory fracturing. In 2018, our 1,839 crews completed 87,007 well-times of downhole jobs, including 11,969 layers of formation testing.

Offshore engineering: We offer offshore engineering services for well drilling, well completion, well cementing, formation testing and production testing, downhole operation as well as the design and construction of offshore projects in the South China Sea, Bohai Sea and Persian Gulf. In 2018, we had deployed a total of 12 offshore drilling rigs and production platforms, completing a total drilling footage of 72,000 meters for the full year.

Oilfield services operations

	2016	2017	**2018**
Geophysical prospecting			
2D seismic data acquired (kilometers)	162,684	154,904	**105,739**
3D seismic data acquired (square kilometers)	58,120	57,182	**76,702**
Drilling			
Wells completed	9,328	11,687	**11,264**
Footage (million meters)	19.50	25.79	**25.71**
Well Logging			
Well logging operations (well-time)	79,231	101,531	**106,963**
Downhole operations			
Downhole operations (well-time)	112,643	110,844	**87,007**
Formation test (layers)	8,515	9,237	**11,969**

Engineering and Construction

In 2018, heightened measures for project lifecycle management contributed to continuous improvement in the construction quality and project execution. R&D efforts on frontier technologies, especially on digital and intelligent applications, have picked up pace. As part of the efforts to create a global network, we entered into strategic partnerships or engineering service agreements with CSIC and Shell, etc. and secured a number of new contracts, e.g. a crude processing project at Garraf Oilfield in Iraq, a pipeline project linking Haradh with Hawiyah in Saudi Arabia and a refinery revamp project in Malaysia.

We executed 97 key projects in oil and gas field surface engineering, refining and chemicals, storage and transportation, and environmental engineering throughout the year, with positive advancements achieved.

Construction of intelligent pipeline

The Russia-China Gas Pipeline (Eastern Route) Project is a pilot program aimed at promoting intelligent pipeline systems. The project integrates real-time data acquisition and transmission, site monitoring, lifecycle project management capabilities, unit communication and project management platforms to enable IT-driven pipeline design, detection, management and hand-over and promote a shift from digital pipeline to intelligent pipeline.

Oil and gas field surface engineering: A range of overseas projects have been delivered or made operational, including the Halfaya Project Phase III (CPF3) in Iraq, the Jose Refinery for the MPE3 project in Venezuela, the Chad Project Phase 2.2, the Karakul Gas Field in Uzbekistan, the EGR Project at the Saman-Depe Gas Field in Turkmenistan, etc. Domestically, a number of projects designed to expand production and stabilize supply were well underway, such as the Changning-Weiyuan Shale Gas Project. The Belt and Road projects including the Amur Gas Processing Plant in Russia and the integrated facilities at the Bab Oilfield in UAE were making steady headway.

Storage and transportation: The construction of key pipelines in China accelerated. A number of refined products pipeline projects were completed, including the Kunming Branch of Yunnan Refined Products Pipeline, Qinzhou-Nanning-Liuzhou Refined Products Pipeline, Fushun-Jinzhou Refined Products Pipeline, Jinzhou-Zhengzhou Trunk and Huabei Petrochemical-to-Beijing New Airport Jet Fuel Pipeline, etc. Key projects aimed at strengthening gas pipeline connectivity were completed. Construction of the Fujian-Guangdong Branch of the Third West-East Gas Pipeline proceeded smoothly. LNG terminal projects (Tangshan, Shenzhen, Jiangsu and Jiangyin) advanced at a faster pace. The Russia-China Gas Pipeline (Eastern Route) gathered pace. The Haradh Gas Pipeline in Saudi Arabia and the single-point mooring (SPM) project in Bangladesh were making steady headway.

Refining and chemical facilities: Domestically, key refining and chemical projects saw new progress. Liaoyang Petrochemical's revamp project for Russian crude processing went on stream. The 10 Mt/a upgrading project was completed at Huabei Petrochemical. Alkylation projects at Qingyang, Jilin and Harbin were delivered and made operational. An integrated project was kicked off at Guangdong Petrochemical. Facility upgrading projects were moving forward as planned at Daqing Petrochemical and Dushanzi Petrochemical. Overseas, the Phase II renovation project became operational at the Shymkent Refinery in Kazakhstan and the refinery expansion project in Algiers, Algeria proceeded steadily.

Environmental engineering and others: Emission reduction, wastewater treatment, VOCs, and off-gas treatment projects were launched at Tarim, Daqing and Liaoyang. Aromatics projects were in full swing at Guangxi Petrochemical, Liaoyang Petrochemical and Urumqi Petrochemical. An Indian polypropylene project was ready for commissioning.

Petroleum Equipment Manufacturing

Undergoing a shift from traditional manufacturing to service-oriented manufacturing, our equipment manufacturing arm is gaining momentum with a substantial boost in profitability. Efforts were made to expand market share both at home and abroad, with an increasingly improved sales network. As of 2018, CNPC made petroleum equipment and materials were

sold in more than 80 countries and regions around the world.

The production and operation management was more lean-oriented. Lean management proved successful two years after the start of its promotion and pilot across the company in 2016. Our equipment manufacturing sites enjoy increased capabilities for visualization and standardization, enabling IT-driven management of production processes and continuous improvement in productivity and product quality.

Centering on a "Manufacturing + Services" model, we continued to push ahead with the integration of R&D, manufacturing, marketing and service competences. We refocused our manufacturing business on the higher end of the value chain through product innovation, technological upgrading and customization. A range of new products have been developed and launched, including X80 steel pipes, 4000m low-temperature composite moving cluster drilling rigs, high-strength variable-thickness coiled tube CT110, etc. Our customer-centered services provide tailored products and solutions, 24h/7d technical support, leasing, maintenance & repair, testing and recycling throughout the entire life cycle of products.

New breakthrough was made in market development, with the number of new contracts increasing significantly year-on-year. Our "Electric pump leasing + Integrated services" entered many markets, taking a 50% market share in Sudan and South Sudan and a 100% market share in Chad and Niger. Low-temperature rigs were sold to Russia; coiled tubing products were exported to South America, South Asia and Europe. We were awarded major contracts for electric pump services in Iraq and line pipes in Egypt. In addition, marketing efforts broke ground in Nigeria and Djibouti.

Financial Services

In 2018, our financial service sector saw robust growth in key operation indicators and remarkable improvement in business agility, R&D and market development capabilities.

We furthered market research and analysis and accelerated business layout. We participated in the fundraising round of China Tower as a cornerstone investor, invested in US-China Green Fund and entered into strategic partnership with five commercial banks. A regional coordination mechanism was taking shape to align financial services with production needs in innovative forms and at a deeper level. Green financing has remained a priority for the company. Financial resources were directed into the green industry to boost the development of cleaner energy sources.

The control and management of financial risks have achieved new results. We bolstered the risk mitigation framework of "two-tier management and three-line defense", and reinforced total-process management for high-risk items. Our key financial risk indicators remained superior to CBRC's thresholds in 2018, with the non-performing asset ratio standing at a very low level and no significant risk event reported throughout the year.