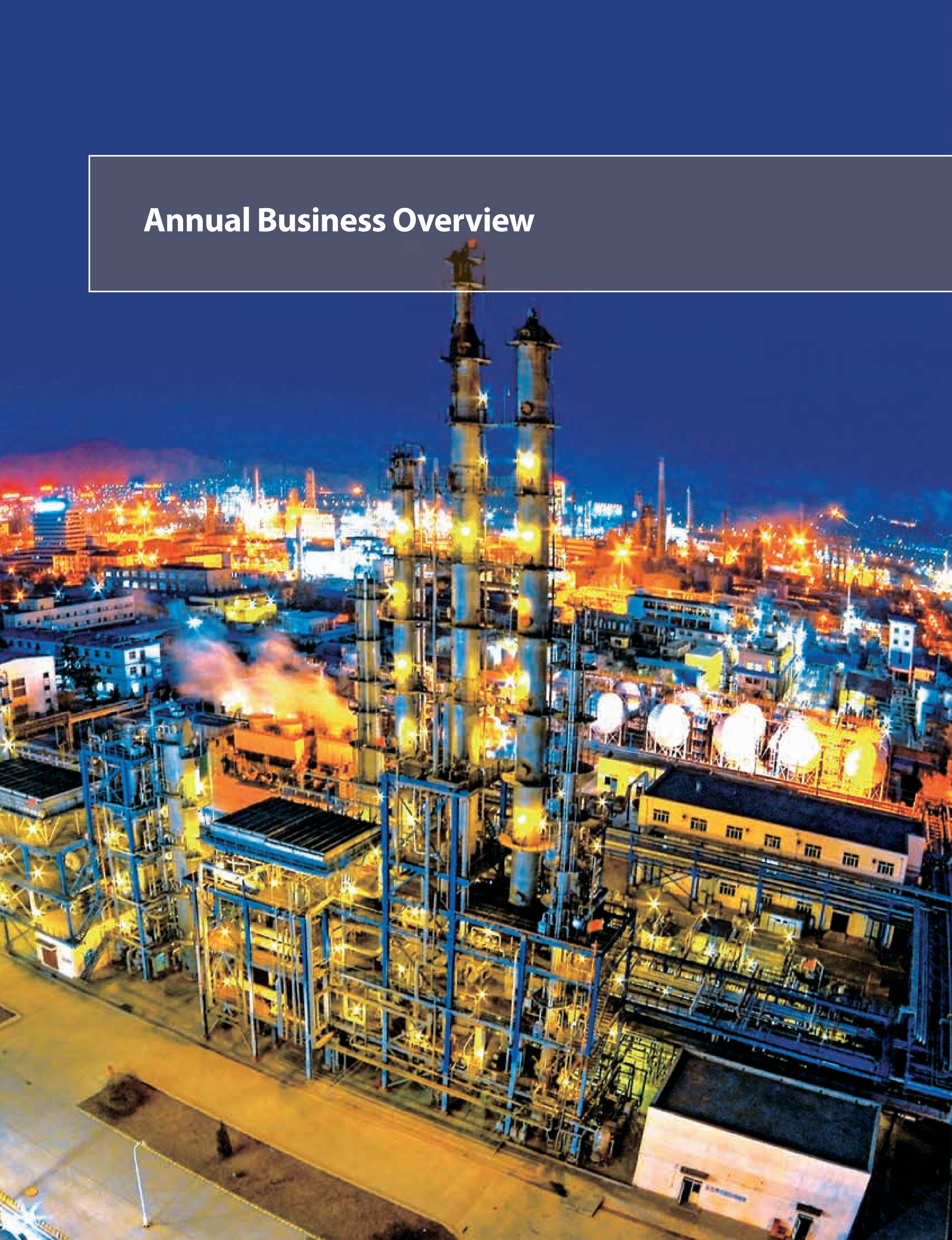
Annual Business Overview



Highlighting market orientation and operational benefits, the company continued to optimize production organization and resource allocation, promote an integrated and coordinated approach to oil and gas production, refining, chemicals, marketing and trade activities, and improve internationalized business operation and service market competitiveness.

Exploration and Production

659.45 mmt

Newly proven oil in place (Domestic)

569.8 bcm

Newly proven gas in place (Domestic)

In 2017, focused on economically producible reserves and effective output, our E&P sector achieved steady growth and better than expected operating results, through promoting technological innovation, scientifically organizing domestic exploration and production activities, furthering unconventional resource exploration and development, and deepening joint E&P in China.

Exploration

With an emphasis on upgradeable and producible reserves, we reinforced preliminary and risk exploration, and rolled out fine exploration in mature areas, resulting in six 100 Mt grade uncompartmented oil zones and six 100bcm grade uncompartmented gas zones in six basins including Tarim, Sichuan and Qaidam. In 2017, we increased 659.45 million tons of proven oil in place and 569.8 billion cubic meters of proven gas in place in China, exceeding 1 billion tons of oil equivalent in total for the 11th consecutive year and sustaining a peak rate of reserve growth.

Reserves and operating data (Domestic)

	2015	2016	2017
Newly proven oil in place (mmt)	728.17	649.29	**659.45**
Newly proven gas in place (bcm)	570.2	541.9	**569.8**
2D seismic (kilometers)	15,909	24,885	**26,813**
3D seismic (square kilometers)	9,095	8,764	**7,843**
Exploration wells	1,588	1,656	**1,773**
Preliminary prospecting wells	924	865	**986**
Appraisal wells	664	791	**787**

Major Discoveries

Oil exploration won new achievements

- Five oil-rich areas and two prolific blocks were discovered, and two 100 Mt grade oil zones, Huachi-Nanliang and Jiyuan, were identified in the Ordos Basin.
- Commercial oil and gas flows were obtained at multiple wells from upper Wuerhe Formation in the Junggar Basin, adding 200 million tons of probable and possible reserves and marking another strata series for reserve replacement in the Mahu area.
- Two 100 Mt grade oil zones were identified in the Songliao Basin, one of conventional oil reserves in the north and one of tight oil reserves in the south.
- A number of large-scale oil zones were discovered in Tarim, Qaidam and Bohai Bay Basins.

Natural gas exploration achieved significant progress

- In the Tarim Basin, three new gas-bearing structures were discovered and proved at the Kuqa Depression, namely Keshen-24, Dabei-11, Bozi-3; high-yield oil and gas flows were obtained from the Tudong-2 well at the northern Kuqa tectonic belt, unveiling new opportunities to tap these Jurassic reservoirs.
- Three 100bcm grade gas zones were identified at Sulige South Block I, Shenmu and Lower Paleozoic of the eastern ancient uplift in the Ordos Basin.
- In the Sichuan Basin, high-yield gas flows were obtained from Xingtan-1 well of Leikoupo Formation in the southwestern part of the basin; new discoveries in Weiyuan and Zhaotong Blocks added 156.5 billion cubic meters of proved shale gas reserve.
- A new gas-bearing belt was discovered in the Altun Mountains in the Qaidam Basin.
- A number of exploration wells at Dinan uplift yielded commercial gas flows, opening up new areas of high-efficiency gas exploration in the Junggar Basin.

Crude production (Domestic) | 102.54 mmt

Natural gas production (Domestic) | 103.3 bcm

Development and Production

Domestic oil and gas production saw balanced running in 2017. Thanks to heightened management and technological progress, the company was able to reduce costs and boost efficiency through overall planning, innovative production models and pad drilling. Throughout the year, our oil and gas production reached 184.82 million tons of oil equivalent.

Crude Oil

In 2017, we stepped up production management in key oilfields and continued to optimize development program and output structure. We highlighted efficient capacity building, maintained a focus on reservoir fine description, waterflood optimization and redevelopment of mature fields, and major field experiment. In 2017, our newly installed capacity for crude oil was 11.61 million tons and the crude output was 102.54 million tons.

Daqing Oilfield continued to roll out tertiary recovery, achieving improved development efficiency and yielding 34 million tons of crude throughout the year. Changqing Oilfield achieved overall improvement in productivity and development efficiency through strengthening fine waterflood and deploying applicable technologies such as reservoir stimulation, horizontal well drilling and SRV fracturing. The yearly production of crude oil was 23.72 million tons. Liaohe Oilfield put over 1,300 new wells into production to boost production capacity. Daily output of new wells hit a ten-year high, thanks to wider adoption of SAGD technology.

Annual output of Changqing exceeded 50 million tons of oil equivalent for the 5th consecutive year

Chanqing Oilfield produced 53.16 million tons of oil equivalent in 2017, including 23.72 million tons of crude oil and 36.9 billion cubic meters of natural gas, marking the 5th consecutive year of achieving an annual output of above 50 million tons since 2013. Over the past five years, Changqing produced a total of 120 million tons of crude oil and 183.7 billion cubic meters of natural gas, i.e. 268 million tons of oil equivalent.

Changqing Oilfield, located in the Ordos Basin, became operational in 1970s, featuring hard-to-tap tight reservoirs with low permeability, low formation pressure and low hydrocarbon abundance. Over the years, we have developed a series of technologies and technical packages for large-scale highly efficient development of the tight reservoirs, making Changqing China's fastest-growing oilfield in recent 10 years in terms of reserves and production. Changqing yielded over 20 million tons of oil equivalent for the first time in 2007, and this figure soared to over 50 million tons in 2013. Now Changqing boasts China's largest oil and gas field.

In recent years, Changqing has been facing challenges caused by continuous decline in reservoir quality and increasing pressure of investment and cost control amidst lower oil prices. The oilfield has managed to address difficulties in stabilizing production by continuously adjusting and improving its exploration and development approaches. Leveraging an elaborate and efficient approach to exploration, Changqing contributed 49% of CNPC's total newly proven oil in place in 2017. Annual crude output has been maintained at about 24 million tons for several years through deploying injection-extraction control and zonal injection, and improving tertiary recovery. The recovery factor of major gas fields has been enhanced, thanks to refined well management by optimizing intermittent production strategy and extensive use of dewatering gas recovery technology.

Changqing Oilfield's sustained and stable high production is underpinned by technological innovation. SRV fracturing of horizontal wells enabled efficient development of tight reservoirs. Pad drilling of large well group increased the average ROP by 50% and reduced the average drilling cycle by 27 days for horizontal wells. EOR techniques such as bridge-type concentric zonal water injection helped increase the recovery percentage of waterflooded reserves by 2.8%, reduce the rate of natural decline by 0.6% and increase the recovery by 5%. The use of a range of techniques, such as sidetracking of horizontal wells, stratum review and bridge-plug gas lift for dewatering gas recovery, increased the yearly gas output by more than 1.7 billion cubic meters. IT technology and tools are thoroughly utilized, building Changqing into a "digitalized oilfield" featuring unmanned workstations and intelligent production and management.

Pilot Development

In 2017, we achieved positive progress in strategic succeeding technologies such as polymer-surfactant flooding, in situ combustion and CO_2 flooding, etc.

Polymer-surfactant flooding tests made significant headway in surfactants development, formulation optimization and study of emulsification mechanisms, as evidenced by an increase of approx. 19% in oil recovery at the Jin-16 Block of Liaohe Oilfield, marking the next-generation EOR technology after ASP flooding which has been proved successful in Daqing Oilfield. In-situ combustion tests at Du-66 Block of Liaohe Oilfield and Hongqian Block of Xinjiang Oilfield achieved favorable results in heavy oil recovery at mid-late development stage. Gas-assisted gravity drainage was tested at the Donghetang oilfield in the Tarim Basin, resulting in a drop of water cut growth rate from 4.5% to -0.4% and substantial rebound of production. CO_2 flooding, as an integrated process of CCS-EOR, is expected to enhance oil recovery by more than 10%.

Natural Gas

In 2017, our four major gas zones, Changqing, Tarim, Southwest and Qinghai, reported sustained growth in natural gas output, thanks to flexible adjustment of production according to the production-sales dynamics and seasonal change as well as improvement in capacity building and production management pattern, featuring big well clusters, multiple layers, diversified well patterns, pad drilling and three dimensional development.

Throughout the year, CNPC built up new capacity of 13.4 billion cubic meters and produced 103.3 billion cubic meters, an increase of 5.2 billion cubic meters year-on-year.

Changqing Oilfield, China's largest natural gas production base and a reliable source for the Shaanxi-Beijing Gas Pipelines, yielded 36.9 billion cubic meters in 2017, over one-third of CNPC's total domestic production. Tarim Oilfield produced 25.3 billion cubic meters of natural gas in 2017, thanks to accelerated implementation of key projects in Kuqa area, such as high-efficiency development of natural gas, and efficient development of carbonate gas fields, and key capacity building programs in Keshen and Tazhong. Gas production of Southwest Oil and Gas field reached 21 billion cubic meters, standing above 20 billion cubic meters for the first time. Qinghai Oilfield managed to maintain steady production in mature blocks and ramp up production in new areas, as a result of synergy in enhanced gas recovery and capacity building measures. Progress was made in natural gas development in the Songliao Basin. Gas production grew steadily in the Daqing, Jilin and Huabei oilfields.

Gasi Oilfield in Qinghai Province

Exploration and Development of Unconventional Oil and Gas

CNPC has made remarkable progress in the exploration and development of unconventional oil and gas in recent years. As a number of production blocks and pilot development bases put into operation, our unconventional oil and gas output continued to grow. The year 2017 saw new achievements in exploration of coalbed methane, shale oil/shale gas and tight oil/tight gas, accelerated capacity building and wider application of innovative key and supporting technologies.

Shale Gas

Leveraging an integrated approach to exploration and development, we produced 3 billion cubic meters of shale gas in 2017, with production capacity expanding as planned. Our shale gas exploration activities in Edong area of Shaanxi province led to new breakthroughs, showing an attractive outlook in that area. Shale gas E&P in the southern part of the Sichuan Basin continued to roll out, with newly added proven reserve of 156.5 billion cubic meters. The demonstration projects in Changning-Weiyuan and Zhaotong speeded up, with a substantial increase in both premium reservoir discovery rate and output per well. The bottleneck projects of Ning-201 dehydration unit, link line of Ning201-209 blocks and Ning-209 central station became operational. A 110km-long shale gas trunk line became operational, which serves as an export channel to deliver a maximum of 4 billion cubic meters of shale gas annually from Changning Block in Sichuan and Zhaotong Block in Yunnan, playing a significant role in ensuring the supply of clean energy in Sichuan and Chongqing. Neijiang-Dazu and Rongchangbei shale gas projects made positive progress.

CBM

Significant headway was made in CBM exploration and development with focus continuously on the Qinshui Basin in Shanxi and Edong Gas Field in Shaanxi, and expanding new areas. In Xinjiang, exploration of CBM made tangible progress. Tectonic pattern and coalbed distribution characteristics of the Houxia Block were basically clear; geological understanding of the Hoxtolgay Block was cleared upon the completion of two exploration wells; the Wucaiwan region showed a potential reserve of 1 trillion cubic meters, with five CBM-bearing areas being identified. A range of measures for revitalizing mature fields were effective, as evidenced by high production maintained at Baode Block and output decline controlled at Hancheng Block. The yield and efficiency of high-coal-rank wells in the Qinshui Basin were enhanced and the low-coal-rank beds in Changzhi, Linfen and Erlian areas were developed efficiently, thanks to innovations in CBM development theories and drainage and production techniques. Capacity building and pilot production activities were implemented steadily in new blocks, including Mabidong, Daning-Jixian, and Jiergalangtu. Joint projects went on smoothly in Shilouxi, Sanjiao, Chengzhuang. We produced 1.79 billion cubic meters of coalbed methane in 2017.

Tight Oil/ Gas

Large-scale development of tight oil and gas continued in the Ordos, Sichuan, Songliao, Qaidam and Santanghu basins. At Changqing Oilfield, main technologies for developing I+II+III strata have taken shape, and three horizontal well SRV fracturing test blocks and three pilot development areas for tight oil production have been in place and saw remarkable increase in the per-well output. At Xinjiang Oilfield, profitable development was promoted further in the Mahu Sag and progress was made in production capacity evaluation in the Jimsar Sag. At Daqing Oilfield, 10 of its 14 tight oil test blocks were completed and went on stream, capable of producing 200,000 tons per year. In Shanxi Province, tight gas exploration activities reported major breakthroughs at the Daning-Jixian Block, and high yield gas flows were obtained from a number of test wells in the Hedong and Hexi areas, especially DJ 5-6 Well block had a daily output above 1.7 million cubic meters. Additionally, we strengthened application of CO_2/sand dry fracturing and large-displacement fissure control SRV fracturing, resulting in increased tight oil/gas production and profits.

Joint E&P in China

In 2017, we continued to work with our partners to explore and develop oil and gas resources in China, with a focus on low-permeability reservoirs, heavy oil, shallow-water reservoirs, sour gas, high-temperature high-pressure gas reservoirs, coalbed methane and shale gas.

By the end of 2017, we had 35 joint E&P agreements in execution, producing 2.49 million tons of crude oil and 9.3 billion cubic meters of natural gas, totaling 9.86 million tons of oil equivalent.

Zhaodong Oil Project

The project covers 77 square kilometers at the tidal and shallow water zone in the Bohai Bay Basin. New XCL-China LLC. and Australia's ROC Oil (Bohai) Company are our partners. In 2017, the project continued to maintain stable and safe operation, producing 480,000 tons of crude oil. Three new wells were completed and two yielded more than 300 tons per day during well testing.

Changbei Natural Gas Project

Changbei block covers an area of 1,691 square kilometers in the Ordos Basin and operates under an agreement with Shell Group. In 2017, the project produced 3.7 billion cubic meters of natural gas, sustaining a stable production of over 3.3 billion cubic meters for nine consecutive years, and delivered 3.6 billion cubic meters to market, with its commercial gas sales totaling 40.8 billion cubic meters on a cumulative basis by the end of 2017. The phase II project has made important progress and is expected to deliver natural gas in wintertime in 2018.

South Sulige Natural Gas Project

Located in the Ordos Basin, the South Sulige block covers an area of 2,392 square kilometers and operates under an agreement with French energy company Total S.A. In 2017, the project's natural gas production and commercial gas sales amounted to 2 billion and 1.9 billion cubic meters respectively, with a daily output soaring up to more than 6.4 million cubic meters.

Chuandongbei Natural Gas Project

Located in the Sichuan Basin, the project covers an area of 876 square kilometers and operates under an agreement with Chevron. In 2017, the project's natural gas production grew steadily, delivering 1.8 billion cubic meters of purified gas.

Chuanzhong Natural Gas Project

Located in the Sichuan Basin, the project covers an area of 528 square kilometers and operates under an agreement with American EOG Resources. In 2017, the project produced 230 million cubic meters of natural gas, with daily output doubled from 0.5 million cubic meters at the beginning of year to 1 million cubic meters at the year end, thanks to continuous technological optimization and improvement. Meanwhile, measures were taken to streamline management and control drilling investment and lifting cost, facilitating the low-cost development of the project.

Neijiang-Dazu and Rongchangbei Shale Gas Projects

The projects cover an area of 1,477 and 990 square kilometers in the Sichuan Basin respectively. BP is our partner and CNPC acts as the operator during the exploration period for the first time. In 2017, the two projects completed a total of 100 square kilometers of 3D seismic data processing and interpretation. Four exploration wells spudded successively and the first horizontal well was completed at the year end, with the reservoir discovery rate of 100% and maximum drilling depth of 3,500 meters.

In addition, the Da'an project in cooperation with MI Energy Corporation and Global Oil Corporation (GOC), Hainan-Yuedong project in cooperation with Tincy Group Energy and Zhoushisan project with Hong Kong-based Central Asia Petroleum achieved better development efficiency, dropping natural decline rate and water cut growth rate of mature wells and stable formation pressure, thanks to technical solutions such as fracture-network fracturing, waterflooding optimization and huff-and-puff steam stimulation. Joint CBM projects saw steady progress, with Sanjiao project in cooperation with Orion Energy and Chengzhuang project with Greka Energy producing 80 million and 90 million cubic meters of coalbed methane in 2017 respectively.

Crude output from joint E&P projects

2.49 mmt

Natural gas output from joint E&P projects

9.3 bcm


中国石油
V-0304

Natural Gas and Pipelines

After separating its pipeline and sales units, the company's natural gas and pipeline business gained new momentum in 2017, with pipeline operation optimized, pipeline construction projects implemented smoothly and a double-digit increase in gas sales volume.

Pipeline Network Operation

In 2017, we ensured safe, stable and efficient operation of our oil and gas pipeline network by improving resource allocation, optimizing centralized control and promoting an "Intelligent Pipeline" and "Smart Network" approach. A total of 22 compressor units were put into operation along the Third West-East Gas Pipeline, Zhongxian-Wuhan Pipeline and Shaanxi-Beijing Pipeline, etc., boosting gas delivery capacity significantly. In particular, the gas pipelining capacity in western China increased by 30% from the previous year. In 2017, the company's long-distance pipelines delivered more than 100 billion cubic meters of natural gas for the first time.

By the end of 2017, CNPC-operated oil and gas pipelines in China totaled 85,582 kilometers, including 20,359 kilometers for crude oil, 53,834 kilometers for natural gas and 11,389 kilometers for refined products, 68.9%, 76.2% and 43.2% of China's total respectively.

New Storage and Transportation Facilities

The company's pipeline construction projects advanced steadily, adding 4,806 kilometers to the existing domestic network. The Zhongwei-Jingbian connecting line of the Third West-East Gas Pipeline, Fourth Shaanxi-Beijing Gas Pipeline, and Yunnan Refined Products Pipeline went on stream. The upgrading of the pipeline system in northeastern China was completed. The Jinzhou-Zhengzhou Refined Products Pipeline reached the final stage of construction.

Zhongwei-Jingbian Connecting Line of the Third West-East Gas Pipeline

The Zhongwei-Jingbian connecting line of the Third West-East Gas Pipeline runs from Zhongwei in Ningxia to Jingbian in Shaanxi, in parallel to the Zhongwei-Jingbian Line of the Second West-East Gas Pipeline, with a total length of 377 kilometers. Designed with a diameter of 1,219mm and operating pressure of 12 MPa, the pipeline has a capacity of 30 billion cubic meters per year.

The pipeline began to be constructed on May 21, 2016, and became operational on November 27, 2017, providing another important route linking the northwestern to the northern China and bolstering effectively the gas distribution capability in North China.

68.9%

Crude pipeline mileage in the nation's total

76.2%

Natural gas pipeline mileage in the nation's total

Fourth Shaanxi-Beijing Gas Pipeline

The Fourth Shaanxi-Beijing Gas Pipeline, comprising of one trunk and one branch, runs from Jingbian in Shaanxi through Inner Mongolia and Hebei to Beijing with a total length of 1,098 kilometers. Designed with a diameter of 1,219mm and operating pressure of 10-12 MPa, the pipeline has a capacity of 25 billion cubic meters per year.

The pipeline started to be constructed on July 30, 2016 and became operational on November 27, 2017 to meet the growing gas demand in North China, facilitate the transformation of the energy mix in the Beijing-Tianjin-Hebei Metropolitan Region and help improve air quality.

Yunnan Refined Products Pipeline

The pipeline, comprising of three trunks and one branch, has a total length of 950 kilometers and an annual delivery capacity of 7.21 million tons.

Construction of the pipeline started on May 18, 2012. The three trunks were put into operation on December 22, 2017 to facilitate the transportation of refined products in Yunnan and expand the company's refined products distribution network in southwestern China. The Kunming Branch has completed the construction for changing route and is expected to become operational in 2018.

Natural Gas Sales

In 2017, the central government explicitly demanded an increase of natural gas share in the primary energy consumption and identified natural gas as one of the main sources of clean energy. As gas-fired power generation continued to gain traction, local governments promoted the coal to natural gas switch, and the "2+26 Cities" Clean Winter Heating Initiative was implemented actively in Beijing, Tianjin and Hebei etc., the demand for natural gas soared. The company seized the opportunity to work 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 and winter heating needs. Our gas sales rose significantly to 151.8 billion cubic meters in 2017, up 15.5% year-on-year.

We continued to develop the market and expand our marketing network. By the end of 2017, our gas distribution network covered 31 provinces, municipalities, autonomous regions, and special administrative regions, maintaining predominance in the northern, southwestern, western, central and northeastern parts of China and enlarged market size in the eastern and southern regions. We secured a total of 93 new clients adding gas sales of 2.46 billion cubic meters. In particular, we began to deliver natural gas to 12 gas-fired generators including Jiangsu CHD Yangzhou Power Plant and CDT Jiangyan Gas-Fired Cogeneration Project.

In 2017, our end-user markets of natural gas grew rapidly, registering gas sales of 23 billion cubic meters, up 5.26 billion cubic meters or 29.6% year-on-year. In particular, the sales of city gas, CNG and LNG reached 15.92 billion, 2.77 billion and 4.34 billion cubic meters respectively. By the end of 2017, we had 543 CNG stations and 615 LNG stations in operation, among the top in China.

Liquefied Natural Gas (LNG)

In 2017, our three LNG terminals in Jiangsu, Dalian and Tangshan offloaded a total of 10.42 million tons of LNG, up 84.3% year-on-year, playing an increasingly important role in peak shaving. Our 24 LNG plants in Hubei, Sichuan, Shaanxi and other provinces are capable of liquefying 22.86 million cubic meters of natural gas per day, with annual LNG capacity accounting for about one-fifth of China's total.

The Fourth Shaanxi-Beijing Gas Pipeline under construction

Refining and Chemicals

The company continued its good performance in refining and chemicals sector in 2017 by pushing ahead with a range of measures for business transformation and upgrading, production scheduling and optimization of processing plans and product portfolio. Production activities went on in a steady and balanced manner throughout the year and contributed significantly to the company's overall growth in profits.

We continued to optimize the allocation of resources in favor of revenue-generating refining facilities. By reasonably matching primary and secondary processing loads, ours integrated refining-petrochemical plants and efficient chemicals facilities operated at high utilization rate. In 2017, we processed 152.45 million tons of crude and produced 103.51 million tons of refined products and 5.76 million tons of ethylene domestically.

We continued to optimize product portfolio with output of high-value refined products accounting for more than 50%. High-grade gasoline production came close to 9 million tons; jet fuel production exceeded 10 million tons; the production of heavy-components oil products decreased by 225,000 tons; and the diesel/gasoline ratio was further reduced.

Crude runs (Domestic) 152.45 mmt

Refined products output (Domestic) 103.51 mmt

Refining and chemicals operating data (Domestic)

	2015	2016	2017
Crude runs (mmt)	151.32	147.09	**152.45**
Utilization rate of refining units (%)	84.5	80.9	**80.8**
Refined products output (mmt)	103.69	99.32	**103.51**
Gasoline	36.47	33.97	**40.98**
Kerosene	8.34	9.32	**10.18**
Diesel	58.88	52.03	**52.35**
Lub oil output (mmt)	1.21	1.16	**1.64**
Ethylene output (mmt)	5.03	5.59	**5.76**
Synthetic resin output (mmt)	8.32	9.20	**9.40**
Synthetic fiber output (mmt)	0.07	0.06	**0.06**
Synthetic rubber output (mmt)	0.71	0.76	**0.81**
Urea output (mmt)	2.57	1.90	**1.44**
Synthetic ammonia output (mmt)	1.85	1.53	**1.36**

Sichuan Petrochemical

Construction and Operation of Large Refining & Petrochemical Bases

In 2017, to achieve stable and efficient operation, we improved production management and reasonably arranged load of crude processing to minimize production fluctuation and improve long-term operation. Overall, 99.57% of our refining and petrochemical facilities operated at steady state, and 20 technical and economic indicators were improved significantly.

Major refining and petrochemical construction projects made headway smoothly. The 13 Mt/a refining facility at Yunnan Petrochemical was successfully put into commissioning and remained steady running for four months by the end of the year. Upgrading and expanding projects proceeded smoothly toward the tubing works at Huabei Petrochemical and Liaoyang Petrochemical. The integration project at Guangdong Petrochemical, reconfiguration project at Daqing Petrochemical and ethane, LNG and light hydrocarbon projects at Changqing and Tarim Oilfields advanced as planned.

Upgrading of Refined Products

Refined products upgrading schemes gathered pace in a bid to improve air quality in polluted regions, especially Beijing, Tianjin and Hebei. According to the national regulations, i.e. motor fuels should meet National V Standard, starting from January 1, 2017 and motor fuels sold in "2+26 Cities" should meet National VI Standard before the end of September 2017, we took the initiative to boost output of high-grade gasoline and diesel by adjusting production plans, replacing and upgrading refining facilities.

Development of New Chemicals

In response to changes in the market, we sped up R&D efforts of new chemical products, delivering 70 new brands of polyethylene, polypropylene and synthetic rubber and other products in 2017, with a total production of 1.14 million tons. Direct sales to key customers expanded, with the rate of direct sales increasing by 3 percentage points year-on-year. High-value products saw an 18% increase in sales volume. In total, we sold 27.98 million tons of chemical products throughout the year. A number of new products were successfully launched, including Dushanzi Petrochemical's metallocene linear polyethylene, Sichuan Petrochemical's low-melt anti-shock polypropylene, and Daqing Petrochemical's PERT pipe materials.

Marketing and Sales

In 2017, we took a lean marketing approach to bolster profitability by upgrading sales network, deepening "Internet + Marketing" and promoting an integrated marketing framework for refined products, fuel cards, non-fuel business and lubricants.

Sales of Refined Products

The year 2017 saw a sustained refined products glut in the overcrowded domestic market. We sold 114.16 million tons of refined products, up 1% year-on-year, by optimizing resource allocation, linking production and marketing closely, expanding gasoline sales and stabilizing diesel sales.

Marketing Network

We continued to make headway in expanding and optimizing marketing network to enhance marketing capacity. In 2017, 463 of our newly built 623 service stations were completed and put into operation, adding 3.79 million tons to our retailing capacity. By the end of 2017, we had 21,399 service stations in operation across the country.

Under an integrated marketing framework for refined products, fuel cards, non-fuel business and lubricants, we further broadened the service offerings of our service stations with a focus on fuel card, and promoted cross-sector cooperation and joint marketing efforts. Centered on the promotional theme of "Four Seasons" and various brand campaigns, we issued 22,420,000 Kunlun fuel cards and various products cards in 2017. Meanwhile, our online customer base and business volume expanded rapidly through our WeChat Official Account, third-party payment and retail APPs. Joint campaigns with SAIC Motor, China Bank of Communications, Alipay, JD.com and other partners continued to gain momentum. The "3+1" model (managed services, accountability, asset leasing + brand franchising) was adopted to address the issue of low-performing gas stations in terms of sales and profitability.

uSmile convenience store in service station

Non-fuel Business

Non-fuel business, with convenience stores as the carrier, saw steady growth in both sales and earnings. In 2017, we newly opened 1,438 "uSmile" stores, bringing the total number to 19,338. Earnings of our "uSmile" stores were approx. 30% more than the previous year. There was a rapid growth in a range of activities, such as own-brand products, kitchen engineering, in-app purchase platform and auto service network, etc. Meanwhile, we explored business opportunities in fertilizer, advertising and fast food. We partnered with the Charoen Pokphand Group to launch the fast food brand "uSmile Chia Tai" and opened 30 new outlets. In 2017, our non-fuel business generated RMB 18.6 billion in revenue, up 29.2% year-on-year.

Sales of Lube Oil

By integrating our channel resources, leveraging on technical and service strengths and targeted marketing, we sold 1.43 million tons of lubricants in 2017, an increase of 260,000 tons. Sales of high-value products such as automotive lubricants, automotive fluids and marine lubricants showed noticeable growth in both absolute and relative terms. In particular, automotive fluid sales soared up to 120,000 tons, up 188% year-on-year.

Sales of Miscellaneous Refined Products

The sales of our miscellaneous refined products recorded a historical high of 33.90 million tons in 2017, an increase of 540,000 tons from the previous year. We sold 8.53 million tons of asphalt, 1.41 million tons more than the previous year and taking a 28% share in the domestic market, number one among the players. And the sales to end-users accounted for 59% of the total, up 42% year-on-year, marking a record high.

Overseas Oil and Gas Operations

Leveraging the opportunities presented by the Belt and Road Initiative, our overseas oil and gas operations expanded steadily in 2017 and saw a number of new cooperation agreements signed. Our overseas investments were further optimized, bringing our international presence to the next level. Major discoveries were announced in main overseas exploration areas. Many key projects became operational. So far, we have oil and gas investments in 38 countries worldwide.

CNPC's share in overseas crude production

68.80 mmt

CNPC's share in overseas natural gas production

25.5 bcm

Exploration

Pursuing a low cost strategy, our overseas exploration activities in 2017 proved very fruitful as we took steps to curb high-risk investment-intensive exploration, focus on readily producible quality reserves and guide exploration funds to key areas and key projects. These activities resulted in newly added recoverable reserves of 90.93 million tons of oil equivalent, including 62.80 million tons of crude oil and 35.3 billion cubic meters of natural gas.

Major discoveries in key areas led to greater than expected total amount of newly proved reserves. In Brazil, a world-class uncompartmented oil prospect was confirmed by deepwater exploration in Libra, identifying 1.56 billion tons of oil in place and 500 million tons of recoverable reserves in the Northwest. Extended well testing resulted in first oil. In Turkmenistan, exploration activities at the right bank of Amu Darya identified large-scale replacement areas and new breakthroughs were achieved in the central and eastern tectonic belts.

A number of high-quality, readily producible reserves were identified through progressive exploration. High yield oil flows were obtained from exploration wells from buried-hill basement and new discoveries were made in the P Formation in the Bongor Basin of Chad. Three new reservoirs were discovered in the Agadem oilfield in Niger. Exploration activities in the Andes Block T in Ecuador proved fruitful. Progressive exploration at the Daleel Oilfield in Oman led to an increase in reserves. High yield and oil enriched reservoirs were discovered at Block 6 in the Sufyan sag in Sudan. In Kazakhstan, detailed prospecting resulted in a number of discoveries in the South Turgai Basin and significant progress was made at the Precaspian Central Block and presalt of the Zhanazhol Oilfield. In Iraq, deep-zone exploration resulted in new breakthroughs in the Halfaya Oilfield.

Production

In 2017, our overseas projects achieved steady growth in oil and gas production by aligning workload schedules with oil price trend and development benefits, optimizing waterflooding measures at matured fields, bringing in new wells and speeding up key projects. The full-year operating production reached 162.74 million tons of oil equivalent, of which equity production was 89.08 million tons, an increase of 17.2% year-on-year. The operating and equity production of crude oil were 136.18 million tons and 68.8 million tons respectively; and those of natural gas were 33.3 billion and 25.5 billion cubic meters respectively.

Central Asia-Russia: The Phase I of Yamal Project, which is the world's biggest Arctic LNG project and has CNPC's full participation in the operation, was completed and put into production with the first shipment launched successfully. In Kazakhstan, Aktobe project won the bids of two exploratory blocks of Teresken I and II, with a total area of approx. 4,500 square kilometers. In Turkmenistan, the Amu Darya natural gas project remained highly productive by bringing in new wells and well stimulation; four compressor units became operational at the Saman-Depe Gas Field as part of the first phase of the EGR Project; the second phase was under construction and expected to enhance the recovery ratio significantly after completion. In Uzbekistan, the first phase of Karakul Gas Field Project, including three fields, went on stream, with a designed capacity to deliver 1 billion cubic meters annually.

Latin America: CNPC Latin America's oil and gas operations remained safe and steady thanks to lean management, deployment of new wells and implementation of stimulation measures. The Libra Project in Brazil started production in November 2017, generating a return alongside investment. The consortium comprised of CNPC, Petrobras and BP won the Peroba exploration block in presalt, deepsea of Brazil, marking another huge deepwater prospect of CNPC following the Libra Project. In Venezuela, the construction of key projects advanced, with new progress achieved in surface engineering of the Phase I 165,000 bbl/d capacity expansion of the MPE3 project, thermal recovery pilot tests at the Junin-4 project, and the 15,000 bbl/d rapid ramp-up for the Zumano Project.

Middle East: CNPC signed a stock purchase agreement with Abu Dhabi National Oil Company to acquire an 8% stake in ADCO onshore concession. The Phase I of Abu Dhabi Al-Yasat project proceeded smoothly and is expected to achieve first oil in the first half of 2018. The Rumaila and West Qurna-1 fields in Iraq saw effective waterflooding and an improvement in production capacity and a continued drop in natural decline through injection-production well spacing optimization and balanced injection. The Phase III of Halfaya Project went on stream ahead of schedule, delivering crude oil at a rate of 250,000 bbl/d. The Rumaila power plant project began to send electricity to local grid. In Iran, the MIS Project restored operation. The consortium by CNPC, Total and a local company signed an agreement with National Iranian Oil Company to develop the South Pars Phase 11 (SP 11) Gas Field.

Africa: CNPC International Nile operated its oilfields in Sudan and South Sudan efficiently by stepping up measures for production management, bringing in new wells and promoting the use of low-cost, proven EOR techniques. In South Sudan, oil and gas production grew steadily in Block 3/7 as a result of dynamic reservoir assessment, optimized well siting and improved stimulation programs. De-bottleneck projects were completed with high quality, boosting fluid handling capacity to 29 Mt/a. New techniques such as gas injection, gas lift and MFCA viscosity reducer were adopted in Block 1/2/4 together with cost-saving drilling solutions. At Block 6 in Sudan, thermal recovery of heavy oil contributed 72% to the total output of FNE Oilfield. In Mozambique, the integrated ultra-deepwater gas E&P and LNG project in Coral Gas Field of Block 4 in the Rovuma Basin was launched. In Chad, the first Daniela CPF train for the Phase 2.2 oilfield surface engineering project went on stream successfully.

Asia-Pacific: In Indonesia, we kept production on schedule by bringing in new wells, tapping potential of old wells and optimizing production processes. In Canada, gas condensate development began at the Duvernay tight oil and gas field, thanks to continuous optimization of drilling and completion design and investment; the Phase I MacKay River oil sands project saw 42 pairs of horizontal wells in production using steam-assisted gravity drainage (SAGD), with daily production peaking at 11,000 bbl. In Australia, the Arrow PTL project saw the fuel gas system for compressors upgraded and put into operation.

Pipeline Construction and Operation

In 2017, we maintained safe and stable operation of the long-distance cross-border pipelines, including the Central Asia-China Gas Pipeline, Myanmar-China Gas Pipeline, Russia-China Crude Pipeline and Kazakhstan-China Crude Pipeline. By the end of 2017, CNPC operated 16,500 kilometers of overseas oil and gas pipelines, including 8,597 kilometers for crude oil and 7,903, kilometers for natural gas, which transported 33.47 million tons of crude and 47.6 billion cubic meters of gas throughout the year.

Key overseas pipeline projects advanced steadily. The Myanmar-China Crude Pipeline and Second Russia-China Crude Pipeline became operational. The north section of the Eastern Route of Russia-China Gas Pipeline fully started construction. The Line D of Central Asia-China Gas Pipeline was kicked off. Two compressor stations along the Phase II Kazakhstan-China Gas Pipeline (the South Kazakhstan section) became operational, boosting the pipeline capacity to 10bcm/year. The Grand Rapids pipeline in Canada started oil transportation, delivering approx. 100,000 tons of crude oil per month.

Myanmar-China Crude Pipeline

The Myanmar-China Crude Pipeline starts at Maday Island in Kyaukphyu in Myanmar, enters China at the border city of Ruili in Yunnan province and terminates at Yunnan Petrochemical in Kunming. The pipeline has a total length of 1,420 kilometers, including 771 kilometers in Myanmar and 649 kilometers in China, with a designed annual capacity of 13 million tons. The pipeline kicked off in June 2010 and became operational on April 10, 2017. Crossing big rivers for many times along the route, the pipeline construction is faced with tough operation and control challenges such as height difference, high operating pressure and multi U turns. In particular, the difference of height is up to 1,500 meters when crossing the Nujiang River, making the pipeline one of the most complicated liquid pipelines in the world. As China's fourth energy import channel following the Central Asia-China Pipelines, Russia-China Crude Pipeline and Maritime Route, the Myanmar-China Oil and Gas Pipelines represent an important achievement of energy cooperation between the two countries.

Second Russia-China Crude Pipeline

The Second Russia-China Crude Pipeline starts at Mohe in Heilongjiang, crosses Inner Mongolia, and ends at Daqing in Heilongjiang. In parallel to the existing Russia-China Crude Pipeline, it has a total length of 932 kilometers, pipe diameter of 813mm, designed pressure of 9.5-11.5 MPa, and designed annual capacity of 15 million tons. The pipeline started to be constructed on July 20, 2016 and became commercially operational on January 1, 2018. Under the agreement between CNPC and Rosneft on the increase of oil supplies, Rosneft will deliver another 15 million tons of crude oil to China every year through the Second Russia-China Crude Pipeline.

Oil tanks under construction in Maday Island, Myanmar

Refining and Chemicals

In 2017, our overseas refineries operated in a safe and steady manner and processed 45.78 million tons of crude throughout the year. In Kazakhstan, the Phase I upgrading project at the Shymkent Refinery went on stream. The refinery's sour oil processing capacity was significantly improved and it was able to produce vehicle fuels in compliance with the Euro IV and Euro V standards; the Phase II project was halfway through the construction plan and expected to start production in the second half of 2018. In Sudan, the takeover in the Khartoum Refinery was completed smoothly and a technical service agreement was signed. The N'Djamena Refinery in Chad and Zinder Refinery in Niger completed production plans successfully, and actively explored markets.

Project Cooperation and Development

In 2017, CNPC's overseas oil and gas cooperation continued to deepen and expand. The cooperation between CNPC and many countries, especially those along the Belt and Road routes, was fruitful and a range of cooperation agreements were signed with the governments and energy companies of Russia, Kazakhstan, Uzbekistan, Azerbaijan, Mozambique, and Abu Dhabi, etc.

In Central Asia-Russia, CNPC and Gazprom signed a number of agreements, including the supplementary agreement to gas sales and purchase contract via the Eastern Route, the MOU on strategic cooperation between CNPC, CCCC, Gazprom and Russian Highways in using LNG as vehicle fuel for trunk road transport, the MOU between CNPC, Gazprom and China Huaneng Group on cooperation in gas-fired power generation. In addition, CNPC signed an agreement with Rosneft on establishing a joint coordinating committee, and an agreement with Novatek on strategic cooperation.

CNPC and KazMunayGas signed an agreement on promoting the renovation of the Shymkent Refinery and an MOU on the export of Kazakhstan gas to China. CNPC and the Energy Ministry of Kazakhstan signed an MOU on the extension of petroleum contracts.

CNPC and Uzbekneftegaz signed a supplementary agreement to the sales and purchase contract between the two companies, an MOU on underground gas storages in Gazli, and an agreement between CNPC, Bank of China and Uzbekneftegaz on financing loan for New Silk Road projects.

CNPC and the State Oil Company of the Azerbaijan (SOCAR) signed an MOU between CNPC, China Development Bank and SOCAR on cooperation in investment and financing for natural gas chemical projects in Azerbaijan, an MOU on oil and gas cooperation, and the FEED/OBCE contract for natural gas chemical projects in Azerbaijan.

In the Middle East, CNPC and Abu Dhabi National Oil Company (ADNOC) signed an agreement on equity purchase of Abu Dhabi's ADCO onshore oil concession. Under this agreement, CNPC is awarded an 8% interest in the project for a contract term of 40 years and an 8% stake in Abu Dhabi Company for Onshore Petroleum Operations (ADCO). In addition, the two sides signed an MOU on strengthening cooperation in oil and gas blocks, gas field development, and construction of oil storage facilities. CNPC, Total and an Iranian company formed a consortium and signed an agreement for gas development and production of Phase 11 of South Pars (SP11) with National Iranian Oil Company (NIOC).

In Africa, we deepened cooperation with ENH Mozambique. The two sides signed a range of cooperation agreements, covering oil and gas exploration and development, oilfield services, engineering construction, refining and chemicals, and logistics.

In Asia-Pacific, CNPC signed an agreement with Myanmar on crude oil pipeline transportation, and an MOU with Pertamina on deepening oil and gas cooperation outside China and Indonesia.

In addition, CNPC and Eni signed an agreement on cooperation in E&P, natural gas and LNG, trade and logistics, refining and chemicals areas. CNPC and Cheniere Energy signed an MOU on long-term LNG sales and purchase, to strengthen LNG cooperation in the Gulf of Mexico and facilitate long-term sales and purchase of LNG between the two countries.

Shymkent Refinery in Kazakhstan

International Trade

In 2017, we continued to boost international trade and overseas futures business in crude oil, refined products, natural gas and petrochemicals while bolstering our three oil and gas operation hubs in Asia, Europe and the Americas. Our overseas marketing network grew steadily to reach more than 80 countries and regions around the globe, including basically all of the world's major oil and gas producers and consumers. In 2017, we reported trading volume of 470 million tons, worth USD 184.4 billion, up 4.4% and 30.6% year-on-year respectively.

We continued to optimize crude oil imports and sales of overseas equity oil by leveraging our trade resources globally. We pushed ahead with importing crude oil from western Kazakhstan and Russia to reduce the procurement costs of our refineries. We ensured the timely supply of crude oil to Yunnan Petrochemical for the start of production through the Myanmar-China Oil Pipeline. We promoted the sales of overseas equity oil and made positive progress in the Americas. We completed blended oil sales for the first time in Canada and moved forward with the presales of equity oil of the Libra Project in Brazil and the import of equity oil from the Americas.

We adapted agilely to adjustments in refined products export plans and traded on the Platts benchmark oil trading window, exporting 12.63 million tons of refined products in 2017. While working on traditional markets such as Myanmar, Sri Lanka, Vietnam, Indonesia, Malaysia, the Philippines and Pakistan, we made significant headway in exploring the Australian and Japanese markets.

Our natural gas business saw advances in the negotiations on major projects between Central Asia-China, Russia-China and Myanmar-China, and LNG import. We signed a one-year sales and purchase agreement and the long-term cross-border pipeline transmission agreement with Kazakh counterpart, and an MOU on long-term LNG sales and purchase with Cheniere Energy. In view of soaring gas demand during the winter, we bought LNG on the spot markets to increase the domestic supply.

As for chemicals, we actively developed overseas resource markets and increased methanol and ethane imports to provide "lighter" feedstock for domestic petrochemical enterprises. Leveraging basis trading, we expanded PTA spot sales and yielded good results.

Our marine shipping business gained relatively good returns by optimizing fleet routes and cargo allocation, despite the sagging freight rates. We expanded time chartering of LNG carriers and very large crude carriers (VLCC) and optimized structure of fleet capacity to enable coordinated development in both scale and quality. Furthermore, we stepped up vessel inspection and anti-piracy security measures to ensure safe transportation.

Overseas Operation Hubs

Our three overseas operation hubs in Singapore, London and New York bring together trade, processing, transportation and warehousing capabilities to improve our capabilities in global resource optimization. In 2017, we continued to expand the marketing network and bolstered the three overseas operation hubs, with an emphasis on the Belt and Road markets.

The Singapore hub streamlined its trade and logistics processes and accomplished sales of equity oil from UAE, Iraq and Iran. As to marketing of refined products, our market share climbed to above 14% in Australia and 32% and 45% in Myanmar and Sri Lanka respectively. As the largest jet fuel supplier of the Hong Kong Airport, we took a 43% share in Hong Kong's retail market in 2017. For the first time, gasoline and aromatics from our joint venture refineries in Europe were sold to the Middle East and Singapore. Refined products, chemicals and LNG saw a growing market in Australia, Japan and the Taiwan region. Our investment project advanced smoothly. The clean gasoline and cogeneration project at Singapore Refining Company went on stream, the oil storage tanks in Myanmar were duly registered, and the sales network building projects in the Philippines and Australia progressed well.

The London hub managed to sell equity oil from Kazakhstan, Sudan and Chad to the Mediterranean region. We were awarded refined product sales contracts in the Baltic region, Lithuania and Ireland, enabling a bigger presence in Europe. Our joint venture refineries in UK and France remained steady with continuous improvement in profitability.

The New York hub introduced innovative trade mode, accomplishing the financing and oil sales for the MPE3 project in Venezuela. The hub successfully sold refined products from our refineries in the Americas to North America, South America and Europe, expanding its market share in these regions. In Brazil, the retail network project progressed well and we reached agreement with Total (Brazil) on the key terms for buying stake in its refined products retail network. When finalized, this deal will give CNPC a stake in nearly 2,000 filling stations selling gasoline, diesel and ethanol fuel in Brazil.

Service Business

In 2017, by leveraging our advantages in integrated operation and specialized services, our service business continued to expand in terms of market share and operation performance. Competitiveness and profitability were brought to the next level as we actively explored market opportunities in oilfield services, engineering construction, equipment manufacturing, and financial services.

Oilfield Services

In 2017, we saw a remarkable increase in the workload completed, market expansion at home and aboard and a growing market share, driven by streamlined business processes, new business models, buoyant EPC activities, innovative technologies and enhanced productivity and quality. By the end of 2017, we had 5,007 crews providing services in geophysical prospecting, drilling, well logging, mud logging, downhole operation and offshore engineering in 51 countries around the world.

Geophysical Prospecting

In 2017, we deployed 150 seismic crews (71 2D and 79 3D) in 289 projects, acquiring data on 154,904 kilometers of 2D lines and 57,182 square kilometers of 3D profiles. With 100% acceptance for both on-site data acquisition profiles and final data processing profiles, the recorded shots per day of domestic onshore 3D surveys increased by 4.3%.

In view of the technology trends and the requirements in both domestic and international exploration markets, we stepped up R&D of core software and equipment and promoted the extensive use of our proprietary devices and packaged technologies, including the GeoEast and KLSeis II geophysical data processing solutions, EV56 high-precision vibroseis, LFV3 low-frequency vibroseis, G3i wired seismograph and eSeis node system, as well as "wide azimuth, broadband and high density" technology and high-productivity blended shooting acquisition techniques. As a result, we saw rapid productivity and competitiveness gains and steady progress in our geophysical prospecting service projects at home and abroad. In particular, the high-productivity blended shooting acquisition techniques proved successful at the PDO project in Oman, enabling more than 20,000 shots per day.

We refocused on overseas high-end markets and won a number of bids such as the integrated onshore 3D survey project in west Kuwait, a deepwater 3D survey project for BP, and a seismic survey project in the Sahara desert. In addition, we were awarded the contract to conduct the first-ever Z100 node system-enabled acquisition survey in Tomori, Indonesia. In data processing and interpretation, we won a five-year open contract from Kuwait National Petroleum Company and a contract for the Saudi Aramco's S78 Phase III (Farshah) project. Our deepwater fleet became the world's largest towed streamer 2D seismic service provider, claiming a 51% worldwide market share. After expanding into six new markets, i.e., Kyrgyzstan, Somaliland, Canada, Egypt, Cuba and Morocco, we made new progress in the United Arab Emirates, Ghana, Egypt, Indonesia and Morocco.

Geophysical prospecting operations

	2015	2016	2017
Seismic crews in operation	166	165	**163**
Domestic	96	96	**94**
Overseas	70	69	**69**
2D seismic data acquired (kilometers)	132,714	162,684	**154,904**
Domestic	22,521	35,919	**30,644**
Overseas	110,193	126,765	**124,260**
3D seismic data acquired (square kilometers)	47,219	58,120	**57,182**
Domestic	10,722	10,844	**10,313**
Overseas	36,497	47,276	**46,869**

Drilling

In 2017, our 1,183 drilling crews spudded 11,916 wells and completed 11,687 wells, registering a total footage of 25.79 million meters.

We boosted drilling efficiency through wide adoption of EPC services and pad drilling. R&D efforts were ramped up and new techniques were deployed to enhance operating performance and bolster market share and service capabilities. ROP speed-up for deep wells was fruitful, seeing 648 wells deeper than 4,000m drilled, an increase of 121 wells from one year earlier; average depth of 4,922m, up 0.65%; average well construction cycle and drilling cycle reduced by 8.38% and 7.34% respectively; and average penetration rate up to 1,449m per month for each rig, up 9.94%. Pad drilling for tight gas and share gas helped improve efficiency and reduce costs under a "3+3" factory management model. New techniques were developed and promoted, such as hydraulic rotary percussion drilling tools. Particularly, hydroscillator, rotating hammers and other tools helped enhance average ROP by 60% at applied intervels. Geo-steering drilling was widely used in Tarim and Xinjiang Oilfields and achieved good results.

Overseas, we were awarded EPC contracts in Iraq, Kazakhstan and Uzbekistan, date rate-based drilling service contracts in Venezuela, Ecuador and Saudi Arabia, and an offshore drilling service contract from National Iranian Oil Company for the first time.

Well Logging and Mud Logging

In 2017, CNPC deployed 813 well logging crews and completed 101,531 well-times of logging in 18 countries; and 1,436 mud logging crews on 13,187 wells.

In view of the service condition and logging needs in oilfield production, imaging logging was used to evaluate complex reservoirs and maximize production per well. A range of innovative techniques and processes were widely adopted to boost efficiency and reduce costs. EILog express and image logging solutions enabled a significant increase in logging workload; LEAP800 logging system saw wider application; memory express logging techniques were improved, increasing operating efficiency by more than 30%; coiled tubing and tractor conveyance techniques were effectively deployed to save the operation time by 16.7 hours per well; advancements in perforation methods, tools and equipment contributed to integrated solutions for well completion and EOR.

Progress was made in exploring the international markets, as evidenced by a number of important well logging contracts in Iraq, Iran and Sudan and debut in Kuwait.

Drilling operations

	2015	2016	2017
Drilling crews in operation	1,230	1,205	**1,183**
Domestic	979	943	**921**
Overseas	251	262	**262**
Wells completed	9,387	9,328	**11,687**
Domestic	8,389	8,686	**10,807**
Overseas	998	642	**880**
Footage (million meters)	20.89	19.50	**25.79**
Domestic	18.38	17.96	**23.55**
Overseas	2.51	1.54	**2.24**

Well logging operations

	2015	2016	2017
Logging crews in operation	803	797	**813**
Domestic	662	663	**677**
Overseas	141	134	**136**
Well logging operations (well-time)	88,926	79,231	**101,531**
Domestic	83,933	75,591	**96,588**
Overseas	4,993	3,640	**4,943**

Downhole Operation

In 2017, our 1,845 crews completed 110,844 well-times of downhole operations and 9,237 layers of formation testing.

Our downhole operation performance was further improved through intensified R&D and wider application of innovative technologies. Multi-stage fracturing solutions featuring bridge plug, open-hole packer, hydraulic jet and slickwater fracturing proved successful in volume reconstruction. Pad drilling facilitated large-scale development of shale gas and tight oil and gas. Operation efficiency and reservoir stimulation effect were greatly enhanced, thanks to improved factory-like cross operation, zipper operation, continuous blending and continuous sand feed. Coiled tubing operations were used widely and the scale of snubbing operation was expanded. CO_2 dry fracturing techniques were polished through field tests for more than 10 well-times. Cluster-based subdivision fracturing with coiled tubing and bottom packer resulted in significant efficiency gains. Breakthroughs were made for wireless transmission of downhole formation test parameters, enabling a working depth up to 5,000 meters.

Downhole operations

	2015	2016	2017
Downhole operation crews	2,153	1,914	**1,845**
Domestic	1,929	1,676	**1,592**
Overseas	224	238	**253**
Downhole operations (well-time)	128,879	112,643	**110,844**
Domestic	126,062	110,818	**109,006**
Overseas	2,817	1,825	**1,838**
Formation test (layers)	7,782	8,515	**9,237**
Domestic	5,051	5,555	**6,227**
Overseas	2,731	2,960	**3,010**

Offshore Engineering

In 2017, we provided services in offshore drilling, well completion, well cementing, formation test & production test, downhole operation, offshore engineering design and construction in various sea areas including the South China Sea, Bohai Sea and the Persian Gulf. Throughout the year, our six offshore drilling and operating platforms completed a total drilling footage of 18,500 meters, and our 20 vessels travelled 122,756 nautical miles in total.

In particular, as the general contractor of the natural gas hydrate pilot production project in the South China Sea, we addressed world-class difficulties in extracting shallow free gas and sand control for silty-sand reservoirs, ensuring the success of the project. In addition, we won a shallow water drilling project from Iranian Offshore Oil Company.

Engineering and Construction

In 2017, China Petroleum Engineering Co., Ltd. (CPEC), a specialized subsidiary in charge of CNPC's engineering and construction business was publicly listed after restructuring. Leveraging its advantages in specialized services and integrated management, CPEC adopts a work flow featuring standardized design, factory prefabrication, modular engineering, mechanized operation and IT-enabled management. While continuing to build competence in offering intelligent engineering and construction solutions, CPEC is speeding up the shift from an EPC contractor to an integrated service provider.

Tapping into domestic and overseas markets, CPEC was awarded the contracts for the non-proprietary facilities at the Amur Gas Processing Plant in Russia, AKK Gas Pipeline in Nigeria, a single point mooring system and pipeline installation at the Eastern Refinery in Bangladesh, Haradh Gas Pipeline in Saudi Arabia and EPC for integrated facilities at the Bab oilfield in Abu Dhabi. In 2017, CPEC executed 43 projects in surface engineering, storage and transportation, refining and chemicals and environmental engineering.

Surface Engineering of Oil and Gas Fields

In 2017, our surface engineering projects progressed well in key oil and gas fields at home and abroad. A light hydrocarbon recovery unit for condensate gas production was put into operation at the Tarim Oilfield. Modules for the Phase II and Phase III Yamal LNG project were completed, A de-bottleneck project was delivered at Block 3/7 in South Sudan. The Phase I pressure boosting project at the Saman-Depe Gas Field in Turkmenistan and the Phase I Karakul project in Uzbekistan became operational. The renovation project at the Basra Natural Gas Plant in Iraq and the oil field surface engineering project at the Phase 2.2 development in Chad advanced steadily. The Amur Gas Processing Plant in Russia and the Central Processing Facility of Phase III Halfaya Project (CPF3) were kicked off.

Successful pilot production of gas hydrates in the South China Sea

On May 18, 2017, China announced the success of its first attempt to tap gas hydrates in the Shenhu area of South China Sea, a historic breakthrough in extracting gas hydrates.

CNPC has played an important role in the project as CNPC Offshore Engineering Company Ltd. (CPOE) worked as the general contractor of the gas hydrate pilot production project. Leveraging advantages in integrated technical solutions and based on CNPC's expertise in oilfield development, CPOE has tackled challenges such as silty-sand reservoirs, shallow burial depth, low temperature under deepwater, sand producing and secondary hydrate generating, etc., greatly facilitating the smooth construction of the project. Eventually, the project maintained a steady gas output for 60 days straight and produced a total of 309,000 cubic meters, world's records in terms of producing period and yield amount. During project execution, excellent HSE performance was achieved and the marine ecological environment well protected, with 100% wastes regulatory compliant discharged and without any safety, occupational hazard or environmental accident. The successful pilot production marks a solid step forward of CNPC in deepwater operation and demonstrates our technical capabilities in deepwater drilling, well completion and pilot production.

On August 24, 2017, CNPC signed a strategic cooperation agreement with the Ministry of Land and Resources and the government of Guangdong Province on promoting the building of a pilot site for exploring and exploiting gas hydrates in the Shenhu area of the South China Sea. Under this agreement, we will carry out field tests for extracting gas hydrates in a bid to increase output per well, reduce costs, protect the environment and facilitate the commercial production of gas hydrates.

Construction of Pipeline and Storage

In 2017, we made important progress in storage and transportation projects. A number of pipelines became operational, including the Zhongwei-Jingbian connecting line of the Third West-East Gas Pipeline, Fourth Shaanxi-Beijing Gas Pipeline, Yunnan Refined Products Pipeline, Myanmar-China Crude Pipeline, Second Russia-China Crude Pipeline and Majnoon Pipeline in Iraq. The north section of the Russia-China Gas Pipeline (Eastern Route) was under construction. A refined products pipeline was kicked off in northern Thailand. The Haradh Gas Pipeline in Saudi Arabia moved forward as planned. The AKK Gas Pipeline project in Nigeria was implemented. As to storage tank engineering, the refined oil tank farm expansion project at the Fishing Port Terminal in Angola became operational.

Construction of Refining and Chemical Facilities

In 2017, we pushed ahead with refining and chemicals projects steadily. The 13 Mt/a refining plant was successfully put into operation at Yunnan Petrochemical. A number of projects made steady headway, including the 10 Mt/a upgrading project at Huabei Petrochemical, Russian crude processing productivity project at Liaoyang Petrochemical and alkylation project for gasoline upgrading under the National VI standards. Phase I of the Shymkent Refinery upgrading project in Kazakhstan was successfully completed and the Phase II project was under construction. The phosphate project in Saudi Arabia went on stream and the refinery expansion project in Algeria was fully launched.

Environmental Engineering

In 2017, a number of environmental engineering projects were ready for commissioning, including wastewater treatment at Ningxia Petrochemical, emission-reduction at Liaoyang Petrochemical, and flue gas purification at Guangxi Petrochemical. The off-gas treatment at Daqing Petrochemical and VOCs project at Sichuan Petrochemical advanced steadily.

Petroleum Equipment Manufacturing

In 2017, our equipment manufacturing business saw an accelerated shift to the "Manufacturing + Services" model. We continued to promote capacity transfer and international cooperation on capacity building, propel product innovation and industrial upgrading, and improve marketing network. As at the end of the year, CNPC-manufactured equipment and materials were sold to more than 80 countries and regions worldwide.

CNPC's equipment manufacturing business segment is transforming from an equipment manufacturer to an integrated service provider. So far, we have launched the Version 2.0 for ten standardized service packages, i.e. "Electric pump leasing + Integrated services", "Steel pipe sales + Service guarantee", "Drilling rig sales + Integrated services" etc. We achieved a significant increase in the value of service contracts signed throughout the year, which included the contracts on maintenance of power generating units and compressor units in Peru, inspection and overhaul services for refining facilities in Niger, and "Electric pump leasing + Integrated services" in Sudan, South Sudan, Chad, Kazakhstan and Ecuador, etc.

We continued to promote product innovation and technology upgrading to push our products to middle-high end of the value chain. We stepped up R&D and application of new drilling equipment, such as the offshore jack-up drilling system, 4,000m low-temperature rig, 9,000m onshore four single-rod rig, and BHDX high-torque drill rods. Milestones were achieved in the development of X90/X100 high-grade, large-caliber, large-wall-thickness steel pipes. The development of low-temperature pipe materials progressed well. X80 Φ1,422mm SSAW and LSAW steel pipes were used in the Eastern Route of the Russia-China Gas Pipeline. In addition, we continued to promote the use of a range of proprietary equipment, including the 2300-type fracturing vehicles, GX/S dual-track vibrating screens, SEW collapse-resistance casings, and BJC-1 special casings, etc.

International cooperation on capacity building and technology made headway. As one of CNPC's overseas investments, the first large-diameter steel pipe manufacturing facility in Kazakhstan – Asia Steel Pipe Co., Ltd. – was under construction in Almaty and expected to be operational in 2018 with a designed capacity of 100,000 tons per year. We also signed JV cooperation agreements with Schlumberger, Caterpillar and Parker Hannifin on equipment manufacturing, including drilling bits, fracturing pumps, and hydraulic line, etc.

Financial Services

In 2017, our financial service arm CNPC Capital was publicly listed after restructuring. The restructured company holds the most extensive set of financial licenses in the A-share market among central enterprises under SASAC, with business covering in-house banking, banking, financial leasing, trust, insurance, insurance brokerage and securities.

Leveraging an integrated platform, CNPC Capital continued to expand its product offering and customer base, deepen channel and service innovations and mitigate financial risks effectively to bring operating excellence to the next level.

Based on its expertise and strengths, CNPC Capital maintained a healthy level of profitability by aligning financial services with oil and gas business, promoting collaboration between financial institutions, creating an information sharing platform for products, customers and channels, and improving service quality, in order to boost the development of CNPC's core businesses.