



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-planned 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, uncompartimentalized 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.



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 uncompartimentalized 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.

