Geothermal Development in PetroChina's Licensed Oil & Gas Basins: Progress and Projects

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INTRODUCTION: STRATEGIC POSITIONING

PetroChina is an integrated international energy company with businesses covering oil and gas exploration and development, new energies, refining & chemicals and marketing, new materials, support & services, as well as capital & finance etc. PetroChina holds a dominant position in China's oil and gas industry and conducts oil and gas investment in 35 countries and regions worldwide.

Recently, PetroChina has incorporated geothermal energy into its overall clean energy strategy under the national goals of "carbon peaking and carbon neutrality". The licensed oil fields whose exploitation right belongs to PetroChina have been coordinated to establish "Geothermal Heating Demonstration Zones".

In the process of transforming the "oil and gas fields" to "geothermal fields", PetroChina has developed a series of leading technologies in scale application of geothermal heating and completed a number of demonstration projects .

EXPLORATION AND DEVELOPMENT TECHNOLOGIES

In locating and evaluating geothermal resources, PetroChina brings its strengths in the leading technologies in oil and gas industries into full play. By utilizing geophysical methods (magnetic, electrical, seismic exploration, etc.) and geological modelling, deep geothermal reservoir structures, fault zones and distribution ranges can be efficiently identified and targeted.

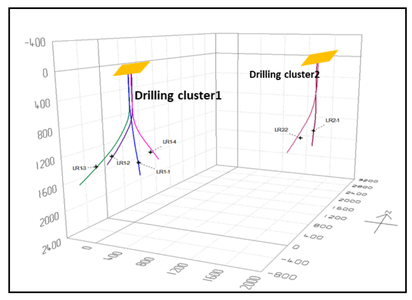
In "extracting" heat from the subsurface, PetroChina also has technical advantages. With its world-leading development and engineering technological capabilities in oil and gas (drilling and completion, acid stimulation, downhole heat exchanger, etc.), PetroChina is able to drill large, high-temperature deep wells (>3000 meters) with its PDC drilling bit, ensuring wellbore quality and long-term stability. The whole geothermal wells are firmly cemented, protecting shallow aquifers without polluting drinking water sources.

With advanced technical support, the geothermal water extraction & injection system and the heating water circulation system operate independently. After heat extraction, the geothermal water is directly re-injected into the original formation, achieving heat extraction without water withdrawal.

Furthermore, power generation and monitoring technologies ensures the "sustainability" and "eco-friendliness" of geothermal development, which PetroChina highly emphasizes.

DEMONSTRATION PROJECTS

Projects	District	Technological Type	Detailed information
Caofeidian Geothermal Heating Project	Undertaken by Jidong Oilfield in Hebei Province	Medium-Low Temperature Geothermal Heating	This is a significant clean heating demonstration project of middle-deep hydrothermal sandstone reservoir. It is reported as the "largest single geothermal heating project in China".
Dachang Geothermal Heating Pilot Project Proposal	Undertaken by Dagang Oilfield in Hebei Province and Tianjin	Shallow Ground-Source Heat Pumps (641 double U-tube exchange wells)	This is the first shallow geothermal project by PetroChina that is selected as a nationally excellent practice case.
Geothermal Heating Project Cluster	Undertaken by Huabei Oilfield in Renqiu, Xianghe County and other areas in the Beijing-Tianjin-Hebei region	Large-Scale Geothermal Heating Project Cluster	The project plan has been approved, marking substantial progress for PetroChina's largest geothermal heating project cluster in the Beijing-Tianjin-Hebei region.



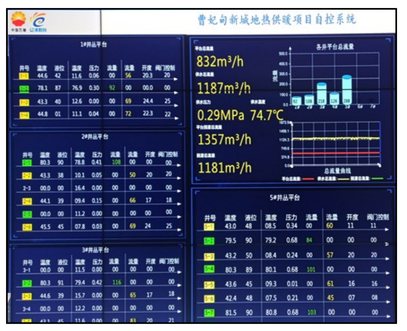
Drilling Layout for Caofeidian



Monitoring Devices



Extraction and Injection System

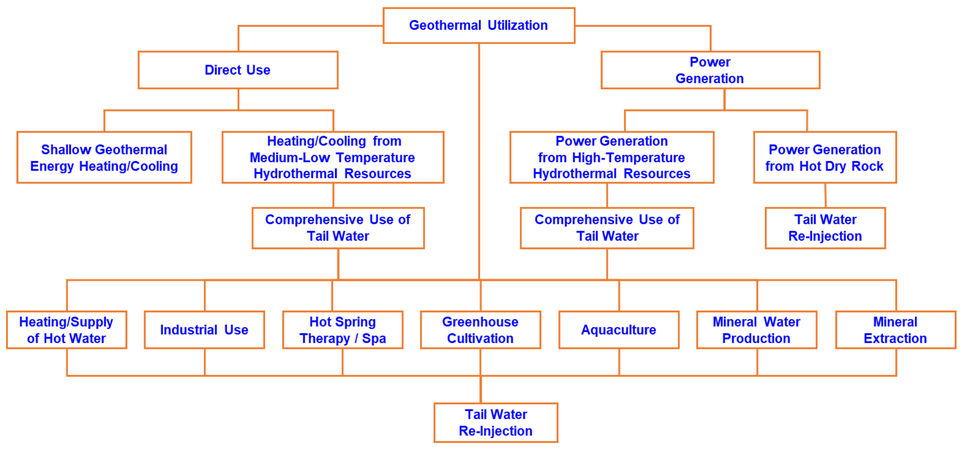


Monitoring Central Panel

Caofeidian Geothermal Heating Project: The schematic design is completed by means of three-dimensional simulation of the geothermal fields, which ensures that the cluster well platform drilling maximizes land resource conservation. With 40 geothermal wells and 7 drilling platforms in total, the temperature, water volume, and dynamic water level remain exceptionally stable. To adjust injection and extraction volumes, all the electric valves and pumps are monitored and managed remotely from a self-controlling system. Currently, geothermal heating in Caofeidian project covers an area of 3.714 million square meters, saving 85,500 tons of standard coal annually and reducing carbon dioxide emissions by 222,000 tons.

DIAGRAM OF PETROCHINA'S ENERGY UTILIZATION

The utilization of geothermal resources can be categorized as the diagram shows. High-temperature geothermal resources (above 150°C) are primarily used for power generation; medium-temperature (90–150°C) and low-temperature (25–90°C) geothermal resources are mainly utilized directly. For shallow geothermal temperatures below 25°C, ground-source heat pumps can be employed for heating and cooling.



PROGRESS AND PLANNING

Based on the specific circumstances of each project, PetroChina adopts tailored business models—including wholly-owned, majority-owned, and minority-stake investments—to ensure construction progress while mitigating operational risks and enhancing investment returns. By 2025, the area covered by geothermal heating (and cooling) has increased by 50% compared to 2020, with a number of demonstration projects of geothermal power generation to be established in regions of better resource conditions. By 2035, the area covered by geothermal heating (and cooling) and the installed capacity of geothermal power generation will be expected to double compared to 2025.



Leaders and CEOs from the Group oversee the overall planning and coordinate all the subordinate departments.

Specialized engineers guide the oilfield companies in expanding their business and provide corresponding supporting policies.

The oilfield companies establish dedicated teams to fully leverage all available resources to advance the development of their geothermal operations.







