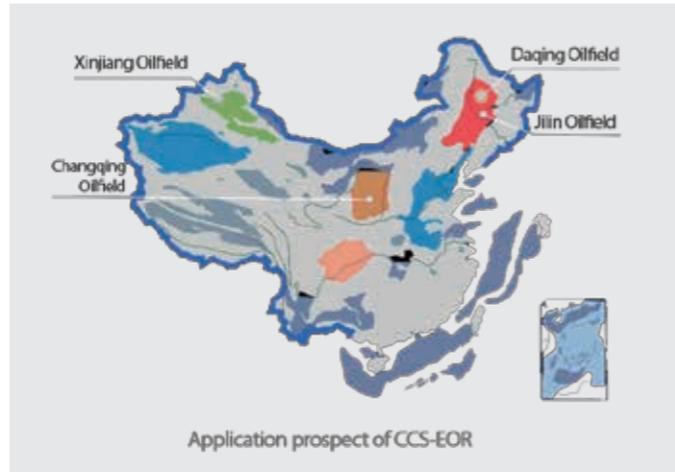


Based on a decade of research, Jilin Oilfield has achieved significant progress in CCS-EOR technology, including natural gas decarburization, miscible mechanism of CO₂ and oil, CO₂ flooding monitoring and dynamic, zonal CO₂ injection, well-bore corrosion control, high-efficiency lifting, long-distance transportation and injection, cyclic re-injection of post-flooded CO₂, analysis and evaluation of CO₂ storage as well as CO₂ flood potential.



In recent years, over 70% of newly discovered reserves in China are from non-marine, heterogeneous and low-permeability reservoirs with average recovery factor less than 20%. Studies show that CO₂ is a suitable medium of oil displacement for such types of reservoir, and can help save a large amount of water use in the beginning of water flood. The success of Jilin Oilfield's CCS-EOR project has set a good example and showed a broad application prospect in China.

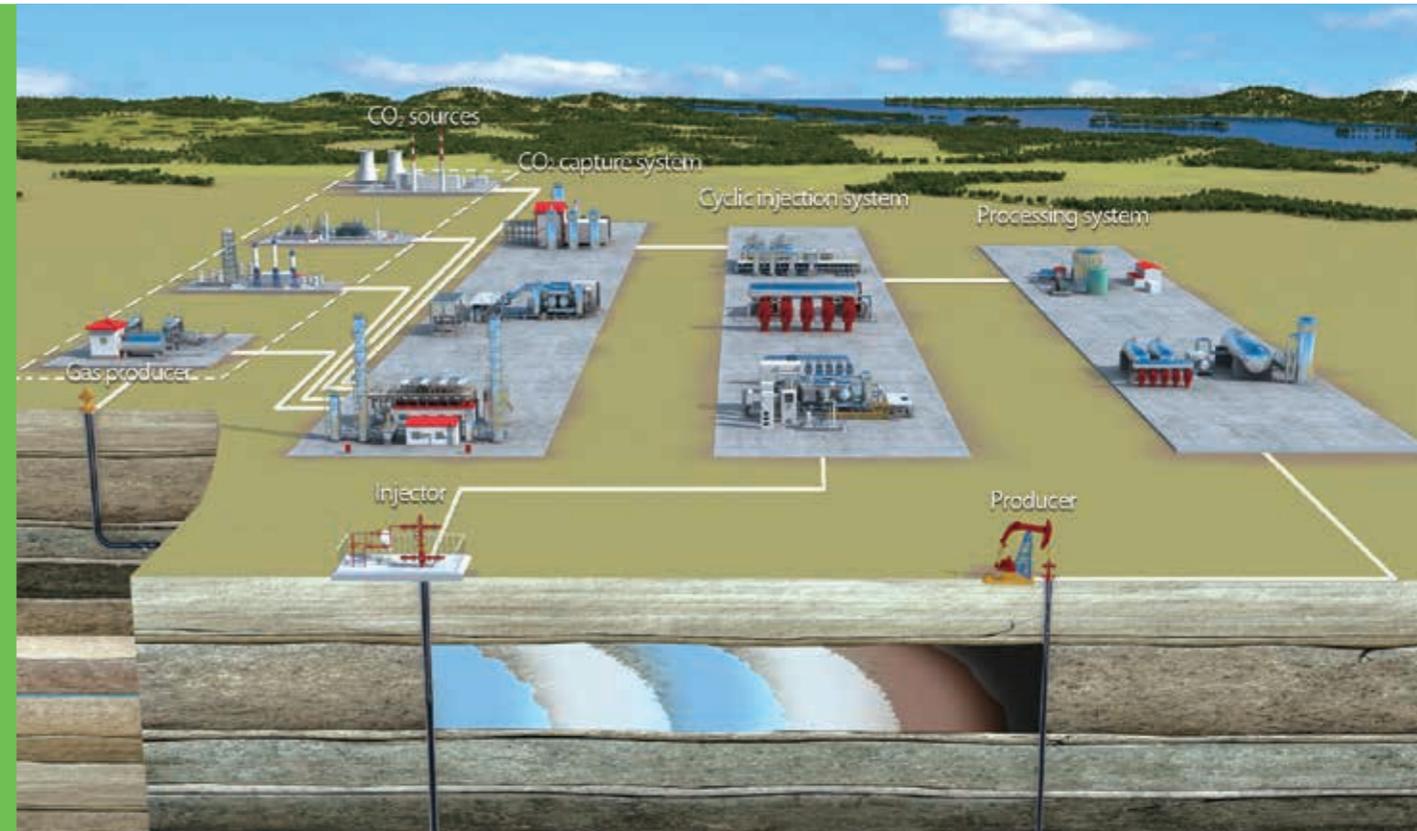
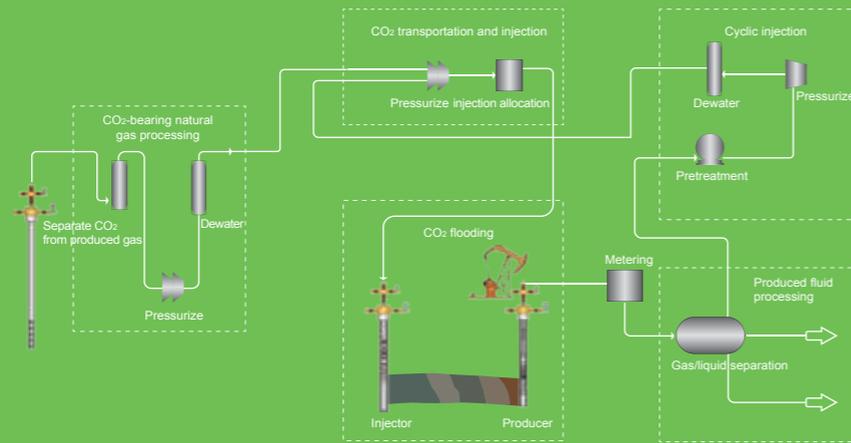


Industrial CCS-EOR in CNPC's Jilin Oilfield

Energize · Harmonize · Realize

CCS-EOR is one of the most realistic approaches to reduce carbon emissions and cope with climate change.

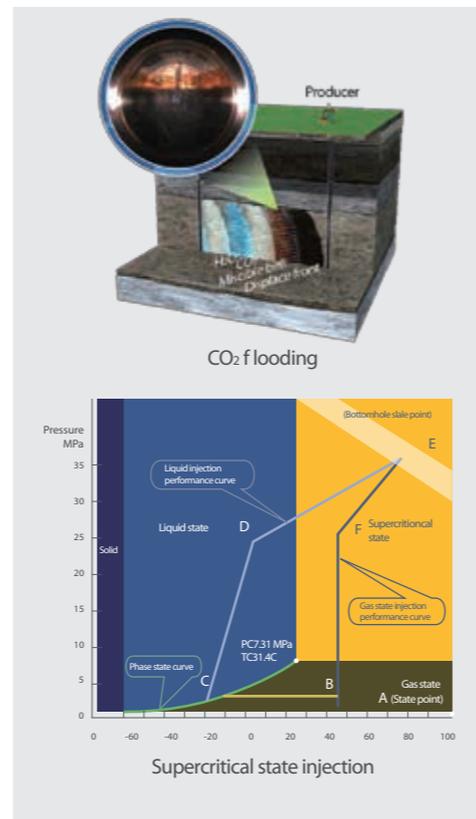
CCS-EOR refers to capturing CO₂ from source gases generated from industry or energy production, injecting CO₂ into reservoirs as displacement media to increase ultimate oil recovery, and storing CO₂ underground so as to realize the dual purposes of carbon emission reduction and oil production increase.



Since 2005, China has initiated comprehensive planning and deployment of CCUS (CCS-EOR) and has listed the technology into its "National Program" as 973 and 863 respectively. CNPC launched research and pilot test of CCS-EOR in Jilin Oilfield in 2007 and has put CCS-EOR into industrial application at 69 well groups. CNPC has also established the State-level CCS-EOR Technology R&D Center and Demonstration Base.

The CCS-EOR project of Jilin Oilfield boasts its unique advantage of CO₂ source about 50 kilometers far from Changling Gas Field, where the CO₂ content of produced gas is 22.5%. Some additional CO₂ is those captured from flue gas of chemical plants such as methanol and fertilizer plants.

- ◆ CO₂ reserves in Changling Gas Field is 12.56 billion cubic meters.
- ◆ 1 billion cubic meters of natural gas can be produced in Changling every year, yielding 200 million cubic meters of CO₂ for EOR use at 45 well groups.



After separation and treatment, the CO₂ is transported through pipelines, pressurized and injected into reservoirs in a super-critical state alternately with water. When CO₂ fully contact with oil at a miscible pressure, a miscible phase can be reached to decrease viscosity and increase mobility of the crude oil. In such a way, more oil can be produced than by water flooding. As the mixed fluid is extracted to the ground, CO₂ is separated and re-injected into the reservoir. By repeating the process circularly, all the CO₂ can be stored and sealed underground permanently.

By April 2017, the CCS-EOR blocks of Jilin Oilfield had witnessed the successful storage of 1.1 million tons of CO₂ with a storage rate over 96%. In average, the oil recovery efficiency is 13% higher than that by water flooding.

