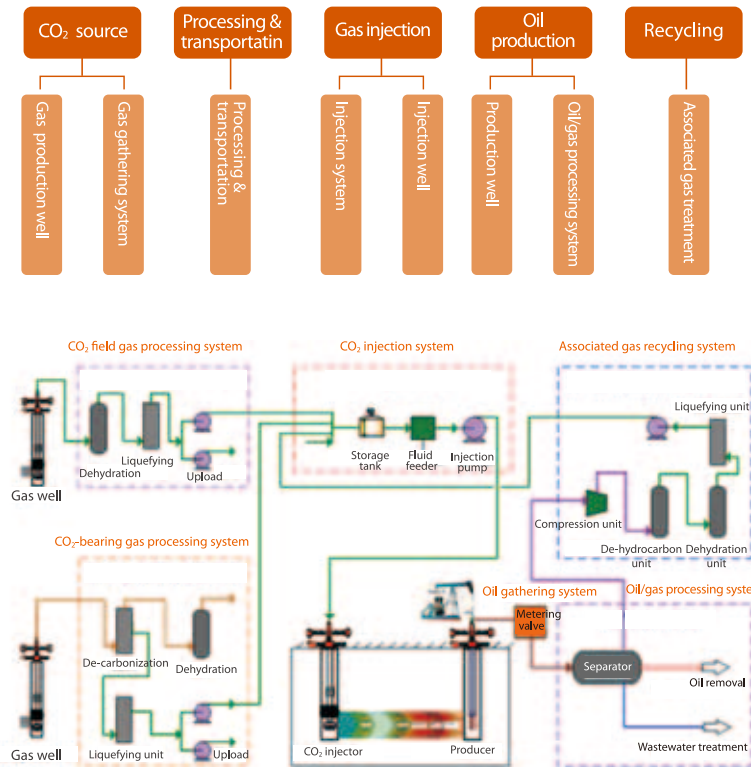


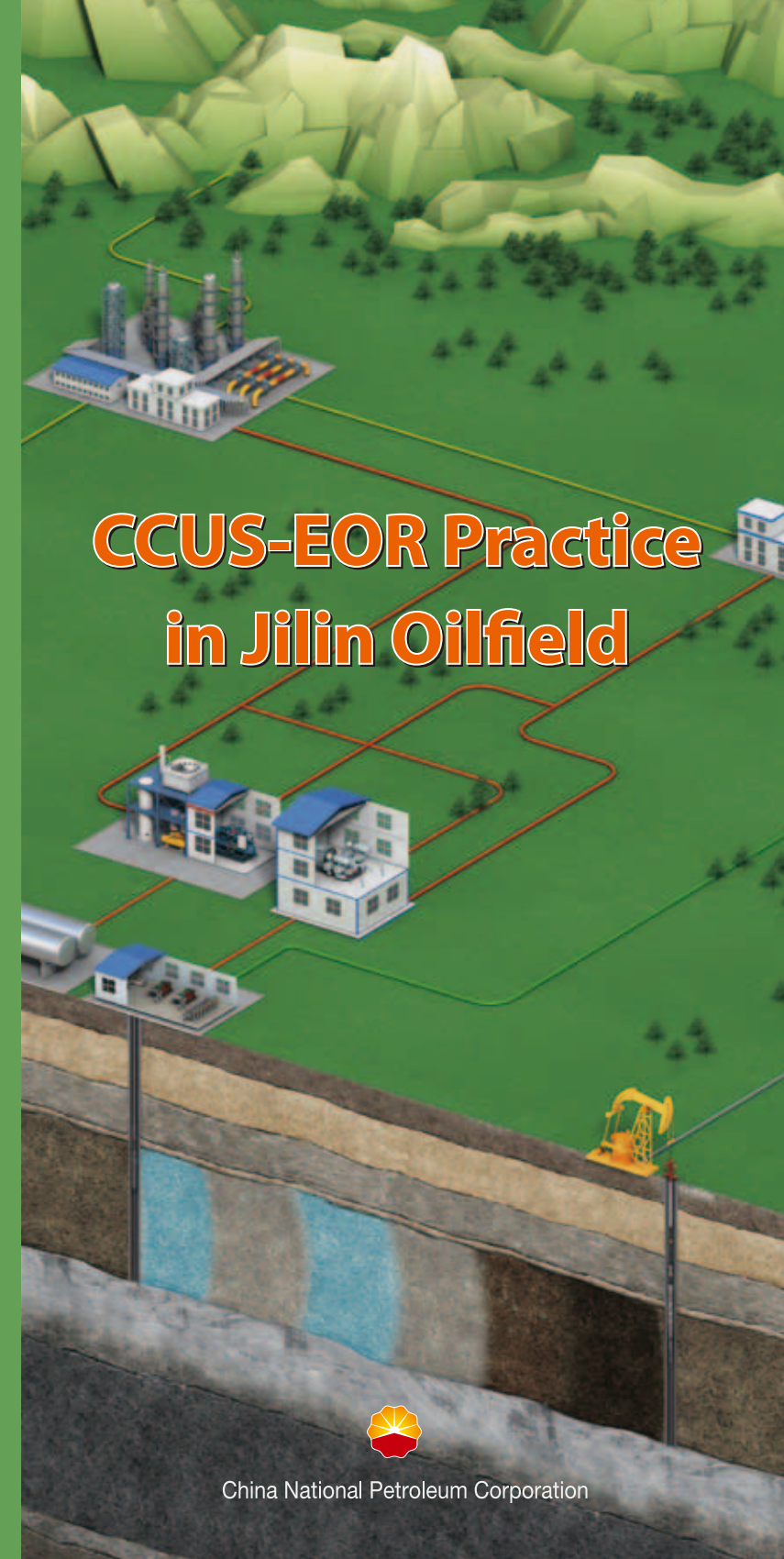
Adancement in CCUS-EOR practice

- Better understanding on CO₂ flooding for low-permeability terrestrial oil reservoirs have been gained.
- Two demonstration areas have been built for safe development of CO₂-bearing gas reservoirs.
- Natural gas production, CO₂ separation, and CO₂ flooding for EOR and carbon storage have been integrated for the first time in China.
- Thirteen unique technologies of three categories have been developed, namely, “Safe development of CO₂-bearing gas reservoirs”, “Enhanced oil recovery and production-reserve ratio of oilfields by CO₂ flooding”, and “Engineering of gathering, transportation, processing, and utilization of CO₂-bearing natural gas” .
- The CO₂-bearing volcanic gas reservoirs in the Songliao Basin are effectively developed with improved economic and social benefits.

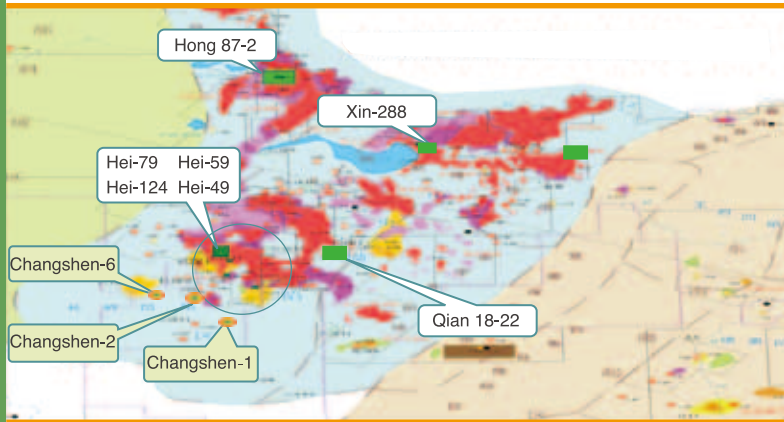
Flowchart of CCUS-EOR process



CCUS-EOR Practice in Jilin Oilfield



Global climate change is endangering the earth's environment that humans depend on for survival. This is why reducing greenhouse gas emissions has become a common concern of the public and a focus by experts in different domains. In the energy sector, to inject CO₂ into oil reservoirs can not only enhance oil recovery but also put these gases in permanent underground storage.



Distribution of CO₂ sources and pilot blocks in Jilin Oilfield

CNPC pays close attention to global climate change and has made due efforts in reducing greenhouse gas emissions. In 2006, we initiated a major research project on CO₂ flooding for EOR and underground storage, and carried out field tests at Jilin Oilfield in the Songliao Basin in Northeast China. The industrial CCUS-EOR test aims at effectively tapping CO₂-rich volcanic gas reservoirs at Changling gas field in the basin, capturing and utilizing produced CO₂ as a drive medium to enhance oil recovery, and meanwhile storing these gases underground in the long run.

CO₂ produced from Changling gas field is transported to nearby oil fields such as Daqingzijing, Daan and Qian'an, and injected into oil reservoirs to carry out field tests of miscible CO₂ flooding and pilot tests of turning from water flooding to CO₂ flooding. Alternative and recycled water and CO₂ injection displaces oil from low-permeability reservoirs and ultimately improves oil recovery, meanwhile realizes geological CO₂ storage and thereby zero CO₂ emissions during the course of oil and gas development.

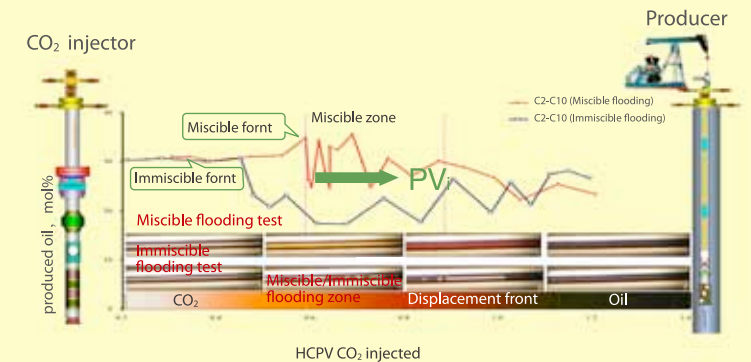
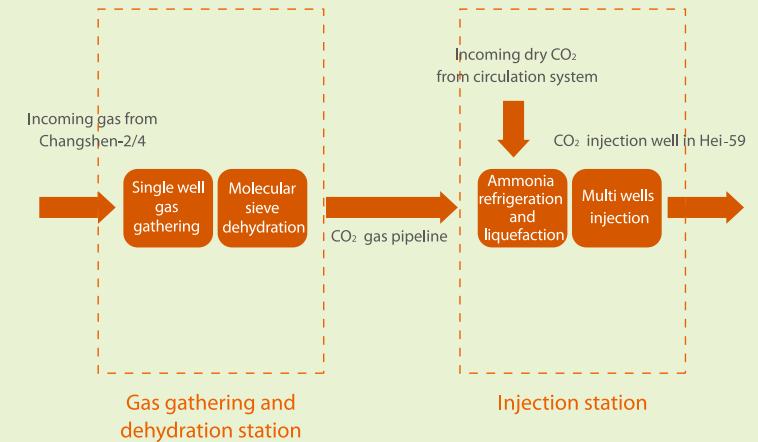
CO₂ source — Changling gas field

- The injected CO₂ is from Changling gas field, which has a CO₂ content of about 22.5%.
- CO₂ reserve in Changling gas field is 12.56 billion cubic meters.
- 1 billion cubic meters of natural gas can be produced and processed every year in Changling field, yielding 200 million cubic meters of CO₂.
- The high CO₂-content natural gas processing plant is expected to be capable of supplying CO₂ for at least 45 well groups.

Field Test for CO₂ Miscible Flooding — Hei-59 Block of Daqingzijing Oilfield



- The injection capacity is 6 times of that of water injection.
- Five well groups of inverse-seven-spot pattern consist of 5 injectors and 19 producers spaced at 440×140 (well spacing × row spacing).
- Injection layers have an average depth of 2,400m.
- A total amount of gas is continuously injected before continuous water injection.
- The recovery rate by CO₂ flooding is 37.1%, expected to be 14.4% higher than that of water flooding.



Mechanism and process of CO₂ flooding

