



中国石油大学(北京)

Challenge and Opportunity for CO₂ -EOR in China

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 3. Challenge and Opportunity for CO₂ Storage-EOR in China
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1.Introduction

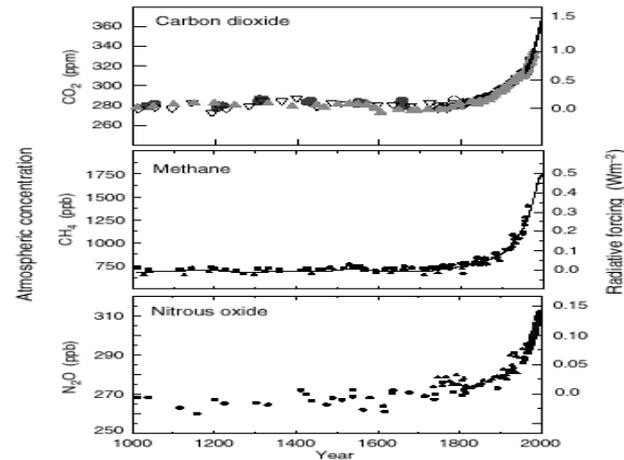
Climate change and green house gas(GHG)



Climate change is the serious problem for human being

Indicators of the human influence on the atmosphere during the Industrial Era

(a) Global atmospheric concentrations of three well mixed greenhouse gases



CO₂ in atmosphere

Before 1800 : 2800ppm

Now: 379ppm

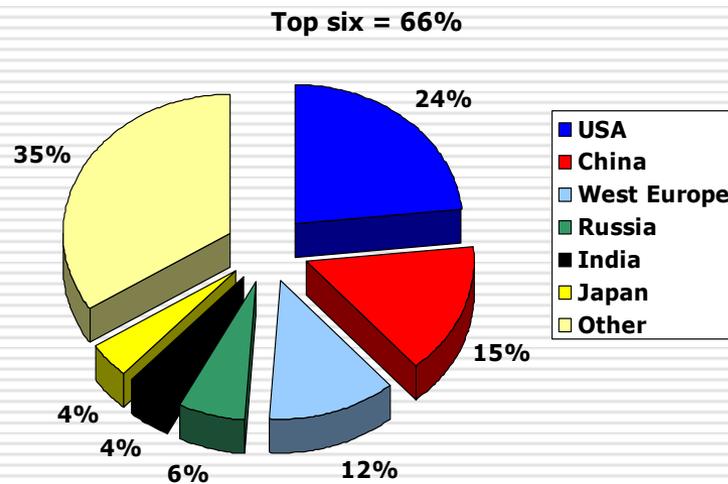
2050: 550ppm



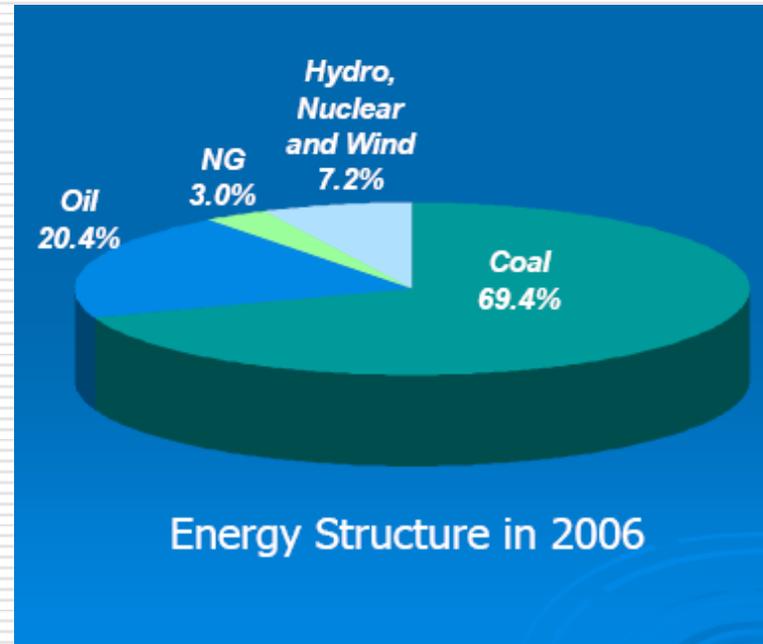
1.Introduction

CO2 emission should be controlled facing climate change

Biggest Emitters 2000-2025



Cumulative CO2 Emissions 2000-2025, EIA, IEA 2002



1.Introduction

New Energy Structure and Lower CO2 Emission

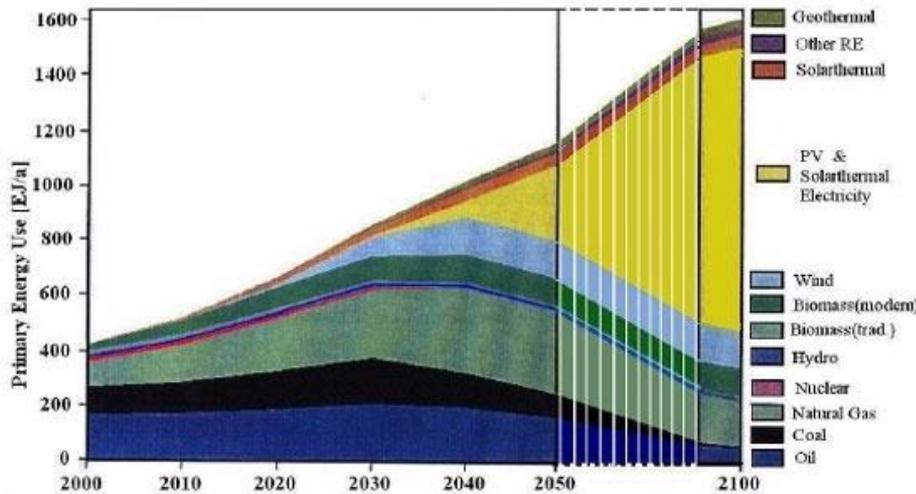
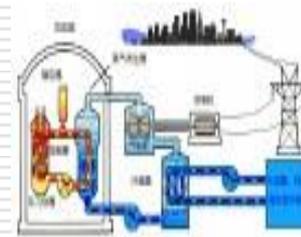


图 2、世界能源发展趋势 (PVNET2003)

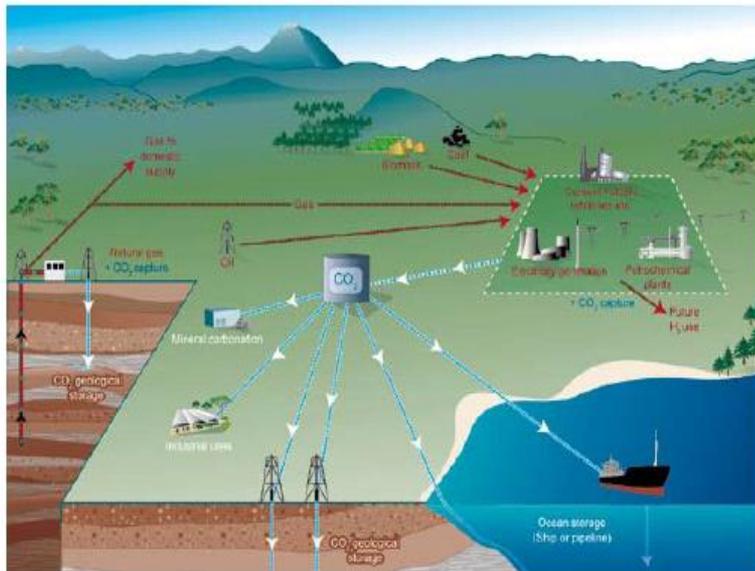


Referring to the simulation results based on an energy system model, if follows today's tendency of energy technology development and energy policy, the fraction of coal in primary energy consumption will decrease after 2015, but still be high: 54.5% in 2030, and 47.2% in 2050. Coal will still be the major primary energy.



1.Introduction

Carbon Capture and Storage is one of necessary and important technology to control CO₂ emission. Chinese Governments, Enterprises,



Activities:

Government: NDRC, MOST, MSR(China Geo-survey), MEP

Coperations: CNPC, SINOPEC, CNOOC, SHENHUA, HUANENG, DATANG, HUADIAN, et al

Universities and Research Institutes



1. Introduction

Laboratory of CO₂ Storage and Enhanced Oil Recovery, CUP
Founded on July, 17, 2008.
BEIJING KEY LABORATORY, JULY, 2012

Object: CO₂ Storage and EOR

Key Major: Petroleum Engineering, Exploration Geology, Applying Chemistry

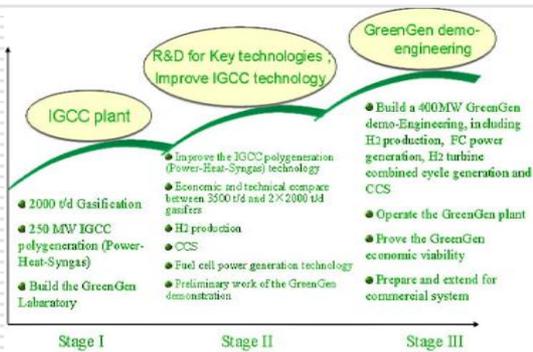
Including: Chemical Engineering (Capture), Transportation; Safety and Security; Economy (Policy and CDM)

Supported by:
State Key Laboratory of Oil Resource
State Key Laboratory of Heavy Oil;
Key Lab of Petroleum Engineering of Education Ministry



2.Chinese Government and Enterprises concerns on CCS

□ CCS Pilot Test in Enterprises



HUANENG, Beijing, Tianjing, shanghai
ZHONGDIANTOU:Chongqing

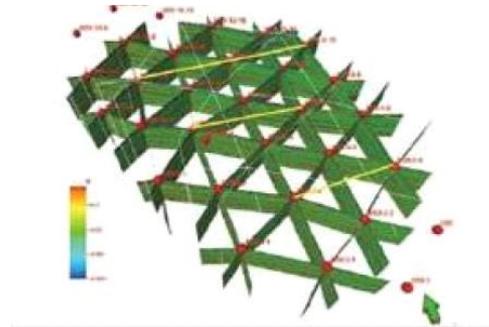


2.Chinese Government and Enterprises concerns on CCS

□ CCS Pilot Test in Enterprises



PetroChina EOR Project



Jilin Oil Field CCS-EOR pilot test block well network design



CNPC:Jilin oilfield(EOR)

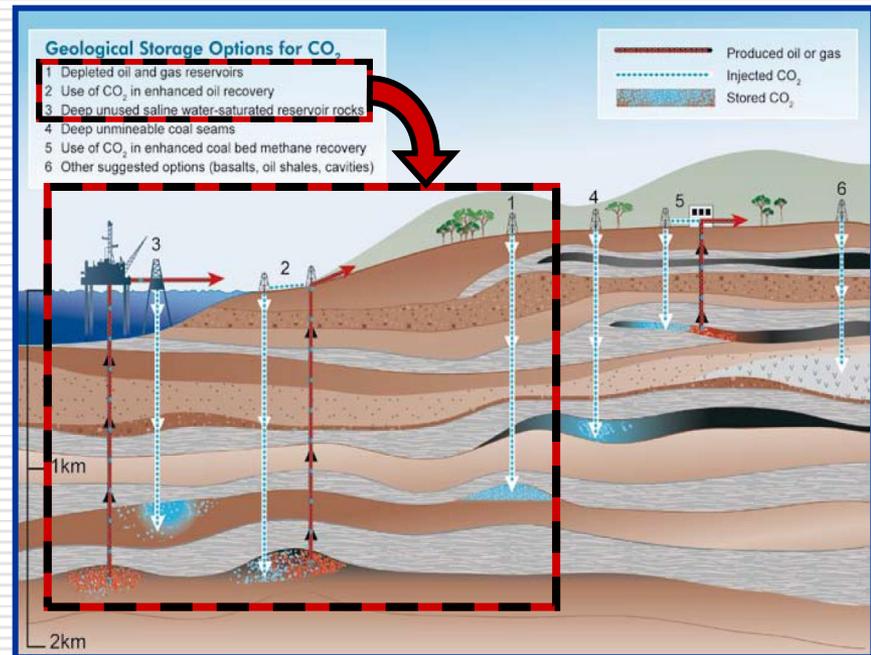
Sinopec: Shenli Oilfield(EOR)

Shenhua:Eldos(Saline)

China United CoalbedMethane
Co:Qinshui Besin(ECBM)

3. Challenge and Opportunity for CO₂ -EOR in China.

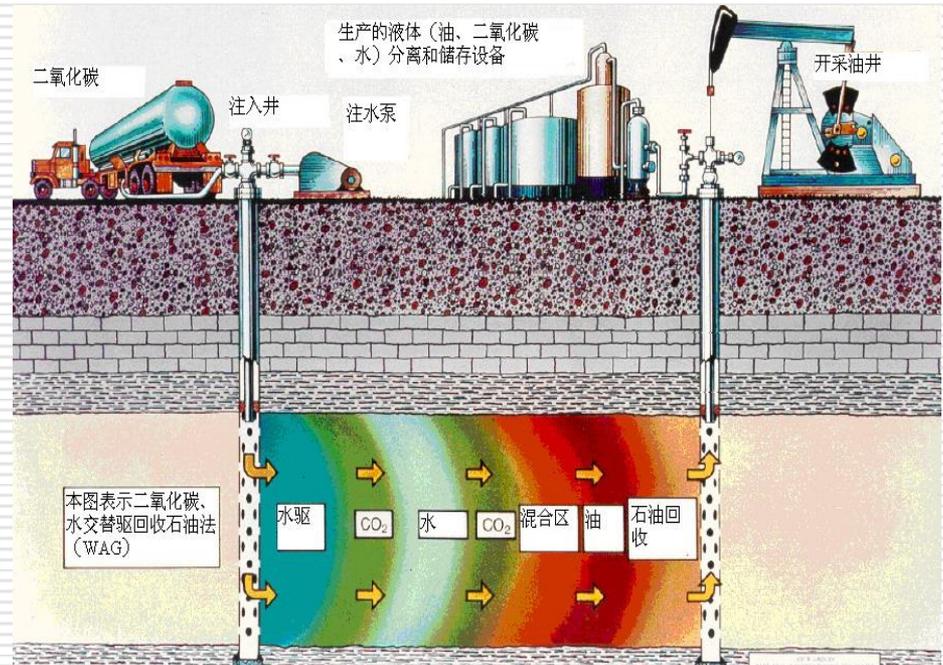
Oil&Gas Reservoir, Subsurface Salaquifer, coal bed, ideal Place for CO₂ Storage
923 billion tons of CO₂ can be stored in reservoir, which is 45% of global cumulative emission in 2050.



3. Challenge and Opportunity for CO2 EOR in China.

- **30% OOIP deposited in the low-permeability reservoirs in China.**
- **2/3 undeveloped oil in place deposited in low-permeability reservoirs ($K < 10\text{mD}$).**
- **Preliminary evaluation result: There are 3.5 billion tons of oil suitable for gas flooding in China. By this production method, 0.35 billion tons of recoverable oil can be enhanced.**

CNPC REPORT



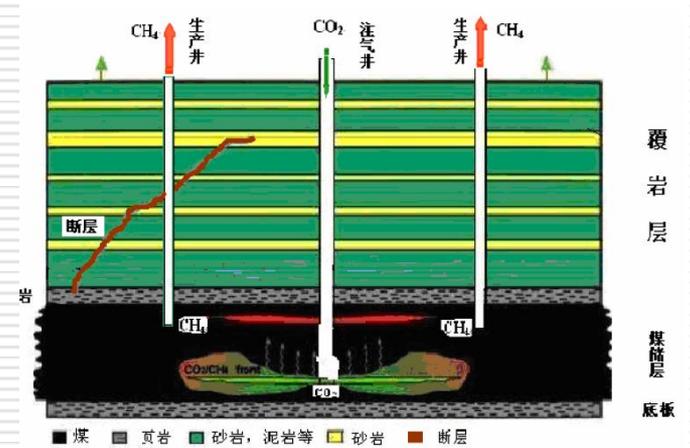
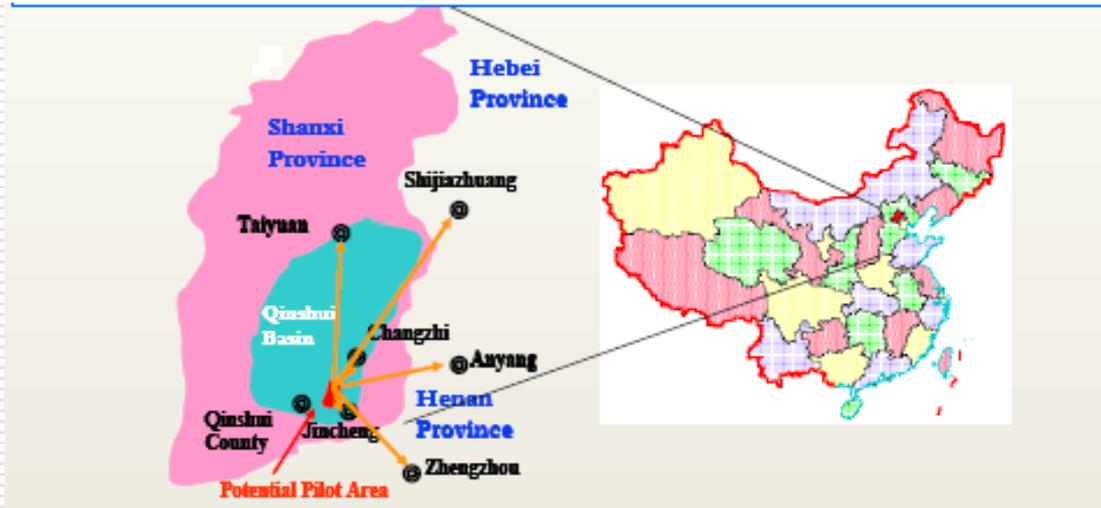
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3. Challenge and Opportunity for CO₂-EOR in China.

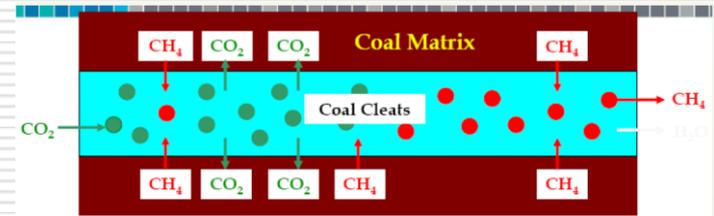
| United States (Oil Reservoir) | China(Daqing) (Oil Reservoir) |
|----------------------------------|----------------------------------|
| Ocean Sediment, Depth >1500m | Land Sediment Depth <1500m |
| Temp. >60°C | Temp. 40-60°C |
| Salinity >30000mg/l | Salinity <10000mg/l |
| Lower Visibility | Mid Visibility |
| Light Component | Heavy Component |
| MMP Lower | MMP Higher |



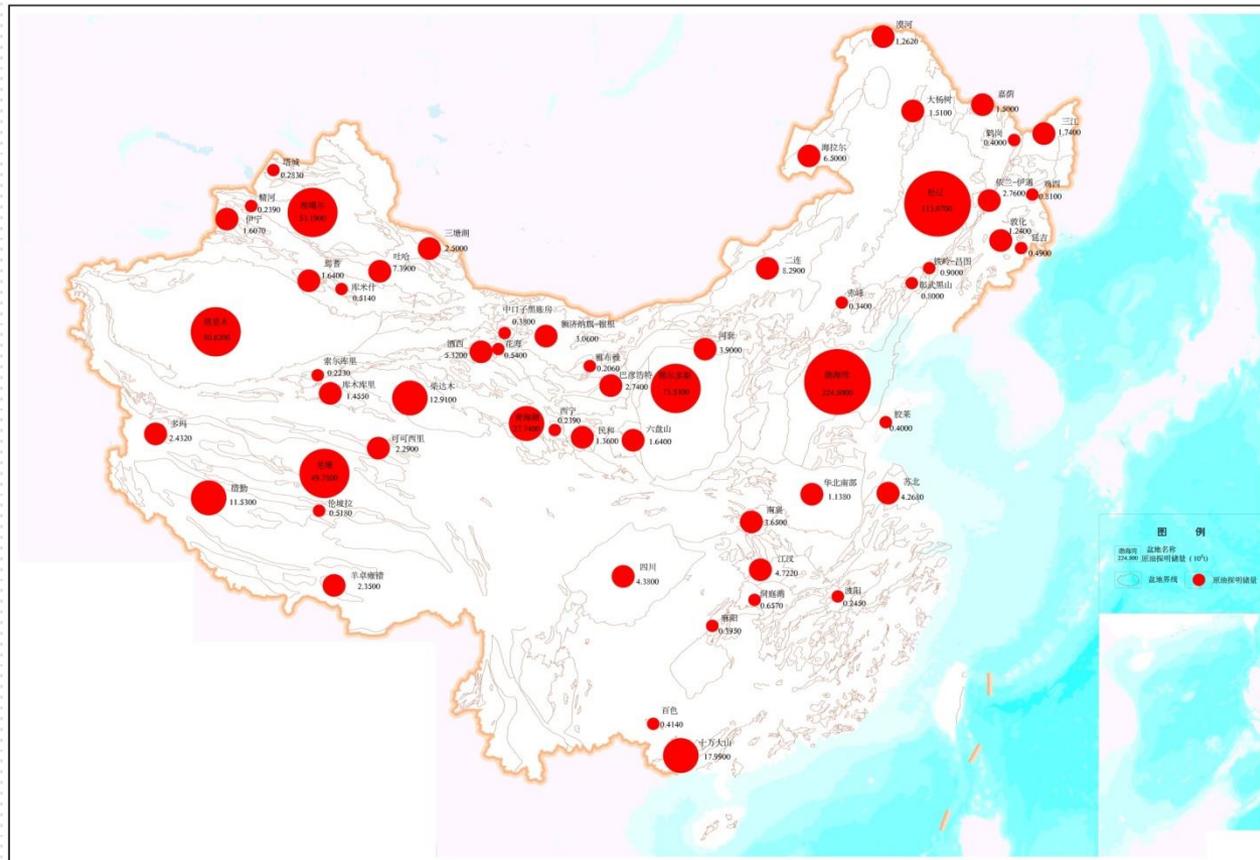
3. Challenge and Opportunity for CO₂-EOR in China.



Coal Methane: $290.275 \times 10^9 \text{ m}^3$
 (New Found: $112.55 \times 10^9 \text{ m}^3$)



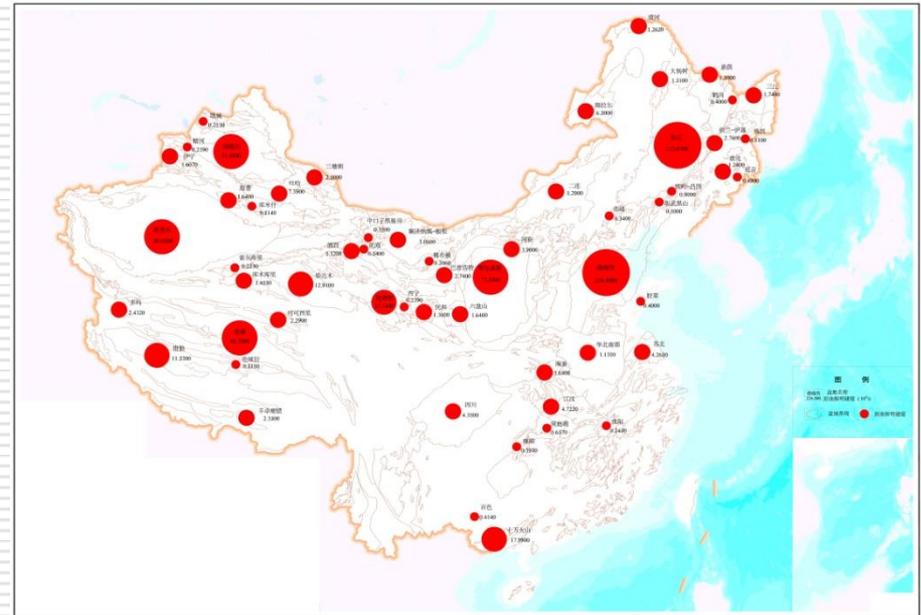
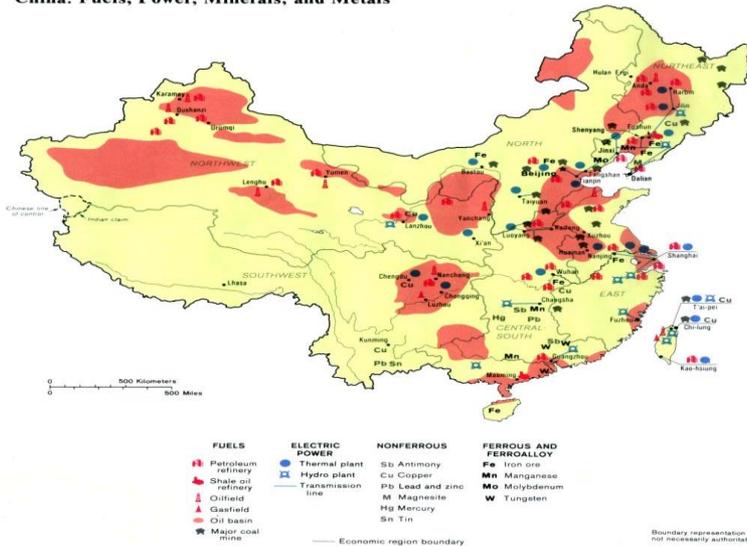
3. Challenge and Opportunity for CO₂-EOR in China.



全国油田原油储量分布图

3. Challenge and Opportunity for CO2 Geo-storage in China.

China: Fuels, Power, Minerals, and Metals



CO2 SOURCE AND STORAGE SITE IN CHINA



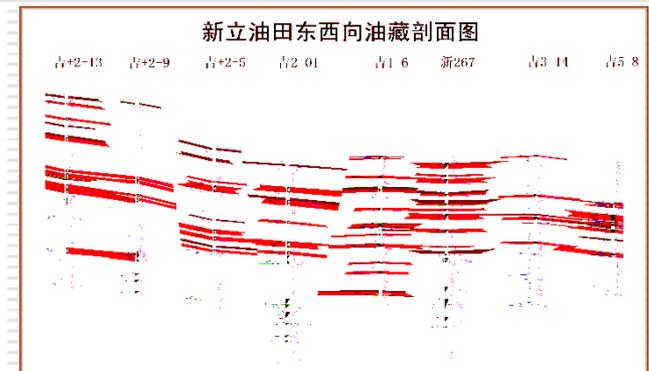
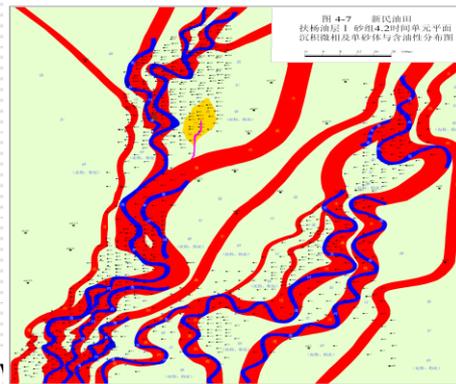
3. Challenge and Opportunity for CO₂-EOR in China.

Reservoir characteristics of low permeability reservoirs in China

- Small pore throat, low P&K, poor reservoir quality
- lithologic trap, poor reservoir continuity
- thin interbedded sandstone and mudstone
- variable reservoir thickness and physical properties
- well-developed micro-fracture
- strong heterogeneity
- higher water saturation



Micro-pore with fracture (thin section)



thin interbedded sandstone and mudstone

3. Challenge and Opportunity for CO₂-EOR in China.

Oil Co.:

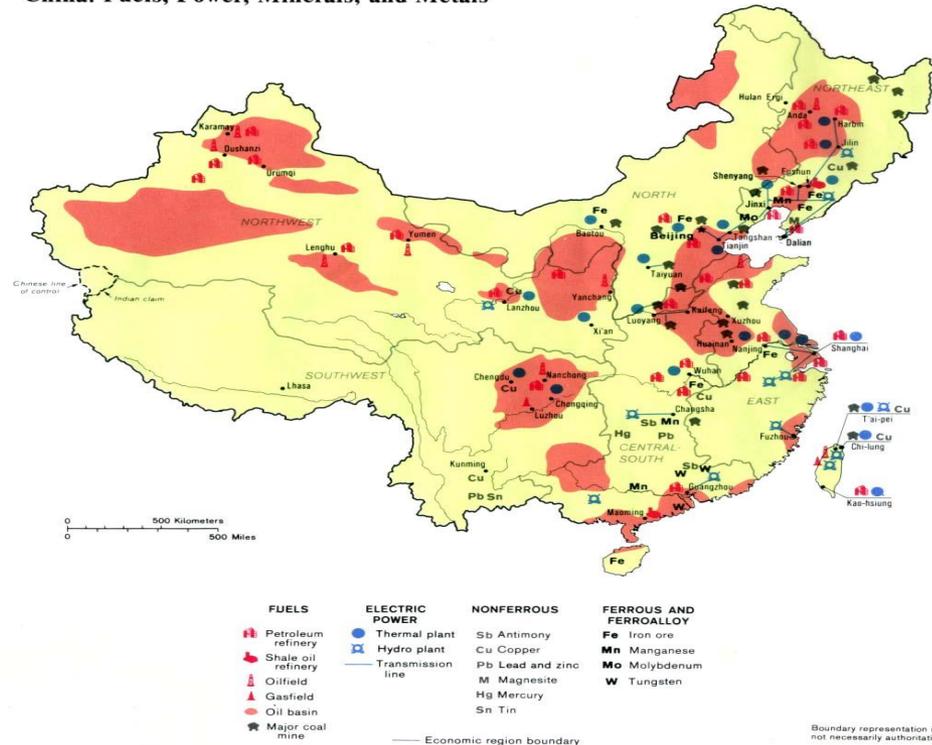
Power Co.:

New Mechanism?

CO₂ Tax?

CO₂ Price?

China: Fuels, Power, Minerals, and Metals

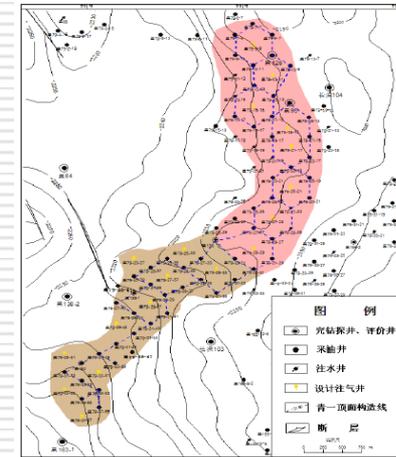
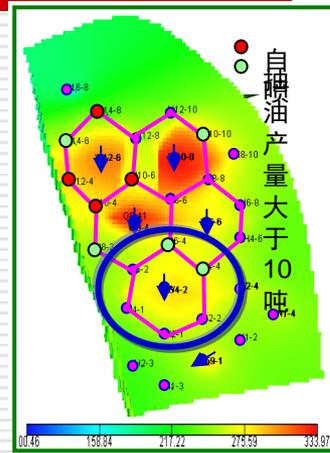
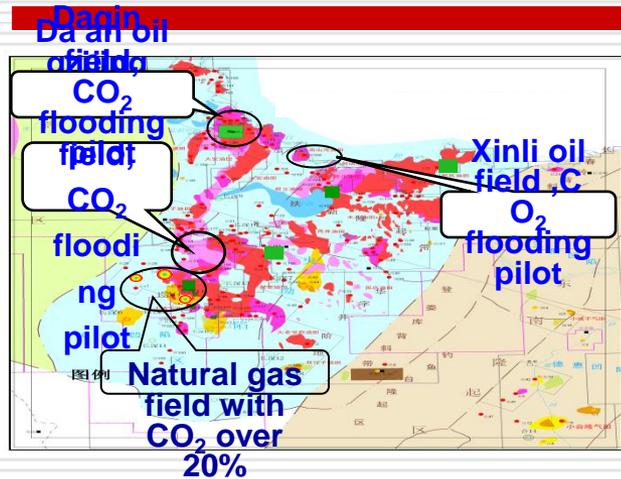




4. Basic Research and Pilot Test

- ❑ **Standard stipulation and potential evaluation for CO₂ storage that meets China geologic characteristic**
 - ❑ **Geologic theory of CO₂ subsurface storage**
 - ❑ **Theory and technology of monitoring and front predicting during CO₂ storage process**
 - ❑ **Research on phase theory of multiphase and multicomponent during CO₂ flooding process**
 - ❑ **Nonlinearity flow mechanism and law of multiphase and multicomponent during CO₂ flooding process, China University of Petroleum**
 - ❑ **Theory and method of engineering for CO₂ corrosion prevention and antiscale,**
-

4. Basic Research and Pilot Test



- **“CO₂ Storage and Enhanced Oil Recovery in Jilin Oil Field” Major Science & Technology Research Project and Key Pilot Test were conducted by PetroChina**
- **In 2007, a key science& technology research project named ‘Utilizing Greenhouse Gas as Resource and Storing it Underground’ was established by PetroChina.**
- **In 2007, a key pilot test named ‘Pilot Test of CO₂ EOR and Storage in Jilin Oil Field’ was established by PetroChina**
- **In 2011 ,Pilot Test Phase II**

4. Basic Research and Pilot Test



Shengli Power Plant Phase III, Rarefied CO₂ (CO₂ 14%)

Chemical Absorption Process

100 t/d

Xianhe Oil Region Flooding



Jan. 2012~Jun. 2013: Research
 Dec. 2014: Project construction
 2015: Project operation, monitoring and evaluation



QPEC Coal Gas, elevated CO₂ (CO₂ 90%)

Cryogenic Distillation Process

50 t/d

Chunliang Oil Region Flooding



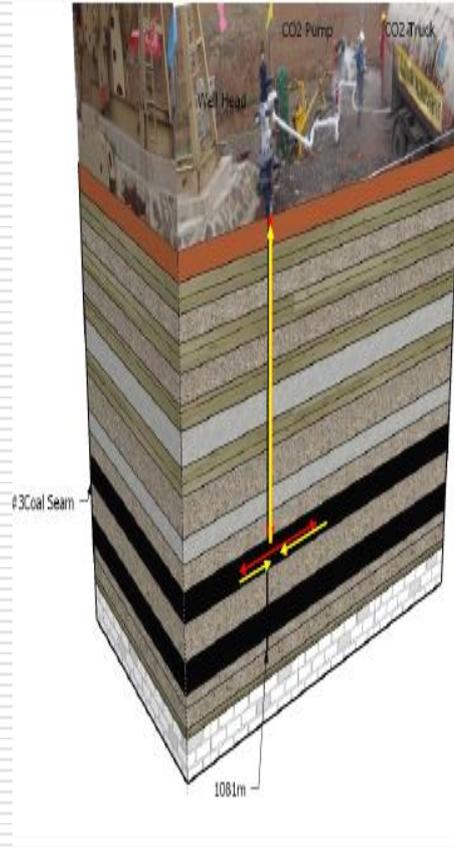
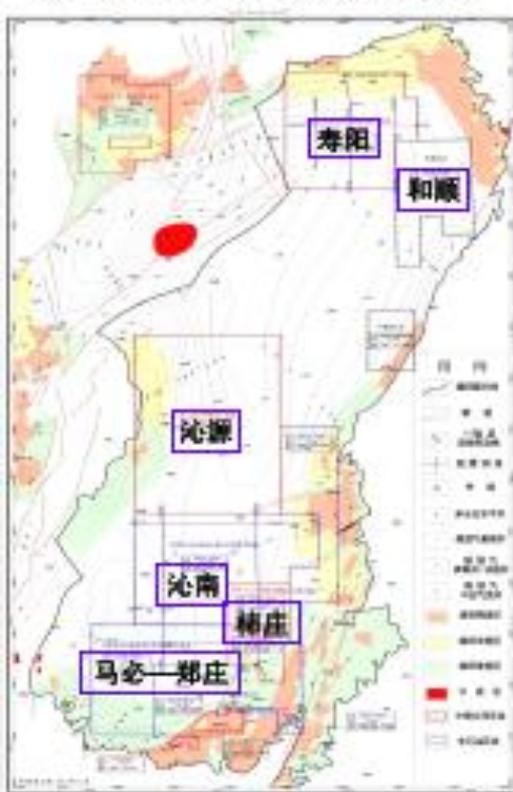
Dec. 2012: Project plan and feasibility study completed
 Dec. 2013: Project construction and

From Sinopec, 2012



4. Basic Research and Pilot Test

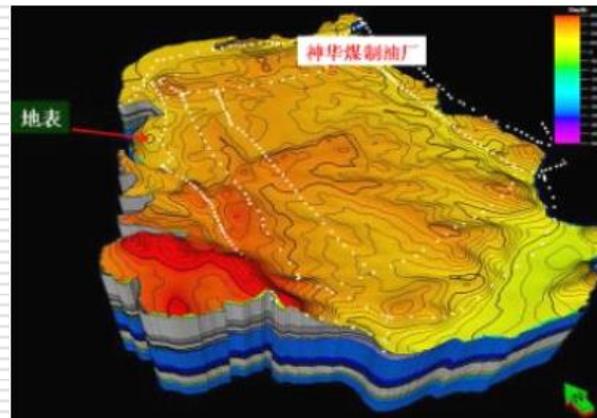
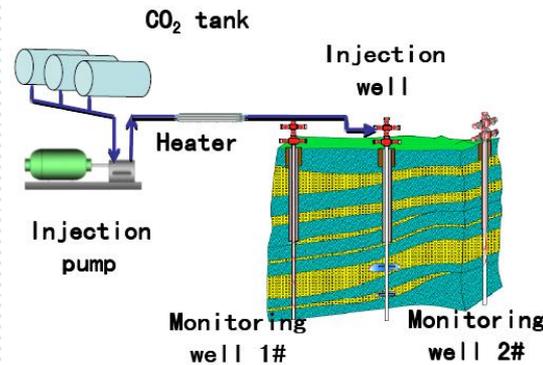
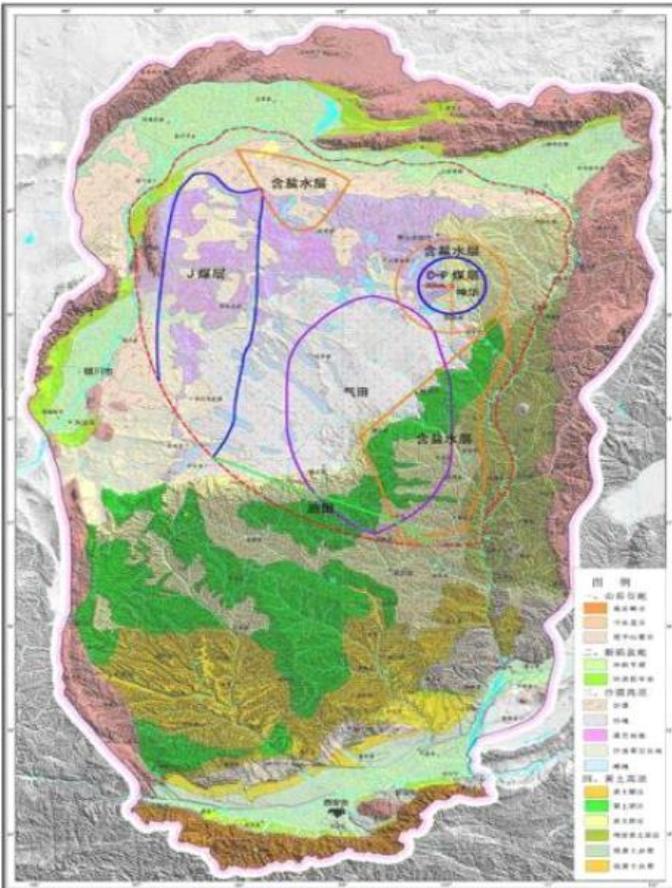
沁水盆地煤层气勘探开发形势图



China National Project
China-Canada Project
China-Australia Project



4. Basic Research and Pilot Test





5. International Cooperation CCS



Jilin Pilot Test Visit

CAGS, NEZC, COACH,

6. Conclusion

1. CCS is one of the necessary and important technologies facing the climate change.
 2. Chinese Government and Enterprises concern on CCS.
 3. It is a great challenge and opportunity for CO₂ Storage and EOR in China.
 4. Broad international collaboration and Educationis need for CCS
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□ Welcome to China University of Petroleum!



Thanks for your attention!
