



Status of CCUS in China and CAS project

Dr. ZHANG Xian

The Administrative Centre for China's Agenda 21



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Contents



Overview of Economy, Energy and Emissions

Role & Potential of CCUS to CO₂ Emissions Reduction

CCUS Activities: Policy, R&D, demo

Cags project



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



1

OVERVIEW OF ECONOMY, ENERGY AND EMISSIONS

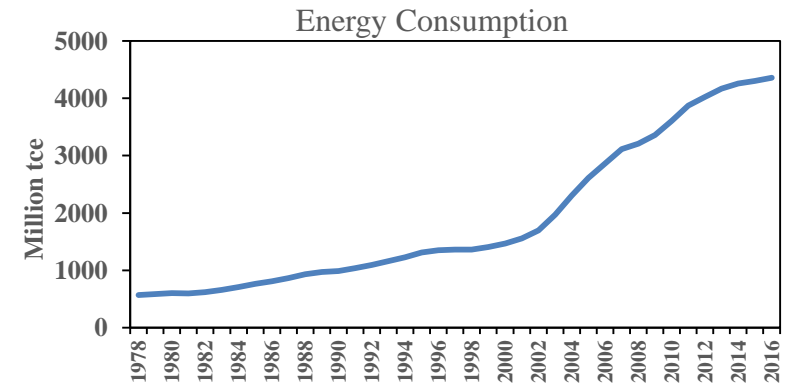
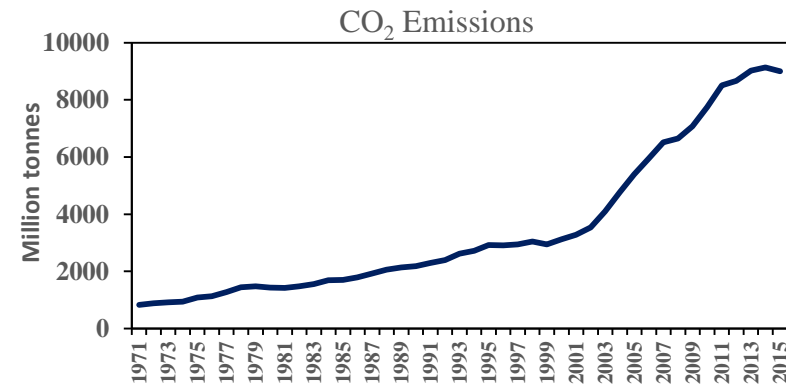
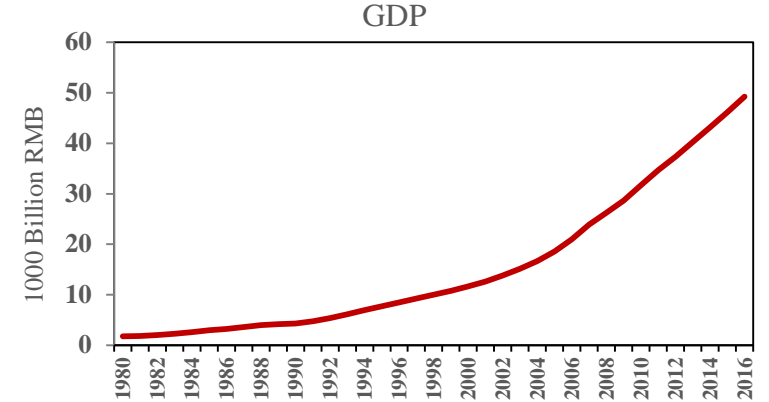


China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Economy, Energy and Emissions in China

- During the period of rapid industrialization and urbanization, the GDP from high energy-intensive industries accounted for a big proportion in China.
- The energy demand increases by 200 million tce annually in the recent years.
- From 1990 to 2015, CO₂ intensity declined by 61%, that is rare all over the world.
- From 1990 to 2015, the GDP grew by 10.7 times, while energy consumption and CO₂ emission increased by 4.4 and 4.1 times.
- CO₂ emission intensity to drop 40-45% by 2020 according to the 2005 level.

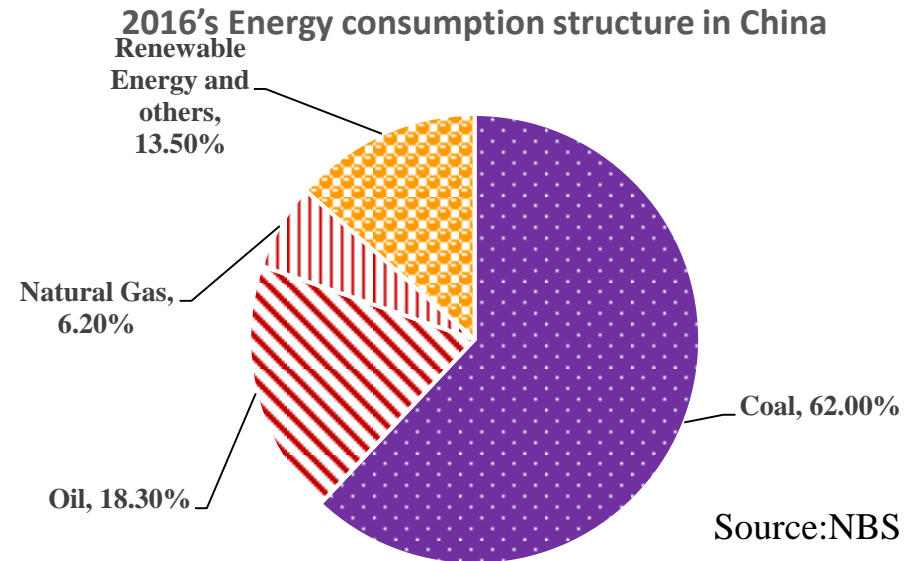
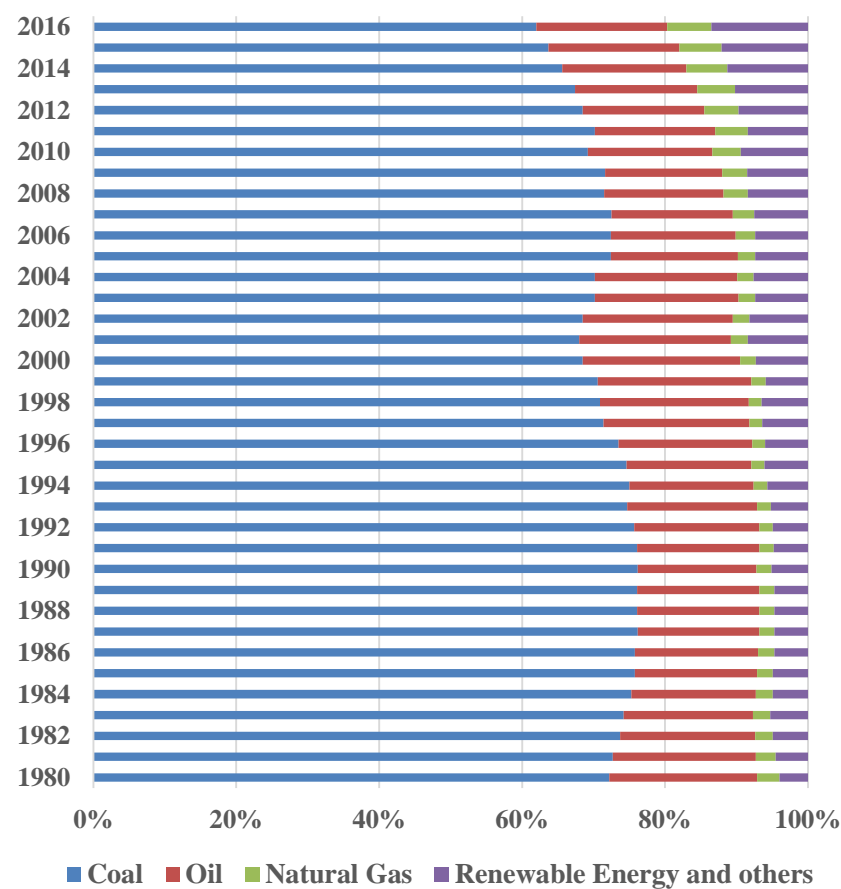


China Australia Geological Storage of CO₂
中澳二氧化碳地质封存

Sources : NBS & IEA



Coal accounts for around 69% of Primary Energy Consumption in the past 30 years.



Renewable and nuclear energy development is remarkable, the share of which in primary energy mix keeps increasing, but still could not meet the new incremental demand for energy services in quite a long time.



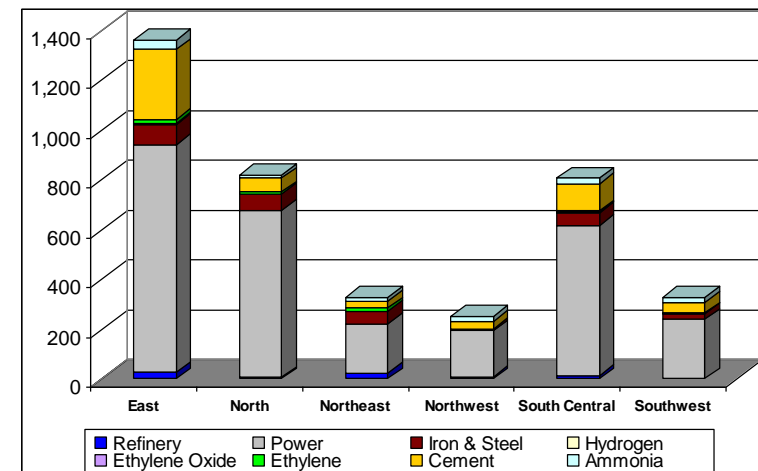
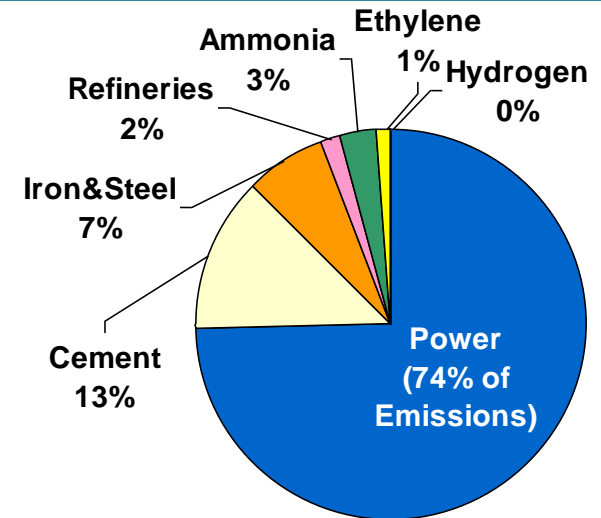
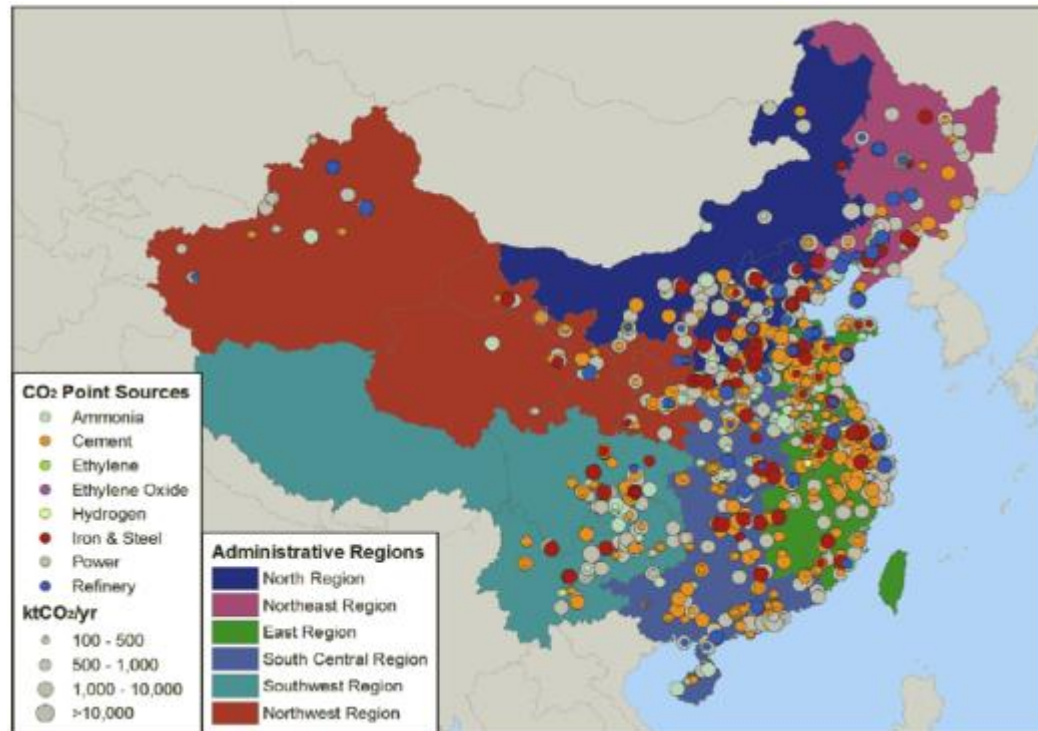
China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Large Industrial CO₂ Point Sources & Distribution

✧ Power, Cement and Iron & Steel

✧ The East, North and South Central



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



2

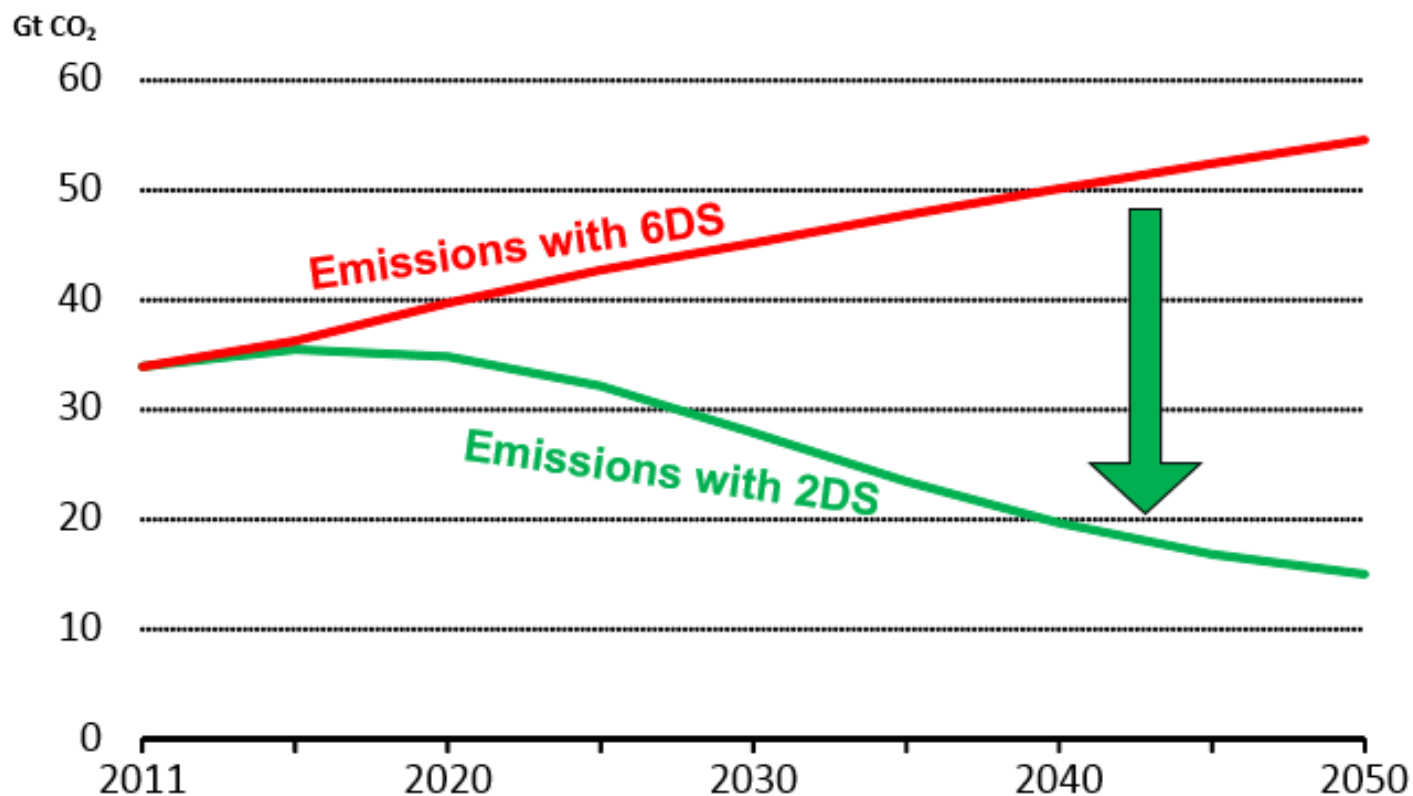
ROLE AND POTENTIAL OF CCUS IN CHINA



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



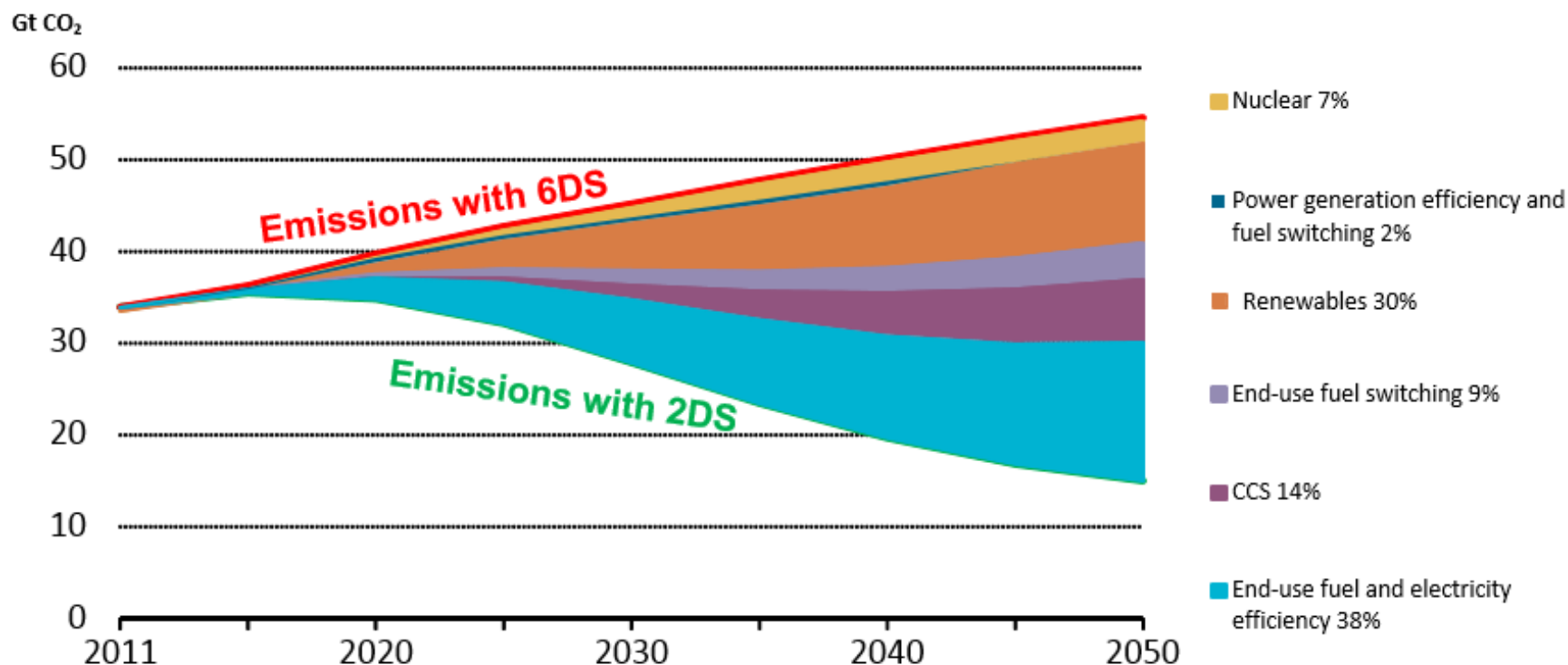
Portfolio of actions to reduce energy sector emissions



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Portfolio of actions to reduce energy sector emissions



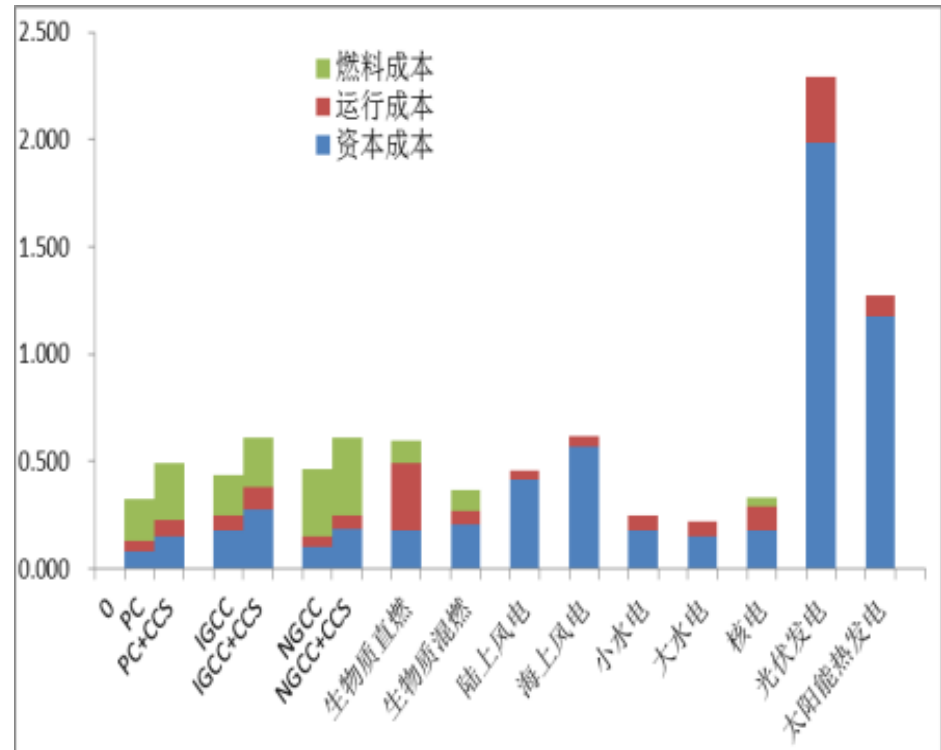
China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



CCUS is not mature and is expensive

- High costs
- High energy penalty
- High risk

A big portion of fuel costs in total cost.



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存

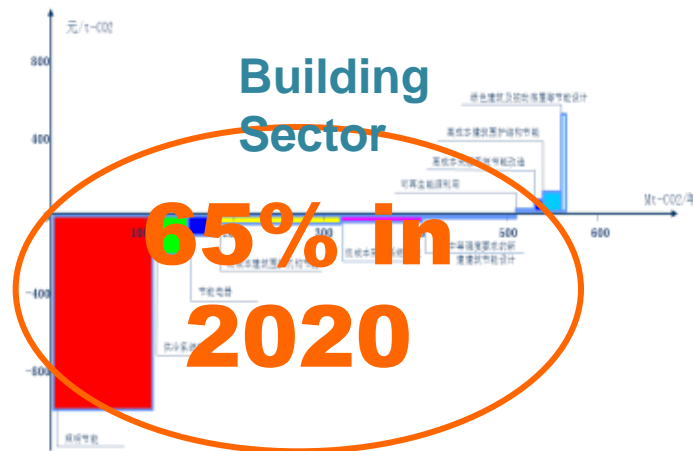
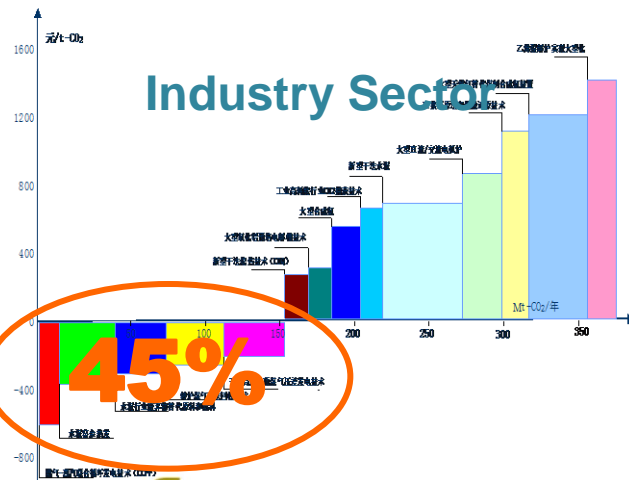


Normal mitigation technologies have great potential for CO₂ reduction in China currently, and are cost effective.

- Mitigation Potential

	2020	2030	2050
Mitigation tech. in Industry, Transport and Building	2.2Gt	3.8Gt	5.0Gt
Non-Fossil Energy Tech.	1.5Gt	3.0Gt	5.3Gt

- Mitigation Cost (big portion of negative cost)

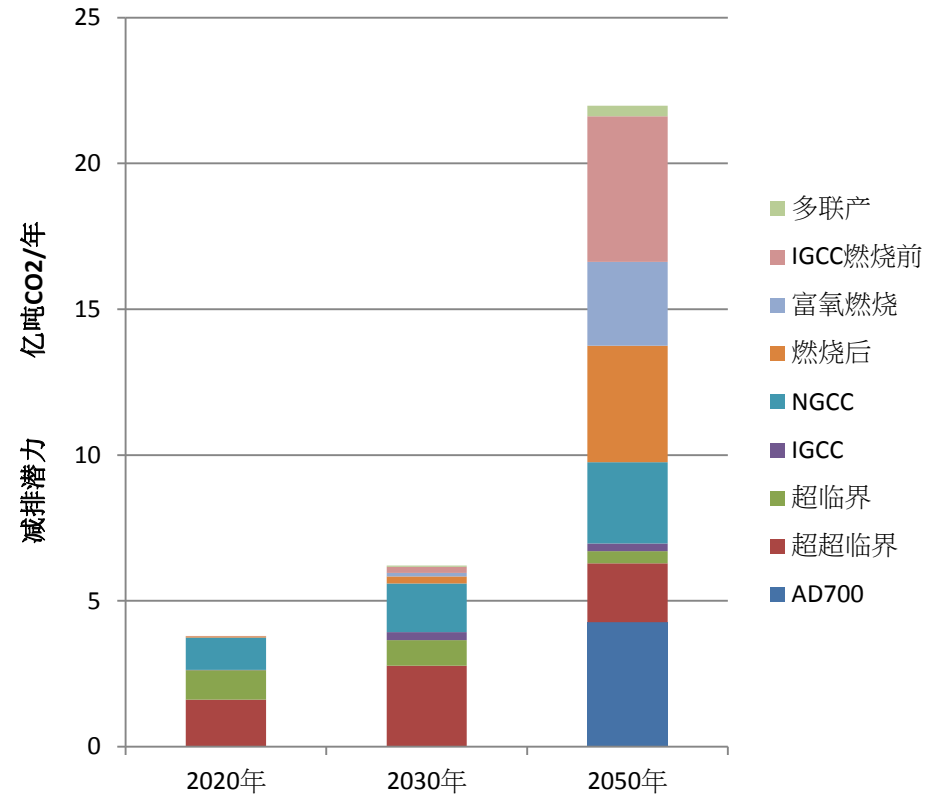
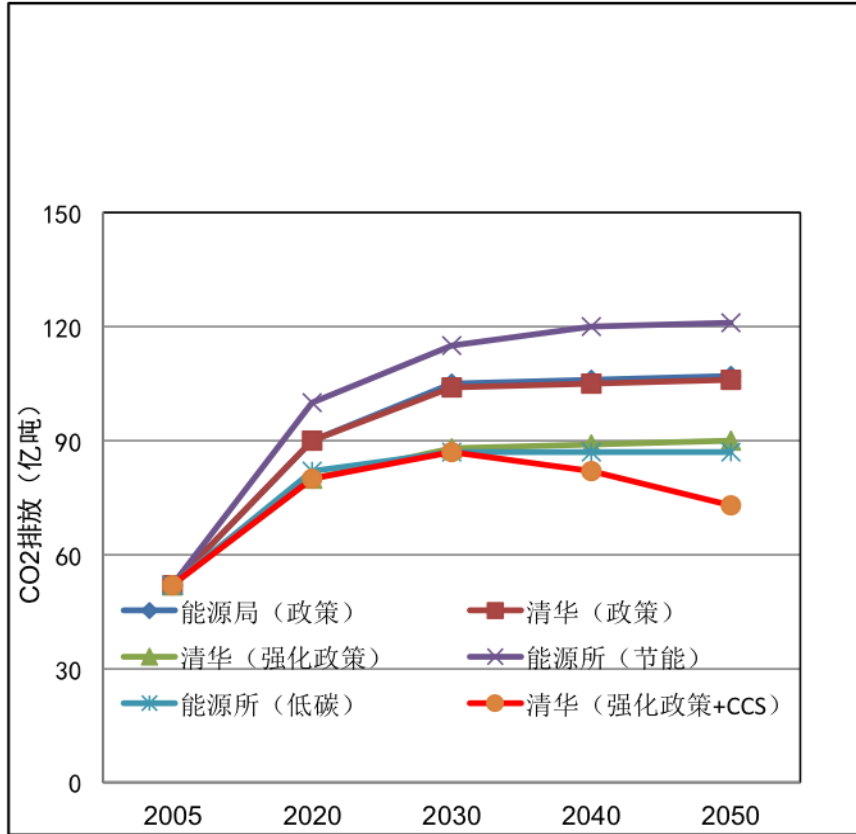


cags

China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Scenario analysis suggests CCUS will play important role in mid- and long-term.

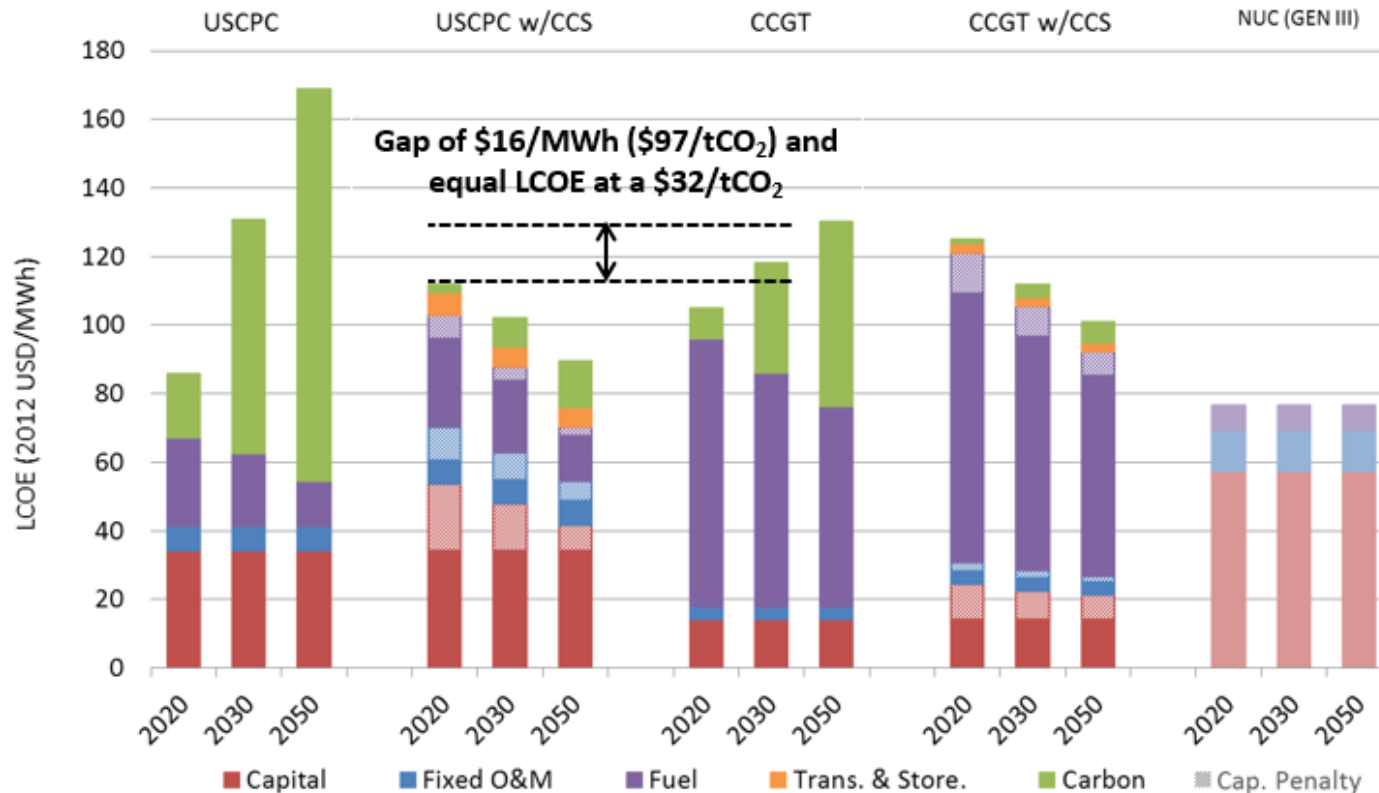


China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Cost of CCS: coal+ccs can compete with gas

Generic costs for Asia, 2030



Where gas prices are high relative to coal, coal with CCS is competitive with CCGT and 75% 'cleaner'

cags

China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



Theoretical Storage Capacity

Saline Aquifer



- Examined 17 onshore basins and 10 offshore
- Applied specific storage volume method based on
- Capacity: **3.1TtCO₂**
 - 2.3 GtCO₂ onshore
 - 0.8 GtCO₂ offshore

EOR



- Examined 29 onshore basins and 21 offshore
- Capacity **4.8GtCO₂**
 - 4.6 GtCO₂ onshore
 - 0.2 GtCO₂ offshore
- Up to 7.0 BBO additional oil recovery

Depleted Gas Reservoirs



- Examined 23 onshore basins and 6 offshore
- Capacity **5.2 GtCO₂** storage potential
 - 4.3 GtCO₂ onshore
 - 0.9 GtCO₂ offshore

ECBM (600-1500m)



- 10% of OCIP for storage
- Examined 69 onshore coal-bearing regions
- **12.1GtCO₂** capacity
- 1.6 Tm³ additional coal bed methane recovery

(Source: Li et al, 2007)

cags

China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



3

CCUS ACTIVITIES: POLICY, R&D AND DEMO



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Policies are getting into details gradually

- National Medium- and Long-Term Program for Science and Technology Development (2006-2020)
by State Council, 2006
- China's scientific actions on climate change,
by MOST, 2007
- 12th National Scientific and Technological Plan on Climate Change
by MOST, May 2012
- Work plan for 12th 5-year National GHG Control
by State Council, 2012
- S&T roadmap of China's CCUS development
by MOST/ACCA21, 2011
- Special Plan for CCUS technology development
by MOST, 2013

General statement

“to develop CO₂ near zero emission technology”



Detailed development measure

Targets, actions in capture, storage, utilization and storage, full-chain demo, etc



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



Policies are getting into details gradually

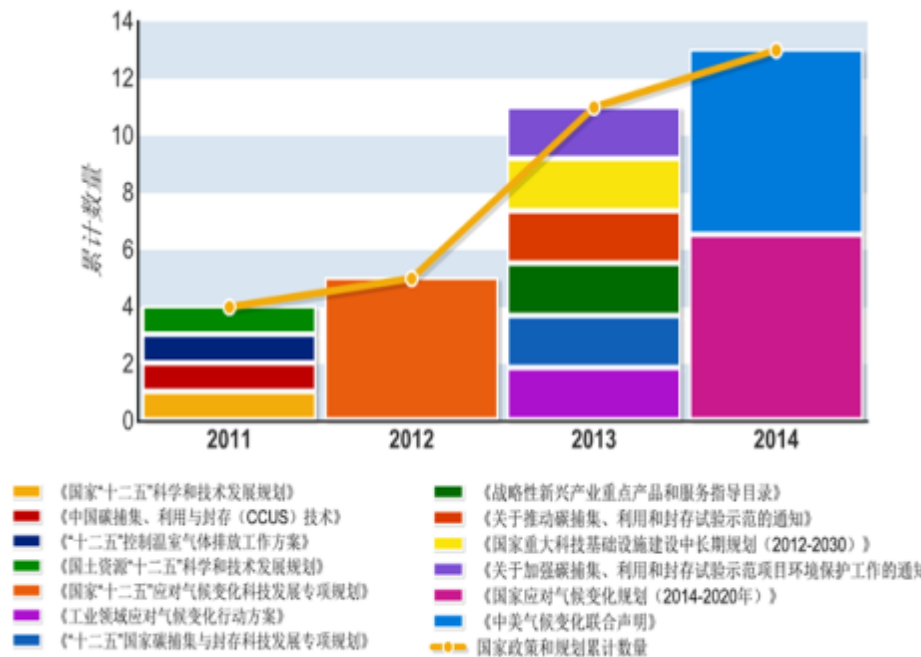


图 1.1 “十二五”期间我国出台的国家政策和发展规划



图 1.2 出台政策和法规的省市分布

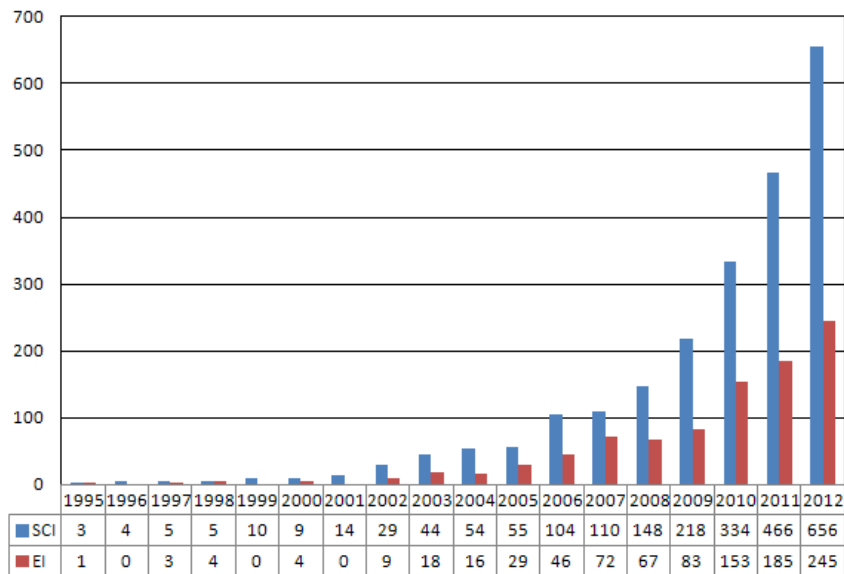
cags

China Australia Geological Storage of CO₂
中澳二氧化碳地质封存

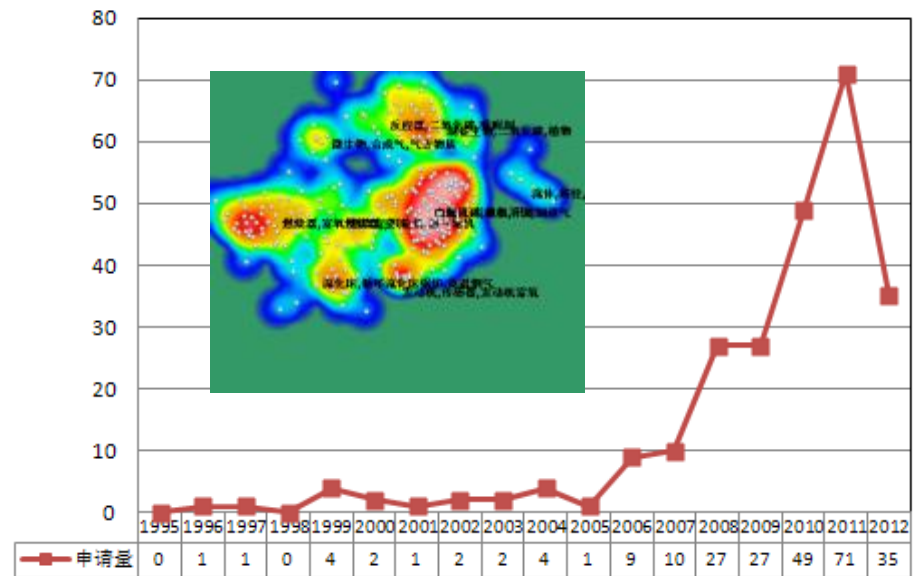


Trends of Paper & Patent on CCUS (1995-2012)

SCI & EI Papers



Domestic Patents



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



CCUS Progress Summary: R&D

- R&D Activities in the 11th FYP

Project Title	Funding by	Duration	Type of projects
The Project of CCS-EOR, Utilization and Storage	973	2006-2010	Basic Research
Program of CO ₂ Capture and Storage technology	863	2008-2010	Technology R&D
The Key Tech Research Program on CCS-EOR and Storage	863	2009-2011	
The Key Tech Research Program on CO ₂ -Algae-Biodiesel	863	2009-2011	
CO ₂ - Safety Mining with CO ₂ Gas Reservoirs and CO ₂ Utilization Tech	National Major Special Project	2008-2010	R& D
Demonstration Project of Mining and Utilization Tech of Volcanic gas containing CO ₂ in Songliao Basin	National Major Special Project	2008-2010	



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



CCUS Progress Summary: R&D

- R&D Activities in the 12th FYP

Name of Projects	Funding by	Duration	Type of projects
Demonstration Project of CO ₂ capture and geological storage in Coal Liquification Plant, China Shenhua Group	National Key Technology R&D Programme	2011-2014	Technology R&D
The Key Tech Research Project of CO ₂ Emission Reducing on Iron-Steel Sector	National Key Technology R&D Programme	2011-2014	Technology R&D
Research and Demostration Program of IGCC +CO ₂ Caputure, Utilization and Storage	National Key Technology R&D Programme	2011-2013	
CO ₂ Storage Capacity Assessment and Demonstration in China	China Geological Survey	2011-2014	
The Program of CCS –EOR, Utilization and Storage	973	2011-2015	Basic Research



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



CCUS Progress Summary: Enterprise Action

Project Title	Scale	Capture Tech	Storage/ Utilization	Status
The pilot project of CO ₂ Capture, Huaneng Beijing Gaobeidian Thermal Power Plant	Capture Capacity:3,000 T/Y	Post-Combustion	Food Use	Operated in 2008
Demonstration Project of CO ₂ capture and storage in Coal Liquefaction Plant, China Shenhua Group	Capture Capacity:100,000 T/Y Storage Capacity: 100,000 T/Y	Coal liquefaction	Saline Aquifer	operated in 2011
Demonstration Project of CO ₂ capture, Storage and Utilization in IGCC Plant Greengen of Huaneng	Capture Capacity:60,000--100,000 T/Year	Pre-Combustion	EOR	Launched in 2011
Small Scale Demonstration Project on CO ₂ Capture and EOR in Shengli Oil Field, Sinopec	Capture/Utilization:40,000T/Y	Post-Combustion	EOR	Operated in 2010
Demonstration Project of CO ₂ capture, Shanghai Shidongkou Power Plant, Huaneng	Capture Capacity:120,000 T/Y	Post-Combustion	Food/ Industrial	Operated since 2010
Demonstration project of Carbon Capture, Shuanghuai Power Plant, China Power Investment	Capture Capacity:10,000 T/Y	Post-Combustion	Food/ Manufacture	Operated in 2010
Pilot Plant of CO ₂ capture in Lianyungang City, CAS	Capture Capacity:30,000 T/Y	Pre-Combustio	N/A	Operated in 2011



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Demonstration

China Power Investment,
10,000t/a capture pilot



Huazhong University of S&T (HUST)
35MWt Oxy-fuel pilot,



Huaneng Group
Gaobeidian & Shidongkou Power Plant Demo



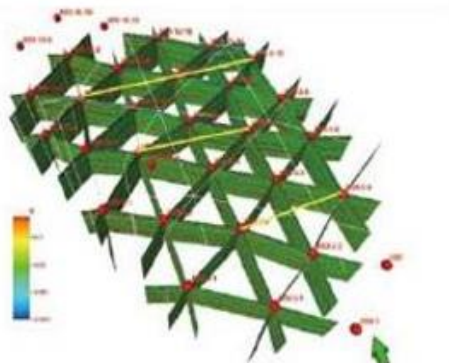
China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Demonstration

PetroChina

CO₂ EOR ,Jilin Oilfield



ENN Group

Micro algae Bio-fuel Pilot
Capacity: 20,000t/y

China United Coalbed Methane

ECBM Pilot Project

Qinshui, Shanxi



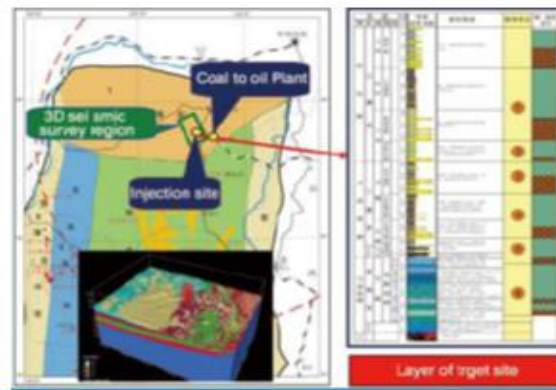
cags

China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Demonstration

SINOPEC, Shengli Oil Field
CO₂-EOR, 1Mt CO₂/year



Shenhua Group
Erdos, 3Mt/a



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



4

CAGS PROJECT



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



CCUS : International Collaboration



Project	Partner	Duration
China-Australia Geological Storage of CO ₂ (CAGS)	RET, GA	2010-
China-EU NZEC Cooperation	UK, EU, Norway	2007-
China-EU Carbon Capture and Storage Cooperation (COACH)	EU	2007-2009
Sino-Italy CCS Technology Cooperation Project(SICCS)	ENEL	2010-2012
China-US Clean energy Research Center	MOST, NEA, DOE	2010-2015
CSLF Capacity Building Projects	CSLF	2012-
MOST-IEA Cooperation on CCUS	IEA	2012-



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



About CAGS

- CAGS is a bilateral project between China-MOST and Australia-RET
- Jointly managed by:
 - **Geoscience Australia**,
Department of Resources, Energy and Tourism
 - **The Administrative Centre for China's Agenda 21**,
Ministry of Science and Technology
 - CAGSI (2010-2012), CAGSII (2012-15), CAGSIII (2016-18)



Australian Government
Geoscience Australia



The focus for CAGS is capacity building on geological storage of CO₂ in China



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



CAGS Activities

Capacity Building

Workshops

Summer Schools

Visiting scholars

Study Tour

Conferences

Website & Networks

Publications

Research

✓ Research Project 1

✓ Research Project 2

✓ Research Project ...

**Final
Symposium**



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



CAGS Outputs: Knowledge Sharing

- **Workshops**
1800 participants attended
- **CCS summer schools**
300 students from China and Australia
- **Scholar exchange**
30 Chinese researchers
10 senior students
- **Networking and linking: Gov, institute, enterprise, NGOs**
61 Chinese organisations and
27 Australian / Int'l organisations



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



Research Projects

CAGSI(2010-2012):

- Site selection methodology and criteria of CO₂ geological storage
- Selection criteria of oil/gas reservoirs for CO₂ EOR and storage
- Study of the EIA and risk management of CO₂ storage

CAGSII(2013-2015):

- CO₂ Geological Storage of Target Area Selection and Evaluation Method
- Possibility and Potential of CO₂ Enhanced Shale Gas Recovery in Ordos Basin
- Identifying Status and Gaps of China's Technologies and Equipment supplies for Implementing CO₂ Saline Formation Storage Project
- Key parameters research for EIA of CO₂ geological storage



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



CAGS Outputs: Policy Supporting

Research results were well informed to Policy Makers:

- Storage capacity assessment methods and tools (EOR and aquifers)
- Storage site selection and assessment criteria
- EIA guideline
- Risk assessment and management guidelines



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存



CAGS Outputs: Public Awareness Raising

• Brochures

• Website

• Newsletter



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



CAGSIII (2016-2018)

- CAGSIII aims to continue to build geological storage research capacity in Australia and China through scientific exchanges and joint research on carbon, capture, utilization and storage (CCUS) demonstration projects.
- CAGSIII will provide an avenue for Australian researchers to gain experience on active Chinese CCUS demonstration sites and the Chinese to gain access to Australian geological storage, monitoring and groundwater expertise.
- A particular emphasis for CAGSIII is capacity building in the western Xinjiang province, a region undergoing rapid industrial growth.



China Australia Geological Storage of CO₂
中澳二氧化碳地质封存



Thanks for your attention!

ZHANG Xian PhD

The Administrative Centre for China's Agenda 21 (ACCA21), Beijing 100038

zx_ama@hotmail.com

For More Information, Please Visit

www.ccusChina.org.cn

www.cagsinfo.net



China Australia Geological Storage of CO₂

中澳二氧化碳地质封存

