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News and Highlights

Progress in carbon capture, utilization and storage of China Geological Survey and other geological exploration entities

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Carbon capture, utilization, and storage (CCUS), as a green and low-carbon technology that can achieve large-scale reduction of direct emission and low-carbon utilization of fossil fuels, has become an indispensable technological option for countries around the world to reduce greenhouse gas emissions, strengthen climate governance, and achieve climate goals. Since 2009, China Geological Survey (CGS) has organized and carried out lots of programs to prompt the development of CCUS technology in China, such as national carbon dioxide geological storage potential assessment, carbon dioxide geological storage and utilization survey, comprehensive geological survey of carbon dioxide geological storage in Junggar and other basins, which made a number of important achievements in regional potential assessment, demonstration project implementation and key technology research and development.

Firstly, CGS has basically revealed the regional scale potential and suitability of carbon dioxide geological storage in China. It has completed the assessment of carbon dioxide geological storage potential and suitability at the national scale, and compiled the *Assessment Map of Carbon Dioxide Geological Storage Potential and Suitability in China's Sedimentary Basin* (1 : 5000000) and the *Atlas of Carbon Dioxide Geological Storage Potential and Suitability Assessment in China's Main Sedimentary Basins*. It is believed that Tarim Basin, Ordos Basin, Songliao Basin, Junggar Basin, Bohai Bay Basins have suitable geological conditions for large-scale CCUS industrial clusters in the future, which have provided important support for strategic planning of CCUS projects.

Secondly, by collaborating with enterprises to carry

out demonstration projects, CGS has mastered key technologies for CCUS. It collaborated to implement the Shenhua CCUS demonstration project, establishing the monitoring system of “atmosphere-surface-underground”, mastering the diffusion and distribution patterns of carbon dioxide in the target reservoir, and playing an important role in the investigation and exploration of storage sites, drilling and gas injection, monitoring, and environmental impact assessment. In 2018, by collaborating with Xinjiang Oilfield, a pilot field experiment was conducted in the Eastern Junggar Basin to enhance deep salt water extraction and storage carbon dioxide. 1010 t of carbon dioxide were injected, verifying the feasibility and geological safety of carbon dioxide driving deep salt water technology. A tracing and monitoring technology for carbon dioxide diffusion and migration in deep underground reservoirs was developed.

Thirdly, CGS has provided technology storage for 100000 t/year of carbon dioxide geological storage. Based on the research and development of key technologies for carbon dioxide geological storage and demonstration project, the integrated innovations have been made in the technical systems of comprehensive geological survey, remote sensing, geophysical investigation, drilling, sample collection and testing, monitoring, numerical simulation, and environmental impact and safety risk assessment, which could meet the promotion and application of 100000 t storage projects in China. It has also successfully developed the leading technical equipment, such as a U-tube sampler for downhole *in-situ* fluid and a deep pH *in-situ* monitoring system. Moreover, it has established environmental impact assessment and monitoring technology system for carbon dioxide geological storage, and preliminarily proposed management policy of the utilization of underground space for carbon dioxide geological storage.

During the 14th Five Year Plan period, CGS will further evaluate the carbon dioxide geological storage potential of

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major sedimentary basins in China, and given priority to high carbon emission areas, such as Ordos Basins and Shandong Peninsula, to carry out fine assessment of carbon dioxide geological storage potential and suitability in deep salt water layer, depleted oil and gas reservoirs, delineate a number of storage target areas, and promote the implementation of million tons carbon storage demonstration projects. Additionally, it will strengthen the safety risk assessment of deep carbon dioxide reservoirs, explore the ecological environment impact assessment of carbon dioxide leakage, research and promote the establishment of geological storage regulatory system, technical system, and legal system.

Presently, many Chinese energy companies have also conducted CCUS demonstration projects (Fig. 1; Table 1) and

made a series of progress, laying the foundation for large-scale CCUS industrial implementation in the future.

Source: Burying carbon dioxide underground, https://www.cgs.gov.cn/xwl/cgkx/202105/t20210508_669884.html. Geological carbon sink and geological energy storage, He Qing-cheng, Geological Lecture of China Geological Survey, 2023-07-14.

Reference

Zhang X, Yang XL, Lu X, et al. 2023. Annual Report on Carbon Dioxide Capture, Utilization, and Storage (CCUS) in China (2023). The Administrative Center for China’s Agenda 21, Global CCS Institute, Tsinghua University.

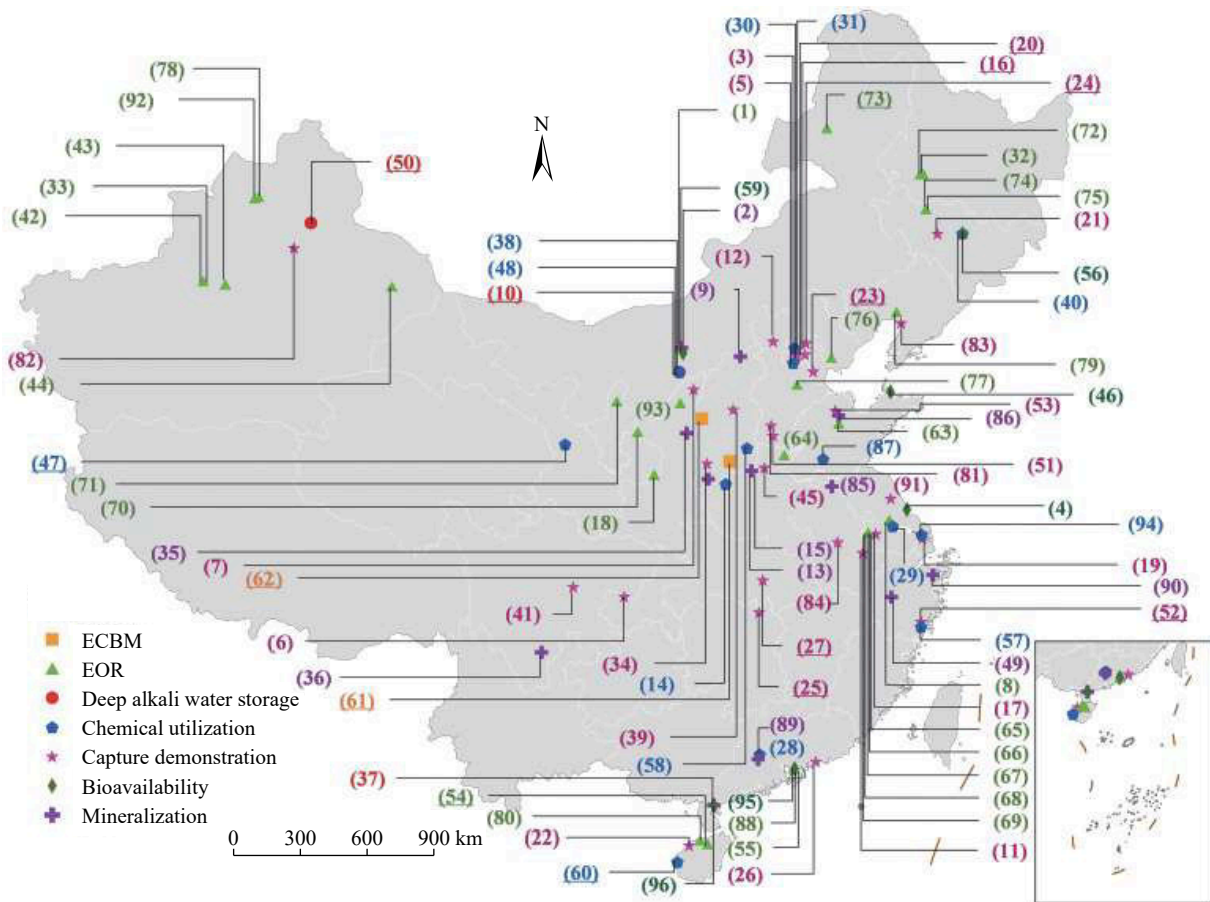


Fig. 1. Distribution of CCUS demonstration projects in China (after Zhang X et al., 2023). The specific project names are listed in Table 1.

Table 1. Table of CCUS Test Projects in China (after Zhang X et al., 2023).

No.	Project name (organizer)
1	Baotou 2 million t (Phase I 500000 t) CCUS demonstration project (BaoGang Group)
2	Baotou carbonization method steel slag comprehensive utilization project (Baorong Environmental Protection Co., Ltd)
3	CO ₂ capture technology demonstration project in complex smoke environment (Beijing Building Materials Academy of Sciences Research)
4	Yancheng microalgae carbon fixation project (Cibainian Co. Ltd)
5	Beijing Gaojing thermal power plant CO ₂ capture project (Datang International Power Generation Co., Ltd)
6	Chongqing Shuanghuai power plant CO ₂ capture demonstration project (State Power Investment Corporation Limited (SPIC))
7	Jinjie power plant 150000 t/year after combustion CO ₂ capture and storage full process demonstration project (CHN Energy Group)
8	Taizhou power plant 500000 t/year CCUS project (CHN Energy Group)
9	CO ₂ chemical mineralization capture and utilization demonstration project at Guodian Datong Power Plant (CHN Energy Group)
10	Ordos CO ₂ salt water layer storage project (CHN Energy Group)
11	Wuhu Baimashan cement plant CO ₂ capture and purification demonstration project (Anhui Conch Group Co., Ltd)
12	Zhangjiakou hydrogen energy development and utilization demonstration project (HBIS Group Co., Ltd)
13	Calcium carbide slag mineralization utilization CO ₂ relaxation gas project (Henan Kaixiang Chemical Co., Ltd)
14	50000 t/year chemical synthesis gas separation CO ₂ to dry ice project (Henan Kaixiang Chemical Co., Ltd)
15	New material CO ₂ solid waste utilization project (Henan Qiangnai New Materials Co., Ltd.)
16	Beijing Fangshan cement plant smoke CO ₂ capture project (Henan Hongyu Huanneng Technology Co., Ltd)
17	Jurong 10000 t/year CO ₂ capture project (China Huadian Corporation)
18	Zhengning Power Plant 1.5×10 ⁶ t/year CO ₂ capture and storage project (China Huanneng Group Co., Ltd)
19	Shanghai 120000 tons/year phase-change CO ₂ capture industrial unit (China Huanneng Group Co., Ltd)
20	Beijing Thermal Power Plant 3000 t/year CO ₂ capture demonstration project (China Huanneng Group Co., Ltd)
21	Changchun Thermal Power Plant 1000 t/year variant CO ₂ capture industrial device (China Huanneng Group Co., Ltd)
22	Yangpu Thermal Power Gas Unit 2000 t/year capture project (China Huanneng Group Co., Ltd)
23	Tianjin IGCC Power Plant 100000 t/year CO ₂ capture project before combustion (China Huanneng Group Co., Ltd)
24	Beijing Miyun gas smoke 1000 t/year CO ₂ capture demonstration project (China Huanneng Group Co., Ltd)
25	Hunan Yueyang low temperature CO ₂ and pollutant collaborative removal project (China Huanneng Group Co., Ltd)
26	Haifeng carbon capture testing platform (China Resources Power Holdings Co., Ltd.)
27	Yingcheng 35MW oxygen rich combustion industrial demonstration project (Huazhong University of Science and Technology)
28	Foshan 10000 t/year flue gas CO ₂ capture and carbon sequestration demonstration project (Jialida Environmental Protection Technology Co., Ltd)
29	Taizhou CO ₂ solidification and utilization project to prepare polypropylene carbonate (Jiangsu Zhongke Jinlong Environmental Protection New Material Co., Ltd.)
30	Liulihe Cement Plant CO ₂ capture and application project (BBMG Corporation)
31	Beijing Cement Plant CCUS Project (BBMG Corporation)
32	Daqing Oil Field Sanzhao CCUS Project (China National Petroleum Corporation)
33	Supplier Selection Plan for Kuche Million ton CCUS Integrated Demonstration Project (Tongyuan Petrotech Corporation)
34	Yuncheng Medium Temperature Pressure Swing Adsorption H ₂ / CO ₂ Separation Pilot Demonstration Device (Tsinghua University)
35	Lvliang Steel Slag and Dust Removal Ash Indirect Mineralization Utilization Project (Jinheng Co., Ltd)
36	Xichang Key Technologies of CO ₂ Mineralized Desulfurization Slag and 10000 t Industrial Test (Sichuan University)
37	Zhanjiang Basalt CO ₂ Mineralization and Storage Demonstration Project (Tencent Holdings Ltd.)Holdings Ltd.)
38	Ordos CO ₂ Electrolysis to Syngas Project (Tianjin University)
39	Taiyuan Ruiguang Power Plant Flue Gas CO ₂ Capture Project (Southwest Chemical Research and Design Institute Co., Ltd)
40	Jilin Baicheng Fermentation Gas CO ₂ Capture Project (Southwest Chemical Research and Design Institute Co., Ltd)
41	Chengdu Coal Chemical Chain Combustion Full Process Demonstration System (Tsinghua University)
42	Tahe Refining and Chemical Hydrogen Production Blowdown Gas CCUS Full Process Project (China Petrochemical Corporation)
43	Tarim CCUS Project (China National Petroleum Corporation)
44	Tuha Hami CCUS Demonstration Project (China National Petroleum Corporation)
45	Xinlianxin CCUS Full Process Project (Henan Xinlianxin Shenleng Energy Co., Ltd.)
46	Yantai Penglai Power Plant Microalgae Carbon Fixation Project (Hairong Company)
47	Lanzhou Liquid Solar Fuel Synthesis Demonstration Project (Lanzhou New Area Petrochemical Industry Investment Group Co., Ltd)
48	Ordos Liquid Sunshine Demonstration Project (China National Coal Group Corporation)
49	Lanxi CO ₂ Capture and Mineralization Utilization Integrated Demonstration Project (Zhejiang Provincial Energy Group Company Ltd)
50	Fukang CCUS Full Process Project (Center for Hydrogeology and Environmental Geology, CGS)
51	Tianjin Iron Works Smoke CO ₂ Capture Project (China National Administration of Coal Geology)
52	Lishui LS36-1 Gas Field CO ₂ Capture and Purification Project (China National Offshore Oil Corporation)
53	Phase I Development Project of Bozhong 19-6 Condensate Gas Field (China National Offshore Oil Corporation)
54	Southern Oilfield Chengmai CCUS Project (China National Petroleum Corporation)

Table 1 (Continued)

No.	Project name (organizer)
55	Enping 15-1 Oilfield Group CO ₂ Storage Project (China National Offshore Oil Corporation)
56	Jilin CO ₂ based biodegradable plastic project (Changchun Institute of Applied Chemistry, CAS)
57	Ruian CO ₂ to Polyol Project (Changchun Institute of Applied Chemistry, CAS)
58	Key Technologies and Demonstration of Large Scale Reforming and Conversion of CO ₂ from Changzhi Industrial Waste Gas to Synthetic Gas (Shanghai Advanced Research Institute, CAS)
59	Ordos CO ₂ microalgae biological fertilizer project (Shanghai Advanced Research Institute, CAS)
60	Dongfang 1000 t CO ₂ hydrogenation to methanol industrial test device (Shanghai Advanced Research Institute, CAS)
61	Qinshui CO ₂ Drive Coalbed Methane Project (China United Coalbed Methane Co., Ltd)
62	Liulin Coalbed Methane Injection Production Project (China Australia Cooperation)
63	Shengli Oil Field CO ₂ capture, utilization and storage whole process project (Sinopec Qilu Petrochemical Company)
64	Zhongyuan Oilfield Puyang CO ₂ -EOR Demonstration Project (China Petrochemical Corporation)
65	East China Oil and Gas Field CCUS Project - Nanhua Synthetic Ammonia Tail Gas Recovery Auxiliary Unit (Phase I) (China Petrochemical Corporation)
66	East China Oil and Gas Field CCUS Project - Nanhua Synthetic Ammonia Tail Gas Recovery Auxiliary Unit (Phase II) (China Petrochemical Corporation)
67	East China Oil and Gas - Nanhua Company CO ₂ Capture Project (Phase III) (China Petrochemical Corporation)
68	East China Oil and Gas - Nanhua Company CO ₂ Capture Project (Phase IV) (China Petrochemical Corporation)
69	Jinling Petrochemical - Jiangsu Oilfield CO ₂ Capture Project (China Petrochemical Corporation)
70	Changqing oil field Jiuyan CCUS pilot test project (China National Petroleum Corporation)
71	Changqing oil field Ningxia CCUS Project (China National Petroleum Corporation)
72	Daqing Oil Field Daqing Petrochemical Cooperation CCUS Project (China National Petroleum Corporation)
73	Daqing Oil Field Hulunbeier CCUS Project (China National Petroleum Corporation)
74	Jilin oil field Jilin Petrochemical Cooperation CCUS Project (China National Petroleum Corporation)
75	Jilin Daqingzijing Oilfield CCUS Project (China National Petroleum Corporation)
76	Jidong Oilfield CCUS Project (China National Petroleum Corporation)
77	Huabei Oilfield Cangzhou CCUS Project (China National Petroleum Corporation)
78	Xinjiang Oilfield CCUS Industrialization Project (China National Petroleum Corporation)
79	Liaohe oil field Panjin CCUS Project (China National Petroleum Corporation)
80	Southern Oilfield Lingao CCUS Project (China National Petroleum Corporation)
81	Xingtai coke oven flue gas CO ₂ capture demonstration project (China Risun Group Limited)
82	CO ₂ capture of metallurgical gas from Urumqi European smelter (China Baowu Steel Group Corporation)
83	Yingkou Green Hydrogen Fluidized Bed Direct Reduction Technology Demonstration Project (Ansteel Group)
84	Phase II of New Energy Photovoltaic Cell Packaging Materials and CO ₂ Capture and Purification Project (China Building Materials (Hefei) New Energy Co., Ltd)
85	Xuzhou 10000 t CO ₂ purification steel slag mineralization comprehensive utilization industrial test project (Xusteel Group)
86	Zoucheng 10000 t flue gas direct mineralization demonstration line (Chambroad Group)
87	1000 t/year CO ₂ hydrogenation to gasoline project (Dalian Institute of Chemical Physics, CAS)
88	Unit 3 1 million t/year flue gas CO ₂ capture project (China Resources Power Holdings Co., Ltd)
89	Zhaoqing 100000 t/year flue gas CO ₂ capture and mineralization project (China Resources (Holdings) Co., Ltd)
90	20000 t/year lime kiln tail gas CO ₂ capture and mineralization project (Ningbo Iron and Steel Co., Ltd)
91	Yancheng Thousand Ton Phase Change Capture Technology Demonstration Project (Tsinghua University)
92	Xinjiang Oilfield CCUS Pilot Project (China National Petroleum Corporation)
93	300000 t/year CO ₂ capture device project (Shaanxi Yanchang Petroleum Yulin Coal Chemical Company)
94	100000 t coal-fired gas turbine CCUS project (Changxing Island Power Plant, SPIC)
95	Shenzhen microalgae carbon sequestration project (China Resources (Holdings) Co., Ltd)
96	Demonstration of flue gas microalgae carbon sequestration project (Guangdong Energy Zhanjiang Biomass Power Plant)