ICCSD 合作应对气候变化 携手推动低碳转型
Step up for Change

CHINA PAVILION COP28

Policy Incentives of CCUS development under China's Carbon Neutrality Goal

Song Weize, Li Zheng, Sun Boda

Institute of Climate Change and Sustainable Development, Tsinghua University

ICCSD

CONTENTS

POLICY INCENTIVES OF CCUS DEVELOPMENT UNDER CHINA'S CARBON NEUTRALITY GOAL

Song Weize, Li Zheng, Sun Boda
Institute of Climate Change and Sustainable Development,
Tsinghua University

The Chinese government has consistently emphasized the importance of addressing climate change and actively engages in global governance. In September 2020, during the 75th session of the United Nations General Assembly, China pledged to reach the peak of its carbon emissions before 2030 and accomplish carbon neutrality no later than 2060. The commitment was swiftly followed by the launch of the "1+N" climate policy system. It explicitly highlights that carbon capture, utilization, and storage (CCUS) will play a pivotal role in promoting green low-carbon transition and is an part of China's decarbonization technologies[1]. The results of several institutions indicate that by 2060, China's annual demand for carbon capture could be approximately 1.0~2.5 billion tons of CO_2[2,3,4]. A study conducted by the Administrative Center for China's Agenda 21 projects that the reduction of carbon dioxide emissions achieved by CCUS

1 Information Office of the State Council. China's Policies and Actions on Climate Change. 2021 [cited 2023 13th October]; Available from: https://www.gov.cn/zhengce/2021-10/27/content_5646697.htm.

2 ZHANG Xiliang, HUANG Xiaodan, ZHANG Da, et al.Research on energy economy transition path and policy under the goal of carbon neutrality[J].Management World,2022,38(01):35-66. DOI:10.19744/j.cnki.11-1235/f.2022.0005

3 Global Energy Interconnection Development and Cooperation Organization. 2021. China Carbon Neutrality Before 2060.

4 Xian Zhang, Xiaoliang Yang, Xi Lu, China Carbon Capture, Utilization and Storage (CCUS) Annual Report (2023). 2023, China Agenda 21 Management Center, Global Institute of Carbon Capture and Storage, Tsinghua University, 2023.

technology would be around 100 million tons per year (ranging from 58 to 147 million tons per year) by 2030, and approximately 2.35 billion tons/year (ranging from 21.1 to 2.53 billion tons per year) by 2060 [4].

1. CHALLENGES AND OPPORTUNITIES FOR THE CCUS DEVELOPMENT IN CHINA

Over the past decade, China has implemented a series of policies to promote the development of CCUS industry. As of November 2022, approximately 100 CCUS demonstration projects are underway throughout the country, at various stages and scales. Half of these projects are already operational. However, despite these efforts, most of CCUS projects in China are still in the pilot demonstration phase. This indicates a significant gap between the current carbon dioxide capture capacity and the target demand. According to the China CCUS Annual Report 2023, the existing annual CO_2 capture capacity stands in only 4 million tons, which is just 0.17% of the projected demand for the year 2060 under the carbon neutrality goal[4]. The main obstacles hindering progress compass missed opportunities in the time window of technology implementation, increased cost of construction and operation, unclear mechanisms for cross-sectoral cooperation, the lack of laws and regulations, and uncertainties in the accounting methodologies for emission reduction [5,6]:

5 Bank, A.D., Road Map Update For Carbon Capture,Utilization,And Storage Demonstration And Deployment In The People's Republic Of China 2022. p. P4-9.

6 Lu, X.Z.X.Y.X., CCUS Progress in China- A Status Report. 2022.

(1) CCUS in Eastern, Central and Southern China is encountering challenges

The pilot and large-scale implementation of Carbon Capture, Utilization, and Storage (CCUS) projects in China has exposed a series of emerging challenges. These encompass limited infrastructural facilities and storage sites, as well as issues related to the incongruity between source and sink alignment. An examination of the distribution of sources and sinks underscores a significant spatial dislocation within China. Although theoretically, the country possesses a storage capacity fluctuating from 1.21 to 4.13 trillion tons of CO_2, principal regions such as the Songliao Basin (695.4 billion tons), Tarim Basin (552.8 billion tons), and the Bohai Bay Basin (490.6 billion tons), cumulatively contribute to approximately half of the total storage capacity[7]. Nonetheless, a considerable difficulty emerges in the realm of spatial distribution, notably in densely populated, energy intensive regions such as East and South China, where significant amounts of CO_2 emissions occur. In these specified areas, the number and capacity of onshore basins suitable for storage are notably constricted[6]. As a result, the scarcity of onshore storage alternatives in Eastern, Central, and Southern China necessitates a significant dependence on offshore storage solutions.

(2) Opportunities for the implementation are easily overlooked.

According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the global objective of maintaining the increase in temperature beneath 2℃ , as stipulated by the Paris Agreement, necessitates a 30% reduction in CO_2 emissions by 2030

7 Cai Bofeng, Li Qi, Zhang Xian, China Carbon Dioxide Capture, Utilization and Storage (CCUS) Annual Report (2021) - Research on China's CCUS Pathway. 2021.

and complete neutrality by the early 2070s. Furthermore, by the year 2050, the global consumption of coal, oil and gas ought be reduced by 80%, 30%, and 15%, respectively, relative to the levels recorded in 2019. The pivotal period for CO_2 emissions reduction in China will occur from 2030-2040. During this critical decade, there is a profound need to sharply decrease fossil fuel consumption. Hence, the implementation of CCUS technology on a grand scale would be necessary by 2040. It is a pivotal strategy to address major challenges such as key technical obstacles and disparities between sources and sinks of CO_2 emissions, in order to meet the emissions reduction target set for the decade. It is important to note that the longer the deployment of CCUS technology is delayed, the smaller the potential for reducing emission becomes [8].

(3) Construction and operating costs remain high, and negative cost opportunities are mainly concentrated in the chemical and cement industries

In China, the coal chemical industry boasts the lowest cost for implementing carbon capture and storage (CCS), with a cost of less than USD 20/tCO_2 [9]. Conversely, the cement industry signifies a myriad of cost-effective emission reduction potentials, attributed to the minimal scale and broad distribution of cement plants. It is projected that CCUS technology will pervasively extend into the energy and industrial sectors by 2050, effecting substantial aggregate cost reductions. Notably, it is anticipated that the expenditure linked to the second-generation capture technology will decline by more that 50% relative to contemporary levels[11]. It is noteworthy that when the benchmark electricity price drops below 311 yuan/MWh (equivalent to approximately 47 USD/MWh), opportunities for cost savings are

8 Hepburn, N.S.J.E.S. Liu.Zhang.Li.C., Embracing a New Paradigm of Green Development: A Study on China's Carbon Neutrality Policy Framework. 2023.

predominantly found through the utilization of enhanced oil recovery (EOR) technology, specifically using gas flooding[9].

2. POLICY INCENTIVES ARE IMPORTANT TO DRIVE CCUS COST REDUCTION AND INCREASE EMISSIONS REDUCTION

In order to promote the expansion of CCUS and achieve significant emission reductions, various incentive policy tools can be employed. These include the implementation of a reasonable carbon pricing mechanism and the provision of tax incentives[15]. Notably, Significant upfront investment and expansive business models affirm that the incentives, for example, investment subsidies and feed-in tariff subsidies, play a crucial role in driving CCUS technology and industry growth. Furthermore, hastening the implementation of policy is vital for the advancement of CCUS technology[10]. Currently, the Chinese government has initiated efforts to support CCUS, including policies related to research and development (R&D) demonstrations, tax incentives, subsidies, as well as capacity building. However, due to factors like varying stages in technological development, disparate local financial conditions, and the nationwide adaptability, the relevant policies have note experienced large-sale promotion.

China's current policies regarding CCUS primarily are composed

9 Lockwood, To, Achieving Carbon Emission Reduction from China's Coal Power Plants through CCUS (Carbon Capture, Utilization, and Storage) Technology Transformation. 2019, National Academy of Energy Technology and Economics.

10 Fan, J.-L., et al., Modelling plant-level abatement costs and effects of incentive policies for coal-fired power generation retrofitted with CCUS. Energy policy, 2022. 165: p. 112959.

of guidance and encouragement mechanisms, devoid of explicit regulations that holistically address key aspects such as market entry, infrastructure construction, operation, oversight, and cessation of CCUS projects. Preferential tax policies for CCUS are dispersed across diverse categories, encompassing environmental protection, energy conservation, water conservation, and comprehensive resource utilization. These tax advantages include value-added tax, resource tax, and corporate income tax, with certain exemptions and deductions awarded in specific instances, termed as "three exemptions and three halves". As for regional financial subsidies, cities like Shenzhen and Beijing offer grants or incentives for CCUS project investments, amounting for 20% and 25% of the overall investment respectively. However, these are subject to maximum limits of 10 million and 30 million yuan[11,12]. The financial policies encompass include the carbon emission reduction support tool of the People's Bank of China and the Green Bond Taxonomy. However, there is a striking scarcity of technical standards and guidelines. To address this issue, in 2018, the Ministry of Industry and Information Technology formulated the design standard for carbon dioxide transportation pipelines. Concurrently, the Ministry of Housing and Urban-Rural Development promulgated the "Design Standard for Flue Gas Carbon Dioxide Capture and Purification Engineering" [13]. Some industrial organizations and academic institutions are spearheading the development of standards for the

11 Shenzhen Municipal Development and Reform Commission, 2023 Guidelines for the Application of Special Fund Projects for Strategic Emerging Industries (First Batch), Shenzhen Municipal Development and Reform Commission, 2023.

12 Beijing Municipal Bureau of Economy and Information Technology; Beijing Municipal Bureau of Finance;, 2022 Beijing Municipal High-tech Industry Development Fund Implementation Guide, Beijing Municipal Bureau of Economy and Information Technology, Beijing Municipal Bureau of Finance, 2022.

13 Ministry of Housing and Urban-Rural Development of the People's Republic of China, State Administration for Market Regulation, Design Standards for Flue Gas Carbon Dioxide Capture and Purification Engineering. 2018.

environmental risk assessment of projects, and for the calculation and verification of reductions in greenhouse gas emission. With respect to project life cycle management, 13 government bodies are currently engaged in the approval and oversight processes prior to a project, indicating a fragmented regulation environment. There is also a lack of clarity regarding the regulatory responsibilities for CCUS storage projects after well sealing.

3. CCUS POLICY IMPLICATIONS CONSIDERING CHINA'S NATIONAL CONDITIONS

(1) Enhance technical standards and clarify regulatory scopes

China is urgent to expedite the development of technical standards related to CCUS. The formulation of an explicit and comprehensive timeline for the evolution technical standards across all CCUS project aspects is imperative. Additionally, specific regulatory authorities responsible for CCUS projects along with their scope should be clearly defined. Equally significant is the delineation of ownership and property rights concerning carbon dioxide as well as the specification of responsibilities in the event of potential leakage in non-integrated projects. Further, the criteria for qualification for policy incentives also need explicit definition.[14].

(2) Establish a systematic subsidy incentive scheme

The implementation of a structured incentive system for CCUS will encourage higher adoption rates, by applicable enterprises and

14 IEA, Legal and Regulatory Frameworks for CCUS. 2022.

organizations. Currently, direct subsidies for CCUS are predominantly allocated within Beijing, Shanghai, Shenzhen, and Zhejiang Province, and only Shenzhen and Beijing have set a maximum subsidy cap for direct subsidies. In addition, it is recommended that the incentive scheme includes an comprehensive subsidy program that encompasses the various modules of CCUS. At the same time, the enlargement of the conventional industrial chain, either through collaboration or transformation via novel integrated industrial models, such as carbon recycling and utilization, could cultivate a new industrial ecology, thus fostering the growth of the CCUS industry.

(3) Improve project revenues and financing channels

To ensure a relatively consistent return on investment for CCUS investors, we suggest incorporating that CCUS project emission reductions into China's Certified Emission Reduction (CCER) scheme. Currently, the Ministry of Ecology and Environment's Pilot Program for Climate Investment and Financing serves as the principal supportive policy for CCUS project investment in China. The first group of financiers selected for climate investments include 23 cities and districts, consisting of 12 municipalities, 4 districts, and 7 state-level new zones. However, significant progress has only been observed in cities like Shenzhen, Liuzhou, which have advanced in developing their climate investment and financing project libraries. The remaining regions have not demonstrated substantial advancements, revealing an immediate need for improved support measures for project investment and financing in CCUS pilot areas.

Annex:

Table 1 CCUS incentives in China's "1+N" policy system

TYPE	NAME	AUTHORITY	DATE
Top-level strategy	Opinions on completely, accurately, and comprehensively implementing the new development concept and doing a good job in carbon peak and carbon neutrality	The Central Committee of the Communist Party of China and the State Council	2021.10.25
	Action plan for carbon peaking before 2030	State Council	2021.10.26
Sectoral or regional policy	Implementation Plan for Science and Technology to Support Carbon Peak and Carbon Neutrality (2022-2030)	Nine departments including the Ministry of Science and Technology	2022.06.24
	Zhejiang Province Carbon Peak and Carbon Neutrality Science and Technology Innovation Action Plan	Zhejiang Provincial Party Committee	2021.06.08

POLICY AREAS	GOALS & ACTIONS
R&D	- Promote the R&D, demonstration and industrial application of large-scale CCUS technology
investment	- Supporting investment and financing of low-carbon technology projects such as CCUS - Mobilize state-owned enterprises to invest in the R&D and application of net-zero technologies
Decarbonization of steel	- Explore pilot demonstrations of hydrogen metallurgy and CCUS integration
R&D	-Promote breakthroughs in the research and development of low-carbon technologies and equipment such as CCUS - Deploy full-process, integrated, and large-scale CCUS demonstrations and application pilots
Technical performance	- Reduce energy consumption per unit of CO_2 captured by 20% by 2025 compared to 2020 and by 30% by 2030
Technical performance	-By 2025, CO_2 capture rate ≥ 90%, CO_2 conversion rate ≥ 90%, carbon capture energy consumption decreased by 35% or more

Table 2 Technical standards related to CCUS technology in China

PHASE	NAME	STANDARD TYPE
Capture	Technical Guidelines for the Evaluation of Carbon Capture Index Systems in the Oil Refining Industry	Group standards
	Technical Guidelines for the Evaluation of Carbon Capture Index System in Modern Coal Chemical Industry	Design standards
Transport	Engineering design standards for carbon dioxide transmission pipelines	Group standards
Storage	N/A	
Whole process	Terminology for carbon dioxide capture, utilization and storage	Group standards
	Carbon Capture, Utilization and Storage (CCUS) Project Emission Reduction Accounting Methodology	Group standards
	Technical specifications for quantifying and verifying greenhouse gas emission reductions for carbon capture, utilization, and storage (CCUS) projects	National standards
	Technical Guidelines for Environmental Risk Assessment of Carbon Dioxide Capture, Utilization and Storage (Trial)	Technical Guidance

LEAD AGENCY	STATE	YEAR
Environmental Engineering Assessment Center of the Ministry of Ecology and Environment, China Petroleum and Chemical Industry Federation	In preparation	2023
Ministry of Industry and Information Technology	Published	2018
Chinese Academy of Environmental Planning, Ministry of Ecology and Environment	Published	2021
Carbon Capture, Utilization and Storage Committee of the Chinese Society of Environmental Sciences	In preparation	2023
China University of Petroleum (Beijing), China National Institute of Standardization, etc.	In preparation	2022
Department of Science and Technology Standards, Ministry of Environmental Protection, etc.	Published	2016

Table 3 Tax incentives related to the CCUS development in China

PHASE	TYPE OF TAX	FIELDS OF APPLICATION	REQUIREMENTS
Capture	Value-added tax	Comprehensive utilization of waste residue, waste water (liquid) and waste gas	High-purity carbon dioxide that conforms to the national standard "High Purity Carbon Dioxide" (GB/T 23938-2009)
Utilization	Resource tax	Geological utilization	Coal seam (formed) gas that needs to be extracted for safe production
			Shale gas extraction
Storage	Corporate income tax	Technological retrofit for energy conservation and emission reduction	The carbon sequestration capacity shall not be less than 100,000 tons/year

IMPLEMENTATION	OFFER DETAIL
Immediate requisition	Tax refund rate: 70%
Income is deducted when calculating the amount of taxable income tax	Tax deduction rate: 90%, based on the total income
Exemption	Exemption from resource tax
Levy reduction	From 1 April 2018 to 31 December 2023, the shale gas source tax will be reduced by 30% from the prescribed 6% rate.
Regular reductions	From the first to the third year, the corporate income tax is exempted, and from the fourth to the sixth year, the corporate income tax is halved
Reduced by a certain percentage	10% of the investment in energy-saving and water-saving special equipment can be deducted from the tax payable of the enterprise in the current year. If the credit is insufficient for the current year, the credit can be carried forward to the next 5 tax years.

Table 4 Funding programs related to the CCUS technology development in China

DEVELOPMENT STAGE	CLASSIFICATION	
R&D	R&D	subsidy
Pilot demonstration	Investment	Reward
		Subsidy
		Subsidy
		Loan
		Bond
	Sealed	Subsidy
	Electricity price	Subsidy
Pilot demonstration	N/A	

	DETAILS	APPLICABLE REGIONS	YEAR OF RELEASE
	- Subsidies of 200,000-500,000 yuan will be given to newly recognized high-tech enterprises - Provide a subsidy of 0.5-1 million yuan to the enterprises under review;	Nationwide	2022
	- CCUS projects that reduce carbon dioxide equivalent by 300 tons per year will be rewarded with 25% of the total investment, up to 30 million yuan	Beijing	2022
	- Construction of coal-fired power CCUS and offshore CCUS demonstration projects, and new high-efficiency and low-energy CCUS projects, with a subsidy of 20% of the total investment, up to 10 million yuan.	Shenzhen	2022
	To support the continuous and efficient operation of CCUS projects, the subsidy will be 20 yuan per ton of carbon dioxide after the project is put into operation.	Shenzhen	2022
	Carbon Emission Reduction Supporting Tool: Provides financial support at 60% of the loan principal amount at an interest rate of 1.75% with a tenor of 1 year and can be renewed twice	Nationwide	2021
	Green industries, green projects, or green economic activities that meet the specified conditions will be included in the taxonomy	Nationwide	2021
	N/A		
	N/A		

ABOUT ICCSD

Institute of Climate Change and Sustainable Development (ICCSD) of Tsinghua University was founded in October 2017. ICCSD is committed to building a collaborative platform for strategy and policy research, talent cultivation, international dialogue, bridging the gap between academic research and policy, and providing support and solutions related to climate change and sustainable development.

ICCSD has accomplished several flagship research projects, such as Strategy and Pathway of Low-carbon Transition in China, and Synergizing Actions on the Environment and Climate, etc. Also, ICCSD has established the Methane Emission Reduction Cooperation Platform and Nature-based Solution Cooperation Platform to foster broader collaboration and knowledge sharing. The Institute has also launched extensive bilateral and multilateral dialogues, including "Climate Change Global Lectures" and "Friends of the Paris Agreement"; and provided full support for "Global Alliance of Universities on Climate" and held two South-South cooperation climate training programs.