Padjadjaran Journal of International Relations (PADJIR)
e-ISSN: 2684-8082 Vol. 8 No.2, Agustus 2026 (57-68) doi: 10.24198/padjir.v8i2.71441

The Dynamics of China's Emissions Mitigation Policy: An Analysis of the Limitations of Adopting Carbon Capture, Utilization, and Storage as a Primary Instrument for Carbon Emissions Reduction

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| Dikirim: 30-06-2026 | Diterima: 08-07-2026 | Dipublikasikan: 17-08-2026 |

Keywords
Carbon Policy, CCUS, China, Mitigation

ABSTRACT
This study examines China's carbon emission mitigation policy by focusing on the limited adoption of Carbon Capture, Utilization, and Storage (CCUS) as a primary decarbonization strategy. The study employs James S. Coleman's Rational Choice Theory as the main theoretical framework and the concept of Energy Security to explain the Chinese government's policy preferences in carbon mitigation. This research uses a qualitative method with a case study approach, relying on library research and descriptive qualitative analysis. The findings indicate that although China has implemented various mitigation policies, including the Emission Trading Scheme (ETS), large-scale renewable energy development, industrial energy efficiency, and transport electrification, CCUS has not become the country's primary mitigation instrument. The limited adoption of CCUS is influenced by high investment costs, weak regulatory and financial incentives, technological and infrastructure constraints, and limited international pressure. From the perspective of Rational Choice Theory, these findings suggest that the Chinese government prioritizes policies that strengthen energy security, economic stability, and sustainable development. Consequently, CCUS is positioned as a complementary long-term technology rather than the main pillar of China's decarbonization strategy.

Kata Kunci
CCUS, Kebijakan Karbon, Mitigasi, Tiongkok

ABSTRAK
Penelitian ini menganalisis dinamika kebijakan mitigasi emisi karbon di Tiongkok dengan fokus pada rendahnya prioritas teknologi Carbon Capture, Utilization, and Storage (CCUS). Penelitian menggunakan Rational Choice Theory James S. Coleman (1990) sebagai landasan teori dan konsep Energy Security untuk menjelaskan preferensi pemerintah Tiongkok dalam menentukan kebijakan dekarbonisasi. Metode yang digunakan adalah penelitian kualitatif dengan pendekatan studi kasus melalui studi kepustakaan yang dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa meskipun Tiongkok telah menerapkan berbagai kebijakan mitigasi seperti Emission Trading Scheme (ETS), pengembangan energi terbarukan, efisiensi energi industri, dan elektrifikasi transportasi, CCUS belum menjadi instrumen utama mitigasi. Rendahnya prioritas CCUS dipengaruhi oleh tingginya biaya investasi, lemahnya insentif dan regulasi, keterbatasan teknologi dan infrastruktur, serta rendahnya tekanan internasional. Berdasarkan perspektif Rational Choice Theory, kondisi tersebut menunjukkan bahwa pemerintah Tiongkok lebih memprioritaskan kebijakan yang mendukung keamanan energi, stabilitas ekonomi, dan keberlanjutan pembangunan, sehingga CCUS diposisikan sebagai teknologi pelengkap dalam strategi dekarbonisasi nasional.

INTRODUCTION

Over the past decade, the issue of climate change has undergone a significant transformation from being merely an environmental agenda into a strategic issue closely intertwined with political, economic, and national development interests. Over the past ten years (2015–2025), the increasing concentration of global greenhouse gas emissions has prompted major countries to reassess and restructure their energy policies, particularly following the adoption of the Paris Agreement in 2015. This period has been marked by growing international pressure on high-emitting countries to demonstrate compliance with climate policies through concrete instruments, including energy transition, carbon market mechanisms, and the development of mitigation technologies such as Carbon Capture, Utilization, and Storage (CCUS).

Over the past five years (2020–2025), green political dynamics have become increasingly prominent amid growing pressure from the global climate crisis, the COVID-19 pandemic, and the green economic recovery agenda (Hao et al., 2025a). G20 countries have increasingly positioned decarbonization not only as a global moral obligation but also as a political and economic instrument to maintain industrial competitiveness, energy stability, and the legitimacy of international leadership. However, the implementation of green policies at the domestic level is often confronted with competing interests between the demands for emissions reduction and the need for national economic growth, particularly in countries with strong heavy-industrial bases (Hao et al., 2025a).

In this context, Carbon Capture, Utilization, and Storage (CCUS) technology has emerged as a compromise-oriented policy solution. CCUS enables countries to maintain fossil fuel-based industrial activities while reducing carbon emissions, and is therefore often positioned as a bridging technology (Wei, 2022). However, the adoption of CCUS is determined not solely by technological readiness but is also strongly influenced by policy compliance, regulatory design, domestic economic interests, and long-term political cost-benefit calculations (IEA, 2020).

In practice, the implementation of CCUS in G20 countries is shaped by a complex interaction between international commitments and domestic political interests. Although G20 countries collectively support the climate change mitigation agenda through various joint declarations, the level of compliance with these commitments depends heavily on the compatibility between climate policies and the economic structures of individual countries. In many cases, compliance with the global climate agenda is not fully translated into operational domestic policies, particularly when such policies have the potential to increase production costs in strategic industries or undermine national energy stability.

For high-emitting countries such as China, a policy dilemma arises between international obligations to reduce emissions and the need to sustain industrial-based economic growth. This imbalance has led CCUS policies to tend to be positioned as a long-term option or pilot project rather than as a primary instrument for emissions reduction. Therefore, the limited adoption of CCUS does not necessarily reflect a lack of environmental commitment; rather, it is more accurately understood as the outcome of policy calculations that take into account economic risks, fiscal constraints, and national political interests (Hao et al., 2025a)

In the global context, China's position as the world's largest contributor to carbon emissions means that the mitigation policies adopted by the country have significant implications for international efforts to address climate change. Data from the Global Carbon Budget indicate that in 2023, China's production-based carbon emissions reached approximately 11.9 gigatonnes of CO_2-eq, accounting for around 31% of total global emissions (Friedlingstein et al., 2023). This substantial contribution is closely associated with China's economic structure, which remains heavily reliant on energy-intensive manufacturing industries, as well as its high dependence on coal as a primary energy source. Although China has succeeded in reducing its carbon intensity and significantly expanding its renewable energy capacity in recent years, the absolute scale of its emissions remains exceptionally high.

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On the other hand, various studies have demonstrated that Carbon Capture, Utilization, and Storage (CCUS) technology has significant potential to support the decarbonization of hard-to-abate heavy industries, such as steel, cement, and petrochemicals (IEA, 2021). By 2021, China had developed approximately 40 CCUS demonstration projects with a capture capacity of around 3 million tonnes of CO_2 per year (Liu et al., 2022). However, most of these projects remain at the demonstration stage and have yet to develop into large-scale commercial applications. This situation indicates a gap between the potential of CCUS technology as an emissions mitigation instrument and its actual position within China's national decarbonization policy. Therefore, analyzing the dynamics of CCUS policy is important for understanding how China responds to global pressure to reduce carbon emissions.

Based on this background, the main research question is: Why has China, as the world's largest contributor to carbon emissions, not yet adopted CCUS technology as a primary instrument in its national emissions mitigation policy?

This study is based on the fact that China has established a number of CCUS demonstration and pilot projects, yet the technology has not been positioned as a primary instrument in its national decarbonization strategy. Therefore, the analysis focuses on political-economic factors, the dynamics of international compliance, and structural transformation processes that influence the position of CCUS policy at the domestic level. This study aims to analyze the limitations of CCUS adoption in the context of China's domestic economic structure, the non-coercive nature of climate commitments within the G20 framework, and the dynamics of China's transformation toward a low-carbon economy.

CONCEPTUAL FRAMEWORK

Carbon Capture, Utilization, and Storage (CCUS)

Carbon Capture, Utilization, and Storage (CCUS) refers to a range of technologies designed to capture carbon dioxide (CO_2) from major emission sources, such as fossil fuel-fired power plants, heavy industrial facilities (including cement, steel, and chemical industries), as well as directly from the atmosphere, and subsequently store it permanently or utilize it for specific purposes. This technology is considered one of the strategic solutions for reducing greenhouse gas emissions, which are a major driver of climate change (IEA, 2020).

According to Jiutian et al. (2022), CCUS involves three main stages: (1) the capture of CO_2 from emission sources; (2) the utilization of CO_2, for example in the production of synthetic fuels, fertilizers, or other industrial processes; and (3) the permanent storage of CO_2 in secure geological reservoirs, such as deep saline aquifers, sandstone formations, or depleted oil and gas reservoirs. This technology not only helps curb the increase in atmospheric carbon concentrations but also creates new economic opportunities by treating captured carbon as a resource.

Several approaches to CO_2 capture within CCUS include pre-combustion capture, post-combustion capture, and oxy-fuel combustion. Once captured, CO_2 can be compressed and transported via pipelines or ships to storage sites. In the context of utilization, CO_2 can be further processed for Enhanced Oil Recovery (EOR), used in the production of construction materials such as carbon-negative concrete, or employed as a feedstock for the chemical industry.

In the context of energy policy and the energy transition, CCUS plays an important role as a bridging technology toward a low-carbon energy system. The International Energy Agency (IEA) states that CCUS can make a significant contribution to cumulative emissions reductions required to achieve the net-zero emissions target, particularly as current technologies remain at the demonstration stage, and emphasizes the need for continued development and widespread deployment of CCUS, as achieving net-zero emissions by mid-century would otherwise become considerably more difficult and costly (IEA, 2021). Therefore, many countries, particularly G20 members, have begun incorporating CCUS into their national emissions reduction strategies, although the pace and extent of progress and implementation vary considerably across countries.

G20 Members' Obligations Regarding CCUS Policies Within the Framework of Global Commitments

G20 member states play a strategic role in global climate change mitigation efforts, as the group represents approximately 85% of global Gross Domestic Product (GDP) (Teske, 2023) and nearly 75% of total global greenhouse gas emissions (Umana & Eigen, 2022). Given their substantial contribution to global emissions, G20 countries bear significant responsibility for promoting the development of carbon mitigation technologies, including Carbon Capture, Utilization, and Storage (CCUS). CCUS is a technological system designed to capture carbon dioxide (CO_2) from major emission sources, utilize it for various industrial purposes, or permanently store it in geological formations to prevent its release into the atmosphere. This technology is regarded as an important instrument for decarbonizing hard-to-abate industries, such as steel, cement, and petrochemicals, which face significant challenges in reducing emissions through renewable energy alone (IEA, 2020).

The commitment of G20 countries to emissions reduction is also reflected in the Paris Agreement under the framework of the United Nations Framework Convention on Climate Change (UNFCCC). Through this agreement, each Party is required to formulate and periodically update its Nationally Determined Contributions (NDCs) as a form of national contribution to reducing greenhouse gas emissions (IEA, 2021). Although the agreement is not legally binding in terms of specific emissions reduction targets, this mechanism creates normative pressure on G20 member states to align their domestic policies with the broader objectives of global climate change mitigation.

Furthermore, various G20 Climate and Energy Communiqués, particularly those issued following the summits in Osaka (2019), Riyadh (2020), and Bali (2022), have consistently emphasized commitments related to the outcomes of COP26, including the achievement of net-zero emissions (G20, 2022). The development of CCUS technology has also been consistently identified as part of the energy transition and decarbonization strategies for the global industrial system (IEA, 2021). These commitments emphasize the importance of increasing investment, strengthening regulatory frameworks, and promoting international cooperation in the development of carbon capture and storage technologies. Thus, although these commitments do not possess legally binding force, collective commitments within the G20 framework continue to generate political and normative pressure that encourages member states to integrate CCUS technologies into their national climate policies.

This study employs Rational Choice Theory as its analytical framework to explain the position of Carbon Capture, Utilization, and Storage (CCUS) within China's decarbonization strategy. Rational Choice Theory was systematically developed by James S. Coleman, who argued that social actors, including states, can be viewed as rational entities that make decisions based on cost-benefit calculations in pursuit of specific objectives. Within this framework, states are assumed to establish policy priorities through strategic calculations that take into account the benefits, costs, and potential risks associated with each policy option (Coleman, 1990).

In the context of climate policy, the rational choice approach suggests that the selection of mitigation instruments is influenced not only by global normative pressures but also by considerations of economic efficiency, domestic political stability, energy security, and the compatibility of policies with national development structures. Accordingly, a country's decision to adopt or refrain from prioritizing a particular technology, such as CCUS, as a major emissions mitigation instrument can be understood as the outcome of a rational calculation that weighs long-term benefits against the economic costs and political risks that may arise.

In the contemporary environmental political economy literature, the rationality of high-emitting developing countries is often explained through three main variables: technological costs, domestic energy structures, and institutional incentives. CCUS technology has significant potential to support carbon neutrality targets, particularly in hard-to-abate industries and coal-fired power generation. However, various studies indicate that large-scale implementation continues to face challenges, including high upfront investment costs, commercialization uncertainties, and the need for complex carbon transportation and storage infrastructure. Therefore, the implementation of this technology requires careful and comprehensive planning (Liu et al., 2022). From a rational perspective, the large-scale adoption of CCUS requires substantial long-term fiscal and regulatory commitments.

When associated with China's economic structure, which continues to experience carbon lock-in due to the dominance of coal and energy-intensive manufacturing industries, the decision not to make CCUS the primary mitigation instrument can be understood as the result of a rational calculation of macroeconomic risks. The early retirement of coal-fired power plants, the retrofitting of carbon capture technologies, and the development of a nationwide CO_2 pipeline network would require substantial financial resources and could potentially generate significant socio-political impacts, including risks to employment and energy price stability (Liu et al., 2022).

Conversely, instruments such as the expansion of renewable energy, transportation electrification, and the strengthening of the national emissions trading system are considered capable of producing more rapid reductions in carbon intensity at increasingly competitive marginal costs. Empirical evidence indicates that investments in solar and wind energy in China have achieved economies of scale that have significantly reduced costs, thereby generating dual benefits: emissions reductions and increased competitiveness in green industries. From the perspective of rational policy-making, these options offer greater cost-effectiveness than large-scale CCUS deployment at the current stage.

This approach also helps explain the relationship between international commitments and domestic implementation. The G20 forum and the global climate regime generate normative pressure but do not provide strong coercive mechanisms that are legally binding. Under such conditions, states retain policy discretion to adjust their priorities according to their national development interests. Support for CCUS in international declarations can function as a signal of global commitment, while domestic implementation can be adjusted to reflect a country's economic and institutional readiness.

Therefore, from the perspective of Rational Choice Theory, the position of CCUS within China's climate policy should not necessarily be interpreted as an inconsistency in its international commitments. Rather, it can be understood as a gradual strategy that takes into consideration economic efficiency, energy security, and long-term development stability.

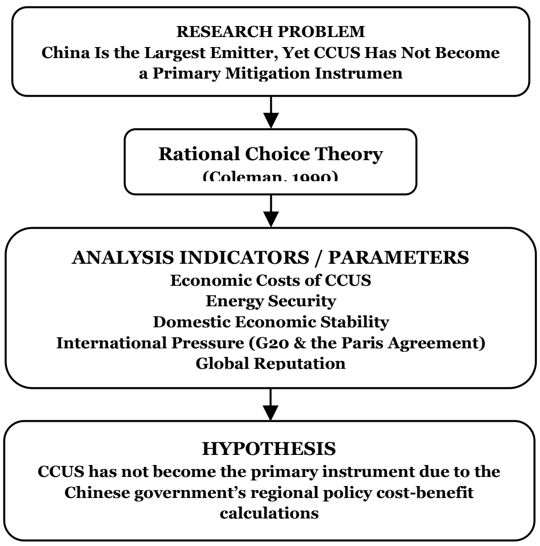

Figure 1. Analysis Framework

RESEARCH METHODOLOGY

This study employs a qualitative approach to analyze how China responds to G20 commitments concerning Carbon Capture, Utilization, and Storage (CCUS) policies. The methods used include document analysis in the fields of energy, the environment, and international relations. The main variables examined in this study include the international norms established within the G20 framework, China's national identity as a developing country with aspirations for global leadership, and its political commitment to addressing climate change and advancing the energy transition.Data are collected from various sources, including official G20 reports, Chinese national policies, scholarly journal articles, reports published by non-governmental organizations (NGOs) and think tanks, as well as publications from international organizations such as the International Energy Agency (IEA), the United Nations Framework Convention on Climate Change (UNFCCC), and the World Resources Institute (WRI). The data are analyzed using a narrative analysis approach that emphasizes patterns of argumentation, discursive interactions, and shifts in policy. The narrative is constructed systematically to identify how China adjusts its CCUS policies within the framework of global norms and how the construction of national identity contributes to shaping its policy response.

RESULTS AND DISCUSSION

Emission Mitigation Policies in China

1. China's Contribution to Global Emissions Over the Past Two Decades

Over the past decade, China has emerged as the most dominant contributor to global carbon emissions. Historical data indicate that from 2000 to 2020, China's CO_2 emissions increased from approximately 3.3 gigatonnes to more than 10 gigatonnes, reflecting significant growth driven by rapid industrialization, coal-based energy consumption, and the expansion of heavy industries (Wei, 2022). Over the past five years, however, China's emissions trend has shown signs of slowing, with a slight decline of approximately 1% recorded between 2023 and 2024. For the first time, this decline was not driven by an economic slowdown, but rather by the accelerated deployment of clean energy sources such as solar, wind, and nuclear power, which grew faster than new electricity demand (Myllyvirta, 2025).

According to a Carbon Brief report, China's carbon emissions in the first quarter of 2025 decreased by 1.6% compared with the same period of the previous year, with the renewable energy sector accounting for the largest share in offsetting the growth in electricity consumption. This trend is consistent with the findings of Zhu et al. (2021), who reported that during the second half of 2020, although electricity demand increased, nearly 93% of the increase was met by low-carbon energy sources. The share of low-carbon electricity reached 36.7% of total national electricity generation, while the carbon intensity of power generation declined to a historical low of 519.9 CO_2/GWh.

Despite these positive signs, China's overall emissions remain at a very high level. Recent data estimate that China's production-based emissions in 2023 exceeded 11.9 gigatonnes of CO_2-equivalent, accounting for approximately 31% of global emissions (Friedlingstein et al., 2023). This indicates that, despite the initialsigns of structural changes in the energy mix, the scale of the challenge toward achieving the target of peaking emissions before 2030 and reaching carbon neutrality by 2060 remains substantial.

2. Carbon Emissions Mitigation Policies

As part of its efforts to mitigate carbon emissions, China has formulated a number of strategic policies centered on efficiency, technology, and market-based measures. Among the various instruments employed to mitigate carbon emissions, five key instruments are particularly important in achieving measurable reductions in carbon emissions, despite the fact that CCUS technology has not yet been widely adopted.

a. *Emission Trading Scheme*

The National Emissions Trading Scheme (ETS), the world's largest carbon market, was introduced in July 2021. The scheme currently covers the power generation sector, which accounts for approximately 40% of national emissions. Under the scheme, companies are allocated tradable carbon allowances. Research has shown that this measure could achieve emissions reductions of 16–17% and reduce carbon intensity by nearly 10%. However, its effectiveness remains relatively limited due to low carbon prices and uneven sectoral coverage (ICAP, 2024).

b. Renewable Energy Development

China is a global leader in renewable energy development, particularly in solar and wind power. In recent years, more than 93% of the increase in energy demand has been met through low-carbon energy sources. In 2023, more than 36.7% of the electricity generated nationally came from low-carbon energy sources. This development is already reflected in emission trends, with emissions declining by approximately 1–1.6% due to the increasing production of renewable energy (ICAP, 2024).

c. Energy Efficiency Policies in the Industrial Sector

Heavy industrial sectors, such as steel, cement, and petrochemical industries, have become the primary focus of energy efficiency policies. The government has implemented stringent technical standards and supported the modernization of production capacity in these industries. Energy-inefficient industries have been gradually phased out. As a result, the carbon intensity of power generation has been reduced to as low as 519.9 CO_2/GWh. These policies have contributed significantly to reducing energy consumption per unit of output (Zhao et al., 2024).

d. Electric Vehicle Promotion

To promote the adoption of electric vehicles, the Chinese government has implemented a number of measures, including financial incentives and tax reductions. As a result, the electric vehicle market has grown to one million units, compared with fewer than 10,000 electric vehicles prior to the implementation of these policies. It is worth noting that China currently has the largest electric vehicle market in the world (Zhao et al., 2024).

e. CCUS Policy

Unlike the four other policies discussed above, the implementation of CCUS in China has not yet been fully realized. In 2021–2022, there were approximately 40 CCUS demonstration projects, with a combined capacity to capture around 3 million tonnes of CO_2 annually. This amount is relatively insignificant compared with China's total national emissions, which were estimated at 12.6 gigatonnes of CO_2-equivalent in 2023. Furthermore, most of these projects have focused on EOR (Enhanced Oil Recovery) rather than permanent CO_2 storage. Although CCUS was included in the 14th Five-Year Plan (2021–2025), it lacks clear national targets and commercial incentives and has remained largely complementary to existing mitigation measures.

China relies on policies that have relatively direct impacts and are economically more justifiable, such as renewable energy development and improvements in energy efficiency. Consequently, CCUS has not yet been widely adopted due to various factors and has therefore not become a major component of the country's emissions reduction efforts (Jiang et al., 2019).

Challenges and Obstacles for China in Fulfilling Its Emissions-Free Commitments

China's position as the world's largest contributor to carbon emissions is often misunderstood as merely a reflection of weak political will to reduce emissions. However, academic studies indicate that the reality is far more complex: it is the result of a combination of China's enormous economic scale, an energy structure that remains heavily dependent on coal, energy security requirements, and technical and institutional barriers to the energy transition.

1. Development of CCUS Technology Deployment in China

China's Carbon Capture, Utilization, and Storage (CCUS) technology has demonstrated considerable progress in research and pilot projects; however, commercial implementation remains limited. Overall, China's CCUS technology is currently at a transitional stage, bridging the gap between technological trials and policy-driven adoption.

In terms of the number of projects, China had approximately 40 CCUS projects in operation or under construction between 2021 and 2023, with an estimated CO_2 capture capacity of 3 million tonnes per year. In terms of emissions mitigation, the overall reduction reached approximately 4 million tonnes of CO_2 per year, which is negligible given that China emits more than 12 gigatonnes of CO_2 annually.

One important characteristic of CCUS project implementation in China is its relatively small scale, with most projects being demonstration projects. The capture capacity of most projects ranges from 10,000 to 100,000 tonnes of CO_2 per year, while only a few projects exceed 500,000 tonnes per year. In addition, most projects are point-to-point in nature rather than being integrated into complex systems, which limits the development of integrated CCUS industrial clusters.

In terms of sectors, CCUS applications in China have primarily focused on power generation, chemical production, steel manufacturing, and cement production, with more than 40% of CCUS projects concentrated in energy and chemical production. It is also important to note that the utilization of captured CO_2 is largely associated with EOR (enhanced oil recovery).

Nevertheless, China has enormous potential for carbon capture and storage. Studies indicate that China has a very large carbon storage capacity, ranging from 1.21 to 4.13 trillion tonnes of CO_2 in deep saline aquifers and depleted oil and gas formations. In particular, deep saline aquifers alone could potentially store approximately 2.42 trillion tonnes of CO_2, placing China among the countries with the highest carbon storage potential in the world.

From a policy perspective, the Chinese government has begun to incorporate CCUS into the national policy agenda, including medium-term development plans. In addition, dozens of policy documents have been issued to promote research, technological development, and demonstration projects. However, these policies remain primarily focused on the research and demonstration stages rather than large-scale commercialization. The development of CCUS in China can be summarized in three main points:

a. Significant progress at the research and demonstration stages;
b. A still very small contribution to national emissions reduction; and
c. The absence of full-scale adoption as a primary decarbonization instrument.

Thus, although China possesses substantial technical capabilities and considerable geological potential for CCUS development, its implementation remains constrained by high costs, immature infrastructure, and policy priorities that continue to favor renewable energy and energy efficiency.

2. Key Challenges for China in Implementing CCUS as a Primary Carbon Mitigation Instrument

Although Carbon Capture, Utilization, and Storage (CCUS) is recognized as an important technology for decarbonizing heavy industrial sectors, its implementation in China has not yet become a top priority. This is influenced by a combination of economic, political, technological, and global factors that shape the country's policy calculations from a rational perspective (Jiang et al., 2019).

a. Economic Factors

From an economic perspective, CCUS faces significant cost barriers. Estimates indicate that carbon capture costs in coal-fired power generation range from USD 40–90 per tonne of CO_2, while transportation and storage costs can add another USD 10–30 per tonne. Compared with carbon prices under China's ETS, which remain in the range of USD 7–10 per tonne, there is a substantial economic gap. This makes CCUS financially uncompetitive without significant subsidies. Furthermore, most CCUS projects in China still rely on enhanced oil recovery (EOR) as a source of revenue, which indicates that the economic value of CCUS remains dependent on the fossil fuel industry. In contrast, the costs of renewable energy sources such as solar and wind power continue to decline significantly,

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making them more attractive for investment and enabling them to deliver economic benefits more rapidly (Jiang et al., 2019).

b. Policy Factors

From a policy perspective, China has incorporated CCUS into the 14th Five-Year Plan (2021–2025), but it has not yet been designated as a top priority. To date, there are no clear national targets for carbon capture or storage capacity. Furthermore, although approximately 63 policy documents related to CCUS have been issued, most of them focus on research and demonstration rather than commercialization incentives (Feng et al., 2024). Unlike renewable energy, which is supported by substantial subsidies and clear capacity targets, CCUS has not yet received strong fiscal support. The absence of a comprehensive regulatory framework, including clear standards regarding long-term liability for carbon storage, also poses a barrier to private investment. Therefore, CCUS remains positioned as a complementary technology within China's decarbonization policy.

c. Technological and Infrastructure Factors

From a technological perspective, China has developed approximately 40 CCUS projects with a total capacity of around 3 million tonnes of CO_2 per year. However, this figure remains very small compared with China's total national emissions, which reached approximately 11.9 gigatonnes of CO_2 in 2023 (Friedlingstein et al., 2023). Most of these projects remain at the demonstration stage, with relatively small capacities ranging from 10,000 to 100,000 tonnes per year, while only a few are approaching commercial scale. In addition, supporting infrastructure, such as CO_2 pipeline networks and integrated geological storage facilities, remains very limited. Another challenge is the additional energy required for the carbon capture process, which can reduce power plant efficiency by up to 20–30%. The absence of a standardized Monitoring, Reporting, and Verification (MRV) system also hinders the development of a CCUS-based carbon market.

d. International Factors and Global Commitments

In the international context, the low priority given to CCUS in China is influenced by the non-binding nature of global commitments. Under the Paris Agreement, countries are required to establish emissions reduction targets through their Nationally Determined Contributions (NDCs), but they are not obligated to adopt any specific mitigation instrument. This provides China with the flexibility to prioritize policies that are considered more economically efficient, such as renewable energy, over CCUS.

Within the G20 framework, CCUS is recognized as part of the broader decarbonization strategy; however, such recognition remains largely recommendatory and is not accompanied by clear implementation targets. As a result, international pressure to adopt CCUS remains relatively weak. There is also a significant incentive gap between China and developed countries. The United States provides tax credits of up to approximately USD 85 per tonne of CO_2, while the European Union is supported by high carbon prices and innovation funding. In contrast, carbon prices in China remain relatively low, at approximately USD 7–10 per tonne, which is insufficient to stimulate substantial investment in CCUS. Policy priorities are also more strongly oriented toward renewable energy and energy efficiency. Consequently, CCUS has not yet become mainstream, leading China to rationally position it as a complementary technology rather than a primary instrument for carbon mitigation.

To genuinely move away from its position as the world's largest carbon emitter, China requires a simultaneous strategy that includes strengthening grid flexibility, accelerating the early retirement of the most carbon-intensive coal-fired power plants, strengthening the carbon market, and deepening decarbonization policies for heavy industry. Without these comprehensive measures, the continued reliance on fossil-fuel-based energy will constrain the pace of emissions reductions. This is a fundamental reason why China remains the world's largest carbon emitter.

The Role of the G20 in Promoting CCUS Adoption in China

Carbon Capture, Utilization, and Storage (CCUS) technology is considered one of the key solutions in China's strategy to achieve carbon neutrality. Although China has taken promising initial steps, further adoption of CCUS is influenced by global collaboration through forums such as the G20. The following provides a more in-depth discussion.

Over the past decade, China has developed a number of CCUS demonstration projects. As of 2021, approximately 40 demonstration projects had been established, with a combined CO_2 capture capacity of around 3 million tonnes per year. The primary focus has been on the use of CCUS for enhanced oil recovery (EOR), which also highlights the limitations of its application for long-term carbon storage. Demonstration projects such as those in the Ordos Basin, with a capacity of 300,000 tonnes, the Guohua Jinjie Power Plant, and the large-scale Qilu–Shengli project demonstrate China's technical readiness; however, the scale and technological diversification of these projects remain limited (Liu et al., 2022).

A policy review published in Frontiers in Energy indicates that China had issued nearly 59 CCUS-related policy documents by mid-2022, involving various government agencies, including the State Council, the National Development and Reform Commission (NDRC), the Ministry of Science and Technology (MOST), and the Ministry of Ecology and Environment. However, these policies remain imbalanced, with a strong emphasis on research and demonstration, while environmental policies and demand-side measures remain limited. This indicates a significant need to strengthen operational incentives and market regulations.

From a technological and strategic planning perspective, a study examined the technical and economic aspects of CCUS in China's major oil-producing sectors. The study classified CO_2 emissions according to their sources and geographical distribution, assessed the cost thresholds for CO_2 capture and EOR, and developed short- to long-term strategic frameworks using mathematical programming. These findings indicate that although substantial technical potential exists, economic gaps remain a significant constraint requiring policy intervention and public financing (Hao et al., 2025).

At the global level, the G20 is a major economic forum that has consistently recognized CCUS as an important component of the energy transition. Although the literature specifically examining the relationship between the G20 and China remains limited, theoretical frameworks suggest that collective commitments among developed countries within the G20 can generate normative pressure and provide technical legitimacy for China. Consequently, international pressure has encouraged China to incorporate CCUS into its national development plans, although it has not yet established concrete targets for capture capacity or commercialization.

The positive influence of the G20 may also include technology exchange and cross-border investment, for example, through technical platforms and energy ministers' meetings. Collaboration with foreign research institutions and multinational corporations could help address cost barriers and limitations in China's carbon storage infrastructure.

The implementation of Carbon Capture, Utilization, and Storage (CCUS) in China demonstrates moderate progress, particularly through the expansion of industrial demonstration projects, but commercialization remains limited. External drivers through the G20, including normative pressure, institutional support, and international legitimacy, are important for accelerating this transition. If the G20 succeeds in facilitating technical assistance or cross-border financing mechanisms, such as joint projects or co-financing arrangements, there is considerable potential to expand China's CCUS capacity in the future.

CONCLUSION

This study shows that China's carbon mitigation strategy does not position Carbon Capture, Utilization, and Storage (CCUS) as a primary instrument, but rather as a complementary technology for the long term. This finding addresses the research problem by demonstrating that the low priority given to CCUS is not due to a lack of potential, but rather to rational considerations of its effectiveness, costs, and implementation readiness compared with other policy measures. China has adopted various more mature policies with direct impacts, such as the Emissions Trading System (ETS), large-scale renewable energy development, industrial energy efficiency measures, and transportation electrification. These policies have proven effective in reducing emissions intensity and significantly increasing the share of low-carbon energy. In contrast, CCUS implementation remains largely limited to small-scale demonstration projects and has not yet been integrated into the national industrial system. The low priority given to CCUS is influenced by four main factors: high and uncompetitive economic costs, limited policy support and incentives, technological and infrastructure constraints, and international factors that do not exert strong pressure for its adoption. In addition, the global trend toward greater emphasis on renewable energy further reinforces the position of CCUS as a secondary option. Thus, China's approach reflects a pragmatic strategy that prioritizes policies that are more efficient and ready for implementation. CCUS will continue to play an important role in the future, particularly in heavy industrial sectors; however, its broader implementation will depend on further technological development, stronger policy support, and improved economic viability.

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