

## An International Comparative Study of China-US Carbon Neutral Incentive Mechanisms

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**ABSTRACT:**Through the research and comparison of the carbon neutrality incentive mechanism between China and the United States, this paper firstly describes the status and policies of energy conservation and emission reduction in the United States and my country, and secondly, through the analysis and comparison of the US steel, coal, cement, oil and gas and other industry policies. Where my country's incentive mechanism needs to be improved, it summarizes the differences in the incentive mechanisms for energy conservation and emission reduction between China and the United States. Thirdly, based on the comparison, it puts forward enlightenment and suggestions for the policy system in related fields in my country, including improving the energy conservation legal system and promoting the refinement of energy conservation standards, improve the incentive policy and market guidance mechanism, build an energy-saving statistical system, and do a good job in energy-saving and carbon-control management at different levels. By providing a reference for the incentive mechanism that is more targeted and in line with my country's national conditions, my country will be better able to achieve energy conservation and emission reduction and will be one step closer to achieving "carbon neutrality" in 2060.

**KEY WORDS:**Carbon neutral; Incentives; China; USA

### I. INTRODUCTION

Climate change is a global problem faced by human beings. With the progress of human science and technology and the rapid development of industry, carbon dioxide emissions are increasing, which also leads to more and more serious greenhouse effect and more and more serious pollution on our planet. Therefore, many countries have held relevant meetings to formulate relevant strategies to reduce greenhouse gas emissions. China has put forward the goal of peak carbon dioxide emissions and carbon neutrality: carbon dioxide emissions will reach the maximum in 2030 and be completely carbon neutral in 2060. Peak carbon dioxide emissions means that the emission of carbon dioxide will not increase at a certain point in time, and carbon neutrality means that the production and absorption of carbon dioxide can be offset by energy saving and emission reduction in a certain time node.

Global warming is closely related to the increase of greenhouse gas emissions caused by human activities. However, the efforts made by the signatories of the Paris Agreement are far from reaching the goal at the end of this century. Therefore, we must take active actions immediately to ensure that the goal of energy conservation and emission reduction can be continuously implemented in the next decade while striving to reduce emissions. To meet the climate challenge, all walks of life should give priority to and actively invest in projects to curb global warming, actively implement transformation, and find the way to success in a low-carbon world. Climate change is a global problem facing mankind. With the rapid development of human economy, science and technology, carbon dioxide emissions are gradually increasing, which has caused more and more pollution to the earth. Under the background of carbon neutrality, under the guidance of the 14th Five-Year Plan, the national carbon trading market is being built in an orderly way, and seven provinces and cities, such as Hubei, have taken the lead in starting the pilot project, which has promoted the desire of relevant enterprises to obtain more carbon emission trading quotas. For a long time in the future, China will adjust the energy consumption structure to achieve zero growth of coal consumption, to achieve a stable peak of coal consumption and begin to decline gradually; The adjustment of power production mode bears the brunt, followed by the peak of energy-consuming industries such as steel and cement, and the transformation and upgrading of transportation. In recent years, China has attached great importance to environmental protection, building a resource-saving and environment-friendly society and improving people's quality of life. More importantly, when we push forward the task of energy conservation and emission reduction, we have changed from a passive attitude in the past to a proactive attitude now, which is of positive significance to the efficiency of emission

reduction. Moreover, this is in line with the current industrial transformation in China. Under the goal of "carbon neutrality", the use of traditional energy such as oil, natural gas and coal will be reduced, the use space of non-fossil energy will be increased, and its competitiveness and economy will be enhanced. At present, China's incentive mechanism system needs to be improved. In this regard, this paper will study and compare the carbon-neutral incentive mechanisms between China and the United States and explore the differences between the policy-guided incentive mechanisms implemented by China and the United States in the carbon-neutral era, so as to further help China to achieve carbon neutrality.

## II. CARBONNEUTRALINCENTIVEMECHANISMANALYSISOF THESTATUSQUOOF CHINAANDTHEUS

### 2.1 China and the United States Overall Carbon Neutral Incentive Mechanism Status Quo

#### 2.1.1 The United States-achieve "carbon neutrality" by 2045

If the American government before Obama had a vague attitude towards climate issues, the Obama administration has made clear its position in this field, ensuring the position of the United States in international politics and energy security, and adopting market-oriented means to solve the problem of energy conservation and emission reduction. For this reason, the Obama administration has issued a series of policies to deal with climate change since it took office, the most noteworthy of which is the Clean Energy Security Act, which was passed only four days after the US House of Representatives passed the Greenhouse Gas Cap and Trade Act in April. This bill clearly stipulates the transformation from green energy to low carboneconomy and makes certain standardization requirements for related enterprises in the United States, so that they can achieve the goal of energy conservation and emission reduction under the specified conditions. Among them, there are strict regulations that the United States should reduce greenhouse gas emissions from year to year, from year to year to year. To achieve this goal, the bill must vigorously improve the utilization of renewable energy. For carbon dioxide recovery technology, etc., at the same time, the bill also puts forward relevant development requirements for smart grids and other related support funds for enterprises and formulates energy efficiency standards for various industries. To meet the international trend of energy conservation and emission reduction, this bill also requires the establishment of a corresponding carbon financial service mechanism in the United States. Including the carbon market and related security system, so we can see that during the Obama period, its energy-saving and emission-reduction strategy mainly includes three aspects. First, it is necessary to vigorously develop clean energy. During the Obama presidential campaign, he once proposed to vigorously develop clean energy such as solar energy, and repeatedly said that he would invest hundreds of millions of dollars in clean energy development and expand the commercial scale of renewable energy, thus creating tens of thousands of new jobs in fields such as research, manufacturing, and construction. To this end, the Obama administration has proposed the proportion of renewable energy in the future energy and plans to raise this proportion to. To realize this goal at an early date, the US government has increased its total investment in capital, encouraged the use of new energy, and provided financial support for scientific research such as clean coal and biomass energy. As the country with the largest automobile production and possession in the world, the investment and improvement in automobile energy is very prominent in this respect. To help automobile manufacturers, recommend new energy vehicles to consumers, the United States provides direct subsidies to buyers of new energy vehicles to reduce their prices. Second, reduce energy consumption and ensure energy security. The trend of carbon neutrality has been deepening since 2020. In 2020, the European Union has legislated to determine the path to achieve carbon neutrality in 2050. The Fit for 55 bills proposed in July 2021 is more stringent than the 2020 plan, and the policy objectives are constantly increasing. After the ambitious targets of peak carbon dioxide emissions in 2030 and carbon neutrality in 2060 have been set in China, the details of the construction plan for peak carbon dioxide emissions in 2030 have also been laid down recently. After Biden took office, the United States put forward the goal of realizing the carbon-free power sector in 2035 and the penetration rate of new energy vehicles in 2030. The tax credit policy under consideration this time is one of the ways to achieve its grand goal. At the same time, at the COP26 Summit, countries outside China, Europe and the United States also made commitments in reducing coal use and accelerating the transformation of zero-emission vehicles. All the above shows that the era mission of carbon neutrality is getting better and better, and the policy side is still expected to continue to increase. Continue to firmly look at investment opportunities in new energy vehicles, photovoltaic wind power, energy storage, emerging power systems and other industries. The United States is the world's largest energy consumer, and at the same time, as the world's largest energy importer, its characteristics are more obvious. Together, these two conditions make the energy security of the United States a problem that the US government must consider. Although successive American presidents have promised to ensure energy independence, the United States is increasingly dependent on external oil supply. In recent years, the development and changes of oil prices have experienced large-scale fluctuations frequently. Turbulence has occurred in many parts of the world, which makes the Obama administration take reasonable measures to ensure the United States to achieve energy independence. On the one hand, the United States has approved oil exploration projects in the United States, so that it can meet the needs of public utilities, and correspondingly, it can save the use of natural gas and

develop related new energy technologies. The goal of the United States is not to import oil from the Middle East and Venezuela in the next year. Third, establish a climate change response mechanism. At the same time, we can also analyze that the Obama administration has promised that to cope with climate change and reduce greenhouse gas emissions on a large scale, the United States has adopted a series of market-oriented programs, and only then has it adopted non-cautious means to promote energy conservation and reduce emissions. The United States has established a market-oriented carbon emission trading system, which enables large carbon emission units to be restricted by licenses in this process to control quotas for enterprises and conduct transactions in the market. To ensure that ordinary people can be completely liberalized, all subsidies will be traded by auction, so that carbon emissions can be adjusted by market means, and traditional producers can be allowed to adjust.

On the morning of November 19th, 2021, US time, the House of Representatives passed Biden's \$1.75 trillion Build Back Better Act, including:

1) For photovoltaic wind power, PTC (Electricity Tax Credit) will be given for 10 years, and 2.5 cents/kWh tax credit will be given to renewable energy power enterprises that meet the incentive conditions from 2022 for 10 years; 3) Extend ITC (Investment Tax Credit) and give 30% investment tax credit to qualified renewable energy power enterprises from 2022 to 2026. ITC and PTC shall be selected by the taxpayer. If more than 40% of the manufacturing costs are local production costs, enterprises can get an additional 10% PTC or ITC.

2) In terms of energy storage, a separate ITC tax rebate will be obtained. For energy storage systems above 5KWh, a maximum ITC tax rebate of 30% will be given by 2026. This is the first time that a separate ITC tax rebate has been formulated for energy storage.

3) In terms of new energy vehicles, the tax credit will be raised from \$7,500 to a maximum of \$12,500, specifically: the basic amount of subsidy is \$4,000+\$3,500 (40kwh before 2027 and 50 kWh after 2027) +\$4,500 (American trade unions) +\$500 (50% of parts and components are Americanized and batteries are produced locally).

Table 1 Development course of photovoltaic ITC

Year	Policy Name	Main Content of Policy	Execution time question
2005	Policy Act of 2005(P.L.109-58)	Created a 30% ITC policy for residential and commercial solar systems.	2006.1.1-2007.12.31
2006	Tax Relief and Health Care Act(P.L.109-432)	Extend the credit for another year until December 31, 2008.	2008.1.1-2008.12.31
2008	Emergency Economic Stabilization Act (P.L. 110-343)	Extend residential and commercial ITC for 8 years	2009.1.1-2016.12.31
2015	Omnibus Appropriations Act (P.L.114-113)	Multi-year extension of residential and commercial ITC	It has been extended for many years since 2017
2018	IRS issued guidance (Notice 2018-59)	The ITC reduction and exemption ratio of projects that started on 19/20/21/22 and connected to the grid before the end of 2023 is 30%/26%/22%/10% respectively.	2019.1.1-2022.12.31
2020	Text of The House Amendment to The Senate Amendment to H.R.133	Two years' extension, 26% in 2021-2022, and then deferred.	2021.1.1-2022.12.31
2021	Build Back BetterAct	Before the end of 2026, all projects before construction will be reduced by 30%.	2022.1.31-2026.12.31

Source: US Government, Changjiang Securities Institute.

In recent years, driven by the economy and rush to install in the US market, the installed capacity of photovoltaic continues to increase, and the newly installed capacity will reach 19.2GW in 2020. At the same time, the reserve projects are abundant, and the PPA projects signed by the end of 2021Q2 have reached 85GW, which is double the accumulation of projects compared with 2019. From 2022 to 2026, the ITC of photovoltaic projects in the United States will increase from the current 26% to 30%, and we observed that on November 10 and 16, 2021, the US Department of Commerce rejected the anti-circumvention investigation on the capacity of China enterprises in Southeast Asia and the tariff exemption of double glass modules 201. The easing of trade friction will also contribute to the decline of photovoltaic costs in the United States. In addition, considering that

the price of photovoltaic industry chain will return to the downward channel in the following years, we expect that the economy of photovoltaic projects in the United States is expected to be significantly improved and stimulated.

Table 2 Historical Changes of PTC Policy

Serial Number	Name of the Case	Effective Period
1	Energy Policy Act of 1992	1994.1-1999.6
2	Ticket to Work and Work Incentives improvement Act of 1999	1999.7-2001.12
3	Job Creation and Worker Assistance Act	2002.1-2003.12
4	Working Families and Tax Relief Act	2004.1-2005.12
5	The Energy Policy Act of 2005	2006.1-2007.12
6	The Tax Relief and Health Care Act of 2006	2008.1-2008.12
7	The Emergency Economic Stabilization Act of 2008	2009.1-2009.12
8	The American Recovery and Reinvestments Act of 2009	2010.1-2012.12
G	The American Taxpayer Relief Act of 2012	2013.1-2013.12
10	Tax Increase Prevention Act of 2014	2014.1-2014.12
11	Consolidated Appropriations Act,2016	2015.1-2019.12
12	Bipartisan Budget Act of 2018	2017.1-2017.12
13	Further Consolidated Appropriations Act of 2020	2018.1-2020.12
14	Build Back Better Act	2022.1-2026.12

Source: CRS, Changjiang Securities Institute.

The change brought by the "Rebuild Better Act" is that from 2022, the wind power PTC will maintain 100% ratio (2.5 cents/kWh) until 2026. Considering the cost reduction caused by the current large-scale wind turbines, it is expected that the installed power of wind power in the United States will be improved far beyond the level in 2020 and 2021. Before 2026, with the cost continuing to decline steadily, the wind power in the United States will probably usher in a golden five-year period. Based on this, we predict that the growth rate of wind power installed capacity in the United States is expected to increase from 5%-8% to about 10%-15%, and the new installed capacity is expected to reach about 25GW in 2025-2026.

Table 3 Changes of Tax Credit Policy Scheme for New Energy Vehicles in the United States

Policy Shift	Policy Content
Early introduction	The upper limit of the benchmark subsidy (tax credit) is \$7,500. After the sales volume of automobile enterprises reaches 200,000, the slope will be reduced by 50% in T+1~2 quarters and 50% in T+3~4 quarters, and then it will be completely withdrawn.
Car enterprise change	Tesla and GM have successively reached 200,000 vehicles, and the bicycle tax credit in the second half of 2019 is \$1,875 and \$3,750 respectively.
End of 2020-Biden	1) Sponsor: Biden (Infrastructure Plan); 2) Proposal content: All the tax credits for electric vehicles will be restored, and they are more inclined to middle-class consumers, giving priority to American-made cars; According to Reuters, the total amount of Biden's plan is \$174 billion, of which \$100 billion is used for subsidies for new energy vehicles; 3) Progress: Biden will separate the proposal related to electric vehicles from the infrastructure plan, plan to vote on the proposal separately, or solve it through the "budget reconciliation" mechanism (which can speed up the policy).
2021.5-Democratic Party	1) Sponsor: Democratic Party (Senate Finance Committee); 2) Proposal content: The restriction that car companies need to retreat within one year after the sales volume exceeds 200,000 vehicles is cancelled; The tax rebate subsidy will only be refunded after electric vehicles account for 50% of the total car sales in that year; The upper limit of bicycle subsidy is revised from \$7,500 to \$10,000 (assembled in the United States)-\$12,500 (members of the American Automobile Union), and the upper limit of the corresponding car price is \$80,000; Clean energy tax credit scheme, totaling \$215.5 billion, of which \$31.6 billion is the consumer tax credit for electric vehicles. American manufacturers will provide 30% tax credit for new advanced production capacity such as batteries, and the purchase of commercial vehicles will also provide incentives; 3) Progress: Revision by the House of Representatives
2021.9-Democratic Party	1) Sponsor: Democratic Party (House Ways and Means Committee); 2) Proposal content: The subsidy standard is \$4,000 (basic amount)+\$3,500 (above 40kwh before 2027 and 50 kWh after 2027)+\$4,500 (American trade union)+\$500 "50% Americanization of parts and components and local production of batteries"; Subsidy restrictions, the amount of tax credit is not higher than 50% of the car price; Only applicable to cars assembled in the

Policy Shift	Policy Content
	United States from 2027; Including plug-in hybrid, with a charge of not less than 7kwh; The retail price ceiling is 55,000 cars, 64,000 trucks, 69,000 SUVs and 74,000 pickup trucks; The tax credit for household income of \$800,000 and household income of more than \$600,000 will be reduced; Effective on December 31, 2021 and ending on December 31, 2031; 3) Progress: The Ways and Means Committee of the House of Representatives put the tax credit into the 3.5 trillion stimulus plan and will vote according to the overall progress.
November 2021-The House of Representatives passed the draft.	1) Contents of the bill: the subsidy standard is \$4,000 (basic amount)+\$3,500 (above 40kwh before 2027 and 50 kWh after 2027)+\$4,500 (American trade union)+\$500 (50% of parts and components are Americanized and batteries are produced locally); Only applicable to cars assembled in the United States from 2027; Including plug-in hybrid, with a charge of not less than 7kwh; The retail price ceiling is 80,000 cars, 80,000 trucks, 80,000 SUV8 and 55,000 others; The tax credit for household income of \$500,000 and household income of more than \$375,000 will be reduced; 2) Progress: The \$1.75 trillion Build Back Better Act was included, which was passed by the House of Representatives on November 19th, 2021.

Source: US Government, Changjiang Securities Institute.

This bill is mainly aimed at the tax credit policy of new energy vehicles in the United States. At present, the tax credit policy for new energy vehicles in the United States is \$7,500, and a single car company can only get a cumulative quota of 200,000 vehicles. Tesla and GM all entered the exit stage after selling 200,000 vehicles. The latest plan passed by the House of Representatives plans to increase the tax credit to a maximum of \$12,500, of which the basic subsidy amount is \$4,000. If the battery capacity is above 40kwh before 2027, an additional \$3,500 will be obtained after 2027. If the car companies involved are American trade union units (mainly American car companies such as GM and Ford, excluding Tesla and Japan, etc.), an additional \$4,500 will be obtained. If the parts are 50, Compared with the previous proposal, the scheme is only slightly adjusted, which is generally similar and in line with expectations.

## 2.2 China-to Achieve "Carbon Neutrality" by 2060

Realizing peak carbon dioxide emissions and carbon neutrality is a major strategic decision made by the CPC Central Committee with Comrade Xi Jinping at its core to coordinate the domestic and international situations, which is of great significance to China's high-quality development and comprehensive construction of a socialist modernization power.

Central enterprises account for a relatively high proportion in the industries related to the lifeline of the national economy, and their decision-making is of great significance. They are also the key units to realize carbon emission control in China and have a very important demonstration and leading role in the future peak carbon dioxide emissions and carbon neutrality of the country. After five years, the industrial structure and energy structure of central enterprises should be adjusted obviously. In many key industries, the energy utilization efficiency needs to increase obviously, the power system needs to be improved quickly, and green and low-carbon technologies are developing rapidly. The energy consumption ratio of related central enterprises per 10,000 yuan of output value will be reduced by 15% compared with 2020, the carbon dioxide emission ratio per 10,000 yuan of output value will be reduced by 18% compared with 2020, and the installed capacity ratio of renewable energy will reach 50%. By 2030, central enterprises will be fully green and low carbon. The scale and proportion of green and low-carbon industries should be significantly improved. By 2060, the green and low-carbon recycling industrial system and clean energy management system of central enterprises will be fully established, and the core competitiveness of building green and low-carbon will be enhanced, making do contributions to the country's carbon-neutral development.2.3The Status Quo of Carbon Neutrality in Representative Industries in China and the United States

### 2.3.1. Overall situation of carbon emissions in China and the United States

According to the Kyoto Protocol, "greenhouse gases" include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and so on. Among the greenhouse gases produced by human activities, the proportion of carbon dioxide is the largest, and its impact is also the biggest, reaching more than 90% of the total energy emissions. Therefore, we mainly analyze carbon emissions through the study of carbon dioxide. The carbon dioxide in human production activities mainly comes from fossil energy consumption, accounting for 95%. According to "China Energy Big Data Report" released by CLP Media Energy Information Research Center from 2016 to 2020, in recent years, coal and oil account for about 80% of primary energy consumption in China, which are the main sources of carbon dioxide emissions.

With the rapid development of China's economy, carbon dioxide emissions have also increased to some extent. According to the following table, the total carbon dioxide emissions in China increased from 719,501 kilotons in 2008 to 1,031,346 kilotons in 2019, an increase of nearly 300,000 kilotons (see Table 1). In fact, according to the statistics of the World Bank, China surpassed the United States in 2005 and became the largest carbon emitter in the world. In 2016, China's carbon emissions accounted for nearly 30% of the world's total emissions. Even so, our per capita emissions were lower than those of the United States.

Table 4 Comparison of Carbon Emissions between China and the United States

Year	China		United States of America	
	Carbon dioxide emissions are thousands of tons	Per capita carbon dioxide emissions	Carbon dioxide emissions are thousands of tons	Per capita carbon dioxide emissions
2008	719501	5.417	556334	18.4892
2009	771511	5.7229	515955	17.1924
2010	847057	6.5544	539287	17.4848
2011	927825	7.2349	517210	17.0194
2012	953321	7.419	495021	16.2871
2013	993668	7.5509	508950	16.3898
2014	989494	7.5439	510258	16.4937
2015	983043	7.1691	498279	15.5353
2016	981431	7.1187	488864	15.1317
2017	1001777	7.2258	481372	14.8059
2018	1031346	7.4052	498130	15.2409

Source: Guotai Junan Database.

### 2.3.2 Steel Industry

At present, the carbon dioxide emission rate of the steel industry is 7% in the world. In the past ten years, every ton of steel produced will emit 1.83 tons of carbon dioxide. If the world wants to develop sustainably, it needs a lot of steel. Because the demand for steel in developed economies is so great, and about three-quarters of the world is still in the development stage, the demand forecast shows that by 2050, the annual consumption of steel will be about 2.6 billion tons. Although existing stocks are recycled or reused, the impact on the environment must still be addressed.

China's steel industry also plays an important role in the world, accounting for half of the world's total steel output. However, at present, China's steel industry is still dominated by long-term processes with high carbon emission intensity, and the crude steel production capacity accounts for about 90%. Under the dual pressure of carbon neutrality commitment and capacity reduction, China's steel industry is facing severe challenges. With the slowdown of urbanization and construction industry, the new demand for steel will decrease compared with previous years. In addition, the improvement of material efficiency in the construction industry and the breakthrough of new alternative materials will further reduce the demand for steel replacement. With the further deepening of domestic supply-side reform and destocking, the reduction of high-level inventory in iron and steel enterprises will also bring about a decline in apparent demand.

From the eight batches of scrap steel processing enterprises announced by the Ministry of Industry and Information Technology, only 215 of the 478 enterprises have enjoyed the policy of immediate tax collection and refund: Thirdly, import. In 2020, the state announced a new policy of recycling steel raw materials, allowing the import of high-quality scrap steel. This caliber can be further expanded in the future, which is the basis of circular economy.

Similarly, the steel industry is an important industrial pillar of the American economy, and it plays a significant role in all stages of American economic development. From 1940 to 1973, the American economy was in the golden age of rapid development, and the steel industry also had a high degree of output increase. From 1980 to 1982, there was a financial crisis in the world, and the output of steel in the United States fell sharply. After the financial crisis, the United States turned to the tertiary industry, the demand for steel further declined, and the fluctuation of enterprise output was small, showing the phenomenon of "declining without retreating". Overall, from 2016 to 2019, the output of crude steel and scrap steel in the United States showed a slight upward trend. In 2020, it was greatly affected by the epidemic and the output declined.

Carbon dioxide emissions in the steel industry. During the decade from 2008 to 2018, the highest per capita carbon dioxide emissions in China were in 2014, the lowest per capita carbon dioxide emissions in China were in 2008, and the highest per capita carbon dioxide emissions in the United States were in 2014. However, the per capita carbon dioxide emissions in the United States were more than twice that in China in the same year, and the lowest per capita carbon dioxide emissions in the United States were in 2017. However, although the per capita carbon dioxide emissions in the United States were the lowest in this year, it was still close to the highest per capita emissions in China.

### 2.2.3. Cement Industry

The carbon dioxide emission in the cement production process mainly comes from the clinker production process, in which the carbon dioxide emission in the process of calcining limestone to produce quicklime accounts for about 55-70% of the total carbon emission in the whole production process; The high-temperature calcination process needs to burn fuel, so the carbon dioxide produced accounts for about 25-40% of the total carbon emission in the whole production process.

Looking around the world, the cement industry contributes 7% of the total carbon emissions. If the global cement industry is regarded as a country, it will be the third largest carbon emitter after China and the United States. China produces more than 60% of the world's cement, and its carbon emissions also reach half of the total global cement emissions. As far as American cement is concerned, it is mainly produced by 96 factories in 34 states and 2 cement factories in Puerto Rico. Among them, Texas, Missouri, California and Florida are four major cement producing states (from large to small), accounting for about 45% of the total output in the United States. As can be seen from the following table, China's cement output in 19 years and 20 years is 230,000 and 2,200,000 tons respectively, which is much higher than that in other regions.

Table 5 Comparison of World Cement Production

Unit (ten thousand tons)	Cement output	
	2019	the year of 2020
United States of America	8900	9000
Brazil	5400	5700
China	230000	220000
Egypt	4700	5000
India	34000	34000
Indonesia	7000	7300
Iran	6000	6000
Japan	5300	5300
South Korea	5000	5000
Russia	5600	5600
Türkiye	5700	6600
Viet Nam	9700	9600
other countries	88000	89000
World total	415300	408100

Source: Guotai Junan Database.

As far as the carbon emission of China's cement industry is concerned, the cement output in 2020 is 100 million tons less than that in 2019, and the cement output in the United States is 1 million tons more than that in 2019. China's cement output is more than half of the world's total, and it needs to emit carbon dioxide in the process of cement production. Obviously, China has the highest carbon emission in the cement industry, but because of its large population base, the per capita cement carbon emission is not high.

Compared with China and the United States in the cement industry, the per capita carbon emission in China was the highest in 2013-2014, the per capita carbon emission in China was the lowest in 2008, the per capita carbon emission in the United States was the highest in 2008, the per capita carbon emission in the United States was the lowest in 2017, and the per capita carbon emission in the United States was nearly 60,000, almost twice as high as that in China.

To reduce the carbon emission in the cement production process, we have introduced various measures, which can use alternative fuels to reduce CO<sub>2</sub> emission. Alternative fuels are a more priority and cost-effective means, which can promote the carbon emission reduction of the industry by about 10% by 2050. And waste is a better potential carbon emission reduction resource. On the one hand, organic waste can be used as fuel, on the other hand, solid waste can replace clinker, reducing the use of limestone, thus further reducing carbon emissions in the production process. At the same time, waste utilization in China is supported by favorable policies, relatively continuous supply and continuous improvement of waste classification.

For the building materials industry, we can see that in order to achieve the requirements of carbon neutrality, we should effectively supervise its energy, make a reasonable analysis of its production capacity, and strictly prohibit the addition of cement clinker and other aspects of production capacity, making the building materials industry more intensive and lightweight. We should promote the peak-shifting production of cement, shorten the operation time of cement clinker, adopt more renewable energy such as solar energy, and increase the proportion of natural gas use. Encourage building materials enterprises to use industrial waste residue and other raw materials to complete cement mixed production, accelerate the certification and construction of green building materials products, popularize mechanical energy technology and equipment and strengthen the construction of energy management system, so that energy conservation and emission reduction can be completed in a short time.

#### 2.3.4. Oil and Gas Industry

According to statistics of the International Energy Agency (IEA), in 2019, the global carbon dioxide emissions were 33 billion tons, mainly for fossil energy and other related uses, of which oil and gas emissions were 18.2 billion tons, more than half. The entire industrial chain of the oil and gas industry will produce a large amount of carbon emissions during the mining and transportation process. During the whole chain process, the gas emissions reached more than 40% of the global total, including 20% in the production stage and 80% in the use stage.

In 2020, the oil and gas industry were hit hard by the COVID-19 epidemic. This year, the epidemic and the international oil price plummeted, which brought unprecedented challenges to the oil and gas industry. China aims to be carbon neutral in peak carbon dioxide emissions by 2030 and carbon neutral by 2060, and promotes energy transformation, thus making the market prospect of traditional oil and gas industry more complicated. Therefore, in the oil and gas supply chain, from upstream drilling and midstream transportation to downstream refined products sales and export, new and old market participants should now focus on low-carbon development and fully consider environmental impact and ESG rules. For the United States, as the world's largest producer of oil and natural gas, its oil and gas production reached a record level in 2019. However, due to the severe impact of the COVID-19 epidemic, its oil and gas production declined significantly in 2020. Based on recovery in 2021, both the official US energy information administration and some enterprises and consulting institutions are optimistic that the oil and natural gas output of the United States will reach a new record level in 2022, and it will surpass Australia and Qatar to become the world's largest LNG exporter.

The total carbon emission of oil and gas industry in China is higher than that of the United States, but the per capita carbon emission of China is much lower than that of the United States. The per capita carbon emission of oil and gas industry in the United States is higher than 250,000, the highest year is 2018, and the lowest year is 2011-2012. The per capita carbon emission of oil and gas industry in China is lower than 150,000, the highest year is 2018, and the lowest year is 2008. The per capita carbon emission of oil and gas industry in the United States is higher than that of China.

#### 2.3.5 Coal & Chemical Industry

In the coal chemical industry, there are two products that consume the most coal-synthetic ammonia and methanol, which account for more than half of the coal consumption in the coal chemical industry in 2019. The carbon emission of synthetic ammonia and methanol comes from by-product carbon dioxide and coal combustion in the process of hydrogen production from gas. According to calculation, 1 ton of synthetic ammonia emits about 4.9 tons of carbon dioxide in the whole life cycle, and 1 ton of methanol produces about 4.4 tons of carbon dioxide.

The coal chemical industry has always been a major carbon emitter in the coal industry chain, contributing about 10% of the total carbon emissions in China in 2015. Due to China's resource advantages, compared with many countries, our chemical industry uses more coal as raw material, but its carbon emissions are very high. For example, we need a lot of natural gas in the process of synthetic ammonia and methanol. In China, 4/5 of synthetic ammonia and methanol are formed by coal, which makes the carbon emissions of our coal chemical



industry much higher than those of other countries. Using coal to produce hydrogen requires 11 kilograms of carbon dioxide per kilogram, in order to achieve the control goal of greenhouse effect.

In addition, according to the statistical yearbook data released by BP, the United States has always been the country with the richest coal reserves in the world. In 2020, its coal reserves accounted for 23.2% of the global reserves, which was 8.08% lower than that of Russia, the second place. The overall coal resources reserves are strong. However, in terms of global coal production, the United States ranks fourth in the world, and the actual mining scale is far lower than its reserves, which is 1/8 of the output of China, which ranks first in the world.

In 2020, the global coal output is the highest in China, the second in India, the third in Indonesia, the fourth in the United States, the fifth in Australia, and 4,000 in China. In terms of global coal output, the United States ranks fourth in the world, and the actual mining scale is far lower than its reserves, which is 1/8 of the output of China, the world's number one.

The total carbon emission of coal industry in China is higher than that of the United States, but the per capita carbon emission of China is much lower than that of the United States. The per capita carbon emission of coal industry in the United States is higher than 80,000, the highest year is 2008, and the lowest year is 2017. The per capita carbon emission of coal industry in China is lower than 60,000, the highest year is 2018, and the lowest year is 2008. The per capita carbon emission of coal industry in the United States is more than 10,000.

### III. RESEARCH & INVESTIGATION

#### 3.1 Questionnaire Design and Distribution

The design of the questionnaire conforms to the theme of this survey, considering the actual situation and its logical problems. The survey of the problems also involves the age, income, and education of the respondents, and from the perspectives of law, industry standards and community. Combining the thinking logic of the respondents, the arrangement is made from an objective point of view, putting aside subjective factors, and following the principles of first being complicated, first being easy and then difficult, first being concrete and then abstract. At the same time, to make the respondents clear briefly and be willing to answer. The language of the questionnaire is concise and sincere. Let as many respondents as possible answer within their knowledge, and the questionnaire does not have any hint. In principle, the time for answering the questionnaire is also controlled within 10 minutes. And the questionnaire did not set too many variables for later data statistics and analysis. Questionnaires were distributed through questioners, 150 copies were distributed as a whole, and 140 copies were recovered, including 130 small questionnaires, with an effective rate of 94%.

#### 3.2 Analysis of Survey Results

##### 3.2.1. Basic information

Table 6 Frequency Analysis Results

name	option	frequency	Percentage (%)	Cumulative percentage (%)
2. Your gender is:	Man	133	62.74	62.74
	Woman	79	37.26	100.00
3. Your age is:	Under 18 years old	five	2.36	2.36
	18-25 years old	122	57.55	59.91
	26-35 years old	48	22.64	82.55
	36-45 years old	30	14.15	96.70
	Over 45 years old	seven	3.30	100.00
4. What is your education level?	Junior high school and below	27	12.74	12.74
	senior high school	18	8.49	21.23
	University college	138	65.09	86.32
	undergraduate college	29	13.68	100.00
5. Your monthly income:	3,500 yuan and below	24	11.32	11.32
	3501-6000 yuan	92	43.40	54.72
	6001-9500 yuan	80	37.74	92.45
	9500-12000 yuan	twelve	5.66	98.11
	More than 12,000	four	1.89	100.00

name	option	frequency	Percentage (%)	Cumulative percentage (%)
Total		212	100.0	100.0

Respondents, 133 males and 79 females, accounting for 62.74%; In the age survey, there are 5 people under 18 years old, 122 people between 18 and 25 years old, accounting for 57.55%, 48 people between 26 and 35 years old, accounting for 22.64%, 30 people between 36 and 45 years old, accounting for 14.15%, and 7 people over 45 years old. In the survey of education level, there are 27 junior high school students and below, 18 senior high school students and 138 junior college students, with the largest number of junior college students, accounting for 65.09%, and 29 undergraduate students, accounting for 13.68%, accounting for 100%. As for the survey of monthly income, 24 people are below 3,500 Yuan, accounting for 11.32%, 92 people are between 3,501 and 6,000 Yuan, accounting for 43.40%, 80 people are between 6,001 and 9,500 yuan, accounting for 37.74%, and 12 people are between 9,500 and 12,000 yuan, accounting for 5.66%.

### 3.2.2 Legal Cognition

Table 7 Frequency Analysis Results

Name	Option	Frequency	Percentage (%)	Cumulative percentage (%)
What do you think is the perfection degree of the overall framework of carbon neutrality laws and regulations in China at present?	imperfection	80	37.74	37.74
	common	72	33.96	71.70
	improve	60	28.30	100.00
Do you think there are the following problems in the content of carbon neutrality laws and regulations in China at present?	Lack of many specific details.	46	21.70	21.70
	Lack of determination of responsibilities of each subject.	64	30.19	51.89
	Lack of specific punishment measures	52	24.53	76.42
	Lack of supporting measures with other related industries.	50	23.58	100.00
What do you think is the overall implementation degree of carbon neutrality laws and regulations in China at present?	be poor	85	40.09	40.09
	common	73	34.43	74.53
	good	54	25.47	100.00
Total		212	100.0	100.0

Regarding the survey of legal cognition, "What do you think is the perfection degree of the overall framework of China's carbon-neutral laws and regulations at present?" In this survey, 80 people think it is imperfect, accounting for 37.74%, 72 people think it is ordinary, accounting for 33.96%, and 60 people think it is perfect, accounting for 28.30%; In the survey on the question "Do you think there are any problems in the contents of China's carbon-neutral laws and regulations at present?", 46 people, accounting for 21.7%, think that there is a lack of specific details, 64 people, accounting for 30.19%, 52 people, accounting for 24.53%, think that there is a lack of supporting measures with other related industries, accounting for 23.58%. "What do you think is the overall implementation degree of China's carbon-neutral laws and regulations?" In this survey, 85 people think it is poor, accounting for 40.09%, 73 people think it is average, accounting for 34.43%, and 54 people think it is good, accounting for 25.47%. It shows that various industries lack a complete supporting legal system, which requires the state and local governments to take the lead in solving it.

### 3.2.3 Industry System

Table 8 Frequency Analysis Results

Name	option	frequency	Percentage (%)	Cumulative percentage (%)
What do you think is the current	not serious	78	36.79	36.79
	common	69	32.55	69.34

Name	option	frequency	Percentage (%)	Cumulative percentage (%)
situation that carbon neutrality standards are not unified in the implementation of carbon neutrality in China?	serious	65	30.66	100.00
In your opinion, which of the following problems exist in the implementation of carbon neutral technology in China?	There is not enough research on basic technologies related to carbon neutral standards.	75	35.38	35.38
	There are few high-level professional and technical personnel.	42	19.81	55.19
	Less investment in technology	44	20.75	75.94
	Related technologies cannot be closely related to carbon neutrality standards.	51	24.06	100.00
Do you think the following problems exist in China's carbon neutral standard system?	There are few greenhouse gas management standards such as carbon emission accounting, which need to be improved urgently.	85	40.09	40.09
	There are still a lot of standard gaps in renewable energy, CCUS, carbon sink and other fields.	40	18.87	58.96
	There are multiple sets of standards in the same field.	28	13.21	72.17
	Not unified with international standards	52	24.53	96.70
	other	7	3.30	100.00
Which of the following problems do you think exist in the implementation of China's carbon neutrality standards?	The standard publicity training is not strong enough.	50	23.58	23.58
	Some enterprises, implementers and other relevant implementers do not understand and master the standards.	73	34.43	58.02
	Lack of statistical monitoring means for standard implementation	53	25.00	83.02
	The implementation of standards is unclear, and standards are not updated in time.	36	16.98	100.00
Total		212	100.0	100.0

In the industry system survey, "What do you think is the current situation that carbon neutrality standards are not unified in the implementation of carbon neutrality in China?" In the survey, 78 people chose not serious, accounting for 36.79%, 69 people chose ordinary, accounting for 32.55%, and 65 people felt serious, accounting for 30.66%; In the survey of "Which of the following problems do you think exist in the implementation of carbon-neutral technology in China", 75 people think that the basic technology related to carbon-neutral standards is not studied enough, accounting for 35.38%, 42 people think that there are at least high-level professional and technical personnel, accounting for 19.81%, 44 people think that the investment in technology is less, accounting for 20.75%, and 51 people think that related technologies cannot be closely related to carbon-neutral standards, accounting for 24.5%. In the question "Do you think the following problems exist in China's carbon-neutral standard system", 85 people think that there are few greenhouse gas management standards such as carbon emission accounting, accounting for 40.09%, 40 people think that there are still a lot of standard gaps in renewable energy, CCUS, carbon sink and other fields, accounting for 18.87%, and 28 people think that there are multiple standards in the same field, accounting for 13.21%, which is not in line with international standards. In the question "which of the following problems do you think exist in the implementation of carbon neutrality standards in China?" There are 50 people who think that the training of standard publicity is not enough, accounting for 23.58%; 73 people think that some enterprises, implementers and other related implementers do not understand and master the standards, accounting for 34.43%; 53 people think that the statistical monitoring means of standard implementation are missing, accounting for 25%; 36

people think that the implementation of standards is unclear and the standards are not updated in time, accounting for 16.98%. It shows that the existing standards are insufficient in coverage, technical level, working mechanism, implementation mode and internationalization degree.

### 3.2.4 Carbon Neutral Implementation

Table 8 Frequency Analysis Results

name	option	frequency	Percentage (%)	Cumulative percentage (%)
12. What do you think are the following problems for Chinese enterprises in the process of carbon neutrality implementation?	Only a few enterprises have participated in low-carbon emission reduction.	31	14.62	14.62
	Many enterprises have rejected low carbon emission reduction.	31	14.62	29.25
	The regulatory mechanism of low-carbon emission reduction related to industries and enterprises is not perfect enough.	81	38.21	67.45
	Overall, the participation of enterprises is not enough.	69	32.55	100.00
13. Which of the following measures do you think are beneficial for enterprises to actively participate in the implementation of carbon neutrality?	The state has issued policies to support related low-carbon emission reduction and given policy support to enterprises.	48	22.64	22.64
	Improve the carbon footprint assessment system and strengthen refined management.	42	19.81	42.45
	Innovating the talent training mechanism to transport professionals for enterprises	63	29.72	72.17
	Give financial support to enterprises	25	11.79	83.96
	Give low-carbon emission reduction enterprises priority development policy support incentives.	34	16.04	100.00
total		212	100.0	100.0

In the investigation of carbon neutrality implementation, in the question "What problems do you think Chinese enterprises have in the process of carbon neutrality implementation?" In the survey, only a small number of enterprises participated in the low-carbon emission reduction of 31 people, accounting for 14.62%; a large number of enterprises rejected the low-carbon emission reduction of 31 people, accounting for the same 14.62%; 81 people, accounting for 38.21%, believed that the overall participation of enterprises was not enough for 69 people, accounting for 32.55%; In the question "Which of the following measures do you think are beneficial for enterprises to actively participate in the implementation of carbon neutrality?" According to the survey, 48 people, accounting for 22.64%, were given policy support by the state to support related low-carbon emission reduction, 42 people, accounting for 19.81%, thought that the carbon footprint evaluation system was improved and refined management was strengthened, 63 people, accounting for 29.72%, were trained by innovative talent training mechanism, and 25 people, accounting for 11.79%, were given financial support to low-carbon emission reduction enterprises. It shows that there are still many problems in the implementation of carbon neutrality, and enterprises need to increase their efforts.

### 3.2.5 Community Mechanism

Table 9 Frequency Analysis Results

name	option	frequency	Percentage (%)	Cumulative percentage (%)
In the process of community participation in carbon neutrality, which of the following problems	The public goods are carbon-neutral communities, so the construction cost and benefits cannot be balanced.	42	19.81	19.81
	Only a small number of community members participated.	64	30.19	50.00
	Only a few community organizations are involved.	56	26.42	76.42
	Lack of effective supervision of community participation	50	23.58	100.00

name	option	frequency	Percentage (%)	Cumulative percentage (%)
exist?				
Which of the following measures do you think are beneficial for communities and individuals to actively participate in the implementation of carbon neutrality?	Encourage communities to cooperate with professional organizations to carry out energy-saving transformation in communities.	37	17.45	17.45
	Give certain energy cost concessions to communities that apply energy-saving and emission-reduction technologies.	48	22.64	40.09
	Give preferential treatment to communities and individuals who want to install energy-saving and emission-reduction equipment.	34	16.04	56.13
	Strengthen offline publicity for communities and individuals and energy conservation and emission reduction in media online.	49	23.11	79.25
	The government organizes community individuals to participate in low-carbon lifestyle promotion activities such as junk trading and shared travel.	44	20.75	100.00
Total		212	100.0	100.0

In the survey, it is considered that 42 people, accounting for 19.81%, cannot balance the construction cost and construction income in the carbon-neutral community with public goods, 64 people, accounting for 30.19%, 56 people, accounting for 26.42%, and 50 people, accounting for 23.58%, lack effective supervision on community participation. In the survey on the question "Which of the following measures do you think are beneficial for communities and individuals to actively participate in carbon neutrality", it is considered that 37 people are encouraged to cooperate with professional institutions to carry out energy-saving transformation in communities, accounting for 17.45%, 48 people are considered to be given certain energy cost concessions for communities applying energy-saving and emission-reduction technologies, accounting for 22.64%, and 34 people are considered to be given energy cost concessions for communities and individuals who want to install energy-saving and emission-reduction equipment. It accounts for 16.04%, and 49 people, accounting for 23.11%, think that the government organizes community individuals to participate in low-carbon lifestyle promotion activities such as junk trading and shared travel, accounting for 20.75%.

#### IV. CHINA'S CARBONNEUTRALINCENTIVEMECHANISMPROBLMS

##### 4.1 The Lack of a Complete Supporting Legal System in Various Industries

Achieving carbon neutrality and peak carbon dioxide emissions is a very important social system reform, not only in terms of economy and technology, but also in terms of our overall ecological development. The realization of the goal of carbon neutrality involves multiple stakeholders, which requires a systematic legal system to regulate the behavior of all parties, clarify the legal responsibilities of different subjects, and clarify different behavioral norms according to their behavior patterns. Factors to be considered in promoting the construction of carbon-neutral legal system and giving full play to the leading role of the government. At present, all parts of China are actively carrying out energy conservation and carbon reduction, but a perfect institutional framework has not yet been formed, and supporting laws related to various industries need to be improved.

##### 4.2 The Relevant Standards of Various Industries Have Not Yet Been in Line with International Standards.

Facing the new demand of carbon neutrality in peak carbon dioxide emissions, the existing standards are insufficient in coverage, technical level, working mechanism, implementation mode and internationalization degree. First, the standardization coordination mechanism is not perfect. The construction of carbon neutral standard system in peak carbon dioxide emissions is a cross-disciplinary and multi-sectoral system engineering, and the multi-head standard formulation is prone to cross-repetition. Second, the standard technical level needs to be improved. There is insufficient research on basic technologies related to carbon neutral standards in peak carbon dioxide emissions, the combination of standards and technological innovation is not close, the number of high-level and interdisciplinary talents is small, and the capital investment is insufficient. Third, there are many gaps in the standard system. For example, there are few greenhouse gas management standards such as carbon emission accounting, which need to be improved urgently, and there are still a lot of standards gaps in renewable energy, CCUS, carbon sink and other fields. Fourth, the standard implementation method is not perfect. The training for publicizing standards is not strong enough, and some enterprises do not understand and master

standards. Lack of statistical monitoring means for standard implementation, unclear standard implementation, and untimely standard update. Fifth, the consistency with international standards is not high, and carbon emission accounting guidelines are not in line with international standards. These problems need to be paid attention to by relevant parties and studied and solved in practical work.

#### **4.3 Enterprises in Various Industries Have Not Yet Formed an Effective Coordination Mechanism.**

In fact, I need to achieve peak carbon dioxide emissions goal in the next 10 years and carbon neutrality in the next 40 years. This task is very arduous. Relevant enterprises in China must formulate an important strategy for low-carbon development according to national requirements. In terms of international policies, the EU and the United States have also controlled carbon emissions in taxation and other aspects. We can see that its future trend is to realize the global responsibility decomposition of carbon emissions through more policy means. So that it can become everyone's social responsibility. Therefore, enterprises must form a certain business thinking to establish a more reasonable business strategy to help us achieve the goal of emission reduction. For China, energy enterprises are an important subject to deal with climate change, so it is very important and urgent to better complete the simple emission reduction goal in the business process. At present, only a small number of enterprises in China have effectively promoted low-carbon emission reduction measures, and the regulatory mechanisms of other industries and enterprises are still not perfect.

#### **4.4 Individuals and Communities Have Not Been Effectively Guided.**

Under the background of carbon neutrality, under the guidance of the 14th Five-Year Plan, the national carbon trading market is being built in an orderly way, and seven provinces and cities, such as Hubei, have taken the lead in starting the pilot project, which has promoted the desire of relevant enterprises to obtain more carbon emission trading quotas. However, there are fewer social individuals and enterprises that have finally landed, especially at the individual level, and everyone's awareness is not strong enough. At present, there is no effective and complete incentive mechanism system that can be implemented. From Shanghai, we can see that there are 1,200 communities in Shanghai, and each community has more than 20,000 permanent residents and the total carbon emission can reach 72 million tons. If biological means are used to comprehensively neutralize carbon, then we can adopt the way of broad-leaved forest, and one square kilometer of broad-leaved forest can absorb 36,000 tons of carbon dioxide every year. We can calculate that it takes 1.67 square kilometers of forest for a community to complete carbon neutrality, and 2,000 square kilometers of forest for the whole city of Shanghai. The annual land lease and forest maintenance per square kilometer of forest is about 5.5 million, and the annual forest maintenance cost is about 11 billion. To achieve carbon neutrality by market means, based on the current EU carbon transaction price of 50 euros per ton, it will cost about 25.5 billion yuan per year. To achieve carbon neutrality by technical means, the operating cost of CCUS technology will cost 23 billion yuan per ton of 320 yuan.

To achieve carbon neutrality in the community requires the joint participation of residents and communities, because many items in its comprehensive community have public attributes, so its construction and development cannot be balanced in the same subject, so it needs the joint participation of many parties, and a consensus can be reached under effective internal and external supervision. To effectively realize its creation with the community, it needs technical and publicity support from social organizations, enterprises, and governments.

### **V. THE FUTURE PROSPECT OF CHINA'S CARBON NEUTRAL INCENTIVE MECHANISM**

#### **5.1 Improve the Relevant Legal System**

Achieving peak carbon dioxide emissions and carbon neutrality is an extensive and profound systematic economic and social change. The realization of the goal of carbon neutrality involves multiple stakeholders, which requires a systematic legal system to regulate the behavior of all parties, clarify the legal responsibilities of different subjects, and clarify different behavioral norms according to their behavior patterns. Factors to be considered in promoting the construction of carbon-neutral legal system and giving full play to the leading role of the government.

Construct a legal enforcement mechanism to promote the realization of carbon neutrality. We will continue to improve and implement the responsibility mechanism of "Party and government share responsibility" and "one post and two responsibilities", and build an institutional mechanism of integrated planning, deployment, promotion and assessment of carbon neutrality and economic and social development. At the same time, improve the current ecological environment law enforcement mechanism, and build a law enforcement mechanism that conforms to the characteristics of carbon neutrality from the five stages of "evaluation-decision-making-implementation-supervision-relief" to realize source prevention, process supervision, damage compensation and accountability.

Achieving the goal of carbon neutrality is a major decision made by the CPC Central Committee and an important responsibility of party committees and governments at all levels. We must give full play to the leading role of the government, and the government should comprehensively use administrative and economic means to mobilize the enthusiasm of all parties to realize the strategic adjustment of industrial structure and transportation structure and the greening of production and lifestyle. Pay attention to the systematization of the legal system. Integrate and apply administrative law, civil law, criminal law and other legal systems to form a systematic legal system to promote the realization of carbon neutrality, provide a universal basis for the balance of multiple interests, and form a good social order of common governance. Reflect the principle of minimizing the loss of interests. The goal of carbon neutrality comes at a price, and it is inevitable that the economic interests and environmental interests of different subjects will change or even decrease. In building a legal system to achieve carbon neutrality, it is necessary to consider minimizing the loss of economic and environmental benefits.

### **5.2 Promote Low-carbon Industry Standards in Line with International Standards.**

Standards are the binding means to achieve the goal of carbon reduction. Mandatory energy-saving standards are an effective scheme to strictly control projects with high energy consumption and high emissions, and can also transform backward production capacity, so that excess production capacity can be transformed into brand-new production capacity. There are 112 mandatory energy consumption limit standards and 75 mandatory energy efficiency standards in China, which strongly support the work of energy saving, carbon reduction and pollution reduction. Resolutely curbing the blind development of the "two high" projects is an important link to realize the current task, and it is urgent to further strengthen the standard constraints. From 2005 to 2020, the implementation of mandatory energy efficiency standards and energy efficiency labeling system has brought more than 2.5 trillion kWh of electricity saving, with an average annual electricity saving of more than 170 billion kWh, which is 1.5 times of the annual power generation of the Three Gorges Hydropower Station. During the "Thirteenth Five-Year Plan" period, China issued 16 mandatory energy consumption limit standards, reducing carbon dioxide emissions by 148 million tons.

Standards are the basic tools for green and low-carbon transformation and upgrading. To achieve the goal of carbon neutrality in peak carbon dioxide emissions, it is necessary to systematically promote industrial transformation and upgrading, energy structure optimization and green financial development under the guidance of green and low-carbon goals. In terms of industrial transformation and upgrading, greenhouse gas accounting standards provide a basic common method for finding out the background of carbon emissions, and standards such as energy saving, carbon emission management and recycling fully support the green and low-carbon transformation and upgrading of various industries and fields. In terms of energy structure optimization, renewable energy standards support various entities to greatly increase the proportion of non-fossil energy utilization and achieve the goal of energy saving, carbon reduction and efficiency improvement. In the development of green finance, green financial standards provide key technical basis for capital investment in green and low-carbon fields. Standards are an effective way to popularize and apply green and low-carbon technologies. The popularization and application of innovative green and low-carbon technologies, such as new energy, renewable energy, and negative emission technologies, is the key to achieve peak carbon dioxide emissions goal of carbon neutrality. Standards are the basis for the iterative upgrading of innovative technologies and the construction of industrial chains, and the passport for the popularization and application of innovative technologies. Taking the hydrogen energy industry as an example, the technical, design and safety standards of hydrogen refueling stations are formulated to provide important technical basis for the construction and operation of hydrogen refueling stations.

At present, more than 170 hydrogen refueling stations have been built and operated in China according to relevant standards, and China has become one of the countries with the largest number of hydrogens refueling stations in the world. Standards are an important part of international rules to deal with climate change. Mitigating and adapting to climate change cannot be separated from the role of international standard rules. For example, ISO 14068 carbon footprint standard has become an international unified yardstick for evaluating carbon emissions of products. For another example, the rules of free trade agreements such as the Comprehensive and Progressive Trans-Pacific Partnership Agreement (CPTPP) have also included issues related to low-carbon transition, encouraging the promotion of low-carbon environmental protection products based on international standards.



### 5.3 The Formation of an Effective Coordination and Incentive Mechanism Between Enterprises and Industries

On March 13th, the 14th Five-Year Plan for People's Republic of China (PRC)'s National Economic and Social Development and the Outline of Long-term Goals in 2035 (hereinafter referred to as the "14th Five-Year Plan") was officially announced. This document formally stated that we should achieve the relevant goals of the country's independent contribution to climate change in 2030, formulate relevant carbon-neutral plans for peak carbon dioxide emissions, and provide more technical support in energy conservation, emission reduction and clean energy. Only in this way can the steel, cement and other industries effectively complete the supply-side structural reform, make its emissions less and pollution less, and achieve our clean energy goal with higher efficiency to help advanced leading enterprises improve their core competitiveness.

We should constantly curb the development of projects with high energy consumption and high emissions. Central enterprises should strictly control the optimization and industrial layout of these projects, realize their classified disposal and dynamic and effective management, scientifically and steadily promote new projects, and strictly implement the emission control and requirements of enterprises for new and expanded projects such as steel and cement, and strictly implement the capacity control policy, so that the potential of their original stocks can be deeply tapped, and the efficient reform of energy efficiency level can be promoted, so that they can reach the domestic and international advanced level quickly.

Improve carbon emission management capabilities. Promote central enterprises to establish and improve carbon emission statistics, monitoring, verification, reporting and disclosure systems. Vigorously improve the monitoring ability of carbon emissions, and monitor its energy consumption online through key units, so that the specific emissions of carbon dioxide can be known more accurately, making its detection level higher. Scientifically carry out carbon emission inventory, establish and improve the carbon footprint assessment system, strengthen the refined management of carbon emissions throughout the product life cycle, and strictly implement the requirements for the preparation and reporting of greenhouse gas emission reports by key emission units. Innovate the talent training mechanism, organize professional and systematic training on carbon emission reduction, carbon management and carbon trading, and build a high-level professional talent team.

### 5.4 Encourage Policies to Guide Communities and Individuals

At the same time, we can also encourage professional institutions to complete the rapid energy-saving transformation of the community through the contract energy management model. For example, we can fully combine the intelligent sensing device with the big data algorithm and use the big data algorithm to clean up the relevant data obtained from the intelligent sensing device, so that the relevant data of public facilities in the community are more accurate. Encourage the installation of solar power generation hot water devices and promote many efficient coal-fired stoves and solar lighting. In the concrete transformation of the community, more solar photovoltaic grid-connected power generation technology is adopted, and the construction of the community is strengthened through the development of high-efficiency and polluting bio-carbon sink technology. We can also take the city as a unit, use new media and other publicity means to strengthen publicity and encourage the knowledge of carbon neutrality to be more publicized in schools. Through the publicity of low-carbon lifestyles such as sharing travel appliances and saving electricity in the community, these public facilities can meet people's low-carbon life needs both technically and in use.

## VI. CONCLUSION

By comparing the similarities and differences between China and the United States in the development of low-carbon economy, we can see that in common, they mainly combine the overall goal of energy conservation and emission reduction with the national conditions effectively, and both can propose their own ways to set the goal of carbon neutrality reasonably and achieve it quickly. The standard of the United States for China is higher, and there are many reports that China has invested more in new energy technologies. It will reach RMB 3,000 billion in the next 10 years, but we can also see that the related technologies of energy conservation and emission reduction in the United States are still relatively advanced, and we need to invest more time and energy to study them. From a higher strategic perspective, we can see that the motives and interests of energy conservation and emission reduction in China and the United States are similar, so we should analyze the relevant gaps between China and the United States in the strategic sense and learn more from the technology, to effectively enhance the competitiveness of our country's low-carbon economy.

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