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*Centro de Política  
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**Documento de Trabajo**  
**Serie Política de la Competencia y Regulación**  
Número 61 / 2020

# **A Study on China's Measures for the Decoupling of the Economic Growth and the Carbon Emission**

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**Rao Lei**  
**Gao Min**

Jean Monet Network EU-China:  
Comparative experiences and  
contributions to global governance  
in the fields of climate change, trade  
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Ref. 587904-EPP-1-2017-1-ES-EPPJMO-NETWORK



Co-funded by the  
Erasmus+ Programme  
of the European Union

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ISBN: 978-84-17385-95-8

Depósito legal: M-26147-2020

Maquetación: Gráficas Vergara, S. A.

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# 1. Introduction

China's economy has been developing at a continuously rate of the average annual growth rate of 9.36% since the economic reforms and open-door policies in 1978, which has become the fastest growing economy in the world. China's GDP in 1978 was 367.87 billion yuan, which accounted for 1.8% of the world economy<sup>1</sup>, while in 2019, China's GDP has exceeded 99 trillion yuan, which is expected to account for more than 16% of the world economy<sup>2</sup>. However, since the foundation of China's national economy was weak and the economic development lagged far behind western developed countries at the time of 1978, China has started with the extensive economic growth mode based on the low level of technologies, resulting excessive energy consumption, causing the rapid increase of carbon dioxide emissions and environmental pollution from then on. As China has made considerable progress in the economic development and technologies, the awareness of energy saving and emission reduction has been gradually enhanced as well. At present, China is at a critical period of national economic development, accompanying with the reduction of the consumption of fossil energy and reducing carbon emissions.

As a big and responsible country, China has made a commitment to reduce carbon dioxide emissions per unit of GDP by 40% to 45% by 2020, based on the level of that in 2005, and has successfully fulfilled the commitment in advance. Then China has announced to reach the peak of CO<sub>2</sub> emissions at around 2030 and strive to achieve it even ahead of that time. Another commitment for 2030 is that the CO<sub>2</sub> emissions per unit of GDP in China is to be reduced by 60% to 65% than that in 2005<sup>3</sup>. Therefore, it is significant to study the causes and the measures for the decoupling of China's economic growth and carbon emissions to find out the more efficient measures for the further carbon reduction.

## 2. Literature review

The current study on the relationship between economic growth and carbon emissions focuses on the following aspects: firstly, using economic analysis tools to study the law between carbon emissions and economic growth Zhang (2013) has used environmental Kuznets curve (EKC) to analyze the relationship between per capita income and per capita CO<sub>2</sub> in the study of carbon emissions and economic growth in Beijing. Via EKC hypothesis and the decoupling theory, Zhang et al. (2017) have found that the coordination of carbon emissions and economic growth between EU and other countries is very good, but in the developing countries, such as China and India, it needs to be strengthened. Qi (2018) has analyzed the fluctuation trend of the "expansion connection –weak decoupling– strong decoupling" between China's economic growth and carbon emissions by using the decoupling model.

Secondly, by summarizing empirical data, analyzing empirically the relationship between economic growth and carbon emissions Wang (2010) has analyzed the relationship between energy consumption and economic growth in China, basing on the historical data from 1990 to 2007, and has pointed out that at certain stages, the economic growth and energy consumption can be in absolute decoupling or in relative decoupling. Peng et al. (2011) have analyzed the relationship between carbon dioxide emissions and economic growth from a national or regional perspective, which shows a weak decoupling phenomenon in China then. Schandl (2016) has assessed the decoupling potential of economic growth and environmental pressure in 13 countries and regions around the world, and has found that OECD countries still have great potential to reduce carbon emissions and have little impact on economic growth.

As for the building of China's emission trading scheme (ETS), it is based on the experience of EU ETS with the typical mode of Cap and Trade. Wang & Chen (2018) have combed through the relevant policy development and the process of China's carbon market building. They have analyzed the market performance and the performance of each pilot carbon market. Tian & Xu (2019) have summarized the

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1 *The 23th of series reports on the achievements of economic and social development in the 70th anniversary of the founding of the People's Republic of China.* National Bureau of Statistics of China: <http://www.stats.gov.cn/>  
2 *China's economy in 2019.* The State Council Information Office of the People's Republic of China: <http://www.scio.gov.cn/>  
3 *China's Energy Policy 2012.* The State Council Information Office of the People's Republic of China: <http://www.scio.gov.cn/>

results of China's carbon trading pilot and has put forward relevant policy recommendations considering the existing problems. Li et al. (2014) have compared the operation mechanism and current situation of emission trading market at home and abroad, and has analyzed the transaction volume and transaction volume of the seven major carbon emission trading pilot areas in China to found out the root cause of the slow development of carbon emission trading market. Based on the development of global carbon market, Wang & Zhao (2019) have analyzed the research situation of carbon accounting, carbon quota and carbon pricing and have put forward corresponding countermeasures and suggestions for China's national carbon market construction according to the research results and gaps.

The above-mentioned literatures mainly analyze the relationship between economic growth and carbon emissions through empirical analysis, but few studies the reasons for the decoupling of economic growth and carbon emissions from the internal relationship among the economic growth, energy consumption and carbon emissions. Therefore, it is significant to take the coupling relationship between energy consumption and economic growth as the starting point so as to have further explanation for the policies and measures which make China's economic growth and carbon emission be decoupled through the reduction of carbon intensity.

### 3. The decoupling process of China's economic growth and carbon emission

China has become a middle-income country since 2012 and has become the world's second largest economy after the United States. As China's economic development continues, the quality and the efficiency of the economic development are taken into consideration with keen interest. For a couple of decades, China has been trying to find a green and low-carbon development mode consistent with the national conditions to decouple the economic growth from the carbon emissions. As the carbon emissions mainly depends on energy consumption structure and energy efficiency, on the premise of unchanged energy consumption structure, the larger energy consumption means the more carbon emission, and the higher the energy efficiency, the lower the carbon intensity. Therefore, China takes energy consumption as the breakthrough point and gradually realizing the decoupling of the carbon emissions from the economic growth by optimizing energy structure and improving energy efficiency.

#### 3.1. The decoupling turning of China's economic growth and carbon emission

##### 3.1.1. China's economic growth coupling the increasing growth rate of energy consumption

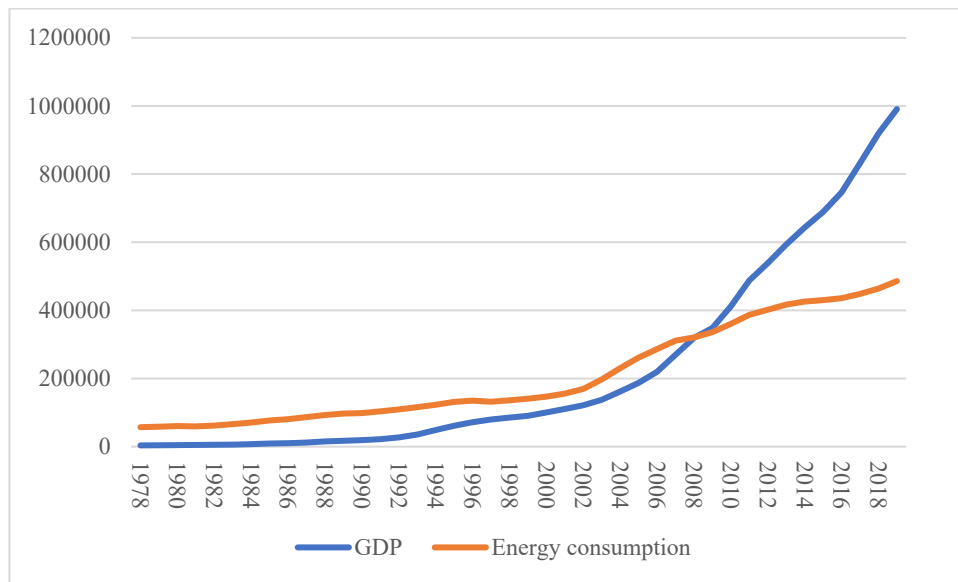
China's GDP has shown a rapid growth trend from 1978 (the beginning of the reforms) to 2019. In the period of the early stage of the reforms and opening-up, the economic growth has the priority and the extensive and high-speed growth is characterized by "high energy consumption and high pollution" which lead to various environmental problems. The growth of GDP means the increasing consumption of energy. The dual effects of industrialization and urbanization cause the energy consumption and carbon emission increasing rapidly, which make China become the world's top energy consumer and carbon dioxide emitter, accounting for nearly 30% of global emissions although China's per capita carbon emission is still at a low level<sup>4</sup>.

It can be seen from Fig. 1 that over the past 40 years, China's energy consumption has increased with the increase of economic aggregate, especially before 2008. Although China's economic development has made remarkable achievements, the rapid growth trend of energy consumption should be eased.

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4 Shan, Y.; Guan, D. et al. *China CO2 emission accounts 1997–2015*. Sci Data 5,170201 (2018); <https://doi.org/10.1038/sdata.2017.201>

**Figure 1. The trend of GDP growth and energy consumption growth in China 1978-2019**

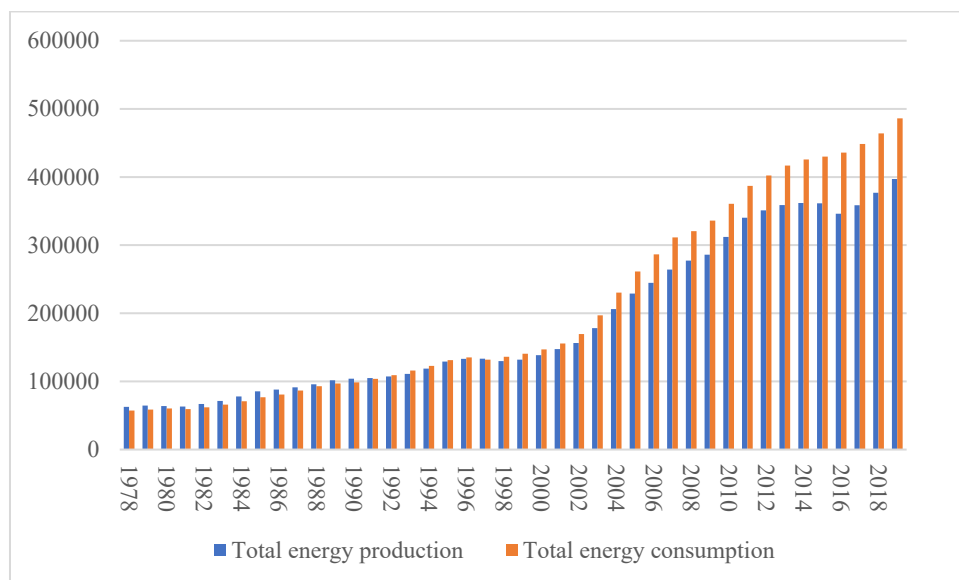


Data source: National Bureau of Statistics of China

Fig. 2 shows that since 1978, with the development of China’s industry and the advancement of urbanization, the total energy consumption has increased year by year and exceeded the total energy production in early 1990s. As China’s economic growth has increased continuously together with that of the energy consumption, it brings about the increase of carbon emission since 1978.

Since 2000, due to the rising proportion of manufacture in the national economy, China’s growth rate of energy consumption is much higher than that of energy production. Until the “12th Five Year Plan” period of 2011-2015, China has emphasized the transformation of energy development mode and the adjustment of energy structure as well, resulting in the slowdown of the growth rate of total energy consumption and total energy production, although the energy production and consumption have picked up a bit since 2017.

**Figure 2. China’s energy production and consumption from 1978 to 2019**



Data source: National Bureau of Statistics of China



The following is the global carbon emissions ranking (Table 1) in 2018. Only the top seven countries and regions are selected here. The data in the table shows that in 2018, the global carbon emission is 33,890.8 million tons, while China as a developing country with rapid economic development and the world's largest carbon emitter, the carbon emission is 9,428.7 million tons, which accounts for 28% of the world's total carbon emission and is 1.8 times than that of the second ranked United States and 2.7 times than that of the third ranked EU. However, as for the per capita carbon emission, it is 6.7 tons in China, which is lower than that of the developed countries such as the US (14.6 tons), Japan (8.9 tons) and Germany (8.7 tons)<sup>5</sup>.

**Table 1. Ranking of global carbon emissions for 2018**

Country	Total CO <sub>2</sub> emissions (Mt)	Proportion of global carbon emission (%)	CO <sub>2</sub> emissions per capita (t)
World	33,890.8	1	4.4
China	9,428.7	0.28	6.7
United States	5,145.2	0.15	14.6
EU	3,479.3	0.10	6.3
India	2,479.1	0.07	1.6
Russia	1,550.8	0.05	10.6
Japan	1,148.4	0.02	8.9
Germany	725.7	0.02	8.7

Data source: BP Statistical Review of World Energy (2019)

The main reason for the continuous increase of carbon emissions in China is the increase of the huge consumption of fossil energy. China is rich in coal but poor in oil and gas. Such characteristics of the natural resource endowments determine that the primary energy consumption structure is dominated by coal which may cause more emissions than oil and gas.

Since 1978, China's total carbon emissions show an overall upward trend, which are showed in Fig. 3. The carbon emissions before 1995 have showed a relatively uniform growth trend, but after 1995, they are more diverse. The carbon emissions from 1995 to 2018 can be divided into three dynamic stages: firstly, from 1995 to 2001, the total carbon emissions increase slowly from 3,029 million tons to 3,525 million tons, with a growth rate of only 16.37%; secondly, from 2002 to 2011, it is a period of a rapid growth from 3,845 million tons to 8,805 million tons, with a growth rate of 129%; thirdly, from 2012 to 2018, the growth rate slows down to 4.9% and the total carbon emissions just increase from 8,991 million tons to 9,428 million tons, and even with a slightly drop down in 2013<sup>6</sup>.

The causes for the dynamic changes of the carbon emission are closely related to the development of China's economy and the macro-control of the government. Before 2000, China's economy had developed more slowly with less energy consumption increase and less carbon emission increase. Since the accession to WTO in 2001, China's economy has developed rapidly. The GDP has increased from 12 trillion yuan in 2002 to 47.2 trillion yuan in 2011<sup>7</sup>. As the economic growth mainly depends on the increase of the output value of the second industry, which causes a sharp increase of the energy consumption and then leads to a rocket-up in carbon emission.

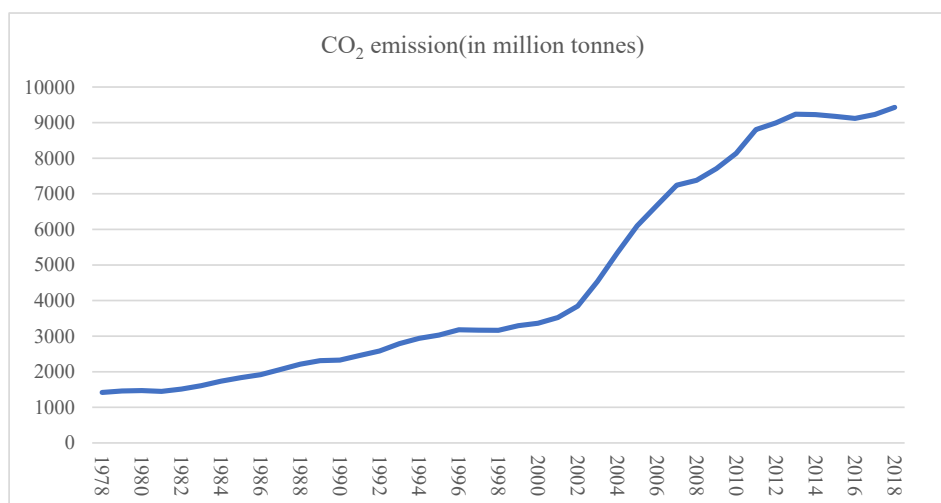
The turning point of China's carbon emission comes as China's energy saving and emission reduction policies have been successively introduced in line with the "Common but Differentiated Responsibilities" for the emission reduction. Since 2011, China has started to carry out carbon emission pilots, to establish voluntary emission reduction mechanism, and to deploy comprehensively the key emission reduction plan. From then on, the carbon emissions have been controlled with a relatively stable growth trend.

5 BP Statistical Review of World Energy (2019): [https://www.bp.com/zh\\_cn/china/](https://www.bp.com/zh_cn/china/)

6 BP Statistical Review of World Energy (2019): [https://www.bp.com/zh\\_cn/china/](https://www.bp.com/zh_cn/china/)

7 National Bureau of Statistics of China: <http://www.stats.gov.cn/>

**Figure 3. Total carbon emissions in China from 1978 to 2018**

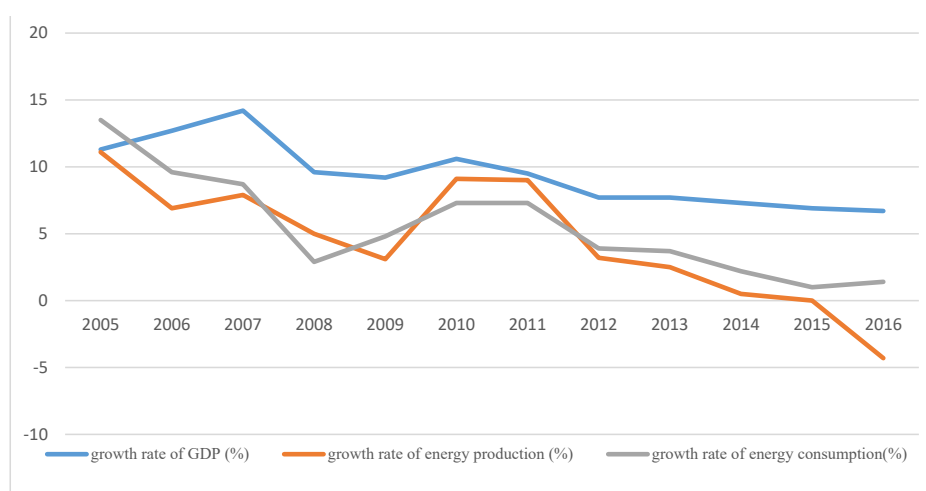


Data source: BP Statistical Review of World Energy (2019)

### 3.1.2. China's economic growth coupling with the slowdown growth rate of energy consumption

Energy is one of the basic elements of production, and the growth rate of energy consumption is often used as an important indicator to judge the economic situation. However, as the industrial structure and energy structure are constantly changing, the progress of science and technology and the improvement of energy efficiency result in the gradual decoupling of economic growth and energy consumption. As can be seen from Fig.4, in recent years, China's economic growth and energy consumption have achieved a slight decoupling. During the 11th Five Year Plan (2006-2010) and the 12th Five Year Plan (2011-2015), China has taken a variety of energy saving and emission reduction measures so that the growth rate of energy consumption has slowed down notably. With the adjustment of China's industrial structure and the transformation of economic growth mode, the energy consumption from 2013 has declined significantly.

**Figure 4. GDP growth rate and energy growth rate in China**



Data source: National Bureau of Statistics of China

It is shown in Fig. 4 that China keeps an increasing growth rate of GDP in the recent decades, but the energy production growth rate drops down obviously in recent years. Meanwhile, as the economic development goes hand in hand with the improvement of people's living standard, the demand for energy consumption also grows in China. However, due to the improvement of energy utilization, the carbon emission per unit GDP, in other words the carbon intensity, is continuously reduced. Although China's economic growth

and energy consumption have not yet achieved a strong decoupling, as the increasing contribution of the tertiary industry in the proportion of GDP, the adjustment of the energy structure for less fossil fuels especially for less coal, and the improvement of energy efficiency, China is striving to peak the greenhouse gas emissions by 2030 or even earlier. The significant contribution of the decreasing carbon intensity is remarkable for China's low-carbon development.

## 3.2. The causes for the decoupling of China's economic growth and carbon emission

### 3.2.1. The decrease of carbon intensity as the most apparent cause

The most apparent cause for decoupling economic growth from carbon emissions in China is the decrease of carbon intensity which mainly due to the reduction of energy consumption and improvement of energy efficiency. The carbon emission intensity index, which reflects the resource utilization efficiency and carbon emission efficiency in the process of economic development, can reflect the level of technology efficiency in the production of a country or region. According to China's Intended Nationally Determined Contributions (INDC) submitted to the Secretariat of the United Nations Framework Convention on climate change at the world climate conference in 2015, China has committed that the carbon intensity by 2030 is to be 60%-65% lower than that in 2005. In order to achieve this goal, China has accelerated the green and low-carbon transformation. China's climate actions provide a solid base for the global goal of temperature control of 2<sup>8</sup>.

China's goal for reducing carbon intensity is clear and determined and it is correlated with the plans for the economic development in the country. It also shows China's efforts to cope with global governance of climate change and China's determination to improve the mode of economic development by reducing energy consumption, developing green economy, and taking on the sustainable development in the production and the low-carbon life style of the people.

Table 2. Global carbon intensity change in 2014-2018

Country	2014-2015	Country	2015-2016	Country	2016-2017	Country	2017-2018
World	-2.8%	World	-2.6%	World	-2.6%	World	-1.6%
China	-6.4%	UK	-7.7%	China	-5.2%	Germany	-6.5%
UK	-6.0%	China	-6.5%	Mexico	-5.0%	Mexico	-5.2%
US	-4.7%	Mexico	-4.6%	Argentina	-4.9%	France	-4.2%
South Africa	-4.5%	Australia	-3.8%	UK	-4.7%	Italy	-4.0%
Mexico	-4.4%	Brazil	-3.8%	Brazil	-4.5%	Saudi Arabia	-4.0%
Canada	-4.2%	US	-3.4%	US	-3.7%	China	-3.9%
Japan	-2.7%	Japan	-2.4%	South Africa	-3.6%	EU	-3.7%
Turkey	-2.6%	Canada	-2.1%	Germany	-2.8%	Brazil	-3.5%
India	-2.0%	Russia	-1.7%	India	-2.5%	UK	-3.5%
Korea	-1.4%	EU	-1.7%	Australia	-1.8%	Japan	-3.0%

Data source: Price Waterhouse Coopers

Table 2 shows the data by PwC (Price Waterhouse Coopers) of the global carbon intensity changes in 2014-2018 as well as the top 10 countries in terms of carbon intensity reduction. From 2014 to 2015, as the global carbon emission intensity decreasing by 2.8%, China ranked first with a decline rate at 6.4%, and in the following two years, kept the rate at 6.5% and 5.2%. However, by 2017-2018, China dropped to the sixth

8 *Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions*. The State Council Information Office of the People's Republic of China: <http://www.scio.gov.cn/>

place with the carbon intensity decreasing rate at 3.9%<sup>9</sup>. The decline of the decreasing rate for China's carbon intensity since 2017 is caused firstly by the smooth growth of the macro-economy in China which leads to the coal consumption growing continuously; secondly by the instability of alternative non fossil energy. Since the hydropower generation was affected by the fluctuation of incoming water, the power generation capacity was reduced by 4.2% in 2017, and at the same time, the instability of wind power generation led to an increase of 7.1% in thermal power generation and an increase in coal consumption of more than 70 million tons<sup>10</sup>; thirdly, by the declining trend of emissions, China's carbon emissions have been continuously in a fast-declining trend, but it would inevitably come across the bottleneck in the process of decline, because there are many factors which may influence the speed of carbon intensity decline so that it would be difficult to maintain the high-speed decline all the time; fourthly by the cyclical recovery of the global industrial production. Since the decline of energy intensity and carbon intensity can hardly be offset with the growth of population and that of the per capita income, especially in the year of 2017, hence the increase of carbon emissions; fifthly by the continuous promotion of energy saving and emission reduction in the previous years, which has been hindered for it is difficult to furtherly stimulate the reduction of carbon emissions with the measures already in use. Therefore, it is urgently demanded to have creative methodologies and innovative measures for further emission reduction in China.

### 3.2.2. The energy saving and carbon reduction policies as the most important cause

Since 1978, China's total carbon emissions have continuously increased, because China's economic development depends a lot on the manufacture which causes the increase of energy consumption. However, due to the policies and the measures for energy saving and emission reduction, China has made great improvement in decreasing the energy intensity and increasing the energy efficiency.

In November 1997, the first Energy Conservation Law of the People's Republic of China has been passed by the National People's Congress, which has been implemented since 1998. With the implementation of the law, a series of energy saving policies and regulations related to industry, construction, transportation, and end products have been issued later, promoting the overall improvement of energy saving and energy efficiency. In August 2004, China's National Development and Reform Commission and the General Administration of Quality Supervision have jointly formulated and issued the measures for the administration of energy efficiency labeling. From then on, China's energy efficiency labeling system has been established with a great significance to improve the energy efficiency for the energy consuming equipments and to improve the consumers' awareness of energy saving. In addition, energy saving and emission reduction are closely related to the implementation of the policies for industrial structure adjustment.

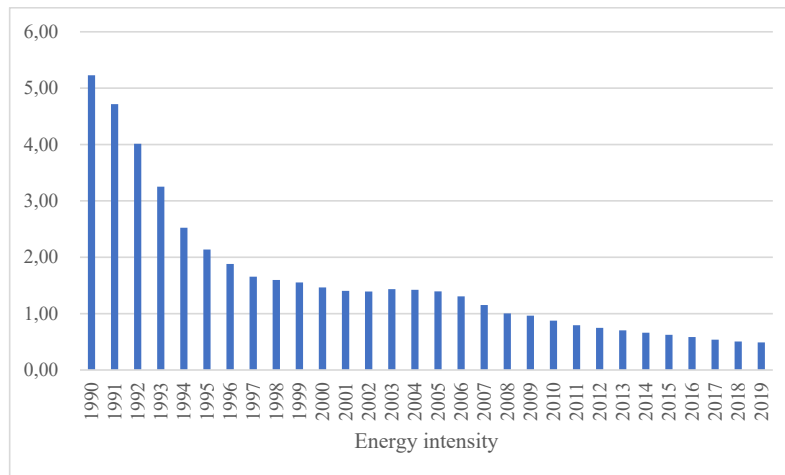
Because of implementing the policies to promote energy saving and emission reduction, China's energy efficiency, as an example, is getting more and more efficient and the energy intensity is getting lower and lower. As can be seen from Fig. 5, China's energy intensity has greatly decreased since 1990.

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9 *The Paris Agreement: a turning point? The low carbon economy index 2016-2019*. Price Waterhouse Coopers: <https://www.pwccn.com/>

10 National Bureau of Statistics of China: <http://www.stats.gov.cn/>

Figure 5. Trends of energy intensity in China from 1990 to 2019



Data source: National Bureau of Statistics of China

## 4. The measures for the decoupling by decreasing carbon intensity in China

The decrease of carbon intensity in China is the most apparent reason to achieve the goal for the decoupling of China's economic growth and carbon emissions, which mainly depends on the reduction of energy intensity, the improvement of energy productivity and energy efficiency. Therefore, it is significant to study the measures taken to reduce the carbon intensity in China from the perspectives of energy activities and carbon emission reduction.

### 4.1. The measures on energy-activities for the decrease of carbon intensity in China

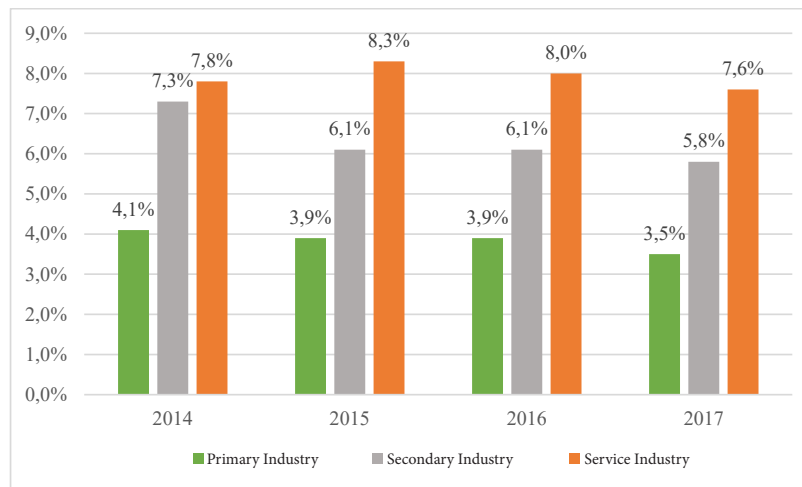
#### 4.1.1. Adjustment of industrial structure to decrease carbon intensity

In the past four decades, China's rapid economic development is a coin with two sides, and the backward side shows a series of problems as the acceleration of resource consumption, pollution, and emission and so on. The problems are closely related to the characteristics of China's industrial structure: the continuously increase of manufacture which causes more energy and resource consumption. In recent decades, China's industrial structure has been constantly adjusted. An important feature as China's economy entering the "new normal" stage is to emphasize the importance of continuous optimization and upgrading of economic structure. In the 13th five-year plan released in 2015, the government's work has focused on transforming the mode of economic development, adjusting, and optimizing the industrial structure to achieve sustainable economic development.

As energy saving and emission reduction are closely related to economic development, which are inseparable from industrial restructuring and promoting the upgrading of the industrial structure, changing the mode of economic development have become the main theme of China's economic and social development. China has adopted the industrial restructuring measures include upgrading traditional industries, accelerating the development of emerging industries, closing backward production capacity, and reducing production in energy intensive industries. The increasing growth rate of tertiary industry, which exceeds the second industry from 2014 on<sup>11</sup>, is a good way to show the decrease of the carbon intensity by adjusting the industrial structure in China.

11 National Bureau of Statistics of China: <http://www.stats.gov.cn/>

**Figure 6. Changes in the growth rate of the industries**



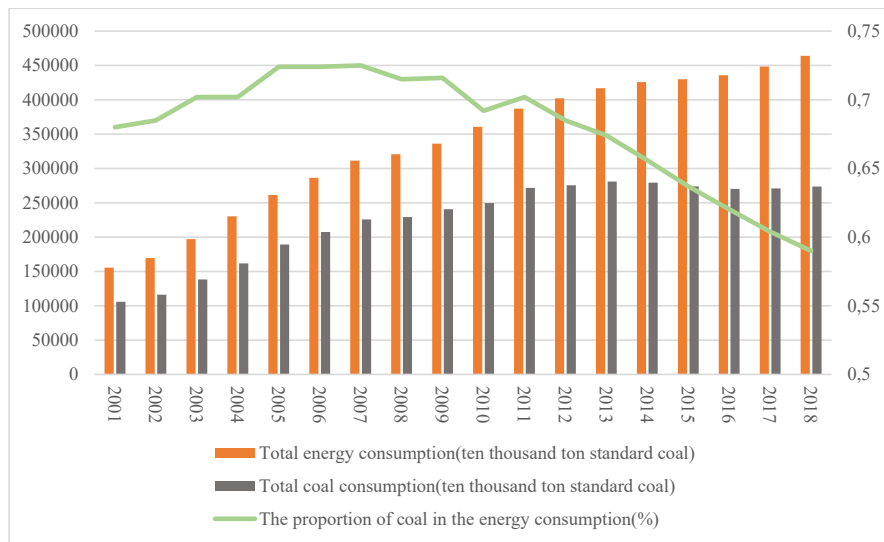
Data source: China Statistical Yearbook 2015-2019

Fig. 6 shows the development and changes of the industrial structure of China in 2014-2017. The first industry keeps at a lower growth rate and has a declining trend, and the second industry keeps at a higher growth rate as 7.3% in 2014, but declines to 5.8% in 2017. However, the service (or tertiary) industry has developed more rapidly, which surpasses the second industry for years. As the proportion of tertiary industry consists more in the GDP, China's industrial structure is to be greener and the carbon intensity is decreasing<sup>12</sup>.

#### 4.1.2. Optimizing of Energy Structure to decrease carbon intensity

The optimization of energy structure demands the reasonable proportion of all kinds of energy in the total energy consumption in which the proportion of fossil energy consumption should not be too large. It could be diverse for different countries with different economic conditions so that countries may optimize the energy structure in accordance with their own resources and technologies to effectively achieve energy saving and carbon emission reduction. At the background of low-carbon economy, China's measures for optimizing energy structure includes: imposing strict control over the growth of total energy consumption, especially that of coal and oil which are the high-carbon energy; promoting the clean utilization of fossil fuel and the development of non-fossil energy. In Fig. 7, it can be seen that China's total energy consumption is growing and the coal dominates the biggest proportion in the energy consumption structure. However, since 2013, China's total coal consumption has declined, and the proportion of coal consumption in the total energy consumption has declined, which makes the energy structure be optimized with the decrease of heavy emission by coal.

**Figure 7. Total energy consumption and coal consumption of China**



Data source: National Bureau of Statistics of China

Traditionally, coal is used for urban heating in China, and the heating has caused a lot of coal consumption and carbon emissions especially in the cold north part of the country. In order to promote the clean use of fossil fuels, it is a good way to reduce the amount of coal consumption for household heating and to increase the proportion of electricity-producing coal. As the thermal power generation plants equipped with higher level of technologies and the modern equipment, they can be more efficient to make clean use of the coal and produce more coal-fired power to support the transformation project from “coal to electricity” for household heating. By 2018, China has completed the project for 2.74 million households, decreasing the end consumption of coal scattering around.

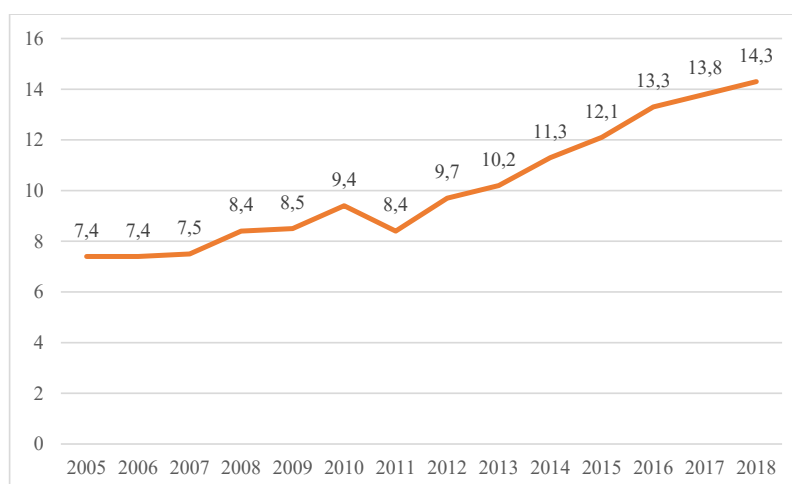
Another way to optimize the energy structure is to increase the supply of oil and gas to replace the higher-carbon coal consumption. The household heating project of transforming from “coal to natural gas” is a good example for the optimization. More than 2 million households have turned from “coal to natural gas” for heating by 2018 in China, decreasing the bulk coal consumption in order to have the emission reduction<sup>13</sup>.

Gradually, as reducing the dependence on fossil energy and increasing the utilization of non-fossil energy, the renewable energy and even some new clean energy are to consist of more in the energy supply system to achieve the coordinated and sustainable development of economy, environment, and resources. Fig. 8 shows the upward trend for the proportion of non-fossil energy sources in the primary energy consumption in China.

13 Ministry of Ecology and Environment of People's Republic of China.



**Figure 8. The percentages of non-fossil energy sources in the primary energy consumption in China**



Data source: China Statistical Yearbook 2019

China is increasing the proportion of non-fossil energy in the total primary energy consumption to about 15% by 2020, and about 20% by 2030. As shown in Fig. 8, since 2005, the proportion of non-fossil energy consumption in China has basically maintained an upward trend with a slightly decline in 2011. Then it has been on a rapid upward trend since 2012 and reached 14.3% in 2018<sup>14</sup>. As China's total energy consumption in 2019 has grown at a low speed, the energy consumption and energy structure have continued to be cleaner and more efficient. Therefore, the target of 15% of non-fossil energy consumption in 2020 can be achieved apparently, which may contribute to the decrease of the carbon intensity in China.

#### 4.1.3. Improvement of energy efficiency to decrease carbon intensity

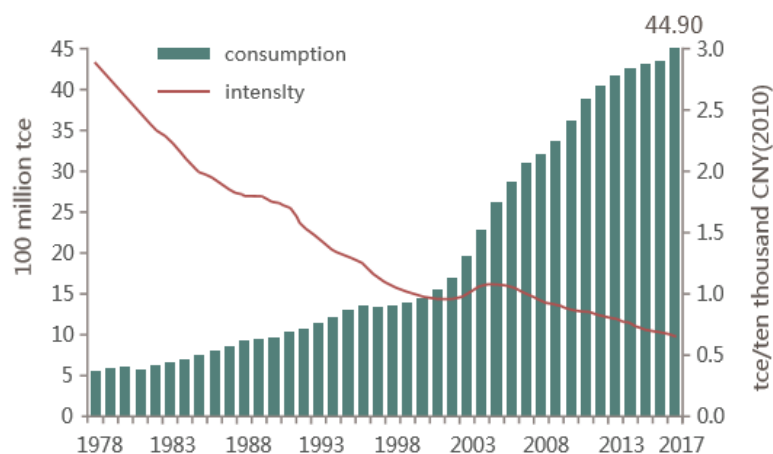
Since the promulgation of Energy Conservation Law of the People's Republic of China in 1998, the implementation of energy saving measures has been guaranteed by the law. China has taken reducing energy intensity as a binding indicator and implemented strict annual assessment since 2006. Fig. 9 shows that between 1998 and 2002, China's energy consumption intensity, dened as energy consumption per unit of GDP, falls by an average of 2.5%. From 2003 to 2004, while China's economy grows significantly, the intensity of energy consumption has increased. In this regard, the government quickly makes corresponding adjustments, and has issued and implemented a series of energy efficiency policies to save energy, reduce emissions, improve quality, and increase efficiency. Since 2005, China's energy intensity has continuously declined, with energy intensity falling by 39.8% from 1.08 tce/ten thousand CNY (2010 CNY) in 2005 to 0.65 tce/ten thousand CNY (2010 CNY) in 2017<sup>15</sup>. As the economy continues to grow steadily, China's total energy consumption has shown an overall growth trend over the last decade. However, due to a series of energy savings measures, China's energy intensity has declined, resulting in a slow-down growth rate of total energy consumption.

14 National Bureau of Statistics of China: <http://www.stats.gov.cn/>

15 *Energy Efficiency China 2018*. China Council for an Energy Efficient Economy: <http://www.cceee.org.cn/class/view?id=38>



Figure 9. Energy Consumption and Intensity in China (1978-2017)



Data source: The Energy Efficiency Report of China 2018

In addition, since the implementation of the energy efficiency labeling system in 2005, the energy efficiency labeling system has covered 33 kinds of energy consumption products, involving more than 9,000 enterprises and more than 900 testing institutions, and has achieved more than 441.9 billion-kilowatt hour energy-saving results. The system has effectively guaranteed the energy efficiency improvement of energy consumption products in China, and promoted the development of national energy saving and emission reduction. It is estimated that by 2020, the implementation the system is to save 277.5 TWH of electric power, 129 million tons of standard coal and more than 110 million tons of carbon emissions<sup>16</sup>.

As a successful case, the energy efficiency labeling system has enhanced the improvement of air conditioning energy efficiency level which further promotes the improvement of the energy efficiency standards in the air conditioning industry in China. The high-power with low energy efficiency air conditioning products are gradually eliminated from the market, and the upgraded high energy efficiency air conditioners prevail. Other industries producing energy consuming products follow the example to upgrade the energy efficiency of the products, and further promote the energy saving and emission reduction in China.

## 4.2. The measures on carbon reduction for the decrease of carbon intensity in China

In addition to the energy saving activities, China also takes measures of emission reduction to achieve the decoupling of economic growth and carbon emissions, although the emission reduction measures are relatively lagging in the starting time and effects. In terms of reducing carbon emissions and achieving low-carbon development through emission reduction measures, EU's experience of ETS is very significant and China follows the example and draws the lessons from EU ETS so as to establish China's ETS with more effective measures for the emission reduction in China.

### 4.2.1. China's ETS as a significant measure for the carbon reduction

Emission trading scheme is regarded as an efficient market-based measure for emission reducing. EU ETS has implemented for more than fifteen years and has accumulated valuable experience in supervision and management for China. To follow the "cap and trade" mode of EU ETS, China learns to do and has the pilots for ETS. In October 2011, the National Development and Reform Commission of China has announced to have carbon emission trading pilots, approving five cities as Beijing, Shanghai, Tianjin,

16 *The 10th Anniversary Seminar of Energy Efficiency Labeling System*. National Development and Reform Commission: <https://www.ndrc.gov.cn/>

Chongqing, and Shenzhen, and 2 provinces as Hubei and Guangdong, to carry out carbon emission trading pilots which have been launched since 2013.

After more than four years of pilot operation, China's national ETS and the unified carbon trading market have been established. On December 19, 2017, with the approval of the State Council, the National Development and Reform Commission officially has issued China's national carbon emission trading market construction plan. The issuance of this document officially marks the start of China's carbon emission trading scheme. Although only one industry (the power generation industry) is included in at first, China's ETS, with the continuous development and improvement, would cover more energy intensive industries and other carbon intensive industries. China's carbon trading market is to be one of the most important carbon markets in the world.

China has carefully studied EU ETS offset mechanism, and China's pilots of ETS in the 5 cities+2 provinces have innovatively used the mechanism with creative ideas so that the industries which are not yet covered in China's pilot ETS are also motivated in activities of emission reduction. With the participation of more industries that are not even covered by the ETS, the carbon emission reduction in China is to be successfully implemented.

#### 4.2.2. China's pilot ETS test providing successful experience for the implementation

China's pilot ETS in the 5 cities+2 provinces for emission trading before the establishment of a national emission trading market shows the practical and cautious ways of the Chinese government for policy making and implementation, since China is such a big country that any fault in the policy making and implementation might cause serious results for a lot of people. Therefore, China always has pilots for some fresh and innovative ideas and policies in order to decrease the lost in case of failure and increase the possibilities for the success.

From June 2013 to June 2014, the 5cities+2 provinces pilot carbon emission trading markets have started one after another, and some of them, especially Hubei province have successively carried out the work. On December 22, 2016, Fujian Province voluntarily has launched the carbon emission trading market, becoming the eighth carbon emission trading pilot in China. Table 3 shows the rules of the 8 local carbon trading pilot markets. Some of the provisions of the pilots are similar, while others are quite different, because each of the pilot market is supervised in accordance with the local conditions by the local provincial government. The local autonomy for the pilot carbon markets provides the local authorities with the flexibilities to adopt the most effective modes for them, and with the motivation for the creativities in implementation. The enthusiasm of the local industries to participate in the carbon emission market is motivated and the different rules of the regional development lead to the different market performance.

**Table 3. the rules of China's 8 local carbon emission trading pilot markets**

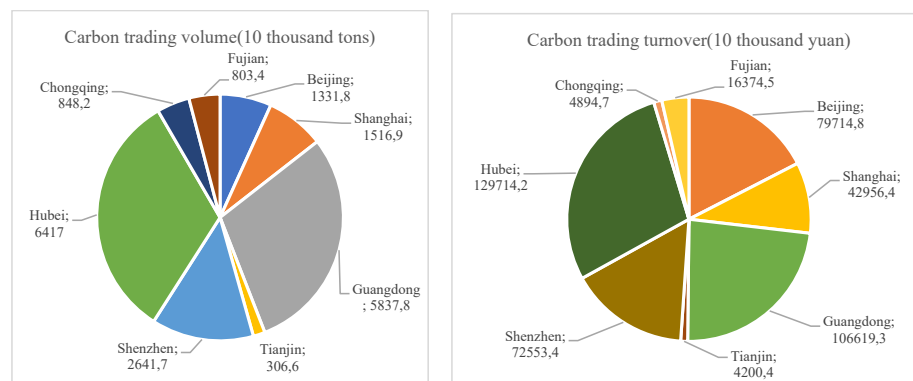
Provinces and cities	Quota allocation mode	Quota allocation method	Carbon market coverage	Subject of carbon market
<b>Shenzhen</b>	Mixed mode: more than 90% of the quota be issued free of charge, and the quota from 2013 to 2015 be allocated in one time, considering the growth of the industry.	Based on the baseline method (the annual carbon emission quota of the enterprise is determined, based on its emission efficiency and its actual business volume), some industries adopt the competitive method to determine.	635 enterprises from 26 industries including power, gas, and water supply.	Performing enterprises, institutional investors, and individual investment.
<b>Shanghai</b>	Free distribution: 100% free, one-time allocation of 2013-2015 quota, with appropriate consideration of industry growth.	Baseline method and historical emission method (the carbon emission quota is determined, based on the historical emission level of the enterprise and the contribution of early emission reduction).	197 enterprises from steel, petrochemical, chemical, metal, building materials, fiber industries, covering 57% of the city's emissions.	Performing enterprises, institutional investors.
<b>Beijing</b>	Mixed mode: more than 95% free allocation, distributed annually, based on the data of the previous year (without considering the increment).	Historical emission method.	About 490 enterprises from power, heat, cement, petrochemical, and public construction industries covering half of the city's emissions.	Performing enterprises, institutional investors.
<b>Guangdong</b>	Hybrid mode: 97% of the free allocation for electric power enterprises in 2013 and 95% in 2014, distributed annually, considering the trend of economic and social development.	Historical emission method (based on the amount of emissions in 2010-2012), considering the characteristics of the industry.	239 enterprises from power, cement, steel, ceramics, metals, petrochemicals, plastics, and paper industries, accounting for 42% of the province's emissions.	Performing enterprises, institutional investors.
<b>Tianjin</b>	Free distribution: 100% free allocation, annual quota for 2013-2015 are set at one time, which can be adjusted every year.	Historical emission method is adopted for stock and baseline is adopted for increment.	114 enterprises from steel, chemical, power, petrochemical, oil refining and other industries, accounting for 60% of the city's emissions.	Performing enterprises, institutional investors, and individual investors.
<b>Hubei</b>	Free distribution: 100% free allocation, no increment considered.	Stock: 80% of quota allocation is based on historical emission method, 20% is used for auction; increment: 15% quota reserved by the government.	138 enterprises from iron and steel, chemical industry, cement, electric power and other industries, accounting for 35% of the total emissions of the province.	Performing enterprises, institutional investors, and individual investors.
<b>Chongqing</b>	Distribution free of charge: 100% free allocation, the upper limit for the total amount control of the annual quota is determined with an annual decrease of 4.13%, without considering the increment.	Historical emission method.	240 enterprises from cement, steel, electric power, and other industries, accounting for 30%-45% of total emissions.	Performing enterprises.
<b>Fujian</b>	Distribution free of charge: 100% free allocation.	Adopt the combination of baseline method and historical emission method.	Power, petrochemical, chemical, building materials, steel, nonferrous metals, paper, aviation, ceramics and other nine industries.	Performing enterprises, institutional investors, and individual investors.

Source from: Official websites of the development and reform commissions of the pilot provinces and cities

Fig. 10 shows the volume and the turnover of the transactions per pilot in 2019. During this period, Hubei is the most successful pilot in China, with a carbon trading volume of 64.17 million tons and a turnover of 129.7142 million yuan, which has accounted for more than 30% of the eight pilots in the country, ranking the first. Hubei has fully played a pilot role and provided the valuable experience for the building of the national carbon emission trading scheme. The second one is Guangdong with a turnover of 106.619 million yuan and the volume of 58.378 million tons<sup>17</sup>.

In sum, the market performance of each pilot carbon market is quite different, which is related to the differences of the local energy consumption and carbon emissions, the economic development level, and the government supervision. The pilot projects of the local provinces and cities have made a very important contribution to the building of the national carbon emission market.

**Figure 10. Trading volume and turnover of 8 carbon trading pilots in 2019**



Source link: <http://k.tanjiaoyi.com/>

#### 4.2.3 EU-China cooperation in the emission reduction

EU ETS is the largest carbon emission trading scheme in the world, which makes a great contribution to the global carbon emission reduction by mandating carbon emissions for enterprises. EU ETS has implemented for three phases. The first two phases adopt the decentralized governance model, while the third phase adopts the centralized governance model. The Commission sets the overall quota and distribution rules, and member States are responsible for their implementation. The implementation of the market-based mechanism of ETS has achieved the purpose of EU's climate actions, while China is intended to adopt the market-based mechanism for the pilots. EU's approaches provide China with valuable experience in the implementation of ETS and China expects to cooperate with EU in the global governance of climate change.

In fact, China and EU have a long-standing cooperation on tackling the climate change. In 2005 the EU-China Partnership on Climate Change has provided a high-level political framework for cooperation and dialogue. In 2010, China and EU have issued a joint statement on climate change dialogue and cooperation. Recently, China and EU have issued a statement on climate change and clean energy, which has agreed to strengthen bilateral cooperation. China has learnt from the experience and lessons of EU ETS and EU also provides technical support for China in the design of the national ETS and the pilots of emission trading.

17 Source link: <http://k.tanjiaoyi.com/>

## Conclusion

China's measures to achieve the decoupling between the economic growth and carbon emissions mainly relies on the decrease of energy consumption and increase of energy efficiency as a breakthrough for the carbon intensity reduction, while the emission reduction measures as the pilots of ETS have achieved successful experience, and the national ETS is on the way to be implemented in the country. As the decrease of carbon intensity is mainly due to the achievements of energy saving and emission reduction, China's measures on energy-activities as adjusting the industrial structure, optimizing the energy structure, and improving the energy efficiency are efficient and effective. The building of China's national carbon emission trading scheme, with EU's technical support in the design of the scheme and the projects of EU-China cooperation for carbon reduction, may have more contribution to the future decreasing of carbon intensity in China.

China has fulfilled the commitment made at the Copenhagen climate change conference to "reduce the emission intensity per unit of GDP by 40% to 45% by 2020" three years ahead of the schedule, with an average annual decrease of 4.9% for the carbon intensity<sup>18</sup>. Now China is striving to achieve the goals of the Paris Agreement for the Intended Nationally Determined Contributions (INDCs) as to reduce the carbon dioxide emission intensity per unit of GDP by 60%-65% compared with that in 2005, to increase the proportion of non-fossil energy in the total primary energy consumption to about 20%, and to peak the carbon dioxide emission around 2030 or before.

At present, China is improving the economic development and is turning from the quantity-focused growth of GDP to the quality-focused growth, and switching from the resource dependent development model, which is driven by increasing the input of the factors, to the economic development driven by knowledge and innovation. According to what President XI says that the lucid waters and lush mountains are invaluable assets, China's economic development is to be greener, and the low-carbon economic development with more efficient measures on energy saving and carbon reduction is to decouple furtherly the economic growth and the carbon emissions in China.

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18 SCIO briefing on China's Policies and Actions for Addressing Climate Change (2018). The State Council Information Office: <http://www.scio.gov.cn/>

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**Abstract:** Since the reform and opening-up in 1978, China's economy has been growing for decades. At the same time, the total energy consumption and carbon dioxide emissions are increasing, which cause the dual pressure of energy supply and ecological environment. With the development of technology, the adjustment of energy consumption structure, and the transformation and upgrading of industrial structure, China has put great efforts on the increasing of energy efficiency and decreasing of fossil energy consumption, which results in the decline of carbon intensity and the gradual decoupling of China's economic growth and carbon emissions. It is significant to study the main reasons for the decoupling between China's economic growth and carbon emissions, and to discuss the measures for the decoupling is momentous for exploring a green, low-carbon and sustainable development path for future in China.

**Keywords:** Decoupling; economic growth; emission; energy consumption.

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ISBN: 978-84-17385-95-8

