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中国清洁空气联盟
Clean Air Alliance of China

Analysis on the Carbon Emission Reduction Co-benefits of Coal Cap Policy in China's Air Pollution Prevention and Control Action Plan (2013–2017)

National Center for Climate Change Strategy and International Cooperation

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CAAC Policy Report

CAAC Policy Reports are a series products to provide insights, analysis and recommendations based on China's air pollution control policies and management practices, to support the clean air work. The CAAC Policy Reports are compiled by CAAC secretariat in collaboration with CAAC members and experts.

Author

National Center for Climate Change Strategy and International Cooperation (NCSC)

Qiang Liu, Chuan Tian, Zhuo Li

Secretariat for Clean Air Alliance of China (CAAC)

Hongxing Xie

Energy Foundation

Lijian Zhao, Yuan Lin

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Chinese Academy for Environmental Planning

Jintian Yang, Yu Lei, Miao Ning

Energy Research Institute

Kejun Jiang

Center for Earth System Science, Tsinghua University

Qiang Zhang

Augustana College

Mason L. Broxham

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I Main Conclusions and Suggestions

In September 2013, the State Council released its ever-stringent air policy, *China's Air Pollution Prevention and Control Action Plan (2013-2017)* (hereinafter refers to as the Action Plan), to launch a national battle against air pollution. The Action Plan not only sets stringent targets for air quality improvement, but also raises the coal consumption control policy, as one of the key measures to improve air quality.

This study shows that coal consumption control can significantly contribute to both air pollution control and Greenhouse Gases (GHGs) reduction. The CO2 reduction co-benefits brought by such policy may vary via implementing different coal use substitution plans. This study suggests that local governments should consider maximizing the CO2 reduction co-benefits when designing coal consumption reduction and substitution plans.

1 Coal Consumption Control Measures Have Unprecedented Co-benefits on Curbing Climate Change

It was the first time in the nation's history for announcing clearly that it will establish coal consumption mid-term and long-term control goals, and set special requirements for Beijing, Tianjin, Hebei, Shandong, Shanghai, Zhejiang, Jiangsu, Guangdong to cut down their coal use. Furthermore, Liaoning voluntarily announced to keep its coal use at 2012 level in 2017. The study expects there will be reduction of 426 million tons of coal consumption and 605 million tons of CO_2 emission comparied with the 12th Five-Year Plan.

2 Different Coal Substitution Approach Brings Varied CO_2 Emission Co-reduction Effect

Generally speaking, coal use reduction has CO_2 emission reduction co-effect, however different coal substitution approach brings varied CO_2 effect. For example, using renewables to substitute coal burning and using energy efficiency measures can effectively reduce CO_2 emission; on the contrary, using coal gasification to substitute coal burning will increase CO_2 emissions. We suggest that in the nine provinces and municipalities controlling coal use, measures with better CO_2 emission reduction co-effect should be used to achieve co-benefits.

3 The Nine Coal Cap Pilots Are Representative; Broader Scope of Areas Can Be Selected to Set Caps on Coal Consumption

The nine provinces and municipalities with coal cap requirements can generally represent the most coal-intensive areas in China. As the implementation of the policy, other coal-intensive provinces and cities like Shanxi, Henan, Anhui, Chongqing can take measures to control their coal consumption. This study suggests selecting provinces carry out coal consumption control according to indicators such as "coal consumption per unit area", "coal consumption per capita", "coal consumption relative to GDP" and air pollution situation. It is also suggested establishing a national coal consumption cap during the 13th Five Year Period.

4 Effective Measures Should Be Taken to Avoid Potential Carbon Leakage and Pollution Transfer

Coal cap policy may lead to high ratios of electricity purchase or coal gasification in the pilots. Either measure causes carbon leakage and pollution transfer. The *Action Plan* requires each province to improve energy structure and development model, raise the ratio of clean energy. If this can be implemented, the pilots can achieve economic development and air quality improvement through their own efforts, decrease the carbon leakage risk. Furthermore, if some regional electricity transmission cannot be avoided, decision makers should encourage increasing the ratio of renewables for cross-regional transmission. This will not only minimize the negative effects from carbon leakage, but also bring positive impacts in terms of optimizing the national energy structure. Lastly, coal cap policy may lead to some coal-intensive industries move to areas without coal use limitation, causing carbon leakage. The Action Plan requires environmental threshold and strengthens the pollution emission control. If this can be effectively implemented, pollution transfer can be minimized.

5 With the Implementation of the Coal Cap Policy, Further Co-Benefits Can Be Achieved in the Future

The other 22 provinces without a coal consumption cap also released their air quality action plans and included various measures for coal saving, emission reduction, clean utilization of coal, and energy structure adjustment. These measures will also play a positive role in controlling growth of coal consumption in these regions. Along with the implementation of the coal cap policy, further co-benefits can be achieved in the future.

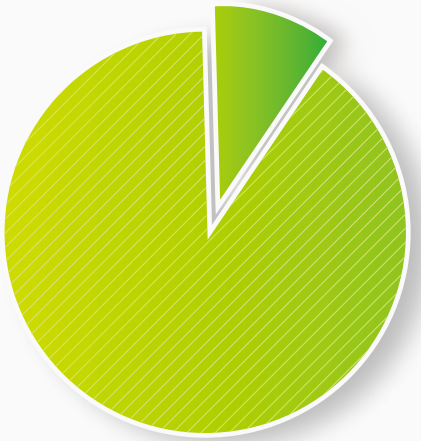
II Introduction

China's air-quality crisis in January 2013 served as a wake-up call for Chinese government and the public. To improve air quality, in September 2013, the State Council released the **Action Plan**. The **Action Plan** sets the road map for air pollution control for the next five years in China, with a focus on three key regions – Beijing-Tianjin-Hebei area (Jing-Jin-Ji), Yangtze River Delta (YRD, including Shanghai, Jiangsu and Zhejiang) and Pearl River Delta (PRD, including Guangdong). For these three key regions, annual average concentrations of $PM_{2.5}$ were to be reduced by 25%, 20%, 15% respectively in 2017 camparied with 2012 their levels; for Beijing, annual average concentration of $PM_{2.5}$ should be controlled at 60ug/m^3 level in 2017.

It is very rare for the government to develop a plan that does not fit into the Five-Year Planning cycle. Most of the measures set in the **Action Plan** are more stringent than that of the 12th Five Year Plan. This reflects the determination from the new government to tackle air pollution issues. Among the various aspects of policy-level progress made in the Plan, a breakthrough was made on coal consumption cap policy. It represents the first time the nation has clearly put forward mid and long-term goals for controlling national total coal consumption.

With the intention to implement the **Action Plan**, local governments have established local action plans, and signed the *Liability Agreement on Goal of the Prevention and Control of Air Pollution* (hereafter refers to as the **Liability Agreement**). In these signed **Liability Agreements**, nine provinces have set their mandatory targets for controlling total coal consumption by 2017 (see Chart I).

Coal burning is the largest contributor to both air pollution and Greenhouse Gas (GHG) emissions in China. Coal consumption control policy can facilitate numerous co-benefits, such as coal use reduction, coal burning-related air pollutants emission reduction, and carbon reduction. Created by the pressure of air pollution control efforts,



Jing-Jin-Ji-Shandong

to cut **83** million tons of coal consumption in 2017 comparing with 2012 level

Beijing：-13 million tons
Tianjin：-10 million tons
Hebei：-40 million tons
Shandong：-20 million tons

Yangtze River Delta
Pearl River Delta

each province to **decrease** in 2017 comparing with 2012 level

Liaoning

to keep its coal consumption in 2017 within **200** million tons

Chart I Coal consumption control targets of the nine provinces/cities

attempts to mitigate climate change, and limited economic resources, choosing measures which have air pollution reduction and GHG reduction multi-benefits are necessary.

There are a range of paths and measures for implementing coal consumption control. This report explores which measures bring more carbon emission reduction co-benefits, which bring less or no co-benefits, and which even emit more GHGs to the air. The aim is to provide decision makers with policy references when implementing coal consumption control, to put priority on the measures which have better carbon reduction co-benefits. By doing that, it will be conducive not only to the prevention and control of air pollution, but also to promoting carbon reduction, thus providing a better solution to cope with climate change.

After calculation, in 2017, nine provinces with coal consumption caps will jointly achieve 426 million tons of coal use reduction, and 605 million tons of carbon reduction. Among all of the coal consumption control measures, outdated capacity elimination and replacement by renewable energy bring the strongest co-benefits. For using gas to replace coal, the decision makers need to consider the availability and the cost of transferring gas from west to east. Purchasing electricity from outside reduces local coal consumption, however, its carbon reduction effect depends on the structure of the electricity purchased-coal-fired power, renewables, etc. Replacement by coal gas will result in more carbon emission instead of reducing carbon outputs, causing a negative effect of carbon emission reduction.

III Setting of Scenarios and Methodology

The scenario analysis method is adopted in this study. Two policy scenarios are set: one is the 12th Five-Year Plan policy scenario; and the other is "the Action Plan" scenario. Calculating data for the 12th Five-Year Plan scenario are based on official figures from China Statistical Yearbook, China Energy Statistical Yearbook and regional documents. Calculating data of scenarios for "the Action Plan" are from both the national action plan and local action plans which were announced by relevant provinces to support the realization of the national targets.

Scenario 1: Scenario of the 12th Five-Year Plan

- During the period of the 12th Five-Year Plan, annual average growth rates of GDP are, in accordance with goals set in the 12th Five-Year Plan, set to increase at a constant yearly rate. From 2016 to 2017, annual average growth rate of GDP will remain the same as that of the 12th Five-Year Plan.
- During the period of the 12th Five-Year Plan, energy intensity will, in accordance with goals of the *12th Five-Year Plan for Energy Development*, decrease by the equivalent amounts each year. From 2016 to 2017, energy intensity decreasing rate will remain the same as that of the 12th Five-Year Plan.
- During the period of the 12th Five-Year Plan, energy structure, in accordance with goals of the *12th Five-Year Plan of Energy Development*, will decrease by the equivalent amount each year. As for regions which still fail in releasing the 12th Five-Year Plan of Energy Development, it shall refer to values stipulated in other relevant plans and schemes. From 2016 to 2017, energy structure will remain the same as that of the end of the 12th Five-Year Plan.

Scenario 2: Scenario of the Action Plan (2013–2017)

- Based on coal reduction amount proposed in local action plans, we assume that coal consumption from 2013 to 2017 will decrease at the equivalent amount each year.
- Four provinces (municipalities) in Yangtze River Delta Region and Pearl River Delta Region only proposed a non-quantitative goal of "decreasing coal consumption". Calculation is carried out based on the scenario of "non-increase of coal consumption" in order to be conservative in estimation.

Calculation of Carbon Emissions

With the intention of calculating CO_2 emission reduction differences between the Action Plan scenario and the 12th Five-Year Plan scenario, we, in accordance with local action plans, identify emission reduction measures corresponding to different carbon reduction amounts and calculate the CO_2 reduction amount. In instances where local action plans have no clear and concrete reduction amount set for measures related to coal reduction, coal consumption structure and resources endowment are taken into comprehensive consideration and calculation is carried out based on the assumption of its coal reduction measures.

IV Calculation and Analysis

1 Coal Reduction

Results show that if the only step taken is implementing the 12th Five-Year Plan, by 2017, total coal consumption of nine provinces and municipalities will increase by 22.2% from 2012, reaching 1.89 billion tons. There is, however, noticeable effect on coal consumption control expected to result from implementation of the **Action Plan** from 2013 to 2017, total coal consumption in nine provinces and municipalities are estimated to peak and decrease to 1.56 billion tons, which will lead to a decrease of 4% from 2012. Moreover, about 426 million tons of total coal consumption reduction will be achieved based on scenario of the 12th Five-Year Plan.

Other measures of the **Action Plan** also have co-benefits, such as emission control measures for vehicles, industrial sectors, etc. Co-effects from these measures are not included in this study because of difficulties in quantifying the effects. Furthermore, the other 22 provinces without a coal consumption cap also released their regional plans and included various measures for coal saving, emission reduction, clean utilization of coal, and energy structure adjustment in the signed **Liability Agreement**. These measures will also play an active role in controlling growth of coal consumption in these regions.

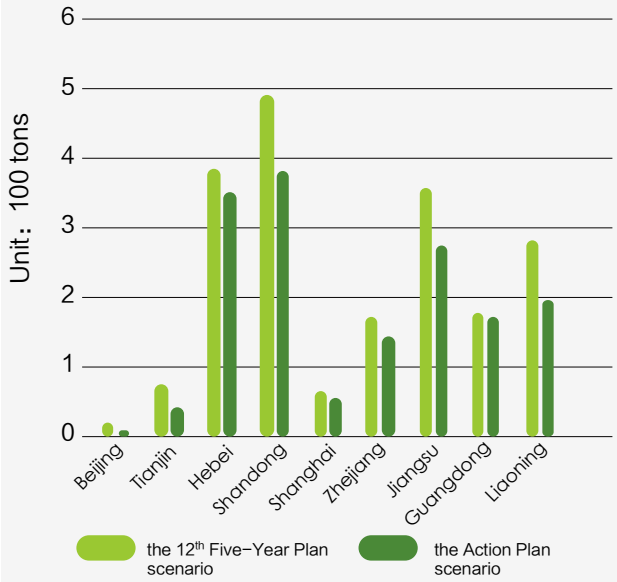


Chart II 2017 coal consumptions in the nine provinces/cities under two scenarios

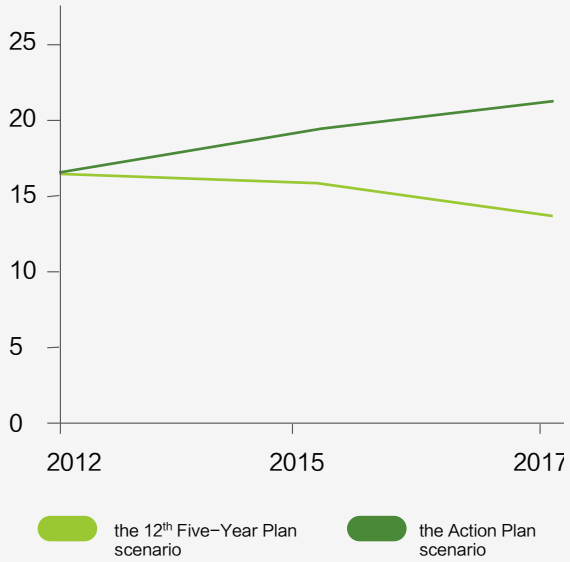


Chart III 2012-2017 total coal consumptions in the nine provinces/cities under two scenarios

2 Carbon Emission Reduction

According to coal consumption reduction measures that will be adopted in regional action plans, 426 million tons of coal consumption reduction in nine provinces and municipalities will contribute 605 million tons of carbon emission reduction.

Policies to reduce coal consumption include shutting down thermal power plants or fuel changing, retrofitting coal-fired boilers, bulk coal governance and outdated capacity elimination, etc. Although coal restriction and carbon reduction share almost the same source, effects of carbon reduction vary due to different measures for coal restriction. The following table shows coal restriction measures adopted in local action plans as well as carbon reduction amount for every ton of coal reduced through each measure. Phasing out obsolete capacities and replacement by renewable energy bring the strongest effect. Replacement by gas is the next most effective approach. With respect to reducing local coal consumption by electricity purchase from outside, it almost has no benefit of carbon emission reduction. Replacement by coal gas will result in more carbon emissions instead of reducing carbon emissions, causing negative effects for carbon emission reduction.

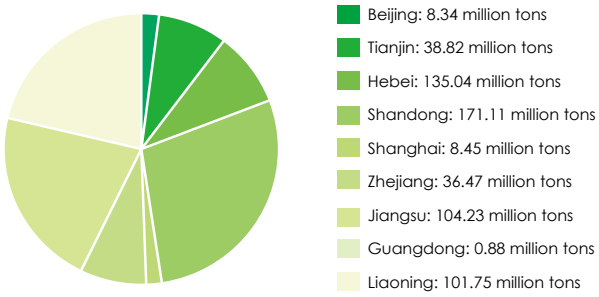


Chart IV Carbon reduction in the nine provinces/cities in 2017

Table I CO_2 reduction effect of different coal consumption control measures

Measures	Emission factor (ton/ton)
Replace bulk raw coal burning with energy saving methods and renewable energy	2.99
Energy saving and replacement by power generated by renewable energy	2.8
Coal-fired heating boilers changed to use renewable energy	2.53
Coal-fired industrial boilers changed to use renewable energy	2.53
Phase out and cut down productivity	2.49-2.53
Replace bulk raw coal burning with conventional natural gas	2.25
Replace thermal power with conventional national gas burning	1.44
Coal-fired industrial boilers changed to use conventional natural gas	1.22
Coal-fired heating boilers changed to use conventional natural gas	1.14
Replace bulk raw coal burning with electricity	0.83
Replace bulk raw coal burning with SNG	0.58
Electricity purchase through power grid.	0.42
Move thermal power plants to areas without coal restrictions	0
Move productivity to areas without coal restrictions	0
Replace thermal power with SNG	-0.26
Coal-fired heating boilers changed to use SNG	-0.97
Coal-fired industrial boilers changed to use SNG	-1.06

3 Carbon Leakage

Carbon leakage means if one region adopts measures which have carbon reduction effects, energy-intensive or carbon-intensive industries in this area are inclined to move to other regions without the limitation. Since carbon emitted from different areas has the same effect on climate change, this method cannot help the whole country to reduce its carbon emissions.

Chart V and VI show coal consumption levels and economic growth levels from 2012 in 31 provinces in China. They show that coal consumption per unit area tends to be higher in the areas where GDP per capita is higher, meaning currently in China economic growth largely relies on coal consumption. Most of the nine areas carrying out coal restriction are more developed provinces with high coal consumption levels. These provinces have the capability to and necessarily do limit their coal use. However, some other provinces with high coal consumption levels, such as Fujian, Chongqing, Hubei, Shanxi, Henan, etc., should also establish their specific coal control targets, so as to avoid heavy industry moving to these places and causing further pollution.

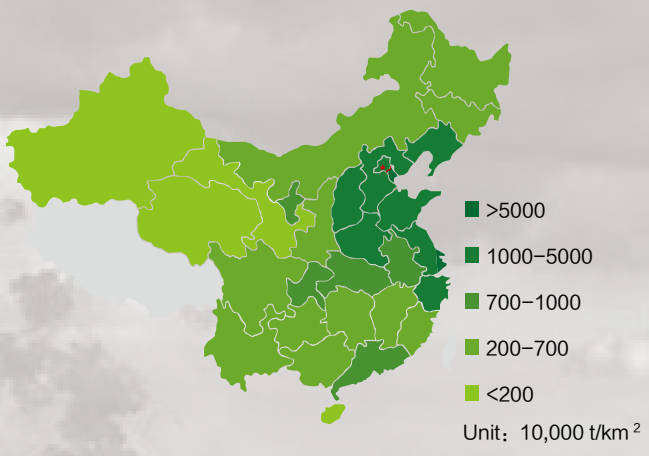


Chart V Coal consumption per unit area in each province in 2013

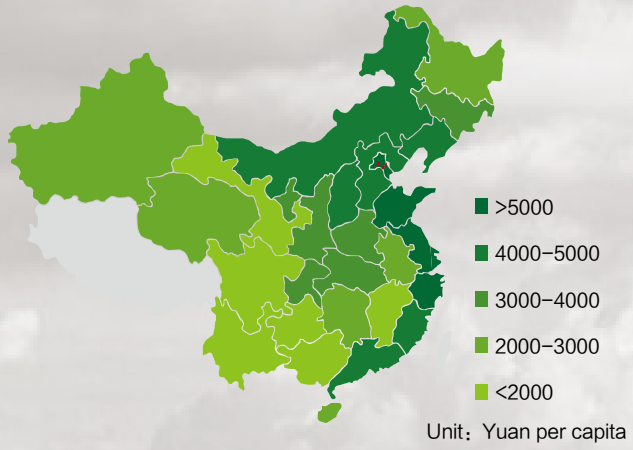


Chart VI GDP per capita in each province in 2013

Furthermore, most of the nine provinces with local action plans are located in the most polluted areas. However, there are also some provinces that are heavily polluted but do not yet have their coal consumption reduction targets. Most of these provinces are located in central and western China, where GDP per capita is relatively lower, compared to the east. Due to the need for economic development, these provinces may possibly absorb the energy demand through industries transferred from the nine provinces with coal caps, and thus increase their pollutants and carbon emissions. This phenomenon would not only accelerate the air pollution in these areas, but also pose negative impacts on China's overall plan for energy structure and economic structure adjustment, as well as the improvement of national air quality.

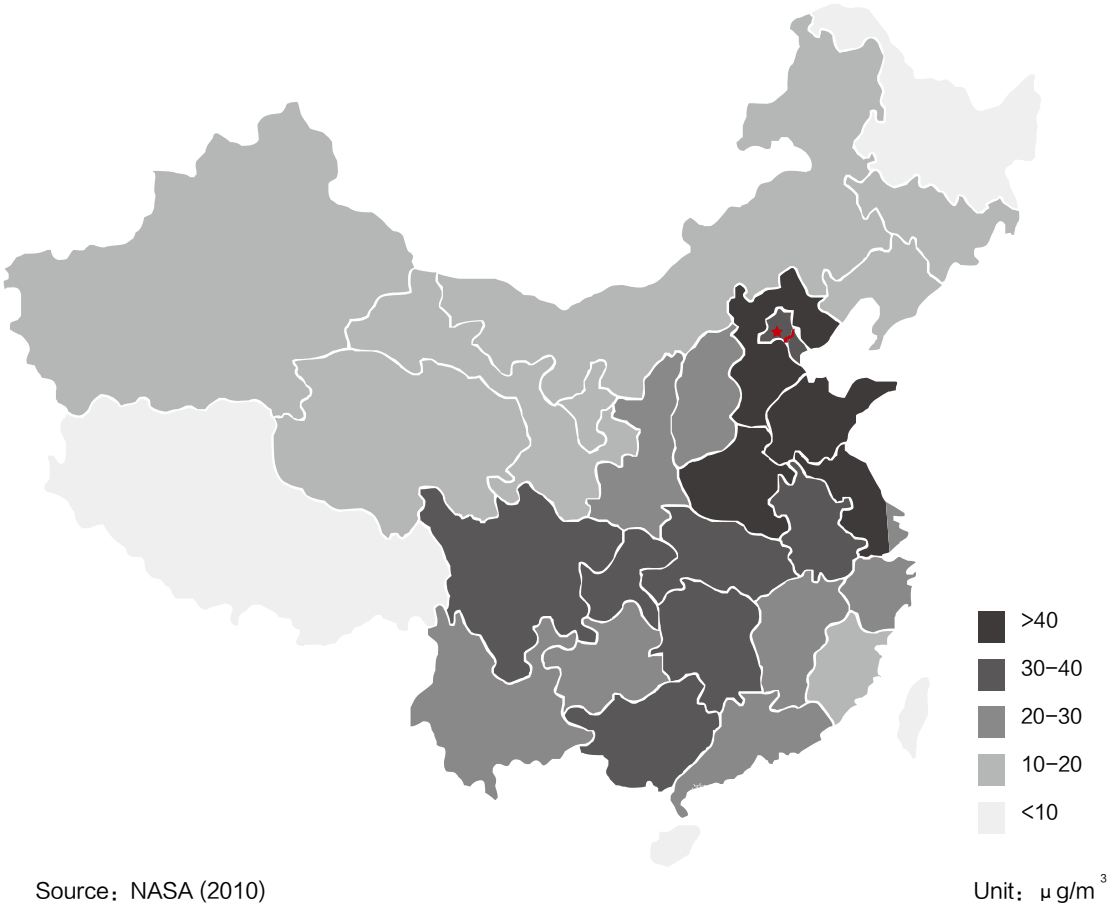


Chart VII Average exposure to fine particulate matter concentrations 2008-2010

Air pollution is becoming a national problem. In 2013, among 74 cities releasing hourly monitoring data of $PM_{2.5}$ in China, only three met national Grade II standard. Coal burning is still the biggest source contributing to air pollution. Among all of the coal use reduction measures, phasing out obsolete capacities and purchasing electricity from outside are the two measures that can most easily result in the carbon leakage problem. There are two options for outdated capacity elimination , these are direct shutdown and moving to other places without coal use limitations. For the second option, the promotion of national wide Best Available Technologies would help to reduce the pollution relocation and carbon leakage problems.

Purchasing electricity from outside to substitute local coal-fired power is effective to reduce local carbon emissions. However, if this policy leads to the coal-fired power share increase in the electricity-exporting areas, such carbon leakage should not be neglected. If the clean energy resource in the energy export region can be fully taken advantage of, renewables can be promoted. If renewables' share in the energy grid can largely be increased, the negative effect of carbon leakage can be minimized. Simultaneously this can also help the country to adjust its energy structure.

Of course, if we can make full use of the external power supply region's resources, to promote the development of renewable energy power generation, increasing renewable energy in the proportion to cross regional transmission can greatly reduce the negative effects brought about by carbon leakage, and have a positive impact on the overall optimization of the energy structure in china.

V Reference

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中国清洁空气联盟
Clean Air Alliance of China

Secretariat for Clean Air Alliance of China

Suite 709, East Ocean Center, 24A Jianguomenwai Street, Beijing, 100004
Tel: +86-10-65155838
E-mail: cleanairchina@iccs.org.cn
Website: www.cleanairchina.org

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