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The Story of Improving Air Quality in China: An Assessment of Action Plan of Air Pollution Prevention and Control

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Foreword »

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Since its opening-up and reform, China has been in the process of rapid economic development with its people enjoying an increasingly improved standard of life. Meanwhile accompanying this dramatic economic growth is the degradation of environment which has, to some extent, damaged the gains of the opening-up and reform and prevented the economy from a healthy and sustainable development. The Chinese government is increasingly aware of that without addressing the environmental issues it is facing now, will jeopardize its long term goal of the great rejuvenation of the Chinese nation. Given the magnitude and complexity of the environmental issues in China, there is no easy way in addressing them and the solution to them entails an equal priority being given to environmental protection, ecological conservation and economic development or even higher than the latter by mainstreaming the former into the overall socio-economic decision-making process. As a matter of fact, China has been in the struggle against environmental pollution since the very beginning of its economic take-off and trying to explore a pathway that could help address China's environmental issues in the way most suitable to China's specific circumstances.

In recent years, especially since the 12th Five-Year Plan period, the enhanced measures including legislation, policy, regulatory and economic means have been taken by the Chinese government in dealing with environmental problems, of which environmental policies have played an important role in this regard. Corresponding to this situation and in meeting the demand of governments at different levels for environmental policy tools, the environmental policy research projects on topics of a wide range have been conducted by some Chinese environmental research institutions including the Chinese Academy of Environmental Planning (CAEP).

CAEP founded in 2001, is a research advisory body supporting governments in the development of key environmental planning, national environmental policies, and major

environmental engineering projects. In the past more than 10 years, CAEP has accomplished the development of the overall planning of national environmental protection for the 10th, 11th and 12th Five-Year Plan periods; water pollution prevention and control planning for key river basins; air pollution prevention and control planning for key regions; soil pollution prevention and control planning; and some regional environmental protection plans. In the same period of time, CAEP also actively engaged in research on such topics as green GDP, environmental taxation, emission trading, ecological compensation, green financing, etc. By so doing, CAEP has become an indispensable advisory body in the environmental decision-making in mainland China. According to *2013 Global Go To Think Tanks Report and Policy Advice* published by University of Pennsylvania, CAEP was ranked 31 in the field of environment in the world. Many of CAEP's research results and project outcomes regarding environmental policies have drawn great attention of decision makers and international institutions, and have been utilized to contribute to the formulation of national environmental policies concerned.

The Chinese Environmental Policy Research Working Paper (CEPRWP) is a new internal publication produced by CAEP for the purpose of facilitating the academic exchange with foreign colleagues in this field, in which the selected research papers on environmental policies from CAEP are set out on the irregular basis. It is expected that this publication will not only make CAEP's research results on environmental policies be known by foreign colleagues but also serve as a catalyst for creating opportunity of international cooperation in the field of environmental policies, and environmental economics in particular, with a view of both the academic research and practical policy needs.

In September 2013, the State Council issued the "*Action Plan of Air Pollution Prevention and Control*" (hereinafter referred to as the Action Plan). For both the Party Central Committee and the State Council, this is a major strategic initiative to resolutely wage a war on pollution, and systematically carry out pollution control in order to promote ecological improvement. It's also the first action plan to tackle key environmental issues with comprehensive governance in mind.

The end of 2017 was the deadline of establishing the Action Plan of Air Pollution Prevention and Control and now it has come to a successful conclusion. Air quality improvements have exceeded targets both on a national-wide basis (including the 74 key cities) and in the key regions (including Beijing). By reviewing and summing up the effectiveness and results of the Action Plan, this paper formulates a Chinese way for improving air quality which seeks to *"unite various forces, adjust relevant structures, prioritize key areas, consolidate the compliance with laws and regulations, and apply delicacy management"*. It also proposes to establish a medium and long-term action outline, build long lasting institutional mechanisms, highlight source prevention and control, and scientifically manage atmospheric quality, etc.

Contents

1. ALL GOALS OF THE ACTION PLAN EXCEEDED

Overall, the nation's air quality has improved significantly. Since the implementation of the Action Plan in 2013, the annual average concentrations of particles with diameters of 10 μm or less (PM_{10}), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) in 338 prefecture-level and above cities have dropped by 16%, 47%, and 3% respectively, now at 81 μg/m^3, 19 μg/m^3, and 31 μg/m^3. Land areas affected by acid rain fell from 10.6% of the total landmass in 2013 to 7.2% in 2016 with acid rain pollution levels dropping to levels last seen in the 1990s. Compared with 2013, the proportion of "days of good and moderate air quality" in the 74 cities (the first batch of Chinese cities implementing the new environmental air quality standards) increased by 12 percentage points to 73%, and the proportion of heavy pollution days decreased by 5.7 percentage points, to 3%.

The improvement of ambient air quality in key regions is particularly pronounced. Compared with 2013, the average concentration of $PM_{2.5}$ in the Beijing-Tianjin-Hebei region(BTH), the Yangtze River Delta(YRD), and the Pearl River Delta(PRD) decreased by averages of 39%, 34%, and 26% in 2016, reaching 64 μg/m^3, 44 μg/m^3 and 35 μg/m^3 respectively. The decrease in the average annual concentration of $PM_{2.5}$ in BTH was particularly noticeable, with a decline rate of 1.14 times the average level of 74 cities. In addition, for BTH (including its surrounding areas), YRD, and PRD, the average PM_{10} concentrations decreased by averages of 19%, 28%, and 22%, respectively, and the decreases were 1.24, 1.79, and 1.40 times the national average. Their average annual SO_2 concentrations decreased by 51%, 54%, and 48%, the decreases were 1.08, 1.15, and 1.02 times the national average; the average annual concentrations of NO_2 decreased by 4%, 10%, and 8%, respectively, and the decreases were 1.36, 3.22, and 2.63 times the national average. Compared with 2013, the proportion of days of good and moderate air quality in BTH, YRD, and PRD increased by 19, 11 and 8 percentage points, respectively. And the proportion of days of good and moderate air quality in the BTH region increased by 1.52 times the average of 74 cities; The proportion of heavy pollution days in BTH decreased from 21% in 2013 to about 8% in 2017, representing a solid step toward the elimination of heavy pollution in the medium to long-term.

Fig.1: Improvement in the Annual Average Concentration of $PM_{2.5}$ in China, 2013-2017

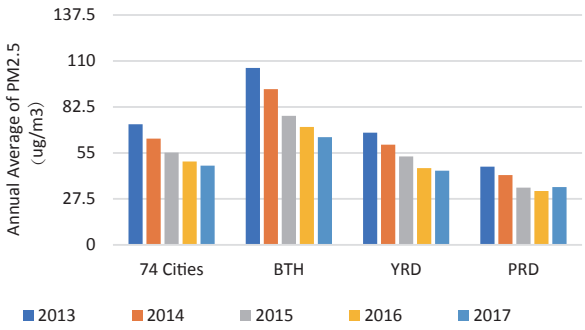


Fig.2: Improvement in the Proportion of Good and Moderate Days in China, 2013-2017

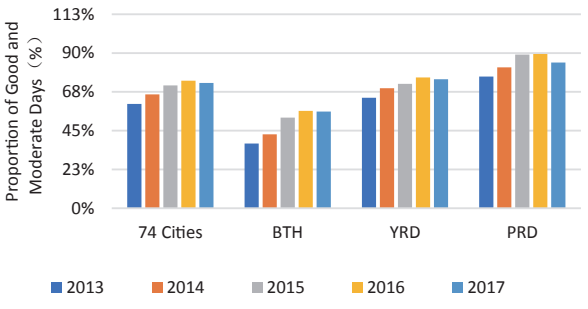
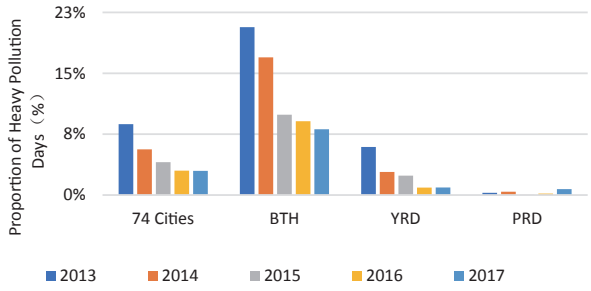


Fig.3: Decreases of Heavy Pollution Days in China, 2013-2017



Ambient air quality goals set out in the Action Plan have been exceeded. The air quality improvement goals set by the Action Plan are as follows: "By 2017, the concentration of respirable particulates in cities at and above the prefecture level in the country should decline by more than 10%; the number of days of good and moderate air quality should increase year on year; The concentration of particulate matter in BTH, YRD, and PRD should drop by 25%, 20%, and 15%, respectively, and the annual average concentration of fine particulates in Beijing in particular should be kept at around 60 μg/m^3." All these goals have now been exceeded. Among the 10 provinces and the Pearl River Delta region in Guangdong that monitored $PM_{2.5}$, its average annual concentration in eight provinces (Beijing, Tianjin, Hebei, Shandong, Shanghai, Jiangsu, Zhejiang, and Chongqing) decreased by more than 30%; in the provinces that monitored PM_{10}, its average annual concentration has dropped by more than 20% in Guizhou, Fujian, Qinghai and Hunan. Mostly notably, the annual $PM_{2.5}$ concentration in 2017 reached 58 μg/m^3 in Beijing. In the past, the city had been a focus of world attention with regard to fine particulate pollution. It is now clear that both on a nation-wide basis (including the 74 key cities) and in the key regions including Beijing, the air quality improvement targets have either been met or exceeded, laying down the foundation for winning the "Battle of Blue Sky".

2. THE CHINESE WAY AND EXPERIENCES

Rapid economic and social development in China had led to a tsunami of air pollution of harmful compounds. The problems of acid rain, $PM_{2.5}$ pollution and O_3 pollution need to be solved urgently. There was no international experience for solving these many complex air pollution problems in a short period of time. In the process of implementing the Action Plan, a model for improving air quality was established through the promotion of institutional innovation, technological innovation, and management innovation. The model or way is well suited to China's national conditions and seeks to "unite various forces, adjust relevant structures, achieve breakthroughs in key areas, consolidate the enforcement of laws and regulations, and apply delicacy management."

2.1 Uniting Various Forces: Establishing a Framework with an All Hands on Deck Approach

The pollution combating measures formulated in the Action Plan were effective, and the key lies in the Party and the Government carrying out their shared responsibility for the "Battle of Blue Sky". To this end, a comprehensive responsibility allocation and implementation mechanism was established, taking into consideration of the characteristics of China's administrative and governing system, right after the announcement of the Action Plan. The mechanism sought to ensure all the concerned local party committees, governments, and departments faithfully carrying out their part of responsibility in order to build a comprehensive management framework for atmospheric environment. First of all, the State Council and local governments have signed target responsibility memorandums and annual assessments of implementation would be carried out. Each province (region, city) formulated a plan for the implementation of the Action Plan. The plan distributed the target tasks all the way down to the lowest rung of the Government.

Second, relevant departments took up the responsibility to divide all the tasks by cooperating closely with one another and acting in unison. They have issued more than 20 supporting policies for the implementation of the Action Plan, including price subsidy and taxation policies such as ultra-low emission electricity rate, raising collection standards for sewage charges, imposing VOC discharge fees, etc. They also issued energy policies for the upgrading of petroleum products and the strengthening of coal quality management. Between 2013 and 2017, the central government earmarked a total of 47.59 billion yuan of special funds and more than 10 billion yuan of budget investment to support the elimination of yellow-label vehicles (old vehicles with high emission), the promotion of "clean coal", and other key works such as promoting clean winter heating in 12 pilot Northern cities. Various provinces, cities, and counties also implemented three-level support for funds related to air pollution prevention and control.

Third, administrative boundaries and divisions were broken down, extending the responsibility for improving air quality to regional level. This led to major breakthroughs in joint regional prevention and control, reducing the impact of regional pollution transmission and achieving overall improvement of air quality in key regions.

In BTH (including its surrounding areas), YRD, and PRD, cooperation mechanism for prevention and control of atmospheric pollution was established and regular coordination meetings were held to explore an unified approach on regional planning, standardization, monitoring, governance, law enforcement, and emergency response, etc. This led to effective coordination over key tasks, such as the handling of heavy pollution weather. One example of these efforts is that BTH and its surrounding areas adopted more stringent regional prevention and control measures with the rolling out and implementation of the Detailed Rules for the Implementation of the Action Plan of Air Pollution Prevention and Control.

In recent years, the Chinese Government has further strengthened its environmental departments' administrative functions concerning atmospheric environment. In particular, on the basis of pilot projects in Hebei Province, the Central Government completed environmental protection inspections in 31 provinces and municipalities across the country. And a trans-regional atmospheric environment management agency was established in BTH and its surrounding areas as part of a trial. In 2017, it issued the Action Plan for the Comprehensive Prevention and Control of Atmospheric Pollution in BTH for the Autumn and Winter 2017 - 2018, together with six supporting programs. Relevant tasks were specifically handed down to local party committees and governments at various levels. Starting from April 2017, 5600 environmental law enforcement officers were drafted from across the country to carry out a year-long intensive inspection campaign on "2+26" cities. In September, units reporting to higher-level governments were dispatched to all districts and counties to carry out routine inspections in order to fully verify the rectification results of environmental issues.

2.2 Adjusting Structures : Changes in Industrial Structure and Energy Structure Leading to Prevention and Control of Pollution Sources

The key to solving the problem of atmospheric pollution is to change production methods and lifestyles. The Action Plan led to active attempts to promote green developments and lifestyles and built a system of pollution prevention and control at the source. First, it was necessary to accelerate industrial structure adjustment, actively combating overcapacity of steel production and coal production, and eliminating outdated production methods in key industries. From 2013 to 2016, a total of 100 million tons of obsolete steelmaking capacity, 230 million tons of cement, and 110 million weight cases (about 50 kilograms per case) of flat glass, over1.3 million tons of electrolytic aluminum were eliminated. A thorough inspection campaign were unleashed onto all the relevant enterprises in the "2+26" cities of the BTH air pollution transmission corridor (hereinafter referred to as the "2+26" cities). Polluting firms were sternly dealt with. The campaign deemed 62,000 enterprises and 55,000 small coal-fired boilers as air polluting sources. Unveiled problems were promptly rectified. Second, energy use efficiency and coal quality were vigorously improved. From 2013 to 2016, the national total energy consumption per unit of GDP decreased by approximately 14.4%, and the cumulative energy saving was approximately 850 million tons of standard coal; the "Interim Measures for the Administration of Commercial Coal Quality"

was promulgated to improve the quality and utilization efficiency of commercial coal. Third, reduction and replacement of coal consumption is promoted so as to actively optimize the structure of energy consumption. The nation's total coal consumption had changed rapidly after doubling in 10 years. It started declining in 2013, from 4.2 billion tons that year to 3.8 billion tons in 2016. The share of coal in primary energy consumption decreased from 67.4% to 62%; the supply of clean energy such as hydropower, wind power, nuclear power and solar energy continued to increase. Their share of primary energy increased from 15.5% in 2013 to 19.7% in 2016, equivalent to reducing the use of 240 million tons of coal. This in turn means an emission reduction of 500 million tons of carbon dioxide, thereby improving air quality and making outstanding contributions to the handling of global climate change.

In 2017, with winter clean heating in the "2+26" cities as a starting point, China's energy structure adjustment and optimization process was further accelerated. By the end of 2017, 4.74 million households from the "2+26" cities had completed the switching from "coal to gas" and "coal to electricity" (hereinafter referred to as "double-switching"). The clean-heating work in BTH achieved the most significant results. About 3.24 million of households completed "double-switching", accounting for 68% of the total number of households in the region. And this cut the consumption of unclean coal by approximately 8 million tons, reducing the emission of SO_2, NO_x, PM_{10}, and $PM_{2.5}$ by 59,500 tons, 12,300 tons, 109,200 tons and 87,400 tons respectively. According to calculations and simulations, "double-switching" reduced the annual $PM_{2.5}$ concentration in BTH by at least 2.3 $\mu g/m^3$.

2.3 Prioritizing Key Regions: Emission Reduction Programs for Important Regions and Industries

Concentrating resources on major emission reduction programs in key regions and key industries is another distinctive feature of China's campaign against air pollution. Since 2005, when China implemented control over the total amount of major air pollutants discharged, it has initiated large-scale emission reduction projects throughout the country. By now, China has built the world's largest clean and efficient coal-fired power system. The installed capacity of coal-fired generator units with desulfurization function accounts for more than 99% of the total installed capacity of coal-fired power plants. Units with denitrification function account for more than 92% of the total installed capacity of thermal power plants. Since 2015, the ultra-low emission retrofitting of coal-fired power units has been promoted. Compared with the national emission standards, after retrofitting, the emission figures of SO_2, NO_x, and soot of coal-fired power plants have been reduced by 83%, 50%, and 67% respectively. Their emission levels are now on a par with of natural gas power plants.

Currently, more than half of the country's coal-fired units have completed ultra-low-emission retrofitting, and BTH has completed ultra-low-emission retrofitting of all coal-fired units. Other key industries have also implemented large-scale emission reduction programs. For example, sintering machines with desulfurization has reached over 88% of the total operation area. Cement clinker production with denitrification accounts for more than 92% of the total production capacity. Flat glass production

with denitrification accounts for over 57% of the total production capacity. The upgrading and retrofitting of steel, cement, and flat glass production has resulted in a over 30% reduction of pollutant discharge intensity compared with 2012. Nationally, the 10,205 key enterprises under monitoring have all installed online monitoring devices which are connected with the Ministry of Environmental Protection to achieve 24-hour real-time supervision.

The Action Plan also started the fight against mobile pollution sources and diffuse pollution sources. In respect of mobile sources, the prevention and control of motor vehicle pollution has been comprehensively enhanced, with the phase-out of yellow-label and old vehicles being accelerated. Between 2014 and 2016, this eliminated a total of 17.13 million vehicles, promoted the use of new-energy vehicles, and led to the implementation of tax exemption policy for new-energy vehicles. In 2016, annual production of new energy vehicles reached 517,000 units, an increase of 51.7% over the previous year. China 5 emission standards for motor vehicles and standards of clean oil product were implemented. China 6 standards for petrol and diesel and light vehicle emission were released. In addition, ship and port pollution control measures were put into action. Since the end of April 2017, Tianjin Port no longer accepts transport of coal by road. Vapor recovery treatment of petrol stations, oil storage tanks, and tankers have basically been completed. With regard to diffuse pollution sources, the cleanup of small coal-fired boilers has been speeded up with high-pollution fuel prohibition zones designated, and more than 200,000 small boilers under 10 tons of steam in urban areas eliminated.

2.4 Compliance with Laws: Establishing a Strict Legal System for the Environment with Strong Enforcement

The building up of rule of law has been treated as the focal point and breakthrough point for advancing the implementation of the Action Plan. Rule of law in the environmental protection area safeguarded the prevention and control of atmospheric pollution. This has been one of the most important experiences of the successful implementation of the Action Plan. After the announcement of the Action Plan, China came up with the new Environmental Protection Law and the Law on the Prevention and Control of Atmospheric Pollution in order to further strengthen local responsibilities and control pollution sources. The two new laws also sought to establish and improve an environmental management system for fixed pollution sources with permits for pollutant discharge at its core. The new system enhanced control in the area and greatly increased the cost of illegal activities.

Based on the new laws, many prefectures introduced more detailed and more stringent local regulations of air pollution prevention. The Supreme People's Court and the Supreme People's Procuratorate issued a number of explanation notes on the application of the laws in handling criminal cases of environmental pollution, and incorporated the judicial verification of environmental damage into the scope of unified registration management, providing a powerful legal weapon for air pollution control. All of these strengthened environmental law enforcement. Since 2015, Chinese government has continuously carried out annual activities for

the implementation of the Environmental Protection Law and severely cracked down on environmental violations such as exceeding the standard of emission of atmospheric pollutants; and organized special law enforcement inspections in winter. Public security organs cracked down severely on crimes related to air pollution. In 2017, environmental protection departments at various levels issued more than 233,000 administrative penalty notices and imposed fines of 11.58 billion yuan, and the cases of shut down and seizure, production cessation and restriction, and consecutive daily fines increased by 138%, 83%, and 42% respectively.

2.5 Delicacy Management: Refined and Scientific Management

Efforts have been made to enhance the management of atmospheric environment and implement the "Problem Diagnosis-Source Analysis-Countermeasure Formulation-Scientific Assessment" process. It's important to achieve delicacy management, and to direct precise strikes against key areas, key pollution sources, and heavy pollution periods in order to ensure the air quality improvement effect of the Action Plan is maintained. With this in mind, the National Ambient Air Quality Monitoring Network was established. All of its 1,436 central government controlled monitoring stations have the capability of recording six indicators (including $PM_{2.5}$), covering 338 prefecture-level and above cities. And there are more than 3,500 provincial-level and city-controlled monitoring sites around the country, providing ambient air quality monitoring information in real time. The analysis of pollution sources was improved with pilot projects in key cities carrying out professional study of the sources of particulate matter. The Government also focused on the introduction of enhanced control measures for heavy pollution periods. During the heating season in the "2+26" cities of the BTH air pollution transmission corridor , steel making, coking, metal casting, manufacturing of building materials, non-ferrous metals, chemical and many other products with excess production capacity and heavy emissions were given different time slots for production on an alternate basis.

A technical system for heavy pollution weather response has been established, covering "forecasting - decision-making and consultation - early warning issuance - emergency response - tracking assessment - revision of contingency plan". Forecasting capacity has been built up, spanning three levels of monitoring and early warning of heavy air pollution in regions, provinces, and cities. This led to the ability to achieve accurate three-day air quality index forecasting and seven-day potential trend analysis. A unified set of grading standards for early warning was also established, making clear of the deduction figures of pollutants at different early warning levels and laying down in details of emergency emission reduction measures. As a result, a joint response mechanism effectively reduced peak concentration of pollutants during periods of heavy pollution in autumn and winter. Furthermore, the government commissioned the Chinese Academy of Engineering and other third parties to carry out scientific assessments of the progress of the mid-term implementation of the Action Plan, and to conduct a timely search for shortcomings in the implementation process. The Academy was also asked to propose measures for subsequent adjustment

and improvement. This turned out to have provided strong guidance for the successful completion of the Action Plan targets.

Compared with previous action plans with a five-year duration and programs for the prevention and control of atmospheric pollution, the implementation of the Action plan placed greater emphasis on the power of science and technology. To this end, in 2016, the state set up the key research project of Study on the Causes of Atmospheric Air Pollution and Relevant Controlling Technology in order to learn more about the technical and management means for the whole process of air pollution control throughout the country. In 2017, focusing on the transmission corridor cities in BTH and its surrounding areas, the special project of "Causality and Control of Heavy Atmospheric Pollution" was launched. More than 1,500 experts were involved in the research which was carried out on 28 subjects such as assessment of emission status, source analysis, and related health impact. The group of experts went to "2+26" cities to carry out "one city, one policy" field studies to provide support for scientific decision-making and precise policy implementation in BTH and its surrounding areas with regard to air pollution prevention and control.

3. SUGGESTIONS FOR FURTHER IMPROVEMENT

In 2017, only 99 of the 338 prefecture-level and above cities in China reached the targets set down by the Action Plan. The atmospheric environment in China is still facing dire situation. It's a long way to go before the national air quality standards are fully met. In order to further improve air quality, the following measures are proposed.

First, it is the formulation and introduction of guidelines for a national campaign of clean air for the medium and long-term. The Action Plan was formulated and introduced in a specific period, there was no requirement for air quality improvement for the country in the mid-to-long-term. But the "Battle of Blue Sky" is an arduous task for the long term. To this end, on the basis of completing the final assessment of the Action Plan, we propose to accelerate the improvement and revision of national air quality standards, establish a two-stage air quality standard, and encourage the prefectures that have met air quality standards to make further improvement. We should strive to publish the "National Clean Air Action Plan for the Long-term" and "Phase 2 of the Action Plan of Air Pollution Prevention and Control" in 2018. The former is mainly about clearly setting out a national road map for achieving air quality standards, especially for the key regions and 338 prefectures and cities. It should also stipulate that all cities shall meet national air quality standards by 2030 at the latest. The latter is mainly about making clear of the strategy for achieving the national air quality improvement target specified in the 13th Five-Year Plan for Ecological Environmental Protection, in particular to formulate a "construction plan" for the improvement of air quality in BTH and its surrounding areas.

Second, it's about building a long-term mechanism for the continuous improvement of air quality. The Action Plan made an excellent exploration of rationalizing the air quality management mechanism. However, both the national "target responsibility memorandums + annual assessment" approach and BTH's "enhanced supervision + inspection + special supervision + quantitative accountability" method in autumn and winter are top down. Sometimes pressures were unevenly applied across regions. And the pressure of air pollution prevention and control in some areas has not been passed down to the grassroots level step by step, resulting in some cities' failures to contain $PM_{2.5}$ and PM_{10}. Therefore, in the future, a long-term mechanism for air quality improvement should be established with city as a basic unit. The city governments that have failed to meet the goals of the Action Plan should make its own action plan on meeting air quality targets. Relevant deadlines, road maps and key tasks should be made public. Each year, these municipal governments should also make public the implementation status of the compliance plan when reporting environmental status and environmental protection objectives to the people's congress or its standing committee at the corresponding level. Implementation of compliance plans would place future development in the areas of urban energy, transportation, and urban planning concerning industries under air quality related constraints. At the same time, in combination with fiscal transfer payments, the allocation of air pollution prevention and control funds will be linked to air quality improvement. This will encourage

local governments to improve air quality. Thus, top-down responsibility allocation, accountability, and incentive mechanisms can be combined with the "bottom-up" deadline compliance management system in local areas. Together with a set of economic means such as formulation of taxation policy, market mechanisms, ecological compensation, and environment related price setting, this will ultimately provide strong supports for compliance to achieve urban air quality improvement set down at the level of the State Council or province (city, district).

Third, the government needs to form a pollution source control system and place clean energy strategy at a more prominent position. To open up the bottleneck of continuous improvement of air quality, the government must move the focus of pollution prevention forward and accelerate the promotion of certain types of urban planning, industrial structures, production methods, and lifestyles that are conducive to atmospheric environmental protection. In terms of adjustment of industrial structure, there should be constraints based on "ecological protection red line, environmental quality baseline, ceiling of resource utilization, and environmental access negative list". The positioning of development priority zones should be adhered by establishing strict industry access so as to promote the optimization of industrial structure.

In the energy area, clean heating in northern China should be taken as the entry point to accelerate the adjustment and optimization of energy structure; the supply of natural gas and electricity should be better guaranteed; extra supply of natural gas should be mainly used for the replacement of unclean coal; key regions should complete the arduous task of eliminating unclean coal. And this would represent a breakthrough in the adjustment of energy structure. For residents switching from coal to gas or electricity, their supply must be ensured and the prices must be affordable.

In the adjustment of industrial structure, the starting point should be a shakeup of polluting enterprises and the full compliance of industrial enterprises, this in turn will lead to the optimization and adjustment of the industrial structure; key regions should conduct comprehensive investigations of polluting enterprises under the principle of shutting down operations before retrofitting for pollution abatement. Pollutant discharge standards should be raised so as to strengthen control over unauthorized emission by industrial enterprises. A plan for industrial enterprises' full compliance should be made and implemented, specifying deadlines to enterprises that do not meet compliance standards. When an enterprise fails its deadline, it should be shut down to make room for the other economic activities that complies with emission standards.

In the adjustment of transportation structure, we should vigorously develop railway transportation and promote intermodal transport. With regard to the adjustment of bulk cargo transportation structures, we should shift our reliance on roads to more utilization of railways, and propose solutions for the last mile of regional inter-city and inter-enterprise railway freight transport.

With regard to promoting lifestyle changes, the formulation of quality standards for paints and other consumer goods containing VOC should conform to the requirements for atmospheric environmental protection. At the same time, the public should be encouraged to develop a low-carbon and green lifestyle

through the introduction of economic policies on prices, taxes, and subsidies. The people should also consciously fulfill their obligation to environmental protection of the atmosphere.

Fourth, it's very important to continue improving atmospheric environmental management in a delicate and scientific manner. The process of "problem diagnosis-source analysis-countermeasure formulation-scientific assessment" should be strictly followed and promoted to areas outside the key regions, in order to improve the level of delicacy management of the nation's atmospheric environment. The ability to control heavy pollution weather process needs to be strengthened. This means we should keep on building up forecasting systems, and strives to achieve full coverage of heavy pollution weather forecasting systems at the regional, provincial, and municipal levels so that regional air quality forecasting can be made with accuracy for the next 7 to 10 days. Also, heavy pollution weather contingency plan needs to be improved with better standards for initiation. Joint prevention and control at the regional level should be strengthened so that emergency emission reduction measures can be taken in advance to postpone the onset of heavy pollution weather and lessen pollution severity with reduced maximum concentration value of pollutants. Different control measures should be adopted for different pollution periods. For heavy pollution periods such as heating season, industrial and mining enterprises should be encouraged to have off-peak production and transportation in a scientific and economical manner. And key companies and key industries should be directed to pursue differentiated off-peak production.

REFERENCE

1 Jining CHEN. Firmly fight the blue sky battle in the core of air quality improvement [J]. Current Affairs Report: Party Committee Center Group Learning, 2017(3): 45-59.

2 Jiming HAO. Propel technological innovation to win the blue sky battle [N]. China Environmental News, 2017-12-15(03).

3 Zhanfeng DONG, Zengwei YUAN. Investment and financing demand and impact assessment of the Action Plan of Air Pollution Prevention and Control [J]. Chinese Journal of Environmental Management, 2016, 8(2): 47-51.

4 Jinnan WANG, Huili WANG, Yu LEI. Key points and suggestions on air pollution control in Beijing, Tianjin, Hebei and surrounding areas in autumn and winter [J]. Journal of Environmental Protection, 2017, 45(21): 12-16.

5 Ministry of Environmental Protection. Statistics Report of the China Environmental Quality Monitoring (2017) [M]. Beijing: China Environment Press, 2014.

6 Ministry of Environmental Protection. Statistics Report of the China Environmental Quality Monitoring (2017) [M]. Beijing: China Environment Press, 2014.

7 Ministry of Environmental Protection. Statistics Report of the China Environmental Quality Monitoring (2017) [M]. Beijing: China Environment Press, 2014.

8 Ministry of Environmental Protection. Statistics Report of the China Environmental Quality Monitoring (2017) [M]. Beijing: China Environment Press, 2014.

9 Ministry of Environmental Protection. Statistics Report of the China Environmental Quality Monitoring (2017) [M]. Beijing: China Environment Press, 2014.

10 Ganjie LI. Speech content of the 2018 National Environmental Protection Work Meeting [R]. Beijing: Ministry of Environmental Protection, 2018.

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