China Air 2021

Air Pollution Prevention and Control Progress in Chinese Cities

Clean Air Asia

About Clean Air Asia

Clean Air Asia (CAA) is an international non-profit organization which seeks to improve air quality and build livable cities in Asia. Launched by the Asian Development Bank, the World Bank, and the United States Agency for International Development (USAID) in 2001, CAA is also a recognized partner of the United Nations.

CAA's headquarters are located in Manila, Philippines, with offices in Beijing and Delhi. The organization has 261 partners around the world, and its operations cover six country networks including the Philippines, Indonesia, Malaysia, Nepal, Sri Lanka, and Vietnam.

CAA has been working in China since 2002, where it continues to focus on air quality management and green transportation. CAA was issued its "Representative Office of an Overseas Non-Governmental Organization Registration Certificate" by the Beijing Municipal Public Security Bureau on March 12, 2018 and set up the Clean Air Asia (Philippines) Beijing Representative Office. Subject to the supervision and guidance of the Ministry of Public Security and the Ministry of Ecology and Environment (MEE), CAA undertakes capacity building, research, public education initiatives in the field of air pollution prevention and control across China.

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Abstract

CAA has released the series of report China Air: Air Pollution Prevention and Control Progress in Chinese Cities since 2015, aiming to objectively record and analyze the air quality, policies and measures of air pollution prevention and control at country, region and city level. With the emerging synergy between air pollution and carbon reduction and deepening of structural adjustment for energy, industry, transport and land–use, China Air report further includes relevant policies and measures, and analyzes the implementation progress.

Starting in the report China Air 2019, CAA has conducted a comprehensive assessment and ranking of air quality management for 168 key cities in the series of report. Unlike the traditional city ranking for air quality, this assessment approach enables a more extensive evaluation of cities' efforts and achievements in air pollution control. The ranking can motivate cities to strive for continuous air quality improvement.

Content and scope

As the seventh edition of the China Air: Air Pollution Prevention and Control Progress in Chinese Cities series, this report records and analyzes air quality data from 337 cities at and above the prefecture level in 2020. It also provides a recap of China's policies, measures, and implementation progress in air pollution prevention and control over the same year, as well as a comprehensive evaluation and ranking of 168 key cities in the management of air quality. Finally, this report includes a special column summarizing the achievements of the "Three-Year Action Plan for Winning the Blue Sky Defense Battle" (or simply the "Three-Year Action Plan"), which culminates in 2020.

Methodology

Every report in this series adheres to the core principle of objectivity. This report is based on air quality data and policy information released by the government and systematically collected to ensure accuracy and comprehensiveness. Specific sources include (i) air quality data from environmental quality reports and official news releases by the Ministry of Ecology and Environment (MEE) and its provincial and municipal bureaus and (ii) policy information from government documents, speeches by officials, meeting notes, and news reports by mainstream media citing official sources.

This report considers two indicators in its assessment of air quality management in the key cities: improvements in air quality and the relevant policy measures in place. This approach emphasizes that both the efforts made and the outcomes achieved are equally important for air pollution control. Improvements in air quality are assessed using the range of improvement in the three-year moving average of $PM_{2.5}$ concentrations (i.e., the range of improvement in average concentrations in 2018–2020 compared to 2017–2019) and the range of improvement in the three-year moving average of the number of attainment days. Policy measures assessed include control and reduction measures for emissions from stationary, mobile, and area sources, as well as capacity building and safeguarding measures. The assessment result for air quality improvement is the effect score, while the assessment result for policy measures is the effort score. The sum of the two scores makes the total score.

Conclusions

Air quality

The year 2020 closed the 13th Five-Year Plan, the "Three-Year Action Plan," and the seventh year of continuous air quality improvement in Chinese cities and saw more outstanding achievements than 2019. The obligatory targets of the 13th Five-Year Plan were exceeded. The most significant improvement happened in the first quarter of 2020, with the implementation of government policies in response to the COVID-19 outbreak. Compared to 2019 figures, the average percentage of attainment days in 337 cities rose to 87%, and the number of cities with over 80% of attainment days reached 260. The number of heavy pollution days also decreased by 621.

The annual mean concentration of $PM_{2.5}$ across Chinese cities reached the standard, and the concentration of O_3 decreased for the first time.

In 2020, 202 cities fully met the "Ambient Air Quality Standards" (GB3095-2012). The overall concentration of the six criteria pollutants in the annual assessment in China decreased compared to the previous year, as shown in Figure 1. Specifically, the annual mean concentration of $PM_{2.5}$ dropped to 33 μg/m³, meeting the standard for the first time and enabling the concentrations of the six pollutants to also collectively reach the standard. There was a year-on-year decline in the annual mean concentration of O_3 for the first time since 2013. The number of attainment cities also increased by 47 on a year-on-year basis. Aside from the overall decline of the annual mean concentration of O_3 in the three key regions, the annual concentration in the Pearl River Delta (PRD) also improved significantly, decreasing by 15.9% compared to 2019.

In terms of criteria pollutants, all cities met the standards for SO_2 and CO levels. The percentage of cities that attained the standards for NO_2 levels rose to 98.2%, with only six cities failing. The percentage of cities that attained O_3, PM_{10}, and $PM_{2.5}$ standards increased to 83.4%, 76.8%, and 62.9% respectively, with a year-on-year increase from 30 to 47 cities meeting the standards, as shown in Figure 2.

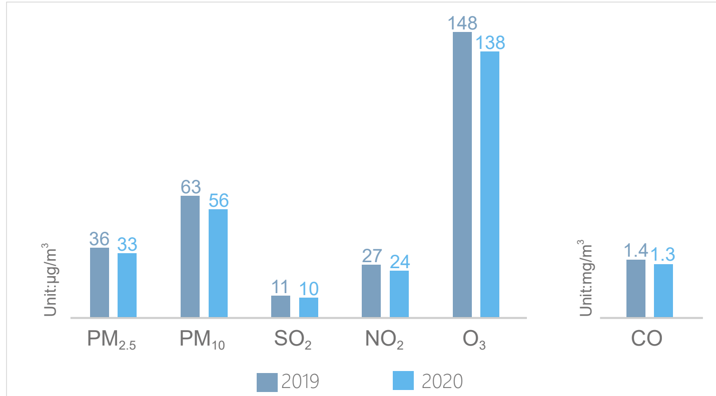

Figure 1: Annual Mean Concentrations of Six Pollutants for the Country as a whole in 2019 and 2020

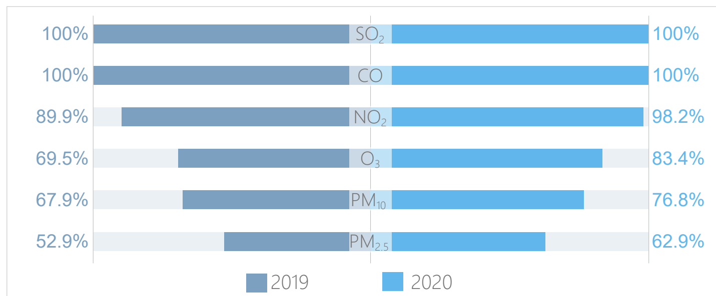

Figure 2: Percentage of Cities Meeting the Standards for Six Pollutants in 2019 and 2020

The trend of deteriorating pollution in the Fenwei Plain has reversed, with the key cities setting the best records in three years.

The Fenwei Plain was designated a new key region in the "Three-Year Action Plan" released in 2018. For two years, however, the air quality improvement in the region was not encouraging. In particular, the annual mean concentration of $PM_{2.5}$ increased in 2019, and heavy pollution frequently occurred, with the region recording the highest number of heavy pollution days among key regions across the country. In 2020, the Fenwei Plain region did not fall behind in the general trend of air quality improvement in China. The annual mean concentration of the six criteria pollutants decreased, with the annual mean concentration of $PM_{2.5}$ dropping by 12.7%. The number of heavy pollution days also decreased by 50%, representing the most significant improvement range in the key regions.

In 2020, 95% of the 168 key cities across China saw an improvement in the annual mean concentration of $PM_{2.5}$ or an increase in the attainment days on a year-on-year basis, achieving their best performance since the implementation of the "Three-Year Action Plan."

Emission activities decreased due to COVID-19 regulations. Compared with 2019, the first quarter of 2020 saw noticeable improvements in air quality.

With the government suspending work and production and restricting travel in response to the COVID-19 outbreak in 2020, air pollution decreased in varying degrees in the first quarter of the year. From January to March, the concentrations of $PM_{2.5}$, PM_{10}, SO_2, and NO_2 in 337 cities at the prefectural level and above decreased by 14.8%, 20.5%, 21.4%, and 25% respectively. These improvements were far more significant than the whole-year decrease and were most pronounced in the first month after the outbreak. The National Joint Research Center for Tackling Key Problems in Air Pollution Control estimated that the annual $PM_{2.5}$ concentration decreased by 2 μg/m³ and the rate of attainment days by 2.2% because of the pandemic regulations in place.

Policy Measures

China continued to implement a series of policy measures on air pollution prevention and control in 2020. These included further strengthening scientific and technological support through the construction of grid monitoring, inventory compilation, source apportionment, and other similar projects; upgrading pollution prevention and control measures in key industries; governing "scattered, unregulated, and high-polluting" enterprises; and optimizing energy, industry, and transportation structures. In September 2020, during the 75th Session of the United Nations General Assembly, President Xi Jinping announced that China will strive to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060. These plans were to be set in motion within the 14th Five-Year Plan period and over the medium and long term in the future. However, based on the progress of policy implementation in 2020, preventing and controlling air pollution in China remains challenging. There is still heavy dependence on coal as an energy source and heavy industry in the key regions, missing the targets for structural adjustment. The country still has a long way to go in further improving air quality within the period of the plan.

Monitoring capacities have improved, and the medium- and long-term monitoring planning outlines have been launched.

Starting in 2020, the action plans on integrated air pollution prevention and control in autumn and winter in the key regions required local governments to focus on the assessment of traffic-related air pollution and complete the construction of air quality monitoring stations in major ports and logistics channels. In addition, these plans included proposals to strengthen for the first time the component monitoring of particulate matter (PM) and the species monitoring of volatile organic compounds (VOCs) in winter. All these measures have further enhanced monitoring capacities and the analysis of pollution characteristics. However, the evaluation index for the attainment and layout of rural and industrial monitoring and evaluation stations still needs to be optimized.

In 2020, China issued the outline of the medium- and long-term ecological environment monitoring plans. This outline included improving China's ambient air monitoring system as specified in the 14th Five-Year Plan in two aspects. First, the evaluation index for attainment and the monitoring network layout will be optimized to better reflect the effects of air pollution prevention and control and establish a closer link to protecting people's health. Second, in addition to monitoring the six criteria air pollutants, emphasis will be on monitoring their components and other poisonous and harmful pollutants to improve pollution source apportionment and environmental risk prevention and control.

Energy efficiency and energy structure continued to improve. The proportion of installed coal power fell below 50% for the first time.

In 2020, China's total energy consumption rose to 4.98 billion tons of standard coal—2.2% higher than the previous year—enabling the gross domestic product (GDP) to exceed RMB100 trillion. During the 13th Five-Year Plan period, national energy consumption per GDP dropped by 13.2% in 2019 compared to 2016. The 2019 value dropped by another 0.1% in 2020. The standard consumption of coal power fell to 305.5 g/kWh—a 3.1% decrease compared to 2015—exceeding the energy efficiency target of coal power consumption falling below 310 g/kWh set by the 13th Five-Year Plan. Coal consumption also dropped to 56.8% of primary energy consumption, and the capacity of coal power installed fell below 50% for the first time.

Meanwhile, the use of clean coal power continued to expand. Coal-fired power units totaling 950 million kW in capacity were retrofitted for ultra-low emissions in 2020, accounting for 88% of the total installed capacity—a year-on-year increase of 2% from 2019. Also in 2020, pollutant emissions from the power sector decreased by 210,000 tons to 1.8 million tons compared to last year.

Clean heating covered 65% of northern areas, but the tendency to reuse loose coal and renovation difficulties in rural areas remained.

According to the National Energy Administration (NEA), the clean heating rate of Northern China in winter reached 65% in 2020 after the implementation of the "Plan of Clean Heating for Northern China in Winter (2017–2021)." In the Beijing-Tianjin-Hebei (BTH) region and its surrounding areas and key regions in the Fenwei Plain, the clean heating rate reached 80%. The areas free of loose coal were built, and loose coal replacement was completed for more than 25 million households, equivalent to a reduction of 50–60 million tons of loose coal.

However, clean heating in rural areas still faces two significant problems. The first round of the three-year subsidy will end, and whether the succeeding subsidy will be provided has not been determined for key areas. In 2020, only Tianjin and Jinan expressly specified that the subsidy policy for clean heating would be extended to the heating seasons in the next three years. Additionally, the business model of clean heating based on local conditions has not been generally formed in most areas, and the risk of loose coal being reused remains. Secondly, rural areas where clean heating has not been introduced would pose more significant difficulties for promoting clean heating. According to NEA, the clean heating rate in northern rural areas is currently 28%—still far from the ultimate goal of 40% by 2021.

Progress in implementing prevention and control measures for motor vehicle pollution continued, and the control of non-road emission sources was upgraded.

In 2020, China made efforts to improve prevention and control measures for motor vehicle pollution, achieving positive progress in emission control, standard upgrading, and structural optimization, among other areas of concern. The full-time and full-life-cycle emission supervision system for in-use vehicles was primarily formed based on China's environmental sampling test and periodic inspection system for motor vehicles. The China VI Vehicle Emission Standards were implemented. The new energy market in the automobile industry also continued to expand following development trends in low carbon emissions. In 2020, the number of New Energy Vehicles (NEVs) reached 4.92 million—an annual increase of more than 1 million for three consecutive years.

In 2020, China adopted prevention and control measures to tighten emission control standards for new nonroad production machinery and strengthen emission control for machinery already in use. The country also strengthened the emission control of inland ships. Requirements for the marine fuel quality of seagoing vessels entering the inland river control area were reinforced. The vessels in the Yangtze River Basin were required through legislation to use shore power, with illegal activities subject to penalty.

Local governments led the upgrading of cement industry standards, and ultra-low emission retrofitting was conducted from bottom to top.

In 2020, the provinces of Hebei, Henan, and Anhui revised local emission standards for the cement industry to be more stringent than the national standard issued in 2013. The goal was to urge manufacturers to speed up technological innovation. At the same time, Henan and Zhejiang released provincial implementation plans for the ultra-low emission retrofitting of the cement industry. They also urged cement enterprises to voluntarily comply through tax reduction and financial support. In particular, the differentiated performance-based management measures launched by MEE were a crucial driver for cement enterprises to independently carry out ultra-low emission retrofitting. In this mechanism, enterprises that meet the ultra-low emission limits of air pollutants are categorized as Class A enterprises that can take independent emission reduction measures in heavy pollution days.

The control of VOCs entered a critical stage with the introduction of the first "coordinated" standards.

The management of VOCs reached a critical stage with the release of the "2020 Action Plan for the Control of Volatile Organic Compounds." In 2020, China started the strict implementation of standards for the fugitive emission of VOCs nationwide and focused control measures on key enterprises with an annual VOCs output of over 10 tons.

To ensure the smooth facilitation of the plan, some cities engaged in innovative approaches. They encouraged enterprises to adopt alternative sources with low VOCs content included in government green procurement lists and the positive lists of supervision and law enforcement entities. They also motivated enterprises and industrial parks to sign VOCs emission reduction agreements with the government and reduce VOCs emission through replacement to further tap the potential of emission reduction and provide flexible emission reduction methods.

In 2020, the oil and gas extraction industry launched the first “coordinated” standards to control air pollutants, including VOCs and methane, a greenhouse gas.

With structural adjustment deepening, the capacity growth of production will likely offset part of the effects.

Structural adjustment has been vital for China’s Blue Sky Defense Battle. After years of efforts, the energy, transportation, and industry structures have improved in the country. However, China’s energy and industry structures remain problematic in 2020, with “large total amount” and “large increment” still causing problems. Road freight also remains a dominant part of the transportation structure.

Regarding the energy structure, China’s total coal consumption remains high: in 2020, standard coal use rose by 0.6% to approximately 2.829 billion tons. In the same year, the coal-fired power industry phased out 7,333,500 kW of outdated production capacity as planned. However, the newly approved coal-fired power exceeded 34 million kW, which was several times higher than the eliminated coal power. The Central Supervision Office of Ecological and Environmental Protection also pointed out that the energy development plan of NEA was not effectively integrated with ecological and environmental protection. Consequently, the setup of coal power projects failed to strictly control the newly increased coal power capacity in key regions for air pollution prevention and control.

For the industry structure, although the demonstration enterprises that achieved full-process ultra-low emissions were at the top level globally, the scale and output of the steel industry in China still increased due to market demand. In 2020, China’s crude steel output increased by 5.2%, exceeding 1 billion tons and accounting for 57% of global crude steel output. This growth trend was counter to realizing China’s industrial structure adjustment goal. It could even offset the emission reduction effects in the industry of ultra-low emission retrofitting and the elimination of outdated capacities.

For the transportation structure, the waterway freight volume achieved the growth goal set in the “Three-Year Action Plan,” while the railway freight volume did not. Compared to 2017 values, China’s waterway freight volume increased by 940 million tons, with a growth rate of 14%. Railway freight volume increased by 770 million tons, reaching a 21% increase and thus missing the 30% goal proposed in the “Action Plan for the Prevention and Control of Pollution from Diesel Trucks.”

Assessment of City Air Quality Management

Nearly half of the cities were ranked as “excellent.” Linfen and Jincheng were removed from the “underperforming” category.

Of the 168 key cities included in the rankings, 82 entered the category of “excellent” in the assessment of air quality improvement—an increase of over three times compared to the previous assessment in the China Air 2020 report. Given their substantial improvement in air quality in 2017–2020, Linfen and Jincheng, previously ranked at the bottom of the list, made it to the list of “excellent” cities.

Hefei ranked first in terms of total scores, while the performance of cities in Henan was largely unsatisfactory.

In this assessment, 43 cities performed outstandingly in air quality improvement and received total scores above 100, which is much higher than in 2019. Given their outstanding performance, Hefei, Guangzhou, Shenzhen, Beijing, Hangzhou, Shanghai, Wuhan, Chengdu, and Qingdao obtained a rating of “excellent” in both their effect and effort scores, achieving the status of “double excellence” cities in this assessment period. In contrast, the overall ranking of cities in Henan Province was affected by their poor performance in air quality improvement. Specifically, more than half of the cities ranked as “ordinary” in air quality improvement were from Henan. Hebi City ranked the lowest; it obtained a “poor” rating due to a high rebound of the annual mean concentration of $PM_{2.5}$ in 2019 and the decrease in its three-year average of attainment days.

Suggestions

The targets and measures for the coordinated control of $PM_{2.5}$ and O_3 should be clarified, and the "National Ambient Air Quality Standards" should be amended.

Despite the continuous improvement in China's city air quality, the eradication of pollution from $PM_{2.5}$ and O_3 remained far from encouraging. In 2020, the percentage of cities that failed to achieve the standards for $PM_{2.5}$ was still as high as 37%. There was also a big gap between the country's overall concentration of $PM_{2.5}$ and the guideline value proposed by the World Health Organization. While the deteriorating trend of O_3 pollution was alleviated in 2020, the mean concentration of O_3 in China still rose by 12.6% since 2015 (or the start of the 13th Five-Year Plan), with a much more significant increase in the key regions.

MEE has indicated the need to strengthen the coordinated control of $PM_{2.5}$ and O_3 during the 14th Five-Year Plan period. However, the implementation of the plan and policy measures remains unclear. According to official information, the 14th Five-Year Plan would only set concentration reduction target for $PM_{2.5}$. To encourage local governments to emphasize and implement the coordinated control of $PM_{2.5}$ and O_3, it is suggested that MEE set the obligatory target for O_3 concentration in summer in the key regions during the 14th Five-Year Plan period. It is also recommended to deploy planning and action plans with the target of reducing the emission of precursors in key regions and areas exposed to the influence of ozone transport.

As the number of attainment cities increases, the current air quality standards can no longer serve as the benchmark. To further improve air quality and protect public health in China, it is recommended that MEE revise the "National Ambient Air Quality Standards" during the 14th Five-Year Plan period and begin the revision of standards based on a feasibility study.

Structural adjustment entails equal emphasis on controlling the total amount of consumption and the flexibility of the measures in promoting coordination and the path optimization of the Blue Sky and "double carbon" goals.

Adjusting the energy structure is the key path of China's reduction of both pollution and carbon emissions in the 14th Five-Year Plan for the medium and long term. In 2020, China announced to the world its target of reaching the peak of CO_2 emissions before 2030 and achieving carbon neutrality before 2060. The carbon peaking and carbon neutrality (double carbon) goals have set higher requirements for structural adjustment in the energy and other major carbon emission industries. Fulfilling these goals would also benefit air quality improvement.

Over the past few years, China's energy efficiency and structure have been continuously optimized with the gradual promotion of structural adjustment measures. However, China's coal consumption has remained high and is still expected to grow. The significant increase in newly approved coal-fired power plants in 2020 would also bring a specific lock-in effect and pose significant challenges to reducing pollution and carbon emissions. The current control measures for coal consumption are mainly adopted in key regions and industries. Some non-key regions have imposed insufficient restrictions on the newly increased coal power capacity. Overall, China has not fundamentally changed its generally skewed energy structure.

Meanwhile, expectations around the implementation of a structural adjustment determined by the central government might differ between local governments. For instance, a "one-size-fits-all" approach might give rise to other social problems that are against China's goal of achieving Blue Sky and low carbon emissions and need to be addressed within the 14th Five-Year Plan period.

It is recommended that China strengthen cross-sectoral coordination and multi-industrial planning to promote goal coordination and path optimization. Controlling the total amount of consumption and flexibility in the measures should be given equal emphasis when adjusting energy production and consumption structures during the 14th Five-Year Plan period. In terms of controlling the total amount, it is recommended that the target for the total coal consumption of key industries be formulated and gradually tightened. Stricter and more precise reduction targets rather than negative growth should be proposed for the key regions. The construction of new coal-fired power plants in regions with large or even saturated installed capacity of coal-fired power generation should also be controlled with adequate access and early warning mechanisms. As for selecting measures, local governments should be allowed to flexibly choose multiple steps in increasing energy efficiency and controlling total consumption. Various analytical measures of the policies, including a cost-benefit analysis, should be employed to identify the combination of actions that can promote the dual goal of pollution and carbon reduction to optimize overall emission reduction.

Further utilize and increase the transport capacity of railways and inland waterways to address the difficulty of adjusting the transportation structure.

While railway and waterway freight volumes have maintained a growth trend over the past few years, the freight volume and growth speed of railway freight still failed to reach the targeted goals. There also remained a demand to increase the transport capacity of waterway freight. During the 14th Five-Year Plan period, the difficulties in urgently addressing the adjustment of transport structure include further utilizing and increasing transport capacity, improving service capacity, and boosting the percentage of clean transportation volume and turnover.

It is suggested that the transportation planning be coordinated with the layout of industrial structure adjustment in the 14th Five-Year Plan period. In regions with a transport demand for bulk cargoes and the potential for railway container transportation in the future, especially in the Yangtze River Delta (YRD) region and the Guangdong-Hong Kong-Macao Greater Bay Area, more investment should be put in the construction of relevant infrastructure to connect transport links more smoothly and enhance organizational efficiency. Service capacity and product design need to be improved to become more competitive. In addition, the inland waterway transportation system can be expanded by constructing more canals to increase transportation capacity.

Summarize the experience of successful cases of clean heating and solve the problems of loose coal use in rural areas based on local conditions.

In 2020, the cumulative clean heating rate in winter in Northern China reached about 65%, making it likely to achieve the ultimate goal set in the Plan of Clean Heating for Northern China in Winter (2017–2021) by 2021. With strong support from the central and local governments, the clean heating rate in the BTH region and its surrounding areas and the Fenwei Plain exceeded 80%. The retrofitting of clean heating in cities and urban-rural fringe areas was also less complicated and progressed faster. However, the clean heating rate in rural areas was only 28%, far from the ultimate goal of reaching 40% by 2021.

This situation meant that the difficulty and focus of retrofitting in the final year lay in the remote rural areas. Given the low grid capacity and significant limitation and high cost of the construction of natural gas pipelines in these areas, it was of great significance to explore other heating methods aside from “coal to electricity” and “coal to gas” mechanisms, such as biomass heating, based on local conditions. In recent years, the pilot cities of clean heating in the key regions have achieved remarkable results and created successful cases suitable for different resource endowments and investment and construction modes. Based on previous experiences, it is suggested to provide models that can be reproduced and promoted for other regions that have not yet undergone clean heating promotion.

Special Column I:
The "Three-Year Action Plan" promoted the overfulÞllment of air quality targets in the 13th Five-Year Plan

With the “Three-Year Action Plan” successfully completed in 2020, the proportion of attainment days in cities at the prefectural level or above across the country reached 87%—an increase of 5.8% from 2015 (the target was 3.3%). The mean concentration of $PM_{2.5}$ in non-attainment cities dropped by 28.8% compared to 2015 (the target was 18%). In three years, various policy measures played a vital role in promoting the attainment of standards for major pollutants, further unhooking economic growth from air pollution and enabling China to overfulfill the obligatory targets for air quality in the 13th Five-Year Plan. Figure 3 shows China’s GDP, energy consumption, motor vehicle population, and changes in air quality in 2018–2020.

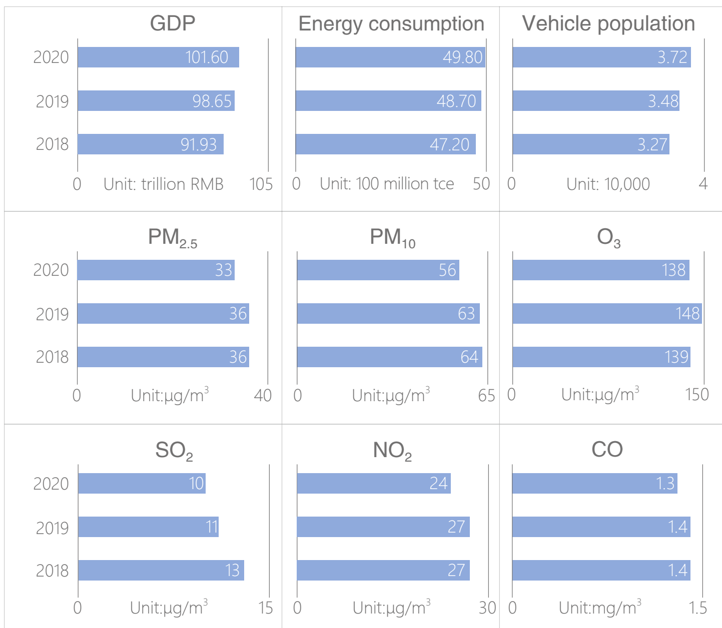

Figure 3: China's GDP, Energy Consumption, Motor Vehicle Population, and Changes in Air Quality in 2018–2020

MEE pointed out that the effects of the “Three-Year Action Plan” were reflected in four aspects: the prevention and control of pollution in the key industries, the adjustment of the energy structure, the adjustment of the transportation structure, and the response to heavy pollution days. The causes of heavy pollution were determined, and improvements were made on scientific decision-making abilities. Structural adjustment efforts have also optimized the overall industry, energy, and transportation structures, although these measures have not fundamentally changed the “skewed” structures.

Key Industries

In 2016, the State Council proposed for the first time the target of resolving excess capacity in the iron and steel industry and the building materials industry by 2020. The target was overfulfilled during the 13th Five-Year Plan period. A total of 170 million tons of excess production capacity for iron and steel were reduced, and 300 million tons of production capacity for cement and 150 million weight cases of plate glass were shut down. However, while resolving overcapacity, the recent increase in production output in China’s key industries should not be ignored. The output of iron and steel, cement, and plate glass, which remained high in the past few years, has increased since 2018. Figure 4 shows the production output of crude steel, cement, and plate glass in 2015–2020.

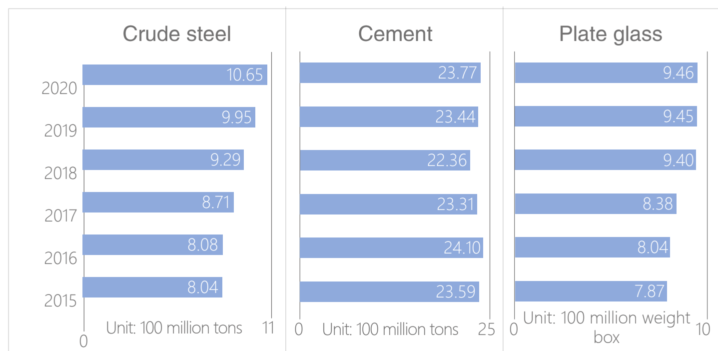

Figure 4: China's Production Output of Crude Steel, Cement, and Plate Glass in 2015–2020

Significant results have been achieved in the power sector regarding ultra-low emissions. The ultra-low emission retrofitting of coal-fired units rose from 580 million kW in 2017 to 950 million kW in 2020—an increase of 60%. In 2020, PM, SO_2, and NOx emissions in the power sector nationwide decreased to 155,000 tons, 780,000 tons, and 874,000 tons respectively, among which SO_2 had the highest reductions. Figure 5 shows the emissions of major pollutants from the power sector in 2018–2020.

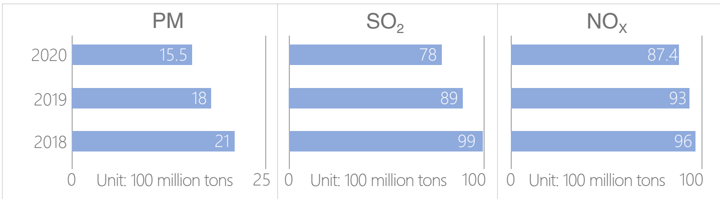

Figure 5: Emissions of Major Pollutants from the Power Sector in 2018–2020

In 2019, China officially launched ultra-low emission retrofitting in the nonpower sectors as led by the iron and steel industry. In particular, 50 million tons of production capacity for iron and steel achieved ultra-low emissions in the BTH region and its surrounding areas. Regional pollution transportation has also decreased by around 30%, while Beijing City has attained a "30+" in the annual mean concentration of $PM_{2.5}$ for the first time.

The “Three-Year Action Plan” specified that particular emission limits for air pollutants should be fully implemented for SO_2, NOx, PM, and VOCs. In 2018, “2+26” cities in the BTH air pollution transmission channels took the lead in implementing the 25 national standards regulating special emission limits for air pollutants. Afterwards, Shanxi Province released the notice of implementing these 25 national standards throughout the province, involving such industries as thermal power, iron and steel, petrochemical, and cement. Shaanxi Province launched the “Emission Standards for Air Pollutants in Key Industries in the Guanzhong Area” in 2019. The included emission limits for the pollutants in the cement, coking chemical, iron and steel, nonferrous metal, and other industries were consistent with the special emission limits stipulated by the central government. In addition, Shanghai City, Jiangsu Province, Zhejiang Province, and Anhui Province in the YRD region announced and carried out the implementation requirements.

Energy Industry

The percentage of coal in China’s primary energy consumption was kept under 60% for the first time in 2018, dropping to around 57% in 2020. In 2019, the target for the percentage of non-fossil energy in energy consumption in the “Three-Year Action Plan” was fulfilled ahead of schedule. In 2020, however, the percentage increased to 15.9%. Figure 6 shows the structure of China’s primary energy consumption in 2015–2020.

In 2020, China’s CO_2 emission per unit of GDP fell by about 48.4% compared to 2005, and the target of 40%–45% was overfulfilled ahead of

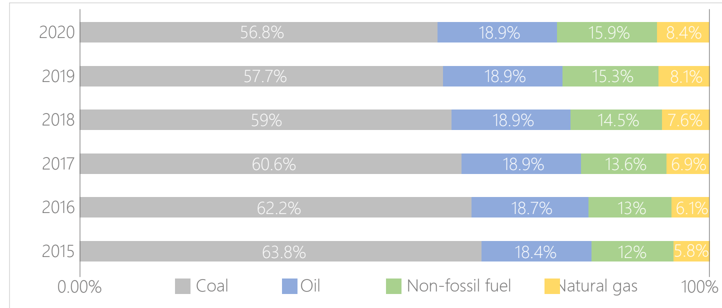

Figure 6: China's Primary Energy Consumption in 2015–2020

time. Energy consumption per GDP in China decreased by 0.1% on a year-on-year basis. The standard coal consumption for power supply fell to 305.5 g/kWh—down by 3.1% compared to 2015— thus overfulfilling the obligatory targets of energy efficiency as specified in the 13th Five-Year Plan. The average standard coal consumption for power supply from coal-fired plants fell below 310 g/kWh.

During the 13th Five-Year Plan period, the installed capacity of coal-fired power generators in China was controlled to stay within 1.1 billion kW. The scale of coal power was reduced to less than 50% of the total installed capacity for the first time, as shown in Figure 7. Implementing the policy to solve the consumption problems of electricity generated from renewable energy led to the strong development momentum of renewable energy. Given this progress, the proportion of the installed capacity of non-fossil energy power generation increased from 38.1% in 2017 to nearly 45% in 2020—an increase of over 6.5%. More than 30 million kW of outdated coal-fired units were also eliminated from 2018 to 2020, exceeding the target set by NEA. The top provinces in eliminating

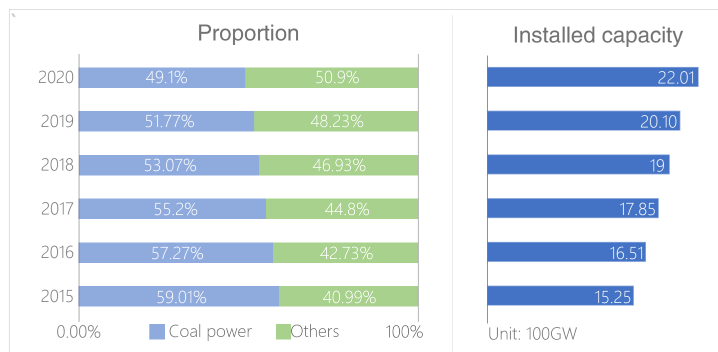

Figure 7: China's Installed Power Capacity and the Proportion of Installed Capacity of Coal-Fired Power

the most outdated coal-fired units included Shandong, Hebei, Shanxi, Guangdong, and Jiangsu. However, the layout of the 2020 coal-fired projects did not strictly regulate the newly increased coal power capacity in the key regions for air pollution prevention and control. The installed capacity of newly approved coal power exceeded 34 million kW, which offset previous efforts in resolving the overcapacity of coal power to a certain extent.

In addition to eliminating the overcapacity of coal power, the structural reform in the supply side, launched in 2018 by NEA, also covered the tasks of phasing out outdated production capacities for coal. In 2020, the number and capacity of coal mines with an annual capacity of fewer than 300,000 tons of coal both decreased by over 40% compared to the 2018 values. A total of 911 coal mines were closed, leading to an annual reduction of 104 million tons of excess capacity. During the 13th Five-Year Plan period, a total of 5,500 coal mines were closed, resulting in an annual elimination of more than 1 billion tons of outdated coal capacity.

In terms of loose coal substitution for clean heating, RMB43.3 billion from central finance was invested in 2018–2020, which supported the full substitution of loose coal in the key regions of Northern China and completed the clean heating targets set by the "Three-Year Action Plan." Since the launch of the second batch of pilot cities for clean heating in 2018, the focus of loose coal substitution has shifted from the "2+26" cities to the Fenwei Plain. From 2019 to 2020, the central government and the local governments of the key regions have encouraged the expansion of clean retrofitting for technological routes based on local conditions. This strategy was adopted to solve the shortage of heating in winter caused by the previously compulsory implementation of "double substitution." Meanwhile, power grids in rural areas were retrofitted and upgraded, thus increasing the electrification ratio in rural areas to 18%.

Regarding pollution control for coal-fired boilers, all the key regions completed the targets set in the "Three-Year Action Plan" in 2019. Coal-fired boilers with a capacity of not more than 35 T/h were almost completely eliminated in the key regions, with about 100,000 small coal-fired boilers eliminated. In 2020, pollution control for large coal-fired boilers was accelerated nationwide, and the combined heat and power generation was promoted as a long-term strategy to increase energy efficiency.

Transportation Industry

Since 2016, more than 14 million used motor vehicles have been eliminated nationwide. In 2020, the China VI Vehicle Emission Standards for light-duty vehicles were implemented across the country. Gasoline and diesel were supplied for China VI vehicles. The number of NEVs increased from 580,000 in 2015 to 4.92 million in 2020, with China ranking first globally, as shown in Figure 8. The proportion of new energy buses rose to more than 60%. In 2020, the production and sales of NEVs in China were 1.366 million and 1.367 million respectively, accounting for about 5.4% of total vehicle production and sales. Although the target of producing and selling "about 2 million NEVs" proposed in the "Three-Year Action Plan" was not achieved, the growth rate turned from negative to positive compared to 2019 values.

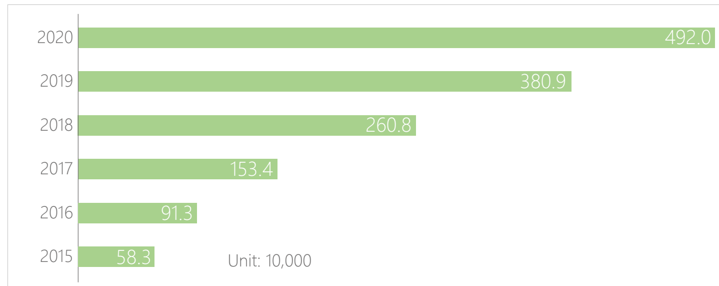

Figure 8: Population of China's NEVs in 2015–2020

In 2020, railway freight volume increased by 21% to 7.616 billion tons from 6.678 billion tons in 2017. This increase was short of the 30% growth target as proposed in the "Action Plan for the Prevention and Control of Pollution from Diesel Trucks." Since 2017, the turnover of road freight has been stable with a slight decline, while those of railway and waterway freight have increased slowly, as shown in Figure 9.

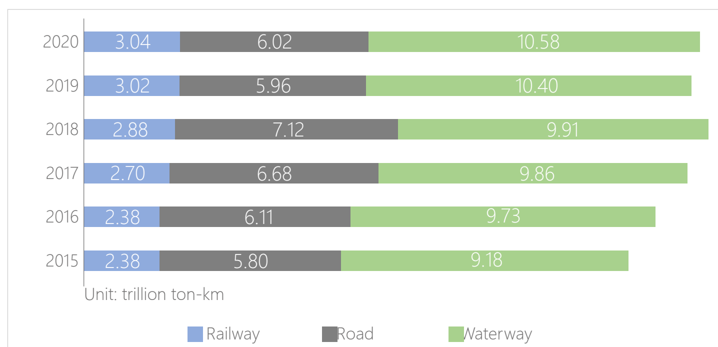

Figure 9: China's Turnover of Railway, Road, and Waterway Transportation in 2015–2020

Responses to Heavy Pollution Days

The autumn and winter actions were vital in successfully curbing heavy pollution days. The regional collaboration mechanism for air pollution prevention and control and emergency emission reduction measures played crucial roles. The air pollution prevention and control group of the BTH region and its surrounding areas was established in 2018. The Fenwei Plain was added to the key regions of the regional collaboration mechanism.

Over four years have passed since the first action plan on integrated air pollution prevention and control in autumn and winter was launched in 2017. The list of emergency emission reductions has included 275,000 enterprises emitting air pollutants in the key regions, with the coverage of key industries expanding from 15 to 39. Performance grading and differentiated management were applied to the emergency emission reduction measures to push enterprises from "passive" to “active environmental protection.” In the fourth quarter of 2020, the annual mean concentration of $PM_{2.5}$ in 39 cities of the BTH region and the Fenwei Plain dropped to 62 μg/m^3—a 39% decline compared to the same period in 2016. Heavy pollution days also decreased by 87%.

From 2018 to 2020, the National Joint Research Center for Tackling Key Problems in Air Pollution Control completed the Project of Causes and Control of Air Pollution (“Prime Minister Fund”) and determined the causes of heavy pollution days. Aside from heavy pollution in autumn and winter, the causes of ozone pollution in summer were also a key analysis topic for the research project.

Chapter I.

Current Air Quality Status

The year 2020 closed the 13th Five-Year Plan, the "Three-Year Action Plan," and the seventh year of continuous air quality improvement in Chinese cities. The same period saw more outstanding achievements than 2019. The obligatory targets of the 13th Five-Year Plan were exceeded. The average percentage of attainment days in 337 cities rose from 82% to 87%, and the number of cities with over 80% of attainment days reached 260—a year-on-year increase of 45. A total of 202 cities fulfilled the attainment for all six criteria pollutants—an increase of 45 cities from 2019. $PM_{2.5}$ was still the primary pollutant in non-attainment days, but the proportion of non-attainment dropped from 47.2% in 2019 to 37.1%.

In 2020, the total number of days with heavy pollution in China was 1,497—a decrease of 621 on a year-on-year basis. Air pollution prevention and control in the key regions in autumn and winter reaped notable results. From October 2019 to March 2020, the heavy pollution days in the key regions dropped by 39% on a year-on-year basis, and 26 of the "2+26 cities" achieved the goal of reducing heavy pollution days. In autumn and winter, from October 2019 to March 2020, heavy pollution days in the "2+26 cities" decreased by 27.8%, exceeding the target.

The annual mean concentrations of the six criteria pollutants decreased on a year-on-year basis. Among these six, $PM_{2.5}$ fell to 33 μg/m³, for the first time complying with the national standard. In addition, since 2013 (when data on O_3 was first released), the annual mean concentration of O_3 registered for the first time a year-on-year decrease from 148 μg/m³ in 2019 to 138 μg/m³ in 2020. The number of attainment cities also increased by 47 on a year-on-year basis.

$PM_{2.5}$

- In 2020, the overall annual mean concentration of $PM_{2.5}$ across the country registered 33 μg/m³—a year-on-year decrease of 3 μg/m³, with a decrease rate of 8.3%—meeting the standard for the first time.

- The proportion of attainment cities increased from 52.9% to 62.9%, with 34 additional cities from 2019.

- The mean concentration of $PM_{2.5}$ improved noticeably in the three key regions, with a year-on-year decrease of 10% or above. The annual mean concentration of $PM_{2.5}$ in the YRD region dropped to 35 μg/m³ (equivalent to the standard limit)—a reduction of 14.6%. As for the BTH region and its surrounding areas, the annual mean concentration decreased by 10.5% to 51 μg/m³. In the Fenwei Plain, the annual mean concentration decreased to 48 μg/m³, with a reduction of 12.7%.

Key Regions

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Beijing-Tianjin-Hebei	Zhangjiakou	40	35	34	32	31	29	25	23
	Chengde	50	52	43	40	35	32	29	27
	Qinhuangdao	65	60	45	46	44	38	41	34
	Langfang	110	100	85	66	60	52	46	42
	Tianjin	96	83	70	69	62	52	51	48
	Cangzhou	102	88	70	69	66	59	49.7	47
	Beijing	89.5	85.9	80.6	73	58	51	42	38
	Tangshan	115	101	85	74	66	60	53.9	49
	Handan	138	116	91	82	86	69	66	57
	Hengshui	122	108	99	87	77	62	56	52
	Xingtai	160	131	101	87	80	69	65	53
	Baoding	135	129	107	93	84	67		50
	Shijiazhuang	156	126	89	99	86	72	66	58
Fen-wei Plains	Lvliang					55	52	39	33
	Jinzhong				62	59	55	45	42
	Linfen			59	74	83	70	62	52
	Yuncheng					73	60	61	57
	Sanmenxia			75	66	57	57	55	48
	Luoyang				79	73	59	62	51
	Xi'an	105	76	57	71	73	63	57	51
	Xianyang			64	82		71	66	54
	Baoji			57	59		54	51	47
	Tongchuan			58	59	54	49	47	43
	Weinan			60	76	71	71	57	53

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Yangtze River Delta	Zhoushan	33	30	30	25	25	22	20	17
	Lishui	49	39	38	33	33	28	25	21
	Taizhou	53	43	39	36	33	29	25	25
	Wenzhou	58	46	44	38	38	30	28	25
	Ningbo	54	46	45	39	37	33	29	23
	Quzhou	57	57	45	43	42	33	33	26
	Yancheng	65	57.5	49	43	43	43	39	33
	Jiaxing	68	57	53	44	42	37	35	28
	Shanghai	62	52	53	45	39	36	35	32
	Shaoxing	71	63	56	45	41	37	38	28
	Jinhua	70	64	54	46	42	34	31	26
	Suzhou	69	66	58	46	43	42	36	31
	Nantong	72	62	58	46	39	41	37	34
	Lianyungang	67	61.2	55	46	45	44	43	37
	Huzhou	74		57	47	42	36	32	26
	Nanjing	77	73.8	57	47.9	40	43	40	31
	Changzhou	72	67	59	49	47	50	44	40
	Hangzhou	70	64.6	57	49	45	40	38	30
	Zhenjiang	72	68	59	50	56	54	45	38
	Yangzhou	70	65.2	55	51	54	49	43	36
	Taizhou	76	68	60	51	48	47	44.1	35
	Wuxi	75.1	68	61	53	45	43	39	33
	Huai'an	79	68	58	53	50	45.2	42	42
	Suqian	76	67.5	61	56	55	53	47	45
	Xuzhou	76	67.3	65	60	66	62	57	50

National Standard 35 μg/m³ | Min 8 | Max 160

Figure 10: Annual Mean Concentrations of $PM_{2.5}$ in 337 Cities in 2013-2020

North China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Inner Mongolia	Erdos			27	24	25	27	23	24
	Chifeng			41	37	34	31	23	25
	Hohhot	56		43	41	44	36	38	40
	Wuhai				46	44	39	32	32
	Baotou				47	46	42	40	44
	Ulanqab					29	28	24	22
	Xilingol					15	16	10	9
	Hulun Buir					20	17	17	18
	Tongliao					35	33	33	34
	Bayannur					36	35	33	33
	Hinggan League					20	21	25	25
	Alxa League					35	38	27	23
Henan	Xinyang				58	54	53	48	40
	Nanyang				63	58	60	60	51
	Sanmenxia			75	66	57	57	55	48
	Xuchang				68	59		60	53
	Zhoukou				68	56	58	56	50
	Zhumadian				68	59	62	52	45
	Puyang				69	64	63	63	58
	Kaifeng				72	62		62	55
	Hebi				73	65	55	61	57
	Pingdingshan				75	63	65	60	51
	Luohe				77	64	61	59	55
	Shangqiu				77	75	62	55	52
	Zhengzhou	108	88	96	78	66	63	58	51
	Luoyang				79	73	59	62	51
	Xinxiang				84	66	61	56	51
	Jiaozuo			87	85	77	67	63	56
	Anyang				86	85	74	71	62

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shanxi	Xinzhou				56	58	53	41	44
	Jincheng				62	62	60	54	46
	Jinzhong				62	59	55	45	42
	Taiyuan	81	72	62	66	66	59	56	54
	Linfen			59	74	83	70	62	52
	Datong					36	36	32	31
	Changzhi					60	54	47	44
	Yangquan					61	59	47	46
	Shuozhou					48	46	45	37
	Yuncheng					73	60	61	57
	Lvliang					55	52	39	33

East China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Weihai			38	35	32	25	29	24
	Yantai			45	39	35	29	35	30
	Qingdao	66	59	51	45	37	34	37	31
	Rizhao			57	55	48	42	45	35
	Tai'an			69	63	56	51	53	46
	Binzhou			77	70	64	54	53	49
	Ji'nan	108	90	87	73	63	52	53	47
	Zaozhuang			92	81	66	56	59	54
	Dezhou			101	81	68	58.7	53	49
	Heze			94	82	70	58	57	53
	Liaocheng			101	86	71	61	60	53
	Ji'ning			82		61	52	54	51
	Dongying			79		57	49	48	45

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Zibo					63	55	56	52
	Weifang					58	51.2	54	47
	Linyi					60	54	57	49
Fujian	Longyan				24	24	26		18
	Nanping				25	24	24		19
	Sanming				26	27	26		22
	Fuzhou	36		29	27	27	25	24	21
	Ningde				27	24	25	19	22
	Xiamen	36	37	29	28	27	25	24	18
	Quanzhou				28	28	27		21
	Putian				29	28	27	25	22
	Zhangzhou				33	35	33		20
Anhui	Huangshan				28	26	24	24	20
	Lu'an				46	47	45	41	37
	Maanshan			61	49	50	45	42.8	36
	Tongling				50.9	58.2	49	47	35
	Xuancheng				51	50	44	41	33
	Wuhu			58	53	49	49	39	35
	Anqing				54	56	46	45	36
	Huai'nan				56	62	56.3	53.4	48
	Hefei	88	83	66	57	56	48	44	36
	Bozhou				58	63	58.6	52.9	47
	Chuzhou				59	56	50	48	39
	Bengbu					60	54.7	50.9	43
	Huaibei					64	57	54	48
	Fuyang					68	55	51	50
	Suzhou					70	58.3	50.2	46
	Chizhou				44	60	44	42	34

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Jiangxi	Yingtan				41	41	36	40	32
	Fuzhou				41	47	36.6		27
	Shangrao				41	44	36		29
	Nanchang	69	52	43	44	41	30	35	33
	Ganzhou				45	47	39	32	
	Jiujiang				50	48	43	46	38
	Jingdezhen					40	31.25		25
	Pingxiang					51	43	40	33
	Xinyu				43	48	39.2	35	30
	Ji'an					53	40.2		
	Yichun					51	40	36	31

South China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Hubei	Xiaogan			72	45	49	42	43	35
	Xianning			55	48	47	37	36	30
	Enshi			54	48	36	38	32	27
	Huanggang			59	51	49	42	40	36
	Shiyan			56	51	41	43	39	33
	Suizhou			66	56	51	45	42	37
	Wuhan	94	82	70	57	53	49	45	37
	Huangshi			68	57	55	43	40	35
	Jingmen		88	71	58	50	57	56	45
	Jingzhou			70	60	56	49	46	37
	Ezhou			68	60	56	46	42	38
	Yichang		93	70	62	58	53	52	41
	Xiangyang			76	64	66	61	60	52

	City	2013	2014	2015	2016	2017	2018	2019	2020
Hunan	Chenzhou				41	38	31	30	
	Huaihua				42	39	31	29	
	Yiyang				44	41	35	54	43
	Xiangxi Prefecture				44	40	35	30	25
	Yongzhou				45	45	48	39	28
	Loudi				46	41	34	40	33
	Zhangjiajie			53	48	42	32	31	
	Yueyang				49	49	45	43	37
	Zhuzhou			55	51	52	45	47	38
	Xiangtan			56	51	51	49	48	39
	Hengyang				52	49	43	37	32
	Changsha	83	74	61	53	52	48	47	42
	Shaoyang				54	55	47	43	
	Changd			52	56	54	44	48	41
Guangxi	Fangchenggang				29	30	30	29	22
	Hechi				34	35	31	30	25
	Nanning	57	49	41	36	35	34	33	26
	Qinzhou				37	35	32		
	Guigang				38	42	40		
	Liuzhou			50	44	45	41	38	29
	Guilin			51	47	44	38	37	
	Beihai					28	27		23
	Wuzhou					41	37		
	Yulin					40	39		
	Baise					42	37		
	Hezhou					42	37.95	33	
	Laibin					48	40		
	Chongzuo					32	31	32	

	City	2013	2014	2015	2016	2017	2018	2019	2020
Guangdong	Shanwei			28	24	27		21	18
	Zhanjiang			28	26	29	27		21
	Meizhou			35	28	30	30	26	22
	Shantou			33	30	29	27		19
	Heyuan			34	32	29			22
	Chaozhou			38	33.4	30			24
	Qingyuan			33	36	32	31	32	28
	Jieyang			39	39	34		31	28
	Shaoguan			34	33	38		29	24
	Maoming			32	30	32			21
	Yangjiang			32	31	33			21
	Yunfu			34	34	37	33	29	22
	Zhuhai	38		31	26	30	27	25	19
	Shenzhen	39.6	34	30	27	28	26	24	19
	Huizhou	38		27	27	29	28	25	20
	Zhongshan	49	38	33	30	33	30	27	20
	Jiangmen	50	44	34	34	37	31	27	21
	Dongguan	48	45	36	35	37	36	32	24
	Guangzhou	53	49	39	36	35	35	30	23
	Zhaoqing	54.7	52	39	37	37	33	32	23
	Foshan	53	45	39	38	40	35	30	22
Hainan	Sanya			17	14	15		14	11
	Haikou			22	21	20	18	17	14

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Sichuan	Guangyuan				27.9	23.1	27.1	27.6	25
	Panzhihua			32	32	34	36	35	29
	Ya'an				42	49	40.8	41.7	27
	Suining				44	38	36	31.2	29
	Guang'an				46	37	40.3	33.8	32
	Mianyang			47	49	47.8	45	37.6	34
	Ziyang				49	36	35.7	34.7	30
	Neijiang				54	48	38	35	34
	Deyang			53	55	54	49	40.2	37
	Dazhou				56	50	47.1	45.8	39
	Chengdu	97	77	64	63	56	51	43	41
	Leshan				63.3	55.3	47	39.1	35
	Luzhou			61	64	52.6	39	41	38
	Zigong			73	73	66	54.1	44.9	43
	Yibin			58		56	51.9	47	40
	Nanchong					46	47.9	42.3	37
	Meishan					49.2	35.4	36.4	32
	Bazhong					32.7	30.3	35	28
	Aba Prefecture					17	15	13	16
	Ganzi Prefecture					19	19.8	11.3	9
	Liangshan Prefecture					22	23.7	20.4	22
Tibet	Lhasa	26		26	28	20	17	12	
	Changdu Prefecture								12
	Shannan Prefecture								
	Shigatse Prefecture								
	Naqu Prefecture								11
	Ali Prefecture								
	Linzhi Prefecture								

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
	Chongqing	70	65	57	54	45	40	38	33
Yunnan	Chuxiong Prefecture				22	22	24		24
	Kunming	42		30	28	29	28	26	
	Lincang				28	24			20
	Qujing					28	30		
	Yuxi					23			
	Zhaotong					31			
	Lijiang					14			
	Honghe Prefecture					34			
	Diqing Prefecture					10			19
	Baoshan					25	21	20	
	Puer					28			
	Wenshan Prefecture					23			29
	Xishuangbanna					26	26	20	
	Dali Prefecture					23	17	14	
	Dehong Prefecture					30			
	Nujiang Prefecture					20			
Guizhou	Tongren				25	24	26	31	25
	Anshun				27	30	32	23	23
	Qiandongnan Prefecture				28	32		26	24
	Bijie				30	30	31	26	24
	Guiyang	53	48	39	37	32	32	27	23
	Liupanshui				39	40	35	24	22
	Zunyi			42	44	33	28	21	18
	Qianxi'nan Prefecture							20	19
	Qiannan Prefecture							19	17

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Gansu	Jinchang				32	29	22	20	
	Jiayuguan				33	23	23	22	22
	Dingxi				36	36	40	26	
	Zhangye				38	29	32	28	
	Gannan				38		32	22	
	Baiyin				39	33	34	27	
	Wuwei				39	38	36	29	
	Pingliang				41	30	37	24	
	Tianshui				42		40	30	
	Lanzhou	67.1		52	54	49	47	36	34
	Jiuquan					28	32	25	
	Qingyang							30	
	Longnan					31	34	19	
	Linxia Prefecture						46	29	
Qinghai	Yushu Prefecture				17	19	18	10	8
	Haixi Prefecture				27	24	20	14	12
	Hainan Prefecture				31	27	20	20	19
	Haibei Prefecture				32	28	25	18	19
	Guoluo Prefecture				37	27	24	15	16
	Huangnan Prefecture				45	33	30	22	21
	Haidong Prefecture				46	47	45	36	38
	Xi'ning	70	63	49	49	39	45	34	35
Ningxia	Shizuishan				47		39	34	40
	Wuzhong				48		31	28	34
	Yinchuan	51		51	56	49	38	31	36
	Guyuan						34	24	24
	Zhongwei					34	33	29	33

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Xinjiang	Karamay			31	30		28		26
	Urumqi	87	61	66	74	70		50	47
	Korla						50		
	Turpan								
	Changli Prefecture					48			
	Ili Prefecture					51			
	Hami Prefecture					31			
	Bortala Prefecture								
	Aksu Prefecture								
	Kizilsu Prefecture								
	Kashi Prefecture								
	Hetian Prefecture								
	Tacheng Prefecture								12
	Altay Prefecture								
	Wujiaqu								
	Shihezi						60		
Shaanxi	Shangluo				39	36		32	30
	Tongchuan			58	59	54	49	47	43
	Baoji			57	59		54	51	47
	Xi'an	105	76	57	71	73	63	57	51
	Weinan			60	76	71	71	57	53
	Xianyang			64	82		71	66	54
	Yan'an							31	32
	Hanzhong					53	49	46	40
	Yulin					34	35	35	33
	Ankang							39	26

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Heilongjiang	Jixi			29	28	43	34	31	28
	Shuangyashan			43	34	40	28	29	26
	Qiqihar			38	36	38	28	28	31
	Mudanjiang		59	48	37	36	30	33	31
	Harbin	81	72	70	52	58	39	42	47
	Daqing			45	38	35	28	29	28
	Hegang			48	38	35	27	24	24
	Yichun			30	19	23	21	22	21
	Jiamusi			31	33	38	29	28	28
	Qitaihe			56	47	47	32	34	33
	Heihe			29	23	23	19	16	17
	Suihua			36	33	36	35	36	41
	Great Khingan			24	22	19	19	20	14
Jilin	Yanbian				31	31	27	26	21
	Songyuan				35	35	27	29	27
	Jilin			59	42	52	37	38	41
	Tonghua				42	35	28	29	27
	Changchun	73	68	66	46	46	33	38	42
	Siping				46	46	38	36	33
	Liaoyuan				46	44	34	36	39
	Baicheng				48	31	28	26	25
	Baishan				50	44	32	29	28

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Liaoning	Dalian	52	53	48	39	34	30	35	30
	Zhaoyang				39	42	39	37	35
	Panjin				40	39	36	39	35
	Dandong			46	42	35	29	32	29
	Fushun			53	44	47	43	45	43
	Yingkou			49	44	43	40	43	41
	Benxi			56	45	40	34	37	35
	Huludao			54	47	47	42.8	47	43
	Liaoyang				47	47	39	41	41
	Tieling				48	50	40	41	39
	Shenyang	78	74	72	54	51	41	43	42
	Jinzhou			60	55	48	46	47	47
	Anshan			72		48	41	43	44
	Fuxin					41	37	37	36

PM_{10}

- In 2020, the overall annual mean concentration of PM_{10} across the country continued to meet the standard. Specifically, it decreased to 56 μg/m³, a year-on-year decrease of 11.1%.

- The proportion of attainment cities increased from 67.9% to 76.8%—30 more cities compared to 2019.

- Among the key regions, the YRD region continued to meet the standard. The annual mean concentration decreased to 56 μg/m³, with a year-on-year decrease of 3.8%. As for the BTH region and its surrounding areas, the annual mean concentration decreased to 87 μg/m³, with a reduction of 13%. In the Fenwei Plain, the annual mean concentration decreased to 83 μg/m³—a decrease of 11.7%.

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Beijing-Tianjin-Hebei	Chengde	104	111	92	81	82	78	63	55
	Qinhuangdao	124	114	99	87		77	80	62
	Beijing	108.1	115.8	101.5	92	84	78	68	56
	Tianjin	150	133	116	103	94	82	76	68
	Langfang	184	159	137	112	102	97	85	76
	Tangshan	184	163	141	127	119	110	101	88
	Hengshui	217	192	174	143	137	101	94	83
	Baoding	220	224	174	147	135	114		86
	Shijiazhuang	309	216	147	164	154	131	122	101
	Handan	238	187	166		155	133	124	102
	Cangzhou	130	138	121		105	102	89	
	Xingtai	294	235	172	144	148	131	115	92
	Zhangjiakou	91	78	78		70	69	56	
Fen-wei Plains	Lvliang					112	95	87	86
	Jinzhong				109	112	110	86	75
	Linfen			89			117	103	86
	Yuncheng					125	108	100	90
	Sanmenxia			134	127	98	99	90	76
	Luoyang				130	123	104	107	91
	Xi'an	190	147	125	137	130	122	96	91
	Xianyang				149		134	101	91
	Baoji			108	111		105	82	74
	Tongchuan			104	104	97	89	80	71
	Weinan			110	139	135	134	101	91

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Yangtze River Delta	Shanghai	82	71	69	59	55	51	45	41
	Ningbo	86	73	69	62	60		48	39
	Shaoxing	98		79	68	63	59		47
	Nantong	108	96	88	70	65	63	55	46
	Suzhou	95	86	80	72	66	65	62	50
	Zhenjiang	124	107	82	80	90	76	72	58
	Changzhou	102	104		81	73	73	69	
	Wuxi	112.1	105	94	82	79	75	69	56
	Nanjing	137	123	96	85.2	76	75	69	56
	Yangzhou			101	87	95	90	71	63
	Taizhou	110	107	101	87	79	74		
	Lianyungang	119	111	94	87	75		66	55
	Huai'an	114	105	96	92	89	69.5	73	61
	Xuzhou	123	119	122	118	119	104	96	83
	Taizhou	75	71	66		59		44	45
	Huzhou	109		76		64			53
	Yancheng	103	92	85		79	81	68	54
	Hangzhou		98	85		72	68	66	55
	Jiaxing		81			67			46
	Lishui	65	62			50	46		40
	Wenzhou	95	75			65	58	53	51
	Suqian	126	113			78	76	78	67
	Jinhua	99				58	55	52	44
	Zhoushan					45			31
	Quzhou					64	54	51	42

National Standard 70 μg/m³ — Min 26.6 — Max 309

Figure 11: Annual Mean Concentrations of PM_{10} in 337 Cities in 2013-2020

North China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Inner Mongolia	Erdos			69	63	72	90	65	58
	Chifeng			88	76	73	76	60	54
	Baotou				105	99	103	82	78
	Wuhai				111	113	99	92	81
	Hohhot	145		103		99	86	77	71
	Ulanqab					53	63	42	39
	Xilingol					46	68	36	26
	Hulun Buir					42	31	33	28
	Tongliao					69	65	71	54
	Bayannur					96	99	78	69
	Hinggan League					45	39	43	38
	Alxa Leagure					76	94	56	44
Henan	Xinyang				96	90	86	76	63
	Zhoukou				113	98	103	94	75
	Nanyang				119	109	96	92	80
	Zhumadian				120	106	111	86	71
	Kaifeng				122	103			86
	Xuchang				122	96		88	75
	Pingdingshan				125	106	101	93	82
	Sanmenxia			134	127	98	99	90	76
	Shangqiu				127	131	103	90	78
	Hebi				128	120	108	99	92
	Luoyang				130	123	104	107	91
	Luohe				130	116	103	94	82
	Puyang				137	107	102	102	87
	Jiaozuo			150	142	134	116	114	97
	Zhengzhou	171	158		143	118	106	98	84
	Xinxiang				144	116	105	101	89
	Anyang				155	132	123	115	104

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shanxi	Xinzhou				103	112	96	79	71
	Jinzhong				109	112	110	86	75
	Jincheng				111	117	118	111	96
	Taiyuan	157	138	114	125	131	135	107	95
	Linfen			89			117	103	86
	Datong					73	82	73	70
	Changzhi					103	98	84	77
	Yangquan					116	108	84	78
	Shuozhou					99	112	86	87
	Yuncheng					125	108	100	90
	Lvliang					112	95	87	86

East China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Weihai			65	63	62	50	56	44
	Yantai			77	76	69	66	70	58
	Qingdao	107	107	94	85	76	72	74	61
	Rizhao			102	101	87	79	85	62
	Tai'an			126	112	103	102	97	82
	Binzhou			126	123	110	98	91	81
	Ji'nan	191	172	157	141	130	112	103	86
	Zaozhuang			159	141	126	115	113	96
	Dezhou				141	122	113.6	103	91
	Heze			155	143	131	119	112	99
	Liaocheng			164	151	136	123	116	94
	Ji'ning			140		103	99		
	Dongying			136		110	94		80

	City	2013	2014	2015	2016	2017	2018	2019	
Shandong	Zibo					119	106	104	90
	Weifang					103	94	104	85
	Linyi					114	106	106	85
Fujian	Nanping				37	37	35		29
	Putian				43	44	44	43	40
	Longyan				44	42	46		33
	Sanming				46	44	42		38
	Ningde				46	44	42	35	37
	Xiamen	62	59	48	47	48	46	40	33
	Quanzhou				48	53	53		38
	Fuzhou	64			50	51	48	42	38
	Zhangzhou				65	59	60		46
Anhui	Huangshan				45	51	42	39	34
	Chizhou				66	89	67	61	51
	Xuancheng				68	76	64	56	43
	Anqing				71	80	65	62	48
	Lu'an				73	80	78	72	62
	Wuhu			81	75	82	67	62	50
	Maanshan			87	75	83	75	68	57.7
	Chuzhou				77	83	80	72	61
	Tongling				77.8	88.4	75	75	64
	Hefei	115	113	91.9	83	80	73	68	58
	Bozhou				83	103	98.3		79
	Huai'nan				85	107	88.9	91.3	76
	Huaibei				87	100	90	84	
	Bengbu					98	87.3		
	Fuyang					108	90	84	78
	Suzhou					97	90.1		

	City	2013	2014	2015	2016	2017	2018	2019	
Jiangxi	Yingtan				59	59	52	52	40
	Fuzhou				63	64	59		46
	Ganzhou				68	72	63	56	
	Shangrao				70	75	63		
	Jiujiang				74	70	68		
	Nanchang	116	85	75	78	76	64		
	Jingdezhen					67	56		45
	Pingxiang					84	71		
	Xinyu				76	82	70.5	64	
	Ji'an					75	66.7		
	Yichun					76	65.8		52

South China

	City	2013	2014	2015	2016	2017	2018	2019	
Hubei	Enshi Prefecture		79	76	69	54	60	58	45
	Huanggang		102	85	75	84	74	73	61
	Xianning		94	90	77	62	56	56	49
	Xiaogan		103	110	78	80	72	73	56
	Shiyan		98	90	81	64	71	68	54
	Suizhou		108	103	88	75	73	69	59
	Huangshi		103	102	89	86	70	71	63
	Wuhan	124	113	104	92	88	73	71	58
	Xiangyang		113	108	93	90	89	84	68
	Yichang		136	107	97	88	77	73	57
	Jingmen		110	114	99	84	79	75	57
	Jingzhou		150	109	100	92	86	83	64
	Ezhou		110	104	100	85	73	74	65

	City	2013	2014	2015	2016	2017	2018	2019	
Hunan	Chenzhou				70	70	61	52	
	Yongzhou				70	67	69	56	43
	Loudi				71	66	66	66	55
	Yueyang				72	71	72	68	56
	Zhangjiajie			78	72	67	58	50	
	Changsha		84	76	73	70	61	57	
	Hengyang				76	70	66	59	50
	Shaoyang				77	78	65	59	52
	Xiangxi Prefecture				78	75	59	49	41
	Huaihua				79	83	50	46	
	Changde			82	80	77	62	60	50
	Yiyang				82	78	69	72	58
	Zhuzhou			86	83	82	71	66	51
	Xiangtan				85	81	68	63	
Guangxi	Fangchenggang				45	46	47	51	42
	Guigang				55	66	63		
	Hechi				55	60	59	53	43
	Nanning	90	84	72	62	56	57	58	46
	Guilin			70	64	60	55	54	
	Liuzhou			70	66	66	62	57	43
	Beihai			48		45	46		40
	Wuzhou					60	61		
	Qinzhou					55	53		
	Yulin					59			
	Baise					63	60		
	Hezhou					66	57	53	
	Laibin					70	65		
	Chongzuo					47	52	58	

	City	2013	2014	2015	2016	2017	2018	2019	
Guangdong	Shanwei			41	38	43		37	29
	Zhanjiang			45	39	42	39		35
	Yangjiang			48	44	48			34
	Meizhou			51	46	50	49	42	33
	Heyuan			49	46	48			37
	Maoming			48	47	50			39
	Shantou			52	48	49	44		34
	Shaoguan			50	51	52		43	37
	Yunfu			54	51	57	53	50	37
	Chaozhou			58	51.2	50			41
	Qingyuan			51	52	47	46	52	46
	Jieyang			56	60	55		52	44
	Zhuhai	59		51	41	43	43	41	34
	Shenzhen	62	53	49	42	45	44	42	35
	Zhongshan	66	57	49	44	49	45	43	36
	Huizhou			50	45	51	47		38
	Dongguan	65	60	51	49	51	50	38	38
	Foshan	83	66	58	55	63	60	56	43
	Jiangmen	76	64	50	55	60	56	49	41
	Zhaoqing		74	56	55	56	51	48	37
	Guangzhou	72	67	59	56	56	54	53	43
Hainan	Sanya			32	28	28		27	23
	Haikou			40	39	37	35	32	29

	City	2013	2014	2015	2016	2017	2018	2019	2020
Sichuan	Panzhihua			64	65	66	64	70	48
	Suining				68	63	61	49	47
	Ya'an				68	67	55.8	30.5	38
	Guangyuan				69.6	59.2	56.5	49.1	44
	Neijiang				76	70	58	51	48
	Mianyang			72	78	71.4	72	58.6	54
	Guang'an				78	74	70.3	55.5	51
	Dazhou				86	77	74.6	73.2	61
	Luzhou			89	86.8	80	59	54	48
	Deyang			75	91	87	78	66.6	61
	Leshan				92.9	83.7	70.1	61.7	53
	Ziyang				95	82	69.5	54	50
	Zigong			103	99	89	77.8	67.1	62
	Chengdu	150	123	108	105	88	81	68	64
	Yibin			82		80	75	62	60
	Nanchong					72	72.9	63.4	56
	Meishan					80.1	60.6	60.5	54
	Bazhong					53.6	51.4	59	44.8
	Aba Prefecture					34	26.6	25	23
	Ganzi Prefecture					31	31.5	18.6	16
	Liangshan Prefecture					45	37.6	34.3	37
Tibet	Lhasa			59	80	54			
	Changdu Prefecture								
	Shannan Prefecture								
	Shigatse Prefecture								28
	Naqu Prefecture								
	Ali Prefecture								
	Linzhi Prefecture								

	City	2013	2014	2015	2016	2017	2018	2019	2020
	Chongqing	106	98	87	77	72	64	60	53
Yunnan	Chuxiong Prefecture				35	40	40		
	Lincang				43.5	40			42
	Kunming	82		56	55	58	51	45	35
	Qujing					54	53		
	Yuxi								
	Zhaotong					56			
	Lijiang					27			
	Honghe Prefecture					51			
	Diqing Prefecture					36			24
	Baoshan					39	40	30	
	Puer					44			
	Wenshan Prefecture					39.7			
	Xishuangbanna					48		54	
	Dali Prefecture					33	38	28	
	Dehong Prefecture					46			
	Nujiang Prefecture					43			
Guizhou	Anshun				38	44	47	30	29
	Bijie				44	47	52	38	35
	Qiandongnan Prefecture				45	46		36	33
	Tongren				50	66	57	52	41
	Guiyang	86	73	61	63	53	57	47	41
	Liupanshui				68	66	57	39	34
	Zunyi			71	69	54	47	38	30
	Qianxi'nan Prefecture							31	29
	Qiannan Prefecture							31	27

	City	2013	2014	2015	2016	2017	2018	2019	2020
Gansu	Gannan				70		63	44	
	Dingxi				75	69	81	57	
	Tianshui				80		79	56	
	Pingliang				80	73	75	56	
	Zhangye				90	81	66	55	
	Baiyin				95	85	82	62	
	Wuwei				97	81	80	61	
	Jiayuguan			98	98	97	79	61	58
	Jinchang				104	101	76	58	
	Lanzhou	153	126	120	132	111	103	79	76
	Jiuquan					89	90.7	65	
	Qingyang							58	
	Longnan					62	58	38	
	Linxia Prefecture						81	59	
Qinghai	Yushu Prefecture				40	46	49	26	25
	Haixi Prefecture				65	62	45	39	39
	Hainan Prefecture				69	57	51	39	36
	Guoluo Prefecture				72	56	47	32	27
	Haibei Prefecture				76	55	49	34	39
	Huangnan Prefecture				86	56	60	44	47
	Xi'ning	163	120	106	113	99	89	59	61
	Haidong Prefecture				114	104	85	60	63
Ningxia	Wuzhong				98		75	64	67
	Shizuishan				114		89	76	75
	Yinchuan	119		112	111	117	87	68	72
	Guyuan						82	59	46
	Zhongwei					81	75	61	65

	City	2013	2014	2015	2016	2017	2018	2019	
Xinjiang	Karamay			64	55		60		54
	Urumqi	146	146	133	115	106		86	83
	Korla						177		
	Turpan								
	Changli Prefecture					77			
	Ili Prefecture					83			
	Hami Prefecture					78			
	Bortala Prefecture								
	Aksu Prefecture								
	Kizilsu Prefecture								
	Kashi Prefecture								
	Hetian Prefecture								
	Tacheng Prefecture								
	Altay Prefecture								
	Wujiaqu								
	Shihezi								
Shaanxi	Shangluo				72	65		54	
	Tongchuan			104	104	97	89	80	71
	Baoji			108	111		105	82	74
	Xi'an	190	147	125	137	130	122	96	91
	Weinan			110	139	135	134	101	91
	Xianyang				149		134	101	91
	Yan'an							67	
	Hanzhong					86	81	71	
	Yulin						78	66	
	Ankang							64	44

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Heilongjiang	Jixi			61	53	75	57	54	49
	Shuangyashan			69	55	61	49	50	44
	Qiqihar			63	61	65	53	52	54
	Mudanjiang		91	78	68	65	58	61	51
	Harbin	119	111	103	74	87	65	67	64
	Daqing			62	59	59	46	48	45
	Hegang			78	67	65	61	46	46
	Yichun			51	33	36	38	35	30
	Jiamusi			53	48	57	47	44	43
	Qitaihe			85	74	84	80	63	57
	Heihe			50	37	41	40	34	31
	Suihua			60	58	65	53	56	57
	Great Khingan			55	43	33	34	30	25
Jilin	Yanbian				49	46	45	44	35
	Liaoyuan				63	59	48	51	54
	Jilin			98	69	79	63	63	60
	Songyuan				69	71	61	58	50
	Baicheng				75	55	50	49	38
	Tonghua				76	62	54	51	50
	Siping				77	80	68	69	59
	Changchun	129	118	107	78	78	61	64	59
	Baishan				81	71	59	56	60

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Liaoning	Dalian	66	74	81	67	59	56	60	50
	Panjin				67	66	59	56	
	Zhaoyang				69	76	76	68	66
	Dandong			76	71	61	50	55	48
	Yingkou			77	73	69	69	69	
	Benxi			89	74	71	65	66	
	Fushun			93	78	81	73	78	71
	Jinzhou			92	81	78	78	77	
	Fuxin				83	81	69	67	
	Liaoyang				83	82	69	74	69
	Tieling				83	85	74	76	
	Huludao			99	87	80	74.25	77	67
	Shenyang	129	124	115	94	88	75	77	74
	Anshan			115		95	77	81	74

SO_2

- In 2020, the overall annual mean concentration of SO_2 across the country continued to meet the standard. Specifically, it decreased to 10 μg/m³—a year-on-year decrease of 9.1%.

- As in 2018 and 2019, the proportion of attainment cities remained at 100%, with all cities continuing to meet the standard.

- In the three key regions, the mean concentration of SO_2 dropped the lowest in the YRD region to 7 μg/m³—a decrease of 22.2%. In both the BTH region and its surrounding areas and the Fenwei Plain, it dropped to 12 μg/m³—a year-on-year decrease of 20% for both regions.

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Beijing-Tianjin-Hebei	Beijing	26.5	21.8	13.5	10	8	6	4	4
	Tianjin	59	49	29	21	16	12	11	8
	Shijiazhuang	106	64	47	41		23	18	12
	Tangshan	114	73	49	46	40	34	22	18
	Qinhuangdao	60	54	38	28		21	19	15
	Handan	97	57	45			22	15	14
	Baoding	69	67	55	39	29	21		11
	Chengde	37	40	22	17	17	13	14	12
	Cangzhou	54	40	40			24	18	
	Hengshui	68	42	36			15	13	12
	Xingtai	113	75	60	52		26	19	14
	Zhangjiakou	51	53	31			14	11	
	Langfang	46	36	24	18	14	11	8	8
Fen-wei Plains	Lvliang						40	29	18
	Jinzhong				88	84	37	26	20
	Linfen						46	28	18
	Yuncheng					51	30	15	13
	Sanmenxia				33				
	Luoyang				39	25	17	10	8
	Xi'an	46	32	24	20	19	15	9	8
	Xianyang			24	20		16	9	
	Baoji			15	13		10	8	8
	Tongchuan			25	22	20	21	12	12
	Weinan			23	22	18	13	10	11

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Yangtze River Delta	Shanghai	24	18	17	15	12	10	7	6
	Jiaxing		26						
	Shaoxing	37		21	12	9	7		5
	Zhoushan								
	Wenzhou	24	17			12	9	8	6
	Jinhua	32					8	7	6
	Quzhou						8	7	6
	Taizhou	18	12	9				4	4
	Lishui	16	13				7		
	Nanjing	37	25	19	18.2	16	10	10	7
	Suzhou	31	24	21	17	14	8	9	8
	Wuxi	40	29	26	18	13	12	8	7
	Changzhou	41	36		19	17	14	10	
	Yangzhou			24	23	18	13	10	8
	Zhenjiang	30	24	25	24	15	10	9	8
	Nantong	28	26	30	25	21	17	10	9
	Taizhou	32							
	Xuzhou	52	38	38	35	22	17	11	10
	Lianyungang	34	30		25	18		13	10
	Huai'an	34	32	21	18		9.25	10	7
	Yancheng	29	20	19			9	4	5
	Suqian	33						8	6
	Hangzhou		21	16		11	10	7	6
	Ningbo	22	17	15	13				
	Huzhou	26		17					6

National Standard 60 μg/m³

Min 2 — Max 114

Figure 12: Annual Mean Concentrations of SO_2 in 337 Cities in 2013-2020

North China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Inner Mongolia	Hohhot	56		34		29	20	15	13
	Chifeng			49		23	20	19	15
	Baotou				31	28	24	22	20
	Erdos			20	15	14	13	13	13
	Ulanqab					27	23	20	20
	Xilingol					18	19	15	13
	Wuhai				56	51	35	32	26
	Hulun Buir					4	3	3	3
	Tongliao					14	14	11	11
	Bayannur					24	14	14	16
	Hinggan League					8	8	7	5
	Alxa League					11	10	9	8
Henan	Zhengzhou				29		15	9	9
	Pingdingshan				30				12
	Sanmenxia				33				
	Luoyang				39	25	17	10	8
	Anyang				52				
	Kaifeng				28				
	Jiaozuo			49	40	25	18	13	
	Xuchang				28				11
	Nanyang				24			7	8
	Xinyang				14			7	
	Zhoukou				21				
	Hebi				43		19	13	11
	Xinxiang				40	28	19	16	
	Puyang				29		16		10
	Luohe				28	15	12	10	9
	Shangqiu				23				
	Zhumadian				31	16			

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shanxi	Taiyuan	80	73		69		29	22	17
	Datong						31	30	29
	Changzhi					43	22	16	17
	Linfen						46	28	18
	Yangquan						32	16	20
	Jincheng				70	47	25	16	13
	Shuozhou						40	26	25
	Jinzhong				88	84	37	26	20
	Yuncheng					51	30	15	13
	Xinzhou				49		34	29	20
	Lvliang						40	29	18

East China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Ji'nan	93	72	50	38	25	17	15	12
	Qingdao	54	37	28	20	14	10	8	7
	Zibo			83		38	24	20	17
	Zaozhuang			63	38	29	19	17	16
	Yantai			21	21	15	10	8	8
	Weifang					26	19.9	13	11
	Ji'ning			56		24	18		
	Tai'an			39	35.2	25	18	15	14
	Rizhao			27	23	16	12	9	8
	Dongying			54			18		15
	Liaocheng				31	18	14	14	12
	Binzhou			58	39	32	22	19	16
	Heze			42	35		14	14	11
	Weihai			17	15	10	7	6	5

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Linyi					23	18	15	12
	Dezhou				34		25.5	15	12
Fujian	Fuzhou	10			6		7	5	5
	Xiamen	20	16	10	11		9	6	6
	Quanzhou				11		10		5
	Putian				7		9	6	6
	Sanming				15		13		8
	Zhangzhou				15		8		7
	Nanping				11		9		6
	Longyan				10		10		8
	Ningde				6	9	8	8	6
Anhui	Hefei			16	15	12	7	6	7
	Wuhu			20	21	15	11.5	11	9
	Maanshan			24	20		15.3	12	10
	Bengbu						16.1		
	Huai'nan				19	18	15.4	14	10
	Huaibei					21	17	11	
	Tongling				43	27	18	15	13
	Anqing				19	15	11	9	8
	Huangshan				15		10	9	6
	Chuzhou				18	13	11	10	7
	Fuyang					13	9	6	7
	Suzhou						16.2		
	Lu'an				13	11	7	6	6
	Bozhou				27		12.7		7
	Chizhou				20	15	12		8
	Xuancheng				21	21	11	8	7

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Jiangxi	Nanchang	40		19	17	15	11		
	Jiujiang				21	20	13		
	Jingdezhen						12.7		
	Pingxiang						19		
	Xinyu						20.75	19	
	Yingtan				32	30	21	18	
	Ganzhou				26		18	13	
	Ji'an						20.2		
	Yichun						18.25		13
	Fuzhou						13.8		
	Shangrao						22.6		

South China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Hubei	Wuhan	33	21	18	11	10	9	9	8
	Yichang			20	14	12	11	7	7
	Jingzhou			26	23	18	15	9	7
	Huangshi				19	18	14	14	15
	Ezhou				23	15	11	12	11
	Xiaogan				11	11	9	7	6
	Huanggang				9	11	9	10	10
	Xianning				8	7	5	7	9
	Shiyan				17	14	15	9	6
	Xiangyang				15	16	14	11	11
	Jingmen				21	18	15	9	6
	Suizhou				10	9	7	7	6
	Enshi Prefecture				10	9	7	4	7

	City	2013	2014	2015	2016	2017	2018	2019	2020
Hunan	Changsha		24	18	16	13	10	7	
	Yueyang				21	14	10	9	10
	Changde			25	19	12	11	8	7
	Zhangjiajie			10	7	8	7	4	
	Zhuzhou			25	25	19	18	11	8
	Xiangtan				25	20	16	10	
	Yueyang				16	16	16	14	
	Shaoyang				31	29	18	15	12
	Yiyang				27	13	9	7	
	Chenzhou				16	15	15	11	
	Yongzhou				19	12	11	9	
	Huaihua				19	11	10	8	
	Loudi				22	17	11	10	
	Xiangxi Prefecture				10	4	4	6	
Guangxi	Nanning	19	15	13	12	11	11	10	8
	Guilin			21	17	15	12	13	
	Beihai								8
	Liuzhou			24	21	19	15	14	10
	Wuzhou					12			
	Fangchenggang				9		11		
	Qinzhou								
	Guigang								
	Yulin								
	Baise								
	Hezhou							11	
	Hechi				12	9			
	Laibin								
	Chongzuo							7	

	City	2013	2014	2015	2016	2017	2018	2019	2020
Guangdong	Shaoguan			19				10	
	Shantou			13	14	12	12		
	Zhanjiang			10	10		9		
	Maoming			14					
	Meizhou			9	7	8	7	8	7
	Shanwei			10				8	8
	Heyuan			10	7				
	Yangjiang								7
	Qingyuan				14	11	10	9	
	Chaozhou								
	Jieyang			17	15	15		11	
	Yunfu						15	15	
	Guangzhou	20	17	13	12	12	10	7	7
	Shenzhen	11	9	8	8	8	7	5	6
	Zhuhai	13		9	9		7	5	5
	Foshan	32	25	17	14	13	11	9	7
	Jiangmen	27	24	16	12	12	9	7	7
	Dongguan	23	19		11	12	10	10	8
	Zhongshan	19	16		11	10	9	6	5
	Huizhou								
	Zhaoqing		25	20	16	13	11		9
Hainan	Haikou			6	6	6	5	5	4
	Sanya			3		2		4	4

	City	2013	2014	2015	2016	2017	2018	2019	2020
Sichuan	Chengdu	31	19	14	14	11	9	6	6
	Mianyang			13	11	9	6.4	9	5
	Yibin			24		18	16	10	7
	Panzhihua			34	38	35	40	31	25
	Luzhou			22	18	17	15	11	10
	Zigong			17	15	15	13.3		6
	Deyang			22	15	14	12		6
	Nanchong						9.4		
	Suining				13		10	9.3	8.5
	Neijiang				18		10	7	8
	Leshan				19.4	16.2	7.7	12.9	
	Meishan						9.8		
	Guang'an				18	13	9		
	Dazhou				12	11	10.2		
	Ziyang				17	10	8.1		7
	Guangyuan				18.9	21.1	19.7	11	
	Ya'an				15	11	14.5		7.3
	Bazhong					42	4.2	4.3	
	Aba Prefecture					11	7.8	9	
	Ganzi Prefecture						10.4		
	Liangshan Prefecture					12	16.4		
Tibet	Lhasa			10	8				
	Changdu Prefecture								
	Shannan Prefecture								
	Shigatse Prefecture								4
	Naqu Prefecture								
	Ali Prefecture								
	Linzhi Prefecture								

	City	2013	2014	2015	2016	2017	2018	2019	2020
	Chongqing	32	24	16	13	12	9	7	8
Yunnan	Kunming	28		17	17	15	13	12	9
	Qujing						14		11
	Yuxi								
	Zhaotong								
	Lijiang								
	Chuxiong Prefecture				22	19	15		
	Honghe Prefecture								
	Diqing Prefecture							5	
	Baoshan						7		5
	Puer								
	Lincang				11.5	12			
	Wenshan Prefecture					9.7		6	
	Xishuangbanna							10	
	Dali Prefecture						5		
	Dehong Prefecture								
	Nujiang Prefecture								
Guizhou	Guiyang	31	24	17	13	13	11	10	10
	Zunyi			16	11	12	12	12	11
	Liupanshui				17	18	17	12	9
	Bijie				17	13	11	9	8
	Anshun				22	20	17	14	13
	Tongren				12	10	4	4	4
	Qianxi'nan Prefecture							5	6
	Qiandongnan Prefecture				13	8		18	18
	Qiannan Prefecture							10	7

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Gansu	Lanzhou	33	29		19	20	21	18	15
	Jiayuguan			25	21	17	14	11	13
	Jinchang				37	27	21	17	
	Baiyin				42		46	42	
	Tianshui				27		17	12	
	Wuwei				23	14	8	8	
	Zhangye				25	13	10	12	
	Pingliang				19		11	9	
	Jiuquan					14	9.4	10	
	Qingyang							11	
	Dingxi				25	22	17	11	
	Longnan					20	17	16	
	Linxia Prefecture						23	13	
	Gannan				19		14	11	
Qinghai	Xi'ning	48	41	31	31	24	20	17	15
	Haidong Prefecture				22	20	18	14	14
	Haibei Prefecture				19	14	16	14	11
	Huangnan Prefecture				17	15	17	15	11
	Hainan Prefecture				13	18	9	10	10
	Guoluo Prefecture				25	27	23	19	21
	Yushu Prefecture				13	20	15	9	14
	Haixi Prefecture				21	20	17	9	11
Ningxia	Yinchuan	77		64		48	27	15	
	Shizuishan						17	30	
	Wuzhong				41		17	16	
	Guyuan						27	10	
	Zhongwei					24	41	14	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Xinjiang	Urumqi	29	25	15	14	13			
	Karamay								
	Korla						7		
	Turpan								
	Changli Prefecture					15			
	Ili Prefecture					23			
	Hami Prefecture								
	Bortala Prefecture								
	Aksu Prefecture								
	Kizilsu Prefecture								
	Kashi Prefecture								
	Hetian Prefecture					35			
	Tacheng Prefecture								
	Altay Prefecture								
	Wujiaqu								
	Shihezi								
Shaanxi	Xi'an	46	32	24	20	19	15	9	8
	Xianyang			24	20		16	9	
	Tongchuan			25	22	20	21	12	12
	Yan'an							10	
	Baoji			15	13		10	8	8
	Weinan			23	22	18	13	10	11
	Hanzhong					15	11	13	
	Yulin							15	
	Ankang							12	
	Shangluo				20			13	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Heilongjiang	Harbin	44	57	40	28		20	17	
	Qiqihar			26	23	22	15		
	Daqing			18		13	13	9	
	Mudanjiang		25	20	18	10			9
	Jixi				20			8	
	Hegang								
	Shuangyashan				18	13	9	8	10
	Yichun								
	Jiamusi								
	Qitaihe								
	Heihe					16			
	Suihua								
	Great Khingan							19	
Jilin	Changchun	44	41	36	28	26	16	11	10
	Jilin			30	23	18	15	12	14
	Siping				22	26	14	11	11
	Liaoyuan				25	18	13	15	14
	Tonghua				29	26	16	11	15
	Baishan				35	29	21	14	14
	Songyuan				15	14	7	6	6
	Baicheng				12	11	10	8	9
	Yanbian				14	15	11	9	11

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Liaoning	Shenyang	90	82	66	47	37	26	21	18
	Dalian	31	29		26	17	12		10
	Anshan			49			22		16
	Fushun			31	27				17
	Benxi			43	36	27	21		
	Jinzhou			59	52	45	39		
	Dandong								
	Yingkou			29	23		12		
	Panjin								
	Huludao			47			38.3		23
	Fuxin				39				
	Liaoyang				27				16
	Tieling				30	20			
	Zhaoyang				34				15

NO_2

- In 2020, the overall annual mean concentration of NO_2 across the country continued to meet the standard, registering at 24 μg/m³—an 11.1% decrease on a year-on-year basis.

- The proportion of attainment cities increased from 89.9% to 98.2%, with only six cities failing to attain the standard in the whole country.

- In the three key regions, the mean concentration decreased to 29 μg/m³ in the YRD region—a year-on-year decrease of 9.4%. In both the BTH region and its surrounding areas and the Fenwei Plain, it decreased to 35 μg/m³—a year-on-year decrease of 12.5% and 10.3% respectively.

Key Regions

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Beijing-Tianjin-Hebei	Beijing	56	56.7	50	48	46	42	37	29
	Tianjin	54	54	42	48	50	47	42	39
	Shijiazhuang	69	54	51	58		50	40	41
	Tangshan	69	60	61	58	59	56	51	46
	Qinhuangdao	47	49	45	48		45	42	41
	Handan	58	52	47			43	38	35
	Baoding	56	55	54	58	50	47		37
	Chengde	36	39	35	35	35	34	32	31
	Cangzhou	31	33	41			43	38	
	Hengshui	46	43	44			34	33	31
	Xingtai	69	62	60	61		50	45	37
	Zhangjiakou	32	29	26			23	22	
	Langfang	48	49	47	52	48	47	39	36
Fen-wei Plains	Lvliang						45	45	39
	Jinzhong				36	44	45	41	36
	Linfen						40	39	38
	Yuncheng					35	31	28	26
	Sanmenxia				39				
	Luoyang				47	42	40	40	34
	Xi'an	57	47	44	53	59	55	48	41
	Xianyang			39	50		50	43	
	Baoji			36	39		41	34	30
	Tongchuan			36	35	35	37	36	31
	Weinan			29	47	56	51	42	38

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Yangtze River Delta	Shanghai	48	45	46	43	44	42	42	37
	Jiaxing		44						
	Shaoxing	42		37	31	31	29		27
	Zhoushan								
	Wenzhou	52	50			41	37	34	30
	Jinhua	38					29	27	24
	Quzhou						32	31	29
	Taizhou	39	25	23				19	20
	Lishui	26	23				23		
	Nanjing	55	54	50	44.3	47	44	42	36
	Suzhou	53	53	54	51	48	48	37	34
	Wuxi	47	45	41	47	46	43	40	35
	Changzhou	48	40		37	41	44	37	
	Yangzhou			30	30.5	40	38	35	32
	Zhenjiang	42	46	42	38	43	38	33	30
	Nantong	36	40	38	36	38	36	32	27
	Taizhou	31							
	Xuzhou	47	37	39	42	44	42	37	35
	Lianyungang	36	35		30	33		30	28
	Huai'an	32	27	22	25		31	26	25
	Yancheng	29	27	23			27	24	22
	Suqian	35						29	25
	Hangzhou		50	49		45	43	41	38
	Ningbo	44	41	43	39				
	Huzhou	41		40					35

National Standard 40 μg/m³ — Min 9.5 — Max 69

Figure 13: Annual Mean Concentrations of NO_2 in 337 Cities in 2013-2020

North China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Inner Mongolia	Hohhot	40		39		45	41	39	33
	Chifeng			25		20	27	26	24
	Baotou				39	42	39	39	38
	Erdos			24	23	27	26	26	25
	Ulanqab					28	25	25	25
	Xilingol					19	12	11	10
	Wuhai				28	31	30	29	28
	Hulun Buir					18	14	12	12
	Tongliao					22	20	20	18
	Bayannur					27	22	21	20
	Hinggan League					16	13	15	14
	Alxa League					11	11	10	9
Henan	Zhengzhou				56		50	45	39
	Pingdingshan				43				31
	Sanmenxia				39				
	Luoyang				47	42	40	40	34
	Anyang				51				
	Kaifeng				40				
	Jiaozuo			50	48	44	41	37	
	Xuchang				47				30
	Nanyang				29			29	24
	Xinyang				28			24	
	Zhoukou				29				
	Hebi				52		44	38	36
	Xinxiang				49	50	49	44	
	Puyang				42		36		30
	Luohe				39	36	35	29	26
	Shangqiu				32				
	Zhumadian				38	36			

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shanxi	Taiyuan	43	36		46		52	50	45
	Datong						29	34	32
	Changzhi					41	31	34	31
	Linfen						40	39	38
	Yangquan						45	34	41
	Jincheng				40	45	40	38	31
	Shuozhou						31	41	32
	Jinzhong				36	44	45	41	36
	Yuncheng					35	31	28	26
	Xinzhou				39		44	43	35
	Lvliang						45	45	39

East China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Ji'nan	59	53	48	45	46	45	41	35
	Qingdao	40	43	33	32	33	31	32	31
	Zibo			61		47	43	42	38
	Zaozhuang			36	31	31	35	34	30
	Yantai			33	33	30	27	27	25
	Weifang					36	34.6	37	32
	Ji'ning			43		38	34		
	Tai'an			42		39	36	34	29
	Rizhao			34	35	36	35	35	31
	Dongying			41			36		31
	Liaocheng				41	40	38	39	33
	Binzhou			41	39	40	39	39	37
	Heze			42	36		39	33	30
	Weihai			23	20	23	17	20	15

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Linyi					45	42	38	34
	Dezhou				40		36.8	34	28
Fujian	Fuzhou	43			30		26	22	19
	Xiamen	44	37	31	31		31	23	19
	Quanzhou				27		25		19
	Putian				18		20	18	16
	Sanming				27		26		21
	Zhangzhou				31		30		24
	Nanping				18		17		14
	Longyan				25		24		21
	Ningde				26	22	20	13	16
Anhui	Hefei			33	45	52	41	42	39
	Wuhu			36	45	49	41.8	26	37
	Maanshan			35	34		37.25	36	34
	Bengbu						37.9		
	Huai'nan				35	31	28.75	28	28
	Huaibei					35	33	29	
	Tongling				43	50	41	37	37
	Anqing				39	36	31	30	27
	Huangshan				21		16	18	16
	Chuzhou				39	40	40	35	31
	Fuyang					36	28	31	26
	Suzhou						42.5		
	Lu'an				35	38	34	31	26
	Bozhou				36		28.75		23
	Chizhou				33	35	35		26
	Xuancheng				38	32	34	29	29

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Jiangxi	Nanchang	40		31	33	37	36		
	Jiujiang				30	29	29		
	Jingdezhen						16		
	Pingxiang						26		
	Xinyu						28.7	26	
	Yingtan				24	26	24	24	
	Ganzhou				24		25	24	
	Ji'an						19.8		
	Yichun						24.2		20
	Fuzhou						17.9		
	Shangrao						22.5		

South China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Hubei	Wuhan	60	55	52	46	50	47	44	36
	Yichang			35	35	35	34	29	24
	Jingzhou			36	34	36	34	32	26
	Huangshi				31	37	36	33	30
	Ezhou				34	36	34	34	29
	Xiaogan				25	26	20	21	18
	Huanggang				25	27	24	25	22
	Xianning				19	18	23	21	17
	Shiyan				28	22	29	26	21
	Xiangyang				32	35	34	32	27
	Jingmen				35	38	34	27	23
	Suizhou				25	24	24	24	19
	Enshi Prefecture				19	23	24	22	18

	City	2013	2014	2015	2016	2017	2018	2019	2020
Hunan	Changsha		42	38	38	40	34	33	
	Yueyang				25	25	23	27	25
	Changde			24	23	22	25	23	19
	Zhangjiajie			18	21	22	22	20	
	Zhuzhou			35	35	36	33	34	29
	Xiangtan				37	37	35	33	
	Hengyang				30	28	30	27	
	Shaoyang				22	24	23	23	20
	Yiyang				29	29	25	23	
	Chenzhou				27	26	26	24	
	Yongzhou				24	22	25	27	
	Huaihua				17	18	13	12	
	Loudi				23	22	22	22	
	Xiangxi Prefecture				19	19	19	16	
Guangxi	Nanning	38	37	33	32	35	35	32	24
	Guilin			26	27	25	23	25	
	Beihai								12
	Liuzhou			24	24	26	24	25	20
	Wuzhou					26			
	Fangchenggang				17		19		
	Qinzhou								
	Guigang								
	Yulin								
	Baise								
	Hezhou							21	
	Hechi				27	25			
	Laibin								
	Chongzuo							19	

	City	2013	2014	2015	2016	2017	2018	2019	2020
Guangdong	Shaoguan			25				24	
	Shantou			20	21	21	19		
	Zhanjiang			15	14		14		
	Maoming			15					
	Meizhou			23	25	28	28	25	22
	Shanwei			13				11	10
	Heyuan			23	19				
	Yangjiang								14
	Qingyuan				37	23	22	33	
	Chaozhou								
	Jieyang			21	25	25		22	
	Yunfu						31	29	
	Guangzhou	52	48	47	46	52	50	45	36
	Shenzhen	40	35	33	33	30	29	25	23
	Zhuhai	37		29	32		30	27	24
	Foshan	53	48	41	41	44	41	41	31
	Jiangmen	33	32	31	34	38	35	32	26
	Dongguan	45	42		34	41	39	37	27
	Zhongshan	43	32		34	36	32	32	25
	Huizhou								
	Zhaoqing		37	31	33	27	25	33	26
Hainan	Haikou			14	16	12	5	13	11
	Sanya			13		12		9	9

	City	2013	2014	2015	2016	2017	2018	2019	2020
Sichuan	Chengdu	63	59	53	54	53	48	42	37
	Mianyang			34	36	32	31.5	53	28
	Yibin			29		34	35	30	28
	Panzhihua			32	34	36	38	40	32
	Luzhou			33	29	35	35	30	27
	Zigong			31	33	37	30.9		27
	Deyang			29	25	28	29		29
	Nanchong						32.8		
	Suining				24		29	23.1	18
	Neijiang				28		26	25	22
	Leshan				24.8	24.6	32.8	24	
	Meishan						34.9		
	Guang'an				24	27	27		
	Dazhou				41	39	40.2		
	Ziyang				20	27	27.2		24
	Guangyuan				35.5	38.2	34.5	31	
	Ya'an				27	28	20.8		19.6
	Bazhong					26.5	23.8	24.5	
	Aba Prefecture					11	9.5	11	
	Ganzi Prefecture						15.9		
	Liangshan Prefecture					14	20.5		
Tibet	Lhasa			21	24				
	Changdu Prefecture								
	Shannan Prefecture								
	Shigatse Prefecture								10
	Naqu Prefecture								
	Ali Prefecture								
	Linzhi Prefecture								

	City	2013	2014	2015	2016	2017	2018	2019	2020
	Chongqing	38	39	45	46	46	44	40	39
Yunnan	Kunming	40		30	28	32	33	31	26
	Qujing						19		16
	Yuxi								
	Zhaotong								
	Lijiang								
	Chuxiong Prefecture				21	21	20		
	Honghe Prefecture								
	Diqing Prefecture								
	Baoshan						12	12	11
	Puer								
	Lincang				12	20			
	Wenshan Prefecture					14.6			
	Xishuangbanna							20	
	Dali Prefecture						16	11	
	Dehong Prefecture								
	Nujiang Prefecture								
Guizhou	Guiyang	33	31	28	29	27	25	21	18
	Zunyi			29	32	29	27	26	19
	Liupanshui				25	23	23	26	15
	Bijie				23	22	20	17	16
	Anshun				16	15	15	12	11
	Tongren				16	22	19	21	16
	Qianxi'nan Prefecture							14	14
	Qiandongnan Prefecture				11	21		23	19
	Qiannan Prefecture							14	9

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Gansu	Lanzhou	35	48		57	57	55	50	47
	Jiayuguan			27	26	25	26	22	20
	Jinchang				17		16	15	
	Baiyin				27		26	27	
	Tianshui				36		34	31	
	Wuwei				27	28	26	25	
	Zhangye				22	21	18	20	
	Pingliang				39		35	35	
	Jiuquan					27	12.3	22	
	Qingyang							18	
	Dingxi				31	30	27	25	
	Longnan					26	25	23	
	Linxia Prefecture						21	21	
	Gannan				22		23	21	
Qinghai	Xi'ning	41	38	38	42	40	39	37	36
	Haidong Prefecture				41	36	39	40	33
	Haibei Prefecture				13	14	16	15	13
	Huangnan Prefecture				11	16	13	12	12
	Hainan Prefecture				16	15	20	16	17
	Guoluo Prefecture				17	16	16	13	15
	Yushu Prefecture				13	15	15	13	14
	Haixi Prefecture				13	15	13	14	13
Ningxia	Yinchuan	43		39		42	37	37	
	Shizuishan						25	29	
	Wuzhong				28		24	28	
	Guyuan						37	28	
	Zhongwei					26	32	26	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Xinjiang	Urumqi	60	56	52	53	49			
	Karamay								
	Korla						21		
	Turpan								
	Changli Prefecture					23			
	Ili Prefecture					38			
	Hami Prefecture								
	Bortala Prefecture								
	Aksu Prefecture								
	Kizilsu Prefecture								
	Kashi Prefecture								
	Hetian Prefecture					26			
	Tacheng Prefecture								
	Altay Prefecture								
	Wujiaqu								
	Shihezi								
Shaanxi	Xi'an	57	47	44	53	59	55	48	41
	Xianyang			39	50		50	43	
	Tongchuan			36	35	35	37	36	31
	Yan'an							41	
	Baoji			36	39		41	34	30
	Weinan			29	47	56	51	42	38
	Hanzhong					32	29	26	
	Yulin							42	
	Ankang							25	
	Shangluo				26			23	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Heilongjiang	Harbin	56	52	51	44		37	33	
	Qiqihar			24	23	22	18		
	Daqing			25		26	23	20	
	Mudanjiang		32	25	26	26			23
	Jixi				20			20	
	Hegang								
	Shuangyashan				22	21	19	15	14
	Yichun								
	Jiamusi								
	Qitaihe								
	Heihe					15			
	Suihua								
	Great Khingan							14	
Jilin	Changchun	44	47	45	40	40	35	34	32
	Jilin			37	30	29	27	24	25
	Siping				32	33	28	27	24
	Liaoyuan				28	30	27	23	21
	Tonghua				31	32	26	26	24
	Baishan				27	26	22	19	19
	Songyuan				23	20	16	17	19
	Baicheng				20	22	16	15	14
	Yanbian				23	22	21	18	16

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Liaoning	Shenyang	43	52	48	40	40	39	36	35
	Dalian	24	27		30	28	27		25
	Anshan			38			34		30
	Fushun			34	33				27
	Benxi			41	33	31	31		
	Jinzhou			38		38	35		
	Dandong								
	Yingkou			31	28		29		
	Panjin								
	Huludao			37			33		
	Fuxin				26				
	Liaoyang				29				27
	Tieling				23	32			
	Zhaoyang				22				21

CO

- In 2020, the overall annual mean concentration of CO across the country registered 1.3 μg/m³, continuing to meet the standard. Specifically, it decreased by 7.1% on a year-on-year basis.

- As in 2019, the proportion of attainment cities remained at 100%. Just like with SO_2, the annual mean concentration of CO also reached the standard across all cities.

- In the key regions, CO concentration decreased to 1.1 μg/m³ in the YRD region—a year-on-year decrease of 8.3%. It fell to 1.7 μg/m³ in the BTH region and its surrounding areas—a year-on-year reduction of 15%— and decreased to 1.6 μg/m³ in the Fenwei Plain—a year-on-year decline of 15.8%.

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Beijing-Tianjin-Hebei	Beijing	3.4	3.2	3.6	3.2	2.1	1.7	1.4	1.3
	Tianjin	3.7	2.9	3.1	2.7	2.8	1.9	1.8	1.7
	Shijiazhuang	6	4.3	4.3	3.9		2.6		2.1
	Tangshan	5.4	2.4	4.2	2.3	2	3.3	2.9	2.5
	Qinhuangdao	4	3.5	3.6	2.9		2.5	2.6	1.8
	Handan	4.8	3.9	3.8			2.8	2.6	2.1
	Baoding	5.5	5.4	5.8	4.4	3.6	2.4		1.8
	Chengde	2.1	2.3	2.3	2.4	2.1	1.9	1.8	1.8
	Cangzhou	3.5	2.9	3.2			1.8	1.8	
	Hengshui	3.8	3	3.7			1.8	1.8	1.6
	Xingtai	5.5	3.8	5.1	1.8		2.8	2.4	2.1
	Zhangjiakou	1.7	2.2	1.6			1.4	1.1	
	Langfang	4.4	3.6	3.4	3.5	2.9	2	1.7	1.6
Fen-wei Plains	Lvliang						2.4	1.6	1.1
	Jinzhong				4.1	2.8	2.1	1.6	1.6
	Linfen						3.6	3.1	2.5
	Yuncheng						3.3	2.7	2.2
	Sanmenxia				3				
	Luoyang				3.38	2.4	2	1.5	1.3
	Xi'an	4.4	4.3	4.3	3.1	2.8	2.2	1.7	1.5
	Xianyang						2.1	1.6	
	Baoji			2.7	2.2		1.5	1.6	1.2
	Tongchuan			2.5	2.16	2.2	2	1.7	1.3
	Weinan						1.9	1.9	1.7

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Yangtze River Delta	Shanghai	0.85	0.77	0.86	0.79	0.76	0.67	0.66	1.1
	Jiaxing		0.9						
	Shaoxing			0.9	0.8	0.8	1.2		
	Zhoushan								
	Wenzhou		1.7			1	1	1	0.8
	Jinhua	1.03					1.1	0.7	0.9
	Quzhou							1.1	1
	Taizhou		1	0.8				0.9	0.7
	Lishui	1.2	1.2				1		
	Nanjing	1.04	0.95	1	1	1.5	1.4	1.3	1.1
	Suzhou		0.92	0.92	1.5	1.4	1.2	1.2	1.2
	Wuxi			1.0	1.1	1.5	1.6	1.4	1.2
	Changzhou					1.5	1.6	1.2	
	Yangzhou			1.4			0.84	0.6	1
	Zhenjiang				0.9	0.9	0.7	0.7	0.9
	Nantong							1.1	1.1
	Taizhou	1.4							
	Xuzhou					1	0.9	0.8	1.4
	Lianyungang		2		1.6	1.5		1.5	1.3
	Huai'an		1.3	1.1	1		0.9	1.2	1
	Yancheng						1.26		0.8
	Suqian	1.3						1.2	1.2
	Hangzhou			1.5					1.1
	Ningbo	1	0.9	1.4	1.2				
	Huzhou			0.9					1

National Standard 4 mg/m^3

Min 0.6 — Max 6

Figure 14: Annual Mean Concentrations of CO in 337 Cities in 2013-2020

North China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Inner Mongolia	Hohhot	4.9					2.2	2.2	2.4
	Chifeng			1.0			0.8	1.3	1.5
	Baotou						2.3	2.6	3.2
	Erdos			0.7	0.7		1.1	1.1	1.1
	Ulanqab						1	1	1
	Xilingol						0.8	0.4	0.5
	Wuhai				2		1.8	1.6	1.8
	Hulun Buir						0.6	0.6	0.6
	Tongliao						1	0.9	0.7
	Bayannur						1.2	1.4	1.6
	Hinggan League						1	1	0.9
	Alxa Leagure						0.9	0.8	0.7
Henan	Zhengzhou				2.8		1.8	1.6	1.4
	Pingdingshan				2.1				1.3
	Sanmenxia				3				
	Luoyang				3.38	2.4	2	1.5	1.3
	Anyang				4.7				
	Kaifeng				2.7				
	Jiaozuo			3.9	1.9				
	Xuchang				2.9				1.5
	Nanyang				2.1			1.6	
	Xinyang				1.6				
	Zhoukou				2.7				
	Hebi				4.1		2.5	2	1.9
	Xinxiang				1.5	3	2.3	2.08	
	Puyang				2.9		1.1		0.8
	Luohe				2.1	1	0.84	0.71	0.7
	Shangqiu				1.7				
	Zhumadian				1.8	1			

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shanxi	Taiyuan	3.4	3.2		3.3		1.9	1.9	1.8
	Datong						3.1	3	2.8
	Changzhi					3.1	2.4	2.1	2
	Linfen						3.6	3.1	2.5
	Yangquan						2.2	2.1	1.8
	Jincheng				4.1	4.3	2.9	2.6	2.1
	Shuozhou						1.9	1.6	1.3
	Jinzhong				4.1	2.8	2.1	1.6	1.6
	Yuncheng						3.3	2.7	2.2
	Xinzhou				3.5		2	1.9	1.7
	Lvliang						2.4	1.6	1.1

East China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Ji'nan						1.7	1.6	1.5
	Qingdao					1.3	1.4	1.5	1.2
	Zibo					2.6	2.1	1.9	1.8
	Zaozhuang								
	Yantai			0.8	0.8	0.7	1.3		1.1
	Weifang							1.7	1.6
	Ji'ning								
	Tai'an								
	Rizhao								
	Dongying						1.5		
	Liaocheng						1.9	1	
	Binzhou								1.6
	Heze								
	Weihai				1.1			1.1	0.9

	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Linyi					2	1.9	1.6	1.5
	Dezhou							1.6	
Fujian	Fuzhou				1.1		0.9	0.9	0.9
	Xiamen		1	0.9	0.9		0.9	0.8	0.7
	Quanzhou				1		0.8		0.8
	Putian				0.9		0.8	1	0.8
	Sanming				2.1		1.7		1.2
	Zhangzhou				1.2		1		0.8
	Nanping				1.4		1		0.7
	Longyan				1.2		1		0.8
	Ningde				1.6	1.1	1.2	1.2	1
Anhui	Hefei			1.06	1	1.4	1.5	1.2	1.1
	Wuhu							1.2	1.2
	Maanshan			1.5	2.1		1.7	1.4	1.2
	Bengbu						1.2		
	Huai'nan				1	0.8	1.2	1.1	1.1
	Huaibei					1.5	1.4	1.3	
	Tongling				1.31	1.1	1	0.9	0.8
	Anqing				1.3	1.1	1.1	1.1	1
	Huangshan				0.5		1.1	1	0.9
	Chuzhou				0.9	0.8	0.7	0.8	1.2
	Fuyang					0.9	0.75	0.7	0.6
	Suzhou						1.3		
	Lu'an				1.3	1.2	1.1	1.1	1.1
	Bozhou				1.12		1.3		1.1
	Chizhou				1.6	1.6	1.4		
	Xuancheng				1.2	1.3	1.2	1.1	1

	City	2013	2014	2015	2016	2017	2018	2019	2020
Jiangxi	Nanchang				1.6	1.6	1.5		
	Jiujiang						1.6		
	Jingdezhen						1.1		
	Pingxiang						2.2		
	Xinyu						1.5	1.4	
	Yingtan				1.1	1	1	0.9	
	Ganzhou				1.8		2	1.9	
	Ji'an						1.0		
	Yichun						1.4		1.4
	Fuzhou						1.05		
	Shangrao						1.2		

South China

	City	2013	2014	2015	2016	2017	2018	2019	2020
Hubei	Wuhan	1.1	1.1	1.1	1.7	1.1	1	1.5	1.2
	Yichang			1.7	1.7	1.7	1.6	1.4	1.2
	Jingzhou			1.8	1.8	1.7	1.8	1.5	1.3
	Huangshi				2.5	1.7	1.7	1.5	1.5
	Ezhou				1.8	1.6	1.7	1.6	1.3
	Xiaogan				2.8	3	1.6	1.6	1.5
	Huanggang				1.7	1.5	1.4	1.2	1.2
	Xianning				1.4	1.6	1.5	1.2	1.3
	Shiyan				1.9	1.7	1.4	1.4	1.3
	Xiangyang				2	1.8	1.6	1.4	1.3
	Jingmen				1.6	1.4	1.5	1.2	1.1
	Suizhou				2	2.6	1.5	1.4	1.2
	Enshi Prefecture				1.5	1.6	1.5	1.3	0.8

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Hunan	Changsha				1.4	1.3	1.3	1.3	
	Yueyang				1.4	1.4	1.4	1.4	1.2
	Changde			1.4	1.8	1.8	1.4	1.5	1.1
	Zhangjiajie			1.6	2.2	1.9	1.4	1.3	
	Zhuzhou			0.9	1.4	1.4	1.4	1.2	1
	Xiangtan				1.4	1.3	1.3	1.3	
	Hengyang				1.8	1.7	1.6	1.6	
	Shaoyang				1.5	1.5	1.4	1.4	
	Yiyang				1.7	1.8	1.8	1.6	
	Chenzhou				1.8	1.9	1.8	1.2	
	Yongzhou				1.1	1	1.1	1.2	
	Huaihua				1.6	1.4	1.5	1.2	
	Loudi				2.5	2.6	2.3	1.6	
	Xiangxi Prefecture				1	1.8	1.2	1.2	
Guangxi	Nanning	1.7	1.6		1.3		1.3	1.4	1
	Guilin			1.8	1.7	1.3	1.3	1.4	
	Beihai								1
	Liuzhou				1.6	1.5	1.4	1.6	1.2
	Wuzhou					1.5			
	Fangchenggang						1.3		
	Qinzhou								
	Guigang								
	Yulin								
	Baise								
	Hezhou							0.8	
	Hechi				1.6	1.3			
	Laibin								
	Chongzuo							1.2	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Guangdong	Shaoguan			1				1.3	
	Shantou			1.2	1.2	1.1	1		
	Zhanjiang			1.4	1.2		0.9		
	Maoming			0.9					
	Meizhou			1.3	1.3	1.3	1.2	1.1	1
	Shanwei			0.8				0.9	0.8
	Heyuan			1.3	1.2				
	Yangjiang								1
	Qingyuan				1.6	1.5	1.3	1.4	
	Chaozhou								
	Jieyang			1.5	1.5	1.3		1.2	
	Yunfu						1.2	1.2	
	Guangzhou	1		1	1.3	1.2	1.2	1.2	1
	Shenzhen	1.2	1.1	0.9	0.8	0.8	0.6	0.6	0.6
	Zhuhai	1		1.6	1.1		1	1.2	0.9
	Foshan	1.6	1.6	1.4	1.3	1.2	1.2	1.3	1
	Jiangmen	2.1		1.5	1.3	1.3	1.2	1.3	1.1
	Dongguan	0.9	1.4		1.3	1.2		1.1	0.9
	Zhongshan	1.5	1.7		1.4	1.3	1.1	1.2	1
	Huizhou								
	Zhaoqing		1.8	1.5	1.4	1.3	1.2	1.3	0.9
Hainan	Haikou			0.9	0.9	0.8	0.8	0.9	0.8
	Sanya			0.8		0.8		0.7	0.6

	City	2013	2014	2015	2016	2017	2018	2019	2020
Sichuan	Chengdu	2.6	2	2	1.8	1.7	1.4	1.1	1
	Mianyang			1.4	1.6	1.4	1.1	1	1
	Yibin			0.9		1.2	0.9	0.8	1.1
	Panzhihua			2.7	2.2	2.2	2.5	2.3	2.5
	Luzhou			0.9	0.9	1	1	1	1
	Zigong			1.5	1.5	1.6	1.4		1
	Deyang			1.4	1.4	1.5	1.3		1
	Nanchong						1.2		
	Suining				1.4		1.1	0.9	1
	Neijiang				1.4		1.2	1.2	1.1
	Leshan				1.1	1.4	1.2	1.4	
	Meishan						1.1		
	Guang'an				1.4	1.5	1.3		
	Dazhou				1.9	1.9	1.9		
	Ziyang				1.2	1.2	1		1
	Guangyuan				0.8	1.5	1.3	1.4	
	Ya'an				1.6	1.2	1.1		0.9
	Bazhong					1.5	1.1	1.1	
	Aba Prefecture					1.3	0.8	1.2	
	Ganzi Prefecture						0.7		
	Liangshan Prefecture					1	1.2		
Tibet	Lhasa			1.1	1				
	Changdu Prefecture								
	Shannan Prefecture								
	Shigatse Prefecture								0.9
	Naqu Prefecture								
	Ali Prefecture								
	Linzhi Prefecture								

	City	2013	2014	2015	2016	2017	2018	2019	2020
	Chongqing	1.5	1.8	1.5	1.4	1.4	1.3	1	1.1
Yunnan	Kunming			1.0	1.0	0.9	1.2		1.2
	Qujing						1.4		
	Yuxi								
	Zhaotong								
	Lijiang								
	Chuxiong Prefecture				0.8	0.9	0.7		
	Honghe Prefecture								
	Diqing Prefecture							0.5	0.6
	Baoshan						0.6		
	Puer								
	Lincang				1.0	0.9			
	Wenshan Prefecture					0.7		0.7	
	Xishuangbanna								
	Dali Prefecture						0.7		
	Dehong Prefecture								
	Nujiang Prefecture								
Guizhou	Guiyang	1.3	1.3	1.1	1.1	1.1	1	0.9	0.9
	Zunyi			1.2	1.2	1.1	1.1	0.9	0.8
	Liupanshui				1.3	1.1	1.2	1.1	1.1
	Bijie				1.6	1.7	1.3	1	0.8
	Anshun				1.1	0.9	1	0.9	1
	Tongren				1.2	1.3	1.4	1.4	1
	Qianxi'nan Prefecture							0.8	0.8
	Qiandongnan Prefecture				1.3	1.2		1	1
	Qiannan Prefecture							0.7	0.9

	City	2013	2014	2015	2016	2017	2018	2019	2020
Gansu	Lanzhou				2.9	2.8	2.7	2.5	2
	Jiayuguan				1	1	1	0.9	0.8
	Jinchang				1.9		0.9	0.9	
	Baiyin				1.4		1.6	1.4	
	Tianshui				2		1.6	1.6	
	Wuwei				2.7	1.8	1.6	1.2	
	Zhangye						1	0.9	
	Pingliang							1	
	Jiuquan					1	1.6	1	
	Qingyang							1.2	
	Dingxi					1.6	1.4	1.2	
	Longnan					2	0.8	1.5	
	Linxia							1.8	
	Gannan				2.2		1.5	1.2	
Qinghai	Xi'ning	1.8	1.3		3.2	2.8	2.8	2.3	2.3
	Haidong Prefecture				2.3	2.5	1.6	1.3	1.4
	Haibei Prefecture				1	0.9	1.1	0.9	0.9
	Huangnan Prefecture				1.6	1.4	1.5	1.4	0.9
	Hainan Prefecture				0.8	1.4	1.3	0.9	0.9
	Guoluo Prefecture				1.2	1.3	1.2	1.3	1.1
	Yushu Prefecture				1.2	1.1	1.1	0.9	1.1
	Haixi Prefecture				1.3	1	1.1	0.9	0.7
Ningxia	Yinchuan	1.2		2.5		2.5	2.1	2	
	Shizuishan						1.2	1.6	
	Wuzhong				1.6		1.2	1	
	Guyuan						2.1	1.4	
	Zhongwei					1.4	1.7	1	

	City	2013	2014	2015	2016	2017	2018	2019	2020
Xinjiang	Urumqi	2	1.4		1.5				
	Karamay								
	Korla								
	Turpan								0.9
	Changli Prefecture					1.1			
	Ili Prefecture					1.8			
	Hami Prefecture								
	Bortala Prefecture								
	Aksu Prefecture								
	Kizilsu Prefecture								
	Kashi Prefecture								
	Hetian Prefecture					1.3			
	Tacheng Prefecture								
	Altay Prefecture								
	Wujiaqu								
	Shihezi								
Shaanxi	Xi'an	4.4	4.3	4.3	3.1	2.8	2.2	1.7	1.5
	Xianyang						2.1	1.6	
	Tongchuan			2.5	2.16	2.2	2	1.7	1.3
	Yan'an							1.9	
	Baoji			2.7	2.2		1.5	1.6	1.2
	Weinan						1.9	1.9	1.7
	Hanzhong					2.4	2.1	2	
	Yulin							1.8	
	Ankang							1.4	
	Shangluo				1.2			1.2	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Heilongjiang	Harbin				2				
	Qiqihar			1.5	1.5	1.5	1.1		
	Daqing			0.6		1.3	1	0.9	
	Mudanjiang								
	Jixi								
	Hegang								
	Shuangyashan				0.81	0.75	0.7	1.4	1
	Yichun								
	Jiamusi								
	Qitaihe								
	Heihe					1			
	Suihua								
	Great Khingan							0.6	
Jilin	Changchun	2.1	1.5	1.8	1.6	1.9	1.3	1.3	1.3
	Jilin			1.9	1.5	1.8	1.5	1.3	1.4
	Siping				1.5	1.8	1.5	1.2	1.3
	Liaoyuan				1.9	1.8	1.6	1.4	1.6
	Tonghua				2.3	2	1.8	1.6	1.6
	Baishan				1.9	1.6	1.6	1.8	2
	Songyuan				1.4	1.6	1.2	1	1.2
	Baicheng				1.1	1.1	1.2	0.9	1
	Yanbian				1.4	1.4	1.2	1	0.9

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Liaoning	Shenyang			1	1.7	1.7	1.8	1.9	1.7
	Dalian					1.4	1.3		1.1
	Anshan			2.7			2.2		2
	Fushun			2.5	2.1				1.5
	Benxi			2.9	2.1	2.3	2.2		
	Jinzhou			2.3		2	1.8		
	Dandong								
	Yingkou			1			1.7		
	Panjin								
	Huludao			1.5			1.7		
	Fuxin				1.2				
	Liaoyang								
	Tieling				1.4	1.2			
	Zhaoyang								1.8

O_3

- The annual mean concentration of O_3 decreased for the first time. In 2020, the overall annual mean concentration of O_3 across the country dropped to 138 μg/m³—a 6.8% decrease—indicating that the continuous upward trend over the years has been curbed for the first time.

- The number of attainment cities has continued to climb since 2019, with an increase of 47 cities on a year-on-year basis. The percentage of attainment cities increased from 69.5% in 2019 to 83.4%.

- The annual mean concentration of O_3 in the key regions witnessed a decrease in varying degrees. In the YRD region, it dropped to 152 μg/m³, which was lower than the standard limit with a year-on-year decrease of 7.3%. In the BTH region and its surrounding areas, it decreased to 180 μg/m³, with a reduction of 8.2%. In the Fenwei Plain, it dropped to 161 μg/m³, with a 5.8% decrease.

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Beijing-Tianjin-Hebei	Beijing	183.4	197.2	202.6	199	193	192	191	174
	Tianjin	151	157		157	192	201	200	190
	Shijiazhuang	191	159	148	164		211		180
	Tangshan	188		182			197	190	182
	Qinhuangdao	164	114	107	149		164	181	166
	Handan	199	147	141			201	201	182
	Baoding	205	177.6	183	174	218	210		178
	Chengde	171	167	178	177	162	174	163	154
	Cangzhou	188	172	169			200	185	
	Hengshui	188	188	183			191	192	180
	Xingtai	190	157	140			203	209	186
	Zhangjiakou	170	133	159			181	162	
	Langfang	159	165	171	182	207	192	196	185
Fen-wei Plains	Lvliang						163	163	152
	Jinzhong				142	190	179	192	176
	Linfen						217	204	184
	Yuncheng						189	181	164
	Sanmenxia				162				
	Luoyang				189	204	175	188	166
	Xi'an	131	131	145	162	185	180	166	159
	Xianyang						198	162	160
	Baoji			132	158		150	138	136
	Tongchuan			132	170	165	168	158	153
	Weinan						170	169	159

Region	City	2013	2014	2015	2016	2017	2018	2019	2020
Yangtze River Delta	Shanghai	163	149	161	164	181	160	151	152
	Jiaxing		109						160
	Shaoxing						156		148
	Zhoushan								136
	Wenzhou		134			145	141	136	140
	Jinhua						152	86	132
	Quzhou							140	140
	Taizhou							125	139
	Lishui	143	111				135		124
	Nanjing								
	Suzhou				167	173	173	166	163
	Wuxi				186	184	179	180	171
	Changzhou					170	191		
	Yangzhou			175			109	108	176
	Zhenjiang				96	108	109	107	164
	Nantong							157	148
	Taizhou								
	Xuzhou					114	111	107	161
	Lianyungang		145		158	153		167	163
	Huai'an		106	105	101		104.9	165	154
	Yancheng						166		159
	Suqian							180	170
	Hangzhou			167					151
	Ningbo								146
	Huzhou			106					160

National Standard 160 μg/m³ — Min 71 — Max 218

Figure 15: Annual Mean Concentrations of O_3 in 337 Cities in 2013-2020

North China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Inner Mongolia	Hohhot						150	146	141
	Chifeng			61			86	127	130
	Baotou						156	143	134
	Erdos			101	105		163	155	145
	Ulanqab						155	152	136
	Xilingol						141	122	112
	Wuhai				140		165	153	146
	Hulun Buir						112	108	104
	Tongliao						148	132	132
	Bayannur						152	143	134
	Hinggan League						118	113	112
	Alxa League						163	146	136
Henan	Zhengzhou				177		194	194	182
	Pingdingshan				165				160
	Sanmenxia				162				
	Luoyang				189	204	175	188	166
	Anyang				154				
	Kaifeng				152				
	Jiaozuo			150	166				
	Xuchang				158				158
	Nanyang				171			181	
	Xinyang				148				
	Zhoukou				158				
	Hebi				154		199	198	177
	Xinxiang				175	209	202	178	
	Puyang				176		117		104
	Luohe				161		111	110	101
	Shangqiu				158				
	Zhumadian				159	108			

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shanxi	Taiyuan	147.9	125		140		191	186	186
	Datong						153	147	150
	Changzhi					188	189	187	170
	Linfen						217	204	184
	Yangquan						184	187	176
	Jincheng					218	214	201	176
	Shuozhou						152	192	150
	Jinzhong				142	190	179	192	176
	Yuncheng						189	181	164
	Xinzhou				138		166	171	170
	Lvliang						163	163	152

East China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Ji'nan						202	203	184
	Qingdao				147	172	154	147	145
	Zibo					193	201	204	188
	Zaozhuang						115		
	Yantai			148	142	164	157		152
	Weifang						179.1	180	168
	Ji'ning								
	Tai'an								
	Rizhao								
	Dongying						198		177
	Liaocheng						212	114	
	Binzhou								192
	Heze								
	Weihai				137			160	142

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Shandong	Linyi					184	185	187	
	Dezhou							201	179
Fujian	Fuzhou				114		151	138	128
	Xiamen		128	95	103		127	136	126
	Quanzhou				109		150		136
	Putian				129		156	138	140
	Sanming				106		124		114
	Zhangzhou				114		155		138
	Nanping				112		128		118
	Longyan				125		129		114
	Ningde				120	124	148	123	137
Anhui	Hefei					170	168	167	144
	Wuhu							196	140
	Maanshan				158		183	178	148
	Bengbu						167.7		
	Huai'nan					109	167	173	160
	Huaibei					184	183	185	
	Tongling				81		89	92	84
	Anqing				130	136	163	106	145
	Huangshan				72		95	140	130
	Chuzhou					115	113	106	153
	Fuyang						104	110	99
	Suzhou						171.6		
	Lu'an				146	156	166	145	154
	Bozhou						170.3		166
	Chizhou				130	138	158		
	Xuancheng					142	137	134	137

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Jiangxi	Nanchang				138	146	144		
	Jiujiang						153		
	Jingdezhen						118.8		
	Pingxiang						140		
	Xinyu						124	144	
	Yingtan				139	151	154	172	
	Ganzhou				128		153	170	
	Ji'an						136		
	Yichun						122.4	154	135
	Fuzhou						127.9		
	Shangrao						120.7		

South China

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Hubei	Wuhan				160	151		183	150
	Yichang			122	126	137	143	162	135
	Jingzhou				156	140	157	158	137
	Huangshi				158	145	164	167	150
	Ezhou				156	139	165	162	150
	Xiaogan				160	158	158	171	142
	Huanggang				176	159	175	167	149
	Xianning				158	156	163	170	142
	Shiyan				122	130	145	140	135
	Xiangyang				152	152	155	162	142
	Jingmen				130	145	154	161	141
	Suizhou				152	148	156	160	142
	Enshi Prefecture				94	121	96	126	110

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Hunan	Changsha				150	153	161	171	
	Yueyang				158	142	155	164	134
	Changde				136	147	151	160	132
	Zhangjiajie				124	129	130	122	
	Zhuzhou				142	142	148	162	142
	Xiangtan				142	142	153	168	
	Hengyang				132	141	130	145	
	Shaoyang				137	138	134	147	
	Yiyang				150	143	140	151	
	Chenzhou				126	140	137	140	
	Yongzhou				124	129	138	143	
	Huaihua				122	122	121	119	
	Loudi				139	134	143	150	
	Xiangxi Prefecture				120	110	104	115	
Guangxi	Nanning	125	126		114		128	138	118
	Guilin			138	135	139	136	149	
	Beihai								120
	Liuzhou				123	127	127	145	115
	Wuzhou					119			
	Fangchenggang						126		
	Qinzhou								
	Guigang								
	Yulin								
	Baise								
	Hezhou							82	
	Hechi				119	110			
	Laibin								
	Chongzuo							131	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Guangdong	Shaoguan							145	
	Shantou			141	132	140	152		
	Zhanjiang			137	138		150		
	Maoming								
	Meizhou			118	111	120	123	131	118
	Shanwei							143	136
	Heyuan			134	124				
	Yangjiang								130
	Qingyuan				144	128	127	152	
	Chaozhou			163.2					
	Jieyang			136	130	146		147	
	Yunfu						134	138	
	Guangzhou				155	162	174	178	160
	Shenzhen				135		137	156	126
	Zhuhai			142	144		162	167	142
	Foshan	169	167	140	160	174	172	185	154
	Jiangmen	164		146	162	193	184	198	173
	Dongguan		187	172	166	170	171	191	155
	Zhongshan	167	152		153	181	165	197	154
	Huizhou								
	Zhaoqing			147	150	143	145	163	128
Hainan	Haikou			103	107	127	116	144	120
	Sanya			113		110		188	99

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Sichuan	Chengdu	157	148	183	168	171	167	160	169
Sichuan	Mianyang			137	136	134	151.6	137	150
Sichuan	Yibin			72			92	83	151
Sichuan	Panzhihua			118	112	119	140	140	128
Sichuan	Luzhou			121	154	147	149	147	142
Sichuan	Zigong			119	116	150	171.6		152
Sichuan	Deyang			156	140	130	158		158
Sichuan	Nanchong						151		
Sichuan	Suining				150		147	135.2	132
Sichuan	Neijiang				157		152	140	142
Sichuan	Leshan				143	129.4	128.6	121.4	
Sichuan	Meishan						155		
Sichuan	Guang'an				147	142	144		
Sichuan	Dazhou				114	123	143		
Sichuan	Ziyang				157	150	157.6		148
Sichuan	Guangyuan				134	120.6	126	101	
Sichuan	Ya'an				119	132	124		132
Sichuan	Bazhong					115	106.6	160	
Sichuan	Aba Prefecture					125	118.8	106	
Sichuan	Ganzi Prefecture						126		
Sichuan	Liangshan Prefecture					108	137		
Tibet	Lhasa			142	151				
Tibet	Changdu Prefecture								
Tibet	Shannan Prefecture								
Tibet	Shigatse Prefecture								136
Tibet	Naqu Prefecture								
Tibet	Ali Prefecture								
Tibet	Linzhi Prefecture								

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
	Chongqing	162	146	127	141	163	166	157	150
Yunnan	Kunming			79	82		130	134	
Yunnan	Qujing						128		128
Yunnan	Yuxi								
Yunnan	Zhaotong								
Yunnan	Lijiang								
Yunnan	Chuxiong Prefecture				76		81		
Yunnan	Honghe Prefecture								
Yunnan	Diqing Prefecture								
Yunnan	Baoshan						91	88	81
Yunnan	Puer								
Yunnan	Lincang				72				
Yunnan	Wenshan Prefecture					118			
Yunnan	Xishuangbanna							82	
Yunnan	Dali Prefecture						92		
Yunnan	Dehong Prefecture								
Yunnan	Nujiang Prefecture								
Guizhou	Guiyang	109	103	120	130	121	118	125	113
Guizhou	Zunyi			108	114	109	124	125	118
Guizhou	Liupanshui				96	114	109	110	102
Guizhou	Bijie				114	120	124	124	124
Guizhou	Anshun				116	122	125	118	120
Guizhou	Tongren				71		108	121	94
Guizhou	Qianxi'nan Prefecture							116	114
Guizhou	Qiandongnan Prefecture				104	83		106	102
Guizhou	Qiannan Prefecture							115	102

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Gansu	Lanzhou				144	161	168	151	150
	Jiayuguan				138	148	140	138	122
	Jinchang				128		146	134	
	Baiyin				112		133	119	
	Tianshui				134		134	127	
	Wuwei				140	138	143	134	
	Zhangye						143	138	
	Pingliang							130	
	Jiuquan					144	148.4	134	
	Qingyang							132	
	Dingxi					144	134	129	
	Longnan					119	86	120	
	Linxia Prefecture							126	
	Gannan				146		136	121	
Qinghai	Xi'ning				128	136	138	129	130
	Haidong Prefecture				130	142	153	138	136
	Haibei Prefecture				154	136	144	131	130
	Huangnan Prefecture				132	124	118	107	119
	Hainan Prefecture				149	130	120	144	130
	Guoluo Prefecture				132	140	142	139	121
	Yushu Prefecture				87	131	118	115	98
	Haixi Prefecture				110	128	126	153	130
Ningxia	Yinchuan			125		169	166	147	
	Shizuishan						144	150	
	Wuzhong				130		147	145	
	Guyuan						166	128	
	Zhongwei					157	157	140	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Xinjiang	Urumqi	116							
	Karamay								
	Korla								
	Turpan								
	Changli Prefecture								
	Ili Prefecture								
	Hami Prefecture								
	Bortala Prefecture								
	Aksu Prefecture								
	Kizilsu Prefecture								
	Kashi Prefecture								
	Hetian Prefecture								
	Tacheng Prefecture								
	Altay Prefecture								
	Wujiaqu								
	Shihezi								
Shaanxi	Xi'an	131	131	145	162	185	180	166	159
	Xianyang						198	162	160
	Tongchuan			132	170	165	168	158	153
	Yan'an							143	
	Baoji			132	158		150	138	136
	Weinan						170	169	159
	Hanzhong					145	137	121	
	Yulin							159	
	Ankang							122	
	Shangluo				98			139	

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Heilongjiang	Harbin		198		106				
	Qiqihar			108	98	111	121		
	Daqing					126	127	118	
	Mudanjiang								
	Jixi								
	Hegang								
	Shuangyashan				54		79	102	103
	Yichun								
	Jiamusi						161		
	Qitaihe								
	Heihe					100			
	Suihua								
	Great Khingan							98	
Jilin	Changchun	127	132	151	141	142	133	134	126
	Jilin			154	151	147	149	135	132
	Siping				130	142	159	150	141
	Liaoyuan				157	141	154	152	141
	Tonghua				129	120	140	104	114
	Baishan				136	126	134	128	118
	Songyuan				154	144	136	121	117
	Baicheng				119	123	135	120	112
	Yanbian				115	126	130	115	107

Province	City	2013	2014	2015	2016	2017	2018	2019	2020
Liaoning	Shenyang			155	162	166	163	155	154
	Dalian				155	163	157		144
	Anshan								
	Fushun			149	162				148
	Benxi			136	137	116	137		
	Jinzhou			165	180	172	151		
	Dandong								
	Yingkou			111			186		
	Panjin								
	Huludao						137.2		
	Fuxin								
	Liaoyang								
	Tieling				160	159			
	Zhaoyang								153

$PM_{2.5}$

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
North China	Inner Mongolia				35	32	31	27	27
	Shanxi		64	56	60	59	55	48	44
	Tianjin	96	83	70	69	62	52	51	48
	Hebei	108	95	77	70	65	56	50.2	44.8
	Henan				73	62	61	59	52
	Beijing	89.5	85.9	80.6	73	58	51	42	38
East China	Fujian				26	27	22	21	18
	Zhejiang	61	53	43	37	35	33	31	25
	Shanghai	62	52	53	45	39	36	35	32
	Jiangxi			45	45	46	38	35	30
	Jiangsu	73	66	58	51	49	48	43	38
	Anhui			55	53	56	49	46	39
	Shandong	98	82	76	66	57	49	50	46
South China	Hainan			20	18	18	17	16	13
	Guangdong		41	34	32	33	31	27	22
	Guangxi			41	37	38	35	34	26
	Hunan				48	46	41	41	35
	Hubei			65	54	49	44	42	35

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
Northeast China	Heilongjiang				34	36	28	28	28
	Jilin			55	43	40	32	32	31
	Liaoning		58	55	46	44	38	40	38
Northwest China	Qinghai				35	30	29	22	21
	Gansu				39	37	34	26	26
	Ningxia		49	47	46	42	35	29	33
	Xinjiang			53	62	55	41	47	47
	Shaanxi		67	59	62	57	51	48	43
Southwest China	Yunnan			28	26	24	25	22	21
	Guizhou			32	32	29	28	24	22
	Sichuan			47	47	42	38.6	34.4	31
	Chongqing	70	65	57	54	45	40	38	33
	Tibet								

National Standard 35 μg/m³ — Min 16 — Max 108

Figure 16: Annual Mean Concentrations of $PM_{2.5}$ in Provinces, Autonomous Regions, and Municipalities in 2013-2020

PM_{10}

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
North China	Inner Mongolia				77	74	80	61	53
	Beijing	108.1	115.8	101.5	92	84	78	68	56
	Tianjin	150	133	116	103	94	82	76	68
	Shanxi		114	98	109	109	107	93	83
	Hebei	190	165	136	123	117	104	93	79
	Henan				128	106	103	96	83
East China	Fujian				46	47	42	39	34
	Shanghai	82	71	69	59	55	51	45	41
	Zhejiang	91	78	68	60	57	56	53	45
	Jiangxi	77	75.8	68	72	73	64	59	51
	Anhui		95	80	77	88	76	72	61
	Jiangsu	115	106	96	86	81	76	70	59
	Shandong	170	142	131	120	106	97	94	80
South China	Hainan		38	35	31	29	30	28	25
	Guangdong	60	60	51	48	51	49	46	38
	Guangxi	62	69	61	56	58	57	56	45
	Hunan				76	74	66	61	50
	Hubei		103	99	85	77	72	70	57

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
Northeast China	Heilongjiang				56	61	52	49	46
	Jilin	78	80	88	71	67	57	56	52
	Liaoning	86	99	93	79	77	69	70	64
Northwest China	Qinghai		106		79	67	59	42	42
	Gansu			95	90	93	77	58	56
	Ningxia		105	106	103	106	82	66	65
	Shaanxi		128	109	112	103	104	81	72
	Xinjiang	137	144	129	141	121	99	126	121
Southwest China	Yunnan		48	45	43	44	46	38	32
	Guizhou			55	53	50	49	38	33
	Sichuan	85	80	76	75	67.7	62.6	52.9	49
	Chongqing	106	98	87	77	72	64	60	53
	Tibet								

National Standard 70 μg/m³

Min 28 Max 190

Figure 17: Annual Mean Concentrations of PM_{10} in Provinces, Autonomous Regions, and Municipalities in 2013-2020

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
North China	Beijing	26.5	21.8	13.5	10	8	6	4	4
	Tianjin	59	49	29	21	16	12	11	8
	Henan				33		16	11	
	Hebei	74	55	41	34	27	20	15	13
	Shanxi		65	61	60	56	33	24	19
	Inner Mongolia				23	21	17	15	14
East China	Zhejiang	26	21	14	11	9	9	7	6
	Fujian				12	10	9	8	6
	Shanghai	24	18	17	15	12	10	7	6
	Jiangsu	35	29	25	21	16	12	9	8
	Anhui		26	22	21	17	13	10	8
	Jiangxi	34	31	27	24	23	17	13	13
	Shandong	71	59	45	35	24	16	14	12
South China	Hainan		5	5	5	5	5	5	5
	Guangdong	19	18	13	12	11	10	9	8
	Hubei			18	14	13	11	9	8
	Guangxi	25	21	18	15	14	13	12	10
	Hunan				20	14	12	9	8

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
Northeast China	Heilongjiang				18	15	12	11	11
	Jilin	32	31	27	23	20	14	11	12
	Liaoning	42	46	40	34	28	23	19	16
Northwest China	Xinjiang	18	16	16	14	13	11	9	8
	Qinghai		29		20	20	17	13	13
	Shaanxi		32	28	23	20	16	12	10
	Gansu			31	26	21	18	14	12
	Ningxia		47	42		33	22	17	
Southwest China	Chongqing	32	24	16	13	12	9	7	8
	Yunnan		25	15	14	12	11	9	8
	Guizhou			19	15	13	12	10	10
	Sichuan	34	25	18	17	13.9	12.2	9.4	8
	Tibet								

National Standard 60 µg/m^3 — Min 4 — Max 74

Figure 18: Annual Mean Concentrations of SO_2 in Provinces, Autonomous Regions, and Municipalities in 2013-2020

NO_2

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
North China	Henan				42		39		
	Beijing	56	56.7	50	48	46	42	37	29
	Tianjin	54	54	42	48	50	47	42	39
	Hebei	51	48	46	49	47	43	39	34
	Shanxi		35	34	37	42	40	39	35
	Inner Mongolia				25	26	23	23	21
East China	Fujian				19	26	17	15	13
	Jiangxi	30	27	25	25	26	25	24	22
	Zhejiang	42	39	28	26	27	32	31	29
	Jiangsu	41	39	37	37	39	38	34	30
	Shandong	48	46	41	38	37	36	35	32
	Anhui		30	31	38	38	35	31	29
	Shanghai	48	45	46	43	44	42	42	37
South China	Hainan		10	9	9	9	8	8	7
	Guangxi	24	24	21	21	23	22	22	18
	Hubei			28	26	28	28	26	22
	Hunan				26	26	26	25	21
	Guangdong	30	30	27	27	29	28	26	21

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
Northeast China	Heilongjiang				23	23	21	19	18
	Jilin	33	30	31	28	28	24	23	22
	Liaoning	32	36	33	31	31	30	28	27
Northwest China	Qinghai		24		21	22	21	20	19
	Xinjiang	35	36	28	29	31	27	27	24
	Gansu			31	30	29	27	25	24
	Shaanxi		39	36	38	42	40	36	31
	Ningxia		29	27		32	29	30	
Southwest China	Yunnan		15	17	17	19	18	16	15
	Guizhou			21	22	21	20	18	15
	Sichuan	36	32	30	30	31.5	30.1	27.8	25
	Chongqing	38	39	45	46	46	44	40	39
	Tibet								

National Standard
40 µg/m³

Min 8 Max 56.7

Figure 19: Annual Mean Concentrations of NO_2 in Provinces, Autonomous Regions, and Municipalities in 2013-2020

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
North China	Tianjin	3.7	2.9	3.1	2.7	2.8	1.9	1.8	
	Beijing	3.4	3.2	3.6	3.2	2.1	1.7	1.4	
	Hebei	4.3	3.6	3.7	3.3	2.9	2.3		1.8
	Shanxi			3.5		3	2.5	2.2	1.9
	Henan						2.1		
	Inner Mongolia					1.6			1.3
East China	Shanghai	0.85	0.77	0.86	0.79	0.76	0.67	0.66	
	Fujian				1.1	1.1	1	1	0.9
	Zhejiang		1.4	1.4	1.2	1.1	1.2	1	0.9
	Anhui			1.8	1.6	1.4	1.4	1.2	1.1
	Jiangxi			1.5	1.6	1.4	1.4	1.4	1.2
	Jiangsu	2.1	1.7	1.7	1.7	1.5	1.4	1.2	1.1
	Shandong							1.5	1.4
South China	Hainan			1.1	1.1	1	0.9	0.8	0.8
	Guangdong		1.7	1.4	1.3	1.2	1.1	1.2	1
	Guangxi			1.8	1.4	1.4	1.4	1.4	1.1
	Hunan				1.6	1.6	1.5	1.4	1.2
	Hubei			1.9	1.8	1.7	1.6	1.4	1.3

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
Northeast China	Heilongjiang				1.5	1.4	1.2	1.1	1.1
	Jilin			1.9	1.6	1.7	1.4	1.3	1.4
	Liaoning				2	1.8	1.7	1.7	1.6
Northwest China	Qinghai				1.76	1.6	1.5	1.2	1.2
	Gansu				1.9	1.6	1.5	1.3	1.1
	Shaanxi			3	2.7	2.3	2	1.8	1.5
	Ningxia		2	1.8		1.8	1.5	1.4	
	Xinjiang					2.4	1.1	0.9	0.8
Southwest China	Guizhou			1.3	1.2	1.2	1.1	1	0.9
	Chongqing	1.5	1.8	1.5	1.4	1.4	1.3	1.2	
	Sichuan			1.5	1.5	1.4	1.3	1.1	1.1
	Tibet								
	Yunnan							1	1

National Standard 4 mg/m^3

Min 0.66 — Max 4.3

Figure 20: Annual Mean Concentrations of CO in Provinces, Autonomous Regions, and Municipalities in 2013-2020

O_3

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
North China	Tianjin	151	157	142	157	193	201	200	190
	Beijing	183.4	197.2	202.6	160	192	192	191	174
	Hebei	183	159	160	171	193	193		174
	Shanxi			134		186	182	180	169
	Inner Mongolia					143	146		130
	Henan								
East China	Fujian				109	137	125	117	109
	Zhejiang		153	135	132	135	159	154	145
	Jiangxi			119	132	141	145	151	138
	Anhui			106	140	160	166	165	148
	Shanghai	163	149	161	164	181	160	151	152
	Jiangsu	139	154	167	165	177	177	173	164
	Shandong							186	172
South China	Hainan			118	105	107	107	118	105
	Guangxi			122	120	128	128	140	117
	Hunan				136	137	140	148	126
	Guangdong		148	138	138	153	154	158	138
	Hubei			146	139	139	154	158	139

Region	Province	2013	2014	2015	2016	2017	2018	2019	2020
Northeast China	Heilongjiang				98	106	120	103	107
	Jilin			136	137	135	141	129	123
	Liaoning				155	157	157	151	146
Northwest China	Qinghai				128	133	132	135	124
	Gansu			129	133	140	139	131	126
	Shaanxi			143	158	166	164	151	145
	Ningxia		139	135		154	151	142	
	Xinjiang					124	89	87	87
Southwest China	Guizhou			106	108	108	116	118	110
	Sichuan			131	132	140.5	144.4	134.1	135
	Chongqing	162	146	127	141	163	166	157	150
	Tibet								
	Yunnan							127	120

National Standard 160 μg/m^3 | Min 87 | Max 202.6

Figure 21: Annual Mean Concentrations of O_3 in Provinces, Autonomous Regions, and Municipalities in 2013-2020

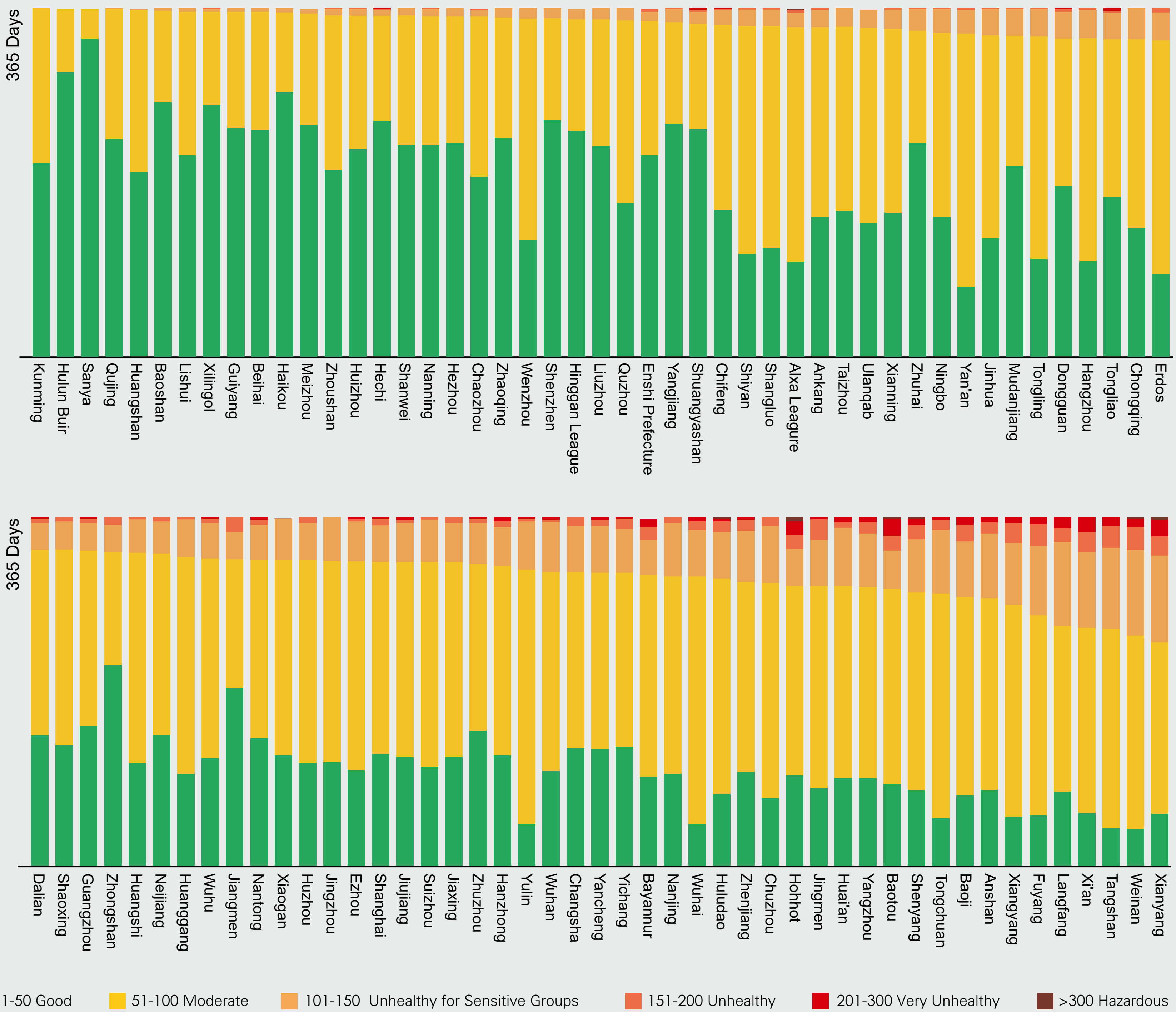

Figure 22: Distribution of AQI for some cities in 2020

On the whole, air quality in Chinese cities in 2020 had the following characteristics.

Overall air quality improved, and the country met the standards for the annual mean concentration of six criteria pollutants.

In 2020, overall air quality in 337 cities in China continued to follow the improvement trend from previous years. The improvement was also more considerable than in 2019. The annual mean concentration of all six pollutants decreased on a year-on-year basis. Among the six pollutants, the annual mean concentration of $PM_{2.5}$ reached the standard, and the annual mean concentration of O_3 witnessed a decrease—both for the first time this year. The years-long deterioration trend of ozone was also reversed, as shown in Figure 23.

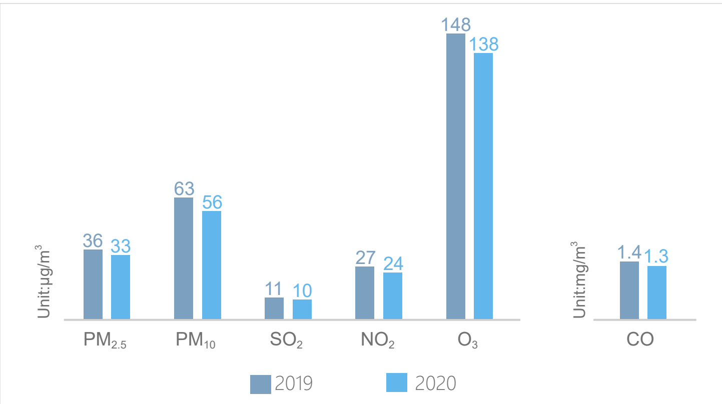

Figure 23: Annual Mean Concentration of Six Pollutants for the Country as a Whole in 2019 and 2020

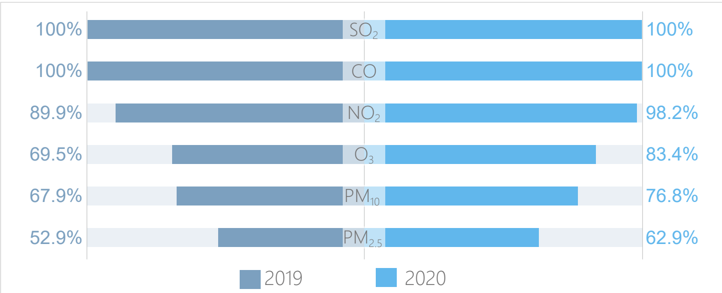

Figure 24: Percentage of Attainment Cities for Six Pollutants in 2019 and 2020

In terms of the percentage of attainment cities for each pollutant, all cities reached the standards for both SO_2 and CO. The proportion of attainment cities for NO_2 increased to 98.2%, with only six failing to achieve the standard. The attainment cities for O_3, PM_{10}, and $PM_{2.5}$ increased to 83.4%, 76.8%, and 62.9% respectively, with an increase of 30 to 47 cities on a year-on-year basis, as shown in Figure 24.

In 2020, a main reason for the significant improvement in air quality was the COVID-19 outbreak. As the government launched a series of policies to suspend production and restrict travel, air pollution in the first quarter was mitigated in varying degrees. From January to March, the year-on-year decrease of the concentrations of $PM_{2.5}$, PM_{10}, SO_2, and NO_2 in 337 cities at the prefecture level or above in China registered 14.8%, 20.5%, 21.4%, and 25% respectively. These percentages were far higher than the annual decrease values. This impact was especially prominent in the first month after the outbreak of the epidemic, see Special Column II. However, due to a complicated generation mechanism, the annual mean concentration of O_3 remained at the same level as in the first quarter of 2019, without registering a year-on-year improvement.

The deteriorating trend of O_3 pollution was reversed. There was an overall decrease in ozone concentrations across China for the first time.

Since data on O_3 was released in China in 2013, O_3 pollution had been in constant deterioration until the end of 2019. The annual mean concentration of O_3 showed a year-by-year growth trend in the

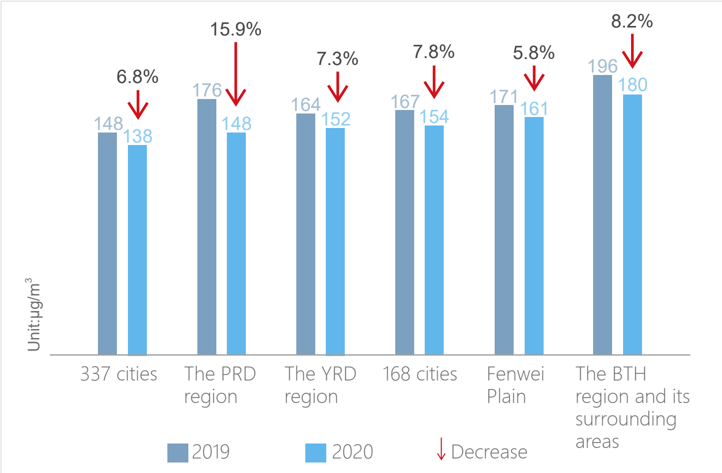

Figure 25: Average Annual Mean Concentrations of O_3 of 337cities, 168 key Cities and Key Regions in 2019 and 2020

Special Column II: Impact of the COVID-19 outbreak on air quality

Due to the COVID-19 outbreak, pollutant emissions in the first quarter of 2020 were obviously lower than those in the corresponding period in previous years. In February, the emissions of SO_2, NOx, CO, NMVOCs, and primary $PM_{2.5}$ decreased by 27%, 36%, 28%, 31%, and 24% respectively compared to February 2019 (Zheng et al., 2021).

In terms of traffic sources, the tightened pandemic prevention and control measures and the reduction of human activities resulted in the sharp decrease of pollutant emissions. In Beijing and Chengdu, the decrease of vehicle emissions at the Level I epidemic control stage was as high as about 60%. In Chengdu, after the Level I control measures were lifted in late February and despite the rapid rebound of traffic emissions during rush hour, emissions during off-peak hours in the daytime and nighttime were still over 30% lower than pre-pandemic levels. (Wang et al., 2020).

In the first month after the outbreak, from late January to late February 2020, the annual mean concentrations of $PM_{2.5}$, PM_{10}, SO_2, CO, and NO_2 across the country dropped by 27%, 36%, 52%, 27%, and 40% respectively compared to the historical mean values, but the annual mean concentration of O_3 increased by 15%. In Wuhan, the annual mean concentrations of PM and NO_2 decreased by more than 50%, while O_3 rose by 30%. The provinces that witnessed significant changes in air quality were mostly regions heavily hit by the COVID-19 pandemic. For example, Zhejiang, Jiangxi, Hubai, and Hunan witnessed a decrease of more than 45% in the concentration of $PM_{2.5}$ in the first month after the outbreak. The concentration of SO_2 also dropped significantly in Beijing, Tianjin, and Henan. All provinces experienced declines in NOx concentration, which tends to be influenced by traffic and industrial emission sources. The lowest decrease was 18%, while 78% of the provinces reduced emissions by over 30% (Wang et al., 2020). According to the estimation of the National Joint Research Center for Tackling Key Problems in Air Pollution Control, the annual mean concentration of $PM_{2.5}$ decreased by 2 μg/m^3 and the percentage of attainment days increased by 2.2% as a result of the COVID-19 pandemic (MEE, 2021).

whole country, especially in the key regions where pollution was more problematic. However, in 2020, the annual mean concentration of O_3 across the country, especially in the key regions, witnessed an overall decrease for the first time. The decrease range in the three key regions dropped by 5.8%–8.2%, with the annual mean concentration of O_3 in the YRD region lower than the standard. PRD also saw an apparent improvement in ozone pollution, with a decrease as high as 15.9% and the annual mean concentration of O_3 falling below the standard limit, as shown in Figure 25.

At the same time, the proportion of attainment cities for ozone further increased to 83.4% based on the first rise in 2019, thus increasing the number by 47 on a year-on-year basis.

Air quality in the Fenwei Plain improved noticeably, with the most significant improvement in the key regions.

In the “Three-Year Action Plan” released in 2018, the Fenwei Plain was designated as a new key region. However, the annual mean concentration of $PM_{2.5}$ in the Fenwei Plain rose instead of dropping in 2019, with the proportion of heavy pollution days increasing from 5.3% in 2018 to 5.9%, higher than 5.5% in the BTH region and its surrounding areas.

In 2020, the Fenwei Plain did not fall behind in the air quality improvement trend in the whole country. Instead, the annual mean concentration of the six criteria pollutants decreased that year, with the annual mean concentration of $PM_{2.5}$ falling to 48 μg/m³—an improvement by 12.7% on a year-on-year basis. The proportion of heavy pollution days dropped from 5.9% in 2019 to 2.8%. The decrease in heavy pollution days represented the best performance in the key regions, as shown in Figure 26.

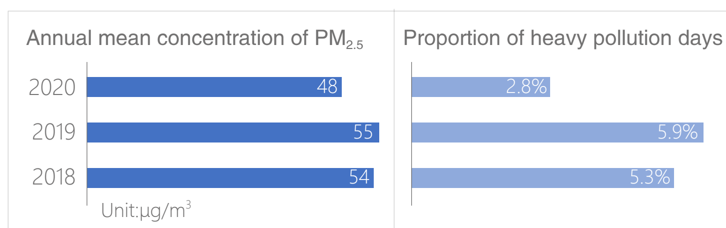

Figure 26: Annual mean concentration of $PM_{2.5}$ and proportion of heavy pollution days of the Fenwei Plain

Both the annual mean concentration of $PM_{2.5}$ and the number of attainment days improved year-on-year in 95% of the key cities.

In 2019, air quality improvement in 168 key cities was not encouraging. Specifically, in more than 30 cities, the annual mean concentration of $PM_{2.5}$ rebounded rather than dropping. The number of attainment days in more than 60 cities also decreased year-on-year. In 2020, the number of cities where the annual mean concentration of $PM_{2.5}$ decreased or where the number of attainment days rose both increased significantly, recording their best performance since the "Three-Year Action Plan" was implemented.

Among the 168 cities, the annual mean concentration of $PM_{2.5}$ decreased year-on-year in 161 cities. The decrease in all nine cities of the PRD region was higher than 20%, and Zhaoqing had the most significant improvement (28.13%) among the key cities. The number of attainment days of 159 cities increased year-on-year. Among the cities, 17 cities in Henan Province performed the best overall, with the attainment days increasing by an average of 52. Pingdingshan had the most significant increase with 77 attainment days, as shown in Figure 27.

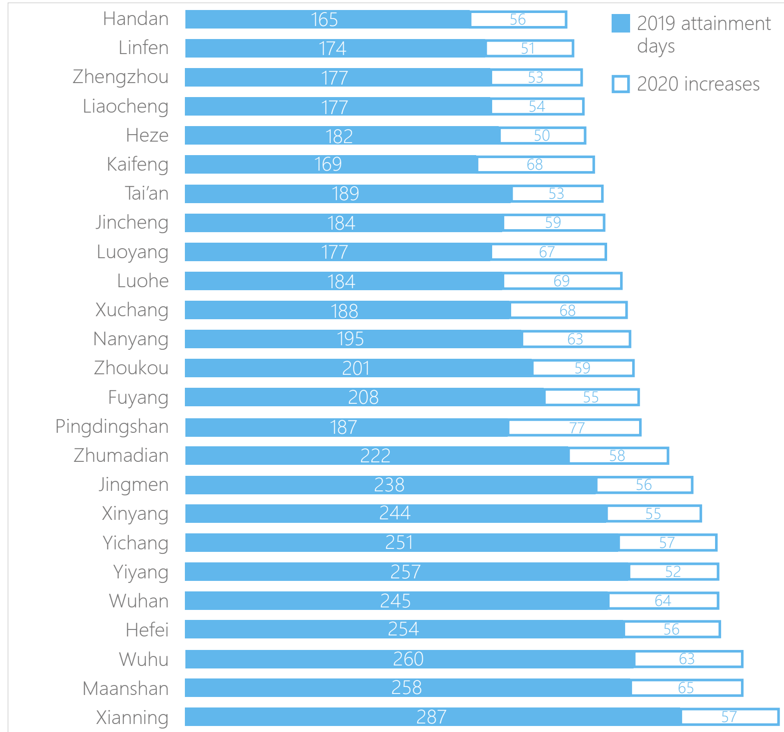

Figure 27: Cities with a SigniÞcant Increase in Attainment Days in 2020

Chapter II.

The Implementation and Progress of Policies

China continued to implement a series of policy measures on air pollution prevention and control in 2020. These included further strengthening scientific and technological support through the construction of grid monitoring, inventory compilation, source apportionment, and other similar projects; upgrading pollution prevention and control measures in key industries; governing “scattered, unregulated, and high-polluting” enterprises; and optimizing energy, industry, and transportation structures. In September 2020, during the 75th Session of the United Nations General Assembly, President Xi Jinping announced that China will strive to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060. These plans were to be set in motion within the 14th Five-Year Plan period and over the medium and long term in the future. However, based on the progress of policy implementation in 2020, preventing and controlling air pollution in China remains challenging. There is still heavy dependence on coal as an energy source and on heavy industry in key regions, missing the targets for structural adjustment. The country still has a long way to go in further improving air quality within the period of the plan.

Major Milestones for Air Pollution Prevention and Control in 2020

1 Jan.

2 Feb.

◆ February 3: Seven ministries and commissions, including the Ministry of Transport (MOT), jointly released the "Guiding Opinions on Vigorously Promoting the High-Quality Development of the Shipping Industry," which outlines the green and low-carbon development direction for the sea transportation industry. The aim is to optimize energy utilization structure and strengthen the prevention and control of vessel pollution.

3 Mar.

◆ March 11: MEE released "Several Opinions on Promoting the Modernization of the Ecological Environment Monitoring System and Monitoring Ability (Exposure Draft)." The goal is to further optimize the "One Network" of ecological environment monitoring, clarify the responsibilities of monitoring institutions for data quality, and require pollutant discharging units to carry out self-monitoring.

4 Apr.

◆ April 2: The National Development and Reform Commission (NDRC) issued the Integrated Development Plan for Higher Quality Transportation in the YRD Region. The aim is to form a modern integrated transportation system that features regional integration, thus enhancing intelligent and green safety development levels and lowering traffic pollution.

◆ April 8: The "Notice on the Establishment and Implementation of Vehicle Emission Inspection and Maintenance System (Exposure Draft)," which was jointly drafted by three ministries including MEE, was intended to enhance the qualification rate of automobiles in terms of emissions inspection and push the maintenance and scrapping of vehicles that exceed pollution standards, thus ensuring road safety and reducing traffic pollution.

◆ April 10: NDRC and NEA officially released the "Energy Law of the People's Republic of China (Exposure Draft)," which filled the gap in China's fundamental laws for energy. The document aims to promote energy revolution; create a safe, clean, and efficient low-carbon energy system; and coordinate the reduction of pollutants and greenhouse gas emissions.

◆ April 27: A company in Huzhou City, Zhejiang Province, was the first case of a penalty involving ozone-depleting substance pollution in China. Over recent years, MEE has sustainably conducted an ozone-depleting substance special enforcement action to maintain the achievements made from adopting the "Montreal Protocol" in protecting global ozone layers.

5 May

◆ May 1: The "Regulations on the Prevention and Control of Emission Pollution from Motor Vehicles and Nonroad Mobile Machinery" were implemented simultaneously in Beijing, Tianjin, and Hebei. According to the unified planning, standards, monitoring, and prevention and control measures, regional coordination in legislation on the control of NOx pollution from mobile sources was achieved for the first time.

◆ May 18: NEA released the "Guidance on Establishing and Improving a Long-Term Mechanism for Clean Energy Consumption (Exposure Draft)," which clarifies the rates of clean energy utilization for all provinces to promote the high-quality development of clean energy.

◆ May 29: MOT released the "Outline of Inland Water Transportation Development," further promoting the high-quality development of "road-to-waterway" transport to increase the proportion of vessels using new energy and clean energy as fuel.

6 Jun.

◆ June 21: The "Outline for Ecological Environment Monitoring Plan (2020–2035)" set up three targets in different phases. The goal is to comprehensively deepen the reform and innovation of the ecological environment monitoring system and further perfect monitoring networks for traffic and industrial pollution sources.

◆ June 29: The "Technical Guidelines for Formulating Emergency Response Measures for Emission Reduction for Key Industries in Heavy Pollution Days (Revised in 2020)" were released, aiming to expand the scope of the key industries graded per performance and perfect relevant indexes and emission reduction measures.

Figure 28: Major Milestones for Air Pollution Prevention and Control in 2020

◆ August 25: MEE issued the "Interview Measures of the Ministry of Ecology and Environment," which specifies the occasions and objects of relevant interviews to assist in the prevention and control of environmental pollution and addressing climate change.

◆ October 21: MEE issued the "Guidance on Promoting Investment and Financing to Address Climate Change." The aims are to create a favorable policy environment and promote coordination in policies addressing climate change and of industry, energy, and environment, among other sectors.

◆ October 30: "The 2020–2021 Action Plan on Integrated Air Pollution Prevention and Control for the BTH Region and Its Surrounding Areas and the Fenwei Plain in Autumn and Winter" and "The 2020–2021 Action Plan on Integrated Air Pollution Prevention and Control for the YRD Region in Autumn and Winter" were released.

◆ November 2: The General Office of the State Council issued the "New Energy Automobile Industry Development Plan (2020–2035)," setting the goals for 2025 and 2035 respectively to promote the competitiveness of the new energy automobile industry in China. The goal is to help the industry reach the international level and make breakthroughs in key technologies.

◆ November 5: MEE issued the "Regulation of National Carbon Emissions Trading (for Trial Implementation) (Exposure Draft)" and the "Regulation of the Registration, Trading, and Settlement of Carbon Emission Permits (Trial) (Exposure Draft)." These regulations expressly set the quotas for carbon emissions and the trading management system to assist the official launching of the national carbon trading market in 2021.

7 Jul. | 8 Aug. | 9 Sep. | 10 Oct. | 11 Nov. | 12 Dec.

◆ December 10: The "Regulations of Pollutant Discharge Permits (Draft)," which were passed at the executive meeting of the State Council, require the setting up of a ledger recording system for the environmental management of pollution discharging units, the disclosure of discharging information, the strengthening of supervision and punishment of the illegal discharging of pollutants, and the further eradication of any discharging of pollutants without permission.

◆ December 21: The State Council released a white paper titled "Energy Development in China's New Era," specifying the strategy for new energy safety and aiming to promote revolutions in the four fields of "energy consumption, energy supply, energy technology, and energy system."

◆ December 22: The State Council released the white paper titled the "Sustainable Development of Transport in China," aiming to promote the green development of transportation, set up emission control areas for vessels, focus on reducing the air pollutant emissions of vessels, and sustainably improve air quality in coastal areas and inland port cities.

◆ December 26: The 13th Standing Committee of the National People's Congress passed the "Yangtze River Protection Law of the People's Republic of China," aiming to strengthen the construction and use of shore power facilities at ports in the Yangtze River Basin and upgrade and construct clean energy facilities for vessels.

Scientific Capability Building

The official launch of the medium- and long-term plan for environmental monitoring in 2020 marked the continual high-quality development and construction of the ambient air quality automatic monitoring system based on the existing one. Monitoring capabilities will be improved, and the primary goal is to protect public health. An increasing number of cities, districts, and counties in the key regions have compiled or updated their emissions inventory and conducted source apportionment.

Monitoring will serve to protect public health, and the network and evaluation indexes will be sustainably optimized.

In 2020, there was positive progress in constructing traffic monitoring stations and stations in industrial zones and parks. The "2020–2021 Action Plan on Integrated Air Pollution Prevention and Control for the BTH Region and Its Surrounding Areas and the Fenwei Plain in Autumn and Winter" requires all cities to focus on evaluating traffic pollution and complete the construction of air quality monitoring stations at major ports and logistics channels. Regarding industrial pollution, the construction of grid-monitoring stations for such pollutants as $PM_{2.5}$, NOx, and SO_2 in the key regions and industrial zones and parks were further strengthened.

In addition, the monitoring of PM components and VOCs was strengthened. The action plan on integrated air pollution prevention and control in key regions in autumn and winter proposed for the first time to enhance the monitoring of PM components and VOCs in winter. The five cities of Xi'an, Baoji, Xianyang, Weinan, and Tongchuan launched their PM component and VOC monitoring programs simultaneously. According to the requirements of the "Notice on Strengthening the Monitoring of Volatile Organic Compounds," 149 cities shall commence the automatic monitoring of Photochemical Assessment Monitoring Stations (PAMS) by the end of 2020. In the YRD region, all cities were requested to set up at least one automatic VOC monitoring point. Hebei Province, Henan Province, and Weihai City in Shandong Province also started their VOC monitoring program. The provinces and cities that conducted the automatic monitoring of PM components include Guangdong, Beijing, Hefei, Shangqiu, Datong, Shuozhou, and Xinzhou.

To implement the "Montreal Protocol on Substances That Deplete the Ozone Layer," China has gradually set up the F-gas (including hydrofluorocarbons) monitoring network and enhanced monitoring capability for relevant substances.

MEE officially released the "Outline for Ecological Environment Monitoring Plan (2020–2035)," proposing three important phased targets: (i) the short-term goal for 2025 is to improve monitoring ability for environmental quality; (ii) the medium-term goal for 2030 is to comprehensively improve environmental quality to sufficiently protect environmental safety and public health; (iii) the ultimate goal for 2035 is to achieve the integrated development of environmental quality, pollution sources, and the monitoring of ecological conditions, as well as the full incorporation of the major indexes of the ecosystem and corresponding health impacts.

In terms of air environment monitoring, constructing the atmospheric environment integrated monitoring system with automatic monitoring as the major tool is a primary task. During the 14th Five-Year Plan period, state-controlled monitoring stations will increase from 1,436 to about 2,000. Monitoring stations for PM components, VOCs, and poisonous and harmful pollutants will be added to enhance source apportionment capabilities and the prevention and control of environmental risk. Moreover, environmental health monitoring has been encouraged to be conducted in schools, hospitals, and residential districts, emphasizing the vital role of environmental quality monitoring in protecting the health of vulnerable people.

The "Outline for Ecological Environment Monitoring Plan (2020–2035)" proposes three new critical measures: optimizing attainment evaluation, building more monitoring stations in rural areas, and expanding the traffic and industrial monitoring network. Firstly, to reduce the impact of the fluctuation of meteorological conditions and perfect the evaluation of air quality attainment and the ranking rules for cities across the country, the three-year moving average of major pollutant concentration will be included in the air quality evaluation. The ranking scope of cities will be expanded to cover all cities at the prefecture level or above. This measure will more elaborately reflect the cities' air pollution prevention and control achievements. It will also promote air pollution prevention and control in non-key regional cities. Secondly, the monitoring network in rural areas will be expanded by constructing more stations. This measure embodies the green and inclusive policy support for the vulnerable people group. In the central and eastern regions, the support will cover all districts and counties, as well as the townships with prominent air pollution problems; in the western areas, the coverage will extend to districts and counties. Thirdly, the focus of upgrading the monitoring network in urban areas will be on expanding the monitoring network for traffic and industrial pollution sources.

Source apportionment extended to districts and counties in some regions.

Some provinces or cities, including Shaanxi, Beijing, Dezhou, Liaocheng, Binzhou, Hengshui, Shenzhen, and Guangzhou, updated their 2019 emission inventories, while others such as Shahe, Heze, Tonghua, and Xiong'an commenced the compilation of their emission inventories. Ningxia Hui Autonomous Region compiled emission inventories for 10 categories of emission sources and nine pollutants.

In 2020, the cities of Changsha, Fuyang, and Daqing completed the PM source apportionment. Beijing also launched the 2020 $PM_{2.5}$ source apportionment and emission reduction effect evaluation. Some cities, districts, and counties such as those in the Beijing Economic-Technological Development Area and Tongzhou District, Yi County in Baoding City, Yishui County in Linyi, Langfang, Yuncheng, and Jinan launched a new round of PM source apportionment.

Control of Major Pollution Sources

Stationary sources

Energy Structure Adjustment and Clean Utilization

Given the severe impact of COVID-19 on the economy, China has continued adjusting the energy structure, keeping up with the “dual control” objective for total energy consumption and energy consumption strength and thus constantly improving electrification levels. Thanks to the significant progress in the development of renewable energy, the percentage of coal power installation dropped below 50% of total power installation for the first time. However, the approval of new coal power projects may offset the emission reduction effects generated by eliminating excessive production capacity during the 13th Five-Year Plan period. The extensive efforts made by NDRC, NEA, and MEE in strengthening reform on both supply and demand sides had laid a solid foundation for the long-term development of renewable energy in terms of legislation, policy stability, and marketization. The combined generation of heat and power is a significant trend in further enhancing energy efficiency and reducing emissions from boilers. In the key regions, clean heating pilot cities have adopted the use of renewable energy as a heat supply. However, in the rural areas, there remains a gap between the target and current progress in the pollution control of loose coal.

The goals of increasing energy efficiency and decreasing CO_2 emissions were achieved, but total coal consumption remained high.

In the first quarter of 2020, the COVID-19 outbreak caused a substantial drop in energy consumption for a short period in China. According to the National Bureau of Statistics, along with the year-on-year decrease of 6.8% in GDP, total energy consumption dropped by 3.1% year-on-year, and year-on-year energy consumption per GDP increased by 4.3%. As the pandemic was controlled and restriction measures were eased in April 2020, the economy gradually recovered, which was immediately followed by the rebounding of energy consumption demand.

In 2020, total energy consumption in China increased to 4.98 billion tce—a year-on-year increase of 2.2%. This increase drove its GDP to cross the threshold of RMB100 trillion for the first time. Meanwhile, in 2020, energy consumption per GDP decreased by 0.1% year-on-year. The consumption of standard coal as power supply decreased to 305.5 g/kWh, down by 3.1% compared to 2015 and exceeding the objective of restricting energy efficiency in the 13th Five-Year Plan.

In 2012–2019, the annual growth of energy consumption in China was at 2.8%, which supported the annual GDP growth of 7%. The elastic coefficient of energy consumption reached 0.41. However, due to the impact of COVID-19 on the economy, GDP growth in 2020 dived, causing the elastic coefficient of energy consumption to go up to 0.96. In 2020, the objective of reducing carbon emission strength per GDP by 18% during the 13th Five-Year Plan period was achieved.

The percentage of coal consumption in primary energy consumption dropped to 56.8%—a year-on-year decrease of 0.9%. However, total coal consumption remained high, increasing by 0.6% to 2.829 billion tons of standard coal. The YRD region requested to complete the control objective of cutting off 5% of total coal consumption as required in the "Three-Year Action Plan." Beijing, meanwhile, reduced its total coal consumption to within 1.5 million tons. On the other hand, in 2020, the consumption of clean energy such as liquefied natural gas, hydropower, nuclear power, and wind power continued rising, accounting for 24.3% of total energy consumption. This percentage was a year-on-year increase of 1%. The proportion of non-fossil energy in primary energy consumption rose to 15.9%. Details are shown in Figure 6 under Special Column I.

The ongoing optimization of the energy consumption structure reflects the enhancement of the electrification level in China. The 2020 target that "electric energy accounts for about 27% of terminal energy consumption" was achieved as planned. The newly increased electric quantity, which replaced another form of energy in terminal energy consumption, reached around 150 billion kW.

The proportion of coal power installation decreased below 50% for the first time, but coal-fired power generation capacity still occupied the leading position.

In 2020, the installed power capacity in the whole country climbed to 2.2 billion kW—a year-on-year growth of 9.5%. Among this total, the percentage of the installed capacity of coal-fired plants decreased to 49.1% for the first time. The percentage of the installed capacity of non-fossil energy generation rose to 44.8%— a year-on-year increase of 4.8%. The total installed capacity of renewable energy generation was at 42.4%, and the total capacity reached 930 million kW. Clean coal power continued to be developed. In 2020, the ultra-low emission retrofitting of coal-fired generating units registered 950 million kW accumulatively, accounting for 88% of the total installed capacity of coal power—a year-on-year increase of 2%. In 2020, the power sector's pollutant emissions dropped to approximately 1.8 million tons—a year-on-year decrease of about 210,000 tons. Standard coal consumption for thermal power generation per kW decreased by 0.6% (after decreasing by 0.3% in 2019).

In 2020, China's newly installed capacity of onshore wind and photovoltaic power generation accounted for 2/3 and 45% of the world's newly added capacity respectively, thus serving as an essential engine for accelerating the development of global renewable energy. The newly installed capacity of wind and photovoltaic power in China accounted for 62.8% of the total newly installed capacity, as shown in Figure 29. The newly installed capacity of wind power increased nearly three times year-on-year, reaching 71.67 million kW; the newly installed photovoltaic capacity was 48.2 million kW, up 60.1% year-on-year, among which were the newly installed capacity of centralized photovoltaic power stations at 32.68 million kW and the distributed photovoltaic stations at 15.52 million kW. By the end of 2020, the installed capacities of grid-connected wind power and solar energy in China accumulated about 282 million kW and 253 million kW respectively, up 34.6% and 24.1% year-on-year.

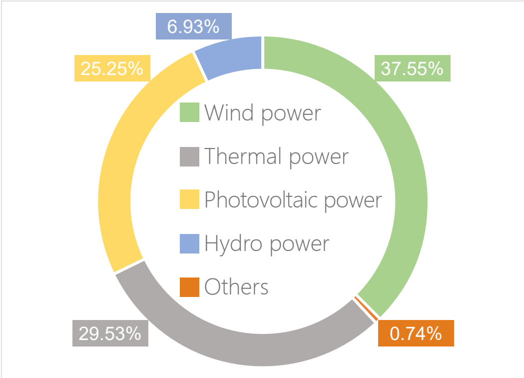

Figure 29: Structure of Newly Installed Power Generation Capacity in China

The rapid development of renewable energy is closely related to solid political commitment. In April 2020, NDRC and NEA jointly issued the "Energy Law of the People's Republic of China (Exposure Draft)," laying a legislative foundation for promoting the clean and low-carbon energy revolution. The law emphasizes the priority in developing renewable energy and clarifies the status of natural gas as a clean fossil fuel. In September 2020, General Secretary Xi made the solemn promise of achieving carbon peaking and carbon neutralization and announced new measures for China's National Determined Contribution, which provided a macropolicy direction for the long-term development of renewable energy.

With the substantial expansion of market scale and industry, the cost of renewable energy power generation dropped again. On the other hand, renewable energy subsidies will gradually decrease, and the resource allocation will be optimized through the market mechanism. In 2019, NEA released a clear policy signal that, from 2021, the newly approved wind and photovoltaic power generation projects will implement the policy of grid parity. In 2020, "Several Opinions on Promoting the Healthy Development of Non-hydro Renewable Energy Power Generation" further guided and established the mechanism of decreasing subsidies for onshore wind and photovoltaic power generation. New offshore wind and solar photothermal power generation projects will also no longer be included in the scope of the subsidies of the central government.

Although the installed capacity of renewable energy had reached a new high, the generation capacity of renewable energy still just served a "supporting role." In 2020, the proportion of renewable energy power generation increased by 1.6% to 29.5%, but coal-fired power generation was still at a high level, accounting for 60.8% of the total. According to NEA data, in 2020, the utilization rate of wind and photovoltaic power increased to 97% and 98% respectively, the same year-on-year. One main challenge in developing renewable energy was still the utilization rate, and the consumption problem was more prominent in Northwest China. In 2020, the average rates of wind and photovoltaic power abandonment were 6.9% and 4.8% respectively.

In May 2020, NEA issued the "Guiding Opinions on Establishing and Perfecting the Long-Term Mechanism of Clean Energy (Exposure Draft)." The draft requires constructing a clean energy development mechanism, with consumption as the core, by increasing the weight of responsibility for renewable energy consumption in each province. By accelerating research and development and the deployment of smart grid and energy storage technology, it aims to significantly improve the stability, flexibility, and grid-connected capability of the power system. At the same time, it encourages the adoption of a multichannel local consumption mode and promotes such measures as electric heating, electric vehicles, shore power at ports, and hydrogen production employing electricity to enhance the consumption demand of clean electricity. In 2020, the scale of the development and utilization of renewable energy reached 680 million tons of standard coal. This value was equivalent to replacing nearly 1 billion tons of coal and signified the total reduction of CO_2, SO_2, and NOx emissions by about 1.79 billion tons, 864,000 tons, and 798,000 tons of coal respectively.

The task of eliminating the excess production capacity of coal was overfulfilled, but the newly approved amount of coal power was several times higher than the eliminated amount.

During the 13th Five-Year Plan period, Shanxi Province eliminated 157 million tons of the excess production capacity of coal, Shaanxi Province eliminated 55.97 million tons, and Anhui Province eliminated 32.82 million tons. In 2020, Shandong reduced the excess production capacity of coal by 8.06 million tons, Henan 4.86 million tons, Hebei 7.83 million tons, and Anhui 2.1 million tons. By the end of 2020, there existed only 1,129 small coal mines with a capacity of below 300,000 tons/year and a total production capacity of 148 million tons/year.

NEA planned to weed out an outdated production capacity of 7,333,500 kW in the coal-fired power industry in 2020. The provinces that overfulfilled their tasks include Henan, Shandong, Shanxi, Jiangsu, Hubei, Chongqing, Heilongjiang, and Jilin, as shown in Figure 30. Shandong and Henan, two provinces with a large backward coal-fired power production capacity, closed the units with the largest capacity. The elimination of outdated production capacity in Shanxi Province was also higher than the planned target. However, its total elimination amount was not high compared to other provinces with a large production capacity.

In 2020, the installed capacity of newly approved coal-fired power projects in China exceeded 34 million kW—over 4.6 times greater than the eliminated coal-fired power installed capacity. The coal-fired power

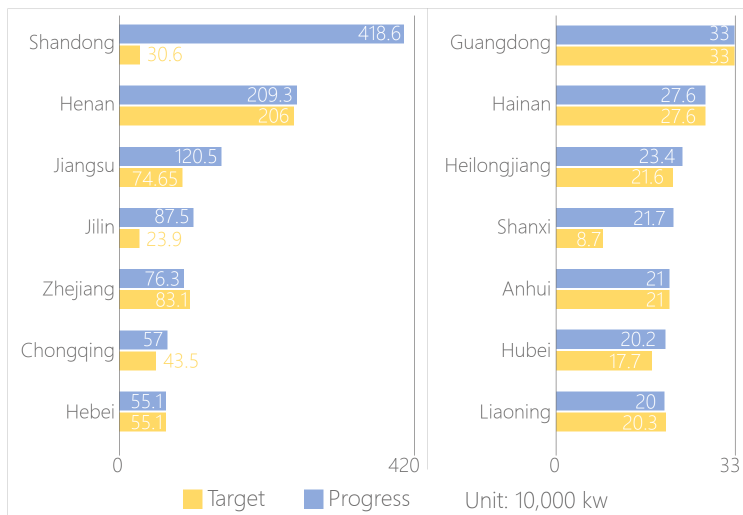

Figure 30: 2020 Targets and Progress in Weeding Out Outdated Production Capacity in the Coal-Fired Power Industry

planning and construction mechanism underwent significant changes in 2018. As a result, according to the “Notice on Risk Early Warning of Coal-Fired Power Planning and Construction in 2023” issued in 2020, only the early adequacy warning index of coal-fired power installed in Shanxi Province was red, while those in the three northeastern provinces and Eastern Inner Mongolia did not play an influential constraining role. Sizeable coal-fired power units (660,000 kW and above) accounted for about 91% of the total increase, concentrated in key regions such as Shaanxi, Jiangsu, Anhui, Heze in Shandong Province, and Handan in Hebei Province. The construction and operation of a newly approved coal-fired power project will become a “roadblock” for the continuous improvement of air quality in these areas and render significant challenges to the realization of the “double carbon” goals.

The pace of clean boiler retrofitting was increased, and combined heat and power generation became a long-term clean heating trend.

Following the shutdown of small boilers with capacity below 35 T/h in the three key regions in 2019, the focus shifted to pollution control for boilers with capacity above 65 T/h in 2020. Good progress was made; specifically, the ultra-low emission retrofitting for coal-fired boilers was completed, along with the low nitrogen emission retrofitting for gas-fired boilers. The provinces of Hebei, Henan, and Zhejiang completed pollution control for 6363, 508, and 287 boilers respectively.

The current heating industry in China is still dominated by coal-fired boilers and coal-fired cogeneration, accounting for 32% and 45% of the total respectively. The long-term development goal is to step up the retrofitting of large-scale coal-fired power units for heat supply in urban areas and support the clean technology path that prioritizes combined heat and power generation. At the same time, thermal energy storage technology should be promoted in the construction and industrial production processes, while the multiform of energy supply should be realized.

Clean heating covered 65% of the northern areas, while the risk of reusing loose coal and difficulties in retrofitting rural heating still existed.

According to NEA, after the implementation of the “Plan of Clean Heating for Northern China in Winter (2017–2021),” the clean heating rate in winter in Northern China rose to about 65% in 2020—an increase of 10% year-on-year. This rate was expected to reach the final goal of 70% in 2021. The clean heating rate in the BTH region and its surrounding areas and the key regions of the Fenwei Plain was over 80%. These regions were also converted into a loose coal-free area. More than 25 million households replaced loose coal use with clean heating approaches, equivalent to a reduction of 50–60 million tons of loose coal use.

After years of effort, the clean heating rate in rural areas of "2+26" key cities reached 71%—up 28% year-on-year and exceeding the final target of 60% by2021. In 2020, the added clean heating area was about 1.5 billion m². According to the information reported by local governments, about 8.97 million households in two key regions completed the replacement of loose coal, exceeding the planned target of 7.09 million households as shown in Figure 31.

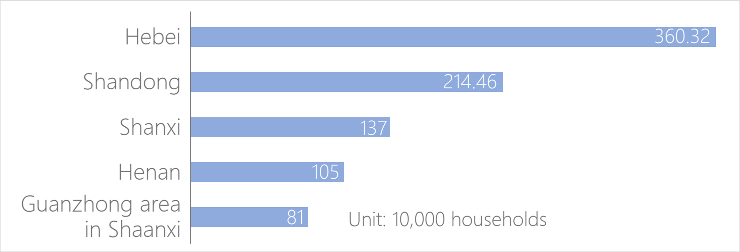

Figure 31: Number of New Households Using Clean Heating in Key Regions in 2020

For the first time, the “Action Plan for the Comprehensive Control of Air Pollution in Beijing-Tianjin-Hebei and Surrounding Areas and the Fenwei Plain in Autumn and Winter for 2020–2021” expressly promoted the replacement of loose coal in agricultural fields such as the agricultural greenhouses, the flue-curing of tobacco leaves, the drying of Chinese herbal medicines, and livestock and poultry breeding in major agricultural provinces such as Hebei, Henan, and Shandong. Henan Province took the lead in retrofitting 3,717 coal-fired facilities for flue-cured tobacco by prioritizing air source heat pumps.

Overall, the clean heating rate in northern rural areas was only at 28%, still far from the ultimate goal of 40% by 2021. This situation could mean that improving the rural clean energy system remains the “main battlefield” in promoting clean heating in the following stages, along with two main challenges. Firstly, the areas already using clean heating approaches faced a decrease in subsidy. In 2020, only Tianjin and Jinan specified that the subsidy policy for clean heating would continue in the heating season in 2020–2023. A clean heating business model based on local conditions has generally not been formed in most areas already using clean heating approaches, and the risk of reusing loose coal cannot be ignored. Secondly, rural buildings demonstrate significant differences in insulation effects, are generally low in energy efficiency, and face an existing colossal energy waste. These three characteristics combined have increased the cost burden of clean heating for rural users.

In this situation, NEA issued the “Plan for the Special Supervision Task of Clean Heating in Winter in Northern China” to launch the special supervision task of clean heating in Northern China in winter. Northwest Energy Regulatory Bureau assigned three working groups to conduct on-site clean heating in Shaanxi, Ningxia, and Qinghai in winter to strengthen communication and coordination with relevant provincial departments, energy enterprises, and heating companies. They also discovered several problems, including gaps between the implementation and objectives, imperfect mechanisms, and insufficient policy support.

Emission Reduction and Comprehensive Control of Key Industries

The iron and steel and cement industries were still the top priorities in promoting the prevention and control of air pollution. The steel industry further deepened the retrofitting of ultra-low emissions while sustainably raising its output scale. The whole process involved with ultra-low emission technology for benchmark enterprises in the sector is leading internationally. The cement industry started retrofitting for ultra-low emissions from bottom to top. The first “synergy” standard was launched in the oil industry, which put forward the treatment requirements for methane, a critical warming gas produced during oil and gas exploitation.

The output of the steel industry continued to rise, and ultra-low emission retrofitting progressed further.

Over the past years, measures for eliminating outdated production capacity and optimizing the industrial structure have been implemented for the iron and steel industry. However, the scale and output of the sector are still rising given increasing market demand. Figure 32 shows the elimination of crude steel in key provinces during the 13th Five-Year Plan period. In 2020, China’s crude steel output increased by 5.2% year-on-year, passing the 1 billion mark (specifically, 1.05 billion tons) for the first time and accounting for 57% of the global crude steel output.

In 2020, the ultra-low emission retrofitting of the iron and steel industry progressed further. That year, the retrofitting of a crude steel production capacity of 620 million tons in 229 enterprises across the country was either completed or implemented. In the key regions, the main task was to promote the phasing out of independent coking enterprises to speed up

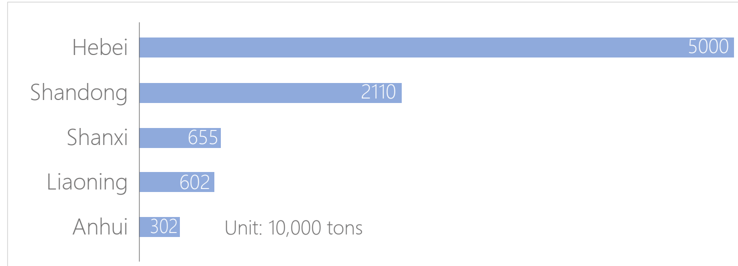

Figure 32: Elimination of Crude Steel in Key Provinces during the 13th Five-Year Plan Period

the adjustment of the industrial structure. The key areas of the BTH region and the Fenwei Plain announced that all provinces and cities should set up one to two demonstration enterprises for ultra-low emission retrofitting in the iron and steel industry and promote the central-government-owned enterprises to play a leading role in the regions. Central enterprises such as Shougang, HBIS, TISCO, Delong, Jianlong, and Shandong Iron and Steel Group successively completed ultra-low emission retrofitting in the autumn and winter of 2020–2021. Among them, Shougang’s Qian’an Iron and Steel Co., Ltd. was the first enterprise in the world to achieve ultra-low emissions in the whole process, thus leading internationally.

Emergency emission reduction measures were further refined following the action plan for integrated air pollution prevention and control in autumn and winter in the key regions. The differentiated management of enterprises was also implemented based on their own conditions. At the same time, penalties for data fraud by iron and steel enterprises and evaluation and monitoring institutions were increased. For example, violators were stripped of relevant preferential policies, and their emergency response performance was reduced to Grade D. Henan Province canceled the qualification of 10 enterprises to obtain special funds from the central government due to their inadequate emission reduction measures to cope with heavy pollution days.

In 2020, MEE and the State Administration for Market Regulation (SAMR) jointly released two modification lists: the “Emission Standards for Air Pollutants for the Sintering and Pelletizing of the Iron and Steel Industry” (GB28662-2012) and the “Emission Standards for Air Pollutants in the Steel Rolling Industry” (GB28665-2012). These lists aim to improve the standards promoting the high-quality green development of the iron and steel industry.

Some provinces implemented stricter local standards, and the cement industry started ultra-low emission retrofitting from bottom to top.

China is a large cement producer, housing more than 3,400 cement enterprises. In 2020, the country's cement output registered 2.38 billion tons, accounting for 57% of the world's total output. The cement industry is one of the key industries in air pollution prevention and control. With the release of the "Action Plan on Air Pollution Prevention and Control," the "Three-Year Action Plan," and the "Plan for the Integrated Control of Air Pollution from Industrial Furnaces and Kilns," the emissions of major pollutants in the cement industry showed a general downward trend, with NOx emissions decreasing the most from 1.969 million tons in 2013 to 1.001 million tons in 2020. In 2020, ultra-low emission retrofitting was launched in the cement industry.

In 2020, the provinces of Hebei, Henan, and Anhui successively revised local standards to become stricter than the national standards issued in 2013. This revision was done to force the cement industry to expedite technological innovation and jointly reduce air pollutants, toxic and harmful pollutants, and greenhouse gas emissions, as shown in Table 1.

Table 1: Emission Limits for Primary Pollutants in Cement Manufacturing in the Standards of the Country, Hebei, Henan, and Anhui (Waste-Heat Utilization System at Cement Kilns and Kiln Tails)

Unit: mg/m^3	PM	SO_2	NO_X	Fluoride	Mercury and its compounds	Ammonia
National standard (GB4915-2013)	30	200	400	5	0.05	10
Hebei local standard (DB13-2167-2020)	10	30	100	3	0.05	8
Henan local standard (DB41/1953-2020)	10	35	100	3	0.05	5
Anhui local standard (DB34/3576-2020)	10	50	100	3	0.05	8

The provinces of Henan and Zhejiang issued implementation plans for the ultra-low emission retrofitting of the cement industry at the provincial level. Among them, Henan Province required that, by the end of 2020, all cement enterprises in Henan Province complete the ultra-low emission retrofitting for the production process. By the end of 2023, the clean transportation of bulk materials and products of all cement enterprises should fully meet the ultra-low emission requirements. The enterprises are required to employ low-nitrogen combustion technology and install high-efficiency desulfurization facilities in cement kilns. The enterprises that use cement kilns to treat solid waste must meet the emission standards for toxic and harmful pollutants. They are encouraged to use such material storage methods as fully enclosed mechanization to ensure that both PM and ammonia concentrations meet the emission standards. Zhejiang Province proposed that the emission limits of major pollutants be aligned with the local standards of Anhui Province by the end of 2022 and should reach ultra-low emission limits by 2025.

Both provinces applied incentive measures to encourage cement enterprises to actively implement ultra-low emission retrofitting. For example, the provinces reduced and exempted a certain proportion of taxes and fees for cement enterprises that met ultra-low emission requirements or provided support of the air pollution prevention and control funds from the central government. Henan Province also encouraged banking institutions to offer green credits to support ultra-low emissions in cement enterprises and facilitated them to issue bonds for financing.

In 2020, the mechanism of differentiated management and performance grading was a significant driving force to encourage enterprises in the cement industry to carry out ultra-low emission retrofitting independently. If the waste heat utilization system of cement kilns and kiln tails of cement manufacturing enterprises met the ultra-low emission limit for air pollutants—that is, if the concentration of PM, SO_2, and NOx were not higher than 10 $\mu g/m^3$, 35 $\mu g/m^3$, and 50 $\mu g/m^3$ respectively—they would be rated as a Class A enterprise and could take emission reduction measures independently during heavy pollution days.

The goal of rectifying "scattered, unregulated, and high-polluting enterprises" was achieved, and the industrial emission standard system of key industries involved in industrial furnaces and kilns improved.

In 2020, "scattered, unregulated, and high-polluting enterprises" in the key regions were rectified and dynamically cleared. Figure 33 shows how remarkable the achievements during the 13th Five-Year Plan period regarding this goal were.

In 2020, 15,000 industrial furnaces were screened and treated nationwide. A total of 2,562 industrial furnaces and kilns were rectified in Hebei Province and 7,276 in Shanxi Province. In 2020, the provinces of Henan and Jiangsu officially implemented the air pollution emission standards for industrial furnaces and kilns. Shanxi Province issued an exposure draft on revised

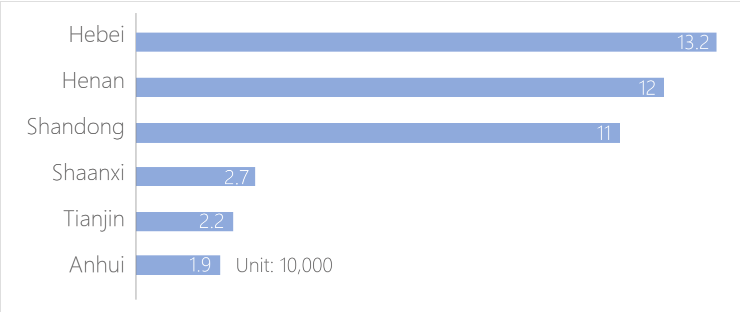

Figure 33: Progress in Rectifying "Scattered, Unregulated, and High-Polluting Enterprises" in the 13th Five-Year Plan Period

standards, and Hunan Province started to revise the standards. The provinces of Shandong and Anhui successively issued provincial treatment plans.

Key industries involving industrial furnaces included the foundry, brick and tile, and inorganic chemical industries. In 2020, MEE and SAMR jointly formulated the "Emission Standards for Air Pollutants in the Foundry Industry" (GB39726-2020), as well as two modification lists for the first time: the "Emission Standards for Air Pollutants in the Brick and Tile Industry" (GB 29620-2013) and the "Emission Standards for Pollutants in the Inorganic Chemical Industry" (GB 31573-2015).

Governance of VOCs continued to address difficult problems, and the first "collaborative" standard was introduced in the oil industry.

MEE issued the "Plan for Controlling Volatile Organic Compounds in 2020," specifying that from 1 July 2020, the fugitive emissions standard of VOCs would be implemented to continuously promote the control of VOCs pollution in industrial parks and enterprise clusters. Compared with the 2019 plan, enterprises with an annual output of more than 10 tons of VOCs were regarded as enterprises that needed tight pollution control. The key objects to be investigated in industrial parks newly included the shipbuilding industry; the chemical industry, with dyes, daily chemicals, chemical additives, and synthetic leather included; and the enterprise clusters, with casting and color-coated plates included. Meanwhile, the treatment efficiency of VOCs was upgraded, and the requirements of "three rates"—namely, the collection rate of waste VOCs gas, the synchronous operation rate of treatment facilities, and the removal rate—were put forward.

The plan focuses on increasing policy support and replacing measures to promote low-VOCs content materials. The enterprises whose VOCs emission was 30% lower than the national and local emission standards would be included in the list of green government procurement and the positive list of supervision and law enforcement. This inclusion means the enterprises could improve economic benefits through technological innovation. The three key regions would select a batch of benchmarking enterprises for VOCs treatment from central-government-owned enterprises such as PetroChina, Sinopec, China National Offshore Oil Corporation, and Sinochem Group, which were encouraged to actively undertake social responsibilities and lead the industry to comprehensively conduct VOCs control.

Based on the traditional environmental governance mode of relying on administrative orders, the plan proposed for the first time to encourage enterprises and industrial parks to sign VOCs emission reduction agreements with the government to mobilize the initiative of the enterprises to reduce emissions. Both the provinces of Shanghai and Shaanxi implemented this innovative measure in local plans and launched the "enterprise + government" emission reduction model. Shanghai is the first city in China to carry out the pilot of the VOCs agreement on emission reduction and VOCs emission offset. The former focuses on tapping the emission reduction potential further, while the latter provides enterprises with flexible emission reduction paths.

Shanghai issued the "Notice on the Comprehensive Control of Volatile Organic Compounds in Key Industries of Shanghai," marking the new phase of VOCs control. Exactly 2,362 key enterprises in 24 industries were identified as control objects. The notice put forward the "one plan for one plant" mode and requested that the enterprises follow the three-step requirements of "plan formulation + technology evaluation + progress tracking" to prepare emission reduction plans to complete VOCs pollution control in 2022.

In 2020, MEE and SAMR jointly formulated the "Emission Standards for Air Pollutants in the Onshore Oil and Gas Exploitation and Production Industry" (GB39728-2020), the first emission standards for the coordinated control of air pollutants and greenhouse gases in the oil industry. The standards aim to promote the green technology development of the onshore oil and gas exploitation industry. Table 2 shows how strict emission limits were set for SO_2, the primary pollutant in natural gas purification plants. The implementation of the standard would reduce SO_2 emissions by about 60%. The control of VOCs emitted from oil and gas gathering and transmitting processes mainly used the control experience of the petrochemical industry for reference. In addition, the standard required the coordinated treatment of methane, a significant greenhouse gas produced in oil and gas exploitation.

Table 2: Emission Limits of Air Pollutants from Sulfur Recovery Units at Natural Gas PuriÞcation Plants

The total size of sulfur recovery units at natural gas purification plants (t/d)	SO_2 concentration limit (mg/m^3)
⩾ 200	400
< 200	800

Mobile Sources

In 2020, China's prevention and control of mobile source pollution continued to deepen. Positive progress was made in emission supervision, standards improvement, and structural optimization. China initially formed a full-time and full-life vehicle emission supervision system based on the motor vehicle environmental protection supervision sampling test and the environmental protection regular inspection system. As for standard upgrading, the China VI Emission Standards were fully implemented. The NEV market continued to expand to comply with the low-carbon development trend. In 2020, the number of NEVs reached 4.92 million, increasing by more than 1 million vehicles annually for three consecutive years. However, China still faces many challenges in the pollution control of diesel vehicles. For example, fuel quality control has not reached the expected goal. The structural adjustment goal of "shifting from road to railway" has not yet been completed.

The crackdown on unlicensed gas stations was strengthened, and fuel quality supervision continued to be upgraded.

The "Action Plan for the Prevention and Control of Pollution from Diesel Trucks" took diesel trucks, vehicle fuel, and urea as key objects for regulation. The plan set the action goal that "by 2020, the qualification rate of sampling inspection of diesel fuel and vehicle urea in China will both reach 95% and in the key regions reach 98%."

In 2020, MEE organized many local governments to conduct diesel sampling inspections, decreasing the number of unlicensed gas stations. However, quality control still needed to be strengthened. In the investigation of diesel quality in seven provinces and 30 cities in the BTH region and its surrounding areas, the Fenwei Plain, the Jiangsu-Anhui-Shandong-Henan Border Area, and the YRD region, 42 unlicensed gas stations (including 12 unlicensed refueling vehicles) were found, mainly concentrated in the provinces of Anhui, Jiangsu, Henan, and Hebei. The sulfur content of diesel samples at these gas stations significantly exceeded the standard, with the overstandard rate reaching 47% or 52 times higher than the standard. About 2% of the samples collected at qualified gas stations exceeded the standard. From a regional perspective, the overstandard rate of diesel samples in the YRD region, the Jiangsu-Anhui-Shandong-Henan Border Area, and the BTH region and its surrounding areas was higher, above 2.5% on average. The sampling results of diesel fuel in the Fenwei Plain were better, with the overstandard rate of 0.7%. According to the goal put forward in the "Action Plan for the Prevention and Control of Pollution from Diesel Trucks," most key regions failed to meet the requirements.

"Clean Fuel Action" was conducted in many cities to continuously crack down on unlicensed gas stations. The central government expressly specified that SAMR is the leading department to crack down on unlicensed gas stations. Consequently, SAMR has stepped up its rectification efforts and continued to vigorously carry out the "Clean Fuel Action" at the city level. For example, Wuxi seized 164 illegal mobile refueling vehicles and 59.35 tons of illegal diesel within just one month. In addition, some cities conducted special continuous campaigns to prevent the resurgence of unlicensed gas stations. For example, Tangshan City in Hebei Province and Puyang City in Henan Province carried out special crackdown and rectification actions against unlicensed gas stations for half a year or more. By the end of 2020, Puyang City had dynamically cleared out unlicensed gas stations.

In-use vehicle emission supervision was upgraded by adopting multi-means screening, real-time monitoring, and closed-loop management.

Supervision efficiency was improved, and full-time and full-life-cycle sampling inspection was realized

Based on the system of the environmental protection supervision sampling test and the regular inspection on environmental protection of motor vehicles, China has initially formed a full-time and full-life-cycle emission supervision system for in-use vehicles. The sampling test on motor vehicle environmental protection supervision includes remote sensing monitoring, road inspection, and household inspection.

Meanwhile, motor vehicle emission inspection includes off-line inspection on new vehicles, registration inspection, in-use vehicle emission inspection, and on-board diagnostics (OBD) inspection.

In 2020, a total of 4.173 million cases of vehicles exceeding the emission standard were found in China through remote sensing monitoring (including the capturing of black smoke emitters), road inspection, and household inspection. As a more efficient, faster, and more intelligent emission screening method to monitor whether exhaust emission exceeds the standard, remote sensing monitoring can use the technology of "capturing black smoke" to lock in illegal evidence. This system helps expand screening scope and enhance supervision ability. In 2020, China's in-use vehicle remote sensing monitoring capability continued to improve. By the end of the year, a total of 2,956 remote sensing monitoring points (including the capturing of black smoke emitters) had been built nationwide, of which more than 80% were connected with national, provincial, and municipal networking platforms.

While expanding emission screening, China's testing ability for in-use vehicles has also improved significantly. In 2020, 3,065 new motor vehicle emission inspection institutions and 8,901 OBD testing lines were established nationwide. To ensure the authority of inspection results, China continuously required cities to introduce an oversight mode of random inspection and public release across the board.

In 2020, to solve the lack of control of the number and layout of emission inspection institutions and the chaotic management of inspection institutions, MEE released the exposure draft for the "Specification for In-Use Vehicles Emissions Inspection," specifying the requirements for equipment, inspection, video monitoring, software and data management, and other elements in inspection institutions. The draft also established a unified and scientific management standard for motor vehicle emission inspection institutions to provide a basis for the supervision and management of inspection institutions.

The technical specifications for remote online monitoring were introduced, and the BTH region led the accurate locating and penalizing of vehicles exceeding emission standards.

The "Action Plan for the Prevention and Control of Pollution from Diesel Trucks" put forward requirements for the real-time online monitoring of vehicle emissions. From 1 January 2020, in-use vehicles without a remote online monitoring device were listed as key supervision object in the key regions.

MEE released the "Technical Specifications for the Remote Emission Monitoring of Heavy Vehicles" to solve the problems found in the emission monitoring of heavy duty vehicles. These problems include emissions exceeding the standard, vehicles with poor environmental protection performance pretending to be China IV or V vehicles for sales, and no or dummy OBD system installation. The specifications clarified the unified technical and networking requirements of vehicle-mounted terminals for the remote online monitoring of heavy duty vehicles, further improving supervision efficiency. Some provinces and municipalities issued relevant plans to implement the remote monitoring of heavy duty vehicles. For example, the "Work Plan for Promoting the Remote Online Monitoring of Pollutant Emissions from Heavy Duty Diesel Vehicles in Shanghai" required that from 1 May 2020, registered heavy duty diesel vehicles (including those transferred from other provinces and cities) must be equipped with online monitoring terminals connected with local ecological and environmental authorities.

The "Regulations on the Prevention and Control of Emission Pollution from Motor Vehicles and Nonroad Mobile Machinery" were issued in 2020. These regulations set special provisions on the law enforcement of vehicles exceeding emission standards. They also focused on the inspection of pollution control devices, emission diagnosis systems, vehicle-mounted terminals for remote emission management, and other equipment. Additionally, the regulations encouraged using online platforms to monitor heavy duty diesel vehicles in real time and increasing penalties on vehicles without undergoing reinspection. Before the official implementation of these regulations, MEE had already opened the authority of the "Motor Vehicle Excessive Emission Data Platform" for the BTH region, established a "blacklist" system, and shared data on vehicles exceeding emission standards. In addition, Beijing also formulated the "Regulations on the Installation of Vehicle-Mounted Terminals for Remote Monitoring and the Management of Heavy duty Vehicles and Nonroad Mobile Machinery (for Trial Implementation)." These regulations were implemented simultaneously. As of September 2020, all newly produced heavy duty diesel vehicles in Beijing had been installed with OBD and connected to the network.

The inspection and maintenance (I/M) system was fully implemented, and the closed-loop management of vehicles exceeding the standard was formed.

The "Three-Year Action Plan" and the "Action Plan for the Prevention and Control of Pollution from Diesel Trucks" expressly require the comprehensive establishment and implementation of the automobile emission I/M system, which forms the closed-loop management of "inspection-maintenance-reinspection." The goal is to reduce the pollutant emissions of in-use vehicles. The sharing of information on emission inspection is key to this closed-loop management and is also required by the "Law on the Prevention and Control of Air Pollution." However, problems in remote inspection in non-registered cities, a lack of a unified business system, issues in networking standards and implementation conditions, and other issues cause difficulties in data sharing between provinces and cities.

Therefore, in 2020, MEE formulated the "Specifications for the Emission Inspection Information System and Networking of In-Use Motor Vehicles." MEE also publicly solicited opinions to realize nationwide information sharing and promote the joint prevention and control of regional air pollution by standardizing the data collection, exchange, interface, security, and networking mode of the emission inspection information system in the future. To promote the implementation of the I/M system, MEE, MOT, and SAMR officially issued the "Notice on Establishing and Implementing the Vehicle Emission Inspection and Maintenance System," requiring inspection institutions to realize the closed-loop management of vehicles exceeding the emission standard via qualification certification and networking with ecological and environmental departments. Such a system ensures the implementation of joint law enforcement with closed-loop information to improve the supervision efficiency of the I/M system.

At the city level, Beijing issued the "Notice on Implementing the Vehicle Emission Inspection and Maintenance System" to standardize I/M for vehicles with emissions exceeding standards. Beijing also revised the "Administrative Measures for the Scoring System of Inspection and Testing Institutions" to further strengthen the management of inspection institutions and ensure that the Inspection and Maintenance Stations, the two tools in the I/M system, effectively play key roles. Ningbo established a mini-program for automobile maintenance service, which provides information such as geographical location, enterprise ranking, and the evaluation of the Maintenance Station to facilitate vehicle owners in actively participating in the closed-loop management of emission inspection.

The vehicle structure was further optimized, and the transportation industry was upgraded as a whole.

The elimination of outdated vehicles continued, and the China VI Emission Standards were implemented.

The "Three-Year Action Plan" clearly defined the elimination target for outdated vehicles. It required that, by the end of 2020, the BTH region and its surrounding areas and the Fenwei Plain weed out more than 1 million medium-duty and heavy duty diesel trucks with emissions exceeding China III Emission Standards. Based on public data, from 2018 to 2020, the BTH region and its surrounding areas and the Fenwei Plain eliminated more than 900,000 heavy duty diesel trucks.

The elimination of outdated vehicles was accelerated through a multipronged approach under national and local policies. In conjunction with four departments including MOT, MEE issued a notice requesting all cities to take comprehensive measures, such as economic compensation, use restrictions, and the strict supervision of excessive emissions, to complete the task of stamping out outdated vehicles as planned. On 31 March 2020, an executive meeting of the State Council passed the measures eliminating old trucks and, with awards from the central government, supporting key regions such as BTH to eliminate diesel trucks with emissions exceeding China III Emission Standards. From 1 May 2020, value-added tax at the rate of 0.5% of sales is levied on used vehicles sold by secondhand vehicle dealers before the end of 2023. Beijing issued the "Beijing Plan for Further Promoting the Elimination and Renewal of Old Motor Vehicles with High Emissions (2020–2021)," which proposes that before the end of 2021, owners who scrap or transfer their old trucks and buses in advance can enjoy government subsidies of up to RMB14,000 and RMB22,000 respectively.

While outdated vehicles are being eliminated, several regions have also restricted the road rights of vehicles with emissions exceeding China IV Emission Standards by expanding no-traffic areas. Cities such as Xingtai, Qinhuangdao, Hengshui, and Zhengzhou restrict trucks with emissions exceeding China IV Emission Standards from entering their downtowns, green freight areas, and factories. They also prohibit these trucks from transporting bulk materials. Port cities such as Rizhao and Tangshan also prohibit these trucks from entering their port areas.

Compared with the elimination of China III vehicles and the traffic restriction of China IV vehicles, China V vehicles are under special supervision, for which the centralized installation of the OBD remote online emission monitoring system is required. Jiangsu, Shanghai, Zhejiang, Henan, Hebei, and Tianjin have explicitly required or forced the installation of such a system. Jinan, Hefei, Luoyang, and Ningbo have provided free installation or subsidies for the installation of the system. Meanwhile, Hangzhou has issued a policy of "exemption from inspection," specifying that vehicles in excellent condition as certified through the OBD examination are exempted from the emissions inspection.

As the China VI Emission Standards for heavy duty vehicles were introduced, such methods as "remote," "online," and "networking" tools may become essential means in the supervision of in-use vehicles. According to the rules and regulations of China, from 1 July 2020, all urban vehicles produced, imported, sold, or registered shall meet the requirements of the China VI a Emission Standards. As one of the leading cities that have implemented the China VI Emission Standards ahead of schedule, Beijing proposed that heavy duty diesel vehicles in some industries (non-urban vehicles) be subject to China VI b Emission Standards starting 1 January 2020. The China VI b Emission Standards also put forward the networking of vehicle-mounted terminals for remote emissions management. In response, some regions have made clear plans for OBD networking. From 1 November 2020, the entire Hebei Province carried out OBD inspections on heavy duty vehicles before their registration. OBD installation and networking for heavy duty vehicles were also completed before the end of the year.

In 2020, considering the stability and expansion of automobile consumption, the buffer period for implementing the China VI Emission Standards for light-duty vehicles was set. “GB18352.6-2016” required the full implementation of the China VI Emission Standards for light-duty vehicles starting 1 July 2020. However, the four ministries and commissions jointly issued the “Announcement on Adjusting the Relevant Requirements for the Implementation of the China VI Emission Standards for Light-Duty Vehicles,” which extended the transition period for the sale of light-duty China V vehicles by six months.

Following the low-carbon development trend, the market for NEVs continued expanding.

In recent years, the number of NEVs has maintained rapid growth. In 2020, the number reached 4.92 million—an annual increase of more than 1 million for three consecutive years. The proportion of NEVs among total vehicles increased from 0.71% in 2017 to 1.75% in 2020.

The “Three-Year Action Plan” proposed that the production and sales of NEVs would reach about 2 million vehicles by 2020. All buses in built-up areas of the municipalities directly under the central government, provincial capital cities, and cities with independent planning status in key regions would also be replaced with NEVs. According to data released by the China Association of Automobile Manufacturers, the production and sales volumes of NEVs in China in 2020 were 1.366 million and 1.367 million respectively, accounting for about 5.4% of the total automobile production and sales volume. Despite the growth in volume, however, the target of “about 2 million vehicles” remained unmet, as shown in Figure 34. On the topic of promotional efforts, the growth rate of NEVs in 2020 turned from negative to positive compared to the previous year. Among this growth, the sales volume of battery electric vehicles increased the fastest, reaching 11.6% and fully demonstrating the strong promotional efforts of NEVs in China. On the topic of category, the sales percentage of NEVs among the total sales of passenger vehicles was almost three times as high as that of commercial vehicles. NEVs were also used in the addition of new buses or replacement of outdated buses in seven provinces (cities), including Beijing, Shaanxi, Shanghai, and Hunan. Such a protocol led to achieving the goal “all buses are replaced by NEVs.”

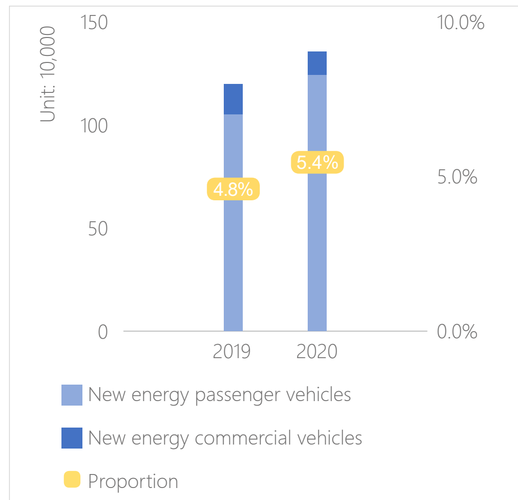

Figure 34: Sales Volumes and the Proportion of NEVs in 2019–2020

Policies assisting in the promotion of NEVs were introduced.

In 2020, China issued some promotion policies for NEVs, mainly focusing on five themes: reducing purchase costs, improving subsidies and rewards, clarifying technical regulations, lowering thresholds for enterprises, and improving layout planning. The goal for these policies is to fully promote purchase, sales, and research and development, as well as bring out the greater vitality of China’s NEV market, as shown in Figure 35.

Regarding the reduction of purchase costs, China issued the “Notice on Relevant Policies for Exempting New Energy Vehicles from Vehicle Purchase Tax,” specifying that NEVs purchased from 1 January 2021 to 31 December 2022 will be exempted from vehicle purchase tax. Reducing purchase costs can promote the development of the NEV industry, stimulate the market consumption of NEVs, and improve their comprehensive competitiveness.

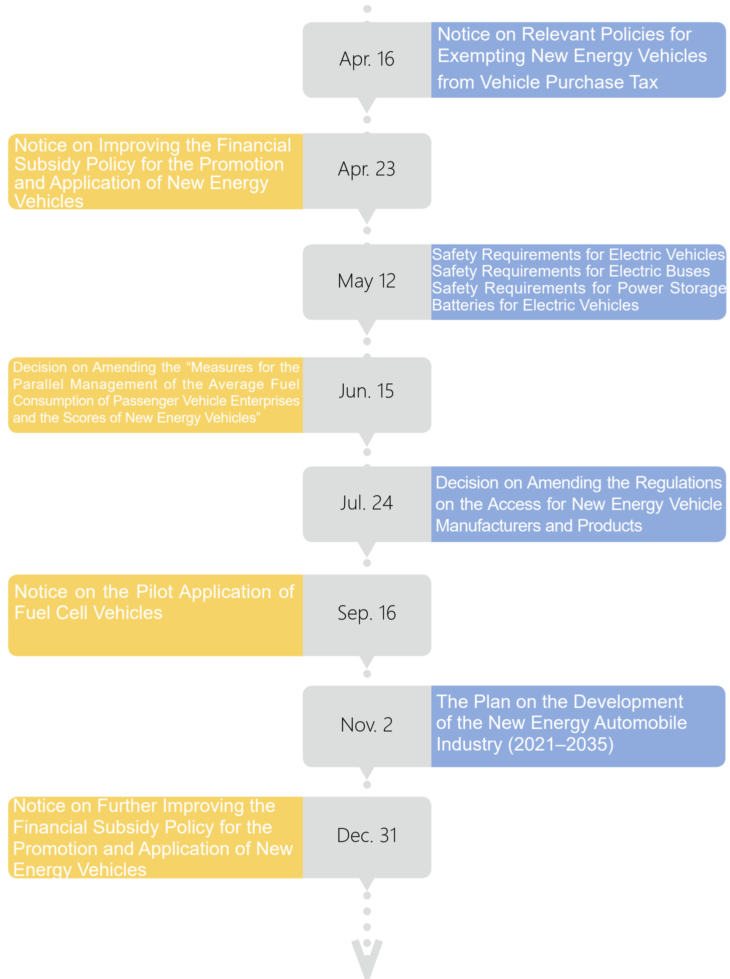

Figure 35: List of Promotion Policies for NEVs in China in 2020

As for the improvement of subsidies and incentives, China successively issued the "Notice on Perfecting the Financial Subsidy Policy for the Promotion and Application of New Energy Vehicles" and the "Notice on Further Perfecting the Financial Subsidy Policy for the Promotion and Application of New Energy Vehicles." Extending the subsidy period, optimizing technical indicators, improving capital settlement, adjusting subsidy methods, and improving supporting policy measures can slow the decline of financial subsidies and promote NEVs scientifically. The "2020 New Energy Vehicles Promotion Subsidy Scheme and Technical Requirements of Products" stipulated the subsidy amount for NEVs, with the capped financial subsidies for each truck and bus at RMB50,000 and RMB90,000 respectively. The "Notice on the Pilot Application of Fuel Cell Vehicles" also proposed to reward pilot city clusters for fuel cell vehicles by "replacing subsidies with awards." At the same time, the central government would allocate bonuses through "post-subsidy" according to evaluation results.

To clarify technical regulations, SAMR issued the "Safety Requirements for Electric Vehicles," the "Safety Requirements for Electric Buses," and the "Safety Requirements for Power Storage Batteries for Electric Vehicles." These comprise the first batch of mandatory standards in the field of electric vehicles in China. They cover the safety requirements for components, systems, and complete vehicles of electric vehicles and buses and aim to improve the overall safety level of the industry. The main contents of the three mandatory standards are fully in line with the United Nations Global Technical Regulations on Electric Vehicle Safety (UN GTR No.20), with some indicators even stricter.

In 2020, China further lowered the threshold for enterprises in the manufacturing of electric vehicles through some relevant policies to stimulate the production vitality of the enterprises. Specifically, the "Decision on Amending the 'Parallel Management Measures for the Average Fuel Consumption of Passenger Vehicle Enterprises and Scores of New Energy Vehicles'" (hereinafter referred to as "Access Measures") and the "Decision of the Ministry of Industry and Information Technology on Amending the 'Regulations on the Access Management of New Energy Vehicle Manufacturers and Products'" (hereinafter referred to as "Access Regulations") were issued. The new scoring method relaxes the standard requirements in the average fuel consumption scoring of enterprises. The revised "Access Regulations" deleted the requirements for the design and development capabilities of enterprises and extended the production suspension time of enterprises that fail to meet the access requirements to 24 months before making a special notice.

In terms of improving layout planning, the General Office of the State Council officially issued the "Plan of the New Energy Vehicle Industry Development (2021–2035)" (hereinafter referred to as the Plan), clearly defining the goal that "the sales volume of NEVs will account for 20% of total vehicle sales in 2025." Regarding the new trend in the future development of NEVs, the Plan emphasizes the transition from electrification to intelligence and networking. It also focuses on the improvement of infrastructure systems, such as charging and replacing power storage battery networks, the intelligent road network, and hydrogen fuel supply, as well as the integrative development of NEVs and energy, transportation, and information industries.

To support the promotion of new energy trucks in China, Beijing, Suzhou, Luoyang, and other cities released relevant subsidies and promotion plans, as shown in Table 3. In 2020, Beijing provided incentive funds for vehicle owners who eliminated or transferred out their gasoline and diesel trucks and replaced them with new energy light-duty trucks. The electrification of vehicles in public service was enhanced by restraining the consumption of automobile diesel. In addition, Zhengzhou, Beijing, Shanghai, Changsha, Hezhou, Taiyuan, Nanchang, Tianjin, Chongqing, Xiangyang, Harbin, Tongchuan, Xi'an, Anyang, and Chengdu successively issued notices on removing restrictions on the driving of NEVs in some areas at certain schedules, further relaxing the right of way.

Connections were made with the state power grid to further reduce the carbon emission of NEVs.

In terms of a life cycle, carbon emissions from vehicles mainly occur in fuel production, vehicle cycle, and fuel use. For traditional fuel vehicles, the fuel use process constitutes the leading force for carbon emissions. The use of NEVs can significantly reduce carbon emissions generated during fuel use. In particular, battery electric vehicles can achieve “zero emissions” of exhaust. These vehicles also have a higher power system efficiency compared to traditional fuel vehicles. Among NEVs in China, battery electric vehicles account for the highest proportion, far exceeding plug-in hybrid vehicles and fuel cell vehicles.

However, battery electric vehicles are more dependent on a power generation system compared to other NEVs, and China's power grid is currently highly dependent on coal-fired power generation. This has led to a rise in the carbon emission intensity of battery electric vehicles. The proportion of power generated by fossil fuels in the power

Table 3: Subsidies for in-Use New Energy Trucks in Selected Chinese Cities

City	Plan	Date	Threshold for enterprises (number of NEVs)	Mileage traveled (km/yr)	Subsidy amount
Shenzhen	Regulations on Special Funds for the Development of the Modern Logistics Industry in Shenzhen	From May 2018 to May 2021	100/50	15,000	RMB75,000 (3 years)
Anyang	Regulations on Special Funds for Operating Subsidies for New Energy Vehicles in Freight Transportation in Anyang	From 2019 to 2021	30	6000	RMB6,000 (1 year)
Zhengzhou	Special Action Plan for New Energy Vehicle Replacement in Zhengzhou (2019–2020)	From 2019 to 2021	None	15,000	RMB50,000 (3 years)
Wuhan	Some Policies for Accelerating the Development of the Modern Logistics Industry in Wuhan	From June 2019 to June 2021	100	20,000	RMB3,000 (1 year)
Suzhou	Regulations on Rewards and Subsidies for Vehicles in Green Freight Transportation in Suzhou	From January 2020 to 2022	None	10,000	RMB28,000 (1 year)
Beijing	The 2020 Incentive Scheme for the Operation of New Energy Light–Duty Trucks in Beijing	From 1 September 2020 to 31 August 2021	Five vehicles updated	10,000	RMB70,000 (3 years)
Luoyang	Incentive Policies and Fund Management Measures for New Energy Vehicles in Urban Transportation in Luoyang	From 25 August 2020 to 30 December 2021	30	20,000	RMB20,000 (1 year)

structure and the electricity consumption of electric vehicles are thus two crucial factors affecting the carbon emission of electric vehicles. Whether cleaner electricity can be used is one key to constraining the carbonization of NEVs.

Reducing carbon emissions in the power generation system through the adjustment of the power structure, the upgrading of power generation technologies, and the expansion of the cogeneration scale can further enhance the carbon emission reduction potential of battery electric vehicles. The “New Energy Automobile Industry Development Plan (2021–2035)” also emphasizes the energy interaction between NEVs and the power grid, as well as the high-efficient coordination between NEVs and renewable energy. For one, the plan aims for highly efficient interaction between NEVs and the power grid. For another, the proportion of the use of renewable energy needs to increase to contribute to the comprehensive reduction of carbon emissions.

The continual optimization of the transportation structure promoted the coordinated emission reduction of air pollutants and greenhouse gases.

To adjust the transportation structure, China set development goals regarding the three aspects of “road-to-railway,” “road-to-waterway,” and “multimodal transport” to reduce road transportation volume and further reduce air pollutant and carbon emissions in the transportation industry. The “Three-Year Action Plan” and the “Three-Year Action Plan for Promoting Transport Structure Adjustment (2018–2020)” set the following goals: waterway freight volume was to increase by 500 million tons in 2020 or by 7.5% compared to 2017, while railway freight volume was to increase by 1.1 billion tons—an increase of 30%, among which the BTH region and its surrounding areas, the Fenwei Plain, and the YRD region were to increase by 40%, 25%, and 10% respectively. From 2017 to 2020, the national multimodal transport freight volume increased by 20% annually. According to the National Bureau of Statistics of China, compared to 2017, China’s railway freight volume increased by 770 million tons in 2020—an increase of 21%—while waterway freight volume increased by 940 million tons—an increase of 14.1%. These values can be interpreted to mean that, in 2020, China met the “road-to-waterway” aspect of the goal, but there remained a gap of nearly 330 million tons in “road-to-railway” transportation.

To achieve the “road-to-railway” and “road-to-waterway” aspects of China’s development goals, port freight became the primary object. In the process, China proposed that the road transportation volume of bulk goods in coastal ports be reduced by 440 million tons in 2020 compared to 2017. China also suggested that the combined transportation volume of containers via the railway and waterway in key ports increase by more than 10% annually. According to public data, in 2020, ports in China reached the combined transportation volume of 6.87 million twenty-foot equivalent units through the railway and waterway, with an average annual growth rate of over 30% compared to 2017. This rate far exceeded the target of “an average annual growth rate of over 10%.”

To further solve the infrastructural problem of the “last mile” in railway transportation, the central government set the goal of constructing special railway lines for key enterprises. By 2020, the access ratio of special railway lines in major coastal ports, large industrial and mining enterprises with an annual volume of over 1.5 million tons of bulk goods, and newly built logistics parks would reach 80%. Special railway lines would be introduced into major ports on the Yangtze River. Tianjin made positive progress in this respect. In 2020, among the 11 large industrial enterprises under the Rongcheng Group with an annual volume of bulk goods exceeding 1.5 million tons, the access ratio of special railway lines was as high as 92%.

Transportation structure adjustment has been the key direction of air pollution prevention and control in the transportation industry in the past three years and the path of pollution reduction and carbon reduction that still needs to be deepened in the future. The “Opinions of the Ministry of Transport on Promoting the Modernization of Transportation Governance System and Governance Ability” issued in October 2020 proposed that a long-term mechanism be established for transportation structure adjustment to adapt to the changes in the industrial and energy structures. The file also defined the future direction of transportation structure adjustment. According to the regional transportation structure adjustment planning, NDRC and MOT jointly issued the “Integrated Development Plan for Higher-Quality Transportation in the Yangtze River Delta Region,” specifying that “by 2025, railway density will reach 507 km/10,000 km², and the average annual growth rate of railway and waterway freight volume will not be less than 5%.” From the perspectives of railway construction and freight structure, the plan set the direction for transportation structure adjustment in the YRD region. The YRD region will build a cleaner, more intelligent, and more intensive transportation system by constructing an integrated facility network with rail transit as the backbone, world-class airport clusters and port clusters, and a modern intelligent transportation system and integrated transportation services.

The aim of promoting the adjustment of the transportation structure in China is to build a modern, comprehensive transportation system, support the victory of the “Blue Sky Defense Battle,” and win a tough battle against pollution. After China set the "double carbon" goal for 2020, the adjustment of the transportation structure stopped being limited to reducing air pollutant emissions. However, the "road-to-railway" and "road-to-waterway" aspects have also become the most important approaches to reduce carbon emissions for the transportation industry, especially in terms of bulk material transportation.

Supervision measures for nonroad mobile sources were enriched, while the supervision system was further improved.

Measures were launched to help reduce emissions and supervise nonroad mobile machinery.

Given high pollutant emission intensity and mobility, information related to the holdings, usage, and emissions of nonroad mobile machinery is always lacking. This information has further deteriorated due to insufficient supervision and irregular management. In recent years, China has gradually strengthened the refined management of nonroad mobile machinery emissions by tightening the emission standards of newly produced machinery, strengthening the emission control of in-use machinery, and adequately obtaining information on holdings, usage, emissions, and other elements.

Firstly, China mainly reduces nonroad mobile machinery emissions by tightening the standards of newly produced machinery and controlling in-use machinery. The "Technical Requirements for the Emission Control of Nonroad Diesel Mobile Machinery" (HJ1014-2020) issued in 2020 supplemented the China IV Emission Standards in GB20891-2014, clarifying that the technical requirements will be fully implemented in December 2022. The new standards were added with the requirements for testing the whole engine using the Portable Emissions Measurement System (PEMS) method, particle number limits and remote monitoring and positioning, and a specified deterioration coefficient. At the same time, the three-wheeled vehicle is included in the unified management of China IV Emission Standards for nonroad mobile machinery. Compared with European and American standards, these new standards pay more attention to real-world emissions and adequate supervision and guide the industry in thoroughly solving the problem of black smokes by setting new particle number limits and adopting diesel particulate filters.

Secondly, the following three measures were adopted to control in-use machinery: designating low-emission zones, high-emission machinery retrofitting, and online supervision. About designating low-emission zones, by the end of 2020, 311 cities at the prefecture level or above in China had designated low-emission zones for nonroad mobile machinery. Among them, Beijing, Hebei, Henan, and other places continued to expand the scope of low-emission zones. These areas only allowed the use of machinery with stricter emission standards or meeting the required emission limits in low-emission zones. They also punished violators illegally selling or operating machinery. Table 4 shows the specific policies in selected provinces and cities. In terms of high-emission machinery retrofitting, Bozhou City provided a subsidy of RMB4,000–6,000 per set to China II Standards machinery for retrofitting and connecting to the network. In 2020, the retrofitting of 261 sets of nonroad mobile machinery was completed, and Hebei Province installed pollution control devices on nonroad mobile machinery. As of August, the devices had been installed on a total of 14,600 machines. As for remote online supervision, the BTH region implemented the "Regulations on the Prevention and Control of Emission Pollution from Motor Vehicles and Nonroad Mobile Machinery," which required the use of vehicle-mounted terminals for remote management to standardize and supervise the pollution emissions of bulldozers, excavators, and other machinery online. Beijing also formulated management measures for vehicle-mounted terminals, requiring production enterprises to install remote monitoring devices and connect them with the municipal ecological environment bureau for the real-time and intelligent supervision of nonroad mobile machinery emissions.

In terms of investigating holdings, 31 provinces, autonomous regions, and municipalities directly under the central government in China have carried out the code registration of nonroad mobile machinery. In 2020, 1.877 million pieces of code registration data were uploaded nationwide. Beijing and Hebei formulated the corresponding "Regulations for the Registration of Nonroad Mobile Machinery (for Trial Implementation)." They implemented the registration method of "one code for one set of a machine" to track machinery usage and strengthen on-site law enforcement. According to statistics, Hebei Province completed the coding registration of 63,100 sets for engineering machinery and on-site vehicles in August.

The shore power policy emphasized promotion and port pollution control was strengthened.

China controls vessel emissions mainly by designating emission control areas and promoting shore power, thus reducing pollutant emissions while vessels are navigating and berthing, and improving the air quality in ports.

For emission control areas, China has continued strengthening and upgrading certain measures. From 1 January 2020, the limit of sulfur

Table 4: Policy Measures for Low-Emission Zones in Selected Cities and Provinces

Beijing	"Notice on the Designation of Zones Banning the Use of High-Emission Nonroad Mobile Machinery" *Since 1 January 2020, the scope of low-emission zones has expanded further, and the low-emission zone policy has been implemented throughout Haidian, Fengtai, Daxing, and Fangshan and some administrative regions of Mentougou, Shunyi, Changping, Pinggu, Huairou, Miyun, and Yanqing.*
Shijiazhuang	"Notice on Adjusting Low-Emission Control Zones for Nonroad Mobile Machinery in Shijiazhuang City" *The scope of low-emission zones was specified, while the sale and use of high-emission nonroad mobile machinery and nonroad mobile machinery with visible black smoke were prohibited.*
Henan Province	"Notice on Further Promoting the Investigation, Coding, and Registration of Nonroad Mobile Machinery" *It is recommended that ecological environment departments at all levels strictly manage the no-traffic areas for high-emission nonroad mobile machinery. Nonroad mobile machinery exceeding the China II Emission Standards, without an environmental protection license plate, or with excessive emissions shall not enter the prohibited areas within the province.*
Shenyang	"Notice on the Demarcation of Low-Emission Zones for Motor Vehicles and Nonroad Mobile Machinery" "Notice on the Supervision and Management of Nonroad Mobile Machinery to Reduce Pollutant Emissions" *The use of nonroad mobile machinery that does not meet the China III Emission Standards within the Second Ring Road of Shenyang will be punishable by law.*

content in marine fuel for sea-going ships entering inland river control areas has been tightened from 0.5% m/m to 0.1% m/m. From 1 March 2020, vessels not using sulfur oxide and PM pollution control devices have only been allowed to load and use marine fuel that meets the requirements of emission control areas. Fuel testing has become important in supervising vessels in emission control areas. The application of rapid inspection devices, remote sensing monitoring, and unmanned aerial vehicles (UAVs) has improved the efficiency of vessel supervision. During the China International Import Expo in 2020, the Shanghai Maritime Safety Administration implemented multiple measures simultaneously. It adopted a new supervision mode of "fixed point screening-verification by UAV-law enforcement personnel boarding vessels for investigation," by which to create an integrated supervision network that operated "at sea, on land, and in the air." It also developed and used black smoke detection applications on vessels, which could automatically identify, track, and judge vessels emitting black smoke, and comprehensively strengthened vessel emission supervision.

Regarding the promotion of shore power, China has issued several policies to encourage and require vessels to use shore power and penalize ships that fail to use shore power as required. In 2020, China issued the "Guide to Green Port Grade Evaluation," the "Outline of Inland River Shipping Development," and the "Regulations of Shore Power for Ports and Vessels," all of which emphasized the promotion of shore power. These regulations put forward several measures for promoting shore power by urging local governments to issue relevant policies, excluding the power consumption of berthing vessels in the statistics of port power consumption, encouraging relevant units to provide priority berthing, reducing or providing exemptions to shore power service fees, and giving priority to gate crossing and passing. Many ports required vessels that berthed for a specified time to use shore power. For example, the Port of Shanghai investigated and penalized all vessels that failed to use shore power as required. In December 2020, China passed the "Yangtze River Protection Law of the People's Republic of China," the first watershed protection law, which specified the penalties for not using shore power. The goal is to effectively promote the use of shore power by vessels in the Yangtze River Basin.

In addition to vessel emissions, the impact of port machinery, port transport vehicles, port vessels, and other emission sources on port air quality cannot be ignored. These emission sources are mainly driven by diesel fuel. As such, the direction of governance in China has primarily reflected two aspects: the "adjustment of the energy structure" and the "upgrading of emission standards." These aspects encourage new or replacement port machinery, port transport vehicles, and port vessels to prioritize new and clean energy. They also promote pollution control and elimination for substandard port machinery to reduce emissions from pollution sources.

Area Sources

The construction of the dustfall monitoring system continued, and the 2020 assessment target for comprehensive dust control in the key regions was successfully achieved. The goal for the comprehensive utilization of straw as specified in the 13th Five-Year Plan was reached. However, the number of straw-burning locations rose. With this increase, the plan to tackle critical problems in autumn and winter further stressed the accurate and intensive monitoring using intelligent means.

The construction of the dustfall monitoring system continued, and the governance goal was achieved in the key regions.

The dustfall monitoring results released by MEE showed that from March to December, the BTH region and the Fenwei Plain reached the assessment target that “the average dustfall shall not be higher than 9 tons/month·km^2.”

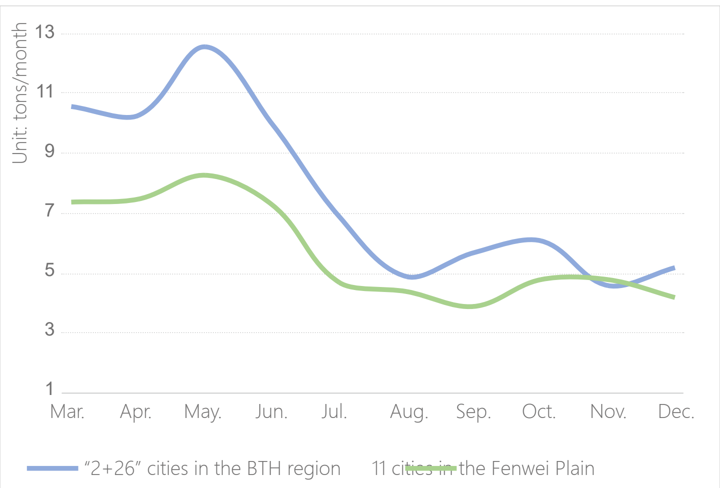

Figure 36: Average Dustfall Amount in the BTH region and the Fenwei Plain from March to December 2020

In 2020, Beijing stepped up its efforts to control road and construction dust, decreasing annual dustfall by 12.1% year-on-year and overall dustfall by 32% compared to 2018. Hebei Province formulated the “Measures for the Prevention and Control of Dust Pollution.” The Department of Ecology and Environment cooperated with seven other departments, including housing construction, natural resources, and transportation, to supervise and manage the prevention and control of dust pollution. Hebei Province built a dust-monitoring system in its cities (counties) and installed video monitoring and online dust-monitoring systems in more than 6,200 construction sites in the province. Shanxi Province achieved full coverage of dustfall monitoring, and the dustfall in its 11 cities was lower than the assessment target of 9 tons/month·km2. Anhui Province released dustfall monitoring results and rankings for the first time, and the amount of dustfall in each city was 0.8 to 4.2 tons/month·km2, which met the YRD’s requirements for dustfall control in Northern Anhui of no more than 7 tons/month·km^2.

Hebei Province achieved outstanding results in mine environment management, with the number of solid mines reduced to 2,186, 2,704 open-pit mines repaired and 58 mines certified as green mines by the central government. Zhejiang Province issued the “Implementation Plan for the Comprehensive Improvement of Open-Pit Mines.” Hangzhou rectified 32 mines and repaired 77 abandoned mines, ranking first in Zhejiang Province.

The goal of comprehensively utilizing straw as specified in the 13th Five-Year Plan was achieved, but the number of burning locations slightly increased.

During the 13th Five-Year Plan period, the national policies for air pollution from agricultural area sources were put forward in the “Action Plan for Agricultural and Rural Pollution Control” and the “Implementation Opinions on Fighting against Pollution from Agricultural Area Sources.” As a result, the use of chemical fertilizers and pesticides in the whole country continuously decreased. The utilization rates of chemical fertilizers and pesticides for the three major food crops (rice, corn, and wheat) reached 40.2% and 40.6% respectively. The level of resource utilization of agricultural wastes also improved. The comprehensive utilization rate of livestock and poultry manure advanced to 75%, while the recovery rate of agricultural film was registered at 80%. The total utilization rate of straw also rose to 86.7%, exceeding the goal for the comprehensive utilization of straw as specified in the 13th Five-Year Plan that “by 2020, the comprehensive utilization rate of straw in China will reach over 85%.”

In 2020, 7,635 straw-burning locations were found via satellite remote sensing. This number is an increase of 1,335 compared to 2019. These locations were distributed in the provinces mainly in Northeast and North China, including Jilin, Inner Mongolia, Heilongjiang, Liaoning, Shanxi, Shandong, Xinjiang, Guangxi, Gansu, and Henan. To strengthen their control of straw burning, the key regions in the BTH region and its surrounding areas and the Fenwei Plain proposed for the first time to launch special inspections on usual straw-burning locations in the autumn harvest season through the use of intelligent tools such as UAV and satellite remote sensing.

Safeguarding Measures

In 2020, the fixed-point assistance in the collaborative supervision of $PM_{2.5}$ and O_3 pollution was completed for the first time. The supervisory authority for ecological environment protection by the central government was upgraded again. Information disclosure was also strengthened, thus laying a solid foundation to ensure the results of the "Three-Year Action Plan" and the successful start of the 14th Five-Year Plan period. In the future, fiscal appropriation from the central government will be significantly reduced. Market-based economic means such as green taxation and financing will become important ways to fill the funding gap and encourage emission reduction.

Administrative Means

O_3 pollution control was included in the scope of supervision and fixed-point assistance, and the frequent occurrence of VOC emission issues was discovered.

In 2020, MEE conducted five rounds of supervision and assistance on O_3 pollution prevention and control in the summer and found 33,000 enterprises with VOC emission issues totaling 105,000. In terms of supervision and assistance on $PM_{2.5}$ pollution in autumn and winter, MEE conducted two rounds of special investigations on clean heating by employing 442 working groups with 1,406 members. They timely informed local governments of the main problems found in the inspections, urged them to rectify the issues within a time limit, and carried out follow-up examinations on the regions behind the rectification schedule.

To deal with key tasks such as eliminating excess production capacity, relocating iron and steel plants, and promoting clean heating, Hebei Province set up 14 supervision and assistance teams and one touring supervision team to implement fixed-point assistance. The province also established one-to-one contacts with the four Hebei cities of Shijiazhuang, Tangshan, Xingtai, and Handan, which were among the 10 cities that ranked last in air quality rankings. Shanxi Province set up six inspection teams stationed in Taiyuan, Lüliang, Jinzhong, Changzhi, Jincheng, and Yuncheng. The investigations were mainly focused on reducing coking capacity and relocating iron and steel plants. Shaanxi Province thoroughly investigated the oil and gas pollution in Yan'an and Yulin. The province conducted follow-up examinations on air pollution prevention and control in four counties or districts, including the Gaoling District in Xi'an City and Chencang District in Baoji City.

The matters and objects of interviews were upgraded, with provincial leaders open to being interviewed for prominent problems.

Based on the Interim Measures for Interviews in 2014, MEE officially released the "Measures for Interviews of the Ministry of Ecology and Environment" in 2020, which added interview occasions, covered provincial leaders and the top leaders of state-owned enterprises, and standardized and refined a series of interview processes. The measures specified four occasions when provincial leaders can be interviewed: (i) the ineffective rectification and implementation of environmental reforms despite the receipt of important instructions from the General Secretary and the central government; (ii) failure to achieve the total emission control goals for major pollutants; (iii) failure to complete environmental quality improvement and carbon emission intensity targets; and (iv) prominent problems that generate public resentment and that they fail to address sufficiently on ordinary days and solve with "one-size-fits-all" approaches.

The supervision and enforcement of the law were strengthened and its scope of functions expanded, while a compensation system for damages to the ecosystem was officially established.

In October 2020, the second batch in the second round of seven environmental protection inspection groups from the central government was stationed for supervision in the three provinces and municipalities of Beijing, Tianjin, and Zhejiang, as well as the two central enterprises Aluminum Corporation of China and China National Building Material Group Co., Ltd. This batch handled 8,766 cases, interviewed 872 people, held 283 people accountable, and conducted 587,400 law enforcement and examination activities. In addition, they initiated a pilot project of exploratory inspection, which included for the first time two departments of the State Council, namely NEA and the National Forestry and Grassland Administration.

As part of the implementation of the "Regulations of the Central Government on the Supervision of Ecological Environment Protection," the implementation of the compensation system for damages to the ecological environment commenced in 2020. The aim was to hold polluting enterprises accountable and make them realize the economic costs of environmental damage. In 2020, more than 2,700 compensation cases were handled—an increase of more than three times over the same period of the previous year, with a total compensation amount of RMB5.3 billion. However, interdepartmental coordination and synergy between MEE and public security organs still need to be further strengthened. In December 2020, MEE and SAMR issued for the first time the "Virtual Treatment Cost Method for Air Pollution," the first part of the "Basic Method of the Technical Guidelines for the Identification of and Assessment of Damages to the Ecological Environment," which refined the verification method for air pollutant emissions and further strengthened capacity building concerning damage identification and assessment.

Central-government-owned enterprises and local governments disclosed their rectified plans and encouraged public participation in reporting illegal acts through incentive mechanisms.

Environmental protection inspection groups disclosed the cases of environmental pollution caused by central-government-owned enterprises such as the Aluminum Corporation of China and China Minmetals Corporation and the results of their inspection and reporting. They required the enterprises to make corresponding rectifications. Based on the feedback from the second round of environmental protection inspection in 2019, Shandong, Shaanxi, Anhui, Gansu, Qinghai, Sichuan, Chongqing, Shanghai, Fujian, Jilin, Hunan, Guizhou, and other provinces made their rectification plans public and put pressure on the cities with lower air quality rankings in the provinces to complete the important tasks in the closing year of the "Three-Year Action Plan."

In addition, provincial and municipal ecological and environmental departments built and implemented a reward system for reporting for the first time in 2020. MEE issued the "Guiding Opinions on Implementing the Reward System for Reporting Illegal Acts on the Ecological Environment," encouraging the public to report environmental problems with rewards in the form of economic incentives. This system assisted local governments in broadening the channels for discovering illegal problems and forcing enterprises to comply with environmental laws. In 2020, 13,870 cases were rewarded nationwide—a year-on-year increase of 44%.

Measures in responding to heavy pollution days were upgraded, and the joint prevention and control of pollution in Shanxi, Sichuan, and Chongqing were strengthened.

The measures for target setting and responding to heavy pollution days in the plan on the integrated prevention and control of air pollution in the autumn and winter of 2020–2021 in the three key regions were upgraded. The two-phased target for $PM_{2.5}$ concentration in October to December 2020 and January to March 2021 was added, while $PM_{2.5}$ pollution levels were refined and graded. The control target for heavy pollution days was also changed from percentage to the number of days.

Heavy pollution days occurred twice during the strict pandemic prevention and control period in early 2020. As a result, MEE issued the "Technical Guidelines for Formulating Emergency Emission Reduction Measures for Key Industries in Heavy Pollution Days (Revised Edition in 2020)." These guidelines increased the number of industries graded for their performance in implementing relevant emission reduction measures from 15 to 39, covering VOC-related industries as well. New key industries included packaging fiber, artificial leather, automobile manufacturing, and construction machinery. Differentiated management and control were also upgraded again. Enterprises with a Grade A rating were allowed to take emission reduction measures independently, while those rated as Grade B or below were required strict compliance with the emission reduction measures. Hebei Province completed performance grading and differentiated control in more than 36,000 enterprises.

For another, the three key regions specified for the first time the intensive promotion of the integrated regional joint prevention and control mechanism. The common governance focus was placed on the ultra-low emission retrofitting of iron and steel plants, the adjustment of the transportation structure, and the governance of industrial furnaces and coal-fired boilers. To address unique pollution problems in different regions, the BTH region and the Fenwei Plain focused on clean heating, rectifying "scattered, unregulated, and highly polluting enterprises," and the ban on straw burning. Meanwhile, the YRD region focused on vessel pollution and VOC control. Under the joint prevention and control mechanism of the BTH region, Hebei Province and Tianjin City organized joint enforcement actions, investigated 238 enterprises emitting air pollution in four counties and six townships under the administration of Langfang City, and helped them rectify 82 environmental violations. Shanxi Province started the "1+30" joint prevention and control mechanism for air pollution in Taiyuan and its surrounding areas for the first time. This mechanism strengthened the ability of the cities in the province to cooperate in coping with heavy pollution days.

Thirdly, Sichuan Province and Chongqing signed the "Agreement on Deepening the Joint Prevention and Control of Air Pollution between Sichuan and Chongqing." In June 2020, the first conference on the joint prevention and control of air pollution in the key regions was held, focusing on strengthening cooperation in controlling air pollution in regional transport channels. The key industries included thermal power, iron and steel, cement, petrochemical, glass, brick, and boiler. At the same time, the rectification of "scattered, unregulated, and highly polluting enterprises" was strengthened. In addition, the two places shared data on air quality, pollution alerts and forecasting, the online monitoring of and law enforcement on pollution sources, inspections on motor vehicles and traffic pollution, and other related information through a large data platform. The goal was to fill the data gap and eliminate dead zones in governance.

Economic Means

Funds for air pollution prevention and control from the central government were decreasing, and the construction of a modern environmental governance system urgently needed to be upgraded through marketized means.

In 2020, the central government allocated RMB25 billion of air pollution prevention and control funds, similar to previous years, of which RMB11.95 billion was used for clean heating. At the local government level, Shanxi Province distributed about RMB1.8 billion of special provincial funds, while Anhui Province distributed about RMB200 million. According to the notice issued by the Ministry of Finance on air pollution prevention and control funds in 2021, despite expanding the scope of support from the three key regions to 31 provinces in China, the total amount of funds decreased to RMB15 billion. Of this amount, nearly half (RMB7.34 billion) was used for clean heating, mainly to support the provinces of Shandong and Shanxi. The sharp reduction of special funds from the central government signaled its shift to promoting the construction of market-oriented mechanisms with local governments as the leading players. In 2020, the General Office of the Central Committee of the Chinese Communist Party and the General Office of the State Council jointly issued the "Guiding Opinions on Building a Modern Environmental Governance System," aiming to complete the establishment and improvement of seven environmental governance systems by 2025. The issuance specified the primary responsibility of local finance over environmental governance expenditure, strictly pressuring enterprises to comply with the polluter pays principle. The issuance also strengthened policy tools, including finance, taxation, and green financing to support the private sector.

Financial policy support was specified for the first time in the key regions' plan on integrated air pollution prevention and control in autumn and winter. The BTH region and the Fenwei Plain specified using various channels to raise funds to support clean heating and focused on increasing financial support for rural low-income groups. The central government also launched an innovative model of "replacing subsidies with awards" to help phase out heavy duty diesel trucks meeting the China III Emission Standards and below. Key areas in the YRD region focused their financial policies on the transportation industry, requiring all places to implement tax exemption on purely natural gas-powered vessels and prioritize the reformation projects of power reception facilities for vessels for funding allocation.

The country promoted pollution and carbon reduction through market incentives and increased green financial policy support.

In July 2020, the National Green Development Fund jointly established by the Ministry of Finance, MEE, and Shanghai Municipality was officially put into operation, focusing on raising funds from the public and private sectors. These funds were intended for such key areas as environmental protection and pollution prevention and control, clean energy, and green transportation, aiming to guide enterprises and consumers in green production and consumption and toward sustainable development. The scale of the first phase was RMB88.5 billion, of which RMB10 billion came from the central government. Shenzhen launched China's first green financial legislation, the "Regulations on Green Finance in Shenzhen Special Economic Zone," which developed green credit and insurance products and forced enterprises to disclose environmental information. In 2020, to further stimulate the vitality of the green market, Shenzhen arranged RMB5.2 billion worth of financial subsidies and RMB356.1 billion worth of green credits. A total of 671 local enterprises invested RMB17 million in purchasing environmental pollution liability insurance.

Green bonds are a core financing tool of green finance, leveraging the capital market to provide financial support for projects that produce environmental and climate benefits and narrowing the vast gap in financing needed for green development. Notably, China has standardized its classification standard for green bonds according to international standards. In July 2020, the People's Bank of China, NDRC, and the China Securities Regulatory Commission jointly issued the "Green Bond Endorsed Projects Catalogue (2020 Edition)," which deleted the relevant categories for the clean utilization of fossil energy for the first time. This issuance marked the release of a clear market signal in China and led domestic and foreign investors to focus on renewable energy investment and financing.

Regarding climate investment and financing, China uses policy guidance and broadens funding channels to invest in climate mitigation and adaptation and reduce air pollution emissions through synergistic efforts. Five ministries and commissions, including MEE, issued the "Guiding Opinions on Promoting Investment and Financing in Response to Climate Change," setting two key policy objectives: form a favorable policy environment for the development of climate investment and financing by 2022; and boost the coordinated and efficient promotion of climate policies and those in investment, finance, industry, energy, and environment by 2025.

Green taxation serves as an essential market-based economic means in environmental governance to improve the initiative of enterprises in technological innovation and promote emission reduction. Since the issuance of the "Environmental Protection Tax Law" in 2018, SO_2 and NOx emissions, the primary air pollutants declared by taxpayers, decreased annually by 3.5% and 3.1% respectively. Pollution equivalents per GDP fell from 1.16 in 2018 to 0.86 in 2020—a sharp drop of 25.8%. During the 14th Five-Year Plan period, China will further promote the reform of the green taxation system, study the inclusion of VOCs in the scope of environmental protection tax collection, and explore preferential tax policies for NEVs and key industries.

The carbon emission trading system is also a critical market-oriented tool for achieving the policy goal of reducing pollution and carbon emission. By establishing a trading market to provide effective price signals, this system helps enterprises reduce emission reduction costs, thus realizing a more optimal allocation of resources. In 2020, the "Regulations for Carbon Emission Trading (for Trial Implementation) (Exposure Draft)" and the "Implementation Plan for Setting and Allocating Total Quotas of National Carbon Emission Trading from 2019 to 2020 (for the Power Generation Industry)" were successively issued. These issuances indicated promoting the national carbon market from the power sector in the first stage, covering 35% of total CO_2 emissions. This percentage included 2,225 key emission units, and free quotas were issued in the power generation industry, laying a solid foundation for the official opening of the national carbon trading market in 2021.

Chapter III.

Assessment of Cities' Air Quality Management

In 2018, Clean Air Asia developed a method to assess air quality management based on the air quality management framework. Building on the idea of the "Clean Air Scorecard," this method was used to comprehensively evaluate air quality improvement and the implementation of policy measures in cities and rank these cities based on their total scores. Unlike the traditional city ranking for air quality, this report adopts a comprehensive assessment approach, enabling a more extensive evaluation of the cities' efforts and achievements in air pollution control.

In 2010, the Clean Air Scorecard was developed by Clean Air Asia with the support of the Asian Development Bank, aiming to provide a comprehensive assessment tool for air quality management in Asian cities. It has been applied for assessment in several cities in China, Southeast Asia, and South Asia, with continuous revision and optimization through the years. The China Air report learned from the idea of the Clean Air Scorecard and redesigned the scoring method to make it more in line with the characteristics of the implementation and assessment system of the air pollution prevention and control policy in China.

In 2021, the team working on the report made some adjustments to the evaluation indicators and scoring methods based on experts' feedback. With the policy of strengthening air pollution control and carbon reduction and coordinated governance, the adjusted scoring emphasized the effectiveness of adjusting the energy and transportation structure. The team also adjusted the scoring rules reflecting the latest policy requirements and the development trends in monitoring, attainment planning, and information disclosure.

Assessment Method

The assessment tool graded cities through two indicators: (i) air quality improvement and (ii) policy measures. The total mark was worth 100 points, with 50 points for each indicator, emphasizing that both the efforts and the outcome of air pollution control in the cities were equally important. Apart from receiving the total mark of 100 points, cities that performed especially well in air quality improvement and had leading practices in their policy measures, such as putting forward more advanced measures in addition to national policies and requirements, were given bonus points. At the same time, points were deducted for cities that failed to publish environmental status bulletins and disclose air quality data as per the policy requirements of the central government. Points were also deducted for cities whose air quality was below standard, that had yet to formulate and issue air quality attainment plans according to the law, or who were interviewed by MEE due to their ineffective work in air pollution prevention and control.

Figure 37 shows the structure of the assessment tool. Air quality was assessed based on two sub-indexes: the improvement range of the three-year moving average of $PM_{2.5}$ (that is, the improvement range of average concentrations in 2018–2020 compared to 2017–2019) and the improvement range of the three-year moving average of the number of attainment days. The change of the number of attainment days could comprehensively reflect the change of the overall urban air quality level, especially the improvement or change of $PM_{2.5}$ and O_3, which were the

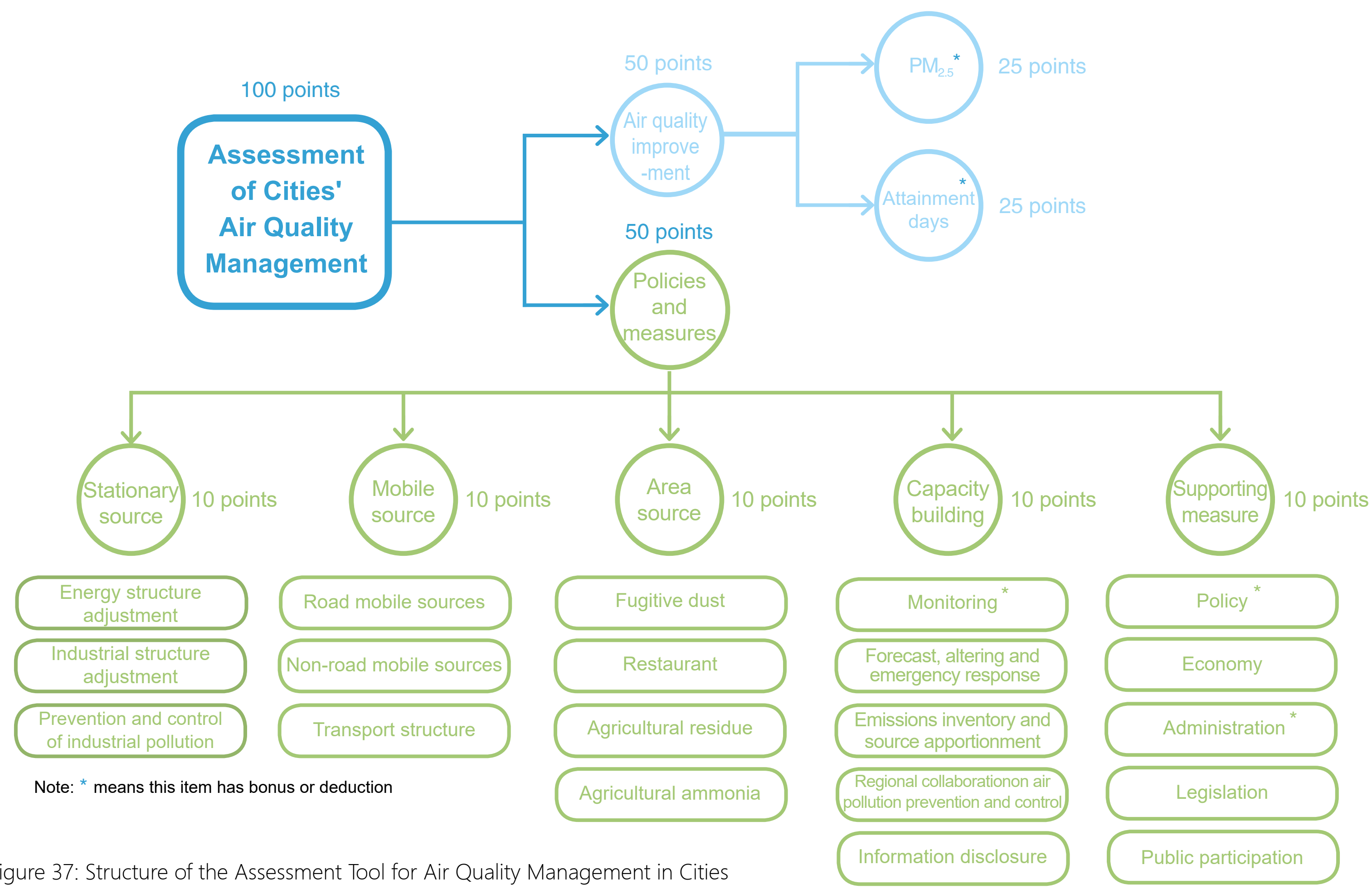

Figure 37: Structure of the Assessment Tool for Air Quality Management in Cities

primary pollutants resulting in non-attainment days. Using the three-year moving average for comparison reduced the influence of meteorological fluctuations and other factors on air quality in a specific year and better reflected the overall improvement of air quality in cities in recent years. This part of the score was the "effect score" of city air quality management.

The policy measures indicator included five sub-indexes: stationary source, mobile source, area source, capacity building, and safeguarding measures. Each sub-index included several sub-items, the aggregate score of which produced the total score for the policy measures indicator. This part of the score was the "effort score" obtained for city air quality management.

A sample graph of the final score is shown in Figure 38.

Figure 38: Sample Graph of Final Score from the Assessment Tool

Score Analysis and City Rankings

Based on the assessment framework, this section of the report ranked and analyzed 168 cities based on their scores on air quality improvement and on policy measures. It examined the cities' progress and achievements in air quality improvement and the policies and actions they put in place. Finally, this report ranked the cities based on the total scores across both indicators. The list highlighted cities with good effect and effort scores to encourage other cities to continuously improve air quality. At the same time, it would motivate cities that performed poorly in both areas to act proactively in raising their position in the rankings.

Air Quality Improvement

The scoring criteria for air quality was designed to encourage cities to make constant improvements in air quality. They gained different base scores subject to their current air quality status; they either acquired or lost scores based on the degree of improvement or decline. Cities that already met air quality standards obtained higher scores if they kept improving, while those with poor air quality had to make more significant improvements to raise their scores. The scores of cities with good air quality history that showed a declining trend decreased; meanwhile, cities with already poor air quality that witnessed further deterioration were included in the category of poorest performers. The Table 5 shows the scores for air quality improvement across 168 cities.

Table 5: Ranking of Air Quality Improvement Scores for 168 cities

Rank	City	Air Quality Improvement Score
1	Ya'an	64.77
2	Huzhou	64.55
3	Foshan	64.08
4	Jiangmen	63.51
5	Chizhou	61.98
6	Jinhua	61.63
7	Zhongshan	61.54
8	Xianning	61.34
9	Lhasa	61.33
10	Meishan	60.98
11	Hefei	60.39
12	Xinyu	60.25
13	Quzhou	59.81
14	Jiaxing	59.68
15	Yinchuan	59.51
16	Ningbo	59.2
17	Tongling	58.99
18	Wenzhou	58.98
19	Lishui	58.95
20	Shaoxing	58.63

Rank	City	Air Quality Improvement Score
21	Zhuhai	58.41
22	Guangzhou	58.18
23	Zhaoqing	57.96
24	Lvliang	57.55
25	Dongguan	57.38
26	Lanzhou	57.01
27	Zhoushan	56.94
28	Xiamen	56.84
29	Shenzhen	56.54
30	Linfen	56.52
31	Yangzhou	56.4
32	Maanshan	56.32
33	Zhangjiakou	56.23
34	Huangshi	56.08
35	Huizhou	55.98
36	Haikou	55.91
37	Yichun	55.84
38	Beijing	55.47
39	Anqing	55.18
40	Wuhu	54.93

Rank	City	Air Quality Improvement Score
41	Kuiyang	54.89
42	Hangzhou	54.84
43	Leshan	54.48
44	Shuining	54.33
45	Taizhou	54.2
46	Jincheng	54.16
47	Pingxiang	53.94
48	Chengde	53.86
49	Nanning	53.82
50	Jinzhong	53.5
51	Ezhou	53.4
52	Deyang	53.31
53	Jingzhou	53.28
54	Xuancheng	53.18
55	Huangshan	53.11
56	Wuhan	53.09
57	Suzhou	52.89
	Fuzhou	52.89
59	Neijiang	52.87
60	Nanchang	52.55
61	Shanghai	52.36
62	Changzhi	52.03
63	Huanggang	51.8
64	Luzhou	51.77
	Wuxi	51.77
66	Xiaogan	51.29
67	Baoding	51.21
68	Nanchong	51.08
69	Kunming	51.02
70	Changzhou	51
71	Chengdu	50.82
72	Huaian	50.73
73	Nantong	50.72

Rank	City	Air Quality Improvement Score
74	Suzhou	50.68
75	Shuozhou	50.67
76	Ziyang	50.64
77	Mianyang	50.58
78	Qingdao	50.56
79	Zhuzhou	50.36
80	Dezhou	50.24
81	Suizhou	50.24
82	Nanjing	50.19
83	Qihuangdao	50
	Langfang	50
	Cangzhou	50
	Handan	50
	Datong	50
	Rizhao	50
	Chaoyang	50
	Shenyang	50
	Dalian	50
	Yancheng	50
	Lianyungang	50
	Taizhou	50
	Lu'an	50
	Chuzhou	50
	Fuyang	50
	Chongqing	50
	Yibin	50
	Zigong	50
	Dazhou	50
	Yichang	50
	Jiujiang	50
	Changde	50
	Yueyang	50
	Harbin	50

Rank	City	Air Quality Improvement Score
107	Zhenjiang	49.92
108	Urumchi	49.9
109	Jinan	49.52
110	Guang'an	49.5
111	Tangshan	49.45
112	Huaibei	49.39
113	Bozhou	49.31
114	Xinzhou	49.21
115	Yangquan	49.19
	Huludao	49.19
117	Binzhou	48.77
118	Bengbu	48.66
119	Tianjin	48.48
120	Changchun	48.42
121	Hohhot	48.39
	Xining	48.39
123	Huainan	48.23
124	Zhumadian	48.19
125	Xiangtan	48.11
126	Hengshui	47.82
127	Dongying	47.79
128	Xingtai	47.62
129	Shijiazhuang	47.5
130	Xianyang	47.41
131	Tongchuan	47.33
132	Baoji	47.2
133	Xinyang	47.13
134	Changsha	46.8
135	Weifang	46.74
136	Baotou	46.56
137	Suqian	46.45
138	Xi'an	46.4

Rank	City	Air Quality Improvement Score
139	Tai'an	46.25
140	Zibo	45.53
141	Sanmenxia	45.33
142	Linyi	44.87
143	Heze	44.68
144	Liaocheng	44.38
145	Weinan	44.05
146	Xuzhou	43.65
147	Zhoukou	43.53
148	Yiyang	43.46
149	Yuncheng	43.39
150	Zhengzhou	43.02
151	Jiaozuo	42.89
152	Shangqiu	42.23
153	Jining	41.63
154	Taiyuan	40.62
155	Luoyang	40.46
156	Jinzhou	39.98
157	Jingmen	39.5
158	Pingdingshan	38.97
159	Zaozhuang	38.48
160	Nanyang	37.8
161	Xiangyang	37.64
162	Luohe	36.96
163	Xinxiang	36.02
164	Anyang	34.19
165	Xuchang	33.89
166	Kaifeng	33.48
167	Puyang	30.7
168	Hebi	26.76

Based on the cities' scores for air quality improvement, the report divided them into five categories: "excellent," "good," "ordinary," "poor," and "underperforming". Table 6 shows the distribution of scores for all cities, while Figure 39 shows air quality improvement of all cities.

Table 6: Distribution of Air Quality Improvement Scores for 168

Range of Score	Improvement	Number of cities	Average concentration of $PM_{2.5}$ in 2018–2020	Average improvement rate compared with 2017–2019	Average number of attainment days in 2018–2020	Average improvement rate compared with 2017–2019
>50	**Excellent**	82	35.88	11.51%	302	5.85%
(45, 50]	Good	59	47.02	8.36%	260	6.21%
(30, 45]	Ordinary	26	56.81	6.43%	215	6.82%
(15, 30]	Poor	1	57.67	2.26%	201	–0.50%
⩽ 15	Underperforming	0	–	–	–	–

Figure 39: Improvement Range of Three-year Averages of $PM_{2.5}$ concentration and attainment days in 2018-2020 compared with 2017-2019

Compared with the air quality improvement assessment results shown in China Air reports in the previous two assessments in the China Air 2020 and China Air 2019 , there were significant changes in the distribution of the numbers of cities of different grades. The number of cities ranked as “excellent” increased three times from last assessment, thus including most cities. The number of cities classified as “good” remained roughly the same as in previous years. The numbers of cities ranked as “ordinary” and “poor” remarkably decreased, with only one “poor” city left. The good news is that no city was ranked as “underperforming.”

There are two reasons for the general increase in the scores. Firstly, among 168 cities, up to 95% made significant improvements in $PM_{2.5}$ concentration or had a significantly higher number of attainment days in 2020 compared to 2019, making the three-year average of 2018–2020 better than that of 2017–2019. The three-year moving average of $PM_{2.5}$ in all cities improved without rebound. Secondly, the 2017–2020 assessment period saw a marked decrease in the number of cities whose air quality deteriorated in the first two years (2017–2018), and $PM_{2.5}$ concentration in most cities in 2018 decreased compared to 2017. These developments were unlike the deterioration in $PM_{2.5}$ concentration in numerous cities in the first two years within the four-year assessment period in the previous two assessments. Instead, $PM_{2.5}$ concentration kept improving over the four years, thus resulting in a more significant improvement in the 2018–2020 three-year average compared to 2017–2019.

These developments reflect that the cities that previously performed well in air quality improvement in China generally maintained an improvement trend during the 2017–2020 period, while cities previously ranked as “poor” or “underperforming” also worked hard to improve, increasing the number of cities that got higher scores.

Cities Ranked as "Excellent": 168 cities performed excellently in the air quality improvement assessment, with nearly half being ranked as "excellent".

Cities Ranked as “Excellent” (score >50): These are cities that made continuous improvement in air quality or made significant improvements despite their air quality failing to reach the standard. Unlike in the previous assessment, when only about 20 cities were ranked as “excellent,” 82 cities in this assessment got bonus points, attaining higher than the total mark of 50 points and thus being ranked as “excellent.” These cities made considerable improvements in both $PM_{2.5}$ concentration and the number of attainment days.

Among them, 35 cities reached the standard in 2019 and further improved in 2020 in terms of $PM_{2.5}$ concentration. The average three-year concentration of $PM_{2.5}$ in 2018–2020 decreased to as low as 13.67–35.67 μg/m³, improving by 5.64%–18.29% compared to 2017–2019 values. In terms of attainment days, the three-year average in 2018–2020 improved by 5.64%–18.29% compared to 2017–2019. In summary, these 35 cities achieved continuous and significant improvement in air quality. Except for Zhangjiakou and Chengde, all are southern cities, including nine cities in Zhejiang Province, nine in the PRD region, and some in Sichuan Province.

More than 40 cities that failed to reach the standard for $PM_{2.5}$ concentration in 2019 also made significant improvements in 2020. The average three-year concentration range of $PM_{2.5}$ in 2018–2020 was 34–61.33 μg/m³; its three-year average concentration improved by 4.27%–17.81% compared to 2017–2019. In terms of attainment days, the three-year average in 2018–2020 improved by 3.18%–22.1% compared to 2017–2019.

Among these “excellent” cities, 20 had a lower ranking (lower than the 80th place) in the previous assessment. Among them, 14 “poor” cities and two “underperforming” cities markedly rose in ranking. The reason was that $PM_{2.5}$ concentration and the number of attainment days in these cities continuously improved in 2017–2020, without deterioration and rebounds from the 2016–2019 assessment period. For example, some cities in the provinces of Shanxi and Anhui, especially Linfen and Jincheng, were at the bottom of the ranking due to a previous substantial deterioration in air quality. Still, they kept improving from 2017 to 2020, thereby producing excellent results.

The same happened with first-placer Ya’an, wherein air quality continuously improved during this assessment period without deterioration from the previous assessment period. Its three-year average concentration of $PM_{2.5}$ in 2018–2020 was 32.77 μg/m^3, with an improvement percentage of 18.29% compared to 2017–2019. The improvement percentage of the three-year average of attainment days was 5.48%. Other similar “excellent” cities that experienced air quality improvement instead of deterioration from the previous assessment period include Foshan, Jiangmen, Zhongshan, Zhuhai, Chizhou, Tongling, Lvliang, Yangzhou, Maanshan, Jinzhong, Suzhou, Changzhou, Shuozhou, Zhuzhou, and Dezhou.

Most of the remaining cities were the top cities in the previous assessment. Among the top 20 “excellent” cities, 18 maintained their “excellent” status, including Lhasa, Meishan, Yinchuan, Lishui, and Lanzhou.

Cities Ranked as "Good": More than half are within the BTH region and its surrounding areas and the YRD region, where air quality kept improving, albeit minimally.

Cities Ranked as “Good” (score 45–50): These are cities that improved in air quality or where air quality was already excellent but still witnessed some slight improvement. A total of 59 such cities are included in the list, 60% of which are cities in the BTH region and its surrounding areas and in the YRD region. Although the air quality level in the BTH region and its surrounding areas remained relatively poor, the trend of continuous improvement did not change. The cities in the YRD region generally scored higher. Except for Xuzhou, the other cities in the YRD region that were not ranked as “excellent” are all included in the list of “good” cities.

Last year, three “excellent” cities (Chongqing, Zigong, and Xining) were moved down to “good” because of a slight decrease or rebound in $PM_{2.5}$ concentration or attainment days in 2020.

Cities Ranked as "Ordinary": Cities in Henan didn’t show a good performance, and they account for over 50% of the "ordinary" list.

Cities Ranked as “Ordinary” (score 30–45): 26 cities are classified as "ordinary". The three-year average concentration of $PM_{2.5}$ in most of these cities in 2018–2020 was comparatively high, with a range of 44 μg/m³–69 μg/m³. Among them, the $PM_{2.5}$ concentration in 24 cities was as high as 50 μg/m³. Although the three-year average of $PM_{2.5}$ concentration and attainment days improved in varying degrees, the range was comparatively small. Henan Province had as high as 14 such cities ranking outside of the 130th place in the previous assessment. Notably, there was a significant increase in attainment days in Henan Province in 2020. However, poor performance in previous years brought down the overall assessment scores of the province.

Cities Ranked as "Poor": Only Hebi City in Henan Province is classified in the "poor" category.

Cities Ranked as “Poor” (score <30): These are cities with poor air quality and that did not show considerable improvement. Only Hebi City scored less than 30 in this assessment—the lowest among all cites—thus achieving a rating of “poor.”

The three-year average concentration of $PM_{2.5}$ in Hebi City in 2018–2020 was as high as 57.67 μg/m³, only 2.26% better than in 2017–2019. The annual average concentration of $PM_{2.5}$ in 2019 increased by 10.9% compared to 2018. Although it improved in 2020, it was still higher than in 2018. In 2018 and 2019, the attainment days decreased year-on-year for two consecutive years, from 225 days in 2017 to 185 days in 2019, causing a decrease in the three-year average of attainment days. In this assessment, there are only two cities whose average attainment days in 2018–2020 were less than those in 2017–2019: Hebi and Anyang, which was not included in the “poor” category due to its improvement in $PM_{2.5}$ concentration during this assessment period.

Policy Measures

The scores in the assessment for policy measures are based on the measures for controlling emissions from stationary, mobile, and area sources, the measures for capacity building that supported the scientific implementation of policies, and the safeguarding measures for promoting the effective implementation of relevant policies. Table 7 shows the scores for policy measures across 168 cities.

Table 7: Ranking of Policies and Measures Scores for 168 cities

Rank	City	Score for Policies and Measures
1	Hangzhou	51.93
2	Guangzhou	51.5
3	Shanghai	51.47
4	Shenzhen	51.46
5	Beijing	51.45
6	Chengdu	51.39
7	Jinan	50.57
8	Wuhan	50.5
9	Qingdao	50.47
10	Tianjin	50.44
	Zhengzhou	50.44
12	Hefei	50.01
13	Chongqing	49.9
14	Lanzhou	49.07
15	Nantong	48.5
	Nanjing	48.5
17	Dalian	48.08
18	Dongguan	48.07
19	Zhongshan	48.05
20	Zhuhai	47.76
21	Hohhot	47.58
22	Wuxi	47.57
23	Xiamen	47.53
24	Shenyang	47.42
25	Shijiazhuang	47.2
26	Jiangmen	46.13
27	Shaoxing	47.16
28	Suzhou	47.1
29	Zhaoqing	47.07
30	Yichang	46.97
31	Wenzhou	46.83
32	Changzhi	46.7
33	Huangshi	46.69
34	Anqing	46.68
35	Yangquan	46.66
36	Changsha	46.63
37	Jingzhou	46.5
38	Wuhu	46.42
39	Changchun	46.38
40	Xi'an	46.34
41	Handan	46.33
42	Jinhua	46.31
43	Xingtai	46.27
44	Yancheng	46.26
	Maanshan	46.26
46	Haikou	46.22
47	Deyang	46.18
48	Zigong	46.14
	Yueyang	46.14
50	Xuancheng	46.07

Rank	City	Score for Policies and Measures
51	Tongling	46.07
	Ezhou	46.07
	Huanggang	46.07
54	Xianning	45.94
55	Ya'an	45.84
56	Hengshui	45.83
57	Luzhou	45.74
58	Changzhou	45.73
	Chizhou	45.73
60	Quzhou	45.71
61	Yinchuan	45.66
62	Nanning	45.65
63	Taiyuan	45.64
	Binzhou	45.64
65	Mianyang	45.63
	Nanchang	45.63
67	Xuzhou	45.62
68	Foshan	45.61
	Kunming	45.61
70	Huangshan	45.6
	Guiyang	45.6
72	Luoyang	45.57
73	Jinzhou	45.36
74	Qinhuangdao	45.33
	Ningbo	45.33
76	Suqian	45.28
77	Linyi	45.2
	Yangzhou	45.2
79	Liaocheng	45.13
	Jingmen	45.13

Rank	City	Score for Policies and Measures
81	Xining	45.1
82	Changde	45.07
83	Ziyang	44.91
84	Huizhou	44.89
85	Fuzhou	44.86
86	Lianyungang	44.83
87	Baoji	44.77
88	Zhenjiang	44.76
89	Huaian	44.73
	Zhuzhou	44.73
91	Leshan	44.71
92	Linfen	44.68
93	Chuzhou	44.64
94	Zhumadian	44.58
95	Huainan	44.57
96	Neijiang	44.54
97	Jincheng	44.51
98	Huzhou	44.5
99	Chaoyang	44.49
100	Nanyang	44.45
101	Xiangyang	44.44
102	Harbin	44.36
103	Pingdingshan	44.33
104	Zibo	44.27
105	Lu'an	44.23
106	Yibin	44.18
107	Tongchuan	44.08
	Xianyang	44.08
109	Xiaogan	44.05
110	Fuyang	44

Rank	City	Score for Policies and Measures
111	Chengde	43.96
	Lishui	43.96
113	Suizhou	43.89
114	Jiaxing	43.85
115	Langfang	43.83
	Hebi	43.83
	Bengbu	43.83
118	Dazhou	43.78
119	Sanmenxia	43.77
	Anyang	43.77
121	Zaozhuang	43.75
122	Suining	43.71
123	Dezhou	43.67
124	Yuncheng	43.66
125	Luohe	43.64
126	Taizhou	43.62
127	Weinan	43.57
128	Bozhou	43.55
129	Huludao	43.54
130	Tangshan	43.4
131	Cangzhou	43.38
132	Xinyu	43.3
133	Datong	42.9
134	Nanchong	42.84
135	Jiaozuo	42.62
	Xinyang	42.62
	Xuchang	42.62
138	Zhangjiakou	42.4
	Weifang	42.4
140	Shuozhou	42.33

Rank	City	Score for Policies and Measures
	Taizhou	42.33
142	Jining	42.31
	Guangan	42.31
144	Yichuan	42.27
145	Rizhao	42.21
146	Urumchi	42.05
147	Suzhou	42.02
148	Baoding	41.96
149	Xiangtan	41.85
150	Yiyang	41.81
151	Jiujiang	41.77
152	Shangqiu	41.71
153	Xinzhou	41.62
154	Heze	41.58
155	Zhoushan	41.47
156	Zhoukou	41.22
157	Puyang	41.08
158	Huaibei	41.07
159	Baotou	40.83
160	Lvliang	40.77
161	Dongying	40.65
162	Xinxiang	40.62
163	Meishan	40.42
164	Pingxiang	40.33
165	Jinzhong	40.32
166	Taian	40.25
167	Kaifeng	40.18
168	Lhasa	40.02

The distribution of scores for 168 cities is shown in Table 8.

Table 8: Distribution of Policies and Measures Scores for 168 cities

Range of Score	Performance	Number of Cities
>50	Excellent	12
(45, 50]	Good	70
(40, 45]	Ordinary	86

Regarding the assessment of the policies and measures of cities, the evaluation based on publicly available information and data was found to reflect the level of completion of the city air quality management framework and the comprehensiveness of their measures. However, the assessment of the actual implementation remains limited because the comprehensiveness and timeliness of each data set released at the city level are quite different. Similar to last year's assessment results, there is a high degree of homogeneity in the policies associated with air pollution prevention and control at the city level. The scores of policy measures in the final assessment are relatively close to each other, with all rising above 40. These results mean that the 168 key cities have introduced and implemented comprehensive air pollution prevention and control measures. Overall, the air pollution prevention and control policy system has not changed significantly, nor are there any significant intercity gaps.

Cities Ranked as "Excellent": First-tier cities demonstrated outstanding comprehensive strength and continued to lead in this regard in China.

Cities Ranked as "Excellent" (score >50): A total of 12 cities scored higher than the full mark of 50 points and performed well in implementing policy measures for air pollution prevention and control. They are Hangzhou, Guangzhou, Shanghai, Shenzhen, Beijing, Chengdu, Jinan, Wuhan, Qingdao, Tianjin, Zhengzhou, and Hefei. An "excellent" city has been added since 2019—Hefei—mainly because the city formulated and implemented comprehensive ambient air pollution prevention and control policies and released its air quality attainment plan in 2020. The other 11 "excellent" cities were unchanged from 2019, but Beijing fell from first place because it did not release its air quality attainment plan as a non-attainment city, thus getting a lower score.

All the 12 "excellent" cities are traditional first-tier cities and new first-tier cities, including three municipalities directly under the central government. Seven are provincial capitals, and two are cities with independent planning status, among which Hefei, a new "excellent" city, ranked 21st in the GDP ranking of Chinese cities in 2020. Other "excellent" cities all ranked in the top 20, with solid financial abilities, scientific research competencies, and planning capabilities. Compared with other cities, they have continuously invested more resources in improving air quality and have robust hardware and software. The leading cities scored high because of better practices. For one, they have established the top scientific decision-making foundations and assessment methods, which include the construction of super monitoring stations to carry out the analysis of pollutant composition and characteristics, the dynamic updating of emissions inventory and source apportionment, and the evaluation of the effects of air pollution control measures. For another, they have conducted the most comprehensive pollutant emission reduction activities and sufficiently disclosed relevant data to demonstrate the progress of these programs, including the adjustment of the energy and transport structures. These practices have ensured sustainability in the air quality improvement of "excellent" cities.

In 2017–2020, these cities made significant progress in the three-year moving average of $PM_{2.5}$ concentration and the number of attainment days.

Cities Ranked as "Good": The number of cities in this category decreased year-on-year, indicating that part of these cities was taken out of the list of "good" cities due to their poor disclosure of information.

Cities Ranked as "Good" (score 45–50): The scores of 70 cities ranged from 45 to 50 points, of which over 50% are from the BTH region and its surrounding areas, the YRD region, and the PRD region. They also include a dozen other provincial capitals, three municipalities with independent planning status, and a dozen medium- and small-sized cities from such provinces as Hubei and Sichuan. Despite some slight differences with the "excellent" cities in terms of financial, scientific research, and assessment abilities, these cities belong to those that put much effort into air pollution prevention and control. Specifically, 90% of these cities are included in the categories of "excellent" and "good" in the air quality improvement assessment.

However, in this assessment, the number of "good" cities decreased by more than 30 compared to 2019, mainly due to poor information disclosure, especially in terms of energy structure adjustment and annual air quality information. Either they failed to release their annual bulletin for environmental status, or the bulletins did not provide information on pollutant concentration. Moreover, some cities fell to the “ordinary” level since their air quality failed to reach the standard and they had yet to release their air quality attainment plan, thus resulting in the deduction of scores.

Cities Ranked as "Ordinary": Cities in the BTH region and its surrounding areas received mediocre scores, and their air quality was not good.

Cities Ranked as “Ordinary” (score 40–45): 86 cities scored a range of 40 to 45 points. Based on the annual mean concentration of $PM_{2.5}$ in 2020, over half of the 20 cities ranked the poorest are from Henan Province, while the others are from Shandong Province and the Fenwei Plain. The annual mean concentration of $PM_{2.5}$ in these cities went as high as 50 $\mu g/m^3$, indicating that insufficient policy actions caused poor air quality.

Under the ranking of “ordinary”, there are more than 20 attainment cities in 2020, including Lhasa, Zhoushan, Fuzhou, Suining, Xinyu, Guang’an, Pingxiang, and Neijiang. Due to being located mainly in the relatively backward areas of Central and Western China or their low industrialization level, these cities have not adopted strict pollution prevention and control measures, making their “effort score” lower than other cities. However, these cities maintained excellent air quality, so they gained higher base scores in the air quality improvement indicator due to their natural advantage.

“Ordinary” cities often lacked important information disclosed about their progress in pollution prevention and control measures, such as controlling total coal consumption and adjusting the transport structure. Most of these cities did not perform well in disclosing environmental information. For example, they did not release environmental status bulletins or provide any data on pollutant concentrations in the bulletins.

Analysis on the Comprehensive Scoring of the Air Quality Management of Cities

The comprehensive scoring for air quality management in cities is the sum of two scores: the air quality improvement score and the policy measures score, both of which reflect the efforts and achievements of the cities in a more holistic manner. Specifically, the "effort score" represents the efforts made in association with policy measures, evaluating the implementation measures in the latest assessment year. The effort score can sufficiently reflect the degree of comprehensiveness of the pollution prevention and control policies of the cities at the time being. Meanwhile, the "effect score" deals with air quality improvement. Because the assessment focuses on changes in the three-year moving average, the scores are influenced by current policies but are also determined by the accumulated effects of the measures over the past few years. In general, only cities that have made sufficient efforts can ensure sustainable improvement in air quality. In contrast, cities that have demonstrated insufficient efforts (non-industrial cities with inherently good air quality excluded) are bound to receive a poor "effect score," putting them at the lowest of the overall ranking.

Table 9 shows the total scores for air quality management in the 168 cities based on their scores for air quality improvement and policy measures.

Table 9: Rankings of Total Air Quality Management Scores for 168 cities

Rank	City	Total Score
1	Hefei	110.4
2	Ya'an	109.9
3	Foshan	109.69
4	Guangzhou	109.68
5	Jiangmen	109.64
6	Zhongshan	109.59
7	Huzhou	109.05
8	Shenzhen	108
9	Jinhua	107.94
10	Chizhou	107.71
11	Xianning	107.28
12	Beijing	106.92
13	Hangzhou	106.77
14	Zhuhai	106.17
15	Lanzhou	106.08
16	Wenzhou	105.81
17	Shaoxing	105.79
18	Quzhou	105.52
19	Dongguan	105.45
20	Yinquan	105.17
21	Tongling	105.06
22	Zhaoqing	105.03
23	Ningbo	104.53
24	Xiamen	104.37
25	Shanghai	103.83
26	Wuhan	103.59
27	Xinyu	103.55
28	Jiaxing	103.53
29	Lishui	102.91
30	Huangshi	102.77
31	Maanshan	102.58
32	Chengdu	102.21
33	Haikou	102.13
34	Anqing	101.86

Rank	City	Total Score
35	Yangzhou	101.6
36	Meishan	101.4
37	Wuhu	101.35
	Lhasa	101.35
39	Linfen	101.2
40	Qingdao	101.03
41	Huizhou	100.87
42	Guiyang	100.49
43	Jinan	100.09
44	Chongqing	99.9
45	Jingzhou	99.78
46	Deyang	99.49
47	Ezhou	99.47
	Nanning	99.47
49	Wuxi	99.34
50	Xuancheng	99.25
51	Nantong	99.22
52	Leshan	99.19
53	Tianjin	98.92
54	Changzhi	98.73
55	Huangshan	98.71
56	Nanjing	98.69
57	Jincheng	98.67
58	Zhangjiakou	98.63
59	Zhoushan	98.41
60	Lvliang	98.32
61	Nanchang	98.18
62	Yichuan	98.11
63	Dalian	98.08
64	Suining	98.04

Rank	City	Total Score
65	Huanggang	97.87
66	Chengde	97.82
	Taizhou	97.82
68	Suzhou	97.78
69	Fuzhou	97.75
70	Luzhou	97.51
71	Shenyang	97.42
72	Neijiang	97.41
73	Yichang	96.97
74	Changzhou	96.77
75	Kunming	96.63
76	Handan	96.33
77	Yancheng	96.26
78	Mianyang	96.21
79	Zigong	96.14
	Yueyang	96.14
81	Hohhot	95.97
82	Yangquan	95.85
83	Ziyang	95.55
84	Huaian	95.46
85	Xiaogan	95.34
86	Qinhuangdao	95.33
87	Zhuzhou	95.09
88	Changde	95.07
89	Suzhou	94.91
90	Lianyungang	94.83
91	Changchun	94.8
92	Shijiazhuang	94.7
93	Zhenjiang	94.68
94	Chuzhou	94.64

Rank	City	Total Score
95	Chaoyang	94.49
96	Binzhou	94.41
97	Harbin	94.36
98	Pingxiang	94.27
99	Lu'an	94.23
100	Yibin	94.18
101	Suizhou	94.13
102	Fuyang	94
103	Nanchong	93.92
104	Dezhou	93.91
105	Xingtai	93.89
106	Langfang	93.83
107	Jinzhong	93.82
108	Dazhou	93.78
109	Hengshui	93.65
110	Xining	93.49
111	Zhenzhou	93.46
112	Changsha	93.43
113	Cangzhou	93.38
114	Baoding	93.17
115	Shuozhou	93
116	Datong	92.9
117	Bozhou	92.86
118	Tangshan	92.85
119	Huainan	92.8
120	Zhumadian	92.77
121	Xi'an	92.74
122	Huludao	92.73
123	Bengbu	92.49

Rank	City	Total Score
124	Taizhou	92.33
125	Rizhao	92.21
126	Baoji	91.97
127	Urumchi	91.95
128	Guangan	91.81
129	Jiujiang	91.77
130	Suqian	91.73
131	Xianyang	91.49
132	Yinchuan	91.41
133	Xinzhou	90.83
134	Huaibei	90.46
135	Linyi	90.07
136	Xiangtan	89.96
137	Zibo	89.8
138	Xingyang	89.75
139	Liaocheng	89.51
140	Xuzhou	89.27
141	Weifang	89.14
142	Sanmenxia	89.1
143	Dongying	88.44
144	Weinan	87.62
145	Baotou	87.39
146	Yuncheng	87.05
147	Taian	86.5
148	Taiyuan	86.26
	Heze	86.26
150	Luoyang	86.03
151	Jiaozuo	85.51
152	Jinzhou	85.34

Rank	City	Total Score
153	Yiyang	85.27
154	Zhoukou	84.75
155	Jingmen	84.63
156	Jining	83.94
	Shangqiu	83.94
158	Pingdingshan	83.3
159	Nanyang	82.25
160	Zaozhuang	82.23
161	Xiangyang	82.08
162	Luohe	80.6
163	Anyang	77.96
164	Xinxiang	76.64
165	Xuchang	76.51
166	Kaifeng	73.66
167	Puyang	71.78
168	Hebi	70.59

Table 10 shows the distribution of total scores for all cities.In this assessment period, air quality improvement across 168 cities is generally better than the previous two assessments, thus pulling up the overall scores. Due to the obvious increase in total scores compared to the last two assessments, no city is ranked as “poor” or “underperforming.”

Table 10: Distribution of Total Air Quality Management Scores for 168 cities

Range of Score	Performance	Number of Cities
>100	Excellent	43
(85, 100]	Good	110
(70, 85]	Ordinary	15
(60, 70]	Poor	0
≤60	Underperforming	0

Cities Ranked as "Excellent": Nine cities are on the list of "double excellence", and Hefei ranked first in terms of comprehensive scoring.

A total of 43 cities scored higher than the full mark of 100 points, mainly thanks to their outstanding performance in air quality improvement. Of these cities, 42 gained over 50 points in terms of air quality improvement. Additionally, 12 cities got over 60 points thanks to significant improvement, and 33 cities met the national air quality standards in the annual mean concentration of $PM_{2.5}$.

A total of nine cities were ranked as “excellent” in the assessment of both air quality improvement and policy measures, thus regarded as the models of making continuous improvement in air quality through consistent efforts. These cities include Hefei, Guangzhou, Shenzhen, Beijing, Hangzhou, Shanghai, Wuhan, Chengdu, and Qingdao.

Cities Ranked as "Good": There is an increasing number of "good" cities in air quality improvement, indicating that their constant efforts have led to progress.

A total of 110 cities scored 85 to 100 points and were ranked as “good”, the scoring section for the most number of cities, with an increase of seven cities compared to 2019. Among them, 90% were ranked as “good” or “excellent” for their outstanding “effect score”. The reason for such results is that over recent years, effective policy measures for ambient air prevention and control have been vigorously carried out from the central government to localities in China, resulting in the continuous improvement in air quality on the whole. At the same time, 40% of these cities ranked as “good” or “excellent” in terms of the policy measures indicator.

Cities Ranked as "Ordinary": Cities in Henan Province ranked at the bottom due to insufficient air quality improvement.

A total of 15 cities scored between 70 to 85 points in the comprehensive ranking of cities. Of these cities, 11 are from Henan Province, and two are from the provinces of Hubei and Shandong. They are characterized with low scores in air quality improvement, thus ranking as “ordinary” or “poor” under that indicator. In terms of the policy measures indicator, 14 cities were classified as “ordinary”. The seven cities with the lowest total scores were all from Henan Province. As the sole “poor” city in air quality improvement, Hebi is at the bottom of the comprehensive ranking.

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