



China Air 2024

Air Pollution Prevention and Control Progress in Chinese Cities

Executive Summary



Conclusion



Air Quality

In 2023, with the end of the COVID-19 pandemic, the production and life of society was fully restored. In this context, the overall national annual mean concentrations of the six criteria pollutants continued to meet the requirements of China's National Ambient Air Quality Standards (NAAQS). The air quality significantly improved compared to 2019, when the same level of social activity was held before the pandemic.

From 2019 to 2023, the overall national annual mean concentrations of the six criteria pollutants showed a decline: The decreases of $\text{PM}_{2.5}$, PM_{10} , SO_2 , NO_2 , and CO ranged from 15.9% to 28.6%, while O_3 achieved a decrease of 2.7%, as shown in Figure 1.

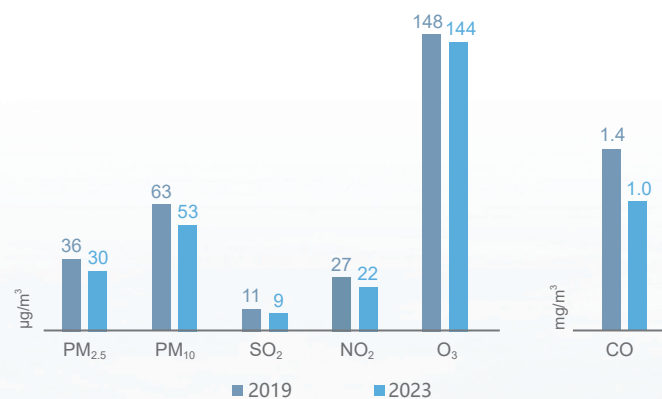


Figure 1: Overall National Annual Mean Concentrations of the Six Criteria Pollutants in 2019 and 2023

The average percentage of attainment days in 339 cities at the prefecture level and above was 85.5%, up by 3.5 percentage points from 2019. The percentage of air quality attainment cities was 59.9%. A total of 203 cities complied with the national Ambient Air Quality Standards, an increase of 46 cities compared with 2019. The percentage of attainment cities reached 100% for SO₂ and CO and increased significantly for PM_{2.5}, PM₁₀, O₃, and NO₂, as shown in Figure 2.

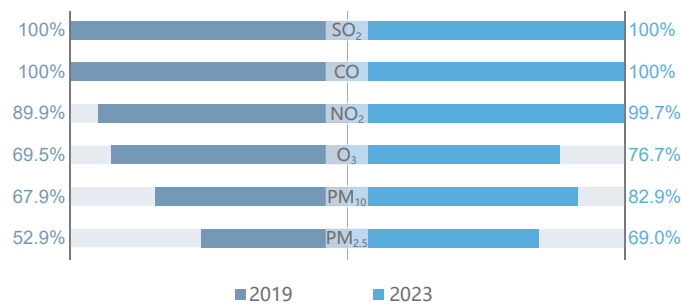


Figure 2: Percentages of Attainment Cities for the Six Criteria Pollutants in 2019 and 2023

The average annual PM_{2.5} concentration in the three key regions all decreased drastically by more than 20%, which was higher than the national average decline. Among them, the average concentration of the Yangtze River Delta region complied with the national standard, while the concentration levels in the Beijing-Tianjin-Hebei region and surrounding areas and the Fenwei Plain were similar, as shown in Figure 3. The annual average O₃ concentrations in the key regions also showed a downward trend, and the O₃ concentration of the Yangtze River Delta region complied with the standard, as shown in Figure 4.

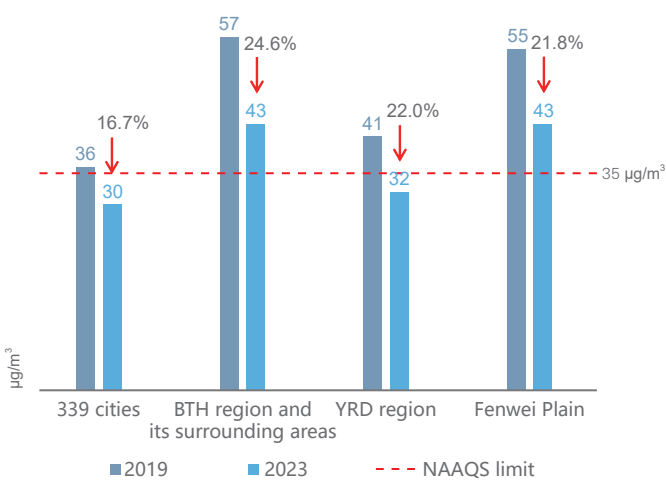


Figure 3: Annual Mean Concentrations of PM_{2.5} Across the Country and in the Key Regions in 2019 and 2023

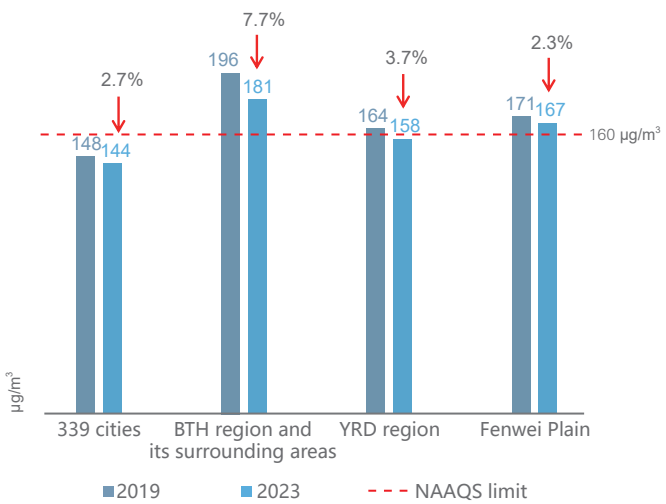


Figure 4: Annual Mean Concentrations of O₃ Across the Country and in the Key Regions in 2019 and 2023



Policies and Measures

Steady progress was made in transforming the energy consumption structure into a cleaner one, with coal consumption share at a record low.

In 2023, China's total energy consumption reached 5.72 billion tons of standard coal, up 5.7% from 2022, which amounted to an increase of 310 million tons of standard coal, the highest annual increase since 2005. All energy consumption types increased, and the energy consumption structure further transformed into a clean and low-carbon one. The share of coal consumption dropped to 55.3%, which is a record low, down 0.7 percentage points from 2022. The consumption of clean energy such as natural gas, hydropower, wind power, and solar power reached 26.4%, up 0.4 percentage points year on year. Non-fossil energy consumption accounted for 17.9%, up 0.3 percentage points year on year.

From 2011 to 2023, the share of coal consumption dropped from 70.2% to 55.3%, a cumulative decrease of nearly 15 percentage points, and the share of non-fossil energy consumption rose from 8.4% to 17.9%, a cumulative increase of 9.5 percentage points. Profound changes have taken place in the way energy is used in industries, transportation, buildings, and people's daily lives.

The installed power generation capacity of renewable energy surpassed that of thermal power, and new energy installations became the main source of the yearly incremental installed capacity.

By the end of 2023, China's total installed power generation capacity reached 2.92 billion kilowatts (kW), up 13.9 year on year. The share of thermal power generation capacity dropped to 47.6%, and coal power capacity fell to below 40%. The installed renewable energy capacity exceeded 1.5 billion kW, surpassing that of thermal power for the first time, rising to 51.9% of the total installed capacity.



The installed wind and solar power capacities maintained rapid growth. In the over 300 million kW of the newly installed power generation capacity in 2023, the installed wind and solar power capacities accounted for about 80%, becoming the main source of incremental installed capacity. The newly installed capacity of wind and photovoltaic power in 2023 increased by 97.4% and 146.6%, respectively, when compared to 2022. By the end of 2023, the combined installed capacity of grid-connected wind and solar power exceeded 1 billion kW. The rapid increase in the installed capacity drove wind and solar power's electricity production to 1,470.1 billion kWh, accounting for 15.6% of the total electricity production. Of the incremental electricity production in 2023, 46.1% came from wind and solar power.

The retrofitting for increasing flexibility of coal power units across the country was further promoted. In 2021–2023, the retrofitting for more than 300 million kW had been completed, achieving the target for the 14th Five-Year Plan ahead of schedule. More than 50% of coal power units across the country have good peak-load regulation capacity. At the same time, China decided to

implement the coal-power capacity electricity price mechanism nationwide from 1 January 2024. This capacity electricity price can make up for part of the fixed cost of coal power units. This also can ease the economic pressure from the participation of coal power enterprises in peak-load regulation, which is conducive to stabilizing the expectations of the coal power industry and investors, so as to ensure the safety and stable supply of electricity, support the grid connection of new energy on a larger scale in the future, and promote the clean and low-carbon transformation of the power industry.

Ultra-low emission retrofitting for the iron, steel, and cement industries continued, and remarkable results were achieved in reducing production capacity.

In 2023, progress accelerated in the ultra-low emission retrofitting for the iron and steel industry. A total of 89 iron and steel enterprises fully completed the retrofitting, involving the crude steel production capacity of 426 million tons, which completed 80% of the targeted 530 million tons set in the 14th Five-



Year Plan. Positive progress in structural adjustment was also achieved with the reduction of iron-making capacity and steel-making capacity, both reaching over 10 million tons. Some advanced steel enterprises made breakthroughs in the research and development of clean and low-carbon technologies.

The national output of cement was 2.02 billion tons, down 0.7% year on year and at the lowest level since 2011. Under the promotion of the Work Plan for Steady Growth of the Building Materials Industry and other policies, the cement industry achieved remarkable results in resolving excess capacity and adjusting the industrial layout. More than 80 cement clinker lines in various provinces were dismantled or scheduled to be dismantled, and capacity replacement programs were implemented. The Ministry of Ecology and Environment reviewed and adopted, in principle, the Opinions on Promoting the Implementation of Ultra-low Emission in the Cement Industry at an executive meeting at the end of 2023, marking that the ultra-low emission retrofitting in the cement industry will be carried out nationwide.

Freight structure adjustment and clean energy transition together accelerated the green and low-carbon process of the freight industry.

The freight industry is a key area for the green and low-carbon development of China's transportation. In 2023, under the guidance and support of policies, China made efforts from two aspects, including transportation structure adjustment and clean energy transition, to promote the green and low-carbon process of the freight industry.

In terms of transportation structure adjustments, "road to railway" and "road to waterway" continued to advance, and the development of the combined railway-water transportation accelerated. The volume of waterway and railway freight achieved the goal of "10% and 12% growth in 2025 compared with 2020" which was set in the 14th Five-Year Plan, in 2022 and 2023, respectively, ahead of schedule. In 2023, China also adopted "multimodal transport" as a major approach to promote the transportation structure adjustments and put forward a number of quantitative targets in 2025, such as the port entry rate of railway, the volume of containers transported by combined railway-water methods, and the average annual growth rate. In 2022 and 2023, the volume of containers transported by the combined railway-water method grew steadily, reaching the development goal of "an average annual growth rate of more than 15%" set in the 14th Five-Year Plan.

In terms of energy transition, the cleaning transport equipment process started to accelerate. Greater efforts were made to promote replacing traditional fuel equipment with new and clean energy through pilot projects, financial support, stricter standards, strengthened supervision, and the elimination of old equipment. The market penetration rate of new energy trucks increased from 2% in 2020 to more than 7% in 2023. China proposed to basically eliminate China III vehicles by 2027, and some regions proposed to include China IV vehicles in the scope of early elimination to promote the old vehicles' replacement. By the end of 2023, the number of electric vessels in the country exceeded 700, and the ships with shore power facilities need to connect with power facilities of the ports along the Yangtze River when the ships berth along the ports.



Recommendations

Continue to promote the retrofitting and upgrading of coal power units and improve the level of low carbonization and flexible adjustment capacity.

During the 14th Five-Year Plan period, China is in a critical period of energy transition. The installed renewable energy capacity has become the main source of China's total installed power generation capacity, and new energy installations have become the main source of yearly incremental installed capacity, which lays a solid foundation for the future electricity supply pattern to center on renewable energy. However, when the water level is low or the weather is unfavorable, the renewable energy output would be less than expected, and thus, coal power would be needed to meet the power demand. In 2023, coal power contributed more than 60% of the total electricity production and less than 40% of the total installed capacity; the number of hours utilized also increased. Data from the China Electricity Council showed that the standard coal consumption of power plants rose to 301.6 grams per kilowatt-hour (g/kWh) in 2023, an increase of 0.9 g/kWh year on year, which is the first rise.

Because coal power is important to the security of China's power supply, it will still be used to calm the volatility and randomness of the large-scale access to new energy for a long time so that it can ensure the consumption of new energy and the stability of the grid. With the future increasing demand for flexible power supply in the new power system, it is suggested that China continue to promote the retrofitting and upgrading of coal power units; increase investment in technological innovation; develop and apply a new

generation of coal power technology, such as rapid load change; optimize the coal power dispatching mode; and reasonably determine the dispatching order and peak load regulation depth. At the same time, China should implement the demonstration and application of low-carbon technologies to reduce their costs so as to achieve large-scale application as soon as possible. In the process of promoting the transformation of coal power from the main power source to the basic support and system regulatory power source, consideration should also be given to the low-carbon development of coal power and ensure that the power industry will reach the carbon peak in step with the country before 2030.

Promote the ultra-low emission retrofitting of key industries in a high-quality manner, while taking into account energy-efficiency improvement and technology promotion.

With the policy promotions, the work of reducing pollution and carbon emissions in key industrial sectors was comprehensively carried out. However, the possibility that the enterprises' environmental protection responsibility would not be implemented still occurred. In 2023, the ecological and environmental protection inspection by the central government found that some provinces had illegally increased new production capacity and created excessive exhaust emissions in key industries. Therefore, in order to achieve the goals of "reducing the emissions of NO_x and VOCs by more than 10% compared with 2020" and "the proportion of capacity reaching the benchmark level of energy efficiency in iron and steel,

electrolytic aluminum, cement, flat glass and other key industries should be more than 30%" set in the 14th Five-Year Plan, key industrial industries need to make further efforts in ultra-low emission retrofitting and the elimination of their production capacities. At the same time, accelerate the large-scale application of energy-saving and low-carbon technologies and promote the high-quality development of key industries.

For the iron and steel industry, it is suggested that enterprises carry out special control of fugitive emissions, promote the application of intelligent control technology, and achieve intelligent and unmanned management of fugitive emissions. At the same time, promote the demonstration of energy-saving and low-carbon technologies, such as hydrogen metallurgy technology, hydrogen-rich carbon cycle blast furnace technology, and hydrogen-based melting reduction technology. For the cement industry, it is suggested to revise the policies related to off-peak production and production-capacity replacement in a timely manner to adapt to the new situation of industry development, including the formulation of unified implementation rules for off-peak production, as well as improving the production capacity replacement policy, implement regional differentiated management, and further improve the proportion of production capacity replacement. In addition, local governments need to strengthen the supervision of key industrial sectors, actively identify problems, and promote relevant rectification work.

Strengthen the elimination of old equipment and supervision of emissions to achieve further emission reduction in the transportation sector.

In recent years, initial progress has been made in the energy transition of China's transportation sector. However, traditional fossil fuel vehicles, ships, machinery, and so on still occupy

the main position in the vehicle stock, and thus there is a huge potential for emission reduction. Therefore, while promoting new energy vehicles, the replacement of existing vehicles and equipment is also crucial. The parallel efforts of the elimination of old equipment and the efficient supervision of emissions can be an effective approach to achieve further emission reduction.

In terms of the elimination of old equipment, it is recommended to clarify the phased goals and plans of elimination and implement supporting incentives and restrictions, supplemented by preferential policies for new energy vehicles in such aspects as purchasing, operation, and others. Through the "elimination" and "incentive" policy combination, orderly promote the replacement of in-use vehicles, ships, and non-road mobile machinery to achieve further emission reduction. At present, some cities have already implemented relevant measures which are worth learning from.

In terms of the supervision of emissions, it is suggested to further strengthen the vehicle-fuel-road-enterprise integrated supervision system in the field of motor vehicles and improve the all-around supervision capacity and efficiency. Some examples are to tighten the limits of regular emissions testing and improve the identification effectiveness of high-emission vehicles, strengthen the requirements of remote-sensing detection technology at the national and local levels, and improve the efficiency and accuracy of OBD remote online monitoring for in-use vehicles. As for the supervision of non-road mobile sources, it is suggested to use the advanced supervision experience of the motor vehicle emissions for reference and upgrade the supervision mode and intensity. In addition, attention should be paid to the innovation of technology and management models, and the integrated analysis and application of multi-source monitoring data should be enhanced to continuously improve the level of refinement, informatization, and intelligence of supervision.

Strengthen the supervision of air pollution prevention and control and continue to identify and rectify prominent problems of air pollution.

Since the implementation of the ecological and environmental protection inspection by the central mechanism in 2016, China has effectively solved a number of environmental problems and helped the steady progress of air pollution prevention and control. The third round of inspection was launched in November 2023. So far, it has been found that, in some provinces, excess “high energy consumption and high emissions” projects were started, enterprises discharged exhaust excessively, motor vehicle inspection and maintenance agencies practiced fraud, and dust control from construction sites was inadequate. The incidences indicate that some local governments have an insufficient understanding of the arduousness and complexity of air pollution prevention and control and, therefore, relax the inspection.

It is recommended that local governments at all levels strengthen inspection. In the gap period after the ecological and environmental protection inspection by the central government, a provincial inspection, routine inspection, special inspection, and so on can be carried out to ensure the continuity and normalization of the ecological and environmental protection inspection. The local governments should integrate resources to expand the inspection's enforcement effectiveness and ensure the full coverage of the industries and regions inspected. In particular, they should strengthen the supervision of key industries and regions, ensure the implementation of various air pollution prevention and control measures, and ultimately achieve continuous improvement of air quality in the jurisdiction. In addition, local governments can also learn from the practice of the central government inspections, namely, give full play to the role of public opinion supervision, promptly disclose prominent

problems found, and promote the active rectification of illegal enterprises by seriously dealing with false rectifications, perfunctory rectifications, and so on.

Accelerate preliminary research on the Ambient Air Quality Standards revision and initiate the revision work at an appropriate time.

From 2013 to 2023, China's air quality improved significantly, and the number of attainment cities for the primary pollutant PM_{2.5} continued to rise, stabilizing at around 70% in the 14th Five-Year Plan period. For the cities in the southeast and southwest regions with good air quality, the current air quality standards cannot effectively play a powerful role in leading to air quality improvement. In addition, China's standard limits are relatively loose; the average annual PM_{2.5} concentration limit is seven times the World Health Organization guideline value and more than three times the European Union's and the United States' newly revised standard limits.

In order to cope with the changes in the air pollution situation and management needs, China's Action Plan on Air Quality Continuous Improvement (issued in November 2023) has clearly proposed to start the research work on the revision of Ambient Air Quality Standards and the related technical specifications. It is suggested that China accelerate the relevant research and actively apply the accumulated local research results on health effects and environmental benchmarks as the basis for the revision of air quality standards. China should also learn from the international standard revision methods and experience and explore how to form the country's revision of institutionalized methods for the Ambient Air Quality Standards so as to start the revision of air quality standards at an appropriate time.

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