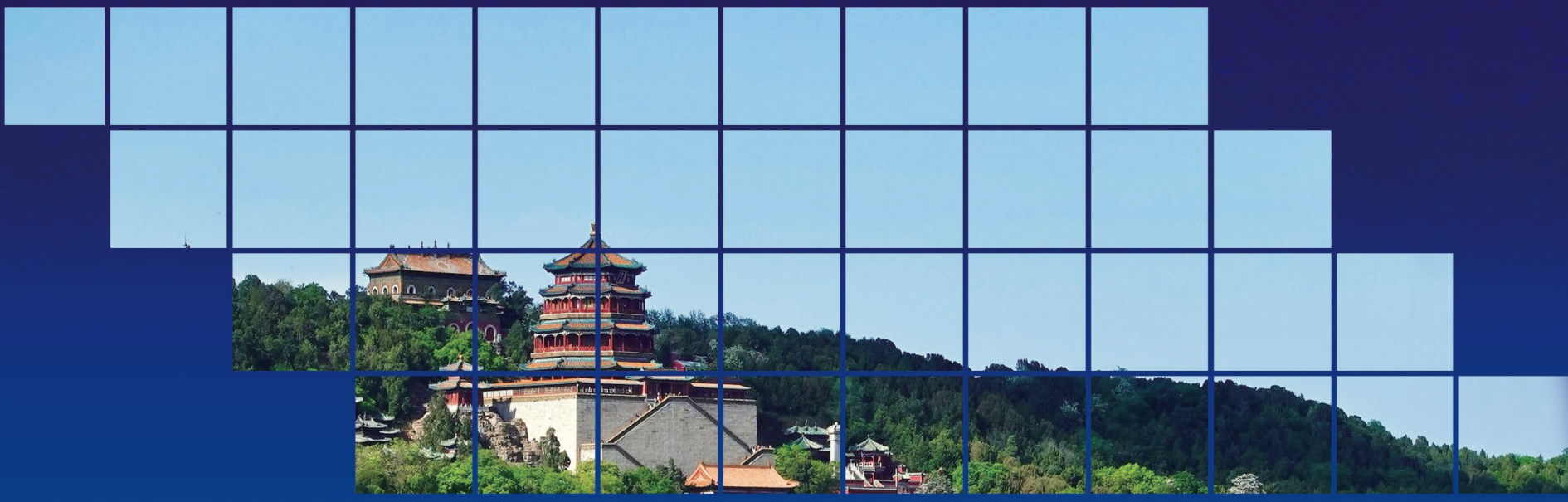

China Air 2023

Air Pollution Prevention and Control Progress in Chinese Cities

Executive Summary

CLEAN AIR ASIA
亚洲清洁空气中心

Conclusion

Air Quality

In 2022, the overall annual mean concentrations of the six criteria pollutants in 339 cities at and above the prefecture level across China met the requirements of China's Ambient Air Quality Standards. The annual mean concentration of $PM_{2.5}$ was 29ug/m^3, reflecting a year-on-year (YoY) decrease of 1 ug/m^3. Meanwhile, the annual mean concentration of O_3 was 145 ug/m^3, showing a slight increase compared with 2021 (Figure 1). Due to a rebound in O_3 concentration in most cities, the overall national percentage of attainment days saw a YoY drop of 1% to 86.5%. Meanwhile, the percentage of days with heavy or severe air pollution was 0.9%, a YoY drop of 0.4%, falling for the first time below 1%.

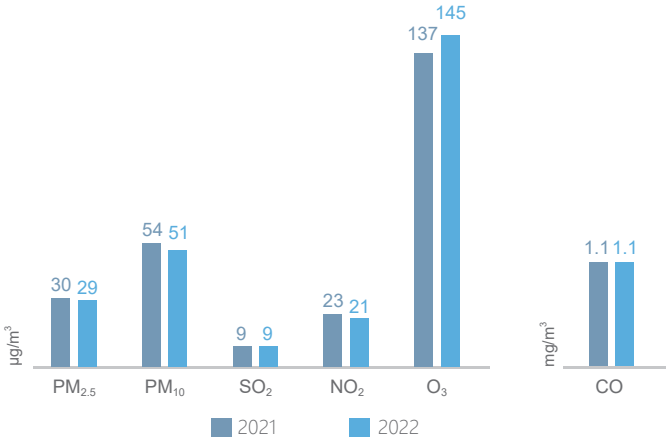

Figure 1: National Overall Annual Mean Concentrations of the Six Criteria Pollutants in 2021 and 2022

The number of cities meeting the air quality standards for the six criteria pollutants saw a YoY drop of 5 to 213. In terms of each pollutant, the proportion of cities meeting the standards for O_3 saw a drastic YoY drop of 12.4%, whereas that of cities meeting the standards for $PM_{2.5}$ and PM10 continued to increase. The proportion of attainment cities for NO_2 reached 100% for the first time. For SO_2 and CO, the proportion of attainment cities has been at 100% for four consecutive years (Figure 2).

Overall $PM_{2.5}$ concentration dropped slightly, but key areas failed to improve

In 2022, the annual mean concentration of $PM_{2.5}$ in 339 cities at and above the prefecture level across China was 29μg/m^3, a YoY drop of 3.3%, falling for the first time below 30μg/m^3. Since 2013, the annual mean concentration of $PM_{2.5}$ has continued to drop, with the proportion of cities meeting the standards for

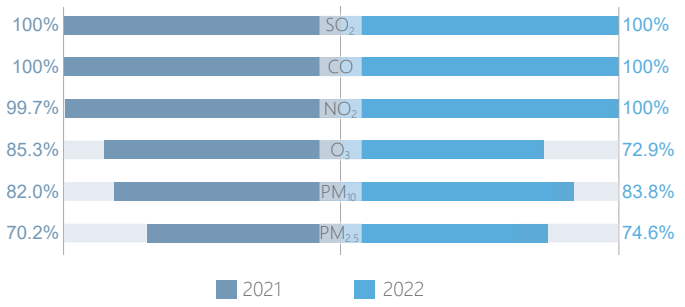

Figure 2: Percentages of Attainment Cities for the Six Criteria Pollutants in 2021 and 2022

$PM_{2.5}$ increasing from 70.2% in 2021 to 74.6% in 2022, with a YoY increase of 15 cities.

However, among the three key regions, namely the Beijing-Tianjin-Hebei (BTH) region and its surrounding areas, the Yangtze River Delta (YRD) region, and the Fenwei Plain, the annual mean concentration of $PM_{2.5}$ failed to improve. The YoY annual mean concentration of $PM_{2.5}$ remained the same at 31μg/m^3 in the YRD region, whereas the BTH region and its surrounding areas and the Fenwei Plain respectively saw a YoY increase of 2.3% and 9.5% to 44μg/m^3 and 46μg/m^3, respectively.

Furthermore, the number of cities among the three key regions seeing a rebound in the annual mean concentration of $PM_{2.5}$ grew dramatically. There was a YoY increase of 12, 11 and 9 cities, respectively, in the BTH region and its surrounding areas, the YRD region and the Fenwei Plain.

The YoY O_3 concentration in over 70% of the cities rose, and the overall national concentration bounced back

Since China included O_3 in its regular monitoring in 2013, the overall national annual mean concentration has continued to rise over the years, with pollution in key regions being far worse. The rising trend slowed down between 2020-2021, when the overall national annual mean concentration of O_3 fell for two consecutive years. However, in 2022, over 70% of the cities saw a YoY increase in O_3 concentration, resulting in a rebound in the overall national concentration, with a YoY increase of 5.8% to 145μg/m^3. Meanwhile, the percentage of attainment cities fell to 72.9% from 85.3%, a YoY decrease of 42 cities.

Among the key regions, O_3 concentration remained high in the BTH region and its surrounding areas. It exceeded the national standard for seven consecutive years, with all the cities failing to meet the standard. In the YRD region, with Changzhou, Huainan, and Xuancheng Cities being the exception, the remaining 38 cities saw a YoY increase in O_3 concentration, and the number of attainment cities also dropped by 15 YoY. The Fenwei Plain saw the slightest YoY increase in its O_3 concentration, but 8 out of its 11 cities still failed to meet the standard. Figure 3 illustrates the O_3 concentration levels across the country and in the key regions in 2021 and 2022.

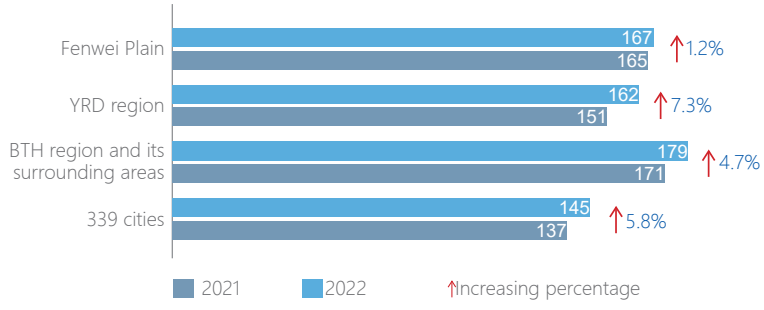

Figure 3: Annual Mean Concentrations of O_3 across the Country and in the Key Regions in 2021 and 2022

Policies and Measures

The proportion of coal consumption rose, while the proportion of installed renewable energy capacity exceeded that of coal-fired power for the first time

In 2022, China's energy consumption reached 5.41 billion tons of standard coal, an increase of 2.9% from the previous year. Coal consumption accounted for 56.2% of total energy consumption, a YoY increase of 0.3 percentage points and a first rebound since 2011, whereas clean energy consumption accounted for 25.9% of the total, a YoY increase of 0.4 percentage points. Meanwhile, the proportion of natural gas consumption dropped slightly as a result of the changing international and national energy markets. In the short term, coal will remain the main energy source in the energy system as it supports the development of a diverse, clean, and stable power supply system and ensures energy security.

Despite the slight increase in the coal consumption proportion in 2022, the rise in renewable energy consumption proportion and newly installed renewable energy generation capacity shows that China remains on track towards clean and low-carbon energy consumption.

By the end of 2022, the national overall installed power generation capacity was 2.56 billion kW, of which coal-fired power generation capacity was 1.12 billion kW, accounting for 43.8% of the total and decreasing by 2.9 percentage points YoY. Installed renewable energy generation capacity increased to 1.21 billion kW, accounting for 47.3% of the total and exceeding the proportion of coal-fired power for the first time in history. To promote the stable transformation of its power system, China has introduced various policies. The country is encouraging the development and consumption of new energy through different measures, including driving the construction of major new energy bases, perfecting the transmission channels for new energy, and advocating the development of energy storage. The "three retrofitting" of coal-fired power units has advanced in an orderly manner. By the end of 2022, a total of about 257 million kW of coal-fired units had been completed for flexibility retrofitting to improve their adjustment capability. Coal-fired power is transforming from being a conventional primary power source to serving as a fundamental support and system regulating power source.

Both crude steel and cement production fell, and the cement industry's ultra-low emission retrofitting was extensively launched

In 2022, China's crude steel production was 1.013 billion tons, a 2.1% drop and a YoY decrease of 22.243 million tons. Despite the decrease for two consecutive years, output remained high, and the iron and steel industry still faces an arduous task of reducing pollution and carbon emissions. The ultra-low emission retrofitting of a total of 207 million tons of crude steel capacity across the country was completed. However, among the enterprises that completed ultra-low emission retrofitting, the effects were dissimilar, and some enterprises falsified their emissions data, consequently dampening the effects of pollution emission reduction.

China's 2022 cement production was 2.12 billion tons, the lowest in the past decade, with a YoY decrease of 10.8%. Nevertheless, the cement industry is still plagued by issues such as overcapacity, a significant difference in the utilisation rate of regional capacities, few adopted alternative fuels, and inadequate application. After the power and the iron and steel industries, the cement industry's ultra-low emission retrofitting was extensively launched. The China Cement Association

published the association standard "Ultra-Low Emission Standard of Air Pollutants for the Cement Industry," which serves as the reference for the industry's ultra-low emission retrofitting. Meanwhile, Guangdong, Henan, and Shandong provinces set the goal of completing ultra-low emission retrofitting for all cement capacities during the 14th Five-Year Plan period and introduced corresponding implementation measures.

The results of loose coal control in key areas require consolidation. Heating with renewable energy in non-key areas is gradually gaining importance

The "Action Plan on the In-Depth Fight to Eliminate Heavily Polluted Weather" requires the complete elimination of loose coal in the plain areas of the BTH region and its surrounding areas and the Fenwei Plain before the heating season in 2025. As the introduction of clean heating in the two key areas comes to an end, the key to eliminating loose coal lies in the consolidation of transformation results. Some of the cities that have completed the transformation are seeing the return of loose coal and their clean-heating equipment lying idle due to the higher costs of clean heating in rural areas, late subsidy payments, the preference of empty nesters for burning coal, and poor building insulation.

In 2022, loose coal control was stepped up in non-key areas. The number of cities covered by clean heating demonstration projects, as supported by the central government funds for air pollution prevention and control, grew to cover those in northeast and northwest China. In conjunction with national policies that support heating with renewable energy in rural areas, some pilot cities also explored the use of renewable energy for heating in winter in line with local conditions, further clarifying the transformation targets for renewable energy heating.

With rapid multimodal development, the optimisation of the transportation structure progressed smoothly

China's "road-to-railway" and "road-to-waterway" freight flow diversion has achieved remarkable success, while its combined rail-water transportation has progressed by leaps and bounds. In 2022, the national railway and waterway freight volumes grew by 9.5% and 12.3%, respectively, compared with 2020. The achievement of the 14th Five-Year Plan's goals of attaining "10% and 12% growth in the national railway and waterway freight volumes compared with 2020 by 2025" look promising. Meanwhile, the container volume of combined rail-water transportation to and from ports reached 8.75 million twenty-foot equivalent units in China, a YoY growth of 16%.

One of the key tasks of speeding up the development of multimodal transportation is the improvement of its connection level. China has further improved its collection and distribution systems and stepped up the construction of railway lines for ports and industrial parks. To date, many key areas designated for transportation-structure adjustment have set the goals of the 14th Five-Year Plan for multimodal transportation and the percentage of clean transportation application, further optimising the adjustment of the transportation structure in key areas and intensifying the construction of demonstration areas.

The expedited energy transformation of vehicle and ship fleets intensified the clean and low-carbon development of the transportation industry

Expedited energy transformation is a major strategic trend for the optimisation of the transportation structure and the achievement of carbon peaking by 2030. China has already established the goal that "about 40% of the newly added means of transport

shall run on new and clean energy by 2030." To this end, policies and measures were introduced in 2022 to speed up the market development of new energy vehicles while defining the pathways for the energy transition of shipping based on fields and periods.

Regarding the development of new energy vehicles, the central and local governments continue to offer financial support for their sales, purchase, operations, and charging. Moreover, pilot projects for battery-swapping models and fuel cell vehicles are being promoted, along with the building of charging infrastructure and systems, to support the high-speed development of new energy vehicles. The percentage of new energy vehicles in vehicle sales rose to 25.6% in 2022 from 5.4% in 2020.

In response to shipping energy transition, pure-electric ships have become the key to the decarbonisation of inland vessels, and different policies are promoting their prominent adoption among cruise ships and inland vessels for short trips. Meanwhile, alternative energy that can help mid- and long-distance shipping decarbonize, such as methanol, hydrogen fuel, and ammonia, is still being tested and requires ongoing breakthroughs and promotion in technology, cost, and policy.

Recommendations

Revise the ambient air quality standards promptly to consolidate the leading and driving role of standards

China's $PM_{2.5}$ concentration remains high, and O_3 concentration is also showing a rising trend. Although the number of cities meeting the standard for $PM_{2.5}$ continued to grow in 2022, the overall national annual mean concentration of $PM_{2.5}$ fell significantly behind the values in developed countries and those stated in the WHO Global Air Quality Guidelines (AQGs). As the Blue-Sky Defense War enters a stage that requires sustained and determined efforts, some cities have begun setting less stringent targets for air quality improvement and slowed down their actions. China needs to set stricter air quality management targets, which can play a strong leading and binding role in improving its cities' air quality. Internationally, the updated AQGs in 2021 are the bellwether for the revision of air quality standards, and both the European Union and the United States have put forward their targets based on health protection. They plan to tighten their air quality targets and standards as they enforce stricter limits on key air pollutants, such as $PM_{2.5}$.

Based on local health effects and benchmark studies, China should learn from existing international research, guidelines, and methodology to promptly revise its ambient air quality standards, strengthen cities' air quality management systems to meet the standards, and devise refined management strategies based on health risk control to continue improving air quality and further protecting public health. It is recommended that governments conduct a review of the health effects of air pollution in China, including benchmark research and research on standard revision methods during the 14th Five-Year Plan period. Proposals for the revision of standards should be initiated, stricter limits for $PM_{2.5}$ considered, and O_3 concentrations during the peak season added as a new indicator.

Introduce supporting incentive policies for the retrofitting of coal-fired power units to improve their adjustment capability and carefully control the increased number of coal-fired power projects

With its dual-carbon goals, China needs to coordinate the retrofitting of existing coal-fired power units with the scale of newly built units to actively and steadily promote the low-carbon transformation of the power industry and ensure that coal power gradually shifts from being the primary power source to becoming a supporter of basic security and regulation.

On the one hand, existing units require high-quality retrofitting for energy conservation, heat provision, and improved adjustment capability. It is thus recommended that the central and local governments promptly introduce supporting incentive policies for the retrofitting of coal-fired power units. Coal-fired power enterprises can be encouraged to retrofit when the costs involved are mitigated through improved ancillary services and the joint management of coal-fired power and new energy.

On the other hand, the number of newly approved coal-fired power projects grew drastically in 2022 in response to needs, such as to ensure steady energy supply, support the launch of new energy projects, and replace small power generators with large ones. Given that most coal-fired power enterprises are currently running at a loss, and with the low utilisation hours of coal-fired power, the unregulated building of a large number of coal-fired power units may lead to wasted resources and idle assets, which is not helpful in the achievement of the dual-carbon goals. It is thus recommended that government departments reasonably assess the utilisation of existing coal-fired power resources and focus on long-term development. New coal-fired power projects should be carefully assessed and scientifically verified to maintain the balance between the optimised transformation of coal-fired power units and secured supply. This will also prevent the unregulated launch of coal-fired power projects.

Innovate management and technology to drive the clean and low-carbon transition of key industries

Driven by ultra-low emission retrofitting policies, the reduction of air pollutant emissions by China's iron and steel and cement industries achieved remarkable results. However, clean and low-carbon transition remains challenging. For example, the results of the enforcement of ultra-low emission retrofitting were dissimilar in different areas, with some enterprises falsifying their emissions data. Meanwhile, the structure of high-carbon fuel sources, such as coal and coke, has yet to fully transform, and the issue concerning increased carbon emissions also emerged when additional facilities were built for ultra-low emission retrofitting.

Regarding ultra-low emission retrofitting, it is recommended that government departments focus on following up its implementation and assessing its results. Stricter control should be in place to seriously tackle and investigate enterprises falsifying their results. Differentiated environmental-protection policies should be introduced based on the different levels of environmental performance among enterprises. Meanwhile, regulations concerning rewards and punishments should be perfected to help leading enterprises boost their competitiveness.

Regarding energy conservation and carbon reduction technology, it is recommended that the iron and steel industry speed up the independent research and development of breakthrough technologies, such as the utilization of low- and medium-temperature waste heat, hydrogen-rich carbon circulation blast furnaces, hydroxy shaft furnaces, and hydroxy fusion reduction iron smelting. In addition, the industry should gradually increase the percentage of steel-making by electric arc furnaces. Meanwhile, the cement industry should expedite the transformation of energy conservation technologies, such as energy-efficient burning, the efficient sealing of rotary kilns, and efficient grinding. It should also focus on issues concerning the replacement of raw materials and fuels of cement kilns.

Promote the extensive connection and integration of multimodal transportation to provide greater room for the optimization of the transportation structure

Driven by different policies, China's multimodal transportation is developing by leaps and bounds but still faces relatively strong pressure to pick up speed. To achieve the goals of the 14th Five-Year Plan, the container volume of combined rail-

water transportation to and from ports needs to achieve a minimum compound annual growth rate of 17%. The development of multimodal transportation requires further impetus from improved carrying capacity and connection level. Meanwhile, to promote combined rail-water transportation, the building of green collection and distribution systems for port areas needs to be accelerated.

It is recommended that the central and local government departments enhance the construction of special railway lines and collection and distribution systems. The seamless connection between railway port stations and storage yards at ports needs to be improved to enhance infrastructure interconnection. Meanwhile, the green assessment of ports should be stepped up, and an assessment system including indicators such as the ratio of connected special railway lines and seamless connections should be introduced to encourage the faster achievement of the development targets of combined rail-water transportation. Furthermore, organisation and coordination should be strengthened. The “single-order system” and the standard rules for combined rail-water transportation needs to be promoted and perfected, respectively. Last but not the least, the building of smart ports should be expedited to create more channels for combined rail-water transportation that are smarter and more exemplary and efficient.

Clean Air Asia China Office

Address: 3-41, JianGuoMenWai Diplomatic Residence Compound, No.1 Xiushui Street, Chaoyang District, Beijing, 100600
Email: china@cleanairasia.org
Tel/Fax: +86 10 8532 6172
Web: www.cleanairasia.org www.allaboutair.cn