



China Air 2017

Air Pollution Prevention and Control Progress in Chinese Cities



Clean Air Asia

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About Clean Air Asia

Clean Air Asia (CAA) is an international non-profit organization established in 2001 by the Asian Development Bank, World Bank, and United States Agency for International Development (USAID). Our mission is to reduce air pollution and greenhouse gas emissions in Asia and contribute to a livable and healthy Asia for all people, both now and in the future. Clean Air Asia is a platform for change, working with partners around the world to reduce emissions through such key approaches as research, policies, information and capacity building.

Our headquarter is located in Manila, Philippines, and we have offices in Beijing, China, and New Delhi, India. Our Country Network includes Indonesia, Malaysia, Nepal, Philippine, Sri Lanka and Vietnam.

Clean Air Asia has worked in China for more than a decade to improve air quality management and promote green transportation in Chinese cities. In collaboration with the Foreign Economic Cooperation Office (FECO) of the Ministry of Environmental Protection (MEP), CAA established a City Air Quality Management Network in China in 2005. To date, Clean Air Asia has organized 12 annual workshops and 25 training activities on air quality management with an attendance of around 150 cities.

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Foreword

Dear readers:

China Air is the bilingual (Chinese and English) annual report released by CAA, which has objectively recorded and tracked the progress of the implementation of air pollution prevention and control policies, air quality status, and case studies of best practices from cities since the release of Action Plan for Air Pollution Prevention and Control in 2013. We hope that these reports will facilitate the whole society to support and supervise the policy implementation, encourage cities to learn from each other's experiences, and help other countries better understand China's approach towards improving air quality.

China Air 2017 is the third report in this series. It is a continuation of the first two reports in terms of content and framework, covering policies and measures as well as air quality status at the national, regional and city levels. The 338 cities that comprise the national air quality monitoring network are all included in this report. Among the two case studies shared, one focuses on vehicle emissions control in Nanjing while the other introduces the regulation of coal-fired boilers in Dalian.

Following the release of the previous report, we were pleased to see that the 13th Five-Year Plan on Eco-Environmental Protection released by the State Council explicitly requested that non-attainment cities declare the timeline and roadmap for air quality attainment. We were also delighted to observe an increase in the number of cities engaging in science-based policymaking. They are establishing or seeking to establish the system for pre-evaluation, tracking, and post-implementation evaluation in order to implement more effective control measures based on local situation. These progresses demonstrate that our work and efforts are meaningful and valuable.

All the original data and policy references from the report can be found in our "Knowledge Hub" (www.allaboutair.cn). Created in November 2015 by CAA, this Chinese online information platform shares city best practices, tailored international experiences, and themed training materials. In August 2016, we launched an online help-desk section on Knowledge Hub which provides a platform for domestic and foreign experts to respond to questions from users.

CAA's vision is Asia without air pollution. We will continue increasing our efforts in China through capacity building, policy research and public education, and strive to achieve clean air in Chinese cities!

Fu Lu
China Director
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Content and Scope

China Air 2017, the third report in the series *China Air - Air Pollution Prevention and Control Progress in Chinese Cities* provides data and analysis of air quality information collected from 338 Chinese cities at and above the prefecture level in 2016, tracks and analyzes policies issued and corresponding implementation progress in the country, 3 key regions ((Beijing-Tianjin-Hebei (BTH), Yangtze River Delta (YRD) and Pearl River Delta (PRD)), and 338 cities. This report also summarizes two case studies on Dalian's experience in regulating coal-fired boilers and Nanjing's experience in managing vehicle pollution. The 338 cities covered in this report are all cities that have been required by the central government to monitor and disclose air quality data since 2015.

Development Methodology

With the goal of providing an objective perspective, this report systematically incorporates air quality data and policy information to ensure accuracy and comprehensiveness. The data and information in this report have all been collected from official sources, including: 1) Air Quality Data: Air quality bulletins and official news released by the Ministry of Environmental Protection (MEP), provincial environmental protection departments, and municipal environmental protection bureaus; 2) Policy Information: Government documents, speeches by officials, meeting reports and media reports that cite official sources.

Furthermore, based on the feedback from municipal environmental protection authorities on the previous two reports in this series, in this report Clean Air Asia (CAA) shares the experiences of specific cities (Dalian and Nanjing were selected as examples) in regulating coal-fired boilers and managing vehicle pollution.

Main Conclusions

Air Quality

The end of 2016 marked four years in the implementation of the Action Plan for Air Pollution Prevention and Control (the "Action Plan"). With under a year to go before the scheduled deadline, all cities and provinces spared no efforts to strengthen air pollution prevention and control and achieved overall improvement in air quality. Among the 338 cities covered in this report, as many as 84 cities complied with the national air quality standards

for six criteria pollutants, representing an increase of 11 cities compared with 2015. In addition, among the 74 key cities, some managed to meet their targets for air quality improvement set in the Action Plan ahead of schedule. However, despite these improvements, non-attainment of PM_{2.5} concentration is still prevalent. At the same time, average O₃ concentrations in 338 cities, though complying with standards, continued to rise and the number of non-attainment cities increased.

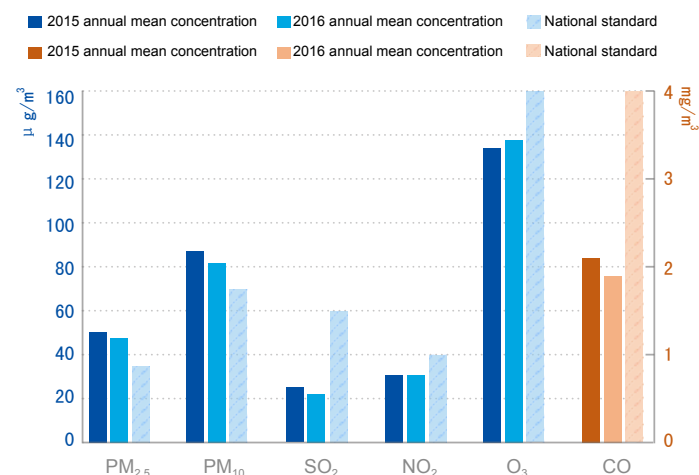


Figure I: Annual Mean Concentrations for 6 Pollutants in 2015 and 2016

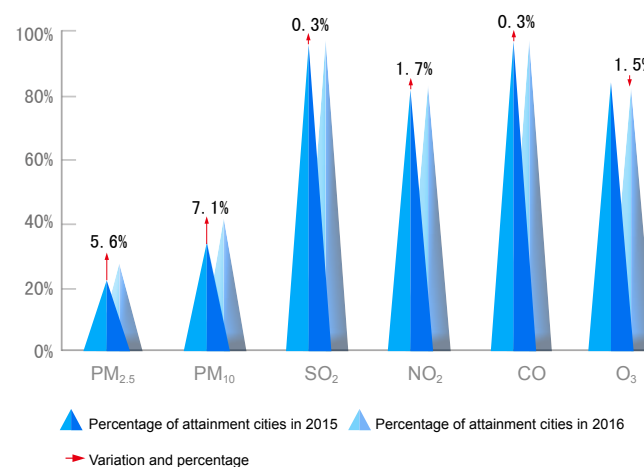


Figure II: Percentage of Attainment Cities for 6 Pollutants in 2015 and 2016

Overall air quality improved but PM concentrations generally failed to comply with standards

The overall air quality of Chinese cities improved in 2016 compared with the previous year. In terms of annual average concentrations of pollutants in the 338 cities, SO₂ and CO concentrations decreased further after complying with standards; NO₂ concentrations remained the same as the previous year, while O₃ concentrations increased slightly. Although PM_{2.5} and PM₁₀ concentrations and the number of non-attainment cities continued decreasing, the annual average concentrations remained higher than standards and 71.9% and 58.3% of cities failed to attain standards for PM_{2.5} and PM₁₀, respectively. Moreover, the annual mean concentration of PM_{2.5} in non-attainment cities ranged from 36 to 158µg/m³, exceeding the national standard by 3.5 times at its highest concentrations.

O₃ pollution was not effectively controlled and number of non-attainment cities increased

Of the six criteria pollutants in the 338 cities, only O₃ concentrations rose in 2016 compared with 2015. The non-attainment concentration range was 161-200µg/m³, staying at the unhealthy-for-sensitive-groups level. The number of non-attainment cities increased from 54 to 59, while the percentage of non-attainment days went up from 4.6% to 5.2%.

Among the three key regions, both YRD and PRD managed to comply with the standard for O₃ concentration in 2016. However, compared with 2015, only YRD improved as their O₃ concentration dropped from 163µg/m³ to 159µg/m³ (by 2.5%). Both BTH and PRD recorded higher O₃ concentrations, increasing from 162µg/m³ to 172µg/m³ (by 6.2%) and from 145µg/m³ to 151µg/m³ (by 4.1%), respectively. Furthermore, the number of days with O₃ being the primary pollutant accounted for 26.3%, 39.8% and 70.3% of the number of non-attainment days in BTH, YRD and PRD, respectively, ranking O₃ second, second and first among all the pollutants in the three regions. Moreover, regions outside BTH, YRD and PRD, including Liaoning Province, Sichuan Province, Jiangxi Province, Guizhou Province, Shaanxi Province, Gansu Province, Ningxia Hui Autonomous Region, Chongqing City, Anhui Province and Jilin Province showed a similar upward trend.

17 cities reached 2017 targets of PM_{2.5} concentration reduction ahead of schedule

Based on available data, 17 out of 74 key cities reached the 2017 target for PM_{2.5} concentration reduction set in the Action Plan ahead of schedule.

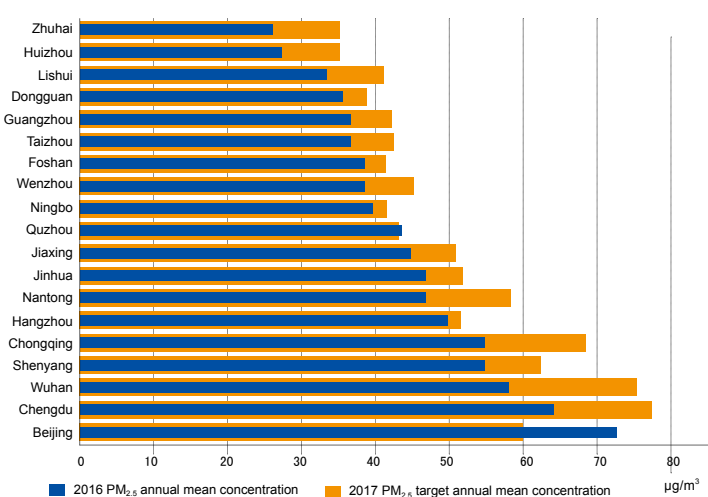


Figure III: Annual Mean Concentrations for 6 Pollutants in 2015 and 2016

Most of these cities are in Zhejiang and Guangdong Province. In addition, Quzhou city in Zhejiang Province came very close to the target (99%), while Beijing faces challenges in achieving the target by 2017.

PM concentrations varied across regions with pollution levels worsening in some cities in central and western China

While some cities in Eastern and Southern China managed to reach the 2017 targets of PM concentration reduction ahead of schedule, performance in other regions remained less satisfactory. Of 338 cities, over 50 failed to reach

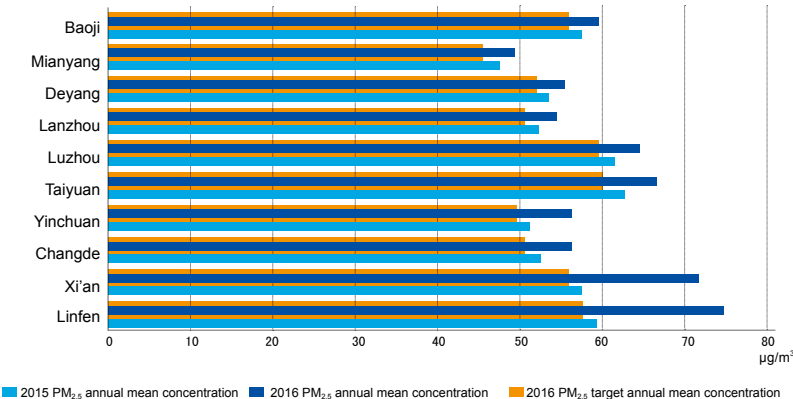


Figure IV: Percentage of Attainment Cities for 6 Pollutants in 2015 and 2016

the 2016 targets for PM_{2.5} or PM₁₀ concentration reduction. Most of these cities are in Henan, Sichuan, Shaanxi, Hubei, Gansu and other provinces in central and western China. Among these cities, Linfen and Xi'an's PM_{2.5} concentrations increased by 20% compared with 2015.

In terms of the extent of improvement in PM concentrations, cities in the Northeast China performed increasingly well. PM_{2.5} and PM₁₀ concentrations both decreased by over 25% in Harbin, Jilin and Changchun, exceeding the 5% improvement in 2015 and satisfying the 2020 target set in the 13th Five-Year Plan. In addition, PM_{2.5} concentrations decreased by over 20% in other northeastern cities such as Yichun, Mudanjiang, Heihe, Hegang, Shuangyashan, and Shenyang.

BTH and its surrounding areas continued suffering the highest levels of PM concentration, with a notable deterioration in air quality during the winter. The extent of improvement in PM_{2.5} concentrations in BTH and its surrounding areas was smaller in 2016 compared with the previous two years.

Policy Measures

China's air pollution prevention and control entered a critical stage in 2016. With an improvement in top-level design at the national and regional levels, cities put more emphasis on the implementation and enforcement of specific pollution control measures. Consequently, there were progresses in coal combustion control, elimination of yellow-label vehicles, promoting new energy vehicles and elimination of outdated capacity. Moreover, breakthroughs were made in previously neglected areas related to loose coal and non-road mobile machinery. Efforts were also stepped up to control VOCs pollution and refined management of fugitive dust. Meanwhile, BTH continued to increase the scope and depth of regional collaboration.

Progress was made in coal combustion control; however coal consumption increased in some provinces

From 2014 to 2016, the total amount of coal consumption declined for three consecutive years by 2.9%, 3.7% and 4.7% year-on-year, respectively. At the same time, the proportion of coal consumption in the total energy consumption dropped from 65.6% to 62%, while the proportion of non-fossil fuels rose from 11.1% to 13.3%.

Based on available data, BTH managed to decrease total coal consumption in 2016 compared with 2012. Within the BTH region, Beijing and Tianjin were ahead of schedule in reaching the coal consumption reduction targets set

by the National Development and Reform Commission (NDRC) for 2017. In addition, 22 provinces (municipalities and autonomous regions) had decrease of total coal consumption in 2015, compared with 2012. However, Shandong Province, Shaanxi Province, Jiangxi Province, Ningxia Hui Autonomous Region, Xinjiang Uygur Autonomous Region and Hainan Province saw an increase in total coal consumption. In extreme cases, some of these provinces were even found to have built illegal coal-fired chemical projects and coal-fired heating boiler projects, or to have reported fraudulent results on the elimination of small coal-fired boilers.

With the air pollution prevention and control entering a critical stage, pollution control for loose coal emissions from household use has become a challenge that must be overcome in the region. In 2016, BTH pressed ahead with loose coal pollution control by replacing coal with electricity, natural gas, or other clean energy sources. However, BTH was only able to replace an equivalent of 5% of 40 million tons of loose coal consumed in the region, showing that this will be an extremely arduous task.

Policy framework for VOCs control was established

As major precursors of PM_{2.5} and O₃, VOCs must be controlled in order to achieve coordinated management of PM_{2.5} and O₃. China was relatively late to initiate VOCs control, and established the relevant policy framework in 2016 to cover specific policies and measures including total VOCs emissions control, management of key industries and VOCs pollution charges.

VOCs were included in total emission control indicators for the first time in 2016. During the 13th Five-Year Plan period, it is specified that total VOCs emission control should be carried out in key regions and industries, while total VOCs emissions should be lowered by over 10% compared with 2015 by 2020. Meanwhile in key industries, the central government requires a minimum reduction of 3.3 million tons in VOCs emissions by 2018 compared with 2015 levels. Specific measures for 11 key industries have also been set. China is gradually adopting a more comprehensive approach characterized by "reduction at the source with process control as the core strategy and end-of-pipe control as a supporting strategy."

With improvements in top-level design under way, some cities also took the lead in carrying out pilot projects on VOCs control to implement relevant policies. For example, financial policies were adopted in VOCs control, with some cities following a differentiated charging principle whereby fees are doubled for higher emissions while preferential fee rates are offered to companies with lower emissions.

With the elimination of yellow-label vehicles near completion, outdated and diesel vehicles are becoming the new focuses of vehicle pollution control

Beijing, Tianjin, Shanghai, Qingdao, Zhejiang Province and Jiangsu Province completed the elimination of all yellow-label vehicles in 2016. The next priority of vehicle pollution prevention and control is to eliminate high-pollution and outdated vehicles while vigorously promoting new energy vehicles. Hundreds of thousands of new energy vehicles have been purchased and used in Tier-1 cities, including Beijing, Shanghai, Guangzhou and Shenzhen. Around 200 cities have started using such vehicles in the sectors of public transport, taxis, sanitation, and government organizations.

Pollution from heavy-duty diesel vehicles also drew wider attention. To tackle this issue, Beijing, Wuhan, Nantong and Zhengzhou designated areas where such vehicles are banned. Moreover, Beijing, Shanghai, Zhengzhou, Shenzhen, Xi'an and Yichang required heavy-duty diesel vehicles to install diesel particulate filters (DPF) and other pollution control devices. For example, in Beijing, DPFs were installed in eight types of heavy-duty diesel vehicles, totaling over 5,500 vehicles, including buses, sanitation trucks, tourist buses, mail trucks, dump trucks, shuttle buses, school buses, and airport buses.

In 2016, NO_x and PM emissions from vehicles decreased by 8.29% and 13.51% respectively compared with 2012.

Non-road mobile machinery was brought under regulation

The number of non-road mobile machinery and their emissions are on the rise in China, while management in this area has been very weak. As required by the Action Plan, non-road mobile machinery is subject to regulation starting from 2016.

In 2016, China began implementing the China III emission standards for non-road mobile machinery and tightened environmental protection requirements. China established preliminary regulatory requirements for non-road mobile machinery, including disclosing environmental protection information, declaring and registering machinery, and designating low-emission zones. By requiring registration or inspecting emissions, Beijing, Shanghai, Shenzhen and Jiangsu Province gathered preliminary emissions data on non-road mobile machinery, thereby solving the longstanding problem of data paucity. Zhengzhou is the first city in the country to designate areas where high-emission non-road mobile machinery are banned.

Multiple measures for fugitive dust control were implemented and refined management was adopted

In addition to existing measures such as installing enclosures required by Action Plan, more cities started levying fees for fugitive dust emissions. Some cities also installed fugitive dust continuous monitoring systems to improve regulation.

Currently, Beijing, Tianjin, Suzhou, Taizhou (Jiangsu Province), Xinxiang, Jiangmen and Chongqing have begun levying pollution charges for fugitive dust emissions. Beijing, Tianjin, Shanghai, Guangdong Province and Sichuan Province have also stepped up efforts and installed fugitive dust continuous monitoring systems so that supervisors can obtain real-time data from construction sites.

Regional collaboration progressed in BTH while YRD was relatively lagged behind

In 2016, BTH continued deepening and broadening efforts in regional collaboration. To broaden efforts geographically, some prevention and control measures were expanded to Beijing, Tianjin, Hebei Province, Shanxi Province, Inner Mongolia, Shandong Province, and Henan Province. In 2016, the seven provinces (municipalities and autonomous regions) managed to establish an information-sharing platform for air pollution control. In addition, the region unified standards for heavy pollution alerting and set up a consultation platform for alerting, which effectively reduced the level of heavy pollution in the winter of 2016. Concerning the depth, BTH preliminarily unified the regional planning, measures and standards for regional heavy pollution monitoring and alerting. Coordinated enforcement was carried out and mechanism of twining-city cooperation on pollution prevention and control was strengthened.

However, the progress made in YRD, one of the three key regions, still fell short of requirements outlined in the Law on Prevention and Control of Air Pollution. In the region, no substantive progress was achieved in unifying standards, prevention and control measures or coordinated enforcement mechanisms.

Furthermore, an increasing number of cities and regions started valuing and implementing regional collaboration. In this respect, the Urumqi-Changji-Shihezi city cluster in Xinjiang Uygur Autonomous Region, the Guanzhong city cluster in Shaanxi Province, the Changchun-Jilin-Siping city cluster in Jilin Province, the Jinan metropolitan cluster in Shandong Province, the Hefei metropolitan area of Anhui Province, and the Southern city cluster in Sichuan have all put in place coordinated prevention and control mechanisms in 2016 to solve air pollution issues.

Information disclosure improved, though some cities are still unwilling to publicize annual air pollution data

Since 2013, notable progress has been made on disclosing air quality data, policy measures and effect of air pollution control. For example, in addition to releasing annual reports on local air quality conditions, some cities (Hohhot, Wuxi, Beihai, Sanya, Shizuishan, Putian, Baiyin, Jixi, Shiyan, Qinzhou, Alxa League, Yulin, Baise, Hechi, Pingliang, Qingyang, Haidong, and Guoluo Prefecture) also disclosed the measures they adopted along with the problems they faced in the previous year in their annual action plans for air pollution prevention and control. As a result, the public could better understand the air quality conditions of their cities and the efforts made by their local governments and participate in the pollution control process.

However, some cities are still unwilling to publicize their annual pollution data. By the end of August 2017, nearly a quarter of the 338 cities failed to release their 2016 annual environmental status bulletins or excluded pollution data from the bulletins. Some of these cities are provincial capitals such as Shijiazhuang and Zhengzhou that already established air quality monitoring network in 2013 and suffered from poor air quality. Zhengzhou has not released its data on annual mean concentrations of air pollutants in its Zhengzhou Environmental Status Bulletin since 2013.

An environmental inspection mechanism was initiated, but progress from the rectification plan implementation is not disclosed

The central government initiated an environmental inspection mechanism and fully launched it in 2016. The environmental inspection teams were dispatched on behalf of the Central Committee of the Communist Party of China (CPC) and the State Council to inspect provincial-level and selected city-level governments and to hold them accountable for environmental protection. Afterwards, some provinces also established their own environmental inspection mechanisms in 2016, enabling further inspections of city-level government. As a result, a two-tier (central and provincial) inspection mechanism was formed. As air pollution was an important part of the environmental inspection, the inspection team initiated an “accountability initiative” which provided strong support for the Action Plan implementation at local level.

Inspection work was conducted through collecting information at meetings, reviewing public reports and other relevant information, on-site spot-checks, one-on-one talks with poorly performing local government officials, and site visits. Collecting reports from the public has become an important channel for

the government to encourage public participation. Except for Hebei Province, which was singled out as the pilot province for the inspection starting at the end of 2015, the central environmental inspection team inspected 15 provinces and cities in two phases in 2016 and reviewed over 33,000 reports submitted by the public.

However, the provinces and cities required by the inspection team to carry out rectification efforts have not released the results of implementation in a timely manner, creating challenges for effective public supervision. The central environmental inspection team publicized its results on the MEP website after inspecting 15 provinces (municipalities and autonomous regions). Following the disclosure, eight provinces (municipalities and autonomous regions) that were inspected in the first phase have released their rectification plans. However, as of the publication of this report, only Hebei Province had disclosed the implementation status of the key measures in its rectification plan. Other provinces (municipalities or districts) have not revealed their implementation results, slowing the information disclosure process.

Structural reform of monitoring and criminal accountability were implemented in a parallel fashion to prevent fabrication of monitoring data

In 2016, the environmental monitoring system was reformed based on the principle that “whoever assesses the performance should also be in charge of monitoring.” This principle aims to prevent local fabrication of monitoring data. The operation authority of 1,436 state-owned ambient air quality monitoring sites across the country was all centralized in the national government. Meanwhile, a reform pilot to establish the vertical management system for environmental protection institutions at the provincial level was launched in Hebei Province. The operation authority over all county-controlled air quality monitoring sites across the province would be centralized in the provincial government.

The Supreme People’s Court and the Supreme People’s Procuratorate issued the Interpretation on Several Issues Concerning the Application of Law in the Handling of Criminal Cases of Environmental Pollution in 2016, explicitly stating that the fabrication of monitoring data would be equivalent to crimes of destroying computer information systems and subjected to a heavy punishment. The first case to emerge involved environmental officials in Xi’an who were found to have fabricated air quality monitoring data. This incident alarmed officials by revealing the consequences of data fabrication.

Recommendations

Since the Action Plan has been promulgated and implemented, China has persistently improved its policy framework of air pollution prevention and control, resulting in significant reductions of PM_{2.5} and PM₁₀ concentrations across the country. In 2016, the Action Plan entered its fourth year of implementation and the 13th Five Year Plan had just reached its first year of execution. The 13th Five Year Plan requires the country to sustain “green development” while maintaining medium-to-high speed economic growth. This requirement has brought new opportunities and challenges for air pollution control. With non-attainment of PM concentrations, China is also experiencing a rise in O₃ levels. As an independent third party, Clean Air Asia has the following recommendations regarding control of PM_{2.5} and O₃ and achieving the long-term goal of clean air.

Develop a clean diesel action plan to comprehensively control pollution from diesel engine exhaust

According to 2015 statistics, diesel engines emitted 9.359 million tons of NO_x and 1.008 million tons of PM, which accounted for 38.74% and 6.36% of the total emissions nationwide, respectively. Controlling emissions from diesel engines is an effective way to lower PM and O₃ concentrations simultaneously. Given the wide variety of diesel engines and their extensive application in vehicles, vessels, non-road mobile machinery, it is necessary to start with top-level design.

This report recommends expediting the official launch of the “National Clean Diesel Action Plan”. In addition to enforcing stricter emission standards, integrating standards for regular diesel and automobile diesel, and designating vessel emission control areas in key regions, the government should also design detailed control measures for in-use diesel engines and strengthen day-to-day enforcement to reduce emissions from diesel engines.

High-emission and outdated diesel vehicles, vessels, and machineries that have high retrofit costs should be eliminated and scrapped. Moreover, the government should designate no-go, low-emission and restricted areas for high-pollution diesel engines with a phased approach throughout China, thus accelerating the elimination process. As for in-use diesel engines in good working conditions, retrofitting and improving maintenance should be encouraged, such as installing DPFs or other mature and effective emission reduction devices on diesel vehicles and non-road mobile machinery and converting in-use vessels to use low-sulfur diesel.

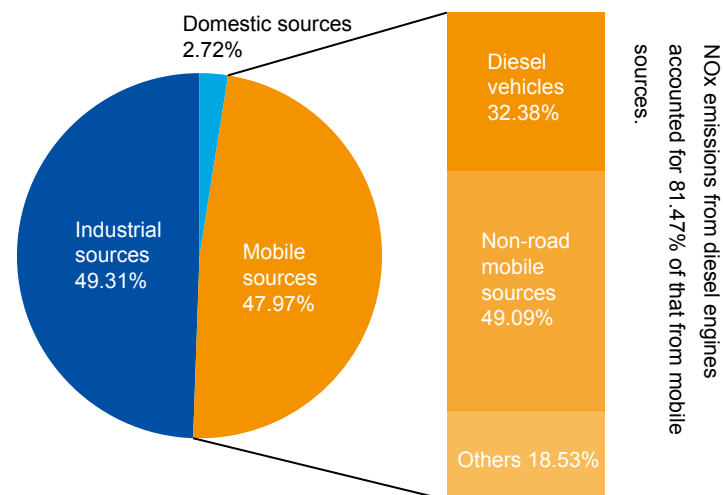


Figure V: Percentage of NO_x Emissions by Sources in 2015

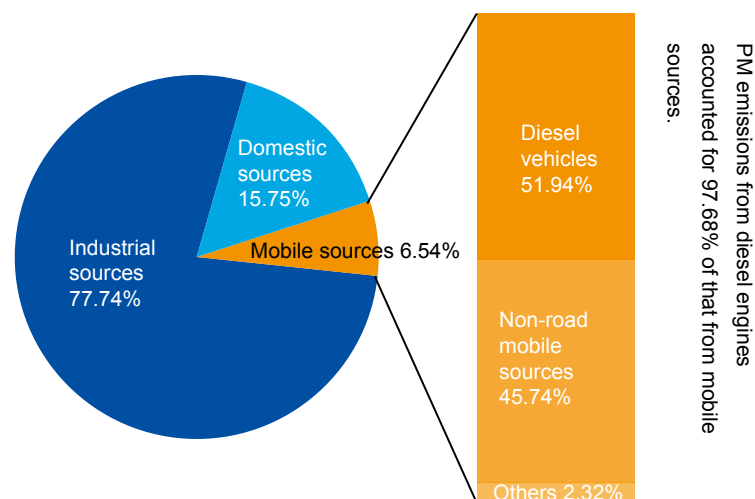


Figure VI: Percentage of PM Emissions by Sources in 2015

With regards to enforcement, the government must increase the frequency of regular inspections and spot-checks, expand the application of remote sensing and other new regulatory approaches, and encourage reporting and supervision by the public. This way, the government will have a variety of strategies to help in-use diesel engines comply with relevant standards.

Explore the potentials for reducing emissions from scattered, unregulated, and high-pollution enterprises

Since the implementation of the Action Plan, significant emission reductions have been mostly attributed to macro-level measures, such as adjustments

in the energy structure and industrial restructuring. During the 13th Five-Year Plan period, it is necessary to enhance regulation and ensure the enforcement of existing measures in order to achieve continuous air quality improvement on one hand; on the other hand, it is also important for the government to explore the potentials for reducing emissions from scattered, unregulated, and high-pollution enterprises by addressing previously neglected areas, such as loose coal burning for household use and non-road mobile machinery.

Pay attention to air quality changes in areas other than the key regions and enhance air pollution control in cities in central and western China

BTH, YRD and PRD are the key regions for implementing the Action Plan and have noticeably improved their air quality in the past few years. However, data shows that air quality is not improved as much in non-key regions, especially in central and western China (including Sichuan, Henan and Shaanxi provinces), which are experiencing either short-term improvements or worsening conditions overall.

In the post-Action Plan period, the central government should devote more attention to non-key regions and take measures such as facilitating them to develop attainment plans, increasing capital investment, promoting learning experience of cities in the key regions, collaborating with scientific research institutes, third-party technology suppliers, international and multilateral agencies; and seeking more opportunities of scientific research support, technical assistance, and capacity building. By strictly implementing relevant national policies for air pollution, the local governments of these regions should initiate more stringent industry access policies and prevent polluting industries and enterprises from relocating to the central and western regions.

Develop national action plan of O₃ pollution control, and conduct coordinated emission reduction of both PM and O₃ and regional cooperation based on photochemical monitoring

The Action Plan uses PM concentrations as the key indicators of emission reduction and the level of PM pollution has improved since its implementation. However, O₃ pollution levels increased. Therefore, more attention should be paid to this particular issue in the future, and it is recommended to develop a national action plan for O₃ pollution control.

The O₃ formation mechanism and the impacts of regional transportation are very complicated, varying from place to place and from time to time. This

means the design and implementation of control strategies must be based on comprehensive and scientific pre-evaluation, tracking progress, and post-implementation evaluation of a suite of policies. Scientific and targeted policies must be created to ensure that O₃ and PM concentrations both decrease.

It is also recommended to establish a photochemical monitoring network and apply localized models to understand O₃ formation mechanisms and features; develop scientific and coordinated reduction strategies for NO_x and VOCs and increase efforts of VOCs emission reduction based on monitoring and modelling results; and adopt regional approach to address O₃ pollution, and develop regional control strategies.

Enhance and refine enforcement and fully utilize public participation and supervision

Although the central government has been focusing on policy implementation, supervision and enforcement capacity is still insufficient in many cities. Therefore, in addition to building strong inspection teams at local level, funds should be allocated from central and local budgets to develop and adopt a variety of enforcement technologies and approaches. This should include expanding the coverage of continuous emission monitoring, equipping enforcement personnel with advanced handheld mobile devices, and applying advanced technologies such as drones, lidars, and remote sensing, thus enabling more standardized, timely, and precise enforcement.

It is also important to emphasize the role of public participation. It is recommended that government disclose inspection and rectification information, encourage the public to report environmental violations, and increase media exposure of violations, mobilizing whole society to support air pollution prevention and control.

Create a template for environmental status bulletins and standardize the disclosure of air pollution information

Although most cities have started disclosing air quality information through a variety of channels, it is still necessary to standardize publications on overall pollution conditions, control measures, and effect.

This report recommends that the MEP create detailed rules on how to publish relevant information on air pollution prevention and control. It is necessary to specify the data and statistics that cities must disclose, as well as the frequency and form of disclosure. Moreover, for the environmental status

bulletins that have been widely used in China, this report recommends that the government issue a specific template with detailed instructions, listing key information as “must disclose” items including annual mean concentrations of criteria air pollutants, specific pollution control measures, and effect. This way, the public, the media, researchers, and other stakeholders concerned about air quality can learn about the condition of local air quality. They can understand whether air quality has improved or worsened, whether the annual mean concentrations of criteria pollutants in specific cities have complied with standards or reached targets, and whether the measures implemented are effective. This will allow all stakeholders to better support local air pollution prevention and control and supervise the progress.

Air Quality Status in 2016

This chapter summarizes the current air quality status and changes in recent years of the 338 cities at and above the prefecture level in China which are required to monitor and disclose air quality information under the Ambient Air Quality Standards. All the air quality information provided is collected from publicly available governmental sources.

PM_{2.5}

The annual mean concentration of PM_{2.5} continued to decline, but still severely exceeded the national standard. Compared with 2015, the annual mean concentration range of PM_{2.5} in the 338 cities changed from 11-125µg/m³ to 12-158µg/m³ in 2016, while the average concentration fell from 50µg/m³ to 47µg/m³, which were respectively 1.42 and 1.34 times of the national standard of 35µg/m³.

The number of cities that complied with the national standard increased. The percentage of attainment cities increased from 22.5% to 28.1%.

Among the three key regions, the annual mean concentration of PM_{2.5} declined most significantly in YRD, from 53µg/m³ to 46µg/m³, or by 13.2%. In BTH, the value fell from 77µg/m³ to 71µg/m³, or by 7.8%. In PRD, the concentration level complied with the standard and continued declining from 34µg/m³ to 32µg/m³, or by 5.9%.

PM₁₀

The annual mean concentration of PM₁₀ continued declining, but still significantly exceeded the national standard. Compared with 2015, the annual mean concentration range of PM₁₀ in the 338 cities changed from 24-357µg/m³ to 22-436µg/m³ in 2016, while the average concentration fell from 87µg/m³ to 82µg/m³, which were respectively 1.24 and 1.17 times of the national standard of 70µg/m³.

The number of cities that complied with the national standard increased. The percentage of attainment cities rose from 34.6% to 41.7%.

Among the three key regions, the annual mean concentration of PM₁₀ in BTH was the highest, but also decreased the most, from 132µg/m³ to 119µg/m³, or by 9.8%. In YRD, the value declined from 83µg/m³ to 75µg/m³, or by 9.6%, while PRD complied with the standard and continued declining, from 53µg/m³ to 49µg/m³, or by 7.5%.

SO₂

The annual mean concentration of SO₂ complied with standards and continued decreasing. Compared with 2015, the annual mean concentration range of SO₂ in

the 338 cities changed from 3-87µg/m³ to 3-88µg/m³ in 2016, while the average concentration value dropped from 25µg/m³ to 22µg/m³, complying with the national standard of 60µg/m³.

Most of the cities complied with the national standard. The percentage of attainment cities increased from 96.7% to 97%. Hence, SO₂ ranked first alongside CO as pollutants for which the number of attainment cities was the greatest.

The annual mean concentrations of SO₂ in the three key regions all conformed to the standard and decreased further. Though BTH recorded the highest annual mean concentration, SO₂ concentration still decreased from 38µg/m³ to 31µg/m³, or by 18.4%. Meanwhile, in YRD and PRD, the levels fell from 21µg/m³ to 17µg/m³ (by 19%) and from 13µg/m³ to 11µg/m³ (by 15.4%), respectively.

NO₂

The annual mean concentration of NO₂ continued complying with the standard. Compared with 2015, the annual mean concentration range of NO₂ in the 338 cities changed from 8-63µg/m³ to 9-61µg/m³ in 2016, while the average concentration was at 30µg/m³, the same level as the previous year and complying with the national standard of 40µg/m³.

The number of cities that complied with the national standard increased. The percentage of attainment cities rose from 81.7% to 83.1%.

Among the three key regions, the annual mean concentration of NO₂ in BTH and PRD increased from 46µg/m³ to 49µg/m³ and from 33µg/m³ to 35µg/m³, respectively. Meanwhile, the value in YRD decreased from 37µg/m³ to 36µg/m³, or by 2.7%.

O₃

Overall, O₃ concentration levels were on the rise. In 2016, the maximum 90th percentile O₃ concentration (8-hour mean value) attained the national standard of 160µg/m³, but the concentration range changed from 62-203µg/m³ to 73-200µg/m³ while the average concentration increased from 134µg/m³ to 138µg/m³.

The number of cities that complied with the national standard continued declining. The percentage of attainment cities decreased from 84% to 82.5%.

Among the three key regions, only YRD achieved a slight improvement in annual mean concentration, falling from 163µg/m³ to 159µg/m³. Meanwhile, the respective values in BTH and PRD increased from 162µg/m³ to 172µg/m³ and from 145µg/m³ to 151µg/m³. Variations in O₃ concentrations in the three key regions were the same as that of its precursor, NO₂.

CO

The annual mean concentration of CO was within the standard and continued decreasing. Compared with 2015, the 95th percentile concentration range (daily mean value) of CO in the 338 cities changed from 0.4-6.6mg/m³ to 0.8-5.0mg/m³ in 2016, while the average concentration fell from 2.1mg/m³ to 1.9mg/m³, attaining the national standard of 4mg/m³.

Most of the cities conformed to the national standard as the percentage of attainment cities increased from 96.7% to 97%. Hence, CO ranked first alongside SO₂ as pollutants for which the number of attainment cities was the highest.

The annual mean concentrations of CO in the three key regions all conformed to the standard. In BTH and PRD, the value decreased from 3.7mg/m³ to 3.2 mg/m³ (by 13.5%) and from 1.4mg/m³ to 1.3mg/m³ (by 7.1%), respectively. Meanwhile, the value in YRD stayed at 1.5mg/m³, with no change compared with 2015.

In general, the air quality status of 338 cities in 2016 can be summarized as follows:

Overall air quality improved but PM concentrations generally failed to comply with standards

The overall air quality of Chinese cities improved in 2016 compared with the previous year. In terms of annual mean concentrations of pollutants in the 338 cities, SO₂ and CO concentrations decreased further after complying with standards; NO₂ concentrations remained the same as the previous year, while O₃ concentrations increased slightly. Although PM_{2.5} and PM₁₀ concentrations and the number of non-attainment cities continued to decrease, the annual mean concentrations remained higher than the national standards, and 71.9% and 58.3% of cities failed to attain standards for PM_{2.5} and PM₁₀, respectively. Moreover, the annual mean concentration of PM_{2.5} in non-attainment cities ranged from 36 to 158μg/m³, exceeding the national standard by 3.5 times at its highest concentrations.

O₃ pollution was not effectively controlled and the number of non-attainment cities increased

Although PM concentrations severely exceeding the national standards remains the biggest challenge for air quality improvement in Chinese cities, the trend of overall increase in O₃ concentrations along with an increase in the number of non-attainment cities cannot be ignored. Of the six pollutants in the 338 cities, only O₃ concentrations rose in 2016 compared with 2015. The non-attainment

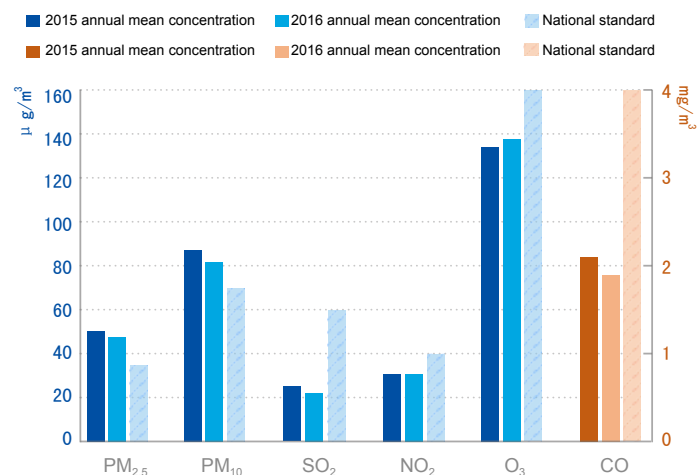


Figure 1: Annual mean concentrations for 6 pollutants in 2015 and 2016

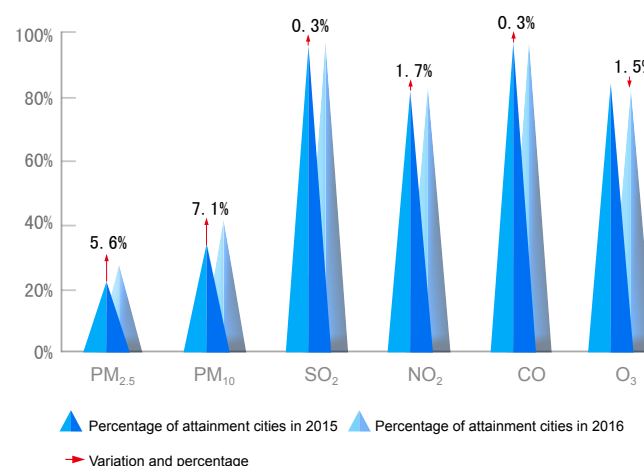


Figure 2: Percentage of attainment cities for 6 pollutants in 2015 and 2016

concentration range was 161-200μg/m³, staying at the unhealthy-for-sensitive-groups level. The number of non-attainment cities increased from 54 to 59, while the percentage of non-attainment days went up from 4.6% to 5.2%.

Moreover, among the three key regions, YRD and PRD managed to comply with the standard for O₃ concentration in 2016. However, compared with 2015, only YRD improved as its O₃ concentration fell from 163μg/m³ to 159μg/m³ (by 2.5%). Both BTH and PRD recorded higher O₃ concentrations, increasing from 162μg/m³ to 172μg/m³ (by 6.2%) and from 145μg/m³ to 151μg/m³ (by

4.1%), respectively. Furthermore, the number of days with O₃ being the primary pollutant accounted for 26.3%, 39.8% and 70.3% of the number of non-attainment days in BTH, YRD and PRD, respectively, ranking O₃ second, second and first among all the pollutants in the three regions. Moreover, regions outside BTH, YRD and PRD, including Liaoning Province, Sichuan Province, Jiangxi Province, Guizhou Province, Shaanxi Province, Gansu Province, Ningxia Hui Autonomous Region, Chongqing City, Anhui Province and Jilin Province showed a similar upward trend of O₃ concentrations in 2016.

PM concentrations varied across regions with pollution levels worsening in some cities in central and western China

While some cities in eastern and southern China managed to reach the 2017 targets of PM concentration reduction ahead of schedule, performance in other regions was less satisfactory. Of the 338 cities, over 50 failed to reach the 2016 targets for PM_{2.5} or PM₁₀ concentration reductions. Most of these cities are in Henan, Sichuan, Shaanxi, Hubei, Gansu and other provinces in central and western China. Among these cities, Linfen and Xi'an instead saw a 20% increase in PM_{2.5} concentrations compared with 2015 levels.

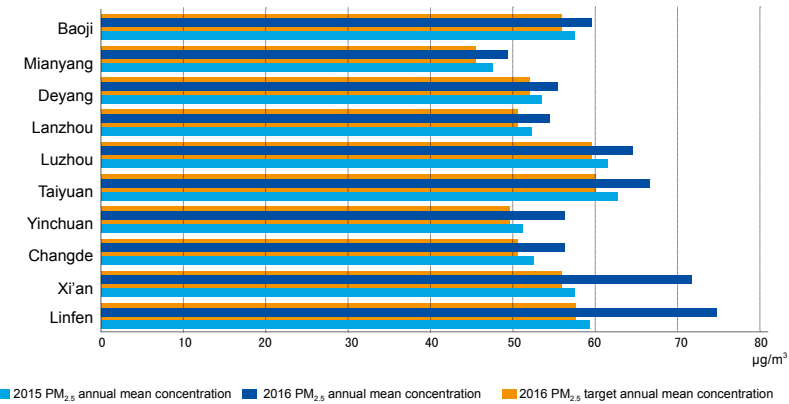


Figure 3: Cities that not only Failed to Achieve PM_{2.5} Reduction Targets but also Experienced Increase in PM_{2.5} Annual Mean Concentration in 2016

In terms of the extent of improvement in PM concentrations, cities in the Northeast China performed increasingly well. The decrease in both PM_{2.5} and PM₁₀ concentrations reached over 25% in Harbin, Jilin and Changchun, exceeding the decrease of 5% in 2015 and satisfying the 2020 target set in the 13th Five-Year Plan. In addition, PM_{2.5} concentrations decreased by over 20% in other northeastern cities such as Yichun, Mudanjiang, Heihe, Hegang, Shuangyashan, and Shenyang.

Meanwhile, BTH and its surrounding areas remained the region with the highest PM concentrations nationwide where heavy pollution was frequent during the winter season. The magnitude of the decrease in PM_{2.5} concentrations in BTH and its surrounding areas was smaller in 2016 than in the previous two years.

Nationwide air quality was the best in summer months, while winter air quality in the BTH region remained an issue of concern

The monthly cities' air quality status reports released by the Ministry of Environmental Protection in 2016 showed that, in terms of PM_{2.5} concentration, air quality in Chinese cities gradually improved in the spring and reached the best levels in June-August, when monthly concentrations of 74 cities and 338 cities all complied with the standards. In autumn, air quality began to worsen progressively, deteriorating to the worst levels in winter. This was especially evident in the BTH region, where monthly concentrations in November and December exceeded the national standard by 3 times and over 4 times respectively. In December, over 20 cities in the region issued red alerts for heavy pollution.

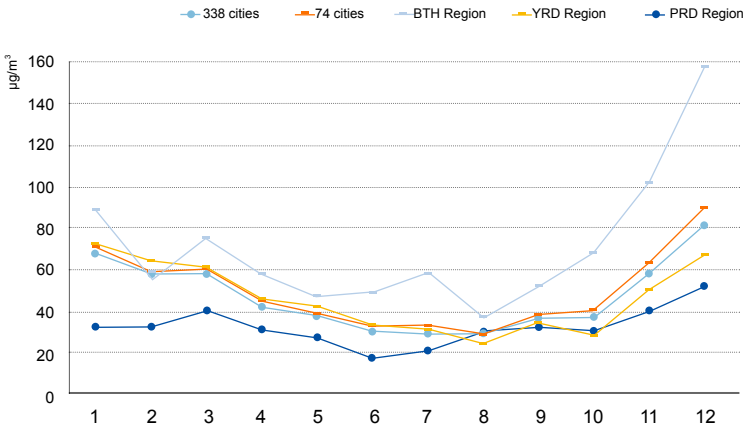


Figure 4: Variation of PM_{2.5} Monthly Concentrations in 2016



Air Quality Status in 2013-2016

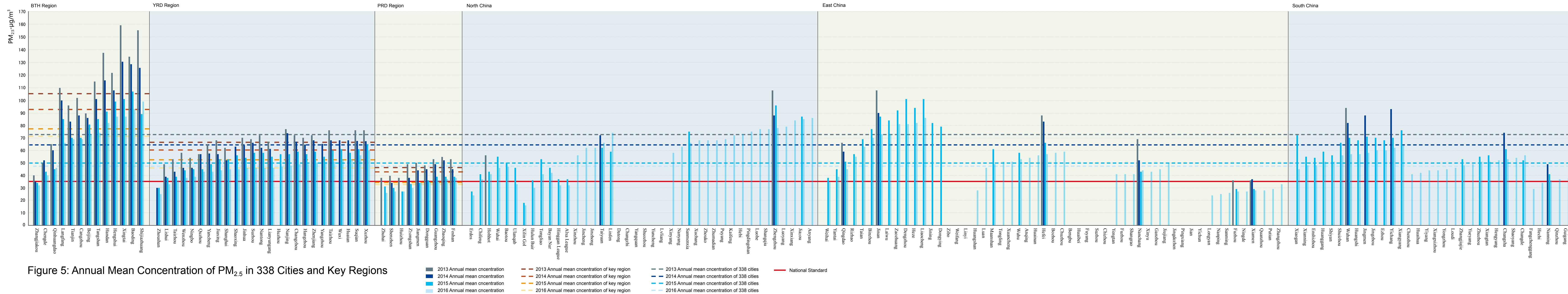
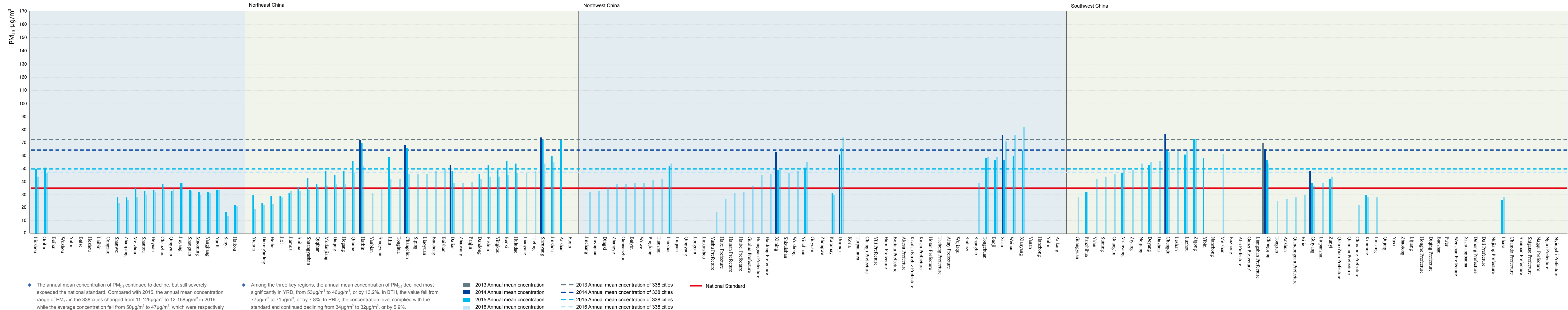
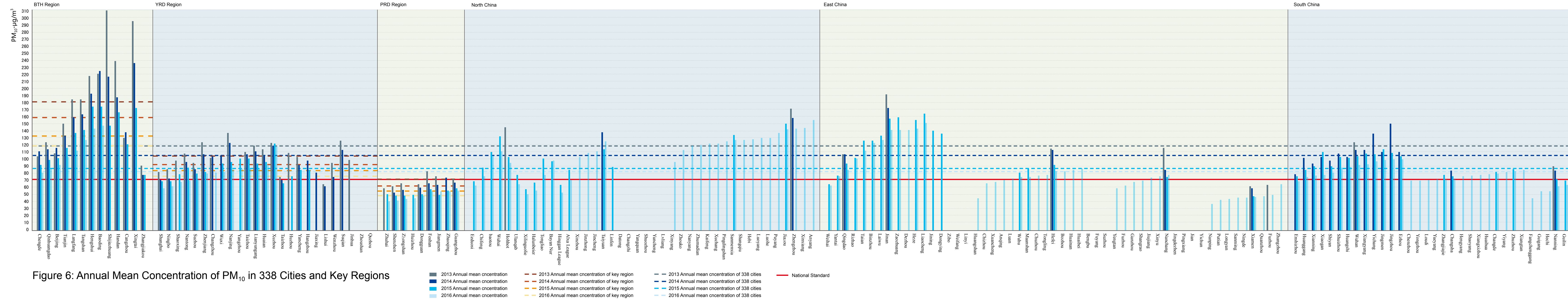
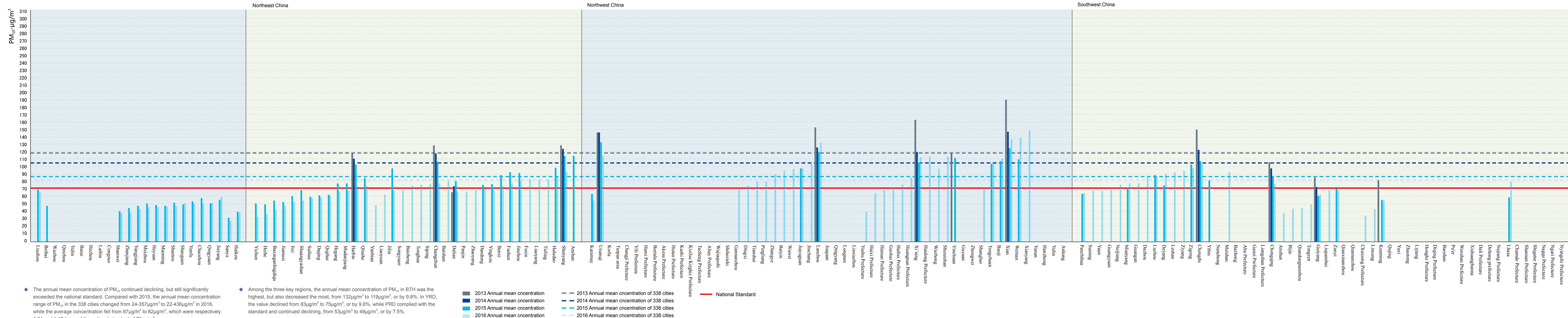
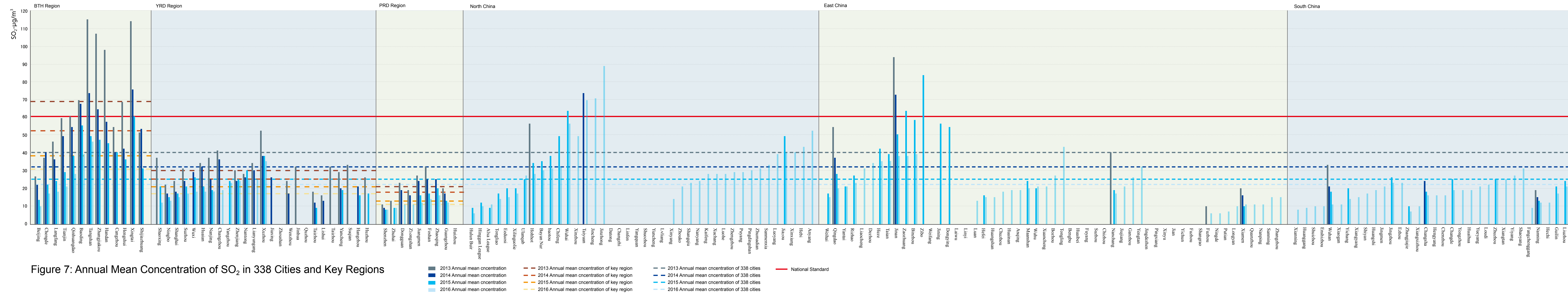


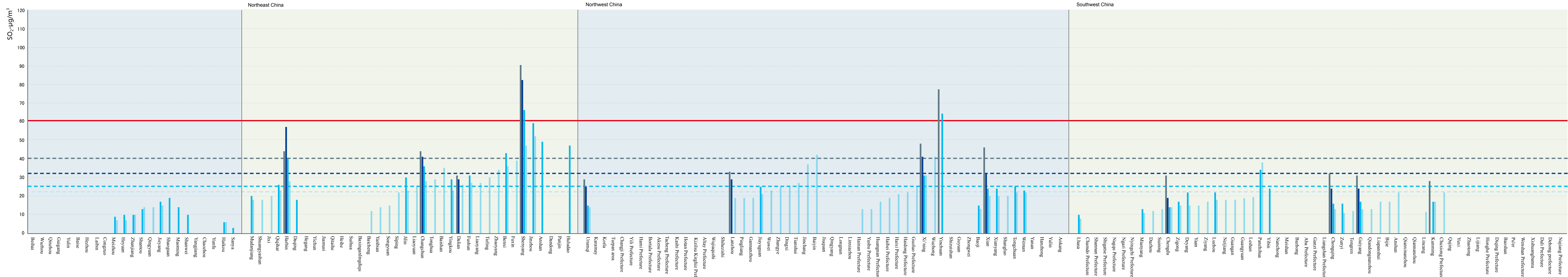
Figure 5: Annual Mean Concentration of PM_{2.5} in 338 Cities and Key Regions



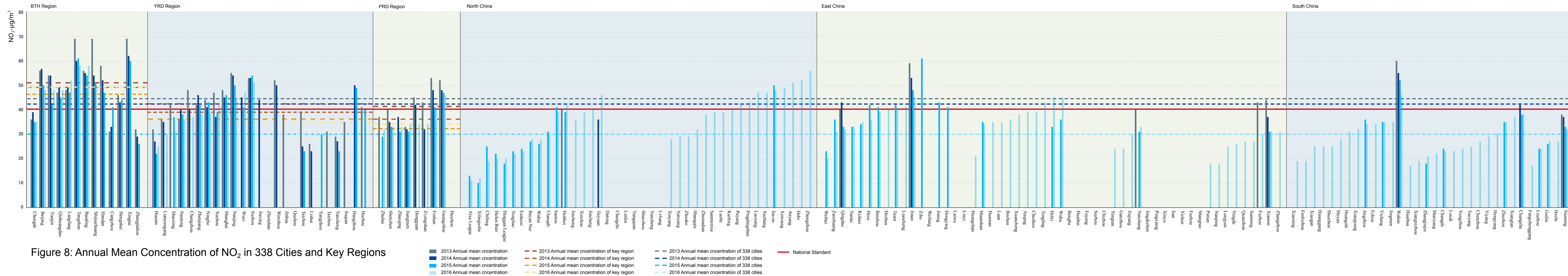




Figure 7: Annual Mean Concentration of SO₂ in 338 Cities and Key Regions



- ◆ The annual mean concentration of SO₂ complied with standards and continued decreasing. Compared with 2015, the annual mean concentration range of SO₂ in the 338 cities changed from 3-87µg/m³ to 3-88µg/m³ in 2016, while the average concentration value dropped from 25µg/m³ to 22µg/m³, complying with the national standard of 60µg/m³.
- ◆ Most of the cities complied with the national standard. The percentage of attainment cities increased from 96.7% to 97%. Hence, SO₂ ranked first alongside CO as pollutants for which the number of attainment cities was the greatest.
- ◆ The annual mean concentrations of SO₂ in the three key regions all complied with the standard and decreased further. Though BTH recorded the highest annual mean concentration, SO₂ concentration still decreased from 38µg/m³ to 31µg/m³, or by 18.4%. Meanwhile, in YRD and PRD, the levels fell from 21µg/m³ to 17µg/m³ (by 19%) and from 13µg/m³ to 11µg/m³ (by 15.4%), respectively.



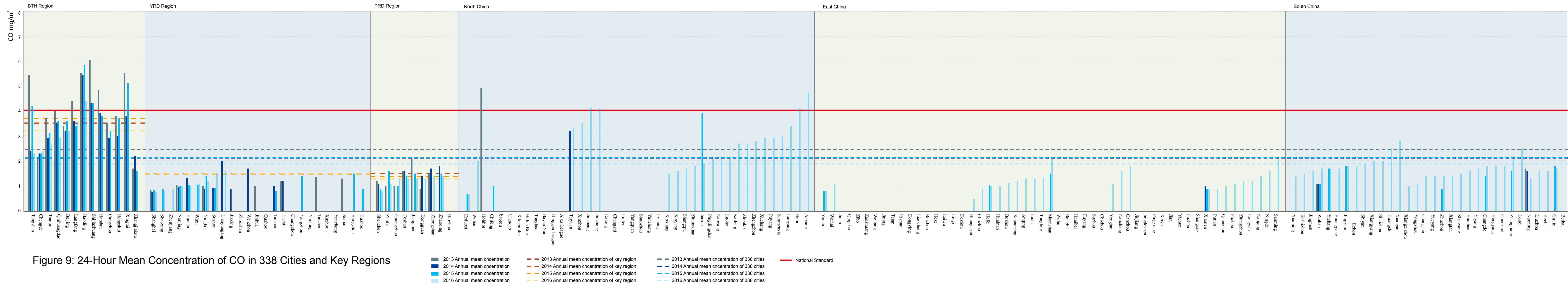
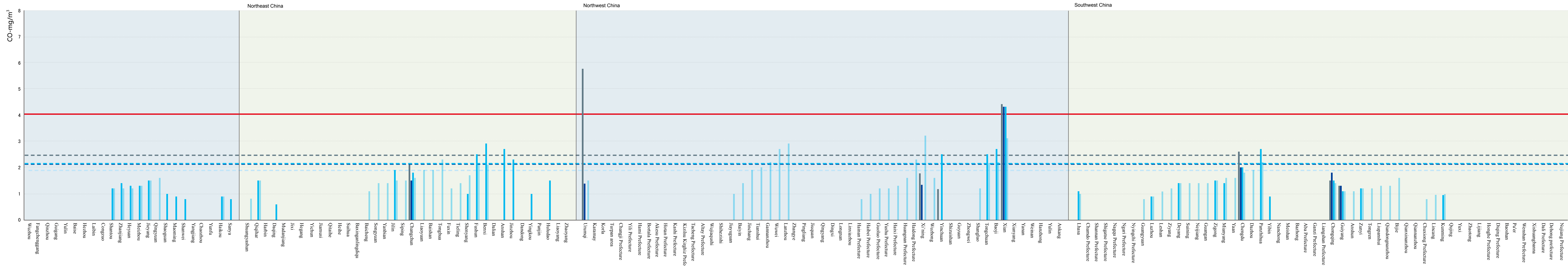


Figure 9: 24-Hour Mean Concentration of CO in 338 Cities and Key Regions



◆ The annual mean concentration of CO was within the standard and continued decreasing. Compared with 2015, the 95th percentile concentration range (daily mean value) of CO in the 338 cities changed from 0.4-6.6mg/m³ to 0.8-5.0mg/m³ in 2016, while the average concentration fell from 2.1mg/m³ to 1.9mg/m³, attaining the national standard of 4mg/m³.

◆ Most of the cities complied with the national standard and the percentage of attainment cities increased from 96.7% to 97%. Hence, CO ranked first alongside SO₂ as pollutants for which the number of attainment cities was the highest.

◆ The annual mean concentrations of CO in the three key regions all complied with the standard. In BTH and PRD, the value decreased from 3.7mg/m³ to 3.2mg/m³ (by 13.5%) and from 1.4mg/m³ to 1.3mg/m³ (by 7.1%), respectively. Meanwhile, the value in YRD stayed at 1.5mg/m³, with no change compared with 2015.

◆ 2013 Annual mean concentration
◆ 2014 Annual mean concentration
◆ 2015 Annual mean concentration
◆ 2016 Annual mean concentration

◆ 2013 Annual mean concentration of 338 cities
◆ 2014 Annual mean concentration of 338 cities
◆ 2015 Annual mean concentration of 338 cities
◆ 2016 Annual mean concentration of 338 cities

◆ National Standard

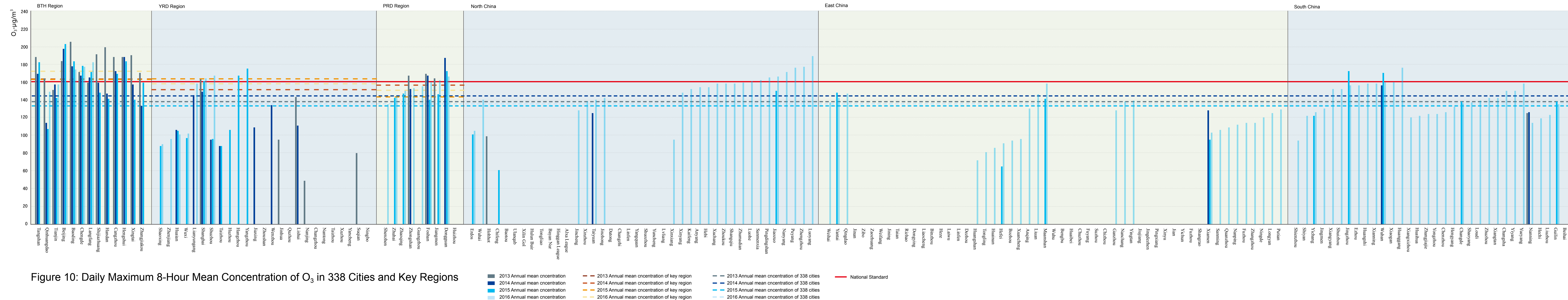


Figure 10: Daily Maximum 8-Hour Mean Concentration of O₃ in 338 Cities and Key Regions

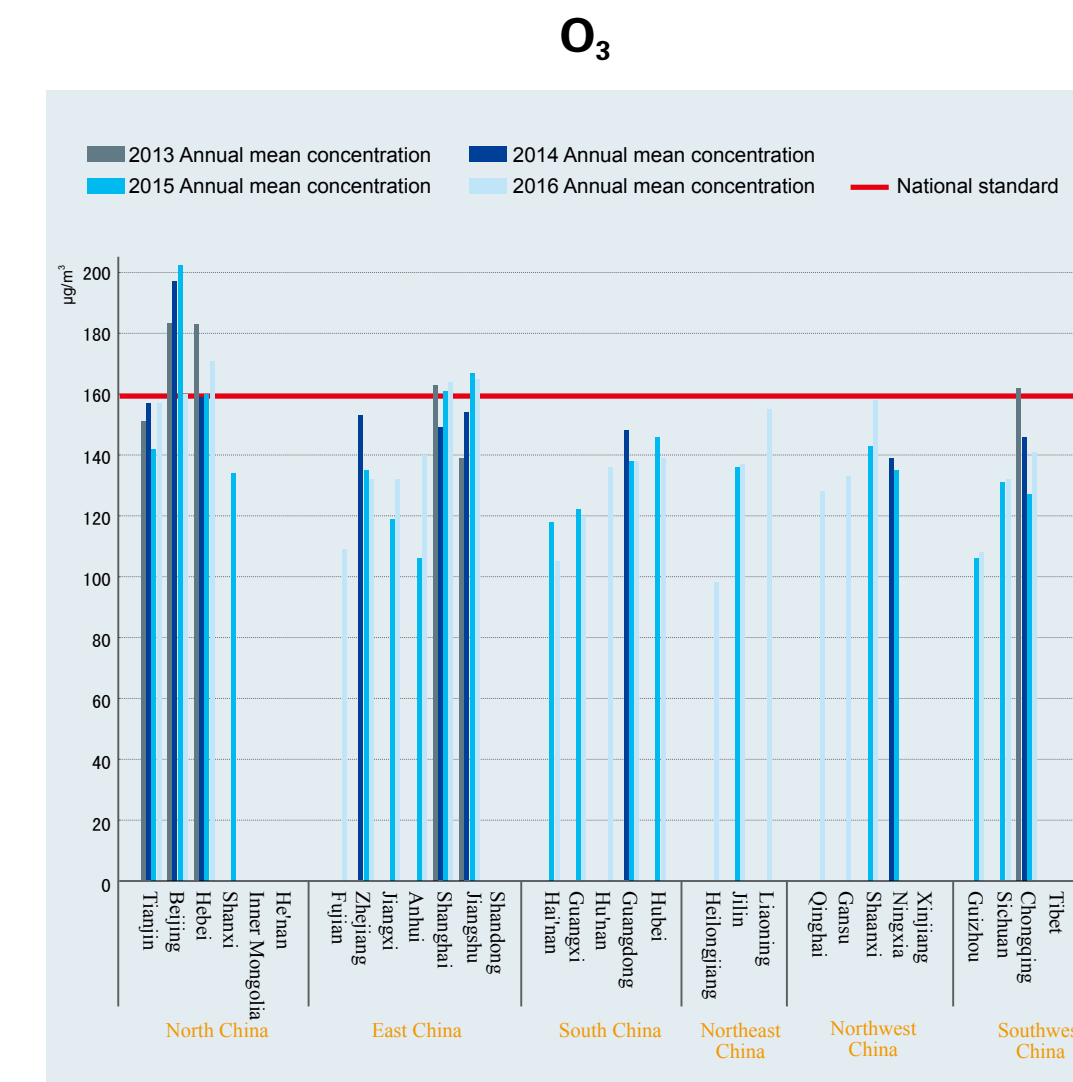
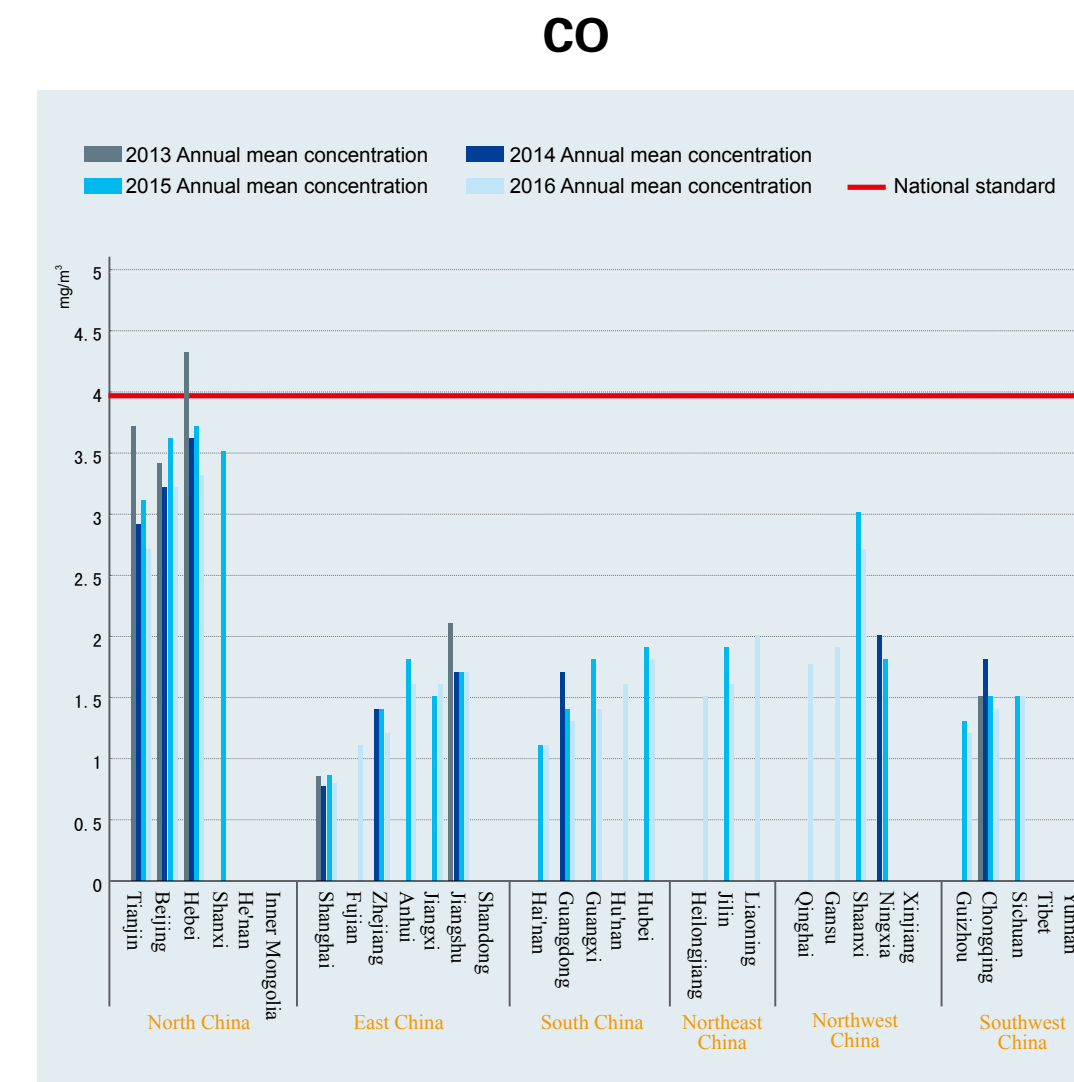
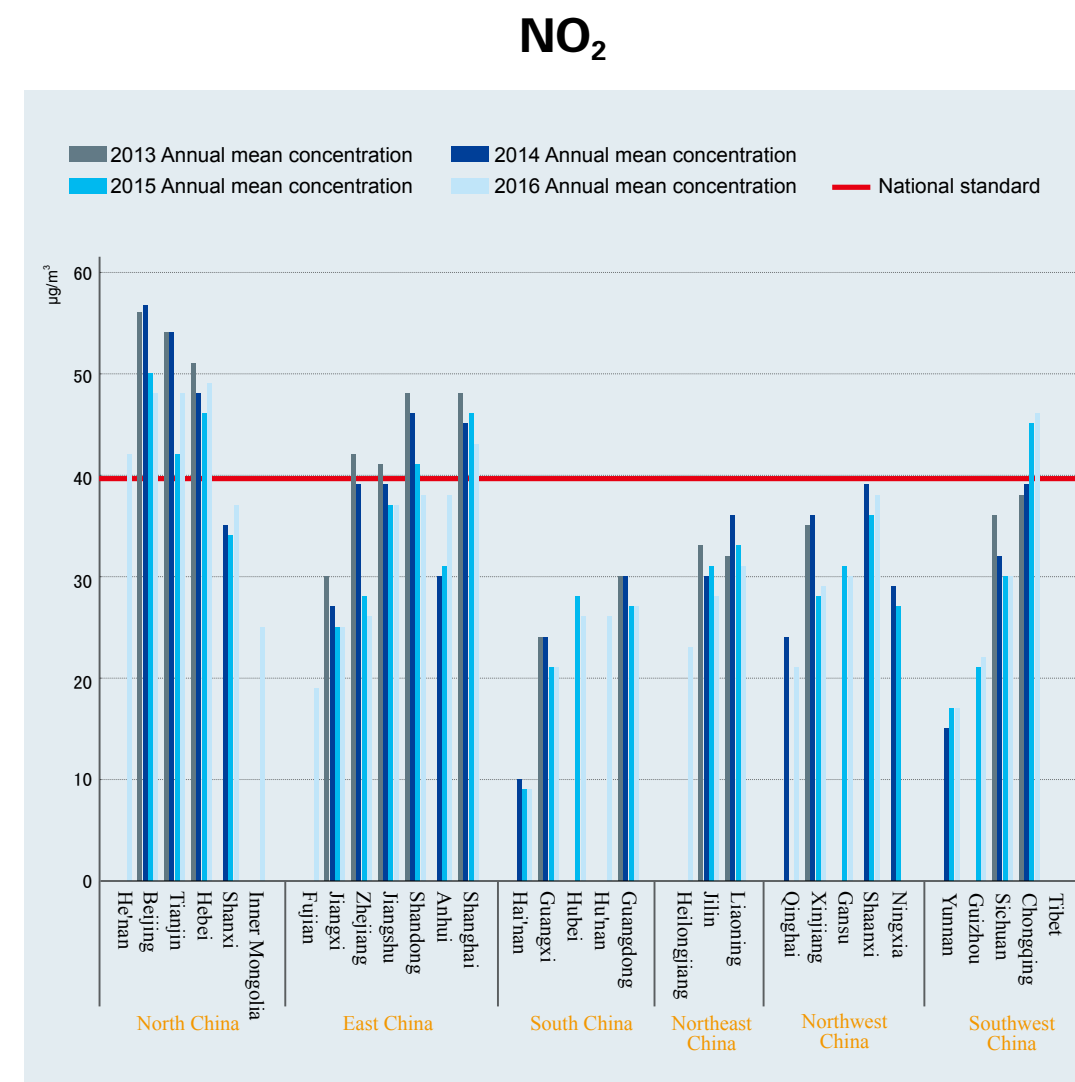
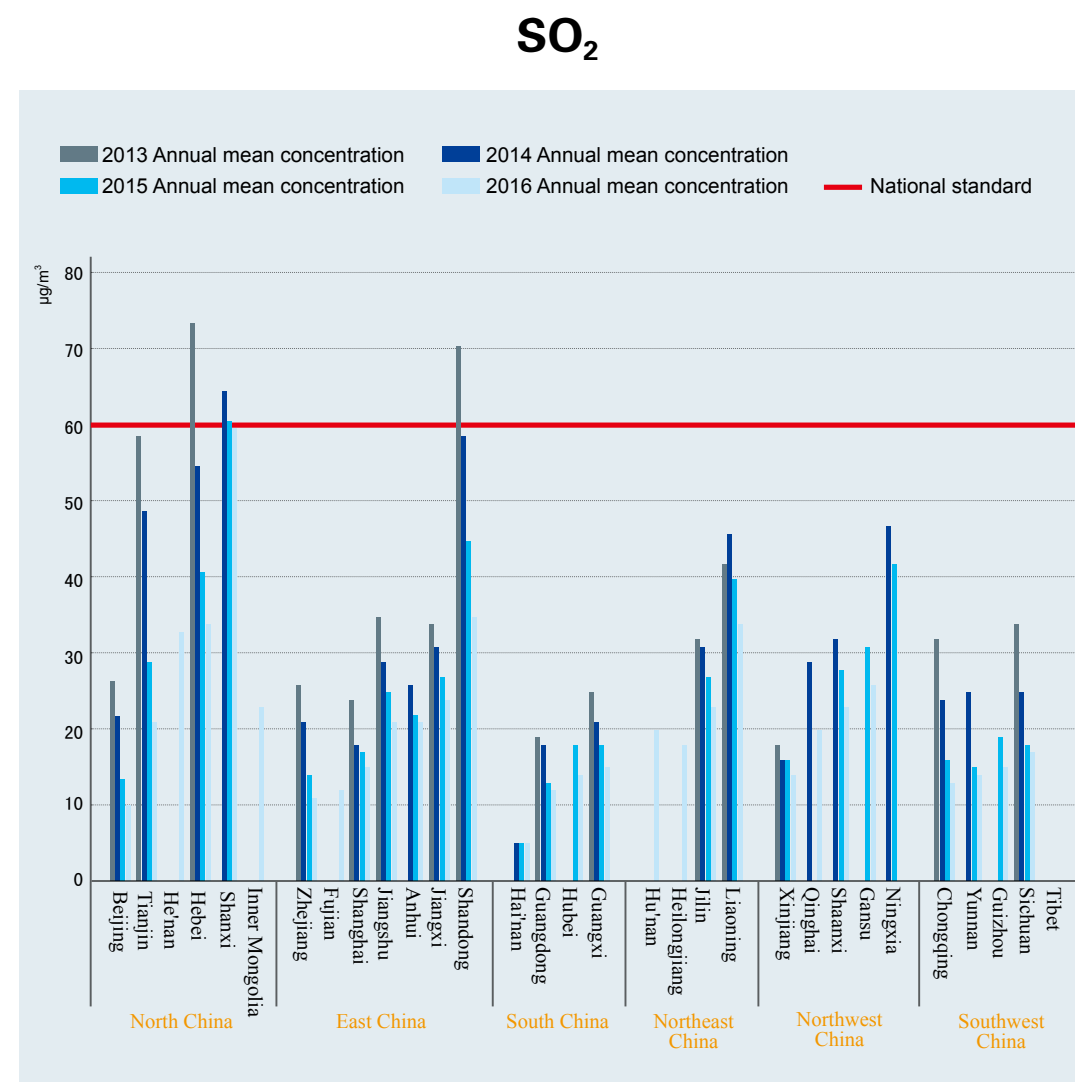
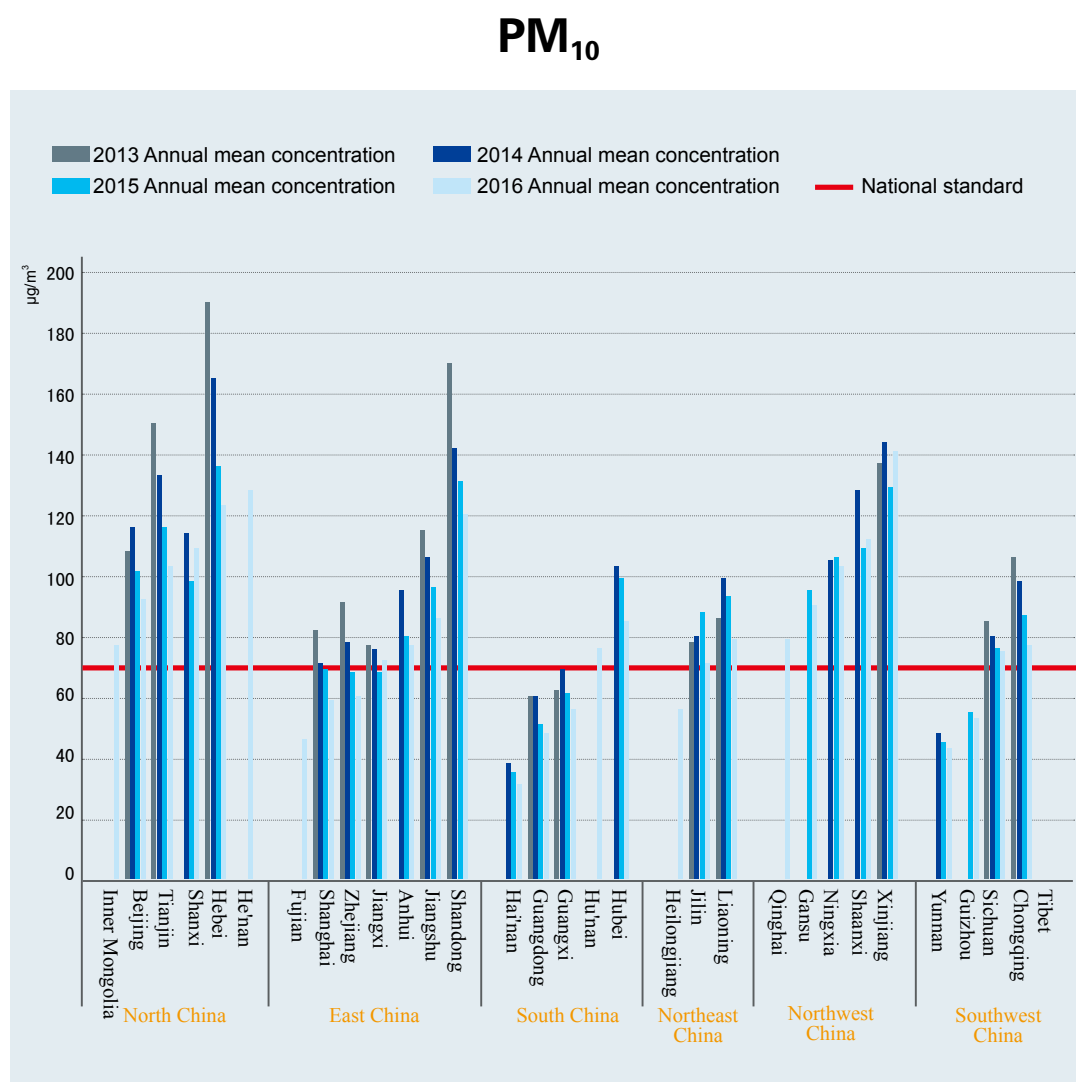
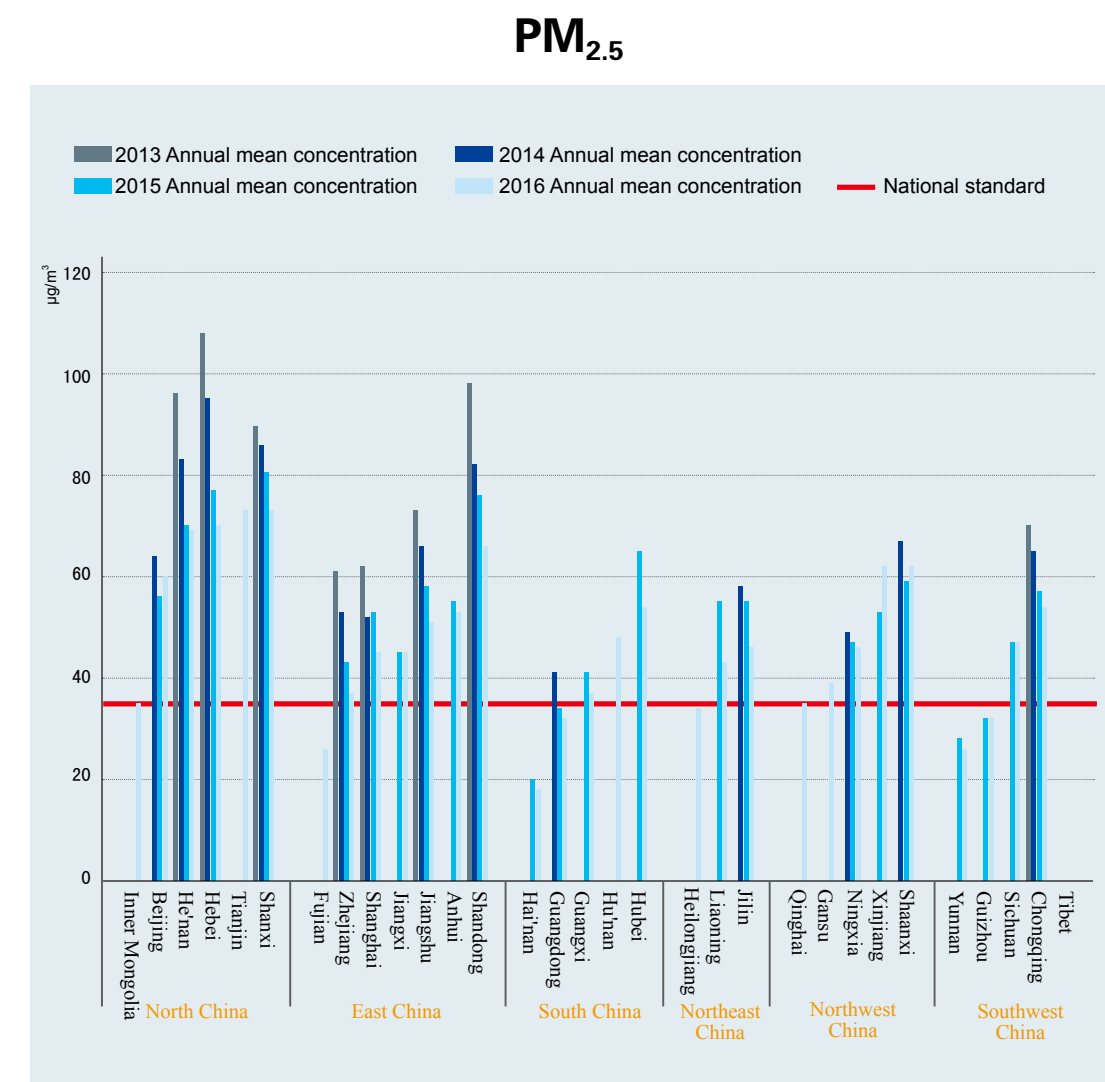


Figure 11: Annual Mean Concentration of 6 Criteria Pollutants by Province in 2016

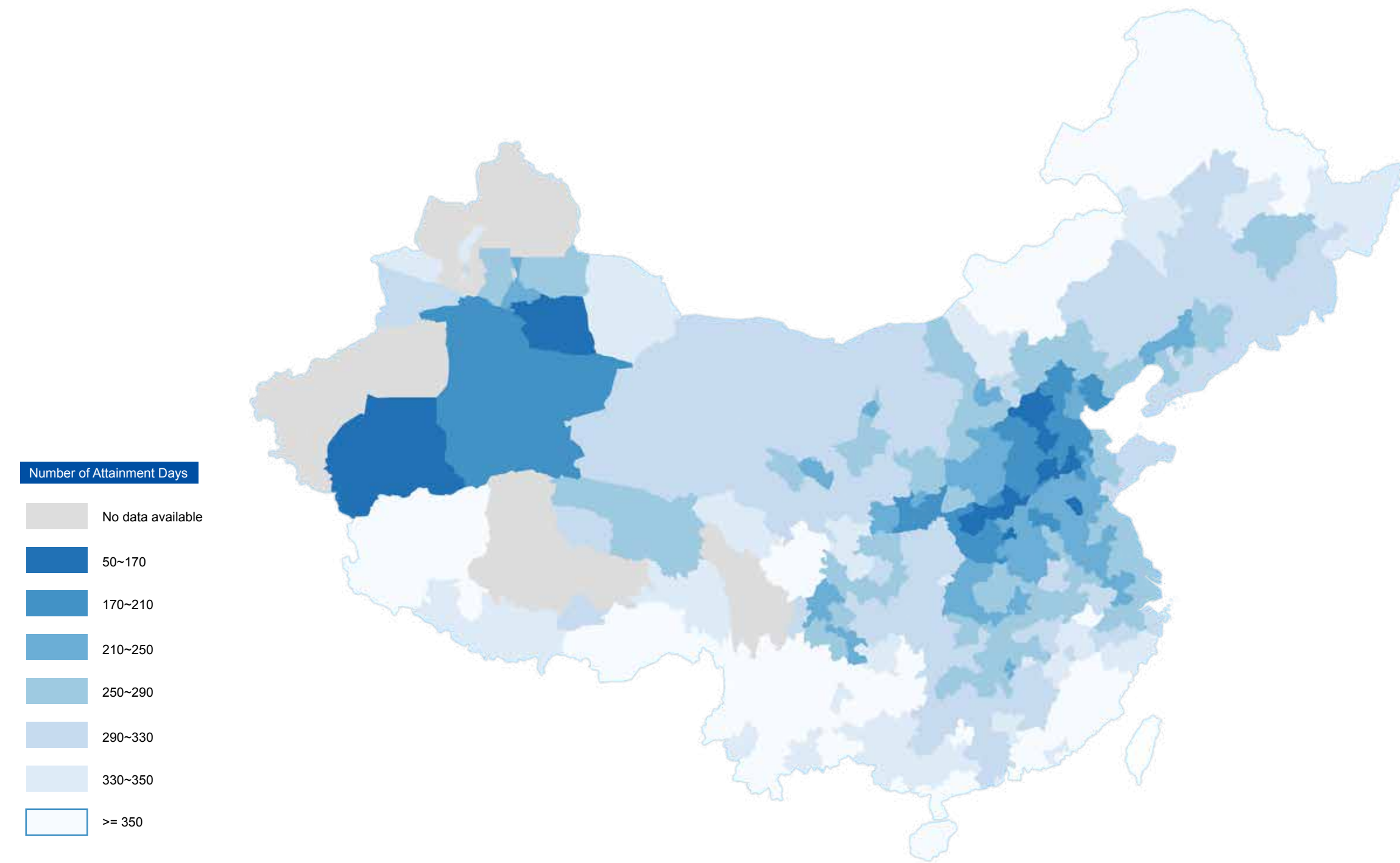


Figure 12: Distribution Map of Total Number of Attainment Days for 338 Cities in 2016

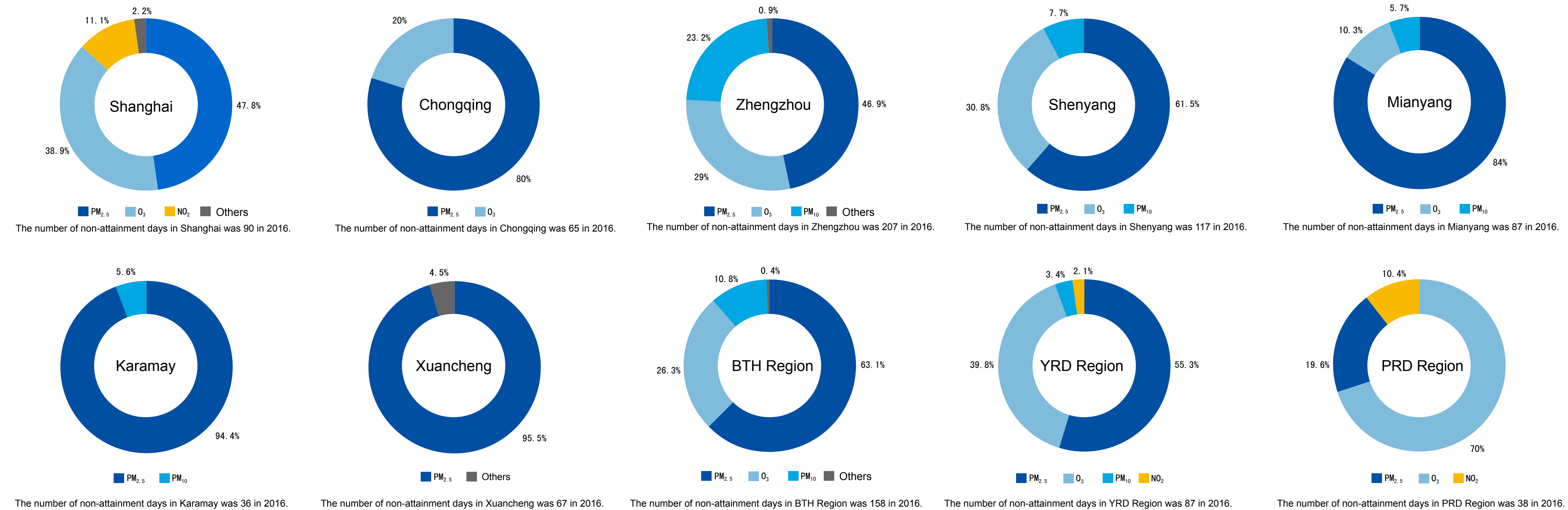
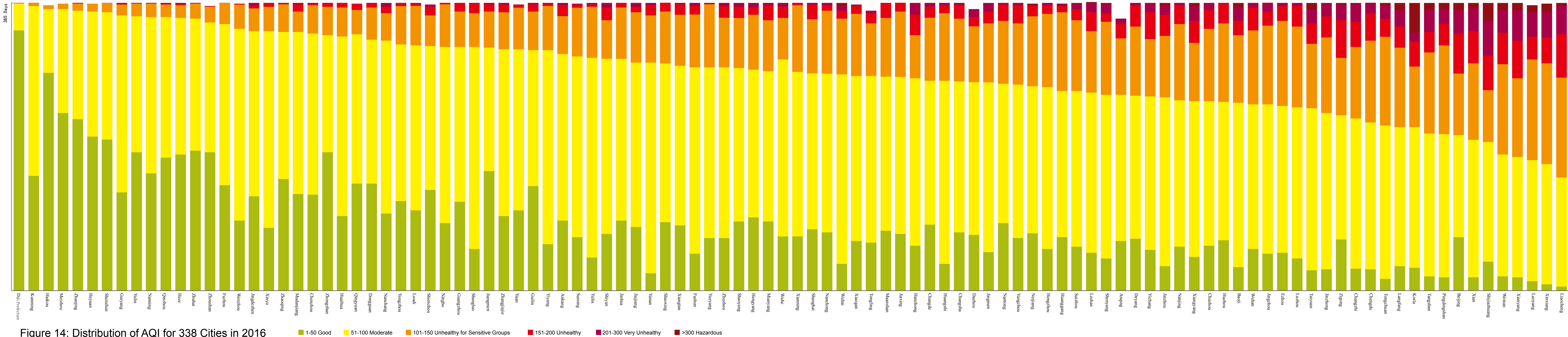


Figure 13 Number of Days with Different Primary Pollutants in Key Regions and Cities in 2016



Policy Implementation and Progress

Major Events of Air Pollution Prevention and Control



China's air pollution prevention and control entered a critical stage in 2016 as it was a decisive year for meeting the targets set out by the Action Plan. Notable progress was made in terms of controlling pollution from coal combustion, eliminating yellow-label vehicles, promoting new-energy vehicles and eliminating outdated capacity. In addition, there were breakthroughs in previously neglected areas such as emissions from loose coal and non-road mobile machinery. Efforts were also stepped up to control VOCs pollution and refine management of fugitive dust. Meanwhile, BTH continued to increase the scope and depth of regional collaboration.

In 2016, the country made progress on coal combustion control through three major measures of “clean coal utilization, total coal consumption control and replacement of fossil fuels with clean energy”. BTH tackled the longstanding challenge of loose coal pollution through a series of measures including designating “no-coal zones” and replacing coal with natural gas or electricity.

With regards to vehicle emission control, China exceeded its target to eliminate yellow-label vehicles while the number of new-energy vehicles nationwide increased by 73.87%. Moreover, methods were put in place to regulate non-road mobile machinery, such as mandatory disclosure of environmental protection information, requirements to register machinery, and designation of low-emission zones. In addition, through requiring registrations and inspections, Beijing, Shanghai, Shenzhen and Jiangsu Province collected preliminary emissions data on non-road mobile machinery, marking the start of China's regulatory work for non-road mobile pollution sources.

Furthermore, VOCs were included in total emissions control indicators for the first time in 2016. The 13th Five-Year Plan specifies that VOCs emissions should be controlled in key regions as well as in key industries, and that total VOCs emissions should decrease by over 10% nationwide. As part of a comprehensive strategy to reduce VOCs emissions in key industries, the central government set a target to reduce VOCs emissions in industrial sectors by over 3.3 million tons in 2018 compared to 2015 levels. The government has also set specific measures for 11 key industries of which VOCs emissions account for over 80% of total industrial emissions.

Meanwhile, continuous monitoring systems have been installed as a new measure to control fugitive dust pollution on construction sites and roads. Fugitive dust pollution control has been gradually enforced across the country through various measures including the implementation of a special action plan for fugitive dust control, initiation of fugitive dust control programs and the establishment of zones dedicated to fugitive dust control.

The BTH region has continued to advance the scope and depth of its regional collaboration efforts. The region completed a preliminary unification of regional planning, heavy pollution monitoring and alerting, and pollution prevention and control measures and standards, while also initiating joint enforcement and enhancing city-to-city cooperation mechanisms. Beijing and Tianjin spent RMB 502 million and RMB 400 million, respectively, to support partner cities in Hebei Province in the implementation of air pollution control measures.

The Environmental Protection Tax Law of the People's Republic of China was released. It is scheduled to take effect on January 1, 2018. The law will substitute a "taxation system" for "discharge fee collection", but the targets, scope and calculation basis of taxation will not change substantially from the current discharge fee system. The charging standard it sets will become the lower limit for the environmental protection tax.

The MEP released the Interim Regulation on Discharge Permits. As the first document of its kind in the country, the Regulation stipulates the procedures for the application, review, issuance, and management of discharge permits.

The operation authority of 1,436 state-controlled ambient air quality monitoring stations across the country was centralized in national government.

The Announcement on Fully Supplying Automobile Petroleum Products Which Meet the China V Mandatory Standards was issued, requiring that automobile gasoline and diesel nationwide must meet the China V standards, beginning January 1, 2017.

The Supreme People's Procuratorate issued the Interpretation on Several Issues concerning the Application of Law in the Handling of Criminal Cases of Environmental Pollution, explicitly prescribing that "emission of hazardous substances during heavy pollution alerting periods shall be given a heavy punishment" and that "independent inspection data of public security authorities can be used as evidence". The Interpretation took effect on January 1, 2017.

The 13th Five-Year Plan on Eco-Environmental Protection was released. It establishes the percentage of air quality attainment days and reduction in PM_{2.5} concentration as two new compulsory indicators for air quality, and implements control over total VOCs emissions in both key regions and industries.

The Implementation Plan for the Pollutants Discharge Permit System was released. The implementation of such a system can achieve comprehensive and dynamic management of pollution sources. It may also provide uniform pollution source emission data for emissions inventories that support atmospheric environment management.

The Ministry of Industry and Information Technology and the MEP issued the Notice on Further Regulating Cement Production during the Winter Heating Period, which restricts cement clinker production within a set time frame in northern cities where heating is provided in the winter.

The Guiding Opinions on Launching the Pilot Reform of the Vertical Management System for Monitoring, Supervision and Enforcement by Environmental Protection Institutions under the Provincial Level were issued. The reform signals that provincial-level environmental protection departments would uniformly perform and manage the environmental inspection and monitoring functions of cities and counties. This is expected to effectively prevent local protectionism, data fabrication, and ineffective inspection practices.

The MEP released the Notice on Carrying out the Management of Discharge Permits for Elevated Pollution Sources in the Coal-Fired Power Generation and Papermaking Industries and Pilot Cities in the Beijing-Tianjin-Hebei Region, requiring the region to complete the application, review, and issuance of discharge permits to enterprises in the two industries before June 30, 2017.

The amended Law on Prevention and Control of Air Pollution came into force.

The Announcement on Implementing the China III Emission Standards for Diesel Engine Exhausts of Non-Road Mobile Machinery was released. It requires that, starting on April 1, 2016, all the manufactured, imported and sold non-road mobile machinery should meet the China III emission standards.

The Announcement on Implementing the China V Vehicle Emission Standards was released. It requires that, starting on April 1, 2016, the China V vehicle emission standards should be imposed on light-duty gasoline and diesel passenger vehicles, and heavy-duty diesel vehicles (for public transport, environmental sanitation, and mail service purposes only) in 11 provinces in the East China.

The Action Plan for Oil Vapor Recovery at Crude Oil and Refined Oil Wharfs was issued. This kick-started the second batch of oil and gas recovery pilot programs at wharfs in Bohai Rim, YRD, PRD, and along the Yangtze River.

In early 2016, it was revealed that the Chang'an and Yanliang Substations in Xi'an had deliberately jammed their air monitoring devices with gauze and deleted monitoring video records. The case was transferred to judicial authorities for investigation on March 20.

YRD took the lead in designating vessel emission control zones in the country, requiring vessels to use low-sulfur oil with sulfur content of 0.5% when docking.

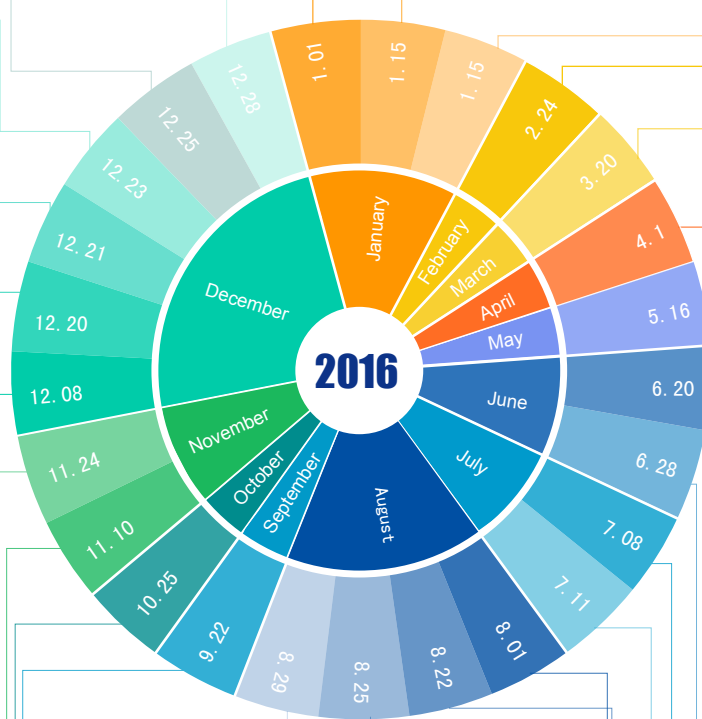
The Measures for Cleaner Production Review came into effect on July 1, 2016. The measures clearly specify the scope and implementation process of cleaner production review.

The Enhanced Measures for Air Pollution Prevention and Control in the Beijing-Tianjin-Hebei Region (2016-2017) were issued.

The Targets and Tasks for Ultra-Low Emission and Energy-Saving Conversion of Coal-Fired Power Plants in Provinces, Regions and Municipalities in 2016 were issued, requiring coal-fired power plants in all provinces to complete the 254 GW ultra-low emission retrofit tasks in 2016.

The Action Plan for Reducing Volatile Organic Compounds in Key Industries was released, requiring industrial sectors to reduce VOCs emissions by more than 3.3 million tons by 2018, compared with 2015. It lays down specific measures for 11 key industries whose VOCs emissions account for over 80% of total industrial emissions.

The Notice on Properly Carrying out Work in Relation to the Reduction of and Substitution for Coal Consumption in 2016 was released, revealing that some key regions built a large number of new high-coal-consuming projects, delaying the progress in attaining coal consumption reduction targets. Hence, the pressure to comprehensively reduce coal consumption remains significant.



The Ministry of Finance and the MEP implemented the newly revised Measures for Managing Funds Dedicated to Air Pollution Prevention and Control, which allocates rewards and punishments in relation to the use of special funds for air pollution prevention and control to the provinces.

The Limits on and Measurement Methods for Marine Engine Exhaust Emissions (China Phases I-II) were released, filling the gap in China's air pollution emission standards for vessels.

The Announcement on Carrying out Work in Relation to the Disclosure of Environmental Protection Information about Vehicles and Non-Road Mobile Machinery was issued, requiring that the public environmental protection information platform of the MEP regarding vehicles and non-road mobile machinery be put on trial operation on September 1, 2016, and that enterprises which manufacture and import vehicles and non-road mobile machinery disclose information on their pollution control technologies and emission inspections to the public.

The MEP released a notice announcing a nationwide environmental enforcement drill from September to November.

Figure 15: Major Events of Air Pollution Prevention and Control

Policy Framework of Air Pollution Prevention and Control

Since the release of the Action Plan, the policy framework shown in Figure 16 has been adopted for China's air pollution prevention and control. A number of supporting policies have also been issued successively, yielding positive results. In addition to the existing policy framework there have been other advances in reforming

the environmental protection system, such as changes to the vertical management system, the replacement of environmental protection charges with relevant taxes, and the implementation of the discharge permit system.

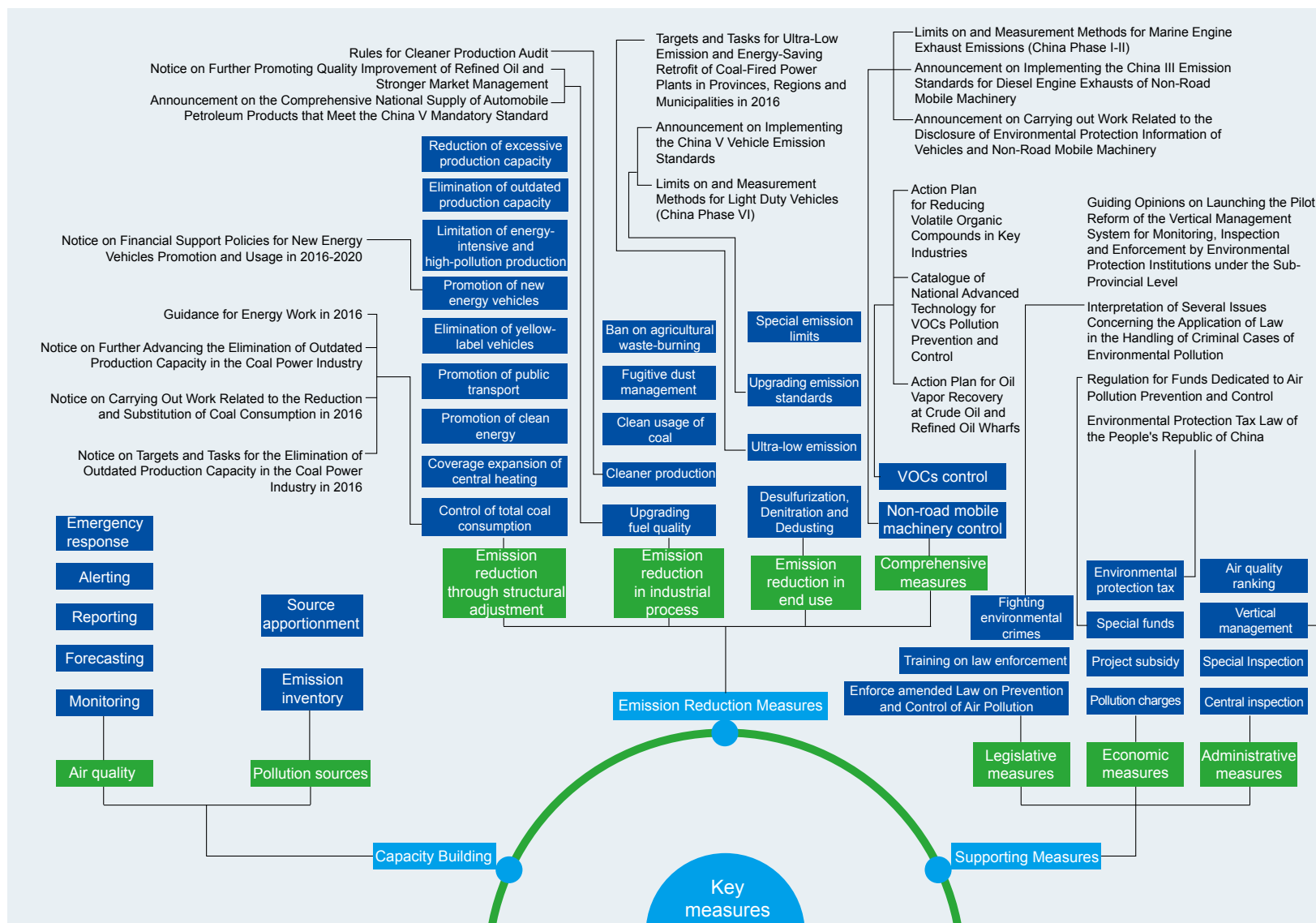


Figure 16: Policy Framework of Air Pollution Prevention and Control

Air Quality Improvement Targets

the primary pollutant for improvement. The plans prescribe either specific target concentrations or rates of concentration decreases in comparison with the benchmark years (2013 or 2015). See Figure 17-20 below for detailed improvement targets.



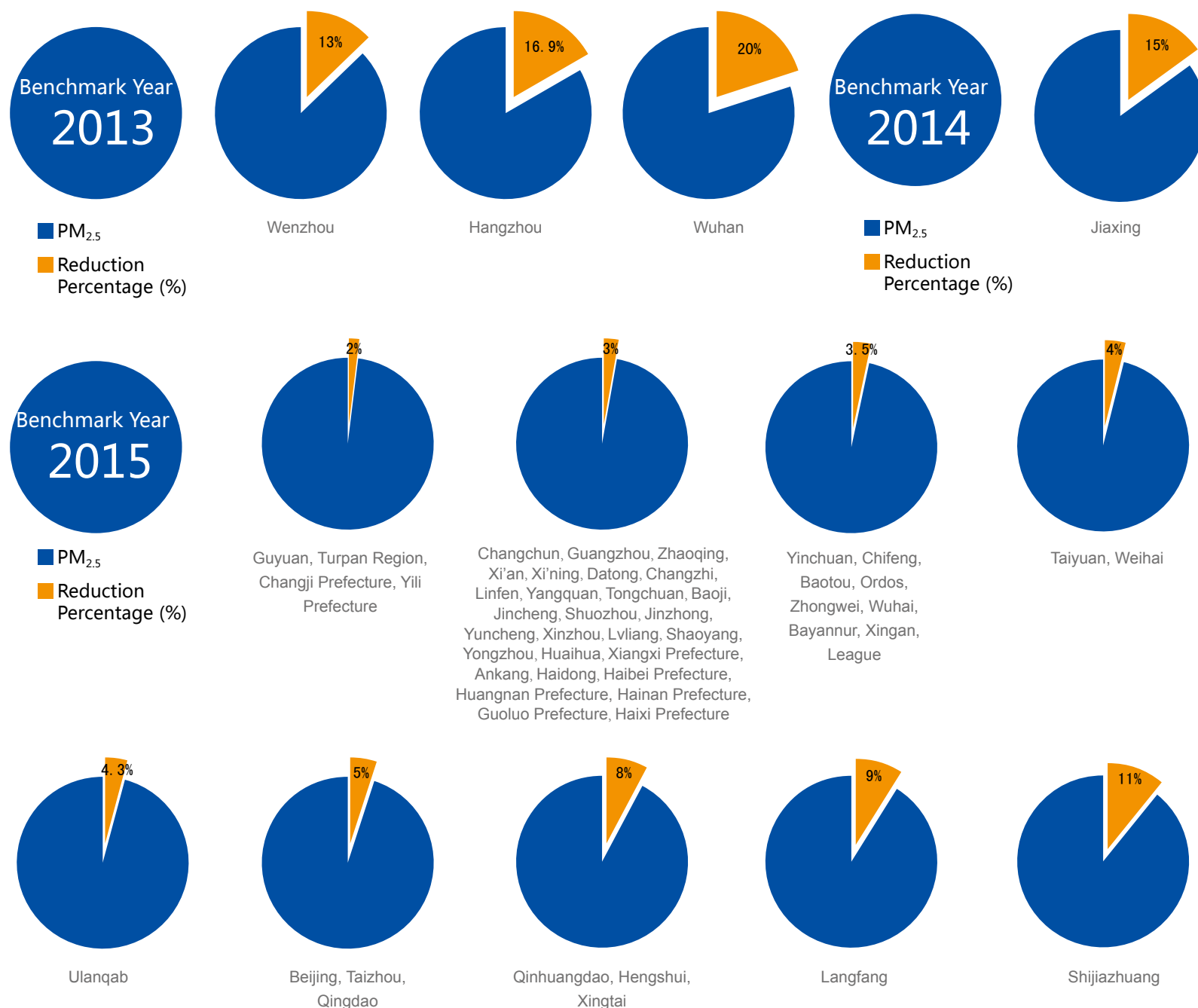


Figure 18: 2016 City Air Quality Improvement Targets (measured by PM_{2.5} reduction percentages compared with the benchmark year)

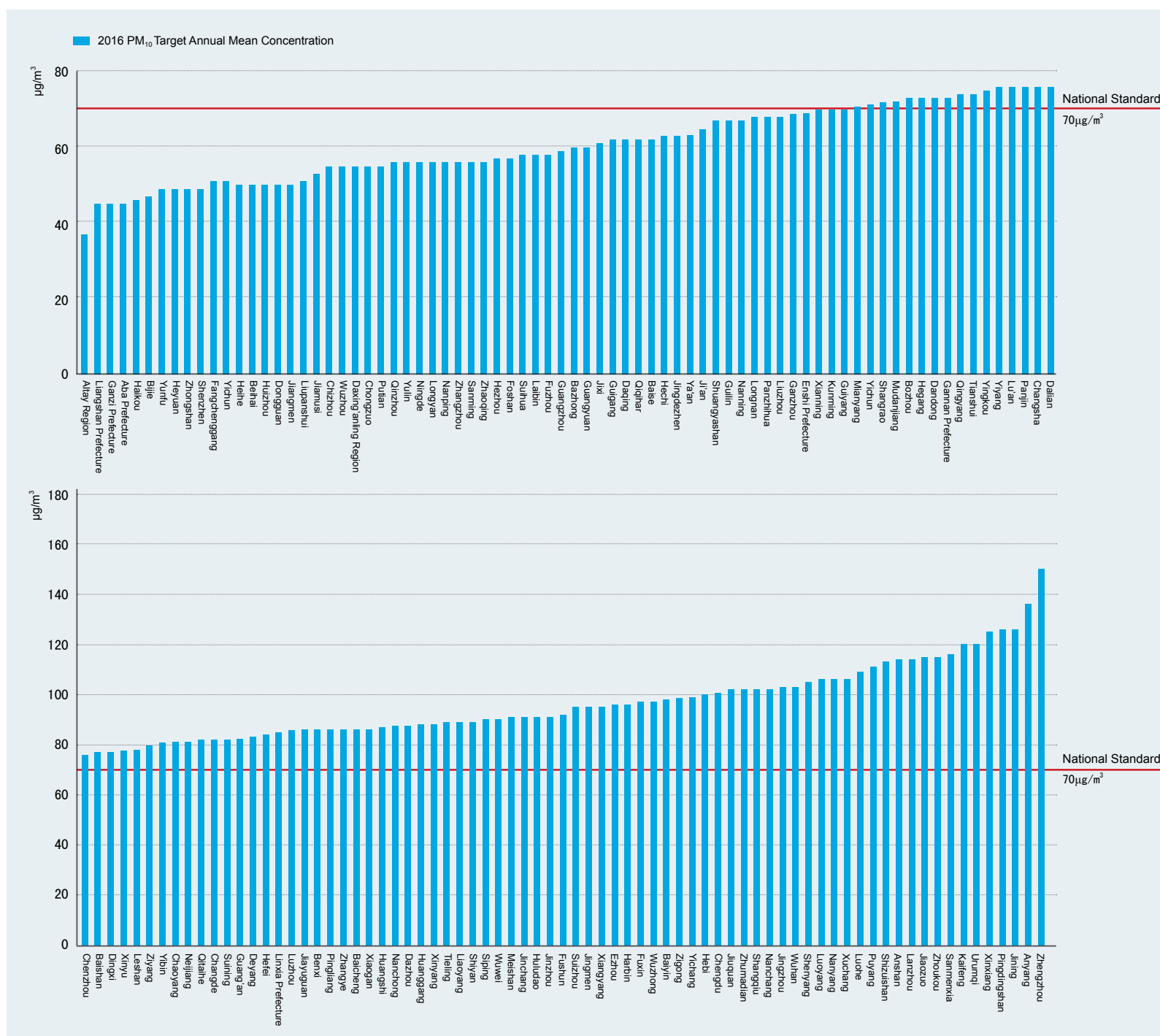


Figure 19: 2016 City Air Quality Improvement Targets (measured by PM₁₀ target concentration)

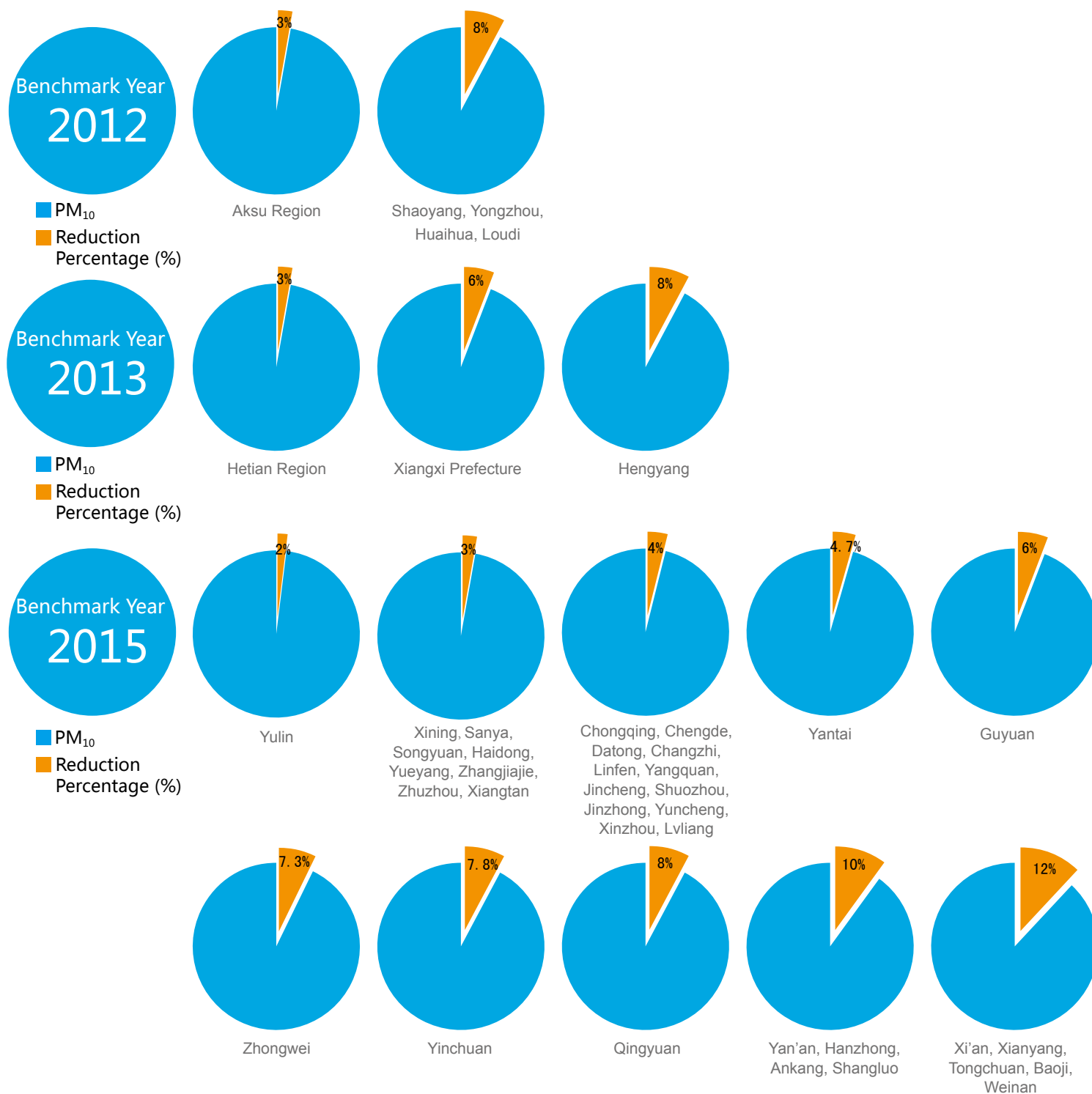


Figure 20: 2016 City Air Quality Improvement Targets (measured by PM₁₀ reduction percentages compared with the benchmark year)

Comparison of Actual Concentrations with Target Concentrations in 2016

The cities that failed to attain the annual concentration improvement targets in 2016 were mostly located in Central and Western China. Some cities not only failed to achieve the targets, but also saw increases in local PM concentrations. For instance, PM_{2.5} concentrations in Linfen, Xi'an, Yinchuan, Changde, Taiyuan, Luzhou, Mianyang, Lanzhou, Deyang and Baoji increased

by 25.4%, 24.6%, 9.8%, 7.7%, 6.5%, 4.9%, 4.3%, 3.8%, 3.8% and 3.5% respectively, compared with 2015. Meanwhile, PM₁₀ concentrations in Weinan, Lanzhou, Xi'an, Mianyang, Xi'ning and Baoji rose by 26.3%, 10%, 9.6%, 8.3%, 6.6% and 2.8% respectively, compared with 2015.

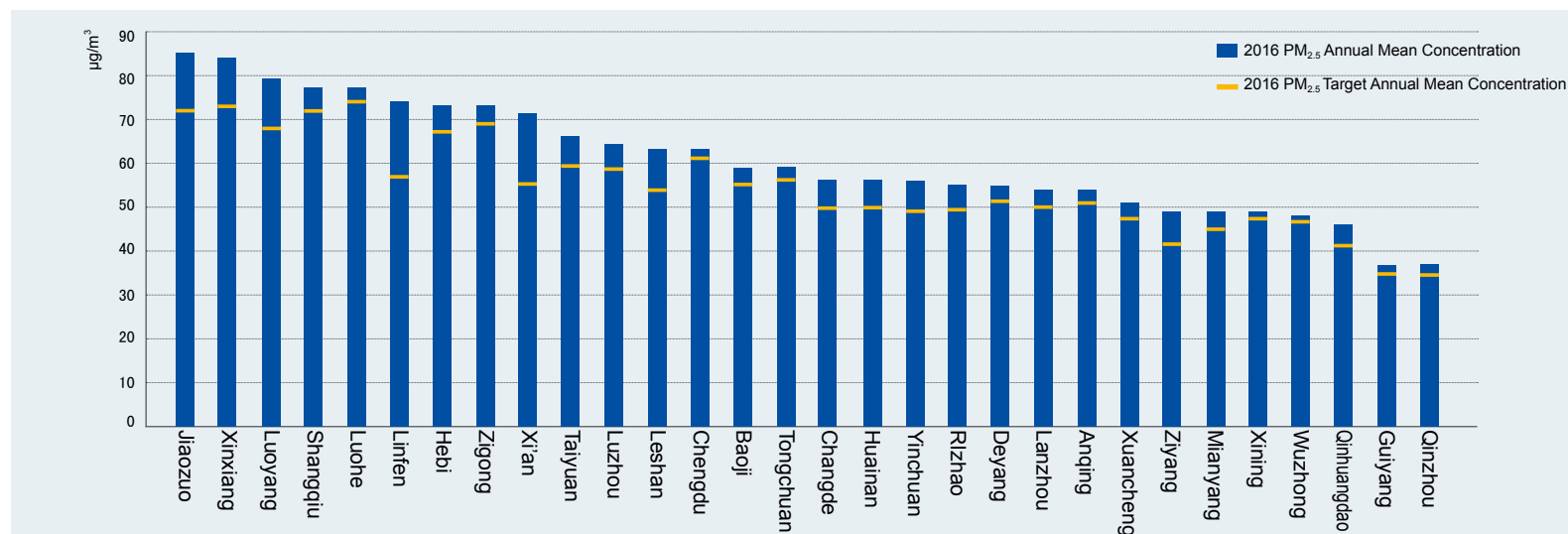


Figure 21: Cities that Failed to Achieve 2016 PM_{2.5} Concentration Reduction Targets

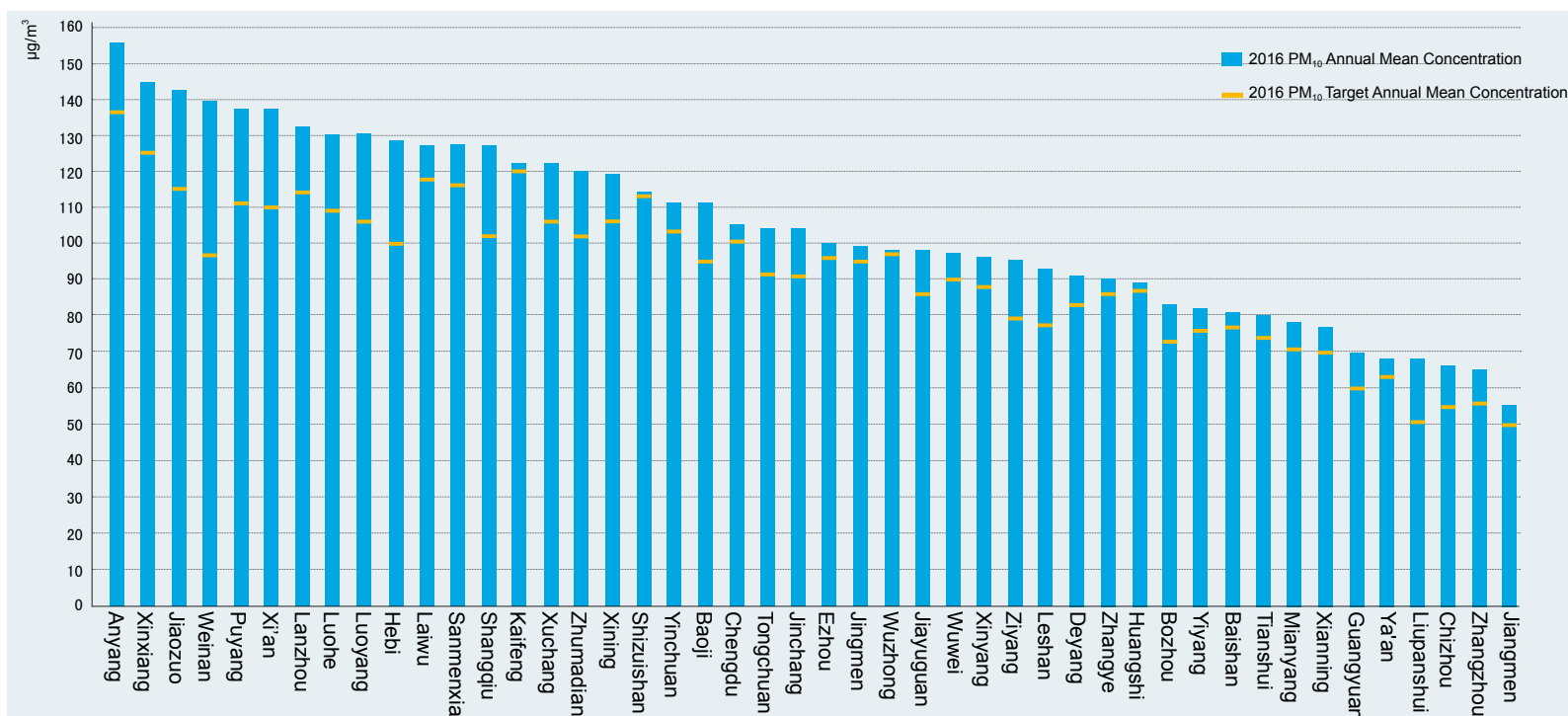


Figure 22: Cities that Failed to Achieve 2016 PM₁₀ Concentration Reduction Targets

Comparison of Annual Mean Concentrations between 2015 and 2016

In 2016, the cities where local PM_{2.5} and PM₁₀ concentrations rose were mostly located in Western China, whereas cities with high concentrations that made limited improvements were concentrated in BTH and its surrounding areas (for PM_{2.5}), and Shandong province and West China (for PM₁₀). Meanwhile, northeastern Chinese cities performed impressively, with Harbin, Yichun, Jilin and Changchun reducing both PM_{2.5} and PM₁₀

concentrations by over 25%. Other cities that managed to cut PM_{2.5} concentrations by over 20% include Meizhou, Heihe, Suzhou, Nantong, Hegang, Shuangyashan, Langfang, Tongliao, Mudanjiang, Shenyang, Ulanqab and Xiaogan. Cities that reduced PM₁₀ concentrations by over 20% include Shuangyashan, Nantong, Daxing'anling Region, Tongliao, Heihe and Xiaogan.



Figure 23: Cities that Achieved Significant PM_{2.5} Concentration Reduction in 2016



Figure 24: Cities that Achieved Significant PM₁₀ Concentration Reduction in 2016

Comparison of Target Concentrations for 2017 with Actual Concentrations in 2016

After the State Council released the Action Plan, 74 key cities made local action plans in 2013-2014 and set their air quality targets for 2017, which is the last year of the Action Plan. Based on available data, the figure 25 shows target concentrations for 2017 in comparison with actual concentrations in 2016. 17 cities, mostly in Zhejiang or Guangdong province, accomplished

the 2017 reduction targets for PM_{2.5} as required by the Action Plan, whereas Quzhou completed 99% of the targets. Only Beijing has yet to complete its targets and will face challenges to complete them in 2017.

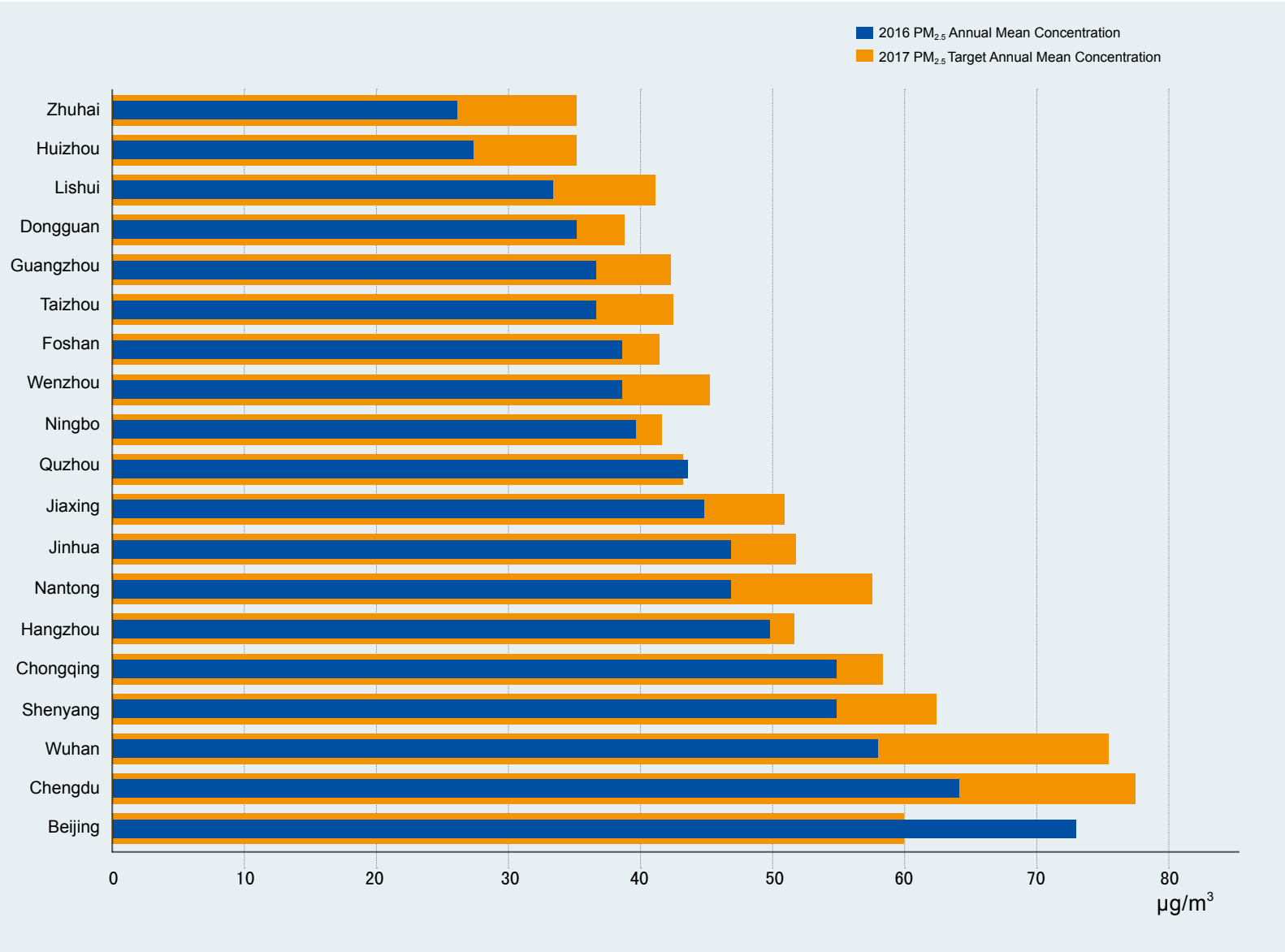


Figure 25: Cities' Progress towards Achieving 2017 Targets of PM_{2.5} Concentration Reduction

Comparison of 2020 Target Concentrations with Actual Concentrations in 2016

Cities disclosed mandatory PM_{2.5} concentration targets for 2020 in their 13th Five-Year Plans released in 2016. By 2020, attainment cities must maintain their attainment status. For non-attainment cities, a comparison of their target concentrations for 2020 with actual concentrations in 2016 is shown in Figure 26, with the following observations:

◆ Changchun, Jilin, Dandong, Fushun, Mudanjiang, Yichang, Ji'nan, Harbin, Suzhou, Nantong and Ma'anshan achieved a substantial reduction (8.7%-30.3%) in PM_{2.5} concentration in 2016. Their 2020 targets for PM_{2.5} concentration have already been achieved. Nanchang's PM_{2.5} concentration in 2016 (44µg/m³) also achieved its 2020 target (50µg/m³), but it is worth noting that Nanchang's PM_{2.5} concentration in 2015 was already 43µg/m³, and its 2020 target as set in the 13th Five-Year Plan

was released in 2016. This can be attributed to a lack of determination from the Nanchang government to further improve air quality.

- ◆ Over half of the cities are less than 20% away from their targets. If they can continue improving by reducing concentrations by 5% a year, these cities are likely to achieve the relevant targets on time.
- ◆ More than 20 cities are between 20.6% to 42.6% away from attaining their targets. Of these cities, Liaocheng, Yantai, Laiwu, Heze, Zaozhuang, Huzhou, Jinhua and Huludao have only achieved limited efficacy while having relatively low target concentrations; in contrast, Xi'an, Urumqi, Linfen, Weinan and Xianyang experienced a 12.1% to 28.1% increase in PM_{2.5} concentrations in 2016, moving these cities even further away from their targets.

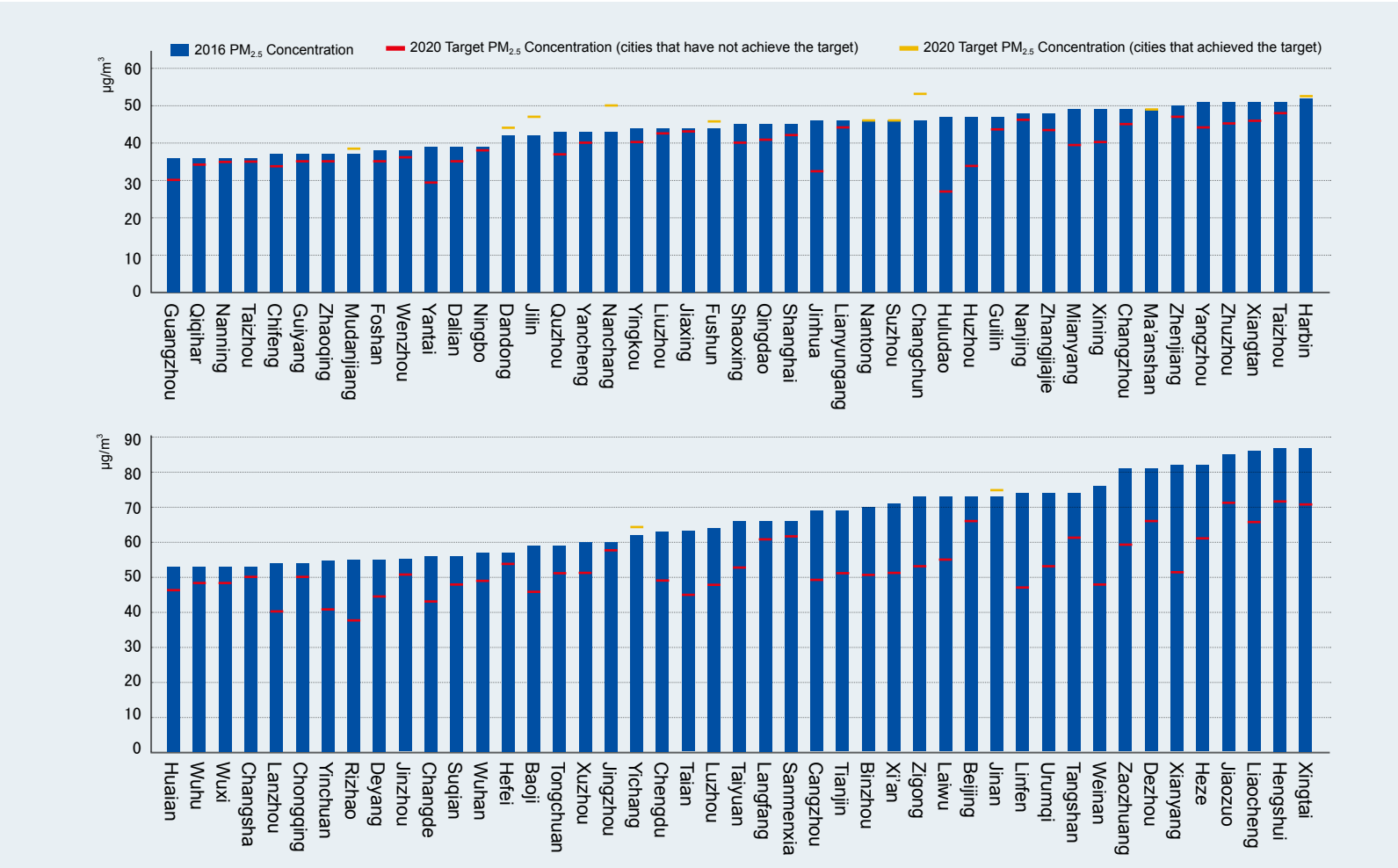


Figure 26: Cities' Progress Towards Achieving 2020 Target of PM_{2.5} concentration reduction

Development of Air Quality Monitoring System

In 2015, the national ambient air monitoring network that included 1,436 state-controlled monitoring sites in 338 cities was completed. Following this development, some cities built automated atmospheric environment quality monitoring stations with self-raised funds in 2016 due to local demands to strengthen ambient air quality monitoring. This includes Beijing, which completed building and upgrading its atmospheric environment quality monitoring network and nearly doubled its ground monitoring sites from an original number of 35. Furthermore, Beijing was the first city in the country to set up a monitoring network for air quality trends. Meanwhile, Kunming built eight new monitoring sites in Guandu district; Dezhou built one additional monitoring site in Linyi county; Henan Province started building 46 new air quality automated monitoring sites in built-up areas controlled by the provincial government and 260 county-level monitoring sites. Dalian, Dandong, Fuxin, Tieling and Chaoyang of Liaoning Province started to build trans-boundary haze monitoring sites, with a plan to build 30 provincial-level haze monitoring sites and 44 county-level ones.

Pollution Alerting and Emergency Response

In the winter, northern cities still face long months of heavy air pollution stretching across vast areas. In early 2016, the MEP and the China Meteorological Administration jointly issued an announcement requiring cities in BTH at and above the prefecture level to unify heavy pollution alerting and grading standards. By the end of the year, these unified standards were extended to cover BTH surrounding areas. Consequently, over 20 cities issued red alerts for heavy pollution days based on suggestions from the MEP and local pollution forecast results. A communications platform for heavy pollution alerting was also set up to enable real-time joint video consultations on air quality during periods of heavy pollution as well as facilitate the coordination of emergency responses such as production and operation

suspensions or vehicle restrictions (i.e. rotating between odd-and-even-numbered license plates) to ease regional air pollutant accumulation. These 20 cities include Beijing, Tianjin, Shijiazhuang, Baoding, Langfang, Xingtai, Hengshui and Handan of Hebei Province, Zhengzhou, Puyang, Xinxiang, Anyang, Kaifeng, Hebi and Luoyang of Henan Province, Jinan, Dezhou and Liaocheng of Shandong province, and Taiyuan of Shanxi Province.

In addition, by the end of 2016, over 200 cities issued local emergency response plans for heavy pollution days. Beijing, Shijiazhuang of Hebei Province, Zhengzhou of Henan Province, Jinan of Shandong Province, Xi'an of Shaanxi Province, Chengdu of Sichuan Province, and Hulun Buir of Inner Mongolia Autonomous Region revised their emergency response plans. The criteria were adjusted to lower the threshold for triggering alerts while adopting more rigorous control measures to more effectively reduce emissions and avoid negative impacts on society.

Source Apportionment and Emission Inventory

To step up research on air pollution formation mechanism and control strategy, more than 100 cities launched air pollution source apportionment programs and began compiling emission inventories in 2016. All of 13 cities in Heilongjiang Province completed the source apportionment of PM_{2.5} and PM₁₀ (although relevant results have yet to be disclosed). Guangzhou also completed a new round of source apportionment. The Figure 27 shows the source apportionment results released by some cities. Of the four major pollution sources (i.e. coal burning, mobile source, fugitive dust and industrial production), coal burning is the primary pollution source in Baoding and Cangzhou of Hebei Province; mobile sources are the primary pollution sources in cities such as Guangzhou and Chengdu where the motor vehicle population is relatively large; fugitive dust is the key pollution source in Lanzhou due to the prevalence of construction sites and stacking yards as well as occurrences of sand storms.

Capacity Building

■ Regional Transportation ■ Coal combustion
■ Mobile Source ■ Fugitive dust
■ Industrial Production
■ Biomass burning, kitchen exhaust, agriculture, etc.

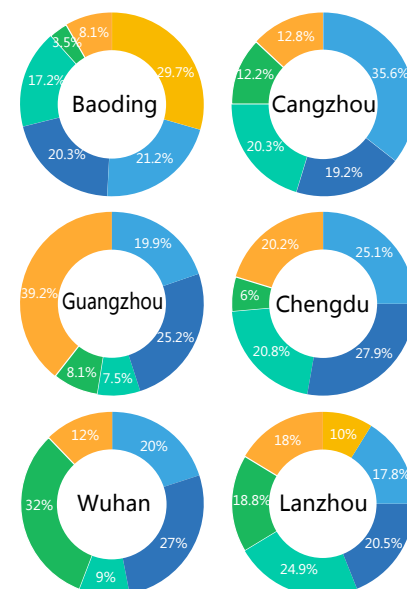


Figure 27: Source Apportionment Results of Some cities in 2016

The first batch of 14 pilot cities have already completed compiling emission inventories, although the conclusions drawn from this phase have yet to be disclosed. The next step will involve continually updating inventories. The MEP has already arranged the work of emission inventory compilation for the second batch of pilot cities. The list of cities and other relevant details have not been released yet.

Emission Reduction through Structural Adjustments

Total Coal Consumption Control

China's energy structure is defined by high levels of energy consumption and coal-centric energy production and consumption. Therefore, controlling pollution from coal burning is a top priority for China's air pollution prevention and control efforts. Figures for total coal consumption and percentage of coal consumption in total energy use have been on a downward trend for three consecutive years since the Action Plan was released. In 2016, total energy consumption increased by 1.4%, although coal consumption fell by 4.7% from 2.810 billion tons of coal equivalent (tce) in 2013 to 2.703 billion tce.

Moreover, the percentage of coal in the energy structure has been decreasing. In 2015, China reached the target of cutting the percentage of coal in the energy structure to below 65% by 2017, as specified in the Action Plan. Subsequently, China set new targets to progressively reduce the percentage to below 63% by 2016, roughly 60% by 2017 and below 58% by 2020. Data shows that coal consumption accounted for 62% of total energy consumption in 2016, down by 2% year on year and meeting the target set for 2016. Moreover, non-fossil fuel energy consumption accounted for 13.3%, up by 1.3% year on year.

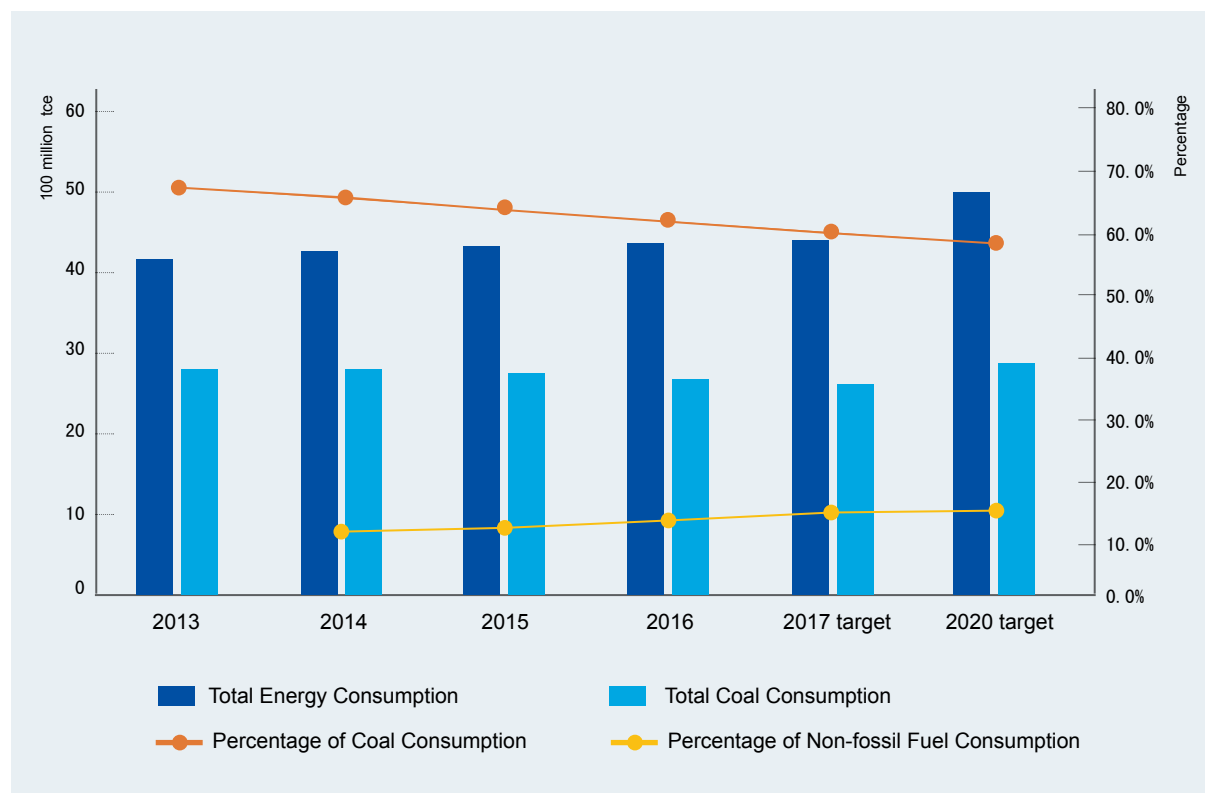


Figure 28: Progress and Targets for Energy Structure Adjustment from 2013 to 2020

In order to achieve the goal of controlling total coal consumption, at the end of 2014 the National Development and Reform Commission (NDRC) and five other government agencies set coal consumption reduction targets for 2017 in BTH and Shandong province.

In 2016, Beijing cut coal consumption by 2 million tons, reducing total consumption to 9.65 million tons and attaining their goal of “controlling total coal consumption within 10 million tons” one year in advance. Tianjin also reduced coal consumption by 2.53 million tons, reducing total consumption to 42.86 million tons and attaining the goal of “cutting total coal consumption by 10 million tons compared with 2012” one year in advance. Hebei Province cut coal consumption by five million tons, reducing total consumption to 284.43 million tons, which is still about 10 million tons away from meeting the target set by the government to “cut total coal consumption by 40 million tons by 2017 compared with 2012”. As data of Shandong Province shows rising coal consumption since 2013, Shandong faces a significant challenge to complete the state-

assigned task of “cutting total coal consumption by 20 million tons by 2017 compared with 2012”.

By the end of 2015, Shanghai, Zhejiang Province and Jiangsu Province in YRD recorded decrease in total coal consumption compared with 2012, accomplishing NDRC's target to achieve decrease in total coal consumption by 2020 in advance. However, in Anhui province, total coal consumption was still higher in 2015 than in 2012. During the “13th Five-Year Plan” period, the State Council required total coal consumption in Shanghai, Zhejiang Province, Jiangsu Province and Anhui Province to be reduced by around 5%.

Meanwhile, PRD accomplished the goal of decrease by 2020 in advance, with a total coal consumption of 80 million tons in 2015. Subsequently the region established stricter total consumption control targets by 2017 and 2020, with the goal of limiting total consumption within 75.14 million tons by 2017 and 70.06 million tons by 2020.

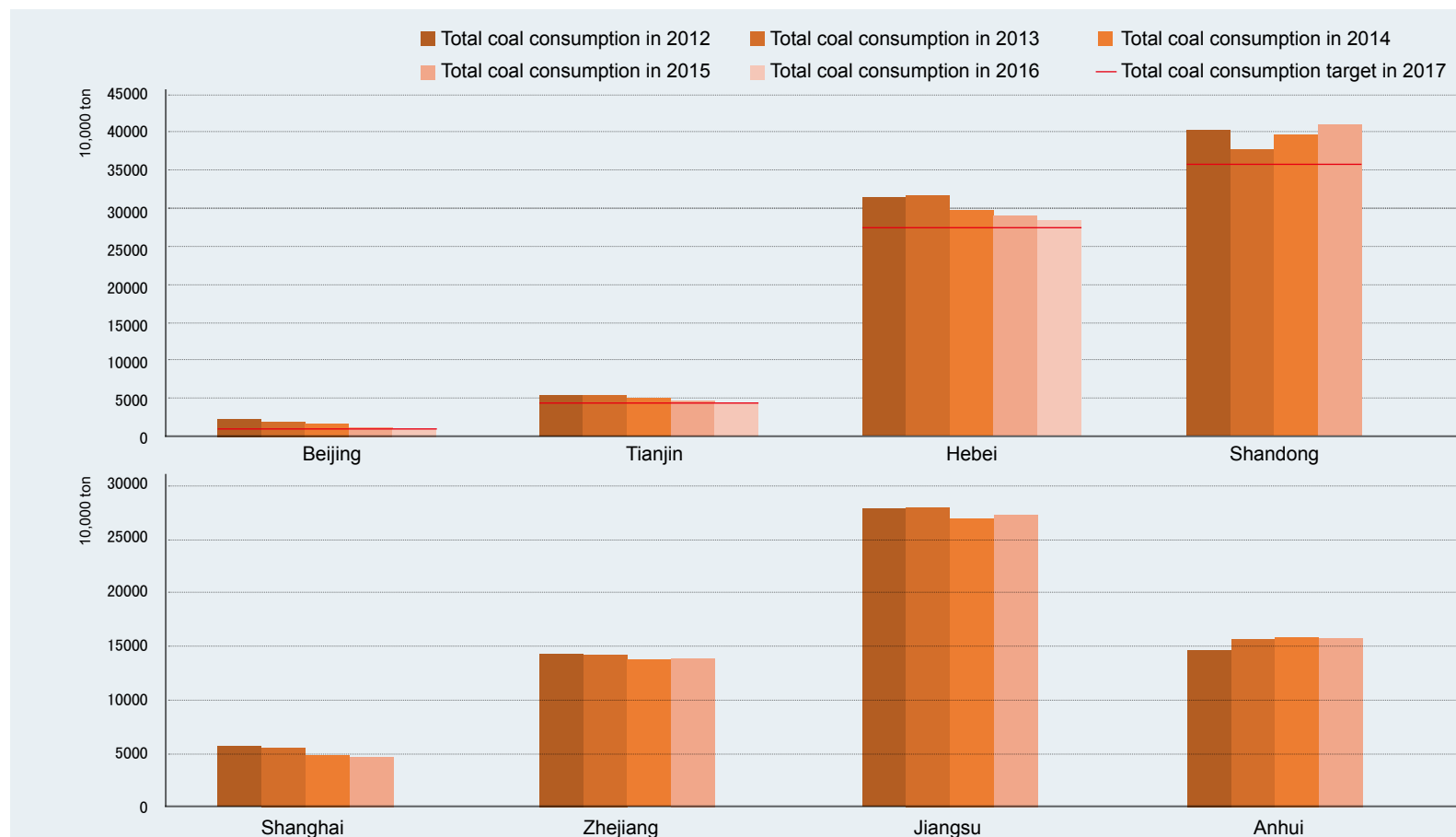


Figure 29: Total Coal Consumption in BTH Region and YRD Region

By the end of 2015, apart from the three regions, most provinces (municipalities and autonomous regions) had decrease of total coal consumption compared with 2012. The provinces of Liaoning, Jilin, Henan, Hubei, Sichuan and Yunnan had decrease in total coal consumption for three consecutive years. In contrast, coal consumption in Shaanxi Province, Jiangxi Province, Ningxia Hui Autonomous Region, Xinjiang Uygur Autonomous Region and Hainan Province rose for three consecutive years. Although total coal consumption in Shanxi Province began to show signs of decreasing, in 2015 it increased by 25.64 million tons from 2012 levels. These provinces failed to effectively control total coal consumption.

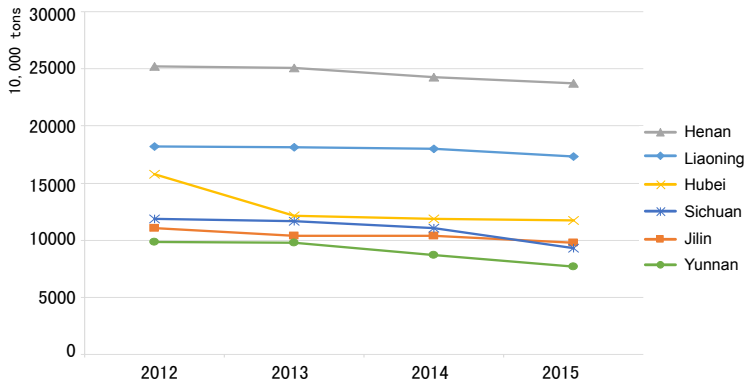


Figure 30: Provinces (outside of 3 key regions) that Have Continuous Decrease of Total Coal Consumption

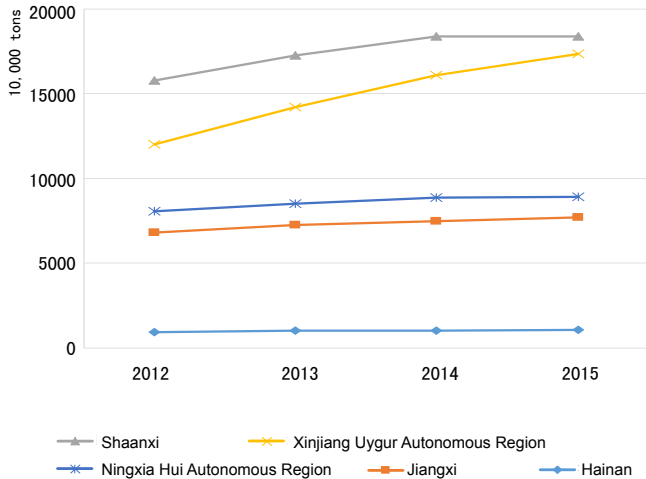


Figure 31: Provinces (outside of 3 key regions) that Have Continuous Increase of Total Coal Consumption

At the city level, coal control targets fall under the following main categories: coal consumption reduction targets, total coal consumption targets, and target percentages of coal consumption in the total energy structure. In cities of Henan Province, for example, the percentage of coal consumption was higher than the national average. The province has set targets to decrease this percentage to 76.5% by the end of the 12th Five-Year Plan period and to 70% by the end of the 13th Five-Year Plan period. However, these target percentages are still over 10% higher than the national level for the same time periods.

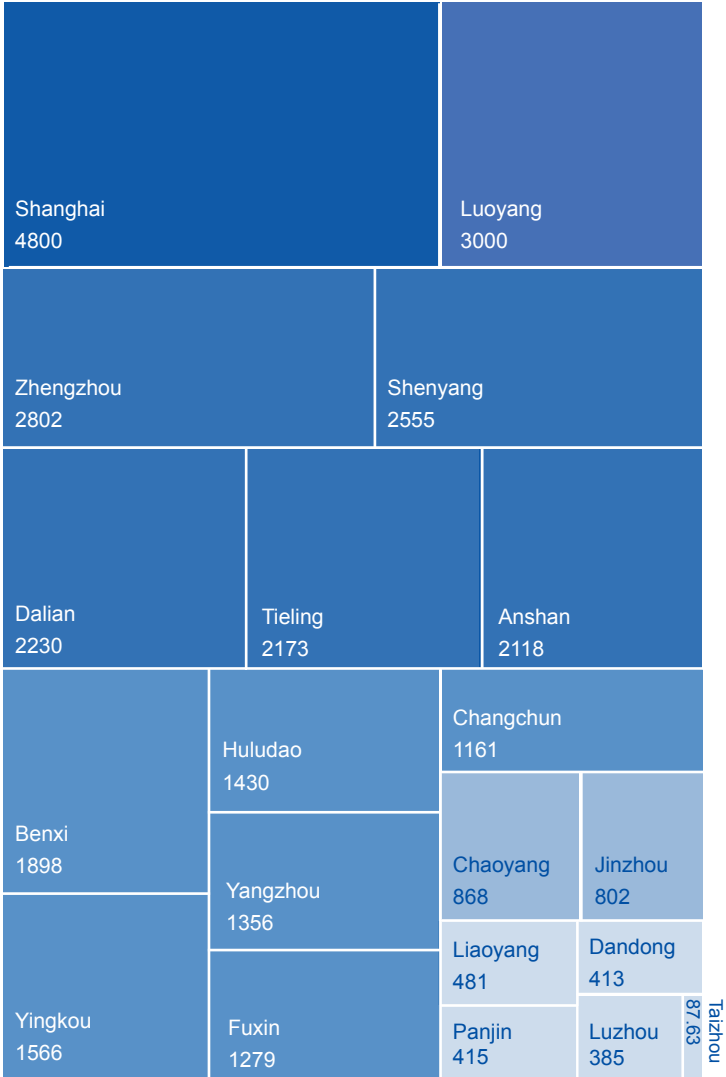


Figure 32: Total Coal Consumption Control Targets of Some Cities for 2016 (10,000 ton)

Specifically, China continued implementing existing measures at the national, regional, and city level. These measures include eliminating outdated coal-fired generating units, eliminating or replacing boilers and furnaces with clean energy, offsetting or reducing the capacity of new coal-based projects, and advancing centralized heating transformation. BTH has focused on reducing and replacing loose coal in 2016, which has seen initial results. Specific measures, targets, and progress in controlling total coal consumption for 2016 at the national, regional, and city levels are described as follows:

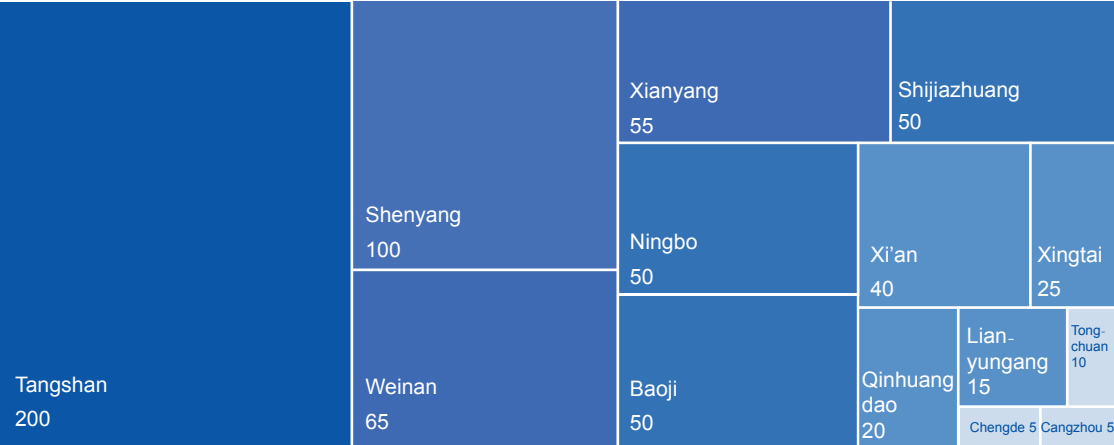


Figure 33: Targets of Coal Consumption Reduction of Some cities for 2016 (10,000 ton)

Elimination of Outdated Coal-Fired Generating Units

To address overcapacity in the power sector, China planned to eliminate 4.918 GW of outdated coal-fired generating units in 2016 and assigned targets to 18 provinces and municipalities, among which Shaanxi Province was assigned the most difficult target to eliminate 0.5965 GW of outdated capacity.

By the end of 2016, most of the provinces and municipalities completed the state-assigned target on time. Shandong Province shut down 1.267 GW of coal-fired generating units, which is 20 times the state-assigned target. See the Figure 34 below for the specific tasks assigned and the progress made.

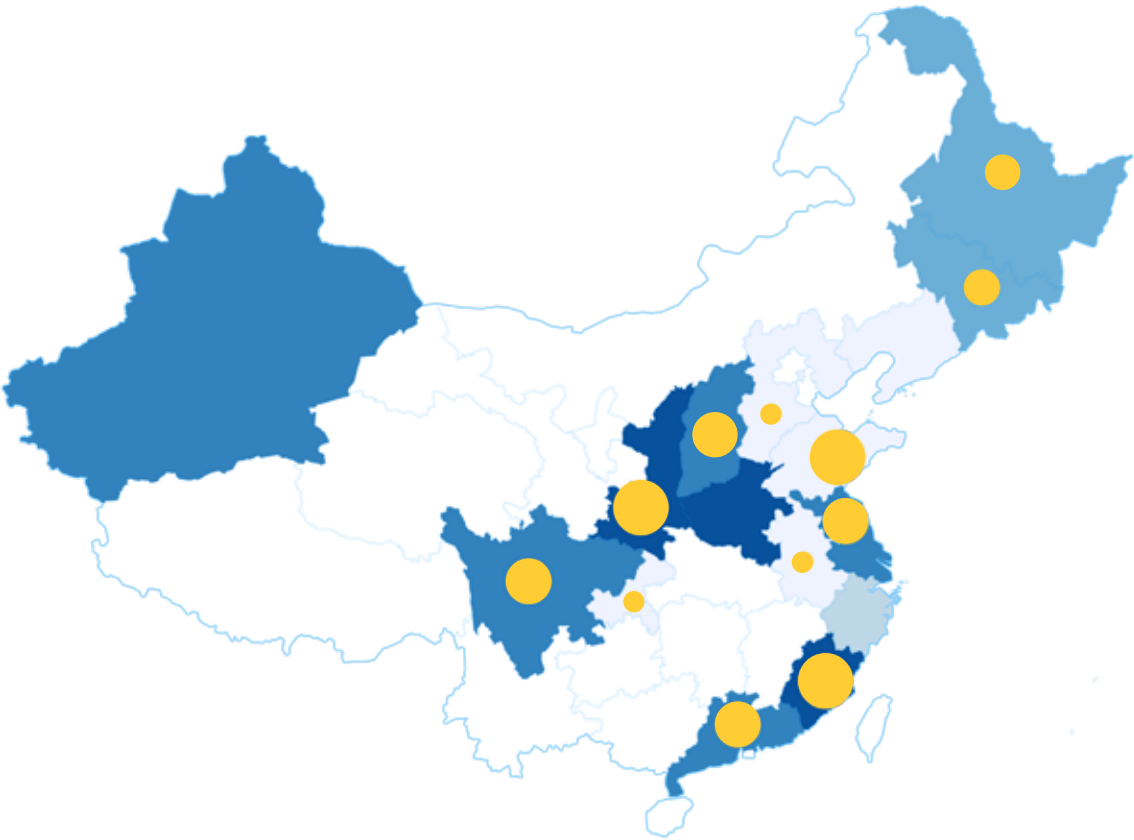
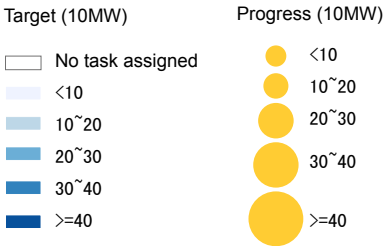


Figure 34: National Targets and Progress of Eliminating Outdated Coal-Fired Generating Units in 2016 (Unit: 10MW)

Elimination and Retrofitting of Coal-Fired Boilers

In 2016, the progress of the three key regions and some cities towards eliminating and retrofitting coal-fired boilers is shown in the Figure 35 and 36.

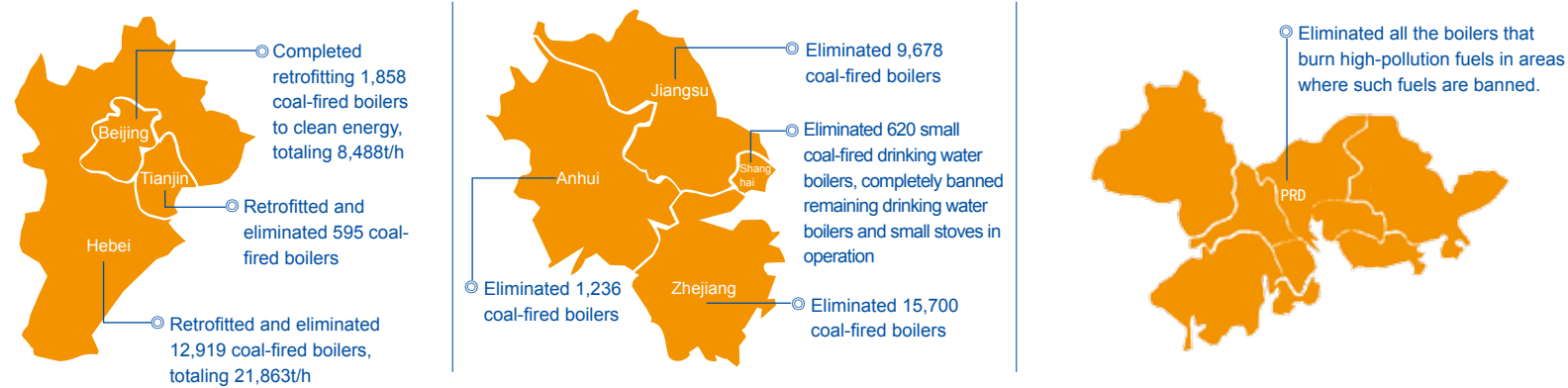


Figure 35: Key Regions' Progress in Eliminating Coal-Fired Boilers in 2016

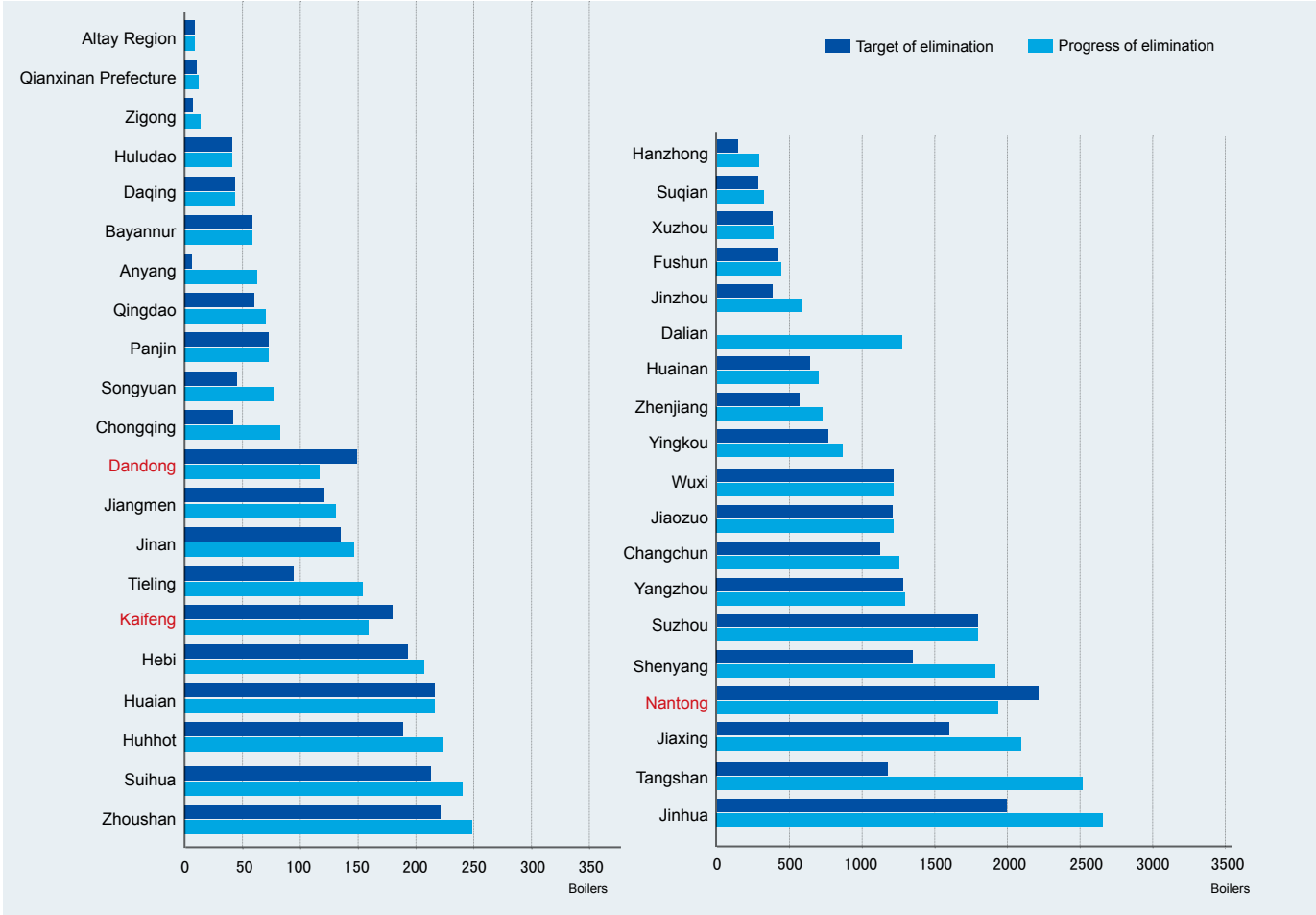


Figure 36: Target and Progress of Eliminating and Retrofitting Coal-Fired Boilers for Some Cities in 2016

Substitution and Clean Conversion of Loose Coal Used by Households

Loose coal-related pollution control became a key measure for air pollution control in BTH in 2016. The region focused on the control of production, distribution, and usage of loose coal, while also increasing efforts to promote clean energy use in suburban and rural areas. In addition, Hebei Province implemented an initiative against loose coal as one of its four special pollution control initiatives and released the Special Action Plan of Hebei Province for Loose Coal Pollution Control. This plan specified detailed measures, including: 1) Expanding the areas where high-pollution fuels are banned and prohibiting the processing and sale of loose coal in these areas; 2) Strengthening the supervision of sales outside these areas, reinforcing coal quality inspection and eradicating any sales of loose coal that do not conform to quality standards; 3) Establishing a complete clean

coal distribution network and encouraging coal users to switch to electricity, natural gas or clean coal, or to upgrade to more efficient stoves.

In terms of production and distribution, provinces and cities strengthened supervision on loose coal by banning the sale of substandard loose coal, increasing clean coal processing, and building distribution centers. These policies helped cut off distribution channels of substandard loose coal and ensured a supply network of clean coal.

Furthermore, to control pollution from loose coal, a few cities in Shandong Province issued subsidy policies to incentivize the implementation of control measures and allocated special funds totaling more than RMB 1.1 billion to control loose coal pollution. These cities included Jinan, Zibo, Dezhou, Liaocheng, Jining, Linyi, Heze, Qingdao, and Laiwu.

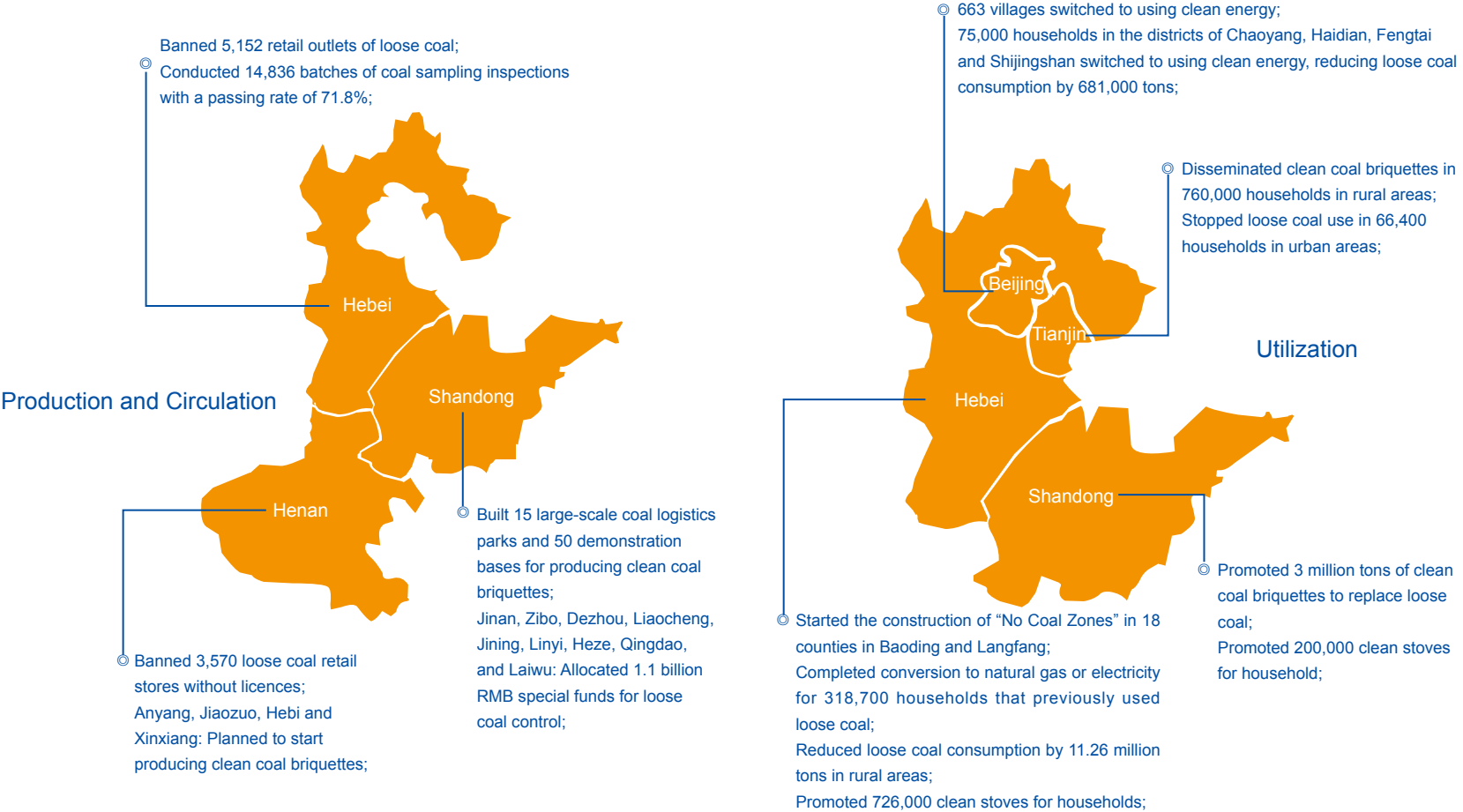


Figure 37: Progress of Controlling Household Use of Loose Coal in BTH and Surrounding Areas

Vehicle Pollution Prevention and Control

Elimination of Yellow-Label and Outdated Vehicles

From 2014 to 2016, more than 16 million yellow-label and outdated vehicles were eliminated across the country. MEP had planned to eliminate 3.8 million of these vehicles in 2016, but ultimately eliminated 4.0458 million, exceeding the annual target by 6.5%. Based on the information provided by provinces on targets and progress, most provinces completed or exceeded their targets of yellow-label vehicle elimination in 2016. However, publicly available information does not reveal the target number of yellow-label vehicles for elimination in Shanghai, Fujian Province, Shandong Province, Guangdong Province, Xinjiang

Uygur Autonomous Region and Tibet. Figure 38 shows the elimination plan and progress made by the provinces in 2016.

To further reduce vehicle emissions, Shandong Province began to convert yellow-label vehicles to green-label ones (“yellow-to-green” conversion) in 2014. Following Shandong Province, Heilongjiang Province and Ningxia Hui Autonomous Region also released their “yellow-to-green” conversion plans at the provincial level in 2016, targeting diesel vehicles that were in relatively good condition and that complied with the China II emission standards. In addition, Luoyang of Henan Province, Xiangyang of Hubei Province and Meizhou of Guangdong Province also undertook “yellow-to-green” conversion.

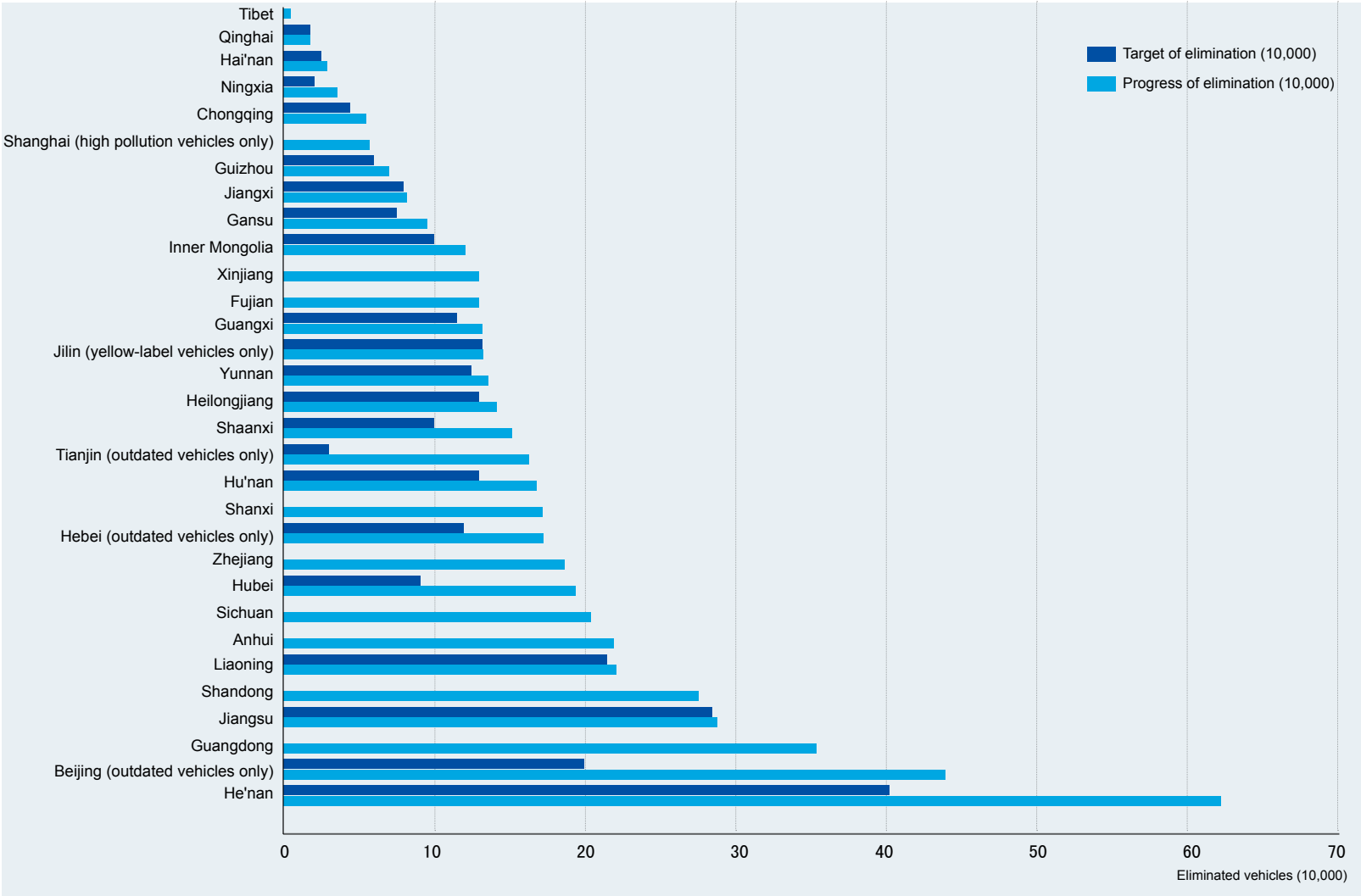


Figure 38: Targets and Progress on the Elimination of Yellow-Label and Outdated Vehicles for Provinces, Regions and Municipalities in 2016

Furthermore, some cities imposed strict restrictions on yellow-label vehicles. Shijiazhuang, Shenzhen, and Puyang implemented permanent bans on these vehicles in their administrative districts, while more than a hundred other cities enforced the regulations on banning or restricting yellow-label vehicles in built-up urban areas, core urban areas, or designated areas. They also conducted rigorous road checks to actively prohibit such vehicles

in restriction areas. It is worth mentioning that Beijing, Tianjin, Shanghai, Qingdao, Zhejiang Province, and Jiangsu Province have completed elimination of all yellow-label vehicles in 2016, and focused on eliminating high-pollution outdated vehicles and promoting new energy vehicles.

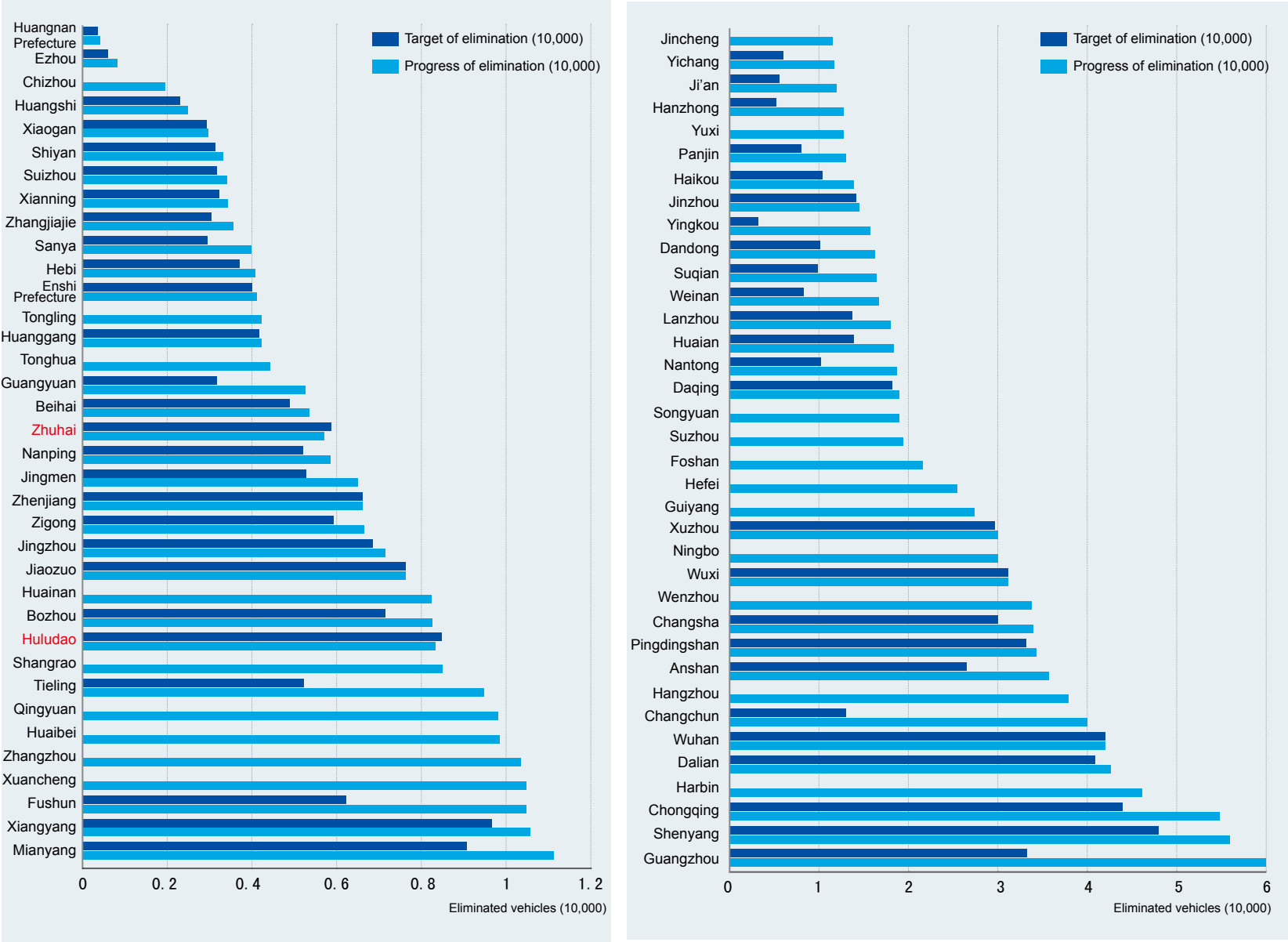


Figure 39: Targets and Progress of Yellow-Label and Outdated Vehicles Elimination of Some Cities in 2016

Encouraging Public Transport and Promoting New energy vehicles

The central government has continued to allocate funds that subsidize new energy vehicles and the construction of charging facilities. Both funding mechanisms have further encouraged the provinces to promote new energy vehicles. Some provinces, such as Guangdong and Hebei, have taken the lead in promoting and using new energy vehicles in the public service sector, increasing the use of these vehicles in public transport, taxis, and urban logistics. Starting in 2016, PRD also aimed to

ban fossil-fuel vehicles for use as new or replaced buses. In 2016, the nationwide population of new energy vehicles had reached 1,014,000, up 73.87% from 2015 when the population was 583,200. Figure 40 shows promotion progress in the three key regions in 2016. Tianjin and Hebei Province exceeded the government-assigned target of “adding no fewer than 30,000 new energy vehicles.” Tianjin increased the number of new energy vehicles by 23.3% and Hebei increased by 65.1%.



Figure 40: Promotion of New energy vehicles in Key Regions in 2016

At the city level, in addition to the cities in key regions such as Beijing, Shanghai, Guangzhou and Shenzhen where new energy vehicles had already been promoted on a large scale, around 200 cities also initiated the switch to new energy vehicles in sectors of public transport, taxis, environmental sanitation, government agencies, and public institutions. In addition, about

100 cities provided incentives to encourage organizations and individuals to purchase and use new energy vehicles. These cities also improved charging facilities for such vehicles and implemented a mechanism to reward and/or subsidize the purchase of new energy vehicles.



Figure 41: Promotion of New Energy Vehicles in Some Cities in 2016

Diesel Vehicle Pollution Control

Managing pollution from heavy-duty diesel vehicles is receiving increasing attention. Beijing, Wuhan, Nantong, Zhengzhou and other cities in their provinces have banned heavy-duty diesel vehicles in designated areas and strengthened the management of pollution emitted by such vehicles. Moreover, Beijing, Shanghai, Zhengzhou, Shenzhen, Xi'an, and Yichang have required that pollution control devices, including DPFs, be installed on heavy-duty diesel vehicles. In 2016, more than 5,500 DPFs were installed on eight types of new heavy-duty diesel vehicles in Beijing, including buses, sanitation trucks, tourist buses, mail trucks, dump trucks, shuttle buses, school buses and airport buses.

Monitoring and Inspection

Over 30 cities, including Beijing, Chongqing, Chengde, Yichang, Xi'an, Shenyang, have required that remote sensing detection devices be installed on major roads to increase inspection and control over exhaust emissions of outdated vehicles. The provinces of Shanxi, Henan, Hubei, Sichuan and Shaanxi have started creating country-province-city interconnected vehicle exhaust supervision systems. Cities in Jiangsu Province have also started to set up a province-city-county interconnected vehicle exhaust supervision system. Such measures pushed forward the establishment of electronic intelligent monitoring networks, realizing real-time transmission of inspection data, real-time monitoring of vehicle inspection, and inspection information sharing.

Optimization of Industrial Structure and Layout

The elimination of outdated capacity progressed smoothly in 2016. More than 65 million tons of excessive iron and steel capacity and 290 million tons of excessive coal capacity were eliminated across the country. See Figure 42 below for the progress of outdated capacity elimination in 3 key regions.

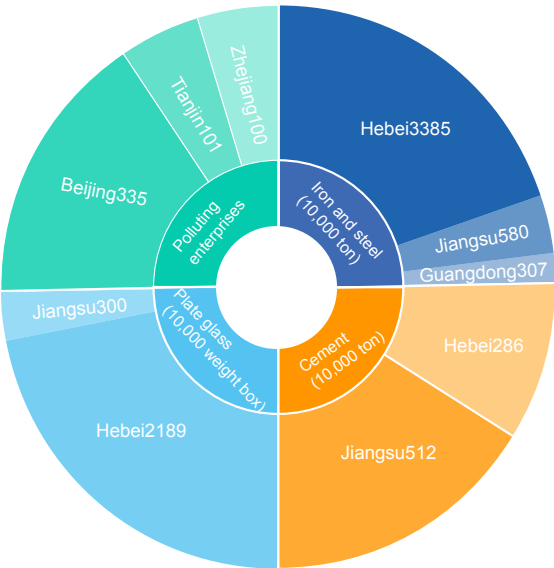


Figure 42: Progress of Outdated Capacity Elimination in Key Regions in 2016

The elimination of outdated capacity continues to be carried forward at the city level. In addition to pre-existing measures, new measures such as differential pricing policies for electricity, water and pollution discharge as well as policies for punitive electricity pricing have been adopted and implemented to further advance eliminations. Figure 43 below shows the progress made on eliminating outdated capacity in some cities.



Figure 43: Progress of Outdated Capacity Elimination in Some Cities in 2016

Reducing Emissions in Industrial Process

Cleaner Production

The Rules for Cleaner Production Audit were officially released on July 1, 2016, expanding the range of enterprises that must go through mandatory cleaner production auditing. Furthermore, the NDRC, the MEP, and the Ministry of Industry and Information Technology have consolidated and revised the relevant systems of cleaner production assessment indicators for the electrolytic manganese, coating, and synthetic leather industries. Moreover, new indicator systems for the photovoltaic cell and gold industries were also set up.

In key regions:

- ◆ Beijing conducted voluntary audits for 353 enterprises and compulsory audits for 114 enterprises since 2013, meeting the target set in its Clean Air Action Plan of “completing cleaner production audits for no fewer than 400 enterprises” one year ahead of schedule.
- ◆ Tianjin completed assessments of cleaner production audit reports for 68 enterprises and acceptance of cleaner production audits for 96 enterprises.
- ◆ Hebei Province completed the acceptance of cleaner production audits for 482 enterprises.
- ◆ Zhejiang Province upgraded 1,000 enterprises following cleaner production processes.
- ◆ Guangdong Province completed the acceptance of cleaner production audits for 234 enterprises.

Following the comprehensive implementation of the 12th Five-Year Plan for the Promotion of Industrial Cleaner Production, China established 24 provincial-level and 31 city-level cleaner production centers, including centers dedicated to the metallurgy, chemical, light industry, nonferrous metals, and machinery industries. Promotion plans for cleaner production in 35 key industries were also released by provinces and cities, including iron and steel, building materials, petrochemicals, chemicals, and nonferrous metals. As a result, emissions of industrial chemical oxygen demand, ammonia nitrogen, SO₂, and NO_x decreased by 28%, 15%, 6.7%, and 4.1%, respectively. These reductions meant that the relevant targets set out in 12th Five-Year Plan were fulfilled. In 2016, over 200 cities continued promoting cleaner production. Moreover, enterprises from major sectors, such as iron and steel, cement, chemical, petrochemicals, nonferrous metal smelting, coal, and power generation, have adopted advanced and useful cleaner

production technologies, processes, and equipment, placing emphasis on boosting the level of cleaner production technology for small and medium-sized enterprises. Cleaner production audits and technology upgrades were comprehensively implemented to lower the intensity of emissions in these key industries.

Upgrading Fuel Quality

According to the national plan for upgrading fuel quality, 11 provinces and municipalities in East China are required to only supply gasoline and diesel that complied with China V standards beginning from January 1, 2016. The implementation status of the 11 provinces and municipalities is as follows:

- ◆ **Achieved Supply Ahead of Schedule:** Beijing and Shanghai in 2013, as well as Tianjin in 2014, supplied gasoline and diesel complying with China V standards. Subsequently, Guangdong, Hainan and Jiangsu provided their supply in 2015.
- ◆ **Achieved Supply on Schedule:** As required by central government, Hebei, Shandong, Zhejiang, Fujian, and Liaoning started supplying auto gasoline and diesel complying with the China V standards from January 1, 2016.

Apart from the East China, other provinces were required to supply gasoline and diesel that comply with the China V standards beginning from January 1, 2017. The provinces of Shaanxi and Henan began fully supplying auto gasoline and diesel complying with China V standards starting on October 1, 2014 and November 1, 2016 respectively, ahead of schedule. Beijing released the 6th stage of its auto gasoline and diesel standards in October 2016 which were due to take effect on January 1, 2017.

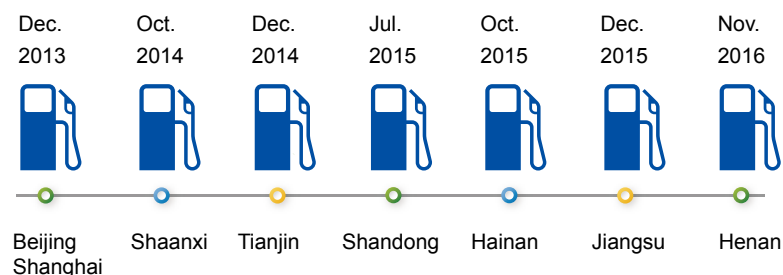


Figure 44: Provinces and Municipalities that Provided China V Gasoline and Diesel Ahead of Schedule

Clean Coal Combustion

In 2016, a total of 2.345 billion tons of raw coal were selected by washing nationwide. The selection rate reached 68.9%, up by 3% compared with 2015, which raised hopes that the country would attain the target of raw coal selection rate of 70% in 2017.

Figure 45 below shows target coal selection rates of cities in 2016. Some cities in northeastern and western China had selection rates that were still lower than the national average target, requiring further measures for improvement.

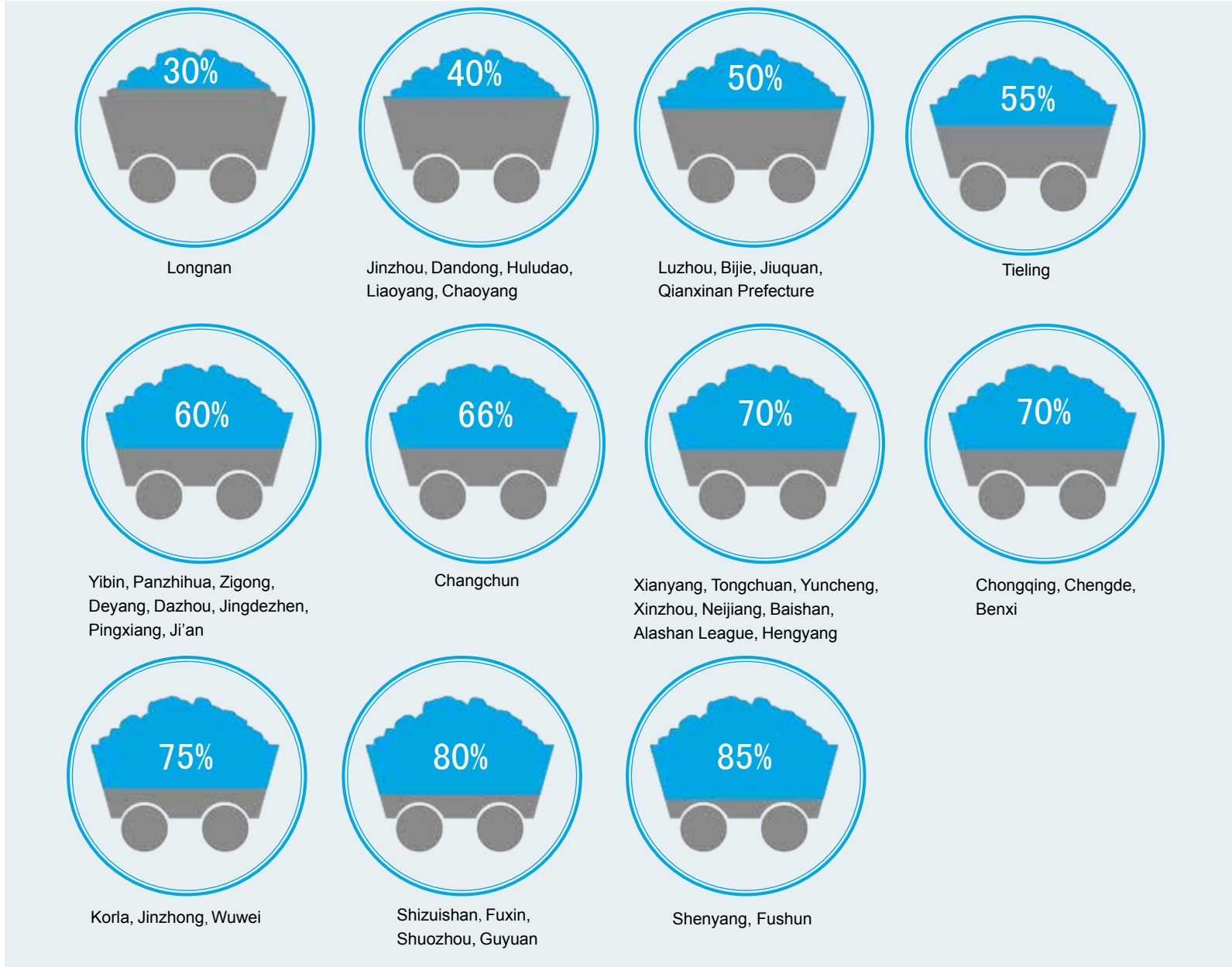


Figure 45: 2016 Targets of Raw Coal Selection Rate of Cities

Increasing Green Space in Urban Areas

Since increasing green space was designed as a new measure to control air pollution in 2015, nearly 200 cities have been expanding green fields

and forest coverage in 2016. The green space and forest coverage of some cities are shown in Figure 46 and 47.



Figure 46: Forest Coverage of Some Cities in 2016

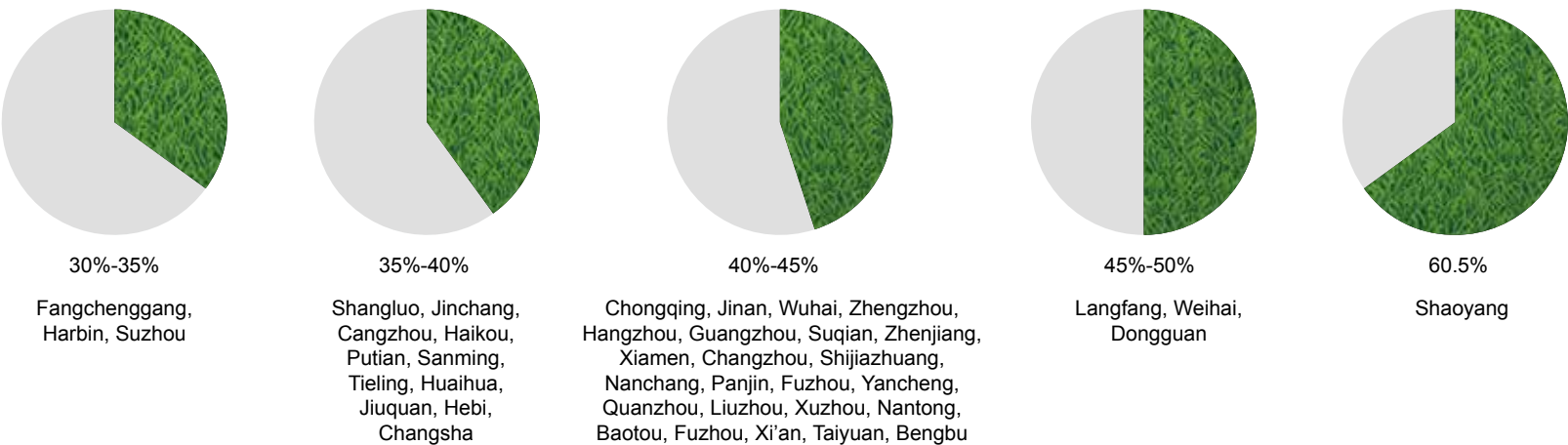


Figure 47: Green Space Coverage of Built-up Areas of Some Cities in 2016

Area Source Management

Installing continuous monitoring systems became a new measure to control fugitive dust pollution in 2016. Some provinces and cities strengthened supervision and control of fugitive dust on construction sites and roads through continuous monitoring and mechanized cleaning.

In BTH, Beijing installed video monitoring systems on 1,540 construction sites. Meanwhile, the operation rate of “absorbing, sweeping, washing and recycling” for road sweeping and cleaning reached 87%. Tianjin completed continuous monitoring and video surveillance of fugitive dust on 1,178 earthwork construction sites and on 235 stacking yards of industrial enterprises. Discharge fees for fugitive dust amounting to RMB 132 million were collected. In addition, Hebei Province issued an action plan for fugitive dust control to implement control measures on construction sites and roads.

In YRD, Shanghai enhanced comprehensive fugitive dust prevention and control beginning with fugitive dust control on roads. The city designated a fugitive dust control zone covering 606 square kilometers and installed 2,100 continuous monitoring systems. Jiangsu Province reinforced control on fine dust at stacking yards of industrial and mining enterprises. Through measures of improving stock bin enclosures and conducting automatic spraying, the qualification rate of dust control on construction sites reached over 90% in whole province. Zhejiang Province completed fugitive dust control on urban construction sites covering more than 150 million square meters, with the mechanized cleaning rate of all major urban arterial roads reaching 100%. Anhui Province implemented fugitive dust control on 1,535 construction sites.

In 2016, Guangdong Province proposed installing video monitoring devices on construction sites covering a total area of over 100,000 square meters and equipping vehicles with GPS devices. However, information on the progress was not available at the time of writing this report.

More than 200 cities continued strengthening fugitive dust control, mainly targeting construction sites, city roads, industrial stacking yards, concrete mixing plants, and mines. Compared with 2015, Hebei, Henan, Liaoning, Guangdong, Sichuan, Gansu and Hainan provinces also increased efforts to install video monitoring devices to improve supervision.

Emission Reduction in End Use

Desulfurization, Denitration and Dedusting

In 2016, desulfurization, denitration and dedusting achieved steady progress across key industries and enterprises nationwide. Beijing was the first city to retrofit gas boilers using low-NO_x emission technology, completing the retrofit for over 1,500 boilers in 2016. Tianjin carried out 152 desulfurization, denitration, dedusting and VOCs emission control projects targeting major industrial enterprises, along with 29 smoke and fine dust emission control projects that targeted iron and steel companies. Anhui Province completed 55 desulfurization projects and 38 denitration projects, and Jiangsu Province dismantled the flue gas bypass of 46 sinter machines' desulfurization devices. Guangdong Province equipped all sinter machines and pellet production lines with desulfurization devices. It installed denitration devices in all clinker production lines with a capacity of over 2,000 tons/day and desulfurization and denitration devices for 26 flat glass production lines. Guangxi Province completed the construction of 16 new dry-process cement kilns using denitration technologies of low-NO_x combustion and SNCR. Guizhou Province upgraded dedusting devices of all coal-fired generating units above 3MW to eliminate fugitive dust emissions. Qinghai Province implemented 27 comprehensive pollution control projects, including upgrading and converting facilities for key industrial waste gas pollution control and building desulfurization and denitration devices.

As a key control measure to prevent frequent heavy pollution days in the northern regions during heating season, clinker production lines in the cement industry in northern regions were required to suspend production on a trial basis in the winter of 2015-2016. Subsequently, when the heating season began in October 2016, the MIIT and MEP required northern regions to fully suspend cement production over all heating seasons in 2016-2020. Other provinces and cities were also encouraged to suspend cement production during the Chinese New Year, hot summer days, and the rainy season. Apart from the northern regions, some cities in Jiangsu Province and Hunan Province also limited or stopped cement production to reduce emissions and mitigate excess capacity. Suspending cement production during heating season eventually became the normal state, which allowed the cement sector to manage excess capacity. The timeline for suspending cement production is shown below in Figure 48.

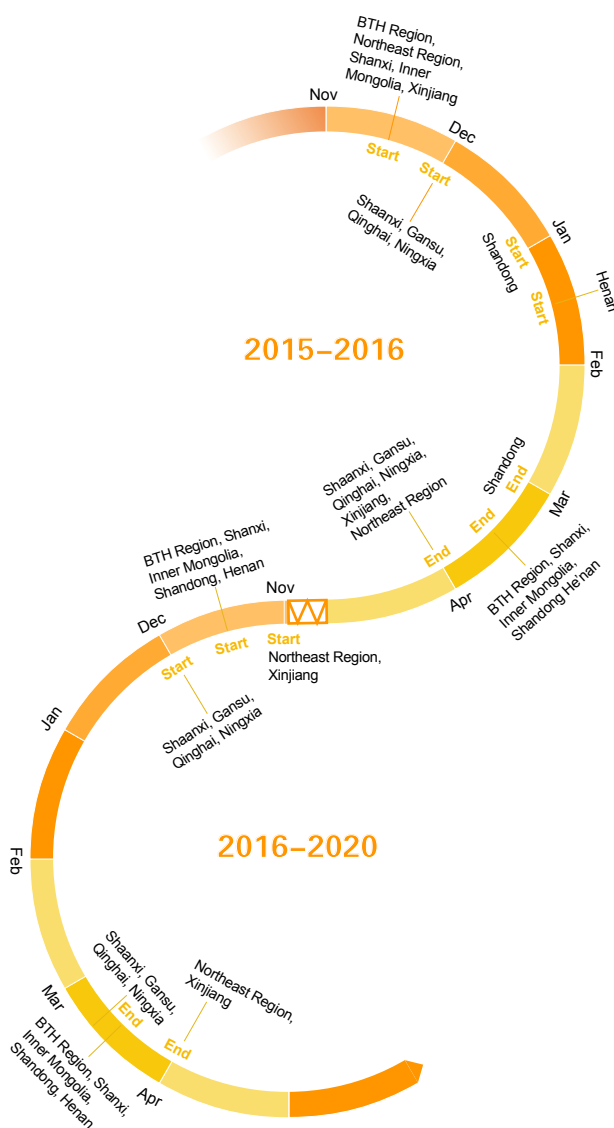


Figure 48: Timeline for Suspending Cement Production in 2015-2020

Converting to Ultra-Low Emission Units

In 2016, the National Energy Administration and the MEP jointly released the targets and tasks of converting coal power to achieve ultra-low emissions for provinces and municipalities, with a plan to complete converting 444 GW of coal power generating units to ultra-low emission units nationwide. All the tasks were completed on schedule by the end of 2016. Generating units totaling 40 GW in Hebei Province were converted to ultra-low emission and the three provinces and one municipality in YRD completed converting 112 coal-fired units for ultra-low emission in power plants. In addition, as many as 65 coal-fired units totaling 24.68 GW were converted in Guangdong Province, exceeding the annual target. According to publicly available data, Jiangsu, Shanxi and Guangxi provinces failed to accomplish their ultra-low emission targets in 2016. Progress made by provinces in 2016 is shown in the Figure 49.

Upgrading Vehicle Emission Standards

According to requirements from the central government, from April 1, 2016, the China V vehicle emission standards applied to all imported, sold, and registered light-duty gasoline vehicles, light-duty diesel passenger vehicles, and heavy-duty diesel vehicles (for public transportation, environmental sanitation and mail purposes only) in the 11 provinces and municipalities in the East China. The progress of relevant provinces and cities is as follows:

- ◆ Beijing, Shanghai, Guangdong Province and Tianjin enforced China V vehicle emission standards ahead of schedule.
- ◆ Hebei Province, Shandong Province, Liaoning Province, Zhejiang Province, Jiangsu Province (excluding Suqian, Zhenjiang and Nantong), and Fujian Province (Xiamen, Fuzhou and Quanzhou only) enforced the standards from April 1, 2016.
- ◆ Hai'nan Province and some prefecture-level cities of Jiangsu Province (such as Suqian, Zhenjiang and Nantong), and Fujian Province (such as Longyan) progressed behind schedule.

Furthermore, MEP, together with the MIIT, the State Administration for Industry and Commerce, and the General Administration of Quality Supervision, Inspection and Quarantine, jointly conducted special inspections on the

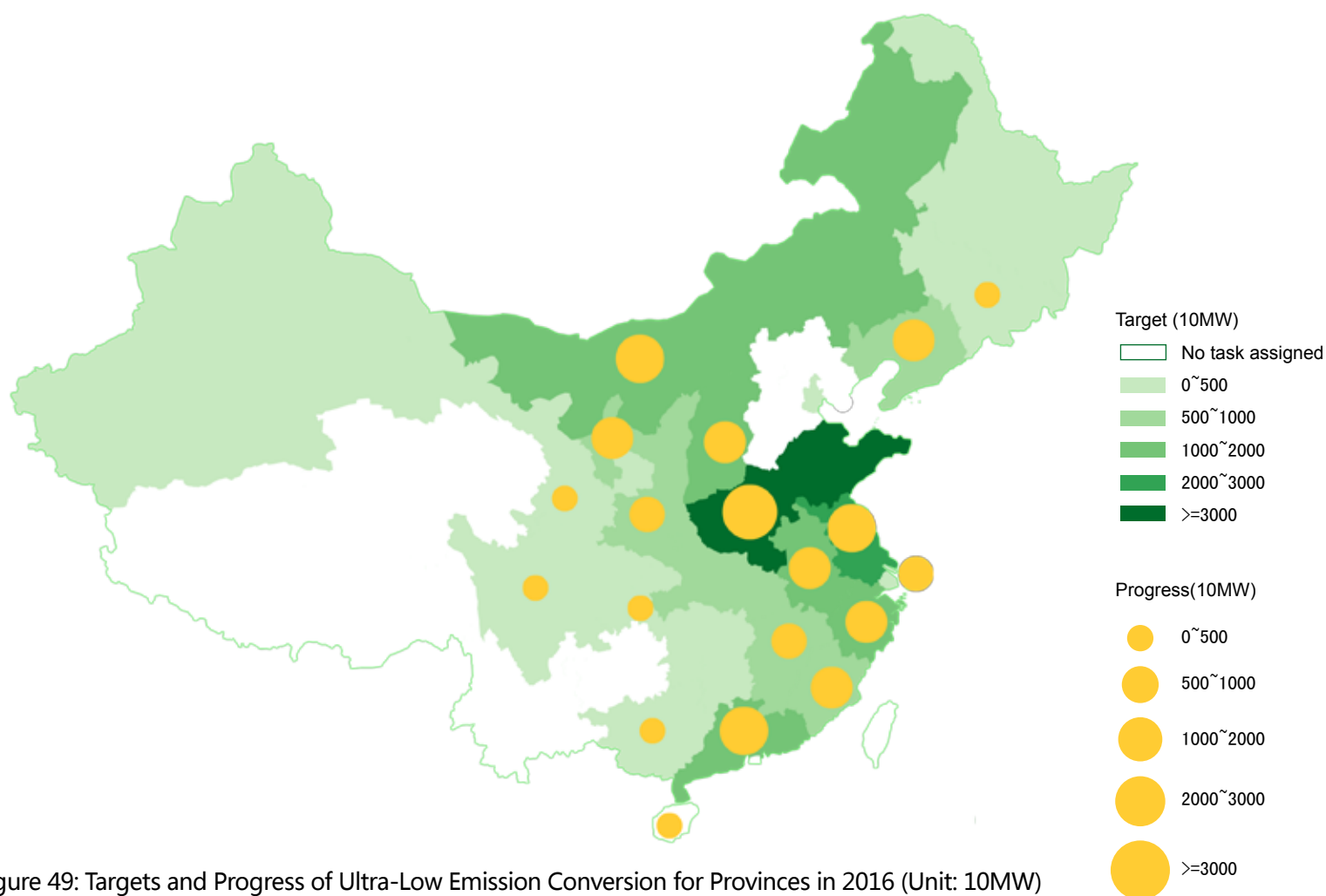


Figure 49: Targets and Progress of Ultra-Low Emission Conversion for Provinces in 2016 (Unit: 10MW)

enforcement of the vehicle standards, supply of petroleum products and auto urea, as well as manufacturers' production status in areas that enforced such standards in advance.

Applying Special Emission Limits

By the end of 2015, China had fully completed formulating and amending emission standards for the "key industries to which special emission limits on air pollutants should be applied". From July 1, 2016, special emission limits were applied to in-use steam boilers at or under 10 t/h and in-use hot-water boilers at or under 7 MW.

In 2016, Qinghai Province, which is not one of the key control regions, volunteered to apply special emission limits on air pollutants to the key sectors of iron and steel, cement, nonferrous metals, chemicals, and newly built coal-fired boiler projects, and to apply ultra-low emission limits to new coal-fired power generation projects in Xi'ning, Haidong, the capitals of the six autonomous prefectures (Haibei, Hainan, Huangnan, Guoluo, Yushu and Haixi), and the built-up area and surrounding industrial parks in Golmud.

Comprehensive Measures

VOCs Emission Control

In 2016, the 13th Five-Year Plan on Eco-Environmental Protection included VOCs in its total emission control indicators. It requires that total VOCs emission control be conducted in key regions and industries and a decrease of over 10% in total VOCs emissions by 2020 compared with 2015. The plan also mandated 16 provinces and municipalities (Beijing, Tianjin, Shanghai and Chongqing, along with Hebei, Liaoning, Jiangsu, Zhejiang, Anhui, Shandong, Henan, Hubei, Hunan, Guangdong, Sichuan and Shaanxi provinces) that had serious PM and O₃ pollution to set total VOCs emission control targets and develop corresponding implementation proposals. Subsequently, 15 provinces and cities set their total VOCs emission control targets for the “13th Five-Year Plan” period, as shown in Figure 50.

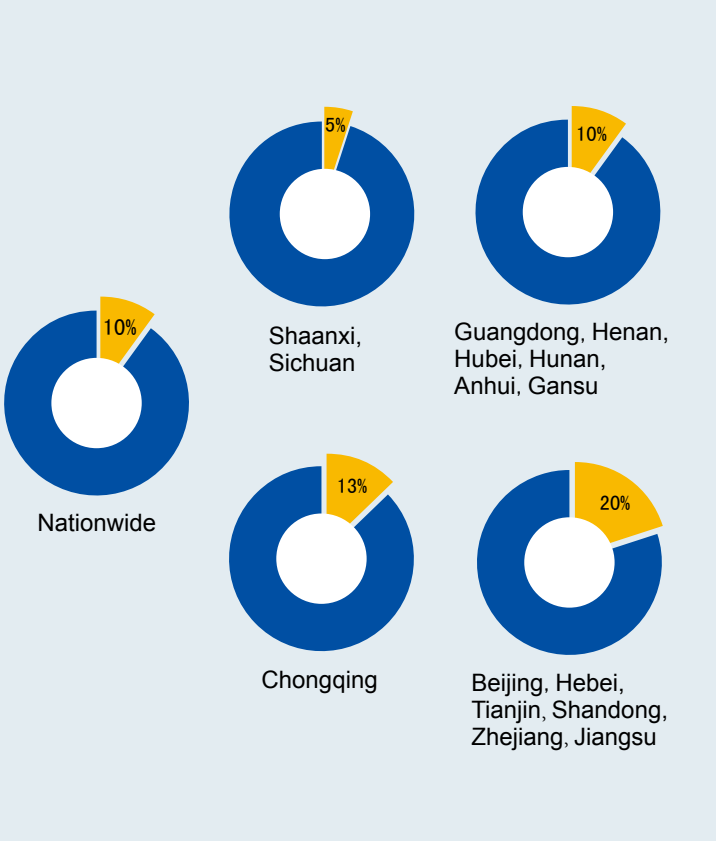


Figure 50: Provinces and Municipalities that Set Total VOCs Emission Control Targets by 2020

The principal goal of VOCs emission control is to manage industrial VOCs emissions, which account for over 50% of total emissions. China is pursuing the goal of cutting VOCs emissions from industrial sectors by over 3.3 million tons by 2018 compared with 2015. In order to achieve the target, specific tasks and measures were assigned to 11 key industrial sectors whose VOCs emissions make up more than 80% of total industrial emissions. These sectors are: oil refining and petrochemicals, coating, printing ink, adhesives, pesticides, automobiles, package printing, rubber products, synthetic leather, furniture, and shoemaking.

Meanwhile, the VOCs pollution charge pilot program that began on October 1, 2015 was expanded to cover 15 provinces and municipalities, including Beijing and Shanghai, Jiangsu, Hunan, Sichuan, Zhejiang, Liaoning, Hebei, Shandong, Shanxi, Hubei, Hainan, Jiangxi, Fujian and Yunnan provinces. All these provinces and municipalities launched pilots mainly in the sectors of petrochemicals and package printing. Beijing, Shanghai, and Shandong Province also carried out pollution charge pilot programs in other key sectors such as car manufacturing, shipbuilding, and furniture manufacturing. In its execution, the pilot program ensured that all revenue goes to local finance and the information regarding pollution charges were disclosed. Shanghai, Hebei Province, Shandong Province, Zhejiang Province and Jiangsu Province released the policies following the principle of “imposing lower charges first, phasing in higher charges later”. See Table 1 below for details.

Table 1: VOCs Pollution Charge Rules

Reduce the discharge fee by half	When the concentration of VOCs emitted by enterprises is over 50% lower than the national or local emission limits.
Double the discharge fee (applicable in any of the situations a, b and c)	a. When the concentration of VOCs emitted by enterprises is higher than the national or local emission limits; b. When the concentration of VOCs emitted by enterprises is higher than the total emissions indicator; c. When the manufacturing process, equipment and products of enterprises fall into the category of those required to be eliminated in the Catalogue for Guiding Industry Restructuring (Amendment).
Triple the discharge fee	When a and b apply simultaneously.

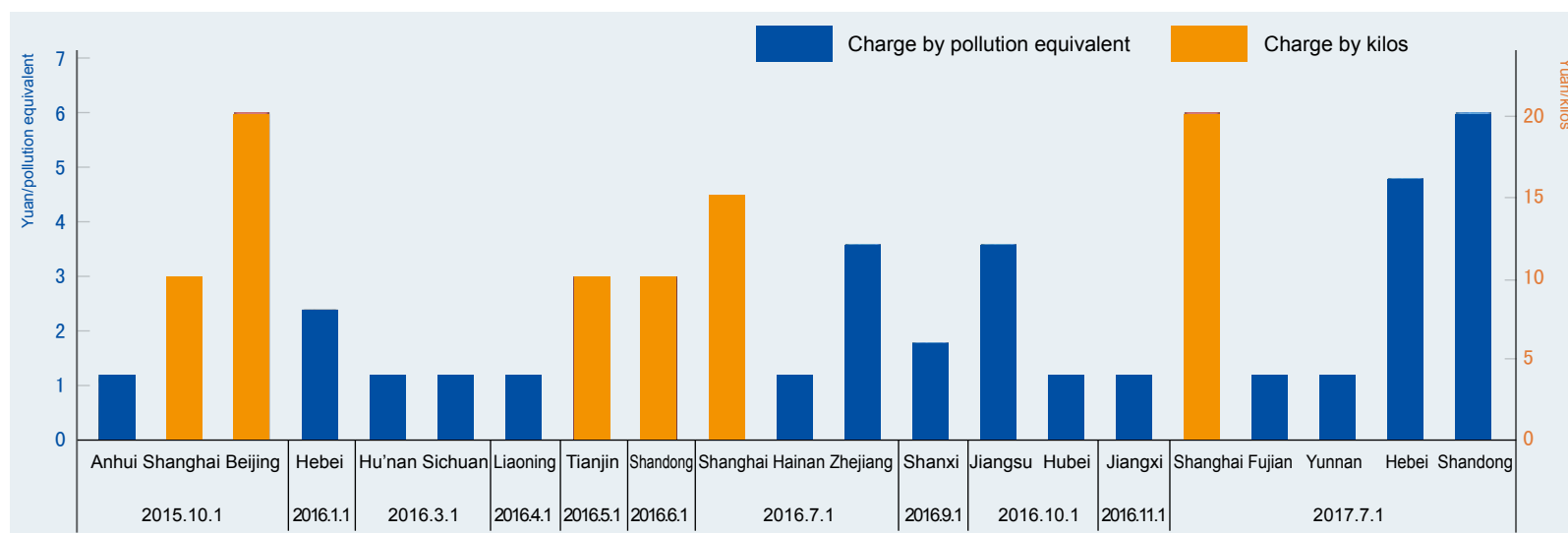


Figure 51: VOCs Pollution Charges Standard in Pilot Provinces

Through the implementation of national policies, the three key regions made the following progress in VOCs emission control in 2016:

In BTH, Beijing cut VOCs emissions by 13,700 tons. Tianjin installed VOCs online monitoring devices for 84 discharge outlets in 19 key enterprises. Hebei Province released the VOCs Emission Control Standards for Industrial Enterprises and implemented VOCs emission control within the specified period in key sectors to meet the standards. Shandong Province completed 1,099 VOCs emission control projects in key sectors.

In YRD, Shanghai completed VOCs emission control for 1,504 industrial enterprises, collected discharge fees of RMB 140 million from over 260 enterprises, and cut VOCs emissions by around 30,000 tons year on year. Jiangsu Province completed 763 VOCs emission control projects in key sectors and issued the Technical Guide on Leak Detection and Repairing. After completing the LDAR pilot program in the petrochemical industry, Jiangsu started applying LDAR technology to major basic chemical sectors with continuous production processes, including the manufacturing of organic chemical materials, synthetic fibers, and synthetic rubber. An "oil-to-water" pilot was also launched in coating sectors including furniture, electronics, exterior walls of buildings, and auto body repair. Zhejiang Province completed VOCs emission control projects targeting 953 enterprises and applied LDAR technology in the petrochemical industry and chemical enterprises with continuous production processes. Anhui Province completed VOCs emission control projects in 216 enterprises.

In PRD, Shunde District of Foshan set up the first VOCs emission trading system in China, attempting to implement an incentive mechanism to encourage VOCs emissions reductions. In March 2016, Shunde auctioned 5 tons of VOCs emission permits through online auctions for the first time (at a base price of RMB 8,000/year/ton). In 2016, Guangdong Province also publicized a list of 855 key enterprises that were under supervision and required to complete control of VOCs emission at a rate of 80%. However, no information on the progress and results of these efforts have been disclosed.

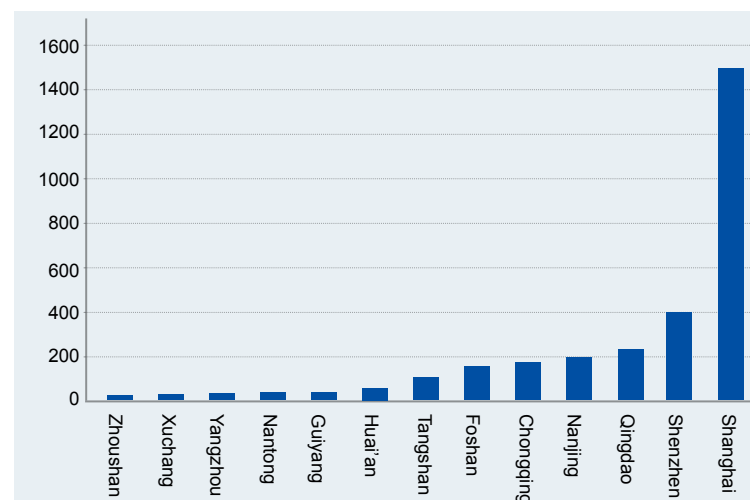
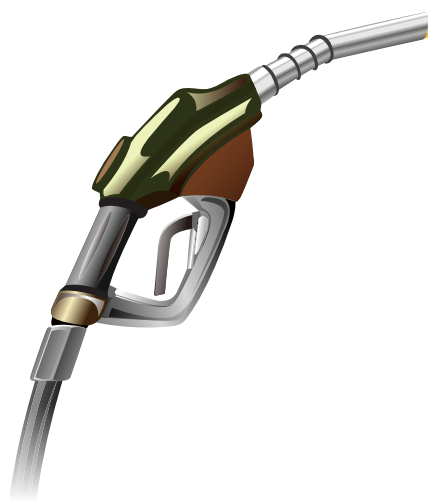


Figure 52: Number of Enterprises that Conducted VOCs Emission Control in Some Cities in 2016



In 2016, more than 100 cities conducted investigations into VOCs emissions sources in key sectors. They focused on major pollution sources and established a VOCs emission inventory in key sectors. Figure 52 shows the number of enterprises that conducted VOCs emissions control.

Since some cities already completed oil vapor recovery in 2015, in 2016 they focused primarily on strengthening the supervision of oil vapor recovery at gas stations, oil storage depots and tank trucks in order to ensure that oil vapory recovery devices were in operation and satisfied recovery and emission standards. The cities also banned the suspension or idling of any of these devices without permission. Additionally, oil vapor recovery was also implemented on newly built, rebuilt or expanded storage depots and gas stations as well as new oil tank trucks. See Table 2 for cities' progress on oil vapor recovery.

City	Gas Stations	Oil-storage depot	Oil-tank Trucks
Huainan	3	1	
Heihe	6	1	
Jixi	11	3	
Tieling	14	3	
Mudanjiang	18		
Huhhot	19		
Panjin	28		
Liaoyang	29	1	
Qitaihe	33	1	
Daqing	41		
Xianning	45	1	
Shuangyashan	51	1	
Yulin	56	1	12
Shizuishan	57		6
Pingliang	58	1	61
Ziyang	63	2	
Haidong	66		22
Jiamusi	79	1	
Fuxin	83	1	16
Kasha Region	90	2	
XilinGol	90	1	
Kashi Region	90	2	
Harbin	97	3	
Jiuquan	100	5	114
Zhuhai	108	5	37
Bayannur	123	2	
Hebi	150	2	
Dandong	161		58
Anshan	190		
Urumqi	191		
Chifeng	222	3	
Qiqihar	253	1	
Pingdingshan	260	1	39
Jinhua	284		57
Zhumadian	335	2	24
Chongqing	300+	16	

Table 2: Progress of Oil Vapor Recovery in Some Cities in 2016

Reducing Emissions from Non-Road Mobile Machinery, and Vessels

Building upon efforts in 2015, control measures for emissions from non-road mobile machinery, such as agricultural and engineering machinery and vessels, continued to advance in 2016. In the same year, the MEP released emission standards for diesel engines of non-road mobile machinery (China III) and marine engines (China I and II). It also put in place a series of regulations to manage the disclosure of environmental information for newly manufactured non-road mobile machinery and designated low-emission zones. Ports also began to impose requirements for vessel emission control zones and onshore power supply was significantly increased. At the same time, regular diesel that complied with China IV standards was supplied in some provinces and cities ahead of schedule. After gaining a greater understanding of pollution conditions on the ground and establishing inventories, all provinces and cities reinforced emissions control for non-road mobile machinery through focusing on updating machinery, fuel quality, maintenance, supervision, regional restrictions, etc.

In 2016, some port cities adopted the following measures to control pollution from ports and vessels:

(1) Vessel Emission Control Zones: After the government put forth a policy to establish vessel emission control zones at the end of 2015, all the core ports in YRD and some core ports in PRD initiated pollution control over vessels. The four core ports

of Shanghai, Ningbo-Zhoushan, Suzhou, and Nantong in YRD (beginning April 1) and Shenzhen Port in PRD (beginning October 1) required ships to use low-sulfur oil (sulfur content $\leq$ 0.5%) while berthing.

(2) Development of Onshore Power Supply: In 2016, Jiangsu Province built 519 new onshore power supply systems, while the Ningbo-Zhoushan Port of Zhejiang Province built and began operating two high-voltage onshore power supply facilities and completed over 100 low-voltage onshore power supply facilities. Meanwhile, Chongqing completed the construction of three onshore power projects and encouraged ships to change their connectors for the use of the onshore power supply systems.

(3) Banning, Eliminating and Converting Outdated Vessels: Jiangsu and Zhejiang provinces banned, eliminated, and converted outdated vessels starting January 1, 2016. The two provinces prohibited single-hull chemical tankers and oil tankers above 600 dwt from entering the main channel of the Yangtze River, Beijing-Hangzhou Canal, and other high-grade waterway networks in YRD to encourage scrapping, eliminating, and upgrading outdated vessels. Moreover, Zhejiang Province banned dry bulk carriers under 200 gross tons from passing through the Beijing-Hangzhou Canal.

(4) Pollution Control at Wharfs: Jiangsu Province comprehensively advanced oil vapor recovery at wharfs, particularly those along the Yangtze River and the Beijing-Hangzhou Canal. Zhanjiang and Shantou of Guangdong Province also improved fugitive dust pollution control at wharfs under 1,000 dwt by using dry fog, spraying and other techniques and at wharfs above 1,000 dwt by using windproof nets and fully enclosed transportation system. The eastern, western and northern regions of Guangdong Province strove to complete fugitive dust control measures at dry bulk wharfs ahead of schedule.

In 2016, the policies that were issued at the national, provincial and city levels for non-road mobile machinery pollution control (vessels excluded) and the progress made on these policies are detailed below:

(1) Disclosure of Environmental Protection Information: A trial operation of the public environmental protection information platform for vehicles and non-road mobile machinery set up by MEP began on September 1, 2016. Enterprises that manufacture and import vehicles and non-road mobile machineries were required to disclose information on their pollution control technologies and emission inspections to the public.

(2) Gradual Regulation of Non-Road Mobile Machinery: In 2016, a total of 4,227 engines for non-road mobile machinery passed environmental protection inspections across the country. All provinces and cities gradually began regulating the machinery. Beijing started registering the labels of construction machinery in the city and recording information on their engines and emission control devices. Shanghai also completed declaring and registering non-road mobile machinery and implemented smoke emission standards for in-use machinery

Table 3: Coverage Area of Vessel Emission Control Areas in YRD

	Sea Area	Inland Waters	Core Ports
Jiangsu	Coastal area of Jiangsu Province to the north of the junction of Jiangsu Province and Shanghai's mainland coastlines, and areas south of the junction of Nantong and Yancheng's mainland coastlines	Navigable inland waters in the administrative jurisdictions of 8 cities (Nanjing, Zhenjiang, Yangzhou, Taizhou, Nantong, Changzhou, Wuxi and Suzhou)	Port areas along the sea or river of the ports of Suzhou and Nantong
Zhejiang	The sea area formed between the junction of Zhejiang Province and Shanghai's mainland coastlines and reef extensions of 12 nautical miles, including the junction of Taizhou and Wenzhou's mainland coastlines and extending beyond 12 nautical miles	Navigable inland waters in the administrative jurisdictions of Hangzhou, Ningbo, Huzhou, Jiaxing, Shaoxing, and Taizhou	Ningbo-Zhoushan Port

beginning on July 1. Jiangsu Province collected basic information on 11 categories of engineering machinery. Shenzhen conducted inspections of exhaust from in-use machinery, completing a total of 10,000 such inspections in 2016, and established a management platform for non-road mobile machinery. In addition to the three key regions, Chongqing, along with Shandong, Henan, Anhui, Qinghai, Gansu, Fujian and Guizhou provinces included measures for pollution and emission control for non-road mobile machinery in their annual action plans, as well as the air pollution prevention and control regulations amended in 2016.

(3) Designation of Low-Emission Zones:

Starting on October 1, 2016, Zhengzhou of Henan Province banned high-pollution non-road mobile machinery from the urban area within the Third Ring Road as well as built-up areas of three development zones. High-pollution non-road mobile machinery refers to non-road mobile machinery below the China I emission standards (i.e. those manufactured before October 1, 2007). In addition, Shanghai, Shenzhen, and Foshan, among other cities, also designated emission control areas and conducted relevant research on low-emission zones.

(4) Upgrading the Quality of Regular Diesel:

China required key cities in the east to supply regular diesel with the same sulfur content as the auto diesel that complies with the China IV standards (sulfur content ≤ 50 mg/kg) beginning January 1, 2016. Shanghai was the first city to supply regular diesel that complies with the China IV standards, beginning April 1.

BTH made the following progress to further regional cooperation in 2016:

(1) **Unification of Planning:** In 2016, the MEP, together with the BTH region, issued the Enhanced Measures for Air Pollution Prevention and Control in Beijing, Tianjin and Hebei Province (2016-2017). The measures require the local governments in the region to create detailed plans to attain air quality targets by 2017, and coordinate to adopt enhanced measures, including cleaning and replacing loose coal in rural areas, eliminating coal-fired boilers, controlling VOCs emissions, and controlling and preventing vehicle pollution.

(2) **Unification of Monitoring and Alerting:** During the winter season at the beginning and end of 2016, northern cities continued to face prolonged and large-scale heavy pollution. At the beginning of the year, the MEP issued a letter co-signed by the China Meteorological Administration that required cities at and above the prefecture level in BTH to take the lead in unifying heavy pollution alerting and grading standards. By the end of the year, the standards were expanded to cover BTH and its surrounding areas. During a period of heavy air pollution across the region on December 2-4, 60 cities in BTH and its surrounding areas initiated uniform alerting and response and for the first time achieved a high level and large scale of regional alerting and emergency responses. Collaboration mechanism of regional alerting and response to heavy pollution days was further improved.

(3) **Unification of Standards:** Beginning in 2016, Beijing, Tianjin and Hebei Province began to supply auto gasoline and diesel complying with China V standards and enforce China V vehicle emission standards. Moreover, they began to develop the Standards for VOC Content Limits on Building Coatings and Adhesives, which would become the first regional standard for BTH.

(4) **Unification of Enforcement:** In December 2016, Beijing and Tianjin launched an enforcement pilot program on excessive vehicle emissions in two cities, which was the first joint enforcement and inspection of its kind conducted. The program aimed to inspect heavy-duty diesel vehicles passing through the borders of the two cities, to gather data on excessive emissions from non-local vehicles, and transmit them to the Air Pollution Control Information Sharing Platform of BTH and its surrounding areas. This would enable environmental protection authorities to conduct door-to-door investigations in their respective areas.

(5) Deepening Coordinated Pollution Control Mechanisms: Beijing spent RMB 502 million to support Baoding and Langfang's efforts towards the elimination of small coal-fired boilers and the management of large coal-fired boilers. In addition, Tianjin provided RMB 400 million in funding and technical assistance to Cangzhou and Tangshan for air pollution control.

(6) Improvements in Information Sharing Mechanisms: An Air Pollution Control Information Sharing Platform for BTH and its surrounding areas was established in 2016. The platform allowed for real-time information sharing on air quality and emissions of key pollution sources in seven provinces (regions and municipalities).

In 2016, YRD held regular inter-agency meetings and became the first in China to enforce the requirements for vessel emission control areas. This ensured high air quality for major events, including the G20 Hangzhou Summit, the 3rd World Internet Conference, and the 9th Global Conference on Health Promotion. However, the progress made in the region has fallen behind the requirements for regional prevention and control outlined in the Law on Prevention and Control of Air Pollution. YRD has been slow to unify standards and pollution prevention and control measures, and conduct coordinated enforcement.

Besides the three key regions, other provinces and cities have established air pollution prevention and control mechanisms with various prefecture-level cities or with surrounding provinces and cities. Coordinated prevention and control mechanisms for metropolitan clusters were successfully put in place in a number of provinces.

Jilin Province assigned air pollution control tasks to Changchun, Jilin and Siping and issued relevant targets. A "6+1" model was adopted to solve the issue of air pollution through collaboration. The model refers to "one overall target and six key measures", involving industrial emission reduction, significant reduction of coal consumption, effective fugitive dust reduction, vehicle emission control, fume control, and crop straw burning mitigation. In addition, the three cities released implementation plans to ensure the completion of these measures.

Shandong Province further reinforced coordinated air pollution prevention and control in the Ji'nan metropolitan cluster by establishing and improving the mechanisms of coordinated regional pollution control, enforcement, and emergency responses. The metropolitan cluster, which includes Ji'nan, Zibo, Taian, Laiwu, Dezhou, Liaocheng and Binzhou, was required to improve regional air quality by roughly 35% by 2017 compared with 2013.

These seven cities conducted two rounds of coordinated enforcement followed up with supervision that dispatched 545 persons, inspected 151 key enterprises, required the rectification of 231 environmental issues, and issued penalties for seven enterprises. Moreover, seven counties and districts of Ji'nan entered into coordinated enforcement agreements on industrial pollution prevention and control with 12 counties and districts of neighboring cities. They cooperated with Zibo and Binzhou to implement multiple rounds of air pollution joint enforcement work and cross-inspections. The cities established an all-round county/district coordination and collaboration mechanism for monitoring, enforcement and pollution control that enabled work across geographical boundaries.

The Xinjiang Uygur Autonomous Region put in place a coordinated prevention and control mechanism for the Urumqi-Changji-Shihezi city cluster. This cluster created a coordinated air pollution prevention and control plan for 2016 and established a coordinated protection mechanism. With uniform leadership and management, the city cluster convened for a major meeting on regional air pollution prevention and control that focused on addressing key air pollution issues.

Jiangxi Province also gradually intensified collaboration on air pollution prevention and control among prefecture-level cities and between cities and surrounding provinces. Nanchang, Jiujiang and Yichun, three prefecture-level cities in the province, experimented with environmental impact assessment consultation, information sharing, and coordinated enforcement. For example, they discussed drafting access requirements for high-pollution industries or key areas within the region as well as information sharing on the key-source automatic monitoring platform and sharing data on vehicle restrictions. In addition, in terms of coordination between cities and surrounding provinces, coordinated regional air pollution prevention and control agreements were signed between Jiujiang and Huanggang of Hubei Province, Pingxiang and Zhuzhou of Hunan Province, and Ganzhou and Longyan of Fujian Province.

In 2016, Zigong, Luzhou, Yibin and Neijiang cities in Sichuan Province strengthened coordinated air pollution prevention and control mechanisms in the southern region of the province. The four cities held meetings on a regular basis, discussed ways to tackle heavy pollution and ban crop straw burning, conducted coordinated enforcement inspections for regional air pollution prevention and control, and coordinated the issuing of alerts on heavy pollution in the region.

The Hefei metropolitan cluster, which includes Hefei, Huainan, Lu'an, Chuzhou and Tongcheng in Anhui Province, signed a special framework agreement on coordinated environmental pollution prevention and control. In the agreement, the five cities advanced measures for coordinated prevention and control of vehicle pollution and established a coordinated monitoring and alerting mechanism.

Furthermore, during the 2016 Silk Road International Exposition, the Guanzhong metropolitan cluster that includes Xi'an, Baoji, Xianyang, Tongchuan, Weinan, and the Yangling Demonstration Zone carried out a series of emission reduction measures targeting coal burning, vehicles, industry and fugitive dust through coordinated prevention and control efforts. During this period, the air quality in Xi'an was good and the city experienced its first attainment day in 2016.

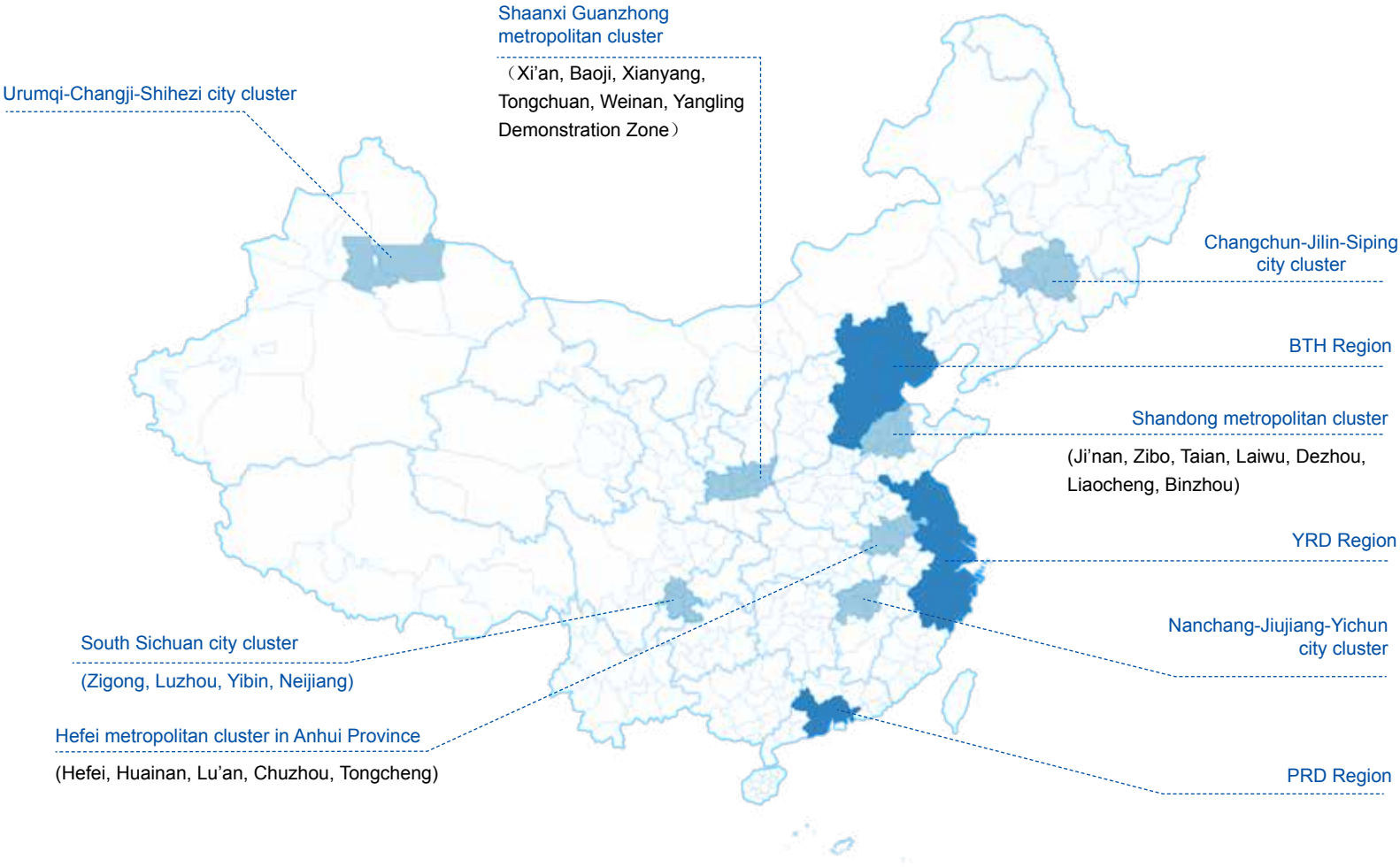


Figure 53: Regional Collaboration on Air Pollution Prevention and Control in 2016

Economic Measures

Discharge Fee

In 2015, Beijing, Tianjin, and Jiangsu Province started levying discharge fees on fugitive dust emissions at construction sites. Starting in 2016, Suzhou and Taizhou of Jiangsu Province, Xinxiang of Henan Province, Jiangmen of Guangdong Province, and Chongqing also began collecting discharge fees on fugitive dust emissions at construction sites, either based on unit area or pollution equivalent values. Financial penalties were used to improve pollution control and emissions reduction. The measures motivated construction entities to control fugitive dust emissions and reduce fugitive dust emissions. After Tianjin implemented a charging system for fugitive dust emissions in 2015, a total of RMB 132 million was collected in 2016.

After initiating Pilots for VOCs Discharge Fees on October 1, 2015, the number of provinces and municipalities with pilot programs increased to 15 in 2016, including Beijing, Tianjin, and Shanghai along with the provinces of Anhui, Hebei, Hunan, Sichuan, Liaoning, Shandong, Zhejiang, Hainan, Shanxi, Jiangsu, Hubei, and Jiangxi. While the petrochemical, packaging and printing industries were

selected as the major pilot industries in these provinces and municipalities, Beijing, Shanghai and Shandong Province expanded their pilot projects to include automobile manufacturing, shipbuilding, furniture manufacturing, and other major industries.

Project Subsidies and Special Funds

In 2016, the central government allocated RMB 11.2 billion to support the implementation of Action Plan in key regions including BTH, YRD and PRD, which represents an increase of 5.66% compared with the amount of funding in 2015. On August 1, the Ministry of Finance and the MEP started implementing the revised Measures for the Management of Special Funds. The special fund for air pollution prevention and control was allocated at the beginning of the Year 1 before the measures implementation. The capital settlement would be conducted in Year 2 based on the reduction of PM annual mean concentration in Year 1. The special fund for Year 2 would be deducted in provinces that fail to reach the Year 1 target, while a fixed amount in financial incentives would be granted to provinces with outstanding performance in air pollution control.

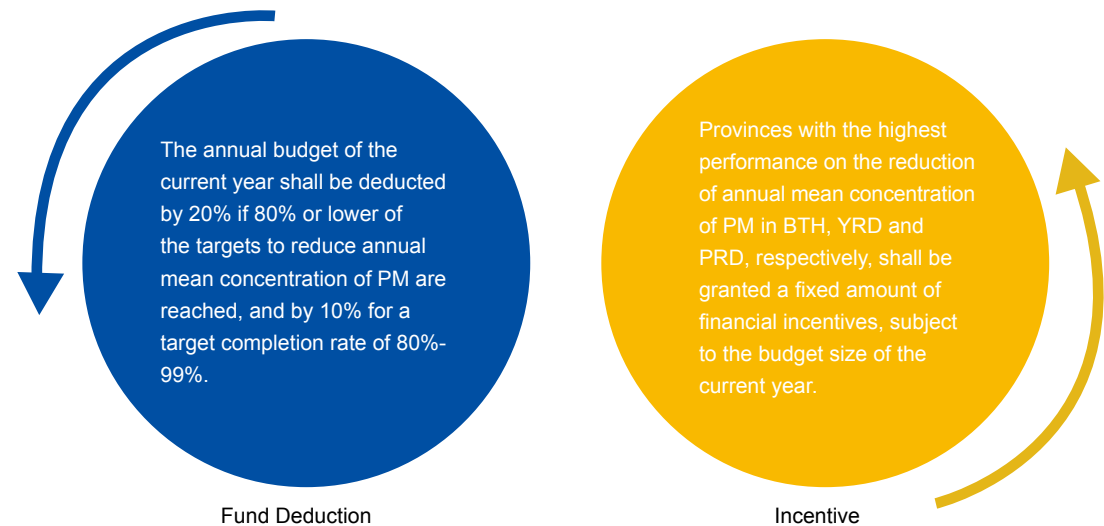


Figure 54: Standard of Deductions and Rewards for Special Fund of Air Pollution Prevention and Control

Special Funds for Air Pollution Prevention and Control Invested by Some Cities in 2016 is shown in the Figure 55.



Figure 55: Special Funds for Air Pollution Prevention and Control Invested by Some Cities in 2016

Environmental Protection Tax Law

On December 25, the Law of the People's Republic of China on Environmental Protection Tax was issued. As of January 1, 2018, the previous "Pollution Discharge Fee" will be replaced by the "Environmental Protection Tax", while the range of tax payers, objects of taxation, and methods of calculation will remain similar. In terms of tax rates, the current level of discharge fees will serve as the lower limit for the environmental protection tax, while the tax rate of air pollutants will range from RMB 1.2 to RMB 12 per pollution equivalent. With the release of this law, taxes will replace fees for environmental protection purposes. However, at present pollutants from mobile sources, including vehicles and non-road mobile machineries, are exempted from the environmental protection tax.

Administrative Measures

Environmental Protection Inspection and Special Inspection

In 2016, central and most provincial governments carried out environmental protection inspection, whereby Communist Party of China (CPC) committees and government agencies were asked to take equal responsibility for environmental protection.

In 2016, the Central Environmental Protection Inspection Team was established to inspect all Party committees, governments, and relevant departments at the provincial and city levels on behalf of the CPC Central Committee and the State Council. The flurry of ensuing activities, including collecting information at meetings, reviewing public reports and other relevant information, on-site spot-checks, one-on-one talks with poorly performing local government officials, and site visits, set off a "storm of accountability".

By the end of 2016, the Central Environmental Protection Inspection Team had completed the inspection on 16 provinces (municipalities and districts). The pilot inspection on Hebei Province was completed in late 2015. Starting in 2016, the team conducted inspection of the other 15 provinces (municipalities, districts) in two groups, with the first covering Inner Mongolia, Heilongjiang Province, Jiangsu Province, Jiangxi Province, Henan Province, Guangxi Province, Yunnan Province, and Ningxia Hui Autonomous Region. The second group included Beijing, Shanghai, Hubei Province, Guangdong Province, Chongqing, Shaanxi Province, and Gansu Province. The team accepted a total of 33,000 public reports, of which 8,500 cases received economic penalties totaling RMB 440 million. They investigated over 800 cases, arrested 720 people, held admonitory talks with 6,307 people, and held 6,454 individuals accountable.

While the inspection team was inspecting the different environmental issues, they considered air pollution to be one of the most important issues of concern. For

Table 4: Information Disclosure of the 2016 Central Environmental Protection Inspection

	Province	Period of Inspection	Date of Release of Inspection Results	Date of Release of Rectification Plan	Release of Implementation Status of Rectification Plan
Pilot Provinces	Hebei	2015. 12. 31—2016. 2. 4	2016. 5. 3	2016. 7. 5	2017. 5. 26
First Group of Provinces under Central Environmental Protection Inspection	Inner Mongolia	2016. 7. 14—8. 14	2016. 11. 12	2017. 4. 27	
	Ningxia	2016. 7. 12—8. 12	2016. 11. 16	2017. 4. 28	
	Jiangxi	2016. 7. 14—8. 14	2016. 11. 17	2017. 4. 27	
	Guangxi	2016. 7. 14—8. 14	2016. 11. 17	2017. 4. 28	
	Jiangsu	2016. 7. 15—8. 15	2016. 11. 15	2017. 4. 28	
	Yunnan	2016. 7. 15—8. 15	2016. 11. 23	2017. 4. 27	
	Henan	2016. 7. 16—8. 16	2016. 11. 15	2017. 4. 27	
	Heilongjiang	2016. 7. 19—8. 19	2016. 11. 15	2017. 4. 30	
Second Group of Provinces under Central Environmental Protection Inspection	Chongqing	2016. 11. 24—12. 24	2017. 4. 12		
	Hubei	2016. 11. 26—12. 26	2017. 4. 14		
	Guangdong	2016. 11. 28—12. 28	2017. 4. 13		
	Shanghai	2016. 11. 28—12. 28	2017. 4. 12		
	Shaanxi	2016. 11. 28—12. 28	2017. 4. 11		
	Beijing	2016. 11. 29—12. 29	2017. 4. 12		
	Gansu	2016. 11. 30—12. 30	2017. 4. 13		

example, public reports showed that, of the environmental protection issues found by the inspection team and transferred to Henan Province Government, issues related to air pollution accounted for 71%. Meanwhile, the Seventh Central Environmental Protection Inspection Team criticized Gansu Province for its passive approach to air pollution control, as it failed to meet the target of air quality improvement in 2014 and 2015. Shaanxi Province was criticized for its poor performance in air pollution control due to the illegal construction of multiple coal-fired chemical and heating projects along with 80 coal-fired boilers of 10t/h or below since 2014 in Guanzhong Region. Moreover, in terms of information disclosure, the team has published the inspection results of supervising 15 provinces (municipalities, districts) on the MEP website. Furthermore, rectification plans for eight provinces (municipalities, districts) inspected by the first group were released. However, information on the actual status of implementation remains limited. During the writing of this report, only Hebei had disclosed information on the enforcement of major measures in the rectification plan, while information on other provinces (municipalities, districts) was still unavailable.

In addition to the central government's efforts to inspect environmental protection, some provinces and municipalities also established their own provincial environmental protection inspection mechanisms in 2016 with the aim to inspecting CPC committees and relevant organizations in cities. The CPC committees and governments of over 20 provinces issued provincial environmental protection inspection plans and carried out environmental protection inspection at the municipal level. Hence, most provinces and municipalities have a two-tiered inspection mechanism at both central government and provincial levels.

Furthermore, the Environmental Protection Departments in Hubei Province, Shanxi Province, Hebei Province, Sichuan Province and Henan Province also initiated special inspection on air pollution prevention and control during winter.

Vertical Management System Reform

In September 2016, the General Office of the State Council released the Guiding Opinions on Pilot Reform of the Vertical Management System of the Monitoring, Inspection and Law Enforcement of Environmental Protection Institutions Below Provincial Level. In November, Hebei Province and Chongqing first piloted reforms of the vertical management system for environmental protection. Provincial environmental protection departments were required to complete setting up eco-environment quality monitoring and environmental inspection mechanisms to define the environmental protection responsibilities of local governments and relevant departments. This also helped to eliminate the impact of local protectionism on environmental law enforcement and advanced coordination of trans-regional environmental management. To

do this, foundational systems, including systems of environmental inspection, monitoring and law enforcement, had to be restructured. This represents a good starting point and an important basis for future reforms in China's wider system of environmental governance.

Centralization of Air Quality Monitoring Authority

In December 2016, the operation authority of 1,436 state-owned air quality monitoring sites across the country was all centralized in the national government. This was completed on schedule and realized national assessment, national monitoring, and third party maintenance. The primary objective of centralization was to effectively keep monitoring data from unwanted administrative interferences by local government, ensuring the objectivity and reliability of the data.

Legislative Measures

Implementation of the New Law on Prevention and Control of Air Pollution

On January 1, 2016, the new Law of the People's Republic of China on Prevention and Control of Air Pollution was implemented. The environmental protection departments and public security departments further enhanced coordinated law enforcement. As a result, over 1,500 people involved in cases related to air pollution laws violation were detained.

Following the implementation of the new law, different provinces and cities started revising their respective air pollution prevention and control regulations. The provinces include Hebei, Jilin, Shandong, Hubei, Anhui, Jiangxi, Fujian, Shandong, and Guizhou. The cities include Shijiazhuang, Hangzhou, Ningbo, Jining, Heze, Shaoxing, and Xi'ning. Other laws and regulations released by the cities include the Air Pollution Prevention and Control Regulations of Guiyang, Measures of Implementing the Air Pollution Prevention and Control Regulations of Jiangsu Province in Wuxi, and Fugitive Dust Emissions Pollution Prevention and Control Regulations of Yancheng.

Moreover, the new law explicitly requires that "the government of city that fails to attain the national standard for air quality shall establish the timeline for attaining national standard". The 13th Five-Year Plan on Eco-Environment Protection also emphasizes that "cities that failed to attain national standards shall confirm a deadline for attainment, disclose such information to the public, establish a schedule, and set up relevant timelines, roadmaps, and key projects."

City Air Quality Attainment Plans

To fulfill the country's requirements for establishing the attainment timeline, the provinces and cities have incorporated the timeline for attaining air quality standards into their policy documents, including the local air pollution prevention and control regulations, the 13th Five-Year Plan on Eco-Environment Protection, and annual action plan for air pollution prevention and control. Meanwhile, the Rules for the Plan of Attaining the Standard of Urban Ambient Air Quality (Trial) has also been put forward for comments.

However, the progress of cities on developing such attainment plans remains slow. As of now, other than Chongqing City, only Guangdong Province has announced the timelines for some its cities to attain national standards. Guangdong Province stipulated all cities (districts) in PRD shall conform to air quality standards by 2020, with Shenzhen striving to reduce $PM_{2.5}$ concentration to $25\mu g/m^3$ and Guangzhou, Foshan, Zhaoqing, Dongguan and Shunde District reducing $PM_{2.5}$ concentrations to $35\mu g/m^3$. Chongqing announced the timelines for different districts and counties to attain standards for $PM_{2.5}$ concentrations. The documents and corresponding provinces and cities are shown in Figure 56.



Figure 56: Provinces and Policies that Required the Development of Attainment Plans

Explanation on Issues Relating to the Applicable Laws for Handling Criminal Cases on Environmental Pollution

In recent years, new situations and problems have emerged with respect to crimes related to environmental pollution, such as challenges in collecting evidence for air pollution violations, disputes over criminal regulations on manipulating or forging automatic monitoring data or sabotaging environmental quality monitoring systems. In the first half of 2016, staff members of the environmental protection departments of Chang'an and Yanliang Districts in Xi'an were found to have interfered with the national air quality monitoring sites by forging monitoring data. This drew public attention to the conviction and sentencing for "sabotaging environmental quality monitoring systems". On November 7 and December 8, the Supreme People's Court and the Supreme People's Procuratorate passed the Explanation on Issues Relating to the Applicable Laws for Handling Criminal Cases on Environmental Pollution, which provides clear explanations on clauses; for example, "heavier punishment shall be imposed for emitting hazardous substances in periods of heavy pollution" and "independent monitoring data from public security agencies can be used as evidence". The document came into force on January 1, 2017. Meanwhile, regarding the much-discussed issue of "forging monitoring data", the document is explicit to define this as "those who compel, command and/or instruct others to modify parameters or monitoring data in violation of the national regulations, and/or sabotage computer information systems". Criminal punishment can be an effective deterrent to the forgery of monitoring data.

Training on Enforcement of Environmental Protection Law

The release of the Environmental Protection Law and the Law on Prevention and Control of Air Pollution has established new requirements for local law enforcement teams. To improve enforcement capacity for these laws, the MEP held nationwide training activities from September to November of 2016. Training teams were set up by the environmental protection departments of different provinces and cities with director generals of these departments or relevant leaders of the environmental inspection organizations heading the teams. At the same time, the authorities strengthened investigations and management of illegal activities such as secret discharge, inappropriate use of pollution prevention and control facilities, and environmental data forgery or manipulation.

Environmental Protection Police

With the enactment of the Environmental Protection Law, China is continuing to increase efforts on pollution control. One important measure is the creation of the environmental protection police, considered to be one of the strongest measures ever employed for air pollution control. As early as 2013, special teams of environmental protection police had already been set up in the provinces of Hebei, Zhejiang, Liaoning, Shandong, Guizhou, and Guangdong (Foshan and Guangzhou). In 2016, Zhongshan and Shantou of Guangdong Province and Shifang of Sichuan Province also set up similar teams. The environmental protection police represent an important effort to enforce the Environmental Protection Law.

Case Study

Case Study on Prevention, Control and Supervision of Vehicle Pollution

Nanjing



I. Background

The number of vehicles in Nanjing has been increasing significantly since the late 1990s. The vehicle population in the city was 305,000 in 2000 and increased to 2,345,000 by 2016. Meanwhile, according to Nanjing's $PM_{2.5}$ source apportionment results in 2015, vehicle pollution became the second largest source of $PM_{2.5}$, composing 24.6% of the total.

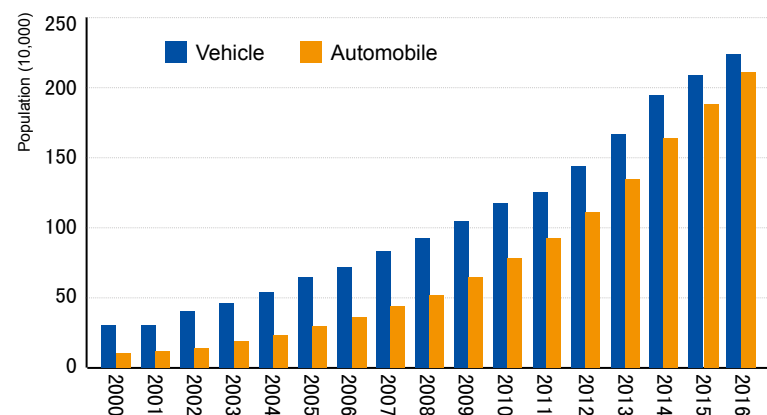


Figure 57: Changes in Motor Vehicle and Automobile Population in Nanjing.

High-pollution vehicles accounted for a large proportion of total pollutant emissions. In 2012, the population of yellow-label vehicles (gasoline vehicles failing to comply with the China I emission standards and diesel vehicles failing to comply with the China III emission standards) was 67,000, representing only 5.7% of total automobiles and 4.3% of all motor vehicles in the city. However, these yellow-label vehicles were responsible for as much as 32.5%, 38.6%, 44.5% and 76.7% of total CO, hydrocarbon, NOX and PM vehicle emissions, respectively.

II. Policy Development

Nanjing has always prioritized the prevention, control and monitoring of vehicle pollution to improve air quality. It has been nearly two decades since the city started vehicle pollution prevention and control efforts in 1998. As one of the first cities to have embarked on these efforts, Nanjing is a leading provincial and national example in many respects.

1. Late 1990s: Initiation

(i) In 1998, the municipal government of Nanjing released the Administrative Measures for Banning the Sale and Use of Leaded Gasoline, fully banning the sale of leaded gasoline two years ahead of schedule. The Measures explicitly tasked the environmental protection departments at all levels to supervise and manage the ban, initiating vehicle pollution prevention and control in the city.

(ii) In 1999, Nanjing set up a leading group for vehicle pollution control that was headed by the deputy mayor responsible for environmental protection. The group involved 16 departments, namely the Publicity Department of the CPC Nanjing Municipal Committee, the Municipal Commission of Development and Reform, the Municipal Environmental Protection Bureau, the Municipal Public Security Bureau, the Municipal Commission of Economy and Information Technology, the Municipal Legal Affairs Office, the Municipal Bureau for Urban Planning, the Municipal Finance Bureau, the Municipal Pricing Bureau, the Municipal Administration for Industry and Commerce, the Nanjing Bureau of Quality and Technical Supervision, the Municipal Bureau of City Administration and Law Enforcement, the Municipal Transportation Bureau, the Municipal Bureau of Commerce, Nanjing Urban Construction Investment Holding (Group), and the Municipal Traffic Management Bureau. This group was tasked with organizing, coordinating and advancing the city's vehicle pollution prevention and control campaign. Moreover, an executive office was set up for the leading group at the Municipal Environmental Protection Bureau, and the director of the leading group served as the office director. Moving forward, other relevant efforts started maturing as vehicle pollution prevention and control was included in the city's environmental protection tasks and targets.

2. 2000 to 2010: Setting the Foundations

(i) In 2005, the Regulation on Air Pollution Prevention and Control in Nanjing came into force, which created 10 specific rules for controlling pollution caused by motor vehicles and vessels. In addition, the regulation included emissions standards and mechanisms for monitoring, spot-checks and environmental inspection of new vehicles. It also provided regulations for the manufacturing, sales, monitoring, spot-checks and inspection of motor vehicles, vessels, motorcycles, engineering machinery and petroleum products. After this, the city's vehicle pollution prevention and control efforts had the backing of the law.

(ii) In 2006, the municipal government of Nanjing issued the Notice on the Work Plan for Implementing the New Emission Standards of the Central Government for In-Use Vehicles and Building a Mode-Method Emission Monitoring System.

Pursuant to the notice, the municipal government was tasked with overall planning and reviewing bids for the construction of monitoring stations by independent third-parties. Meanwhile, the Municipal Environmental Protection Bureau was tasked with conducting remote monitoring and supervising its monitoring center and network supervision system.

(iii) In 2007, the government established the Nanjing Vehicle Emission Regulatory Center. As a fully-funded public institution, the center had a staff of 15 people and was mainly responsible for monitoring vehicle emissions and enforcing relevant administrative laws across the city. This helped to lay the foundation for efficient supervision, law enforcement and motor vehicle management.

(iv) In 2007, the Measures for the Supervision and Management of Pollution by Vehicle Emissions in Nanjing took effect. The measures defined the duties of relevant government departments for vehicle pollution prevention and control, in addition to stipulating basic rules for prevention and control, detection and treatment, and supervision and management. Moreover, the measures laid out foundational tasks, such as prioritized development of public transportation, promotion of low-pollution vehicles and gradual elimination of high-pollution vehicles.

(v) In 2010, the Regulation on the Prevention and Control of Pollution by Vehicle Emissions in Nanjing took effect. It set rules for environmental labels, regular inspection and oil-gas pollution control. For the first time, the regulation also included relevant practices and experience. For example, the regulation included stipulations on categorizing non-local vehicles as new vehicles, banning high-pollution vehicles, application of monitoring and telemetry technologies, and taking away driving licenses when emission standards are exceeded during road checks. This way, city-wide vehicle pollution prevention and control was further supported by law.

3. Since 2011: Comprehensive Efforts

(i) Beginning in 2011, the government of Nanjing has released several documents on air pollution prevention and control for five consecutive years, proposing measures for targeting “vehicles, fuel and roads” simultaneously and specifying roadmap and enforcement plans for city-wide vehicle pollution prevention and control efforts. Specifically, the Action Plan for Air Pollution Prevention and Control issued by the city in 2013 (Action Plan of Nanjing) prioritized the development of green transportation as one of its seven key tasks for controlling air pollution, including constructing public transportation infrastructure, increasing the number of new energy vehicles, making emission standards and fuel quality standards

more stringent for vehicles, regulating pollution from machinery and equipment on construction sites, and eliminating all yellow-label and high-pollution vehicles.

(ii) In March 2011, the municipal government issued the Work Plan for Oil and Gas Pollution Prevention and Control at Oil Storage Depots, Tank Trucks and Gas Stations while the Municipal Environmental Protection Bureau and the Municipal Finance Bureau jointly released the Government Grant and Subsidy Program for Oil and Gas Pollution Control Projects in Nanjing. By the end of the year, all oil and gas pollution control tasks were accomplished and all the oil storage depots, tank trucks and gas stations in the city complied with relevant national standards. Moreover, in 2014, the Municipal Environmental Protection Bureau, along with other five government departments, issued the Administrative Measures for the Supervision of Oil and Gas Pollution by Gas Stations, Oil Storage Depots and Tank Trucks in Nanjing (Trial). The measures enhanced the responsibilities of businesses, increased local supervision and brought in qualified third-parties to inspect oil and gas recovery facilities at gas stations and oil storage depots. In addition, the measures allowed for investigation and penalization of violators according to law. In this way, the city used the measures to enhance a more localized approach to oil and gas pollution control, with relevant government departments leading the work and independent third parties providing technical support.

(iii) In 2013, the municipal government issued the Work Plan for Subsidizing the Elimination of Yellow-Label Vehicles in Nanjing to set up a leading group to eliminate or upgrade of yellow-label vehicles. This group was headed by the mayor and the deputy mayor and comprised of eight government departments in addition to district heads. Moreover, a dedicated general office was also created for the leading group.

(iv) In 2014, the Municipal Human Resources and Social Security Bureau and the Nanjing Administration of Civil Service released the Notice on Managing the Nanjing Vehicle Emission Regulatory Center in Reference to the Civil Servant Law of the PRC. The notice upgraded the nature of regulation from being single-function, manually-based and relying on monitoring to be multi-functional, technology-based and relying on more comprehensive supervision.

(v) In 2015, a police office for vehicle pollution control was established in Nanjing. Here, two key staff members of the Nanjing Traffic Management Bureau were stationed under the leadership of the Municipal Environmental Protection Bureau. In 2016, the Nanjing Municipal Public Security Bureau issued the Notice on Reinforcing the On-Site Investigation of Yellow-Label, No-Label and High-pollution Vehicles and the Notice on the Working Rules for Joint Law Enforcement and

On-Site Investigation in Vehicle Exhaust Pollution Road Checks. These notices specified operational requirements for the Municipal Traffic Management Bureau and the Municipal Environmental Protection Bureau in their joint investigation into environment-related violations by vehicles and led to more consistent and standardized law enforcement in the city.

(vi) Since 2015, the Municipal Environmental Protection Bureau and the Municipal Traffic Management Bureau have been releasing documents on the regular inspection and maintenance system (I/M system) for vehicle emission pollution in the city for comprehensive implementation of the system.

III. Key Policy Measures and Regulatory Methods

1. Strict Implementation of Emission Standards for New Vehicles

To control pollution caused by vehicle emissions, Nanjing has released stringent emission standards for new vehicles since 2000. In addition, Nanjing has also been categorizing non-local second-hand vehicles as new vehicles, which helped Nanjing to become a role model among peer cities that work to control vehicle pollution from the source. When increasing vehicle pollutant emission

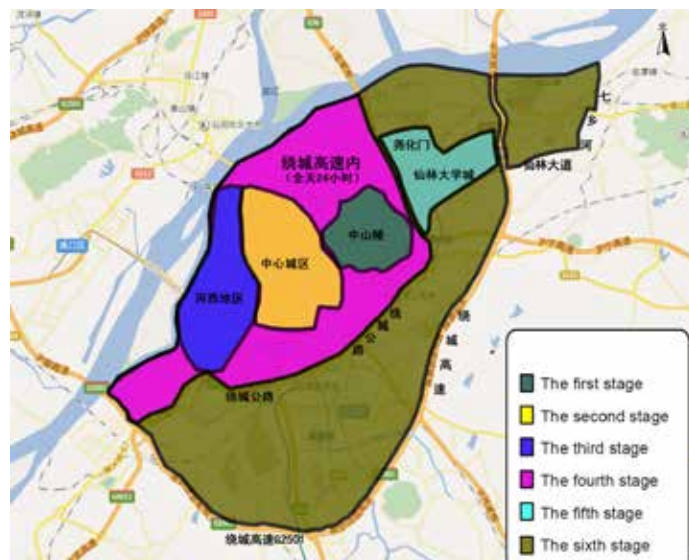


Figure 58: Diagram of Districts Where High-pollution Vehicles Were Banned in Nanjing from 1st to 6th Stage

standards from Phase I to Phase V, Nanjing enforced relevant standards in advance each time, which alleviated the city's air pollution and led to evident environmental benefits.

2. Ban on High-pollution Vehicles

The vehicle ban was implemented by districts through a phased approach. In 2010, the city instated a ban on yellow-label vehicles and quickly advanced from the first stage to the third stage within one year, also expanding the regulated area from the Sun Yat-sen Mausoleum Scenic Spot to cover Hexi New Town and all the major urban districts. On July 10, 2014, the ban was advanced to the sixth stage as the city was hosting the 2nd Summer Youth Olympic Games. The scope of the ban was broadened to cover all the urban areas within the Nanjing Belt Expressway and most of its suburban counties totaling 555 square kilometers, while the timeframe for the ban extended from just 7 am to 10 pm to all 24 hours in a day. Moreover, the ban entered the seventh stage beginning March 1, 2016, with yellow-label vehicles banned from all the administrative districts of Nanjing, making it the first city in Jiangsu Province to implement the ban city-wide.

3. Special Program to Regulate Diesel Vehicles

Urban residents are most effected by diesel vehicles that emit black smoke. To address the issue, the city first targeted buses and used a number of measures, including targeted control measures with a deadline, installing OBD online monitoring devices on buses of certain routes, and replacing diesel vehicles with gas or electric vehicles, generating positive impacts. Afterwards, the campaign was expanded to include all diesel vehicles, thereby creating a complete system that integrated enforcement and control and covered both new and in-use vehicles. Moreover, in 2014, Nanjing began checking diesel vehicles before they are registered. During spot-checks on the road, diesel vehicles emitting black smoke became a key target for law enforcement. Furthermore, major parking lots for diesel vehicles, such as buses, passenger cars, freight cars, and slag trucks were spot-checked on a regular basis. Rewards were also offered to citizens that reported vehicles emitting black smoke. At this time, the municipal government also opened a QQ account, called "Eliminating Black Smoke", and created a mobile application to efficiently manage complaints and reports. The city also began using a video monitoring system to detect smoke-emitting vehicles. Inspection institutions conducted on-site supervision to prevent any fraudulent monitoring results for black smoke-emitting vehicles. To reduce NOx emissions, the city also created a urea supply system and conducted spot-checks for the use of urea by diesel vehicles that employed SCR control technology.

4. Eliminating Outdated Vehicles

On March 1, 2000, Nanjing enforced the China I emission standards for type-1 light-duty gasoline vehicles, four months in advance of the deadline set by the central government. The registration data of new vehicles during the same period shows that these early enforcement efforts of the standards allowed the city to eliminate more than 10,000 yellow-label gasoline vehicles. While strictly enforcing the vehicle emission standards required by the central government, the city also subjected non-local second-hand vehicles to the same registration standards set for new vehicles, which kept more than 30,000 yellow-label vehicles off the road. By strictly implementing national emission standards ahead of schedule, Nanjing effectively controlled the growth and total number of yellow-label vehicles and eliminated more than 40,000 yellow-label vehicles before 2013.

In 2013, a new spate of efforts to eliminate yellow-label vehicles was launched. In line with the idea of “combining the use of sticks and carrots”, the efforts were based on the principles of solving easier problems before difficult problems, tailoring policies based on the conditions of different vehicle types, using both vertically- and horizontally-based approaches, and effectively consolidating efforts. To overcome various challenges in eliminating yellow-label vehicles, the city employed administrative, economic, technical, and media-based strategies. All the districts and government departments adopted a variety of measures, such as scrapping yellow-label vehicles, granting subsidies and rewards, upgrading vehicles, limiting vehicle administration services offered to yellow-label vehicles, and imposing vehicle bans. The measures achieved

Table 5: Rewards for Automobiles based on Price Tier

Vehicle price	≤100,000 RMB	100,000-150,000 RMB	150,000-200,000 RMB	200,000-300,000 RMB	>300,000 RMB
Rewards	1000–5000	2000–6000	2000–8000	2000–15000	2000–100000

Table 6: Enterprise Rewards for Trucks based on Price Tier

Vehicle price	≤100,000 RMB	100,000-150,000 RMB	150,000-200,000 RMB	>200,000 RMB
Rewards	1000–5000	3000–10000	3500–15000	4000–16000

noticeable successes. The city also implemented a “4-in-1” subsidy and reward policy, which included provincial and municipal subsidies, financial incentives for disassembly and incentives from vehicle sellers in the form of car purchase rebates for yellow-label car owners who bought new cars.

The pilot program for diesel vehicle control launched in the city by the Ministry of Environmental Protection allowed some yellow-label diesel vehicles that complied with the China II emission standards, were in a relatively good condition, had low mileage, and had higher value to be equipped with an end-of-pipe control device so that their PM emissions could comply with the China III emission standards or above. A green environmental protection label was also issued to such vehicles. To date, 2,823 special yellow-label vehicles in the city have turned “green.”

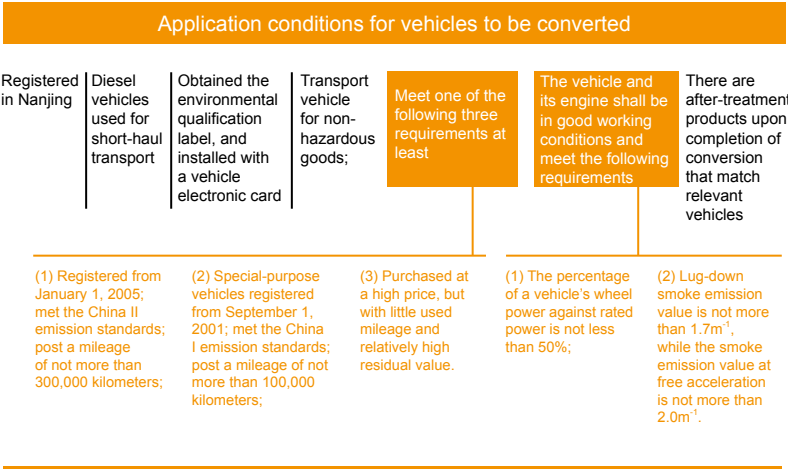


Figure 59: Green-Label Application Requirements for Yellow-Label Diesel Vehicles

5. Upgrading Fuel Quality

The gas stations of Sinopec and PetroChina began supplying gasoline that complies with the China III quality standards in Nanjing in December 2009 and February 2010, respectively. Starting in April 1, 2012, the city began to supply gasoline that meets the China IV standards. In March 2012, the city began supplying automobile diesel fuel that meets the China III emission standards. In December 30, 2012, the city began using this higher quality diesel fuel on a large scale. On November 1, 2013, Nanjing upgraded the emission standards for automobile gasoline to the China V emission standards. Beginning in April 2014, the city began supplying automobile diesel fuel that met the China V

emission standards. At this point, Nanjing became the fourth city, after Beijing, Shanghai and Guangzhou, to enforce the China V emission standards for both gasoline and diesel vehicles.

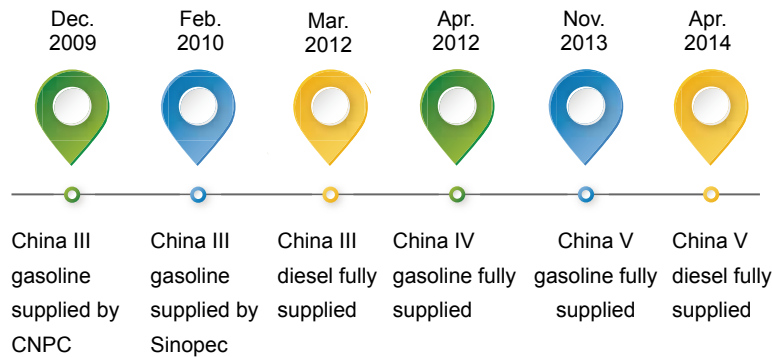


Figure 60: Timeline for Upgrading Fuel Quality in Nanjing

6. Establishing an Inspection and Maintenance (I/M) System for In-Use Vehicles

In 2007, due to a rise in demand for inspections due to the increasing vehicle population in the city, Nanjing set up five privately-run environmental inspection institutions in the eastern, western, southern and northern areas of its main urban centers and in the Jiangbei area. Thus far, there have been 48 vehicle environmental inspection stations set up in Nanjing. Following the creation of the I/M system in 2016, vehicles that failed to meet relevant emissions standards are required to go through closed-loop control. Moreover, the Municipal Environmental Protection Bureau and environmental inspection stations, the Traffic Management Bureau and maintenance enterprises, and the Municipal Environmental Protection Bureau and the Municipal Traffic Management Bureau have all achieved a point-to-point network. If a vehicle fails to meet emission standards in the annual exhaust inspection, the environmental inspection station will inform its owner to fix the problem at a maintenance provider that is rated above Type-II grade. After the problem is fixed, the owner must return to the environmental inspection station for re-inspection and obtain the Certificate of Conformity after Maintenance that is then issued online.

So far, 136 maintenance providers rated above Type-II grade in the city have been successfully connected with the internet-based management system. To be connected, a provider must have inspection data and maintenance and settlement statements uploaded and have video monitoring of the maintenance process. Hence, all vehicles still under violation are put through closed-loop control. Moreover, the Municipal Environmental Protection Bureau and the

Municipal Traffic Management Bureau regularly enforce laws at maintenance providers and environmental inspection institutions. They have penalized seven misconducts, including the issuance of false certificates, issuance of settlement statements in violation of relevant regulations, and fraudulent declaration of parts and materials fees.

7. Oil-Gas Recovery

Launched in 2011, the oil and gas pollution control program were led by the Municipal Environmental Protection Bureau and had participation from many other departments. The program adopted a two-level (municipal and district) coordination mechanism and created a “green channel” for approval of oil and gas improvement actions. During the pollution control process, the city increased supervision of companies and those with slow progress were called in for meetings. Moreover, the city encouraged companies to expedite the pollution control process by implementing the policy of “granting rewards in place of subsidies.” This means that enterprises under compliance are rewarded and those that do not comply are penalized.

Furthermore, six oil storage depots, 279 gas stations, and 182 tank trucks in the city that needed to be retrofitted completed their upgrades with 100% success rate. Simultaneously, managing departments increased checks to see if companies completed retrofits and investigated and penalized five cases of misconduct in the use of oil and gas recovery facilities (four concerning gas stations and one concerning an oil storage depot).

8. Information Management

Nanjing adopted information database management as a fundamental strategy to supervise and manage vehicle emissions. This strategy aided the city in overcoming challenges from the extensive scope, large quantity, and the fact that vehicles had high mobility and hence were difficult to monitor. Thereby, various management measures were interconnected through an information database that helped improve supervision of pollution and enhance regulatory efficiency. Moreover, the city has put in place regulatory system with a vehicle information database that features extended applications, such as a high-pollution vehicle ban management platform, video monitoring and teleconferencing system, continuous monitoring system on oil and gas pollution, electronic card processing system for environmental inspection verification, diesel vehicle OBD real-time monitoring and management system, operating room monitoring system for environmental inspection stations, and electronic law enforcement platform for coordinated prevention and control efforts.

The managing departments have used these systems to accomplish real-time regulation of 46 environmental inspection stations, more than 10 environmental inspection windows, and nine telemetering and black-smoke snapshot points. They have ensured that more than 3,000 vehicles are licensed, inspected, and labeled each day, and they have penalized a total 1.4 million yellow- and no-label vehicles. In addition, using Internet-of-Things (IoT) technology, the city has developed an electronic card embedded with an electronic chip that can store information about a vehicle's license plate, type, exhaust detection results, and terms of validity for detection. The card is also assigned a unique identification code for encrypted protection of vehicle information. Using these electronic cards has made identifying moving vehicles and offsite law enforcement more accurate. These departments have effectively implemented measures banning high-pollution vehicles in certain areas while also eliminating yellow-label vehicles.

According to the Plan of Nanjing for Stationary Vehicle Exhaust Remote Sensing Systems, the city began building telemetering devices for vehicles in 2010. Thus far, Nanjing has set up an exhaust telemetering system with nine telemetering devices, including one mobile exhaust telemetering device, five stationary multilane exhaust telemetering devices, and three stationary smoke telemetering devices. These telemetering devices can screen for high-pollution vehicles easily and efficiently. Since being installed, the telemetering system has monitored 6,475,000 vehicles, of which 304,000 have exceeded relevant emission standards.

9. Strengthening Law Enforcement

The city has continued to improve enforcement by conducting regular and special road checks. First, the city has standardized road checks by setting up police control locations, routine road checks conducted three days per week, and select checkpoints located within the city. Second, the city has launched special measures for specific law-enforcement inspections targeting certain in-use vehicles, including engineering vehicles, long-haul passenger vehicles, supermarket shuttle buses, logistics vehicles and green-label vehicles that were converted from being yellow-label vehicles. The city has also initiated special pollution control measures in key districts, including a comprehensive environmental campaign in Meishan sub-district, law-enforcement measures in an area near the Second Nanjing Yangtze River Bridge, and inspections at intelligent vehicle monitoring and recording systems on highways leading to the city. Third, the city has improved law enforcement. It has investigated 24 cases since 2014 based on the air pollution prevention and control law and relevant municipal and provincial regulations. The cases include non-compliant vehicle environmental inspection institutions, prohibitive use of exhaust end-of-pipe control devices by vehicles, and oil storage depots and gas stations that fail to

use oil and gas emission recovery devices. Meanwhile, the tasks of Nanjing's vehicle pollution control police force have also intensified, from road checks to checks on new vehicles in 4S stores, oil and gas recovery at gas stations, and non-road machinery.

10. Optimizing Urban Transportation and Encouraging Green Travel

With a rapid growth in Nanjing's traffic, the number of daily trips made by the permanent residents in the main urban areas total more than 10 million. As a result, the city encourages and advocates for public transportation. Rail transit development has been accelerated and bike sharing services were launched to solve the problem of the "last mile connectivity" and creating an easy to use green transportation system.

At the same time, the major arterials in the city has matured into a network of roads and expanded the area of the city. The expressway network of grid-like roads and three ring-roads and an arterial network consisting of six horizontal and ten vertical roads are almost completed. Moreover, the river-crossing channels of six roads are also open for use. In total, the city has created a diversified public transportation network system composed of rail transit and road-based transport. Six rail lines are now in operation, with a total length of 225 kilometers. This is the fourth longest rail line in China.

Nanjing has rapidly forged ahead with the development of an efficient public transportation metropolis and increased number of people serviced, as a system of bus lanes is rapidly developing, the buses are being updated and expanded in terms of capacity, and the number of new energy vehicles continuing to increase. In 2012, Nanjing was honored as one of the first cities nationwide undertaking demonstration projects to build a "public transit metropolis." In 2015, Nanjing won the C40 Cities Awards in the category of transportation.

Currently in Nanjing, there are 1,371 bicycle sharing stations, around 40,000 public bikes, about 400,000 public transit cards issued, and number of public bike trips per day reaching 160,000. The number of public bicycles will reach 70,000 by the end of the year. Bike sharing in the city has been rapidly growing in 2017 and it has provided residents with a convenient and green transit option.

Table 7: Key Traffic Data between 2015 and 2007

Year	2007	2015
Permanent Population of Nanjing	7,413,000	8,236,000
Municipal GDP	RMB 328.37 billion	RMB 972.08 billion
Number of Trips by Residents in Main Urban Areas	6,600,000 person/times	10,220,000 person/times (2014)
Length of Roads	4,522.8 kilometers	7,424.2 kilometers (2014)
Length of Rail Lines	22 kilometers	225 kilometers
Length of Bus Lanes	51.1 kilometers	292.8 kilometers
Number of Public Transportation Vehicles in Operation	5,312	9,613
Proportion of Public Transportation (Gas and Electric Buses + Rail Transit) in Main Urban Areas	21.5%	27.1 (2014)

Source: Statistical Communiqué of Nanjing on the 2015 National Economic and Social Development, Annual Report of Nanjing on Transportation Development

IV. Participating Departments and their Responsibilities

Vehicle pollution prevention and control is a difficult endeavor involving a wide range of issues and areas. There are millions of pollution sources and vehicles, they are widely dispersed in terms of location and type, which makes real-time monitoring, enforcement and investigation challenging. Pollution prevention and control must be done through the entire lifecycle of vehicles from manufacturing and sales to use, maintenance, inspection, scrapping, and registration location changes. It involves a number of stakeholders and issues, such as people's livelihood, regulation, and technology. Therefore, it is important to coordinate efforts and advance vehicle pollution prevention and control with a three-pronged “vehicle, fuel and roads” strategy which requires centralized leadership of the municipal government, collaboration of multiple departments and enforcement by specific institutions. Administrative, legal, economic, technological, and other means must be adopted to overcome all the challenges and alleviate pollution.

Nanjing has set up a vehicle pollution control leading group that heads the city's efforts in this area. Collaboration and coordination, routine meetings, and cross-pollination of personnel have all contributed to more effective efforts.

- ◆ **Nanjing Vehicle Pollution Control Leading Group:** This group is responsible for leading relevant departments in following and implementing the laws, regulations, standards, and policies for vehicle exhaust pollution prevention and control. It also drafts, revises, and evaluates regional vehicle environmental protection laws, regulations and standards. They are also responsible for coordinating and advancing efforts of other relevant departments to complete the tasks and objectives of vehicle pollution prevention and control. Finally, they also assess the performance of these departments.
- ◆ **Municipal Environmental Protection Bureau:** They are responsible for setting up the “Joint Station for Yellow-Label Vehicle Elimination Rewards and Subsidies in Nanjing” with the Municipal Public Security Bureau, Finance Bureau and Commerce Bureau and also perform day-to-day management duties. They are also responsible for setting up an information system for yellow-label vehicle elimination updates and management, identifying yellow-label vehicles, coordinating incentives offered by relevant businesses, collecting and analyzing data on the elimination of yellow-label vehicles, converting yellow-label diesel vehicles into green-label ones, and conducting vehicle emission inspections. In addition, they cooperate with the Municipal Public Security Bureau for advancing the ban on high-pollution vehicles and deregistering vehicles that must be scrapped. Moreover, they lead and organize work on oil and gas pollution control, environmental inspection and supervision of oil and gas pollution control,

and review whether or not new vehicles and transferred non-local vehicles conform to certain standards. At the same time, they are responsible for offering technical guidance to maintenance providers on vehicles that have emissions exceeding relevant standards; supervising business practices of vehicle environmental inspection institutions; investigating and penalizing violations by such environmental inspection institutions; designating areas where high-pollution vehicles are banned; and improving integrated capacity building for vehicle emission monitoring.

- ◆ **Municipal Commission of Development and Reform:** They are responsible for approving oil storage depots and gas station construction projects and promoting the use of clean energy. They are also responsible for enhancing the quality of vehicle fuels, setting up natural gas filling stations, developing charging stations, and increasing the use of electric cars.
- ◆ **Municipal Public Security Bureau:** They are responsible for conducting road traffic safety management of tank trucks and cooperating with the Municipal Environmental Protection Bureau to manage the approval of vehicle registration and verifying if vehicles conform to standards. They also create the electronic law enforcement and penalty system in areas where a vehicle ban is enforced and are responsible for the elimination of high-pollution vehicles, including yellow-label vehicles. Moreover, they are responsible for reviewing the validity of Vehicle Deregistration Certificates and identifying and deregistering vehicles that must be scrapped. Furthermore, they have the responsibility of defining the ownership city of eliminated yellow-label vehicles, advancing the ban on high-pollution vehicles, conducting strict vehicle safety inspections, and cooperating with the Municipal Transportation Bureau to manage the permits issued to in-use yellow-label vehicles.
- ◆ **Municipal Bureau of Quality and Technical Supervision:** They are responsible for the measurement and supervision of refueling equipment.
- ◆ **Municipal Fire Department:** They are responsible for fire control inspections for oil and gas pollution control projects.
- ◆ **Nanjing Administration of Work Safety:** They are responsible for safety supervision of oil and gas pollution control projects (excluding tank trucks).
- ◆ **Municipal Bureau of Transportation:** They are responsible for strictly reviewing the qualification of operating yellow-label vehicles towards

elimination or upgrade. They also cooperate with the Public Security Bureau to deregister vehicles that must be scrapped and conduct comprehensive performance inspections on in-use vehicles and improve the levels of vehicle maintenance. Moreover, they are responsible for reviewing and certifying tank truck operators and tank trucks, designing the standards for I/M stations in Nanjing, reviewing and certifying the I/M stations, and make sure branding and public release information is consistent. Furthermore, they shoulder the responsibility of creating technical regulations and operating procedures for vehicle emission inspection and maintenance and data transmission and information sharing. They are also responsible for ensuring job qualifications of employees at I/M stations are met and day-to-day supervision of employees, investigating and penalizing any violations or infractions at I/M stations. They are also responsible for developing the green transportation system; increasing the use of new energy vehicles; accelerating the development of rail transit; setting up green bus lanes and fleets, and creating a bicycle-sharing system.

- ◆ **Municipal Bureau of Commerce:** They are responsible for validating Scrapped Automobile Recycling Certificates; supervising check-ups on the disassembly and recycling of scrapped vehicles; regulating vehicle scrappage processes and guiding enterprises working in scrappage and disassembly to improve service functions. They also encourage enterprises disassembling vehicles to transfer the compensation and financial rewards for recycling to vehicle owners. Moreover, they review the qualification of retailers selling refined oil products and inspect gas stations annually.
- ◆ **Municipal Bureau of Finance:** They are responsible for ensuring the allocation of financial rewards, subsidies and funding for regulation of oil and gas pollution control. They also provide funding and subsidies to eliminate yellow-label vehicles and other high-pollution vehicles. Moreover, they identify vehicles owned by administrative institutions, and allocate subsidies to vehicle owners based on government subsidy standards for eliminating high-pollution vehicles, including yellow-label vehicles within stipulated working days.
- ◆ **Government Offices Administration of Nanjing:** They are responsible for eliminating yellow-label vehicles that belong to government offices, approving the upgrading of yellow-label vehicles in administrative institutions according to the outfitting standards and the number of official vehicles stipulated in the Administrative Measures for the Equipment and Use of Official Vehicles by Party and Government Offices and Public

Institutions. They are also responsible for the approval of upgrading yellow-label vehicles owned by administrative institutions.

- ◆ **Municipal Audit Bureau:** They are responsible for overseeing the use of government subsidies.
- ◆ **Municipal Bureau of City Administration and Law Enforcement:** This organization is responsible for administering special pollution control programs that target sanitation trucks, engineering vehicles for public works, freight vehicles, and eliminating black smoke-emitting vehicles.
- ◆ **District Governments:** They are responsible for tasks related to yellow-label vehicle elimination in their respective administrative districts. They also encourage owners of such vehicles to cooperate and provide oversight on the process of vehicle elimination. Moreover, they are responsible for supervising and managing oil and gas recovery and pollution control in their respective administrative districts and conducting routine road checks.

V. Policy Effects

After years of efforts, Nanjing's regulatory measures have led to positive results in terms of raising the emission standards of new vehicles and eliminating high-pollution vehicles. The positive effects of these various strategies are gradually becoming clear.

Minimizing pollution levels: Both gasoline and diesel vehicles in Nanjing were in compliance with national emission standards ahead of schedule. The city has also tightened standards for vehicle emissions. As a result, the city has optimized pollution control despite not deploying in vehicle population control.

Reducing Overall Pollution: According to annual inspection results for 2008-2016, emissions of NOx, HC and CO per vehicle has decreased by 98%, 41% and 47%, respectively. Both the vehicle inspection rate and the rate of vehicles adhering to standards has increased. Vehicle inspection rates has reached 88%, up by 8 percentage points compared to 2008. Moreover, vehicles that have complied with standards at the first inspection and vehicles that have overall adhered to standards have reached 94% and 99%, respectively. These results indicate a decline in vehicle pollution.

Eliminating Outdated Vehicles: Between 2013 and 2016, 66,000 yellow-label vehicles were eliminated, while the total pollutant emissions from

vehicles dropped by 30.3%, of which emissions of CO, HC, NOx and PM decreased by 46,200 tons, 6,400 tons, 13,500 tons and 1,440 tons, respectively. The number of outdated vehicles in Nanjing's major urban areas also decreased significantly and the number of high-pollution and high-pollution vehicles on the roads in the city dropped from 10% to 0.2%.

Increasing Fuel Quality: The quality of gasoline and diesel was upgraded to comply with the China V standards. In 2016 alone, the consumption of gasoline and diesel in the city reached 1.53 million tons and 2.29 million tons, respectively, but the upgrade in emission standards led to a reduction of SO₂ emissions by 1,300 tons.

Converting Vehicles to Meet Higher Emission Standards: Since December 2013, a total of 2,823 diesel vehicles have been converted and upgraded. These vehicles went from complying with China II emission standards to China III emission standards, which meant an annual reduction of PM emissions by around 100 tons.

VI. Experience

1. Establishing Local Regulations

Legislation and enforcement of this legislation forms the foundation for regulating and enforcing environmental protection. The city has continuously strengthened environmental protection legislation on vehicles, thereby enacting three regulations: Regulation of Nanjing on Air Pollution Prevention and Control in 2007, Administrative Measures for Vehicle Emission Pollution Prevention and Control in 2007 (as an order of the mayor), and Regulation of Nanjing on Vehicle Emission Pollution Prevention and Control in 2010 by the Nanjing Municipal People's Congress. In the preparation and revision of these measures and regulations, Nanjing was cognizant of the realities of implementing these laws and thoroughly assessed how to effectively enforce the relevant laws. The city even implemented a number of innovative policies, and stipulated such policies in local laws and regulations. These include adding management of electronic environmental cards to the assessment of environmental actions, eliminating high-pollution vehicles, and controlling oil and gas pollution from corporate vehicles. These legislations have clarified policy objectives and responsibilities and increased the feasibility of enforcement.

2. Controlling Vehicle Exhaust Pollution at Source

The city aimed to increase the number of energy efficient, environmentally-friendly, and new energy vehicles and vessels through fiscal and taxation measures and government procurement. They accomplished this while also restricting the number of inefficient or high-pollution vehicles and vessels and reducing the use of fossil fuels. The key was to strengthen vehicle pollution control at the source for effective pollution control. Measures also include upgrading the vehicle fuel quality, raising vehicle emission standards, monitoring the installation of pollution control devices for new vehicles, defining non-local vehicles transferred into Nanjing as new vehicles, eliminating yellow-label vehicles, and increasing green transportation.

3. Establishing Cross-Department Collaboration Mechanisms

Vehicle pollution prevention and control must involve coordination among various departments for different aspects. Over the years, Nanjing has created a cohesive coordination and collaboration mechanism for pollution control that is vital for achieving positive results. In conducting inspections to ensure vehicles are conforming to standards, checking vehicles on roads, and enforcing bans on high-pollution vehicles in certain areas, the Municipal Environmental Protection Bureau and the Municipal Traffic Management Bureau have opened servicing windows for each other and they have been dispatching enforcement personnel together since 2008 to improve enforcement. Moreover, nine municipal departments, including the Municipal Environmental Protection Bureau, Municipal Bureau of Commerce, and the Bureau of Quality and Technical Supervision led improvement programs throughout the province in 2011 and completed all their pollution control tasks in 2012.

To increase the supply of clean fuel, the Municipal Environmental Protection Bureau collaborated with the Bureau for Pricing and the Bureau of Commerce to make Nanjing one of the first cities in the country to supply gasoline and diesel that conforms to China V standards. In eliminating yellow-label vehicles, the Municipal Public Security Bureau and the Municipal Environmental Protection Bureau allocated special personnel to centralize efforts. The Finance, Commerce, Public Security, and Environmental Protection Bureaus have also opened a one-stop office to apply for and claim financial rewards and subsidies to make the process more convenient for vehicle owners.

4. Developing Internet-Based Regulatory System

The Municipal Environmental Protection Bureau's biggest challenge is being understaffed. How a team of 20 people can properly manage 2.3 million vehicles remains a conundrum. The city is using Internet-based information technology to make managing these vehicles more efficient. By developing and building an automated, intelligent and internet-based vehicle management system, the problems from being understaffed has been alleviated. This technology has also improved regulation and enforcement of both normal traffic and heavy traffic conditions. This innovation in management techniques have not only made environmental management more intelligent but will also make management in the future more effective.

5. Creating a Green Transportation System

Due to the continued and rapid increase in the sheer number of vehicles, Nanjing must also build a public transportation system to shift trips by car to trips by public transit. Nanjing improved public transportation, and eased transferring between different transit lines, making the system more appealing overall. For transfers, Nanjing advanced the interconnection between walking, biking, and buses, built "park and ride" parking lots ("park and ride" parking lots allow drivers that live far away from urban centers to park their cars and take public transit into the city), increased the convenience of transferring between cars and buses, having improved the experience of transportation by making public transit the best option.

Nanjing decreased the use of cars through optimizing parking fees, used technology to allow transit users to link public transit use data with other personal data, provided bonus to green travel or other rewards and penalty-based systems, encouraging residents to increase use of public transportation.

Finally, Nanjing increased the number of new energy vehicles. This was done by incentive-based policies, such as building supporting facilities for new energy vehicles or offering other types of financial assistance. Also, Nanjing increased the supply of new energy vehicles, including gas, electric, and hybrid vehicles for public transportation vehicles, rental vehicles, environmental sanitation vehicles, and vehicles for use in tourism as well as vehicles used by government agencies.

Case Study on Improving and Regulating Coal-Fired Boilers

Dalian



I. Background

Like other northern Chinese cities in the winter, Dalian was once plagued with air pollution from coal-fired boilers. By the end of 2015, there were 3,001 industrial coal-fired boilers in Dalian, which accounted for more than 70% of the total coal consumption and 60% to 70% of particulate matter emissions in the winter. Of these boilers, 2,503 had a capacity of less than 10 t/h (tons of steam per hour). These low-capacity boilers were outdated, inefficient and did not have appropriate end-treatment technology installed. Due to the sheer quantity and scattered nature of these low-capacity boilers, regulation was challenging. Pollution from these boilers was also severe. During the heating season in 2014, data from air quality monitoring stations showed that SO₂ concentration in the air was 6.6 times of the level during the non-heating season, while coal usage stood at 1.4 times of the usage in non-heating season. This data shows that low-capacity coal-fired boilers are a key source of pollution in Dalian during the winter and should be a primary focus of regulation.

In order to manage the pollution from coal burning during the winter and improve air quality, Dalian has recently started upgrading coal-fired boilers. These efforts have included banning low-capacity coal-fired boilers, upgrading and retrofitting existing boilers, installing continuous monitoring systems, and having coal plants shutting down the most heavily polluting coal-fired boilers. From these comprehensive regulatory and implementation efforts, Dalian aimed to solve the ills of the pollution from low-capacity coal-fired boilers.

II. Policy Development

To manage pollution from coal-fired boilers and improve air quality, new emission standards and pollution control requirements have been released at both national and local levels.

1. Central Government Efforts: In 2014, the Ministry of Environmental Protection and the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) released the Emissions Standards for Boiler Pollutants (GB13271-2014). These emissions standards apply to existing steam boilers with a capacity lower than 10 t/h as of October 1, 2015 and to existing water heaters with a capacity lower than 7 MW as of July 1, 2016. Moreover, the Action Plan for Air Pollution Prevention and Control requires cities at the prefecture level and above and other built-up urban areas to eliminate all unnecessary coal-fired boilers with capacity under 10 t/h by 2017.

2. Liaoning Provincial Government Efforts: After experiencing significant smog in 2015, Liaoning's provincial government prioritized air pollution prevention. Many special meetings were held with the aim of increasing pollution control efforts. Implementation Guidelines of the CPC Liaoning Provincial Committee and Liaoning Provincial Government on Strengthening Air Pollution Control was released by CPC Liaoning Provincial Committee and the provincial government. These guidelines identified coal-fired boiler replacement as the top priority in efforts to improve air quality. It required the elimination of all coal-fired boilers with a capacity lower than 10 t/h within built-up urban areas. The key efforts outlined by the Air Pollution Prevention Guide 2016, issued by Liaoning's provincial government, also required the elimination of 115 low-capacity coal-fired boilers in the city center.

3. Dalian City Government Efforts: To begin eradication of low-capacity boilers, Dalian City Government released the Notice of the Dalian Municipal Government on Defining High-Pollution Fuel Restrictive Zones in September 2015. The Notice restricts low-capacity coal-fired boilers from all city centers. It also requires companies to completely phase-out low-capacity boilers by the end of June 2017. Dalian also issued the Guidelines of Dalian Municipal Government on Restoring Blue Skies at the end of December 2015 which set boiler management as a top priority in the efforts to improve air quality.

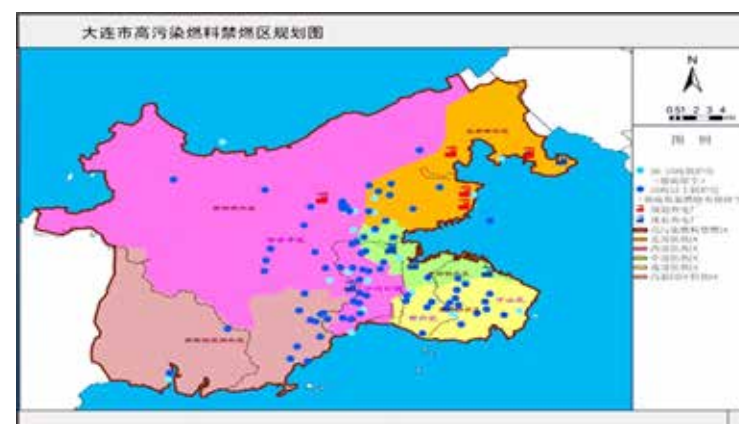


Figure 61: Map of High-Pollution Fuel Restrictive Zones in Dalian

III. Key Policy and Regulatory Measures

Dalian has adopted several regulatory methods to ensure the efficacy of its measures. These include data transparency to improve public supervision,

executing on monitoring efforts from the party committees, implementing strict law-enforcement, and other strong measures to ensure a comprehensive approach.

1.Data Transparency for Public Supervision

(1) Publicizing a List of Boilers in Restricted Zones: To ensure transparency for public supervision of Dalian’s boiler upgrade, the city’s environmental protection bureau, along with the Economic and Information Technology Committee (EITC), Municipal and Rural Construction Commission (MRCC)



and other relevant district and county governments worked together to verify information on coal-fired boilers. In January 2016, through TV stations, official websites, official WeChat platforms and other major media outlets, Dalian published official statements on the work being carried out on the regulation of coal-fired boilers. Moreover, it also publicized a list of boilers that needed to be upgraded. The public was repeatedly notified about the 843 boilers on the list, of which 604 were low-capacity (below 10 t/h) and had to be eliminated while 239 others needed retrofitting. To synchronize efforts at every government level, the municipal government urged the district governments and pilot-district committees to also publicize a list of boilers requiring an upgrade in their jurisdictions before the end of March 2016. Publicizing these lists encouraged public participation, especially those who live or work near coal-fired boilers. Those who joined the efforts became volunteers to aid the government’s efforts and helped to supervise the coal-fired boiler upgrades. Members of the public also reported to the government on boilers that were not on the list but needed upgrade or repair. These additional coal-fired boilers were then included in the citywide upgrade efforts.

(2) Periodically Publishing Progress on Boiler Improvements: To use resources efficiently to upgrade coal-fired boilers quickly, Dalian introduced a mechanism in August 2016 to report new information to the city government and the public. Progress on coal-fired boilers upgrade was reported to the city government on a weekly basis, and disclosed to the public every other week. In 2016, five reports on the progress of boiler improvements were issued. Through publicizing information such as total number of boilers needing upgrade, number of completed upgrades, and percentage completed, healthy competition was created at the district-level to achieve targets.

Table 8: Improvements in Coal-Fired Boilers in Dalian(As of September 28th, 2016)

District	Total number of coal-fired boilers	Retrofit (above 20t/h)					Eliminate or Retrofit (below 10t/h)					Total progress rate
		Total number	Planned	Operated	Completed	Progress rate	Total number	Planned	Operated	Completed	Progress rate	
Zhongshan	45	25	25	25	25	100.0%	20	20	17	17	85.0%	93.3%
Shahekou	148	53	53	53	50	94.3%	95	95	84	84	88.4%	90.5%
Xigang	72	21	21	21	18	85.7%	51	51	47	47	92.2%	90.3%
Hi-tech industrial zone	170	47	47	47	35	74.5%	123	123	112	74	60.2%	64.1%
Ganjingzi	408	93	93	89	89	95.7%	315	315	272	234	74.3%	79.2%
Total	843	239	239	234	217	90.8%	604	604	532	455	75.5%	79.8%
Progress rate			100.0%	98.3%	90.8%			100.0%	88.1%	75.5%		

(3) Media Campaigns to Expose Boilers in Violation of Emissions Standards:

Dalian gathered all the information about boilers that violated emissions standard and released it to the public. In March 2016, media outlets exposed 55 companies under investigation that violated environmental standards during the first phase of the “Fight against Smog” campaign. Exposing these companies and continued media coverage showed strong resolve from the municipal government to fix the boiler problem and deterred companies who thought they could avoid responsibilities. This resolve also induced other companies which were slow to comply with their boiler improvement responsibilities. As a result, all the companies in violation of standards were in compliance by the end of October 2016.



2.Comprehensive Monitoring and Strict Enforcement

(1) Monitoring Coal-Fired Boiler Emissions: Dalian’s environmental monitoring center and third-party supervision completed two phases of coal-fired boiler monitoring during the winter of 2015-2016. All boilers found violating standards during the first phase of monitoring were inspected again during the second phase. Daily penalties were imposed on offenders that failed to improve after the second phase of inspections. Through these efforts, Dalian was able to monitor all boilers and provided a strong regulatory foundation for the city’s boiler improvement efforts.

(2) Strict Enforcement: Urging businesses to collectively shoulder the responsibilities, Dalian started the “Fight against Smog” campaign to curb emissions from coal-fired boilers. During the campaign, 6,847 monitoring personnel checked 3,805 boiler rooms. Coal-fired boilers in violation of emission standards were held responsible and daily penalties were imposed on businesses that did not meet standards during the second monitoring phase. In the end, fines totaling RMB 8.08 million were collected due to 55 coal-fired boiler rooms failing to comply with emission standards. The city’s environmental protection bureau also separately assigned five separate groups of personnel to oversee five districts where monitoring was less thorough and fines were imposed less stringently. Thirty-five heat suppliers and industrial coal-fired boilers were also subjected to randomized checks, of which 24 were found to have violated standards.

3.Working with Governments at All Levels in a Concerted Manner

Dalian established a mechanism that allowed different levels of government to work together. Specifically, the local government authorities managed the overall work, different districts and counties oversaw delegation, and villages and towns were responsible for the final execution. Through this division of responsibilities, Zhongshan district implemented a mechanism in which the district’s party committee and government had equal responsibilities. The district committee’s

序号	单位名称	容量	锅炉类型	是否淘汰	是否开工	是否完成	计划完成时间	责任单位
1	大连供暖 (新日格)	2.8MW	燃煤锅炉	是	是	是	9月30日	区住建局
2	大连供暖 (新日格)	2.8MW	燃煤锅炉	是	是	是	9月30日	区住建局
3	大连供暖 (新日格)	2.8MW	燃煤锅炉	是	是	是	9月30日	区住建局
4	金宇热力 (力旺街)	4.2MW	燃煤锅炉	是	是	是	9月30日	区住建局
5	大连供暖 (北关街)	4.2MW	燃煤锅炉	是	是	是	9月30日	区住建局
6	大连供暖 (北关街)	4.2MW	燃煤锅炉	是	是	是	9月30日	区住建局
7	金宇热力 (大公路)	4.2MW	燃煤锅炉	是	是	是	9月30日	区住建局
8	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
9	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
10	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
11	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
12	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
13	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
14	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
15	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
16	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
17	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
18	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
19	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
20	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局
21	大连供暖 (三元街)	0.07MW	燃煤锅炉	是	是	是	10月20日	区住建局

图例: ■ 已完成 ■ 待完成

secretary issued implementation requirements while the district’s deputy head was in charge of human and financial resource mobilization and monitoring. Many coordination meetings were held and they were able to solve complex problems in Hongqi Community by eliminating boilers and/or connecting boilers to the grid so they can use electricity rather than be coal-fired. Leaders in Xigang district also made specific efforts to resolve boiler elimination issues related to military veterans. The leaders were responsive to their reasonable demands and concerns. Meanwhile, Shahekou district created specific timetables and charts that showed which requirements had to be met. Updating these charts allowed them to track progress in real time and identify issues. Furthermore, the party committee and government of Ganjingzi district worked with sub-district officials to sign the 2016 Statement of Responsibility in Environmental Protection of Ganjingzi District. They allocated specific responsibilities for the leading departments and sub-district governments and ensured follow-through

with periodic checks. Jinpu New District also coordinated with environmental protection agencies and provided best practices, case studies, and technical guidance to businesses to help them create viable modification plans. Meanwhile, Lushunkou district created boiler improvement funds and subsidies and used these district-level subsidies to mobilize additional businesses to eliminate boilers, thereby helping companies that were not able to obtain subsidies from the municipal government.

4. Joint Supervision and Assessment

(1) Implementing Joint Supervision by Party Committee and Government:

Dalian's party committee and municipal government have established a new joint supervision mechanism for environmental protection. They created a Joint Supervision Unit that is composed of supervision units from the CPC Dalian Municipal Committee, Dalian Municipal Government and the municipal environmental protection bureau (EPB). This unit conducted four rounds of monitoring in 2016 on the environmental protection efforts by 14 other district governments and party committees, with an emphasis on coal-fired boiler improvements. Through intensive inspections, they raised the departments' awareness of the importance of upgrading coal-fired boilers, which provided a strong foundation for future efforts.

(2) Defining Jurisdictions: To innovate on regulatory processes, the municipal EPB defined new jurisdictions for department-level leaders. As many as 14 existing commissioners at the municipal EPB were put in direct contact with different levels of the government and pilot-district management committees. The commissioners monitored the progress of boiler elimination once a week and reported back once a month. As a result, they were informed of the progress of each district and could verify the accuracy of results.

(3) Monitoring Included in Purview of "Livelihood Engineering" Projects:

Dalian added the elimination of coal-fired boilers as one of the 18 substantive things the municipal government doing for residents. Progress was tallied every week and reported to major officials in the government and reports were publicized every two weeks.

(4) Strengthening Monitoring Efforts: The progress of coal-fired boiler elimination was included in the assessment of both the districts' action plans for improving air quality and their statement of responsibilities. This motivated other districts as these assessments were given high importance.

IV. Corresponding Support

1. Enhancing Leadership and Prioritizing Rule of Law

(1) Enhancing Organization and Leadership: Dalian upgraded and improved boilers as a crucial part of its Blue Sky Project under the supervision of an existing Blue Sky Project working group. Mayor Xiao Shengfeng managed the efforts and the Secretary-General of the municipal government supervised and coordinated implementation among different departments. In its efforts to upgrade coal-fired boilers, Dalian established a mechanism that was managed by the municipal government, overseen by the EPB, supported by the city's MRCC, EITC, Bureau of Urban Construction and electricity grid companies, and involved public participation.

(2) Publicizing Specific Notices: After releasing the Notice of Dalian Municipal Government on Defining High Pollution Fuel Restrictive Zones (the Notice) in September 2015, the municipal government urged district governments and

pilot-district committees to write and publish notices on high-pollution fuel restricted zones in their jurisdiction by the end of March 2016. The Notice included five districts within the city, industrial parks that are above municipal level, major established regions within counties and pilot regions in high-pollution fuel restrictive zones. The Notice required these areas to eliminate all coal-fired boilers with a capacity lower than 10t/h. The Notice provided a regulatory framework to improve and upgrade coal-fired boilers.



Dalian gave businesses early notification of their upgrade and improvement tasks to help them prepare. Dalian issued coal-fired boiler improvement notices to boiler room owners, notifying them of their responsibilities, timeline, and any penalties in case of in-completion. This helped businesses to be more prepared in carrying out mandatory upgrade and improvement activities.

2.Specifying Management Schemes and Providing Technical Support

(1) Case-by-Case Management: The municipal MRCC, EITC, EPB and governments of different levels were devoted to helping businesses implement action plans for upgrading coal-fired boilers. They were also involved in providing specific technical roadmaps and assessing their feasibility. Multi-stakeholder meetings and discussions were held on how to prioritize grid connections and encourage clean energy development. By the end of June 2016, Dalian had been handling all boiler improvements on a case-by-case basis.

(2) Publicizing Successful Case Studies of Boiler Improvement: To guide and support businesses in their coal-fired boiler improvement efforts, Dalian collected successful case studies and promoted them through news media, websites and WeChat platforms. In addition to promoting desulfurization and dust elimination to reduce pollution, it also provided examples of utilizing clean energy, such as coal-to-electricity switching, alcohol fuel, and heat-pump technologies. Dalian also provided analysis on the technical and financial data behind these case studies. After understanding the pros and cons of each plan, businesses could pick the strategy that best suited them.

(3) Providing Opportunities for Technology Transfers: In order to provide a variety of solutions for businesses, different departments and non-government organizations, such as the municipal EITC, EPB, Ganjingzi district government, and industry associations, held a number of meetings on technical guidance for boiler improvements. Businesses had access to the most up-to-date and successful cases and useful technology. As a result, businesses had access to comprehensive technical assistance.

3.Providing Funding Support and Lowering Follow-Up Costs

(1) Providing Funding Support

Dalian published the Comprehensive Funding Plan for Subsidizing Coal-Fired Boiler Improvements, which outlined the range and amount of funding available in addition to the application process and needed materials. The policy allocated for two types of funding. The first category targets the elimination of low-capacity boilers and RMB 200,000 per t/h of capacity is subsidized to help the boiler connect to the grid and/or switch to using clean energy. Subsidies are given on a RMB 100,000 per t/h basis to help businesses switch to clean energy, such as liquefied natural gas or electricity and encourage agricultural areas to use biomass-fueled boilers (Dalian has specific policies regarding

biomass-fueled boilers as they are banned in non-agricultural areas). The second category targets the upgrading and retrofitting of low-capacity boilers to comply with emissions standards and integrate with EPB's online monitoring equipment. These subsidies are given on a RMB 30,000 per t/h basis. By increasing subsidies, Dalian was able to assist businesses to improve their boiler conditions.

(2) Using High-Quality Heating Sources to Decrease Follow-Up Costs for Businesses

To lower costs for follow-up operations and provide more high-quality heating sources to advance low-capacity boiler elimination and connect boilers to the grid, Dalian looked into the potential of industrial heating from coal-fired electricity plants. Thermal-electricity businesses also assessed the possibility of utilizing methods such as direct pumping from intermediate cylinders, switching to high back pressure and utilizing heat pump technology to increase their heating potential, rather than installing new coal-fired boilers. In one year, heating capacity was increased by 11 million square meters. The municipal government also looked at new heat sources and optimized the market for new high-quality heating sources through adjusting heating supply plans and heating layouts.

V.Participating Departments and their Responsibilities

To upgrade and improve coal-fired boilers, Dalian established a cohesive mechanism centered on the municipal EPB and with participation from MRCC, EITC, Development and Reform Commission (DRC), the Finance Bureau and the Bureau of Urban Construction. The comprehensive coal-fired boiler improvement efforts effectively allocated leadership, execution, funding, coordination, and supervision responsibilities throughout different departments.

- ◆ Departments responsible for leading the efforts included the municipal EPB, MRCC and EITC. Among them, the EPB was responsible for developing policies as well as organizing, coordinating, and supervising elimination and retrofits of coal-fired boilers in the services sector. At the same time, the MRCC led the elimination of coal-fired heating boilers while the EITC oversaw the elimination of industrial coal-fired boilers.
- ◆ Departments responsible for execution included district governments and pilot area management commissions whose main responsibilities were to

implement specific efforts. Some of these departments also re-allocated certain implementation tasks to lower-level governments.

- ◆ Departments responsible for funding allocation included the EPB, MRCC, CITC, Municipal DRC and Finance Bureau. These departments are responsible for creating and implementing funding policies on coal-fired boilers.
- ◆ Departments responsible for coordination include the Civil Affairs Bureau (CAB), the Bureau of Urban Construction, the Bureau of Urban Planning, the Public Security Bureau, the Forestry Bureau and the Electric Power Bureau. The CAB oversaw coordination for boiler improvement projects related to the military. Meanwhile, the rest of the bureaus were each responsible for paving roads, assessment, approval, and adjustments of projects, traffic control, construction needed on mountains or in forests and upgrading the electricity grid infrastructure. Moreover, CITC was responsible for designing and implementing policies to discount electricity rates for heat-generating boilers. The municipal DRC was responsible for promoting coal-to-electricity switching and utilizing industrial heat sources, while MRCC promoted coal-to-gas switching.
- ◆ Departments responsible for supervision include units from the CPC Dalian Municipal Committee, Dalian Municipal Government and the municipal EPB, among others.

Since so many departments were involved, it was crucial to have inter-departmental coordination, including interaction between military departments and lower-level governments.

- ◆ Inter-departmental coordination helped the creation of foundational policies for coal-fired boiler improvement projects. For example, departments responsible for leading and funding jointly managed funding and subsidies.
- ◆ Policies influencing the progress of boiler improvements were issued in a timely manner through inter-departmental analysis of challenges. These policies included the examination and approval of biomass boilers, affirmation and implementation of coal cleaning technology, and promotion and enforcement of coal-to-electricity switching. In this way, difficult issues were coordinated and solved, such as the coal-to-electricity switching of Bangchui Island Hotel. This project needed support in many areas, such as project initiation, forest crossing, military base crossing, road building and increasing power capacity. Moreover, the Bureau of Urban Construction

and local police branches were able to simplify procedures, carry out boiler elimination and achieve grid connection. Furthermore, a total of 122 road projects were completed, stretching over 142 kilometers.

- ◆ Dalian created a platform to establish a working mechanism that enabled local governments and the military to carry out boiler improvement projects simultaneously. Using this platform, Xigang Public Security Branch held meetings with leaders from Dalian Housing Management Bureau under the PLA Shenyang Military Area as well as officials from the Bureau of Veteran Cadres from the Provincial Military District. The Housing Management Bureau, District Heating Office and local heat suppliers also consulted retired veterans many times. After much negotiation, they found common ground and problems such as how to deal with low capacity military boilers in Sanyuan sub-district were addressed.

VI. Policy Effects

In 2016, Dalian eliminated 1,420 coal-fired boilers under the capacity of 10t/h; boilers with a capacity lower than 20 t/h were also completely gone from city centers. In addition, as many as 1,432 boilers were retrofitted to comply with higher standards (i.e. desulfurization, dust elimination, and online monitoring for boilers with a capacity of 20 t/h and above). Of these, 824 boilers with the capacity of 4,650 t/h were connected to the grid instead of being coal-fired; around 700 boilers with a capacity of 1,177 t/h were retrofitted and upgraded to use clean energy (i.e. switching to natural gas, alcohol based fuels, biomass pellets, heat pumps, etc.); and 1,219 boilers with a capacity of 18,942 t/h were upgraded and retrofitted. Following these efforts, statistics from 2016 revealed that coal consumption, sulfur dioxide, and smoke and dust emissions were reduced by 195,500 tons, 12,500 tons, and 9,300 tons, respectively.

The efforts of Dalian outlined above helped to achieve substantial results in terms of restoring air quality. According to data from air quality monitoring stations, compared with the values during the heating season in 2015, 2016 witnessed a decrease in SO₂ and PM₁₀ concentrations by 38.8% and 17.8%, respectively. At the same time, the number of days complying with air quality standards in Dalian reached 299 in 2016, 29 days more compared to 2015. Other than the PM_{2.5} concentration, which is still higher than required in the National Standards, all other criteria pollutants conformed to the standards. Moreover, in 2016, Dalian had the highest air quality ranking in Liaoning province because of its lowered PM₁₀ and PM_{2.5} concentrations. This was unprecedented as it ranked between third and fifth in the province in the past few years. Finally, for the third year in a row, Dalian ranked second, behind Zhangjiakou, in the northern region among

all the 74 major cities that had mandates to first apply the revised air quality standards in China.

VII. Experiences and Challenges

Dalian's efforts to manage the pollution from coal-fired boilers achieved significant results and sets a great example for information transparency, inter-departmental coordination, strict enforcement, and assessment. However, some issues persist. To cite a few, heat supply planning continues to lag; percentage of clean energy use is low; coal quality is not efficiently controlled; and fuel quality and pollution management equipment is not always supervised or operated properly. There is still much work to be done and this is going to be a long process.

Firstly, the municipal government should urge the city's MRCC to continue adjustments, improvements, and enforcement of the region's heat supply planning to be consistent with the latest policy standards. In addition, the DRC should improve the city's cogeneration plans to conform with the heat supply plans.

Second, the EPB, along with the city's DRC, EITC and MRCC should continue efforts in coal-to-electricity or gas switching. The management of the LNG grid and networks in major city zones must be solidified. The ultimate goal should be to burn as little coal as possible.

Thirdly, the municipal government should urge the EITC to effectively monitor coal quality at the source.

Finally, the city's EPB along with the Administration for Industry and Commerce and the Quality and Technology Supervision Bureau should continue to monitor fuel quality. Laws should continue to be strictly enforced and equipment for pollution management must be better operated and supervised.

Conclusions and Recommendations

Air Quality

The end of 2016 marked four years in the implementation of the Action Plan for Air Pollution Prevention and Control (the "Action Plan"). With just under a year to go before the scheduled deadline, all cities and provinces spared no efforts to strengthen air pollution prevention and control and achieved overall improvement in air quality. Among the 338 cities covered in this report, as many as 84 cities complied with the national air quality standards for six criteria pollutants, representing an increase of 11 cities compared with 2015. In addition, among the 74 key cities, some managed to meet their targets for air quality improvement set in the Action Plan ahead of schedule. However, despite these improvements, non-attainment of PM_{2.5} concentration is still prevalent. At the same time, average O₃ concentrations in 338 cities, though complying with standards, continued to rise and the number of non-attainment cities increased.

Overall air quality improved but PM concentrations generally failed to comply with standards.

The overall air quality of Chinese cities improved in 2016 compared with the previous year. In terms of annual average concentrations of pollutants in the 338 cities, SO₂ and CO concentrations decreased further after complying with standards; NO₂ concentrations remained the same as the previous year, while O₃ concentrations increased slightly. Although PM_{2.5} and PM₁₀ concentrations and the number of non-attainment cities continued decreasing, the annual average concentrations remained higher than standards and 71.9% and 58.3% of cities failed to attain standards for PM_{2.5} and PM₁₀, respectively. Moreover, the annual mean concentration of PM_{2.5} in non-attainment cities ranged from 36 to 158μg/m³, exceeding the national standard by 3.5 times at its highest concentrations.

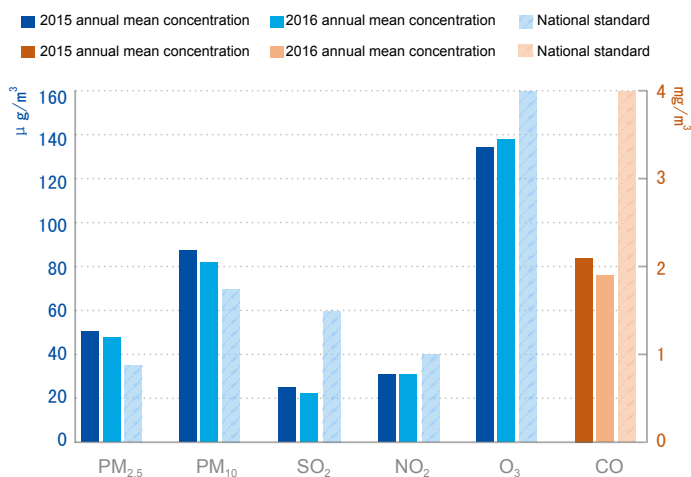


Figure I: Annual Mean Concentrations for 6 Pollutants in 2015 and 2016

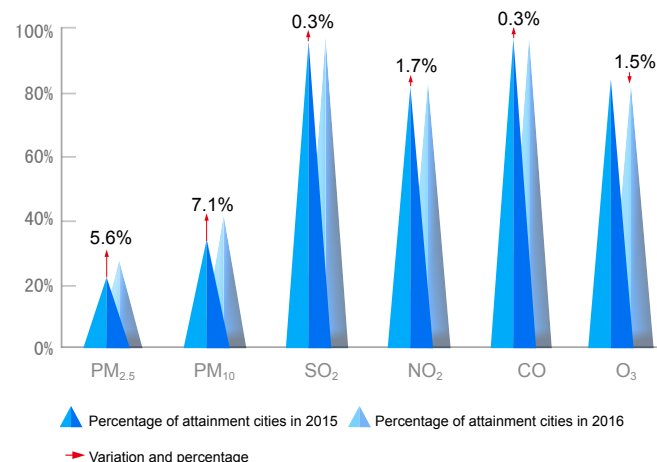


Figure II: Percentage of Attainment Cities for 6 Pollutants in 2015 and 2016

O₃ pollution was not effectively controlled and number of non-attainment cities increased.

Of the six criteria pollutants in the 338 cities, only O₃ concentrations rose in 2016 compared with 2015. The non-attainment concentration range was 161-200μg/m³, staying at the unhealthy-for-sensitive-groups level. The number of non-attainment cities increased from 54 to 59, while the percentage of non-attainment days went up from 4.6% to 5.2%.

Among the three key regions, both YRD and PRD managed to comply with the standard for O₃ concentration in 2016. However, compared with 2015, only YRD improved as their O₃ concentration dropped from 163μg/m³ to 159μg/m³ (by 2.5%). Both BTH and PRD recorded higher O₃ concentrations, increasing from 162μg/m³ to 172μg/m³ (by 6.2%) and from 145μg/m³ to 151μg/m³ (by 4.1%), respectively. Furthermore, the number of days with O₃ being the primary pollutant accounted for 26.3%, 39.8% and 70.3% of the number of non-attainment days in BTH, YRD and PRD, respectively, ranking O₃ second, second and first among all the pollutants in the three regions. Moreover, regions outside BTH, YRD and PRD, including Liaoning Province, Sichuan Province, Jiangxi Province, Guizhou Province, Shaanxi Province, Gansu Province, Ningxia Hui Autonomous Region, Chongqing City, Anhui Province and Jilin Province showed a similar upward trend.

17 cities reached 2017 targets of PM_{2.5} concentration reduction ahead of schedule.

Based on available data, 17 out of 74 key cities reached the 2017 target for PM_{2.5} concentration reduction set in the Action Plan ahead of schedule. Most of these cities are in Zhejiang and Guangdong Province. In addition, Quzhou city

in Zhejiang Province came very close to the target (99%), while Beijing faces challenges in achieving the target by 2017.

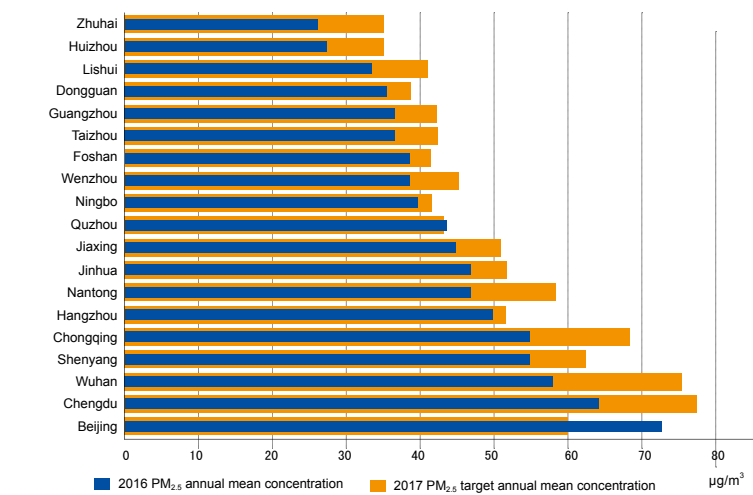


Figure III: Progress towards Achieving 2017 PM_{2.5} Reduction Targets for Cities

PM concentrations varied across regions with pollution levels worsening in some cities in central and western China.

While some cities in Eastern and Southern China managed to reach the 2017 targets of PM concentration reduction ahead of schedule, performance in other regions remained less satisfactory. Of 338 cities, over 50 failed to reach the 2016 targets for PM_{2.5} or PM₁₀ concentration reduction. Most of these cities are in Henan, Sichuan, Shaanxi, Hubei, Gansu and other provinces in Central and Western China. Among these cities, Linfen and Xi'an's PM_{2.5} concentrations increased by 20% compared with 2015.

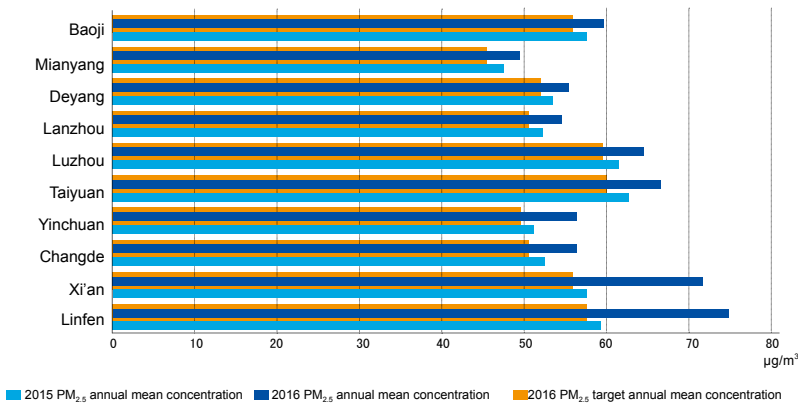


Figure IV: Cities that not only Failed to Achieve PM_{2.5} Reduction Targets but also Experienced Increase in PM_{2.5} Annual Mean Concentration in 2016

In terms of the extent of improvement in PM concentrations, cities in the Northeast China performed increasingly well. PM_{2.5} and PM₁₀ concentrations both decreased by over 25% in Harbin, Jilin and Changchun, exceeding the 5% improvement in 2015 and satisfying the 2020 target set in the 13th Five-Year Plan. In addition, PM_{2.5} concentrations decreased by over 20% in other northeastern cities such as Yichun, Mudanjiang, Heihe, Hegang, Shuangyashan, and Shenyang.

BTH and its surrounding areas continued suffering the highest levels of PM concentration, with a notable deterioration in air quality during the winter. The extent of improvement in PM_{2.5} concentrations in BTH and its surrounding areas was smaller in 2016 compared with the previous two years.

Policy Measures

China's air pollution prevention and control entered a critical stage in 2016. With an improvement in top-level design at the national and regional levels, cities put more emphasis on the implementation and enforcement of specific pollution control measures. Consequently, there were progresses in coal combustion control, elimination of yellow-label vehicles, promoting new energy vehicles and elimination of outdated capacity. Moreover, breakthroughs were made in previously neglected areas related to loose coal and non-road mobile machinery. Efforts were also stepped up to control VOCs pollution and refined management of fugitive dust. Meanwhile, BTH continued to increase the scope and depth of regional collaboration.

Progress was made in coal combustion control; however coal consumption increased in some provinces

From 2014 to 2016, the total amount of coal consumption declined for three consecutive years by 2.9%, 3.7% and 4.7% year-on-year, respectively. At the same time, the proportion of coal consumption in the total energy consumption dropped from 65.6% to 62%, while the proportion of non-fossil fuels rose from 11.1% to 13.3%.

Based on available data, BTH managed to decrease total coal consumption in 2016 compared with 2012. Within the BTH region, Beijing and Tianjin were ahead of schedule in reaching the coal consumption reduction targets set by the National Development and Reform Commission (NDRC) for 2017. In addition, 22 provinces (municipalities and autonomous regions) had decrease of total coal consumption in 2015, compared with 2012. However, Shandong Province, Shaanxi Province, Jiangxi Province, Ningxia Hui Autonomous Region, Xinjiang Uygur Autonomous Region and Hainan Province saw an increase in total coal consumption. In extreme cases, some of these provinces were even found to have built illegal coal-fired chemical projects and coal-fired heating boilers, or to have reported fraudulent results on the elimination of small coal-fired boilers.

With the air pollution prevention and control entering a critical stage, pollution control for loose coal emissions from household use has become a challenge that must be overcome in the region. In 2016, BTH pressed ahead with loose coal pollution control by replacing coal with electricity, natural gas, or other clean energy sources. However, BTH was only able to replace an equivalent of 5% of 40 million tons of loose coal consumed in the region, showing that this will be an extremely arduous task.

Policy framework for VOCs control was established

As major precursors of PM_{2.5} and O₃, VOCs must be controlled in order to achieve coordinated management of PM_{2.5} and O₃. China was relatively late to initiate VOCs control, and established the relevant policy framework in 2016 to cover specific policies and measures including total VOCs emissions control, management of key industries and VOCs pollution charges.

VOCs were included in total emission control indicators for the first time in 2016. During the 13th Five-Year Plan period, it is specified that total VOCs emission control should be carried out in key regions and industries, while total VOCs emissions should be lowered by over 10% compared with 2015 by 2020. Meanwhile in key industries, the central government requires a minimum reduction of 3.3 million tons in VOCs emissions by 2018 compared with 2015 levels. Specific measures for 11 key industries have also been set. China is gradually adopting a more comprehensive approach characterized by “reduction at the source with process control as the core strategy and end-of-pipe control as a supporting strategy.”

With improvements in top-level design under way, some cities also took the lead in carrying out pilot projects on VOCs control to implement relevant policies. For example, financial policies were adopted in VOCs control, with some cities following a differentiated charging principle whereby fees are doubled for higher emissions while preferential fee rates are offered to companies with lower emissions.

With the elimination of yellow-label vehicles near completion, outdated and diesel vehicles are becoming the new focuses of vehicle pollution control.

Beijing, Tianjin, Shanghai, Qingdao, Zhejiang Province and Jiangsu Province completed the elimination of all yellow-label vehicles in 2016. The next priority of vehicle pollution prevention and control is to eliminate high-pollution and outdated vehicles while vigorously promoting new energy vehicles. Hundreds of thousands of new energy vehicles have been purchased and used in Tier-1 cities, including Beijing, Shanghai, Guangzhou and Shenzhen. Around 200 cities have started using such vehicles in the sectors of public transport, taxis, sanitation, and government organizations.

Pollution from heavy-duty diesel vehicles also drew wider attention. To tackle this issue, Beijing, Wuhan, Nantong and Zhengzhou designated areas where such vehicles are banned. Moreover, Beijing, Shanghai, Zhengzhou, Shenzhen, Xi'an and Yichang required heavy-duty diesel vehicles to install diesel particulate filters (DPF) and other pollution control devices. For example, in Beijing, DPFs were installed in eight types of heavy-duty diesel vehicles, totaling over 5,500 vehicles, including buses, sanitation trucks, tourist buses, mail trucks, dump trucks, shuttle buses, school buses, and airport buses.

In 2016, NOx and PM emissions from vehicles decreased by 8.29% and 13.51% respectively compared with 2012.

Non-road mobile machinery was brought under regulation

The number of non-road mobile machinery and their emissions are on the rise in China, while management in this area has been very weak. As required by the Action Plan, non-road mobile machinery is subject to regulation starting from 2016.

In 2016, China began implementing the China III emission standards for non-road mobile machinery and tightened environmental protection requirements. China established preliminary regulatory requirements for non-road mobile machinery, including disclosing environmental protection information, declaring and registering machinery, and designating low-emission zones. By requiring registration or inspecting emissions, Beijing, Shanghai, Shenzhen and Jiangsu Province gathered preliminary emissions data on non-road mobile machinery, thereby solving the longstanding problem of data paucity. Zhengzhou is the first city in the country to designate areas where high-pollution non-road mobile machinery are banned.

Multiple measures for fugitive dust control were implemented and refined management was adopted

In addition to existing measures such as installing enclosures required by Action Plan, more cities started levying fees for fugitive dust emissions. Some cities also installed fugitive dust continuous monitoring systems to improve regulation.

Currently, Beijing, Tianjin, Suzhou, Taizhou (Jiangsu Province), Xinxiang, Jiangmen and Chongqing have begun levying pollution charges for fugitive dust emissions. Beijing, Tianjin, Shanghai, Guangdong Province and Sichuan Province have also stepped up efforts and installed fugitive dust continuous monitoring systems so that supervisors can obtain real-time data from construction sites.

Regional collaboration progressed in BTH while YRD was relatively lagged behind.

In 2016, BTH continued deepening and broadening efforts in regional collaboration. To broaden efforts geographically, some prevention and control measures were expanded to Beijing, Tianjin, Hebei Province, Shanxi Province, Inner Mongolia, Shandong Province, and Henan Province. In 2016, the seven provinces (municipalities and autonomous regions) managed to establish an information-sharing platform for air pollution control. In addition, the region unified standards for heavy pollution alerting and set up a consultation platform for alerting, which effectively reduced the level of heavy pollution in the winter of 2016. Concerning the depth, BTH preliminarily unified the regional planning, measures and standards for regional heavy pollution monitoring and alerting. Coordinated enforcement was carried out and mechanism of twining-city cooperation on pollution prevention and control was strengthened.

However, the progress made in YRD, one of the three key regions, still fell short of requirements outlined in the Law on Prevention and Control of Atmospheric Pollution. In the region, no substantive progress was achieved in unifying standards, prevention and control measures or coordinated enforcement mechanisms.

Furthermore, an increasing number of cities and regions started valuing and implementing regional collaboration. In this respect, the Urumqi-Changji-Shihezi city cluster in Xinjiang Uygur Autonomous Region, the Guanzhong city cluster in Shaanxi Province, the Changchun-Jilin-Siping city cluster in Jilin Province, the Jinan metropolitan cluster in Shandong Province, the Hefei metropolitan area of Anhui Province, and the Southern city cluster in Sichuan have all put in place coordinated prevention and control mechanisms in 2016 to solve air pollution issues.

Information disclosure improved, though some cities are still unwilling to publicize annual air pollution data

Since 2013, notable progress has been made on disclosing air quality data, policy measures and effect of air pollution control. For example, in addition to releasing annual reports on local air quality conditions, some cities (Hohhot, Wuxi, Beihai, Sanya, Shizuishan, Putian, Baiyin, Jixi, Shiyan, Qinzhou, Alxa League, Yulin, Baise, Hechi, Pingliang, Qingyang, Haidong, and Guoluo Prefecture) also disclosed the measures they adopted along with the problems they faced in the previous year in their annual action plans for air pollution prevention and control. As a result, the public could better understand the air quality conditions of their cities and the efforts made by their local governments and participate in the pollution control process.

However, some cities are still unwilling to publicize their annual pollution data. By the end of August 2017, nearly a quarter of the 338 cities failed to release their 2016 annual environmental status bulletins or excluded pollution data from the bulletins. Some of these cities are provincial capitals such as Shijiazhuang and Zhengzhou that already established air quality monitoring network in 2013 and suffered from poor air quality. Zhengzhou has not released its data on annual mean concentrations of air pollutants in its Zhengzhou Environmental Status Bulletin since 2013.

An environmental inspection mechanism was initiated, but progress from the rectification plan implementation is not disclosed

The central government initiated an environmental inspection mechanism and fully launched it in 2016. The environmental inspection teams were dispatched on behalf of the Central Committee of the Communist Party of China (CPC) and the State Council to inspect provincial-level and selected city-level governments and to hold them accountable for environmental protection. Afterwards, some provinces also established their own environmental inspection mechanisms in 2016, enabling further inspections of city-level government. As a result, a two-tier (central and provincial) inspection mechanism was formed. As air pollution was an important part of the environmental inspection, the inspection team initiated an “accountability initiative” which provided strong support for the Action Plan implementation at local level.

Inspection work was conducted through collecting information at meetings, reviewing public reports and other relevant information, on-site spot-checks, one-on-one talks with poorly performing local government officials, and site visits. Collecting reports from the public has become an important channel for the government to encourage public participation. Except for Hebei Province, which was singled out as the pilot province for the inspection starting at the end of 2015, the central environmental inspection team inspected 15 provinces and cities in two phases in 2016 and reviewed over 33,000 reports submitted by the public.

However, the provinces and cities required by the inspection team to carry out rectification efforts have not released the results of implementation in a timely manner, creating challenges for effective public supervision. The central environmental inspection team publicized its results on the MEP website after inspecting 15 provinces (municipalities and autonomous regions). Following the disclosure, eight provinces (municipalities and autonomous regions) that were inspected in the first phase have released their rectification plans. However, as of the publication of this report, only Hebei Province had disclosed the implementation status of the key measures in its rectification plan. Other provinces (municipalities or districts) have not revealed their implementation results, slowing the information disclosure process.

Structural reform of monitoring and criminal accountability were implemented in a parallel fashion to prevent fabrication of monitoring data.

In 2016, the environmental monitoring system was reformed based on the principle that “whoever assesses the performance should also be in charge of monitoring.” This principle aims to prevent local fabrication of monitoring data. The operation authority of 1,436 state-owned ambient air quality monitoring sites across the country was all centralized in the national government. Meanwhile, a reform pilot to establish the vertical management system for environmental protection institutions at the provincial level was launched in Hebei Province. The operation authority over all county-controlled air quality monitoring sites across the province would be centralized in the provincial government.

The Supreme People’s Court and the Supreme People’s Procuratorate issued the Interpretation on Several Issues Concerning the Application of Law in the Handling of Criminal Cases of Environmental Pollution in 2016, explicitly stating that the fabrication of monitoring data would be equivalent to crimes of destroying computer information systems and subjected to a heavy punishment. The first case to emerge involved environmental officials in Xi’an who were found to have fabricated air quality monitoring data. This incident alarmed officials by revealing the consequences of data fabrication.

Recommendations

Since the Action Plan has been promulgated and implemented, China has persistently improved its policy framework of air pollution prevention and control, resulting in significant reductions of PM_{2.5} and PM₁₀ concentrations across the country. In 2016, the Action Plan entered its fourth year of implementation and the 13th Five Year Plan had just reached its first year of execution. The 13th Five Year Plan requires the country to sustain “green development” while maintaining medium-to-high speed economic growth. This requirement has brought new opportunities and challenges for air pollution control. With non-attainment of PM concentrations, China is also experiencing a rise in O₃ levels. As an independent third party, Clean Air Asia has the following recommendations regarding control of PM_{2.5} and O₃ and achieving the long-term goal of clean air.

Develop a clean diesel action plan to comprehensively control pollution from diesel engine exhaust

According to 2015 statistics, diesel engines emitted 9.359 million tons of NOx and 1.008 million tons of PM, which accounted for 38.74% and 6.36% of the total emissions nationwide, respectively. Controlling emissions from diesel engines

is an effective way to lower PM and O₃ concentrations simultaneously. Given the wide variety of diesel engines and their extensive application in vehicles, vessels, non-road mobile machinery, it is necessary to start with top-level design.

This report recommends expediting the official launch of the “National Clean Diesel Action Plan”. In addition to enforcing stricter emission standards, integrating standards for regular diesel and automobile diesel, and designating vessel emission control areas in key regions, the government should also design detailed control measures for in-use diesel engines and strengthen day-to-day enforcement to reduce emissions from diesel engines.

High-pollution and outdated diesel vehicles, vessels, and machineries that have high retrofit costs should be eliminated and scrapped. Moreover, the government should designate no-go, low-emission and restricted areas for high-pollution diesel engines with a phased approach throughout China, thus accelerating the elimination process. As for in-use diesel engines in good working conditions, retrofitting and improving maintenance should be encouraged, such as installing DPFs or other mature and effective emission reduction devices on diesel vehicles and non-road mobile machinery and converting in-use vessels to use low-sulfur diesel.

With regards to enforcement, the government must increase the frequency of regular inspections and spot-checks, expand the application of remote sensing and other new regulatory approaches, and encourage reporting and supervision by the public. This way, the government will have a variety of strategies to help in-use diesel engines comply with relevant standards.

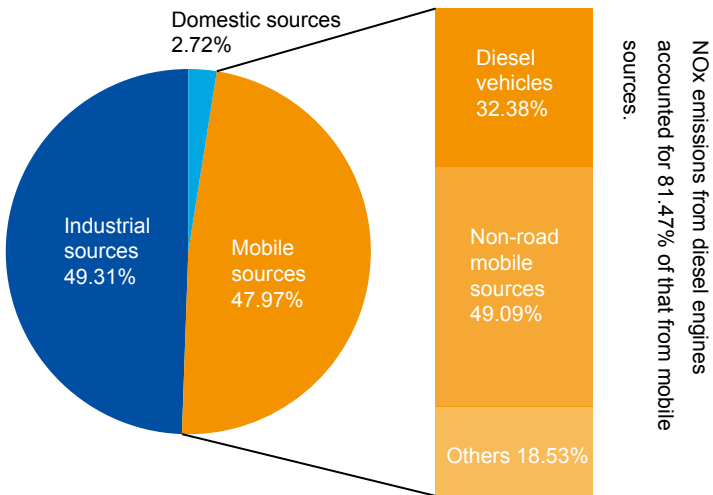


Figure V: Percentage of NOx Emissions by Sources in 2015

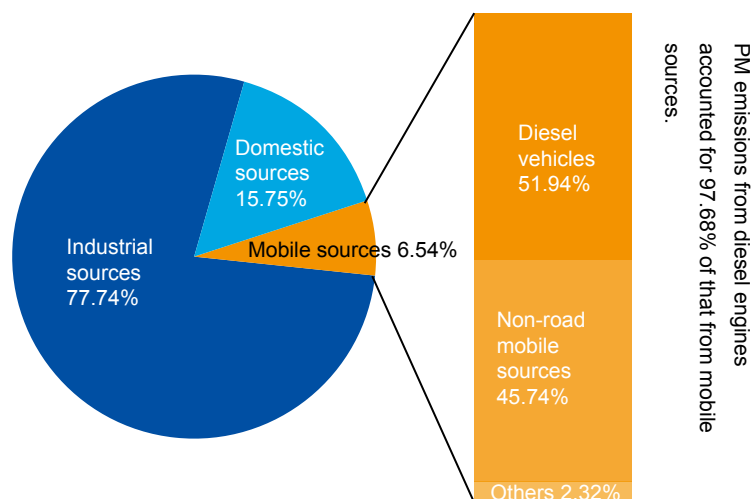


Figure VI: Percentage of PM Emissions by Sources in 2015

Explore the potentials for reducing emissions from scattered, unregulated, and high-pollution enterprises

Since the implementation of the Action Plan, significant emission reductions have been mostly attributed to macro-level measures, such as adjustments in the energy structure and industrial restructuring. During the 13th Five-Year Plan period, it is necessary to enhance regulation and ensure the enforcement of existing measures in order to achieve continuous air quality improvement on one hand; on the other hand, it is also important for the government to explore the potentials for reducing emissions from scattered, unregulated, and high-pollution enterprises by addressing previously neglected areas, such as loose coal burning for household use and non-road mobile machinery.

Pay attention to air quality changes in areas other than the key regions and enhance air pollution control in cities in central and western China

BTH, YRD and PRD are the key regions for implementing the Action Plan and have noticeably improved their air quality in the past few years. However, data shows that air quality is not improved as much in non-key regions, especially in central and western China (including Sichuan, Henan and Shaanxi provinces), which are experiencing either short-term improvements or worsening conditions overall.

In the post-Action Plan period, the central government should devote more attention to non-key regions and take measures such as facilitating them to develop attainment plans, increasing capital investment, promoting learning

experience of cities in the key regions, collaborating with scientific research institutes, third-party technology suppliers, international and multilateral agencies; and seeking more opportunities of scientific research support, technical assistance, and capacity building. By strictly implementing relevant national policies for air pollution, the local governments of these regions should initiate more stringent industry access policies and prevent polluting industries and enterprises from relocating to the central and western regions.

Develop national action plan of O₃ pollution control, and conduct coordinated emission reduction of both PM and O₃ and regional cooperation based on photochemical monitoring

The Action Plan uses PM concentrations as the key indicators of emission reduction and the level of PM pollution has improved since its implementation. However, O₃ pollution levels increased. Therefore, more attention should be paid to this particular issue in the future, and it is recommended to develop a national action plan for O₃ pollution control.

The O₃ formation mechanism and the impacts of regional transportation are very complicated, varying from place to place and from time to time. This means the design and implementation of control strategies must be based on comprehensive and scientific pre-evaluation, tracking progress, and post-implementation evaluation of a suite of policies. Scientific and targeted policies must be created to ensure that O₃ and PM concentrations both decrease.

It is also recommended to establish a photochemical monitoring network and apply localized models to understand O₃ formation mechanisms and features; develop scientific and coordinated reduction strategies for NO_x and VOCs and increase efforts of VOCs emission reduction based on monitoring and modelling results; and adopt regional approach to address O₃ pollution, and develop regional control strategies.

Enhance and refine enforcement and fully utilize public participation and supervision

Although the central government has been focusing on policy implementation, supervision and enforcement capacity is still insufficient in many cities. Therefore, in addition to building strong inspection teams at local level, funds should be allocated from central and local budgets to develop and adopt a variety of enforcement technologies and approaches. This should include expanding the coverage of continuous emission monitoring, equipping enforcement personnel with advanced handheld mobile devices, and applying advanced technologies such as drones, lidars, and remote sensing, thus enabling more standardized, timely, and precise enforcement.

It is also important to emphasize the role of public participation. It is recommended that government disclose inspection and rectification information, encourage the public to report environmental violations, and increase media exposure of violations, mobilizing whole society to support air pollution prevention and control.

Create a template for environmental status bulletins and standardize the disclosure of air pollution information

Although most cities have started disclosing air quality information through a variety of channels, it is still necessary to standardize publications on overall pollution conditions, control measures, and effect.

This report recommends that the MEP create detailed rules on how to publish relevant information on air pollution prevention and control. It is necessary to specify the data and statistics that cities must disclose, as well as the frequency and form of disclosure. Moreover, for the environmental status bulletins that have been widely used in China, this report recommends that the government issue a specific template with detailed instructions, listing key information as “must disclose” items including annual mean concentrations of criteria air pollutants, specific pollution control measures, and effect. This way, the public, the media, researchers, and other stakeholders concerned about air quality can learn about the condition of local air quality. They can understand whether air quality has improved or worsened, whether the annual mean concentrations of criteria pollutants in specific cities have complied with standards or reached targets, and whether the measures implemented are effective. This will allow all stakeholders to better support local air pollution prevention and control and supervise the progress.

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