



Beijing, China

Health evidence accelerates improvements in climate and clean air action

Case study developed in partnership with Energy Foundation China



21.8 millionBeijing population size

6 times the WHO air quality guideline of 5 μg/m³ (30 μg/m³ annual average PM_{2.5} concentrations) **\$23,310**National GDP per capita PPP

11,472 MtCO2e National greenhouse gas emissions per capita

Sources of emissions



Traffic



Coal



Biomass Burning

There is no clear leading emissions source in Beijing

Overview

Beijing has achieved remarkable improvement in ambient air quality in the past decade. From 2013 to 2022, the annual average concentrations of major air pollutants decreased significantly: PM_{2.5} decreased 66.5%; SO₂ decreased 88.7%; NO₂ decreased 58.9% and PM₁₀

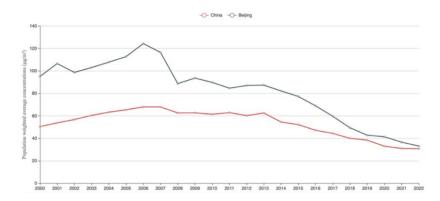


Figure 1: Annual population weighted average PM2.5 concentration, 2000 - 2022 | Source: tapdata.org.cn





decreased 50%.¹ As a result, there are now 21.8 million residents in Beijing breathing substantially cleaner air (Figure 1).

Beijing's clean air actions can be divided into three parts. In the 1990s, Beijing suffered from serious air pollution following its rapid economic and social development, with visible difference in air and local people worried about its health impact. In response, in 1998 the Beijing municipal government published the first local government declaration in China on air pollution control. From 1998 to 2011, Beijing established thorough air pollution control legislation and enforcement mechanism and implemented hundreds of concrete measures. Government, especially the environmental sector, played the main role and took primary responsibility in these efforts. In 2007, the Beijing government consulted with the health sector to support its strategies to control air pollution, inviting public health researchers to collect and summarize evidence on the health impact of air pollution from different sources. The research group found consistent evidence of NOx's impact on the respiratory system and suggested that controlling vehicle emissions could be an important measure to reduce the risk of respiratory diseases. This played an important role in strengthening the control of vehicle emissions, including establishing low emission zones, and restricting the use of high emission vehicles and trucks. The 2008 Beijing Olympic further accelerated Beijing's air pollution control, implementation of more intense with the measures.



Photo: Cityscape of Beijing. In the past decade, Beijing has managed to dramatically improve its air quality.



Photo: Cityscape of Beijing. Public electric vehicle charging station in Beijing, where electric vehicle ownership has reached 617,000.

2

¹ Beijing Ecology and Environment Statement, 2022. Link





Three Phases of Beijing's Air Pollution Control

Targeted pollutants: Total suspended particulates, SO₂

1998

In 1998, Beijing Municipal Government published the first local government declaration in China on air pollution control. From 1998 to 2011, Beijing government established a thorough air pollution control legislation and enforcement mechanism and implemented hundreds of concrete measures, including the closing of high-pollution enterprises, retrofitting and transitioning power plantings, renovating and replacing coal-fired boilers and phasing out heavy-duty diesel/gasoline vehicles, and many more.

Targeted pollutants: PM_{2.5}, PM₁₀, NO₂

2012

Starting from 2012, evidence from the health sector estimating the number of premature deaths caused by air pollution aroused serious concern among the public and it drove the city to unveil another historic action plan—the Beijing Clean Air Action Plan 2013—2017—focusing on controlling PM2.5 pollution to protect public health. Stricter PM2.5 limits were applied, residential coal ban was implemented, sophisticated air quality monitoring system is established, and many more science-driven clean air actions were implemented.

Infographic source: Vital Strategies

Climate change-air pollution comanagement

2020

From 2020, Beijing is stepping into a new phase of climate change - air pollution co-management by coordinating efforts of carbon-peak and carbon-neutrality and air pollution control. The health sector continues contributing to by investing in environmental health surveillance and risk assessment. The goal of this phase is to push for stricter and health sensitive limits for air pollutants and refining the design for city development strategy to make it more sensitive for environment and public health.

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Beginning in 2012, the frequent heavy PM_{2.5} pollution episodes roused serious health concerns among the media and public. From 2013 to 2020, the amount of scientific research on the health impacts of air pollution, especially of PM_{2.5}, skyrocketed from 685 papers in 2004 to 15,200 papers in 2022 in just English language publications alone. Driven by public health considerations, Beijing made air quality-related information public in 2013 that includes not only real-time concentrations of six major pollutants and an air quality index (AQI), but also real-time health advice based on AQI, some of which was targeted for specific groups such as children and people with underlying health conditions. Financial investment also scaled up from 2013, with a nearly sixfold increase in expenditures on air pollution control from 2013 to 2017 (Figure 2).

From 2020 onward. public health considerations have continued to guide the government's clean air strategy. With the release of the new WHO air quality guidelines (2021), advocates are calling for more stringent limits for pollutant concentrations. Driven by health research results, more attention is now being directed to control of ozone and volatile organic compounds (VOC). Advocacy on transitioning from "end-of-pipe" strategies to change pollution climate and air management are being made using health

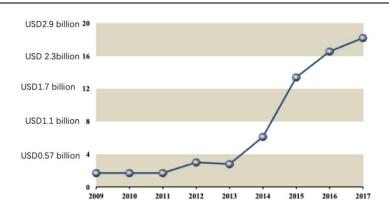


Figure 2. Financial Investment in Air Pollution Control in Beijing, 2009-2017 (Billion Chinese Yuan) | Source: A review of 20 years: Air Pollution Control in Beijing



Air quality health index press conference hosted by Peking University and Energy Foundation and endorsed by a number of research institutes and NGOs. Researchers are calling for a new air quality standard that is more sensitive to public health.

research results as evidence. Researchers are also using local air and health data to create a locally sensitive air quality health index with the goal to drive policy change from air quality and health advice given based on AQI—which only considers the single pollutant that has the highest concentration2—to the air quality health index.

Throughout Beijing's air pollution control efforts, the public health sector has played a key role in the evolution of its clean air actions through informing government stakeholders and the public about air pollution's negative impact on health.

² China National Ambient Air Quality Standards GB3095-2012, Microsoft Word - 2012 年第 7 号附件.doc (mee.gov.cn)





Impact

As a result of significant financial investment and the implementation of hundreds of strict clean air policies, air quality in China has improved dramatically since 2013. Based on reports from the Beijing Ecology and Environment Statement³, coal-fired power plants and boilers were eliminated and all gas-fired boilers in the core city area have been renovated or dismantled. Between 2013 to 2022, all urban areas and over 1 million rural households have transitioned their residential heating from coal to electric or gas. A cumulative number of 610,000 electric vehicles have been put on the road, with more than 1.9 million vehicles that either the failed China III emission standards or were deemed too old scrapped⁴; and a total of 2,154 polluting enterprises were closed, and more than 11,000 polluting businesses and enterprises rectified⁵.

Significant health benefits have been seen since clean air actions were instituted. From 2013 to 2017, the estimated number of premature deaths in the Beijing-Tianjin-Hebei region attributable to short-term PM2.5 exposure decreased from 24,700 to 17,500⁶. And from 2018 to 2020, the number of deaths further decreased from 15,500 to 13,500⁷. The residential coal ban alone is estimated to have averted around a thousand⁸ premature deaths annually.



A Screenshot of Beijing Municipal Ecology and Environment Bureau showing health tips based on air pollution level and main pollutants. In the circled area, the text reads: Health Impact: Symptoms in vulnerable population will be aggravated slightly, healthy people can experience irritating symptoms. Suggestions: Children, the elderly and patients with cardiovascular and respiratory diseases should reduce high-intensity outdoor exercise. | Source: 环境质量 (beijing.gov.cn)

³ https://sthjj.beijing.gov.cn/bjhrb/index/xxgk69/sthjlyzwg/1718880/1718881/1718882/index.html

⁴ https://wedocs.unep.org/bitstream/handle/20.500.11822/27645/airPolCh_EN.pdf?isAllowed=y&sequence=1

https://sthjj.beijing.gov.cn/bjhrb/index/xxgk69/sthjlyzwg/1718880/1718881/1718882/10985106/2021110818014254063.pdf

⁶ https://pubmed.ncbi.nlm.nih.gov/35247451/

⁷ https://pubmed.ncbi.nlm.nih.gov/34941243/

⁸ https://doi.org/10.4209/aagr.2019.11.0565





"The biggest challenge for Beijing's clean air actions was how to transform from the environment sector being the single and passive player to having all relevant sectors as well as the public to be engaged and actively act on it. Beijing achieved it through the following three transformations. First, the public transformed from "the government asked me act on it" to "I want to act on it". Second, relevant sectors were legally obligated to act when previously it required an administrative order. Third, strategy-wise, it transformed from relying on experience to precise pollution control based on scientific evidence."



Liu Xin

Program Director, Environment Management, Energy Foundation China. Former Deputy Director of the Regional Air Quality Management Division at the Beijing Municipal Environmental Protection Bureau

Health highlights

- In 2007, the Beijing government invited public health researchers to collect and summarize evidence on the health impact of air pollution from different sources. The research group found consistent evidence of NOx's impact on the respiratory system and suggested that controlling vehicle emissions could be an important measure to reduce the risk of respiratory diseases. This played an important role in strengthening the control of vehicle emissions, including establishing low emission zones and restricting the use of high emission vehicles and trucks.
- Significant health benefits have been seen since clean air actions were instituted. From 2013 to 2017, the estimated number of premature deaths in the Beijing-Tianjin-Hebei region attributable to short-term PM2.5 exposure decreased from 24,700 to 17,500. And from 2018 to 2020, the number of deaths further decreased from 15,500 to 13,500. The residential coal ban alone is estimated to have averted around a thousand premature deaths annually.

Lessons Learned

Beijing established a system of laws and regulations at the national and city level with supporting
enforcement and supervision. The system gives clear guidance on the mandatory responsibility of city
and district level governments in development and implementation of clean air actions. The identification
of accountable parties was another key component that has resulted in the achievement of annual and
medium-long term targets.

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- Besides financial incentives for not only industries but also citizens to change their norms, Beijing
 also directed resources to public education to engage individuals and families in behavioral and
 lifestyle changes that reinforced clean air actions. All of these make it easier for the public to not only
 adapt to the change but also lead and advocate for the change.
- Beijing established and enhanced its air quality monitoring network and made the data public. The
 city also published systematic research on emission inventories and source apportionment studies.
 The open sharing of data and information enabled health impact analysis. Collectively, the city was
 thus better able to identify key areas of actions to tackle air pollution more effectively.

Key Stakeholders

- The People's Government of Beijing Municipality
- Beijing Municipal Ecology and Environment Bureau
- Beijing Municipal Commission of Development and Reform
- National Institute of Environmental Health, China Center for Disease Control and Prevention
- Beijing Municipal Research Institute of Environmental Protection
- Tsinghua University
- Peking University