Real-world solutions for clean air and health

Six city examples to inspire action on urban air pollution

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Contents

How engaging the health sector in cities advances climate and clean air action

Air pollution is the largest environmental threat to human health worldwide. Health professionals and agencies are usually the most trusted voices in their communities, so when they are actively engaged on climate change and air pollution, they can reframe these is sues as questions of public health and help move public opinion and policy.

With support from the Clean Air Fund, Vital Strategies has partnered with city governments to assemble a set of case studies showcasing real-world examples of how engagement with public health organizations and practitioners can accelerate solutions that promote clean air, climate and health simultaneously. As COP28 approaches, these case studies equip health decision-makers and public health practitioners with examples of real solutions, including:

- Clean air and climate policies where the inclusion of health voices was instrumental in their successful development or implementation
- Successful efforts to empower the health sector to serve as effective change agents
- Approaches to engaging the health sector in climate and clean air action, from cities with varying levels of local data and capacity

The six cities highlighted here are diverse and have different levels of economic development, socio-political backdrops, financial and technical resources, and climate and clean air concerns. Despite these differences, they have all been able to increase momentum and achieve some success in climate and clean air action, proving that every city can do something now.

We aim for these case studies to demonstrate to decision-makers and negotiators of the feasibility and co-benefits of ambitious commitments to the United Nations Framework Convention on Climate Change (UNFCCC).

Featured Cities

New York City, United States
Beijing, China
Barranquilla, Colombia
Accra, Ghana
Kampala, Uganda
Jakarta, Indonesia

Accra, Ghana

Mainstreaming health and climate into urban planning

Case study developed in partnership with the Accra Metropolitan Assembly

5.5 million Accra population size (Greater Accra region)	10.4 times the WHO air quality guideline of 5 μg/m^3 (39 μg/m^3 annual average PM$_{2.5}$ concentrations)	$2,175 National GDP per capita PPP	14 MtCO2e National greenhouse gas emissions per capita

Sources of emissions

Transport

Cooking with Solid Fuels

Open Waste Burning

Transportation is the leading source of emissions in Accra

Overview

Accra, Ghana's capital and commercial center is home to 5.5 million people with a daily influx of 2.5 million commuters. One of the fastest growing cities in Africa, Accra has emerged as a leader in the region in tackling air pollution and climate change together. The city has implemented several innovative programs to center health in all aspects of urban planning that affect air quality.

One such program is the Urban Health Initiative, which has transformed urban planning by engaging the health sector on the full range of benefits of health-driven clean air policies. Launched in 2016 in collaboration with WHO, the initiative in Accra aims to be a blueprint for other cities in low- and middle-income countries. Under the initiative, the city achieved multisectoral health-sector engagement through a six-step process which began with assessment of air pollution levels and then mapping of all the policies and stakeholders that affect the city's air quality. See Figure 1.

For Accra, household energy, transport, solid waste, and land use emerged as the most relevant sectors. The next step was to build capacity across all of these sectors to engage stakeholders and highlight the critical links between air pollution and health. Sector-wise assessments were conducted to quantify the health impacts of existing policies as well as projected health gains under alternative policy scenarios. These scenarios were then used to inform city-level action plans and road maps toward Accra's clean air and climate mitigation goals.

For example, an evaluation of household energy use in Accra found that shifting to clean fuels such as liquified petroleum gas (LPG), biogas and electricity could avert as many as 1,900 deaths in the city each year. Similarly, an analysis of the transport sector revealed that the economic benefits of improved transport interventions that can save nearly 40,000 lives by 2050 are more than twice the initial cost of intervention, making it highly cost effective. Modeling of alternate scenarios in the waste sector indicated that while expanding recycling and composting options would reduce greenhouse gas emissions, ending waste burning is critical to maximize emission reductions.

These multi-sectoral analyses were then complemented with communication campaigns to widely share the results with community leaders, health professionals, media professionals and other relevant stakeholders. The analyses also revealed gaps in capacity within the health sector that the initiative then proceeded to fill; training opportunities were offered to several groups including health care workers, media professionals, and workers in the solid waste sector. Regular press conferences were held throughout to update citizens on the initiative's progress. Finally, progress in both air pollution and health outcomes are being monitored with a policy-tracking framework.

Figure 1. Components of WHO's Urban Health Initiative Model[1]

Photo Above: A woman uses solid fuels to fry fish. Cooking with solid fuels like wood and charcoal is a source of air pollution emissions in Accra. Photo by Abraham Mwaura, WHO.

In 2018, Accra became the first African city to join BreatheLife—a global communication campaign to seek commitments from cities to meet WHO air quality guidelines. As part of this campaign, the city government reached out to the worst hit communities to reduce waste burning and promote development of green spaces. Communication materials were adapted to tell a compelling story of air pollution to specific audiences including community health workers, civic leaders, nongovernmental organizations, community groups, people at increased risk of air pollution-related illness, and the media. Community health workers were engaged throughout the city to promote health messages and advise parents on the dangers of household smoke. The city also launched a "stop waste burning" campaign, using a WhatsApp-based system to identify, report and shut down illegal waste burning sites.
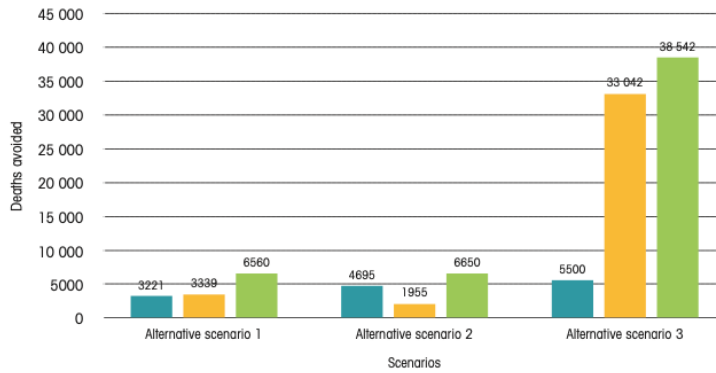
Fig. 8
Premature mortality avoided under three transport scenarios in Accra, 2015–2050, compared with business as usual, using iSThAT model

- Air pollution
- Physical activity
- Total

Note: Alternative scenario 1: cordon charges and other vehicle restraint measures, plus improvements in vehicle fuel economy and emission factors. Alternative scenario 2: scenario 1 plus land-use measure to reduce overall travel demand. Alternative scenario 3: scenario 2 plus shift from cars to buses and cycling, plus bus type shifts towards compressed natural gas (CNG), plus car type shifts towards hybrid and battery electric power. iSThAT: Integrated Sustainable Transport Health Assessment Tool.

Figure 2 - Premature mortality avoided under alternative transport scenarios in Accra, 2015-2030 [1]

"Practicable actions for Accra's reduction of carbon emissions have strong implications for our efforts to improve the quality of air in the city. Again, seeing a strong resolution to implementing our inclusive climate actions across waste, transport and household energy would mean more than half of the job done. Yet, the impact will not be felt if we do not commit to investing financial resources to help our circular transition into green technologies and jobs in a just way."

Hon. Elizabeth Naa Kwatsoe Tawiah Sackey

Mayor of Accra, Chief Executive, Accra Metropolitan Assembly

Impact

Several policy recommendations from the Urban Health Initiative project have been incorporated into Accra's local strategy, including the Air Quality Management Plan, the Accra Resilience Strategy and the city's 2020 Climate Action Plan**.** One of the policy outcomes from the household energy analysis is the Gas Cylinder Recirculation Program to encourage more households to adopt LPG gas in Accra. **Accra has also pledged to cut carbon emissions to zero by 2050**.

Accra set up a health data center to assess various determinants of health and especially to disaggregate health data at the municipal level. This will allow for more effective assessment of health impacts going forward. Seven media houses have made long-term commitments to amplify air pollution, climate change and health stories from Accra and abroad. A University of Ghana media tracking study found increasing coverage of air pollution issues drawing more public attention from 2016 and 2021[1]. As a result of the communication campaign, one community worked with the Ghana EPA to shut down a chronic industrial polluter.

Accra has emerged as a national and global leader in addressing air pollution and climate change mitigation and its efforts have been recognized by C40 as one of the world's seven best climate projects in 2019 for its work to better integrate informal waste collectors into Accra's waste management system. The model has shown how engaging with the health sector can unlock real climate and economic benefits for cities via health-informed policies. Now, representatives of cities in Ghana and elsewhere in Africa are looking to replicate Accra's model.

These innovative actions have also driven national change. In 2018, Ghana published a national action plan to mitigate short-lived climate pollutants, which identifies measures that both improve air quality and help to mitigate climate change. In 2020, it became the first country in the world to include air pollution, in the form of black carbon, in its National Greenhouse Gas Inventory submitted to the United Nations Framework Convention on Climate Change. Last year, in collaboration with WHO, Ghana piloted a program to train health professionals as advocates for clean air policies.

"Air pollution is a major health problem, particularly in cities, but so are other noncommunicable diseases that stem from sedentary lifestyles. There are solutions available now that yield potential multiple benefits for human health. Ensuring that these are given due consideration involves giving the health sector the tools and capacity to quantify all co-benefits in ways that are meaningful to policy and personal decision-making processes."

Dr Owen Kaluwa

World Health Organization Ghana country representative

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[1] Agyei-Mensah, Samuel, Elvis Kyere-Gyeabour, Abraham Mwaura, and Pierpaolo Mudu. "Between Policy and Risk Communication: Coverage of Air Pollution in Ghanaian Newspapers." International Journal of Environmental Research and Public Health 19, no. 20 (2022): 13246.Harvard. Link: https://www.mdpi.com/1660-4601/19/20/13246

Health Highlights

- Accra has transformed its urban planning by including health in sectors that are traditionally not health-related but have a substantial impact on health and air quality, for example, transportation, household energy, waste management and land use.

- For each of these sectors, the city mapped the health and economic co-benefits of climate friendly policies. For example, it was estimated that shifting to clean fuels like liquified petroleum gas (LPG), biogas and electricity could avert as many as 1,900 deaths per year. Similarly, an analysis of the transport sector revealed that the economic benefits of improved transport interventions that can save nearly 40,000 lives by 2050 are more than twice the initial cost of intervention, making it highly cost-effective.

- Several of these health-focused and climate friendly policy recommendations are now incorporated into Accra's local strategy, including the Air Quality Management Plan, the Accra Resilience Strategy and the city's 2020 Climate Action Plan.

- The city has also set up a health data center to assess various determinants of health and especially to disaggregate health data at the municipal level. This will allow for more effective assessment of health impacts going forward.

Lessons Learned

- Centering health impact assessments within traditionally non-health sectors (e.g., transportation and city planning) can unlock powerful insights for health and climate co-benefits.
- Identifying an array of health benefits for simple intersectional interventions will help garner more political and financial support. For example, infrastructure improvements with social inclusivity goals for pedestrians (like crosswalks) not only have immediate health gains (lower injuries) but also have long-term climate gains, as universal changes like these improve walkability and may prevent future carbon emissions.
- Analysis alone is not enough: Widespread communication of results is what drives momentum to adopt the most effective solutions. Accra incorporated strong social media campaigns with television, radio and print media to effectively communicate climate and air pollution impacts.
- Aligning institutional goals in the achievement of workflow synergies across sectors facilitates both downstream and upstream transfer of critical data and institutional resource needs in a self-sustaining way.

Strategic Partners

The city would like to acknowledge the following partners in supporting its clean air and climate journey:

- WHO (https://www.who.int/countries/gha)
- BreatheLife (https://breathelife2030.org/breathelifecity/accra-ghana/)

Barranquilla, Colombia

Urban transformation toward a healthy, clean and resilient city

Case study developed in partnership with the Barranquilla City Government

ALCALDÍA DE **BARRANQUILLA**

1.3 million Barranquilla population size	**3 times** the WHO air quality guideline of 5 µg/m^3 (39 µg/m^3 annual average $PM_{2.5}$ concentrations)	**$19,480** National GDP per capita PPP	**92 MtCO$_2$e** National greenhouse gas emissions per capita

Sources of emissions

Transportation

Industrial Emissions

Transportation is the leading source of emissions in Barranquilla

Overview

Barranquilla has experienced dramatic transformation during the last decade. Previously, the city struggled with flooding issues that were a peril for public safety and private property, lackluster public spaces, and inefficient public transportation. With political leadership, the development of strategic partnerships, and public and private investments, the city is now positioned as a regional champion integrating climate resilience, health and air quality into urban planning.

As a coastal city with intense temperatures that can reach 40° C and a relative humidity fluctuating between 70% and 80%, Barranquilla's leadership recognizes the importance of addressing the environmental determinants of health. In 2018, the city installed its first three air quality monitoring stations and two years later, the city published the city-level integrated Air Quality Management Plan,[2] an ambitious intersectoral plan to tackle air pollution and protect public health.

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[2] https://barranquillaverde.gov.co/calidad-del-aire

The Air Quality Management Plan has set the tone for joint efforts between the Health Secretariat and Barranquilla Verde, the city's environmental agency. The plan established health goals based on WHO guidelines and included public environmental health as the first of the plan's working areas. Key actions included creating air quality and health working groups, implementing an environmental health surveillance system, and periodically estimating the health impacts of air pollution. This component included the restoration and expansion of green urban areas, showcasing the innovative and integrative approach considered in the plan. The plan also focused on reducing emissions from industry and transport, incentivizing active mobility, and raising awareness about the effects of air pollution.

Efforts in Barranquilla also mirror ambitious climate and health goals made at the national level. In December 2020, Colombia revised its Nationally Determined Contribution (NDC) goals to reduce greenhouse gases by 51% and black carbon emissions by 40% in 2030 compared to 2014 levels. This makes Colombia only the third country to include black carbon reductions in their NDCs (after Mexico and Chile).

Black carbon is both a climate and air pollutant; therefore, reducing emissions from major black carbon sources can be an effective strategy to simultaneously mitigate climate change while achieving local benefits for air quality and human health. According to Colombia's first national emissions inventory of black carbon and other air pollutants, the major sources of black carbon include burning firewood for heating and cooking, diesel for transportation and non-road machinery, agricultural burning of sugar cane residue after harvest, and brick production. These sectors also emit other air pollutants such as nitrogen oxides, volatile organic compounds, and other particulates, and in some cases also emit greenhouse gases like carbon dioxide.

Photo: Residents of Barranquilla make use of revitalized urban spaces for exercise and recreation. Photo credit: Mayor's office of Barranquilla. For more images, visit cleanairforhealth.org/barranquilla
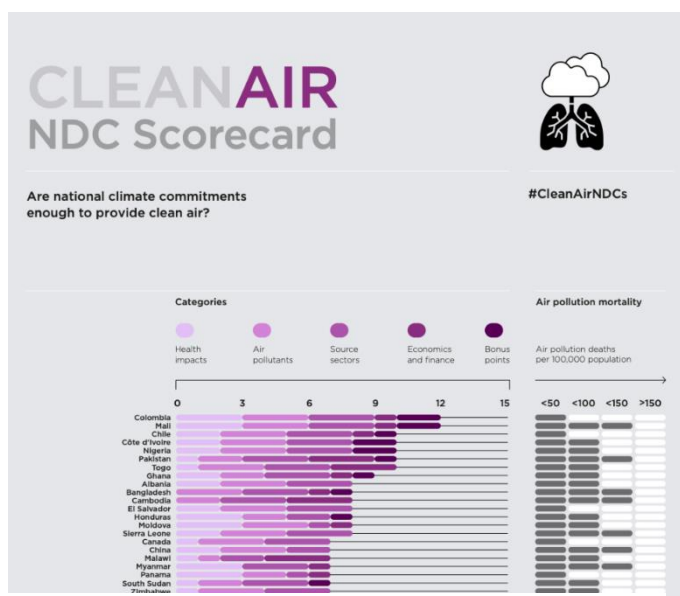
Figure 1: The Clean Air NDC scorecard by the Global Climate and Health Alliance ranked Colombia as the number one country dedicated to clean air and climate action. For more information, please visit bit.ly/CleanAirNDCs

In partnership with Pan American Health Organization and World Health Organization, the country estimated the health co-benefits of these ambitious NDC goals. According to these estimates, achieving the NDC goals would prevent more than 3,800 premature deaths annually from ambient air pollution in 2030. In economic terms, the value from averted morbidity and

premature mortality that would have otherwise occurred in 2030 is US$1.9 billion.[3] In October 2023, Colombia's NDC was ranked 1st (out of 170 NDCs analyzed) in terms of integration of air quality and health targets into national climate commitments. See figure 1.

> "Betting on more sustainable cities also means working for the health and quality of citizens' life. Planting more trees, building more parks, and protecting water bodies, and reducing our emissions, is the only route to guarantee a healthier and safer lifestyle for future generations."

Jaime Pumarejo Heins

Mayor Barranquilla

Impact

This integration of health, climate and environmental criteria is incorporated into some of the main urban development projects in Barranquilla. The Gran Malecon, a 5 km riverwalk beside Magdalena River, is a public space where Barranquilla residents can exercise, bike and relax. The site attracts more than 10 million visitors per year and is a city strategy to not just reduce emissions but also to promote health by incentivizing physical activity and recreation. Similarly, the project Todos al Parque restored 285 public spaces into recreational parks available for community use and health promotion. This included the introduction of 709,849 square meters of green urban areas, allowing 93% of the population to reach a park within an eight-minute walk.

Among these projects was the opening of the Cienega de Mallorquin, which offers 5 kms of pedestrian and transit pathways, protecting a 600-hectare wetland ecosystem. It has been walked by approximately 25,000 people between its opening on Aug. 31, 2023, and mid-October 2023. In addition, the "Siembra+" program has revitalized 333,000 square meters of hard urban areas into green spaces, with 21,000 trees planted and maintained. This creates an environment more conducive to outdoor activities and recreation in a city with a climate like Barranquilla, making use of pedestrian zones, pathways, dividers and other urban spaces.

Currently, Barranquilla city management, Barranquilla Verde and the Health Secretariat are collaborating with the Pan American Health Organization and the Universidad del Norte to use health impact assessment tools developed by the World Health Organization to estimate the health benefits of these and future interventions.

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[3] https://www.who.int/publications/i/item/9789240068834

The city monitors key indicators—such as occupancy, air quality data, and increased physical activity—to highlight the impacts of these projects.

Furthermore, the city's air quality management plan addresses the reduction of main emission sources and includes interventions such as: increasing environmental and energy efficiency in industries; optimizing emission control systems; introducing zero and low-emission vehicles; and expanding cycling infrastructure.

Barranquilla is leading by example, preparing bold interventions that integrate air pollution improvements and health promotion. It is an inspirational example for smaller cities that are looking to revamp and revitalize their development agenda.

Photos: *Los Andes Park before and after its remodeling, with added amenities of a perimeter path, courts, skating rinks and a bio-healthy gym. The park is located in the southwestern part of the city and has an area of 8,992 m2. Photo credit: Mayor's Office of Barranquilla.*

Health Highlights

- The city's Air Quality Management Plan includes health goals based on WHO guidelines. Key actions in the plan include creating air quality and health working groups, implementing an environmental health surveillance system, and periodically estimating the health impacts of air pollution.

- The city's strategy to integrate health, climate and the environment includes the introduction of green public spaces where Barranquilla residents can exercise, bike and relax. These recreational parks not only serve to reduce emissions but also promote health by incentivizing physical activity and recreation. Overall, 709,849 square meters of green urban areas were created, allowing 93% of the population to reach a park within an eight-minute walk.

- The city monitors key indicators—such as occupancy, air quality data, and increased physical activity— to highlight the impacts of these urban development projects. These positive health outcomes can boost greater interest in public health policies and foster sustainability in urban investments.

- The city is currently working with the Pan American Health Organization and the Universidad del Norte to use health impact assessment tools developed by the World Health Organization to estimate the health benefits of these and future interventions.

> "The City of Barranquilla has prioritized health as an essential axis of urban planning. Its programs of green areas, parks and the boardwalk demonstrate how the recovery of public space allows the creation of healthy spaces where people can do physical activity, breathe better air and improve their quality of life."

Gina Tambini

PAHO/WHO Representative in Colombia

Lessons Learned

- Progress depends on cooperation among the health and environmental sectors and strong engagement with other key stakeholders, including academia, and technical partners.
- Momentum is maintained when the city is able to analyze and publicize the health and climate gain from its interventions.
- Integrating health, social, environmental and recreational benefits into projects and events supports greater buy-in from the community.
- The city's investment in monitoring health outcomes and indicators is fundamental to allow the estimation of health gains that can boost public health policies and foster sustainability.
- The conversion of hard urban areas into green spaces encourages city residents to spend more time outdoors. This leads to them appreciating both clean air and active lifestyles, helping to sustain public demand for ongoing efforts.
- The city used the support from the World Health Organization, which has developed tools to support the integration of health impact assessments into urban policies. WHO regional offices such as PAHO are uniquely positioned to support implementation, engage with key stakeholders, and develop actions toward a comprehensive integration of health goals into city programs.

Strategic Partners

The city would like to acknowledge the following partners in supporting its clean air and climate journey:

- City Management Office
- Local Secretary of Environment (Barranquilla Verde)
- Local Secretary of Health
- Siembra Barranquilla (tree/green areas public company)
- Pan American Health Organization
- Universidad del Norte

Beijing, China

Health evidence accelerates improvements in climate and clean air action

Case study developed in partnership with Energy Foundation China

ENERGY FOUNDATION
能源基金会

21.8 million Beijing population size	**6 times** the WHO air quality guideline of 5 μg/m^3 (30 μg/m^3 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%; SO_2 decreased 88.7%; NO_2 decreased 58.9% and PM_{10} decreased 50%.[4] As a result, there are now 21.8 million residents in Beijing breathing substantially cleaner air (Figure 1).

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

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[4] Beijing Ecology and Environment Statement, 2022. Link

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, with the implementation of more intense 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.

Three Phases of Beijing's Air Pollution Control

Targeted pollutants: Total suspended particulates, SO_2	Targeted pollutants: $PM_{2.5}$, PM_{10}, NO_2	Climate change-air pollution co-management
1998	2012	2020
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.	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.	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.

Infographic source: Vital Strategies

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 climate change and air pollution co-management are being made using 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 concentration5—to the air quality health index.

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.

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.

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5 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 Statement[6], 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 scrapped[7]; and a total of 2,154 polluting enterprises were closed, and more than 11,000 polluting businesses and enterprises rectified[8].

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[9]. And from 2018 to 2020, the number of deaths further decreased from 15,500 to 13,500[10]. The residential coal ban alone is estimated to have averted around a thousand[11] 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)

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

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

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

[9] https://pubmed.ncbi.nlm.nih.gov/35247451/

[10] https://pubmed.ncbi.nlm.nih.gov/34941243/

[11] https://doi.org/10.4209/aaqr.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.

- 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

Jakarta, Indonesia

Using data on health impacts to prioritize clean air action

Case study developed in partnership with the Provincial Government of DKI Jakarta and the Jakarta Environment Agency

5.5 million Jakarta population size	**7.8 times** the WHO air quality guideline of 5 μg/m^3 (39 μg/m^3 annual average $PM_{2.5}$ concentrations)	**$15,840** National GDP per capita PPP	**619 MtCO$_2$** National greenhouse gas emissions per capita

Sources of emissions

Vehicle Exhaust	Coal Combustion	Construction Activities	Resuspended soil particles	Open Burning

Transportation is the leading source of emissions in Jakarta.

Overview

Jakarta, Indonesia is a bustling city that has an estimated 25 million motorized vehicles, many of which travel in from outside the city boundaries. During the dry season between May to September, residents are exposed to dangerously high levels of pollution, with daily concentration of $PM_{2.5}$ pollutants as high as 80 μg/m^3. In 2019, a source apportionment study conducted in Jakarta showed that during the dry season, up to 57% of $PM_{2.5}$ emissions came from vehicles—illustrating that transport is a key contributor to air pollution in Jakarta. More information on the sources of air pollution in Jakarta can be found in this report: https://www.vitalstrategies.org/resources/identifying-the-main-sources-of-air-pollution-in-jakarta-a-source-apportionment-study/

Although Jakarta has been battling polluted air for decades, the local government only began to take the problem more seriously in recent years. In July 2019, a citizen lawsuit was filed against seven public officials,

including the country's president and minister of health, and the governor of DKI Jakarta, alleging that they failed to uphold citizens' rights to clean air. In September 2021, after a two-year legal challenge, the central Jakarta district court ruled for the plaintiffs, imposing requirements on the national and local governments.

In early 2023, a new study published by Vital Strategies and the Environment Agency of DKI Jakarta estimated that air pollution potentially caused more than 10,000 deaths, more than 5,000 hospitalizations for cardio-respiratory diseases, and more than 7,000 adverse health outcomes in children each year in Jakarta. The total economic burden attributable to air pollution was estimated to be US$2.9 billion (2.2% of DKI Jakarta's gross regional

Vehicular emissions is the largest source of air pollution in Jakarta; more than half of air pollution comes from vehicles.

domestic product.) The study used local health and economic data to quantify and assess the impacts of air pollution in Jakarta, both on mortality and adverse health outcomes in children, providing timely evidence needed to guide city policymakers as they prioritize clean air actions to be taken to promote the public's health. More information about the study is available here: https://www.vitalstrategies.org/new-study-clean-air-action-in-jakarta-could-protect-10000-lives-and-save-billions-in-health-expenditures/. These research results have been an important motive for the city government's clean air commitments.

Enforcing Regular Vehicular Emissions Testing will yield the Greatest Health Benefits for Jakarta

Total Health Benefits from 2019-2030 for Each Strategy
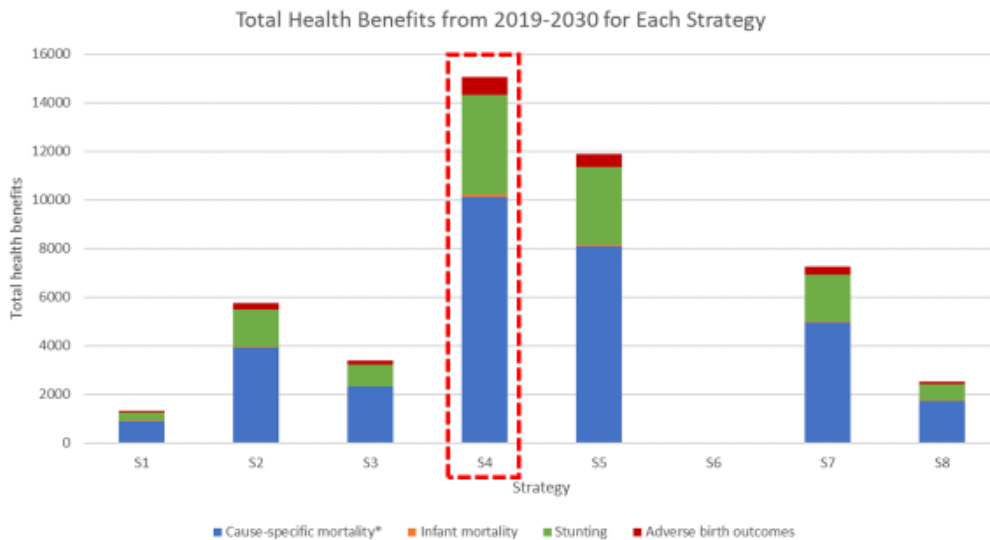
Jakarta Clean Air and Climate Strategies (2023):

- **S1:** Conversion of governmental vehicles to electric (all fleet)
- **S2:** Stringent emission standards for microbuses to comply EURO4
- **S3:** Trans-Jakarta electric buses (annual addition of unit)
- **S4:** Regular emissions testing (targeting to comply minimally to EURO2)
- **S5:** Shifting to public transportation
- **S6:** Conversion from LPG stove to electric stove
- **S7:** Dust control from construction activity
- **S8:** Ban of municipal solid waste open burning

Legend: Cause-specific mortality* ■ Infant mortality ■ Stunting ■ Adverse birth outcomes

* Deaths from air pollution, which are linked to the following diagnoses: Lower respiratory infections, type 2 diabetes, stroke, Ischemic heart disease, Chronic obstructive pulmonary disease, and lung, bronchus, trachea cancers

Vital Strategies

Impact

Elevating the linkages between climate, air pollution and health in Jakarta has been a gradual process and is now yielding results. DKI Jakarta has partnered with international NGOs, including the World Resources Institute and Vital Strategies, to formulate and guide clean air action. Vital Strategies partnered with the city health agency to develop and implement plans to improve awareness of air pollution health effects in the health sector. Vital worked closely with CIMSA (Indonesia Center for Medical Students) to conduct health promotion and education related to health impacts of air pollution.

In 2023, El Niño weather conditions and ever-rising human emissions have created an especially dangerous spike in pollution. In response, the Jakarta environment agency has laid out an action plan for air pollution control, promulgated through the Jakarta Governor's Decree No. 576/2023. To support the

For World Environment Day in June 2023 in Jakarta, medical students conducted a health promotion and education on the health impacts of air pollution and how to protect people from exposure. In addition, they also performed general health assessment, such as checking blood pressure, blood uric acid level, and blood glucose level.

implementation of those actions, Vital Strategies collaborated with the Jakarta environment agency and researchers from universities (Universitas Padjadjaran and Institut Teknologi Nasional) to conduct a cost-benefit analysis of the actions. The study found that if implemented effectively, the policy action of routine vehicle emissions compliance testing has the one of the best returns on investment when weighing health benefits against program implementation costs. These health benefits include averted premature deaths from air pollution, as well as reducing adverse health outcomes in children including infant deaths, stunting and premature birth.

As a direct result of the study, a mass emission testing event was conducted on World Environment Day in June 2023. Jakarta also invited heads of environment agencies from the surrounding cities of Tangerang, Tangerang Selatan, Bekasi, Bogor, and Depok, to the event to sign an agreement to embark on joint air pollution control efforts. This is an important step as it acknowledges that air pollution is a transboundary issue, and that regional cooperation is needed for clean air action.

> **"The DKI Jakarta government sees air pollution as a crucial issue to pay attention to. We have added air pollution control as one of our priorities as stated in our Regional Strategic Activities."**

Afan Adriansyah Idris

The Jakarta Regional Secretary's Assistant for Development and Environment

Health Highlights

- A recent health impact assessment found that air pollution in Jakarta has potentially caused more than 10,000 deaths, more than 5,000 hospitalizations for cardio-respiratory diseases, and more than 7,000 adverse health outcomes in children each year. The total economic burden attributable to air pollution was estimated to be US$2.9 billion (2.2% of DKI Jakarta's gross regional domestic product.) These research results about the negative health and economic impacts from air pollution has been an important motive for the city government's clean air commitments.

- The city is developing plans to improve awareness of air pollution health impacts in the health sector. This includes working with CIMSA (Indonesia Center for Medical Students) to conduct health promotion and education about the health impacts of air pollution.

- The city has relied on health data and benefits to prioritize the implementation of actions for air pollution control. Through a cost-benefit analysis, the city found that routine vehicle emissions compliance testing has one of the best returns on investment when weighing health benefits against program implementation costs. As a result, they are now stepping up enforcement and implementation of vehicle emissions tests.

Lessons Learned

- Support from high-level officials is paramount. Building awareness among leaders about air pollution and especially its health impacts, and potential benefits from its improvement, drives a sense of urgency which is essential to keep the issue on their list of priorities. Public advocacy is an important motivator of governmental action. In Indonesia, the victory from the citizen's lawsuit has been a significant step in making air quality a political priority. It also highlights the importance of citizen and human rights as a cornerstone to demanding change.
- Data integration of available, but underutilized city data can support clean air prioritization. Jakarta supplemented its statistical agency data with air quality monitoring data, vital statistics and health care utilization data to enable a holistic analysis of exposure, sources and health impacts.
- Understanding the specific sources of emission is essential for targeted control measures. However, pinpointing the exact contributors can be difficult. Even low-cost efforts at source apportionment and emissions inventorying can yield data for prioritizing source control strategies.
- Cross-sector collaboration and coordination is critical. Developing effective policies to control air pollution is one thing, but ensuring their successful implementation and enforcement is another challenge that requires numerous convenings among multiple stakeholders. Multisectoral collaboration can be challenging due to limited and unequal understanding about the urgency of air quality issues. In Jakarta, it has been aided by the encouragement of knowledge sharing across multiple agencies so that all stakeholders/sectors involved are aware of their roles and responsibilities to achieve the objectives of the programs/strategies.
- Encouraging sustainable results is crucial. This may require a collaborative approach, long-term goals, consistent funding and resources, and public understanding of the issue.

"The DKI Jakarta government expects that the Grand Emission Test event will stimulate public awareness to have their vehicles tested for emissions regularly. By doing so, it is hoped that the improvement of air quality in Jakarta can be achieved soon."

Asep Kuswanto

The Head of the Jakarta Provincial Environmental Agency, during the Grand Emissions Test, June 5, 2023

Strategic Partners

The city would like to acknowledge the following partners in supporting its clean air and climate journey:

- Jakarta Health Agency
- Vital Strategies
- Bloomberg Philanthropies
- Clean Air Catalyst
- World Resources Institute Indonesia
- ClimateWorks
- CIMSA
- C40
- ICLEI (International Council for Local Environmental Initiatives)
- ITDP (Institute for Transportation and Development Policy)
- KPBB (Joint Committee for Leaded Gasoline Phase-out)
- LCDI (Low Carbon Development Indonesia)

Kampala, Uganda

Health messaging to raise public support for clean air action

Case study developed in partnership with Kampala Capital City Authority

5 million Kampala population size	**7.8 times** the WHO air quality guideline of 5 µg/m^3 (39 µg/m^3 annual average PM$_{2.5}$ concentrations)	**$3,220** National GDP per capita PPP	**5.78 MtCO2e** National greenhouse gas emissions per capita

Sources of emissions

Transportation	Waste Burning	Household Cooking	Industrial Emissions

There is no clear leading emissions source in Kampala

Overview

Kampala is the economic and political capital of Uganda, with a growing resident and transient population of over 5 million. The city and its metropolitan areas contribute to over 60% of Uganda's GDP and host the largest concentration of pollution-generating activities in Uganda. People in Kampala and the metropolitan area live and work near pollution sources. Urban planning shortfalls have also precipitated the growth of dense informal settlement clusters, often intertwined with formal settlements and pollution generating activities. Based on 2021 data, it was estimated that 2,000 deaths a year, or 20% of total deaths, were attributable to long-term exposure to air pollution in Kampala,

The Kampala Climate Change Action strategy (2020-2025) recognizes the value of integrating clean air targets. However, to create even more explicit clean air targets, the Kampala Capital City Authority (KCCA) developed its Clean Air Action Plan in 2021/2022. The implementation of the three-year action plan began in 2023.

In 2018, prior to the development of the Clean Air Action Plan, the KCCA initiated air quality monitoring efforts, with actual measurements commencing in December 2019. Today, Kampala boasts a dense, integrated network of low-cost and reference-grade monitoring stations that provide real-time data access that is used to guide decision-making and monitor the effectiveness of mitigation measures. With over 65 air quality monitors installed and more in the pipeline, it is possible to tell when and where pollution is high and to communicate safety messages tailored to pollution levels both for the general public and strategic stakeholders. KCCA's air quality management plan also includes an emissions inventory to understand the leading sources of emissions, and, with support from the European Union, a source apportionment study to identify the precise sources of pollution is currently underway.

The National Environment Management Authority has also recently developed standards for ambient air in Uganda, and the city authority is in the process of contextualizing these regulations to guide enforcement. Two key sources are expected to be the subject of regulations: household use of firewood/charcoal and solid waste management.

Even though the most urban households are connected to electricity, most still rely heavily on charcoal and firewood for cooking (Figure 1), and the use of open fires and traditional stoves have a strong influence on both indoor and ambient air quality levels. In addition, management of solid waste within Kampala is still a major challenge: In total, up to about 1,400 metric tons per day are generated within Kampala's political boundaries alone. Yet, there is limited capacity for KCCA and municipal authorities within greater Kampala to safely manage all the waste generated. As a result, most of the waste is openly burned.
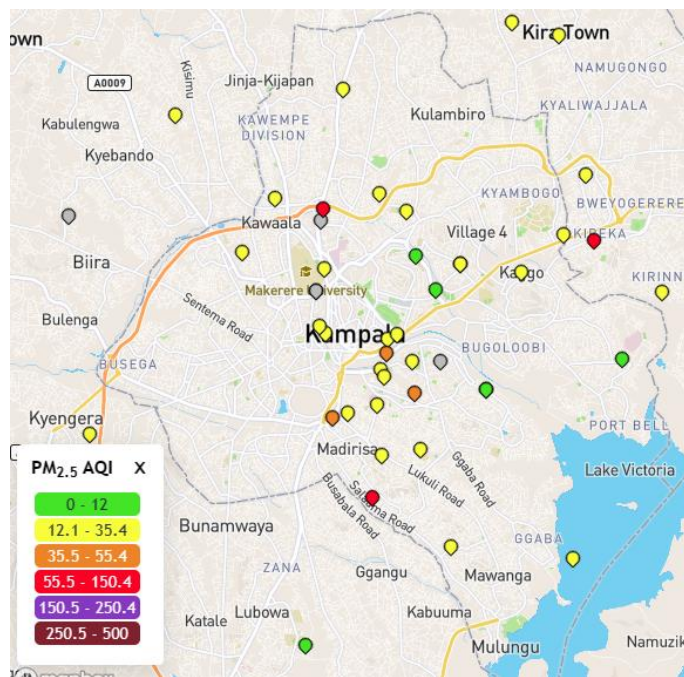
A screenshot of the Kampala Air Quality Monitoring Network (November 2023) demonstrating how air quality can vary across the city. Each colored dot represents an air quality monitor.
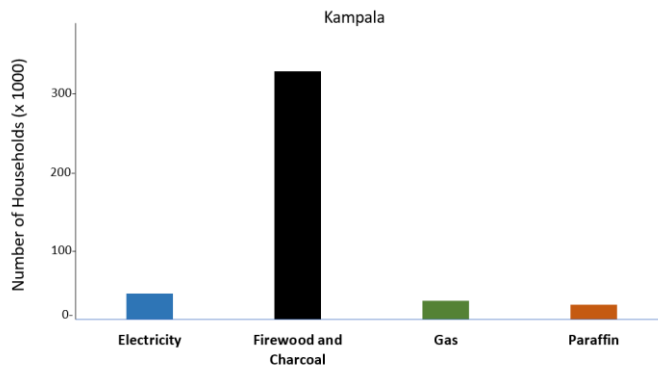

Figure 1: Proportion of Domestic Energy Profile for Greater Kampala (From UBOS, 2015)

Left Photo: Joint team from the Kampala Capital City Authority and National Environment Management Authority on spot inspection of industrial facilities in the city. In this photo, the team was assessing compliance to air pollution control standards at a steel manufacturing plant (Roofings Uganda Limited).

Right Photo: The KCCA Executive Director, Dorothy Kisaka (Right) flanked by Director Public Health and Environment, Dr Daniel Okello launching the research equipment for the source apportionment study. Expected to be completed at the end of 2023, it will present findings about the sources of air pollution in the city, and help authorities to target air pollution mitigation measures to sectors contributing most to the pollution.

"Air pollution is one of the greatest environmental health challenges to our generation that is directly related to population explosion in Kampala City. To address this, we developed the first-ever Clean Air Action Plan in 2022. Many actions are currently ongoing to manage waste, monitor air pollution levels, control pollution at the source, reduce greenhouse gas (GHG) emissions and increase awareness about the health effects of air pollution among the population."

Dorothy Kisaka

Executive Director, KCCA

Impact

One of the first priorities of the Kampala Clean Air Action Plan is improving people's knowledge about the importance of clean air. The KCCA has developed messaging based on literature reviews and published evidence on the health effects and costs of air pollution, weaving in information about multiple community benefits of reducing air pollution. To get these messages to the community, the KCCA has held press and media events alongside the National Environment Management Authority, Makerere University Lung Institute, and the Ministry of Health. In March 2023, Kampala also held its first "car free day," which involved closing some roads to vehicles, making them for walking or cycling only. This event, which is expected to be held regularly, demonstrates and promotes the use of car-free mobility. The event included a community health campaign, so participants were able to screen for various illnesses, donate blood, and participate in physical activities. The initiative attracted senior government officials, including the state minister for Kampala, who spoke to the media about air pollution mitigation measures.

Photos Above: In March 2023, Kampala organised its first ever car free day. The event included community health screening, physical activities, and the promotion of active mobility. It demonstrated that roads aren't for cars alone, a message to promote active transport in the city and to remind motorists to protect pedestrians.

KCCA is also working with health experts to design and produce research outputs and technical reports on air quality. As part of the Partnership for Healthy Cities, KCCA is working with the Makerere University Lung Institute, Vital Strategies and Eastern Africa GEOHealth Hub to conduct health-related studies on the air quality in Kampala, with a plan to translate these research outputs into specific policy initiatives.

In addition, Kampala has found it useful to leverage the health sector's network and experience in risk communication. The house-to-house approach that was reinforced during the COVID-19 pandemic and more recently the Ebola virus disease outbreak has enabled the communication campaign to reach the community. Because many sources of Kampala's pollutants are locally generated, having the support of the population will be extremely critical in accelerating policy formulation and behavior change for specific air quality control measures in the city.

Health Highlights

- The Kampala city government relies on the expertise and credibility of their health community, including academia and the Ministry of Health, to emphasize the importance of clean air to various stakeholders, such as decision-makers, health workers and the general public. The health messaging is based on literature reviews and published evidence on the health effects and costs of air pollution.

- The city organized its first "car-free day" in March 2023, which involved closing some roads to vehicles, making them for walking or cycling only. The event included a community health campaign, where participants were able to screen for various illnesses, donate blood, and participate in physical activities.

- The city is currently working with working with the Makerere University Lung Institute, Vital Strategies and Eastern Africa GEOHealth Hub to conduct health-related studies on the air quality in Kampala, with a plan to translate these research outputs into specific policy initiatives.

- The city has also leveraged the health sector's network and experience to disseminate information about air pollution risks and impacts. They adopted the house-to-house approach that was reinforced during the COVID-19 pandemic and the Ebola outbreak. Because many sources of Kampala's pollutants are locally generated, having the support of the population will be extremely critical in accelerating policy formulation and behavior change for specific air quality control measures in the city.

"Deaths attributable to air pollution are more than HIV/AIDS deaths! This means that the simple act of breathing kills more people than HIV/AIDS. While I don't intend to undermine the HIV/AIDS epidemic control efforts, I call upon everyone to give air pollution control as much attention as we give other health epidemics."

Dr Daniel Ayen Okello

Director Public health and environment, KCCA

Lessons Learned

While one of the key concerns when implementing clean air action plans is maintaining the balance between livelihoods and air pollution mitigation, Kampala found that emphasizing the health benefits of clean air can be an effective way of getting communities to invest in interventions such as paying for their trash to be collected rather than burning it.

When the level of knowledge on the impacts of air pollution is low, focusing on its health effects resonates with stakeholders.

Lower-income communities often suffer disproportionately from air pollution emitted by more privileged communities and economic actors. The KCCA is developing an innovative policy to empower citizen enforcement and reporting of air pollution emissions offenders.

It is important to operate a multi-stakeholder system to achieve air quality goals. This includes health authorities, environmental authorities, transport, energy, manufacturing and enforcement.

Strategic Partners

The city would like to acknowledge the following partners in supporting its clean air and climate journey:

- European Union
- United Nations Environment Program (UNEP)
- Partnership for Healthy Cities
- World Health Organization
- Bloomberg Philanthropies
- Vital Strategies
- U.S. Embassy in Kampala
- Health Effects Institute
- Makerere University Kampala
- National Environment Management Authority
- Eastern Africa GEOHealth Hub
- Environment Compliance Institute
- Makerere University AirQo

New York City, USA

Identifying and eliminating a leading source of pollution using enhanced local air quality monitoring

Case study developed in partnership with the New York City Department of Health and Mental Hygiene

8.3 million New York City population size	**1.6 times** the WHO air quality guideline of 5 μg/m^3 (8 μg/m^3 annual average PM$_{2.5}$ concentrations)	**$80,410** National GDP per capita PPP	**5,007 MtCO2e** National greenhouse gas emissions per capita

Sources of emissions

Commercial Cooking

Industry

Transportation (Non-Public)

Building Heating

Commercial cooking is the leading source of PM2.5 emissions in New York City

Overview

New York City established its first sustainability plan in 2007, envisioning a city committed to growth and carbon mitigation. The city's Department of Health and Mental Hygiene successfully argued for the importance of a robust system to evaluate local sources of air polluting emissions and track their trends. As a result, the city established the New York City Community Air Survey (NYCCAS) program, which designed and deployed across the city lamppost-mounted air pollution monitoring devices to measure key pollutants. NYCCAS marked the first time the health department was responsible for monitoring ambient air quality. This decision reflected a growing understanding that a significant health burden from air pollution occurs even at levels of pollution that may be compliant with standards, but still too high for safety. By giving responsibility to the health department, the city recognized that policy improvements would need to be driven by health concerns and by the potential for health benefits.

NYCCAS data is used to:

- Help inform New York City's sustainability plan

- Estimate the health impact of exposures and the health benefits from policy options

- Drive legislative and regulatory changes to reduce local sources of emissions

- Track changes in air quality over time

- Inform the public about local topics such as recent air quality improvements, climate-friendly initiatives like car-free zones, and changes in the sources of air pollution

- Highlight disparities in exposures and health impacts across NYC neighborhoods

- Provide high-quality data to academic investigators for air quality studies

NYCCAS is the largest ongoing urban air monitoring program of any U.S. city and has been measuring citywide fine particulate matter, nitrogen dioxide, nitric oxide, black carbon, wintertime sulfur dioxide and summertime ozone for more than a decade. Since the inception of the program in 2008, there has been a remarkable decrease in air pollution levels.

Where there are no monitors, air quality data is approximated using a land-use regression model. This means integrating data on factors known to influence air quality, including land use, population and building density, traffic, and other natural and built environmental characteristics.

Data from NYCCAS is routinely analyzed and made available to the public on a dedicated [website - https://www.nyc.gov/site/doh/data/data-sets/air-quality-nyc-community-air-survey.page](https://www.nyc.gov/site/doh/data/data-sets/air-quality-nyc-community-air-survey.page). The website is used to highlight pollution trends and reveal beneficial impacts of air quality regulations to garner more support for climate-friendly policies.

Location of NYCCAS network sensors. Blue markers are locations selected based on their pollution characteristics—industrial, residential, commercial, and high traffic areas. Green markers are newly added sites with populations at greater risk of air quality-related health impact.

Table: Decline in Air Pollution From 2008 to 2021

Pollutant	Decease in %
Fine Particles ($PM_{2.5}$)	↓ 40%
Nitrogen Dioxide (NO_2)	↓ 38%
Nitric Oxide (NO)	↓ 58%
Sulfur Dioxide (SO_2)	↓ 97%

Impact

NYCCAS data has been used to identify and address leading sources of pollution in the city. For example, NYCCAS's first ever report in 2009 on wintertime air quality identified high levels of pollution in areas where buildings were using residual fuel oil for heating (i.e., heavy oil). These sulfur-heavy oils were a major source of sulfur dioxide (SO2) in New York City. The health department estimated the number of lives lost and hospitalizations caused by this source and used the data to convince the mayor's office to support a rapid phase-out, resulting in the Clean Heating Law of 2010 that mandated use of cleaner fuels for residential buildings by 2015.

But changing the law was not enough. Because building owners were expected to fund the upgrades themselves, NYCCAS data were also used to identify economically disadvantaged neighborhoods where compliance would be more difficult. The neighborhood-scale data on air pollution and disproportionate health impacts helped the city prioritize neighborhoods for financial assistance for converting to cleaner fuel technology.
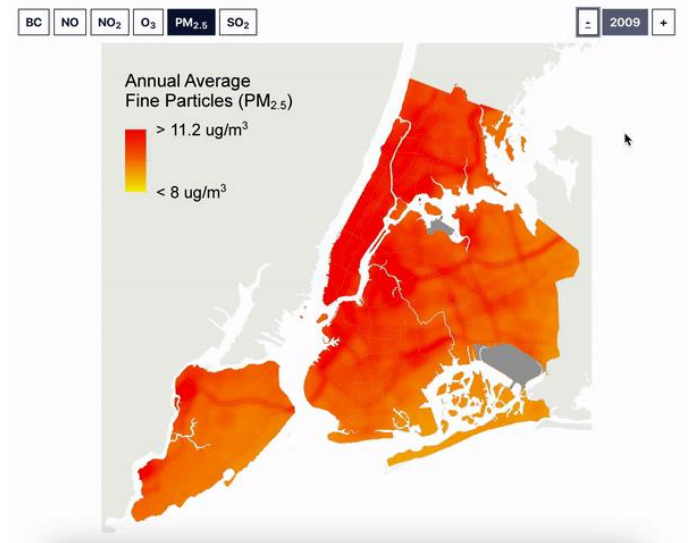
Changes in PM$_{2.5}$ levels over time using annual average pollution maps. Source: https://a816-dohbesp.nyc.gov/IndicatorPublic/beta/key-topics/airquality/nyccas/

"Focusing on what the data is telling us is critical. Being able to say that commercial cooking contributes to higher levels of PM in some NYC neighborhoods so let's push hard on this, is ultimately what matters"

Sarah Johnson

Executive Director, Air Quality Program, New York City Department of Health and Mental Hygiene

Continued monitoring by NYCCAS revealed that air quality improved significantly after the law, resulting in the prevention of an estimated 290 premature deaths, 180 hospital admissions for respiratory and cardiovascular disease, and 550 emergency department visits for asthma each year.[12]

NYCCAS also identified restaurant emissions as an important unregulated source of local emissions. The use of char broilers and open-fire grills in restaurants contributed a significant proportion of the city's ambient $PM_{2.5}$ pollution. The combined evidence of emissions and their health impacts led to local regulations requiring the phase-in of emissions control devices in restaurants.

There have been many other significant wins. New York City's record of promoting rules to curtail greenhouse gas emissions has been informed by NYCCAS' efforts to estimate the health and economic co-benefits of these laws. The NYCCAS team continues to work with the Mayor's Office of Climate and Environmental Justice to identify indicators (such as asthma-related emergency department visits attributable to air pollution) to prioritize neighborhoods for interventions where the health impacts of air pollution are the highest. Originally funded with mayoral discretionary funds, NYCCAS is now mandated by law following the New York City Council's passage of Local Law 103 of 2015, which amended the city's administrative code to require the health department's air quality monitoring and annual reporting of findings.

Health Highlights

- NYCCAS marked the first time the health department was responsible for monitoring ambient air quality in the city. This decision reflected a growing understanding that a significant health burden from air pollution occurs even at levels of pollution that may be compliant with standards, but still too high for safety. By giving responsibility to the health department, the city recognized that policy improvements would need to be driven by health concerns and by the potential for health benefits.

- The hyper-local air quality data from the NYCCAS network helped the city identify a leading source of pollution, i.e., residential heating fuel. The health department estimated the number of lives lost and hospitalizations caused by this source and used the data to convince the mayor's office to support a rapid phase-out, resulting in the Clean Heating Law of 2010 that mandated use of cleaner fuels for residential buildings by 2015.

- Continued monitoring by NYCCAS revealed that air quality improved substantially after the law came into force, resulting in the prevention of an estimated 290 premature deaths, 180 hospital admissions for respiratory and cardiovascular disease, and 550 emergency department visits for asthma each year.

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[12] Kheirbek, Iyad, Jay Haney, Sharon Douglas, Kazuhiko Ito, Steven Caputo Jr, and Thomas Matte. "The public health benefits of reducing fine particulate matter through conversion to cleaner heating fuels in New York City." *Environmental science & technology* 48, no. 23 (2014): 13573-13582.

Lessons Learned

- Air quality evaluation is an essential component of climate action planning, as health and economic co-benefits of emissions curbs can serve to support climate laws.
- It's important to have clarity about the purpose of air quality monitoring. The type of air quality monitoring system needed should be determined by what questions the monitoring data is expected to address, such as identifying pollution sources, evaluating geographically targeted clean air interventions, etc.
- A city may be compliant with air quality guidelines, but there remains significant opportunity for further improvements to influence population health.

Commercial cooking in New York City is a leading source of emissions for the city.

- The investment of resources to characterize key local sources of air pollution yields a huge return when the health benefits of air quality improvement are factored in.
- Making routine air quality data publicly available is critical for clean air action. In addition, it is crucial to make sure there are sufficient staff and other resources to analyze the data and identify actionable paths for a range of audiences.
- Sharing data is only meaningful if there is an audience and the information is presented in a way the audience can understand. New York City conducts community meetings and journalist trainings and offers school curricula to build a group of data users.

Strategic Partners

The city would like to acknowledge the following partners in supporting its clean air and climate journey:

- Barry Commoner Center for Health and the Environment, Queens College City University of New York
- NYC Mayor's Office of Climate & Environmental Justice
- NYC Department of Environmental Protection
- New York State Department of Environmental Conservation
- New York State Energy Research and Development Authority

Lessons Learned

What can we learn from these cities?

The diversity of the cities and their real-world solutions integrating public health show how every city can do something to promote clean air, climate and health now.

Accra, Barranquilla, Beijing, Jakarta, Kampala, and New York are cities with differing levels of socio-economic development. They have different sources and levels of pollution to address, and varying levels of air quality data and management capacity and resources. They are also at different points on their journey to clean air, with some of the cities are at a more advanced stage, showcasing measurable air quality and health benefits that they are proud of. This is evident in New York and Beijing, which have been working against air pollution for over a decade, and have achieved significant reductions in air pollution levels. Contrast this with Kampala and Barranquilla, which are only just starting their air quality efforts but have managed to leverage health sector engagement to build momentum and make sustainable change.

Overall, we discuss the key learnings below.

Expand the innovative collection and use of air quality data

- **Air quality monitoring should be fit to purpose, and carefully designed to address questions prioritized by the city.** While air quality monitoring is a critical first step in clean air action, it need not follow the traditional path of relying on reference grade monitors. There are a range of lower cost and innovative solutions available. Air quality monitoring systems can integrate data from a range of sources at different spatial resolutions, including remote sensing data from satellites, gravimetric samplers that can also identify leading sources of pollution, and low-cost sensor networks. In the case of New York, they also relied on land use regression to determine air quality levels where there were no monitors.

- **Resources need to be invested for the analysis and communication of data.** Simply providing the data for technical stakeholders is insufficient. Data must be publicly available and accessible to a wide range of audiences. To maximize data use, key stakeholders need to be constantly reminded about the data being collected, and shown its relevance for decision-making and informing the public.
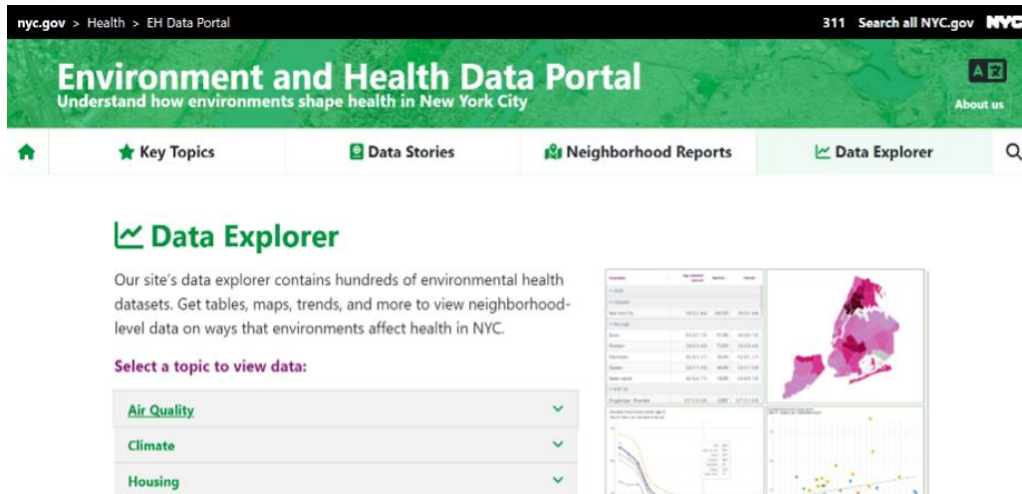

Photo Above: Screengrab from the New York City Environmental Health Data Portal, which makes abundant data, stories and knowledge about environmental and climate health

- **Characterizing trends in the leading sources of pollutant emissions is critical to prioritizing control measures.** This should include consideration of leading local sources of pollution, as well as the contribution from regional sources, including agricultural burning, desert dust, or industries located outside city limits.

Photo Above: In recognition that air pollution is a transboundary issue, the Jakarta city government and its surrounding cities signed a joint commitment in June 2023 to improve air quality in the entire region.

Integrate health data and messaging

- **Effective health messaging will resonate with a wide range of stakeholders, from community members to high-level decision makers.** Integrated data from air quality monitors and routinely collected health data has many applications and uses. They can be used to communicate the health impacts of air pollution at a local level. Once there is a general awareness of the links between air pollution and health, stakeholders are often keen on getting more quantitative estimates of potential health gains of proposed actions. Emphasizing health benefits of clean air action can be an effective way of gaining public support for proposed actions. In some cases, it may also help promote behavior change needed at the community level, for example, to reduce waste burning.

- **Health data provides the ability to quantify expected short-term benefits of climate and clean air action, which are often more tangible than longer-term impacts on climate which may not be realized for decades.** Quantifying the potential health benefits can increase the political will and the investment case for proposed interventions. This is particularly true when bundled with estimates of other desired benefits, such as climate co-benefits, increased pedestrian access or more green space. At the same time, residents are interested in the wide range of social, economic, and lifestyle benefits associated with clean air and climate action and should be made aware of how actions will affect them and their families over the short and long term.

- **Health data should be used to evaluate the impact of clean air and climate actions.** The widespread communication of successes and results can redirect attention and demand for the most effective solutions.

Establish good governance and coordination

- **Strong legislation and systematic planning is necessary to ensure that air pollution interventions are effectively implemented.** More importantly, these new laws must be coupled with effective regulation and enforcement.

- **Cross-sector collaboration and coordination is critical.** As climate and air pollution are multi-sectorial issues, an effective multi-stakeholder system is needed. This includes health authorities, environmental agencies, transport, energy, manufacturing and enforcement. Cities need a cooperative setting with well-established mechanisms of knowledge sharing across agencies so that all stakeholders involved are aware of their roles and responsibilities to achieve the objectives of the program.

- **Support from high-level officials is paramount in aligning institutional goals.** This will ensure the achievement of workflow synergies across sectors, facilitates both downstream and upstream transfer of critical data and institutional resource needs in a self-sustaining way.

- **Encouraging sustainable results is crucial.** This may require a collaborative approach, long-term goals, consistent funding and resources, and public awareness.

Targeted advocacy and consistent communication are essential

- **Leverage innovative means to elevate the importance of clean air to lawmakers.** In the case of Indonesia, the victory from the citizen's lawsuit has been a significant step in making air quality a political priority. It also highlights the importance of citizen and human rights as a cornerstone to demanding change.

- **Financial incentives should not only be reserved for industries but also for citizens.** For instance in Beijing, citizens received subsidies for switching from coal to gas for heating. And in New York, financial assistance was offered to building owners for converting to cleaner fuel technology. Incentives can be paired with public education to encourage citizens to change their behaviors and lifestyle. When they understand the full benefits of these changes, the public can not only more easily adapt to the change but also advocate for change.

- **Communication should be targeted to specific groups and address their concerns and vulnerabilities.** For example, people in specific occupations, parents of young children, people living with underlying health conditions or people residing in areas of high pollution may all have different concerns.

- **Consistent engagement with media is critical for maintaining public interest and momentum.** For example, Accra used television, radio and print media to effectively communicate climate and air pollution impacts which in turn led to a measurable uptick in air pollution stories being featured in the local media.

Conclusion

Each of these cities are fundamentally different and has had to develop their own set of unique actions to advance their climate and clean air plans. These efforts are already serving as blueprints for other cities in their regions. For example, many African city representatives are travelling to Accra to learn about their successes so they can replicate them in their own cities. A common theme among all the showcased cities has been their engagement of the health sector and their active use of health data and messaging to accelerate support for climate and clean air solutions. **When we can prove there are immediate health benefits, people will be motivated to act for a better climate and a healthier future.**

Resources

To learn more about air pollution, climate and health, explore the following links:

Statistics on Air Pollution

Poor air quality is bad for our health, planet and economies. Here are some statistics and facts about air pollution to help make the case for clean air. https://www.cleanairfund.org/theme/facts-and-stats/

Air Pollution Myths and Facts

Explore common myths and facts related to air pollution. https://www.vitalstrategies.org/air-pollution-myths/

Climate and Air Pollution

Both air pollution and climate change are mainly caused by burning fossil fuels—and many of the solutions are the same. Cleaning our air is one of the most immediate ways to protect the planet. https://www.cleanairfund.org/theme/climate/

A Call to Action: Air Pollution in Early Childhood

Learn about why air pollution is particularly harmful in the early years. https://www.vitalstrategies.org/resources/a-call-to-action-air-pollution-in-early-childhood/

Clean Air is Everyone's Business

This publication explore how tackling air pollution has benefits for five global issues: climate, public health, childhood development, social justice, and cities and mobility. https://www.cleanairfund.org/resource/clean-air-is-everyones-business/

Accelerating City Progress on Clean Air: Innovation and Action Guide

This guide fast-tracks proven approaches and innovations for rapid air quality improvements. It is created for government officials, their partners and other stakeholders developing clean air programs for cities and other urban areas in low- and middle-income countries. https://www.vitalstrategies.org/resources/accelerating-city-progress-on-clean-air-innovation-and-action-guide/

The State of Global Air Quality Funding 2023

A global analysis of the funding from international development donors to tackle air pollution, revealing that only 1% of international development funding went to clean air projects. https://www.cleanairfund.org/resource/state-of-global-air-quality-funding-2023/

From Pollution to Solution in Africa's Cities

This report looks at the potential benefits of tackling air pollution and climate change together in four cities: Cairo, Lagos, Johannesburg and Accra. https://www.cleanairfund.org/clean-air-africas-cities/

To stay connected to the latest news, views and insights from the clean air movement, please subscribe to the **Clean Air Fund** newsletter through this link: https://www.cleanairfund.org/subscribe/

To be in the first to know about public health news, publications and interviews, please subscribe to the **Vital Strategies** email list through this link: https://bit.ly/vitalstrategies_newsletter

Contact

Email: info@cleanairforhealth.org

Share your successes:

These cities are examples of successful efforts around the world. Is there exciting progress underway in your city? If so, we would love to hear from you through this form

QR code for form

Clean Air Fund is a global philanthropic organisation working with governments, funders, businesses and campaigners to create a future where everyone breathes clean air. We fund and partner with organisations that promote air quality data, build public demand for clean air and drive policy change.
https://www.cleanairfund.org/

Vital Strategies believes every person should be protected by an equitable and effective public health system. We work with governments, communities, and organizations around the world to reimagine public health so that health is supported in all the places we live, work and play. The result is millions of people living longer, healthier lives.
https://www.vitalstrategies.org/