MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
DEPARTMENT OF ENVIRONMENT

Bangladesh National Air Quality Management Plan 2024-2030

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LIST OF ACRONYMS

ABMEAB	Accumulator Battery Manufacturers & Exporters Association of Bangladesh
AOD	Aerosol optical depth
APCR	Air Pollution Control Rules
AQG	Air Quality Guideline
AQI	Air Quality Index
AQM	Air quality management
BADC	Bangladesh Agricultural Development Corporation
BAMM	Beta Attenuation Mass Monitor
BAQ	Better air quality
BARC	Bangladesh Agriculture Research Council
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BBTOA	Bangladesh Bus Truck Owners Association
BCAP	Bangladesh Clean Air Project
BERC	Bangladesh Energy Regulatory Commission
BESF	Bangladesh Environmental Statistics Framework
BEST	Bangladesh Environmental Sustainability and Transformation Project
BIDA	Bangladesh Investment Development Authority
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BLRI	Bangladesh Livestock Research Institute
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BRTA	Bangladesh Road Transport Authority
BRTC	Bangladesh Road Transport Corporation
BSTI	Bangladesh Standards and Testing Institution
BTEB	Bangladesh Technical Education Board
BUET	Bangladesh University of Engineering and Technology
CAMS	Continuous air monitoring station
CCAC	Climate and Clean Air Coalition
CD	Cabinet Division
CDA	Chattogram Development Authority
CEB	Compressed earth blocks
CEMP	Continuous emissions monitoring program
CEMS	Continuous emissions monitoring system
CH_4	Methane
CO_2	Carbon dioxide
COP	Conference of the Parties
COPD	Chronic obstructive pulmonary disease

DAE	Department of Agricultural Extension
DESCO	Dhaka Electric Supply Company Limited
DGHS	Directorate General of Health Services
DIFE	Department of Inspection for Factories and Establishments
DLS	Department of Livestock Services
DMTCL	Dhaka Mass Transport Company Limited DPDC Dhaka Power Distribution Company Limited
DPE	Directorate of Primary Education
DSHE	Directorate of Secondary and Higher Education
DTCA	Dhaka Transport Coordination Authority
DTE	Department of Technical Education
ECA	Environment Conservation Act
ECR	Environment Conservation Rule
EED	Education Engineering Department EIB European Investment Bank
EMRD	Energy and Mineral Resources Division
EPR	Extended Producer Responsibility
ESP	Electrostatic Precipitator EU European Union
EV	Electric vehicle
FBCCI	Federation of Bangladesh Chambers of Commerce and Industry
FD	Finance Division
FID	Financial Institutions Division
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies
GCRD	Green and Climate Resilient Development
GDA	Greater Dhaka Area
GDP	Gross domestic product
GED	General Economics Division
GHG	Greenhouse gas GIZ Deutsche Gesellschaft für Internationale Zusammenarbeit
HAP	Household air pollution
HAPCP	Heavy Air Pollution Contingency Plan
HED	Health Engineering Department
IAP	Indoor air pollution
ICIMOD	International Centre for Integrated Mountain Development
ICS	Improved cookstove
ICT	Information and communication technology
ICTD	Information and Communication Technology Division
IDCOL	Infrastructure Development Company Limited
IGP	Indo-Gangetic Plains
INR	Indian rupee
IPCCAR	Intergovernmental Panel on Climate Change Assessment Report
JICA	Japan International Cooperation Agency
KDA	Khulna Development Authority
LDV	Light diesel vehicle
LGD	Local Government Division
LGI	Local government institutions
LNG	Liquified natural gas
LPG	Liquified petroleum gas
MoA	Ministry of Agriculture
MoC	Ministry of Commerce
MoEFCC	Ministry of Environment, Forest and Climate Change
MoF	Ministry of Finance
MoFA	Ministry of Foreign Affairs MoFL Ministry of Fisheries and Livestock MoHPW Ministry of Housing and Public Works
MoHFW	Ministry of Health and Family Welfare
MoI	Ministry of Industries
MoLGRDC	Ministry of Local Government, Rural Development and Co-operatives

MoPA	Ministry of Public Administration
MoPEMR	Ministry of Power, Energy and Mineral Resources
MoPME	Ministry of Primary and Mass Education
MoR	Ministry of Railways
MoRTB	Ministry of Road Transport and Bridges
MoS	Ministry of Shipping
MoST	Ministry of Science and Technology
MW	Megawatt
NAQMP	National Air Quality Management Plan
NBR	National Board of Revenue
NCAPC	National Committee on Air Pollution Control
NCTB	National Curriculum and Textbook Board
NDC	Nationally Determined Contribution
NGOs	nongovernmental organizations
NH_3	Ammonia
NLDCC	National Logistics Development Coordination Committee
NO	Nitric oxide
NO_2	Nitrous oxide
NO_x	Nitrogen oxides
NSDA	National Skills Development Authority
O_3	Ground-level ozone
Pb	Lead
PD	Power Division
PM	Particulate matter
$PM_{2.5}$	Particulate matter with diameter equal to or smaller than 2.5 micrometers (μm)
PM_{10}	Particulate matter with diameter equal to or smaller than 10 micrometers (μm)
PPM	Primary $PM_{2.5}$
PMO	Prime Minister`s Office
PSD	Public Security Division
QAQC	Quality assurance and quality control
REHAB	Real Estate & Housing Association of Bangladesh
RTHD	Road Transport and Highways Division
SAARC	South Asian Association for Regional Cooperation
SAR	South Asia Region
SEA	Strategic Environmental Assessment
SLCP	Short-lived climate pollutant
SME	Small and Medium-Sized Enterprises
SO_2	Sulfur dioxide
SO_x	Sulfur oxides
SPM	Scondary $PM_{2.5}$
SREDA	Sustainable and Renewable Energy Development Authority
μg/m³	Microgram (one-millionth of a gram) per cubic meter
UDD	Urban Development Directorate
UGC	University Grants Commission
UNFCCC	United Nations Framework Convention on Climate Change
USD	Utility Services Department
VAT	Value-added tax
VOC	Volatile organic compound
WASA	Water Supply and Sewerage Authority
WHO	World Health Organization
WRF	Weather Research and Forecasting Model

Note: All dollar ($) amounts are in US dollars except when specified otherwise.

EXECUTIVE SUMMARY

The Bangladesh National Air Quality Management Plan (NAQMP or "the Plan") was developed with the purpose of outlining a clear pathway and the actions required for Bangladesh to meet World Health Organization (WHO) Interim Target 1 for annual $PM_{2.5}$, as well as the country's own air quality standards, while contributing to the South Asia Clean Air Vision 2030. The NAQMP is aimed at government entities across multiple ministries and agencies, development partners, and the public responsible for its implementation in Bangladesh.

The NAQMP was designed by the Ministry of Environment, Forest and Climate Change (MoEFCC) and the Department of Environment (DoE),* with contributions from the member ministries and agencies of the National Committee on Air Pollution Control (NCAPC). From February to September 2024, the MoEFCC and the DoE conducted a series of stakeholder consultations in the form of workshops, review meetings and inter-ministerial meetings. The inter-ministerial meetings were chaired by the Secretary, MoEFCC. Finally, the NAQMP was submitted to the NCAPC on September 22, 2024. The Committee reviewed and thankfully acknowledged the leadership of the MoEFCC in formulating the Plan, and extended directives to all concerned ministries, divisions, departments and organizations to undertake initiatives to implement the time-bound activities as set out in the NAQMP.

The Plan draws on current data about air pollution levels and sources across Bangladesh (Section 2). It assesses the air quality management (AQM) governance framework (Section 3), abatement options to reduce emissions and to improve air quality (Section 4) and considers the complex influence of Bangladesh's location in a highly polluted region (Section 5). The Plan aligns with the Bangladesh Air Pollution Control Rules 2022, and other national strategies, including the 2018 National Action Plan for Reducing Short-Lived Climate Pollutants and Bangladesh's 2021 Nationally Determined Contributions (NDCs).

The Plan proposes cost-effective policies, investments, and capacity-building activities to achieve two key targets by 2030: (a) improve the annual population-weighted concentration of ambient $PM_{2.5}$ in Bangladesh by 15 $\mu g/m^3$ and in the Greater Dhaka Area (GDA) by 30 $\mu g/m^3$, and (b) increase the number of days with "good" or "moderate" Air Quality Index (AQI) across the country. Beneficiaries include the general population of Bangladesh and the global community, particularly in the Indo-Gangetic Plains and Himalayan Foothills (IGP-HF), who will experience cleaner air, improved health, enhanced productivity, and climate change mitigation.

The following key findings summarize the most significant insights and analyses of this document:

• Urgent action needed. Air pollution in Bangladesh is worsening, causing significant health impacts during life (morbidity), at the end of life (mortality), and at the beginning of life, including premature births and low birth weights. In 2019, it caused 159,000 premature deaths, and 2.5 billion days lived with illness.

• Diverse pollution sources. Air pollution originates from various sources. New studies based on the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model indicate the major contributors to air pollution in the GDA. Overall, emission sources within the GDA account for 56 percent of the population-weighted annual mean $PM_{2.5}$ exposure (or 47 $\mu g/m^3$ out of 84 $\mu g/m^3$ in 2020), while 15.9 percent originates in other regions of Bangladesh, nearly 21 percent from other countries, and 7.1 percent from natural sources (soil dust). Breaking down the 56 percent of ambient $PM_{2.5}$ that originates within the GDA shows the following: the largest share (28 percent) can be traced to households (mainly biomass cookstoves), followed by power plants (24 percent), brick kilns (13 percent), and open burning of municipal solid waste (11 percent). Road dust accounts for about 8 percent, and exhaust emissions from road transport for 4 percent (mainly from heavy-duty diesel vehicles).

* *To design the Plan, MoEFCC and DoE received the financial and technical support provided from the World Bank, including through grants from the Korea Green Growth Trust Fund, PROBLUE, the Global Program on Sustainability, and the Resilient Asia Program.*

• Shared responsibility. The MoEFCC and DoE hold the primary responsibility for AQM, while the NCAPC coordinates the implementation of the NAQMP across various government agencies. However, multiple government agencies must do their part in implementing the NAQMP and achieving the proposed outcomes, especially by reducing emissions in key sectors.

• Balancing enforcement and incentives. Environmental policy instruments need to be diversified and strengthened, moving beyond the typical command-and-control approach that relies on regulations and sanctions for non-compliance. Incentive-based strategies may include economic and market-based instruments such as repurposed energy subsidies, carbon taxes, and green credit guarantees, as well as incentives for households to adopt cleaner fuels and for industries to use cleaner technologies.

The following key calls to action outline the main interventions proposed in the Plan - all of which require immediate action - for the Government of Bangladesh (GoB) to address the improvement and management of air quality:

• Strengthen enforcement and disclose information. The DoE will implement a continuous emissions monitoring program (CEMP) to measure air pollutant emissions. Real-time monitoring devices installed in targeted facilities will transmit data to the DoE's continuous emissions monitoring system (CEMS). The DoE will disclose this information on the CEMP website and initiate enforcement protocols following data analysis and validation.

• Adopt fiscal instruments for air quality management. The GoB will adopt fiscal instruments targeting major sources of air pollution, such as carbon tax, emission tax for vehicles, tax breaks for electric vehicles and green technology, tax credits for small businesses to improve indoor air quality in their facilities, repurposing of harmful subsidies and emissions charges.

• Promote access to clean cooking. The Government will establish a national clean cooking program to improve access to clean cooking solutions. This program will include incentives for households to transition from solid fuels to electric, LPG, or solar cookstoves.

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• Implement abatement measures in power and industry sectors. Multiple government agencies will implement interventions to reduce emissions in power plants and heavy industries, including brick kilns, cement factories, and iron and steel mills. These measures may include stricter emission standards, installation of emission control devices, investment in renewables for electricity generation, and incentives, subsidies, and tax breaks for manufacturers that adopt clean technologies.

Reduce emissions from the transport sector. Various government agencies will adopt measures to improve fuel quality, enforce traffic control and effective management systems, enforce vehicle emissions inspections, restrict high-emission vehicles on the roads (both heavy and light duty, including those with expired economic life), optimize urban layout strategies to prioritize sustainable transportation modes, and incentivize mass, nonmotorized, and electric mobility.

To measure progress in achieving its objectives, the NAQMP established a monitoring and evaluation system, describing the timeline, outputs, responsible agencies to implement target interventions, and results indicators. MoEFCC, DoE and all sector agencies must report to the NCAPC on the implementation of their assigned interventions.

1

INTRODUCTION

While Bangladesh has experienced significant economic growth and improvement in its human development indicators in recent years, this has been accompanied by a rapid increase in air pollution. Today, Bangladesh's air ranks among the most polluted countries in the world. Even among the cities on the heavily polluted Indo-Gangetic Plains (IGP), Dhaka is one of the most polluted. Annual average levels of ambient (outdoor) fine particulate matter ($PM_{2.5}$) across Bangladesh range from 60 to 100 µg/m³ while in Dhaka they are 90–100 µg/m³. This is many times higher than WHO's air quality guideline (AQG) annual value of 5 µg/m³ and Bangladesh's own current standard of 35 µg/m³. Exposure to high levels of air pollution has massive public health impacts. Today, air pollution is the third highest health risk factor in Bangladesh.

The air pollutant of highest public health concern is $PM_{2.5}$. This consists of fine particulate matter that is equal to or smaller than 2.5 µm (2.5 micrometers), which can penetrate through the respiratory system deep into the lungs. While it may take decades for Bangladesh to achieve the WHO AQG, countries of South Asia have set a Clean Air Vision 2030 to achieve WHO's Interim Target 1 for annual average of $PM_{2.5}$ of 35 µg/m³ by the start of the next decade. Achieving this vision in Bangladesh requires investments in cleaner energy for households, cleaner fuels, and abatement measures for the power sector. This vision requires eliminating the open burning of waste, reducing road and construction dust, and renewing/retrofitting the heavy-duty trucking fleet, among other abatement measures, focusing particularly on year-round sources of pollution. It requires addressing many different sources of $PM_{2.5,}$ including sources that directly emit into the atmosphere (primary $PM_{2.5}$), and sources that result in the formation of "secondary $PM_{2.5}$" through chemical reactions in the atmosphere between nitrogen oxides (NO_x), sulfur dioxide (SO_2), and ammonia (NH_3). Achieving this vision will require strong institutional capacity, including interagency coordination, as well as diversified policy instruments and a robust monitoring network, among other interventions.

The objective of the Bangladesh National Air Quality Management Plan (hereinafter "the NAQMP" or "the Plan") is to describe a clear pathway and the actions necessary for Bangladesh to achieve WHO's Interim Target 1 for annual $PM_{2.5}$ (and the country's own air quality standards) and contribute to the South Asia Clean Air Vision 2030.[1] As per Clause 4 of the Air Pollution Control Rules (APCR), the Plan sets forth time-bound priority interventions across targeted sectors through 2030, to control and mitigate both ambient and indoor air pollution.[2] While the focus of the NAQMP is on reducing the average exposure of Bangladeshi citizens to $PM_{2.5}$, it also addresses other pollutants of concern, including coarse particulates such as construction dust, as well as gases such as ozone, NO_x and sulfur oxides (SO_x). In fact, the latter two react in the atmosphere and form particulate matter; this pathway results in a source of secondary $PM_{2.5}$ (SPM).

The specific targets of the NAQMP, according to which its outcomes will be measured, are to (a) improve the annual population-weighted concentration of ambient $PM_{2.5}$ in Bangladesh by 15 µg/m³ and in the Greater Dhaka Area (GDA) by 30 µg/m³ by 2030; and (b) gradually increase the annual number of days with Air Quality Index (AQI) marked as good and moderate (green and yellow green color, respectively) across the country.

To achieve those targets, the NAQMP emphasizes the shared responsibility of multiple government agencies— not only the Ministry of Environment, Forest and Climate Change (MoEFCC) and the Department of Environment (DoE). The National Committee on Air Pollution Control (NCAPC) will use its convening power and coordination role to ensure that all relevant agencies do their part in implementing the NAQMP and achieving the proposed outcomes.

Interventions envisaged in this Plan will result in significant co-benefits, reducing greenhouse gas (GHG) emissions while improving health outcomes and improving productivity. Diverse air pollutants and GHGs often share the same sources. Consequently, by addressing the sources of $PM_{2.5}$, the NAQMP tackles not just the most toxic air pollution, but also contributes to climate change mitigation, and ultimately benefits from carbon markets. Activities that reduce $PM_{2.5}$ emissions will also have a substantial impact on emissions of CO_2, methane (CH_4), the pollutant gases SO_2 and NO_x, and black carbon particles, as well as on atmospheric levels of ozone. For this reason, key actions proposed in this NAQMP greatly overlap with measures proposed in the 2018 National Action Plan for Reducing Short-Lived Climate Pollutants (SLCPs)[3]: clean cooking, reduced open burning of waste and crop residue, reducing vehicular emissions, and promoting biogas. While the SLCP Plan also contains additional measures that focus on reducing methane and black carbon, its components that relate to air pollutants are fully consistent with the NAQMP (DoE-MoEFCC 2018). The NAQMP also aligns well with Bangladesh's 2021 Nationally Determined Contributions (NDCs) that include interventions in energy, industrial processes and product use, agriculture, forestry, and other land use, as well as waste management. The NAQMP also builds upon other relevant government strategies, including the Mujib Climate Prosperity Plan and the draft National Action Plan for Clean Cooking.

The NAQMP is structured as follows. Section 2 covers the current knowledge about air-pollution levels across Bangladesh and sources of air pollution. Section 3 assesses the governance framework for air quality management in Bangladesh, including the needed monitoring and forecasting infrastructure, and the data flow necessary for decision-making. Section 4 describes abatement options available to reduce emissions in targeted sectors and to improve air quality in indoor spaces. Section 5 describes ways to address the added complexity due to Bangladesh's location in a highly polluted region. Section 6 provides a stepwise implementation plan and timebound responsibilities for each actor, as well as the monitoring and evaluation mechanisms for the NAQMP. Appendixes describe temporal trends in pollution across Bangladesh, relevant experiences from other countries, and opportunities to reduce air pollution through long-term infrastructure planning.

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1 While annual average pollution levels are most relevant for long-term health issues, Bangladesh also faces periodic episodes when air pollution levels are exceedingly high across large parts of the country, particularly during the dry season. Bringing down peak pollution levels, and reducing people's exposure to them, requires a different set of short-term measures and government actions. These are covered by the Heavy Air Pollution Contingency Plan (HAPCP), approved alongside this NAQMP as per APCR Clauses 5 and 15(2)(e).

2 "Section 4. National Air Quality Management Plan The Director General, with the approval of the Government, shall formulate a time-bound National Air Quality Management Plan, for the purpose of control and mitigation of air pollution, including the following matters, such as: (a) Institutional framework for strategic management and coordination; (b) effective management of exhaust air from moving, fixed or unfixed sources and permanent sources including chimneys; (c) effective management of indoor air quality; (d) hazardous pollutant control management; (e) recognition and promotion of best practices in air quality management; (f) Clean Energy, Energy Efficient Technology, quality of fuel related to gaseous emissions; (g) air quality monitoring; (h) data collection and preservation, research, management and dissemination campaigns on air quality; (i) research on air pollution and assessment of its harmful effects; (j) participation and cooperation in the global environment on air quality management; (k) sustainable financial arrangements for air quality management; and (l) matters necessary for improvement of air quality and effective prevention and control of pollution."

3 Bangladesh has been a founding member of the Climate and Clean Air Coalition (CCAC) and has been actively involved in the promotion of measures that globally reduce short-lived climate pollutants including black carbon and methane.

2

AIR POLLUTION PROBLEM IN BANGLADESH

Available data indicate that air pollution in Bangladesh is bad and increasing. In many parts of Bangladesh, annual average levels of $PM_{2.5}$ exceed the WHO AQG by a factor of 10 or more. The pollutants originate from a wide variety of sources, ranging from power plants and industries to households, vehicles, waste burning, and agriculture. Air pollution in Bangladesh is responsible for thousands of premature deaths and billions of days lived with illness every year. Health impacts in Bangladesh from ambient and household $PM_{2.5}$ included **more than 159,000 lives lost and 2.5 billion days lived with illness in 2019**. The cost of these health effects was estimated to be equivalent to **8.3 percent of GDP (2019)** (World Bank 2023a). In addition to negative health outcomes during life (morbidity) and at the end of a life (mortality), air pollution also causes significant adverse health consequences at the beginning of a life, including premature births and underweight babies (Ghosh et al. 2021; HEI 2021).

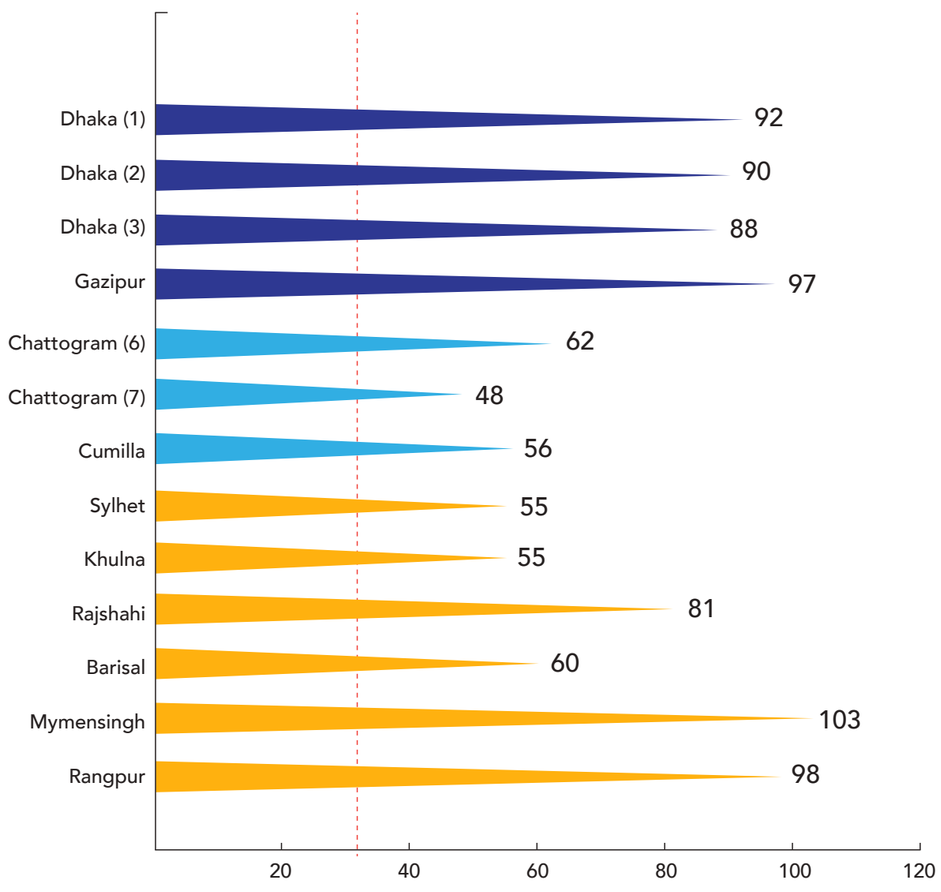
2.1 POLLUTION LEVELS ACROSS THE COUNTRY

Air pollution in Bangladesh has a seasonal cycle, has been increasing over the years, and is higher in the west of the country and around Dhaka than elsewhere. The sixteen continuous air monitoring stations (CAMS) operated by the DoE[4], along with satellite observations of aerosol optical depth (AOD, a measure of haze thickness), provide a picture of the spatial distribution and temporal trends in air pollution across the country (appendixes A and B). Except in Sylhet and at the Khulshi station in Chattogram, surface $PM_{2.5}$ and satellite AOD both exhibit either increasing or stable long-term trends in air pollution nationwide. The annual average $PM_{2.5}$ at CAMS in the eight divisions in Bangladesh ranges from 48 to 103 µg/m³ (figure 2.1). This is 10–20 times the WHO AQG for annual $PM_{2.5}$.

Measurements at existing urban monitoring stations in the eight divisions provide an indication of ambient $PM_{2.5}$ in key urban areas, resulting in population-weighted urban annual ambient $PM_{2.5}$ of 77 µg/m³. While measurements of ambient $PM_{2.5}$ in rural areas are practically nonexistent, population-weighted annual ambient $PM_{2.5}$ in rural areas was estimated based on available urban $PM_{2.5}$ measurements at monitoring stations, chemical transport models, and nationwide urban and rural satellite-imagery data, and found to be 57 µg/m³ (HEI 2020). Estimated annual average ambient $PM_{2.5}$ concentrations for each division and its urban and rural populations is presented in figure 2.2.

4 The CAMS network encompasses 13 cities in eight divisions, covering all regions of the country—Dhaka, Narayanganj, and Gazipur in the center; Chattogram in the southeast; Khulna and Barisal in the south; Rajshai in the west; and Sylhet in the northeast regions of the country.

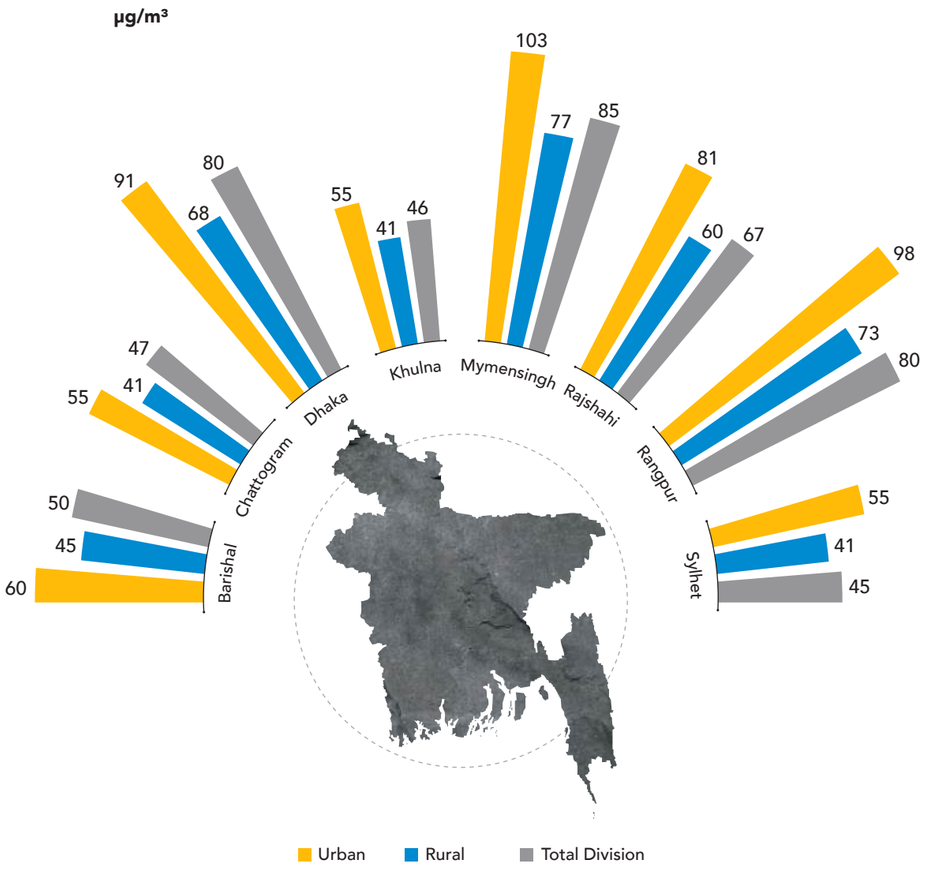
Figure 2.1 Annual Ambient $PM_{2.5}$ at Monitoring Stations in Bangladesh, 2019–21



Source: Produced from data reported in the Monthly Air Quality Monitoring Reports by the DoE, Bangladesh.

Note: The red line is the Bangladeshi annual $PM_{2.5}$ standard of 35 µg/m³. Annual ambient $PM_{2.5}$ is calculated for the full twelve months of a year. Data from the COVID-19 lockdown periods of April, May, and June 2020 are not included. Ambient $PM_{2.5}$ during the lockdowns was substantially lower than during a normal year according to estimates by Qiu et al. (2021). Moreover, Majumder et al. (2021) indicated that $PM_{2.5}$ concentrations were reduced by 12.7 percent compared to 2018 and 23.5 percent compared to 2019 during the lockdown in 2020 in Dhaka based on measurements collected from the US embassy. Data for Dhaka (1), Savar, and Narsingdi were not included because of temporary defects in monitoring devices that impeded the generation of continuous data in those locations.

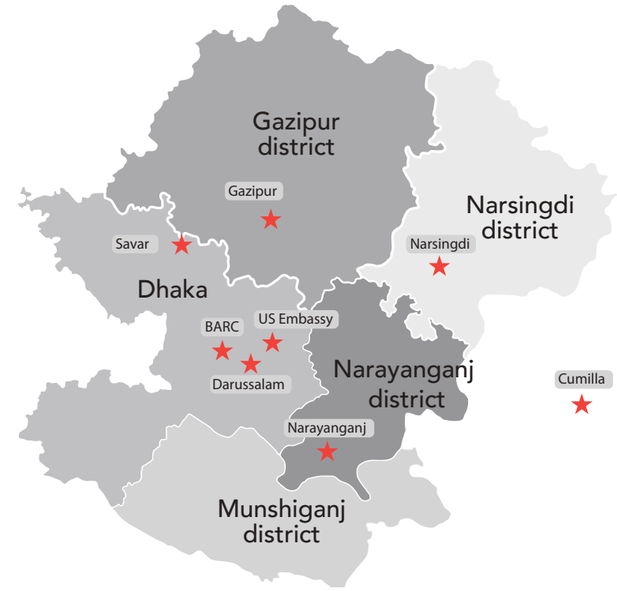
Figure 2.2 Estimated Population-Weighted Annual Ambient $PM_{2.5}$ by Division in Bangladesh, 2019–21

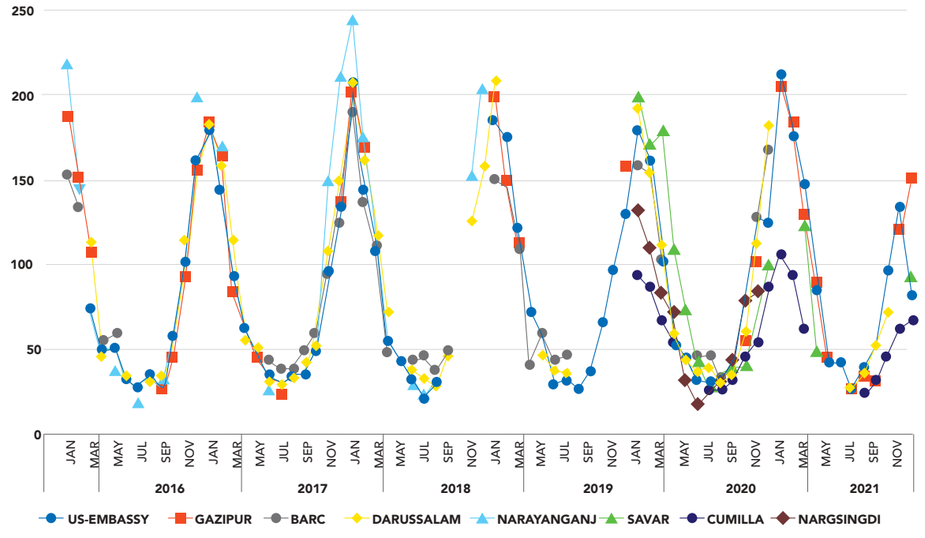


Source: World Bank based on monitoring data from the DoE.

Air pollution in Bangladesh varies by season. During the dry months (November to March), concentrations of $PM_{2.5}$ across Bangladesh are 2–3 times higher than annual means, while they are lower during the wet months (May to October). The Greater Dhaka Area (GDA) too experiences significant seasonal variations that are consistent with those in other parts of the country (figure 2.3). Three stations within Dhaka city show similar $PM_{2.5}$ concentrations, indicating relatively little spatial variation at the city scale. Sites close to Dhaka district, such as Gazipur and Narayanganj, exhibit similar concentrations. Cumilla, located 100 kilometers away from Dhaka city, demonstrates relatively lower concentrations compared to sites within the GDA. The consistent seasonal pattern across all monitored sites suggests that the seasonal variation is a regional phenomenon, primarily influenced by seasonal meteorology, although there may also be some contributions from seasonally varying sources such as the solid fuel burning in brick manufacturing, and the seasonality of transboundary pollution influx from the IGP region (for example, from open burning of agriculture residue) (Lima et al. 2023).

Figure 2.3 (A) Measurement Sites within GDA. (B) Spatiotemporal Trends in $PM_{2.5}$ Over GDA from 2016–2021.





Source: World Bank (2023), based on DoE data.

2.2 MAJOR SOURCES OF AIR POLLUTION IN BANGLADESH

Source-apportionment studies using the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model provide a first look at the contributions by individual sources to annual average $PM_{2.5}$ in Bangladesh (Lima et al. 2023). The model estimates that the population of the GDA was exposed to an annual average of $PM_{2.5}$ of 84 µg/m³ in 2020. Overall, emission sources within the GDA (figure 2.4) account for 56 percent of the population-weighted annual mean $PM_{2.5}$5 exposure (or 47 µg/m³), while 15.9 percent originates in other regions of Bangladesh, nearly 21 percent from other countries, and 7.1 percent from natural sources (soil dust). Breaking down the 56 percent of ambient $PM_{2.5}$ that originates within the GDA shows the following: The largest share (28 percent) can be traced to households (mainly biomass cookstoves), followed by power plants (24 percent), brick kilns (13 percent), and open burning of municipal solid waste (11 percent). Road dust accounts for about 8 percent, and exhaust emissions from road transport for 4 percent (mainly from heavy-duty diesel vehicles).

MAJOR SOURCES OF AIR POLLUTION IN BANGLADESH

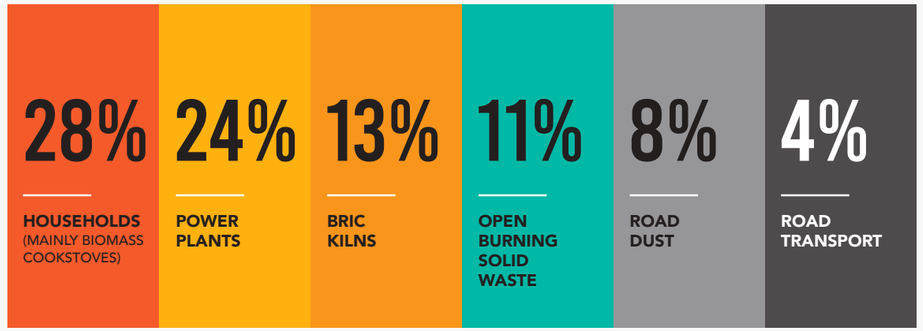
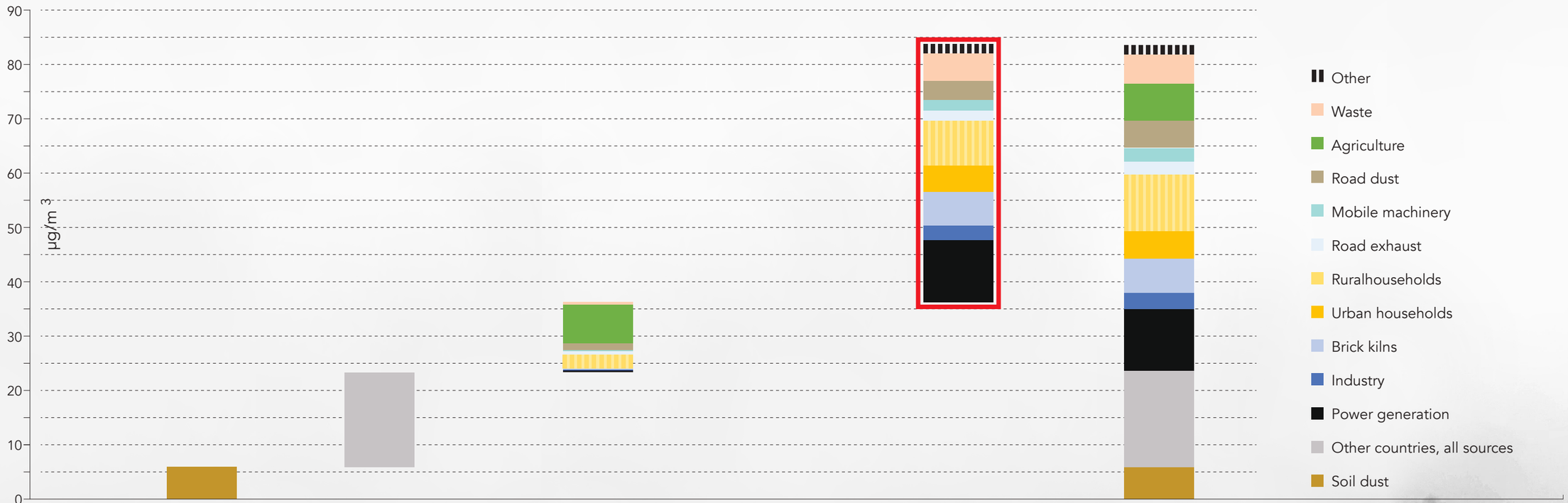


Figure 2.4 Source Apportionment of Annual $PM_{2.5}$ Population Exposure to Primary and Secondary $PM_{2.5}$ in GDA, 2020



Source: Lima et al. (2023), based on data from the DoE.

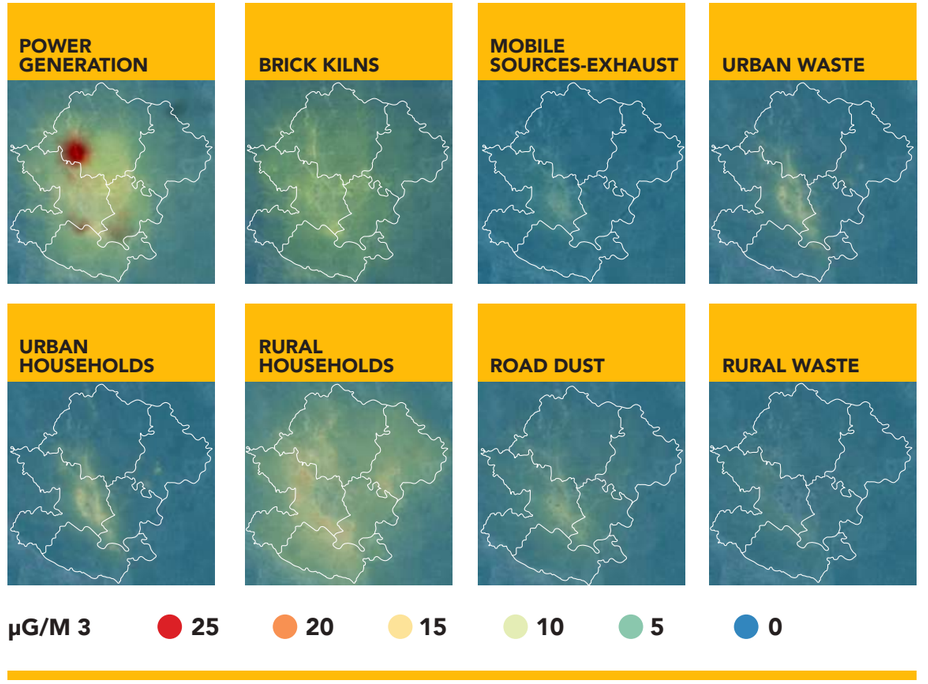
Around 65 percent of this population-weighted annual mean $PM_{2.5}$ concentration is primary $PM_{2.5}$ (PPM) and 35 percent is SPM.[5] More than 40 percent of all PPM emissions in the GDA originated from the residential sector, mainly from solid fuel used for cooking. Municipal waste, road dust, power generation, and industrial activities contributed about 10 percent each. The picture looks fundamentally different for the precursor emissions of secondary $PM_{2.5}$: Power plants accounted for about two-thirds of total sulfur dioxide (SO_2) and 70 percent of NOx emissions, which are important precursors of secondary $PM_{2.5}$ in the atmosphere. Brick kilns contributed 25 percent of total SO_2 but only 3 percent of primary $PM_{2.5}$ emissions.[6] Mobile sources (including non-road mobile machinery) accounted for 15 percent of all NOx emissions.

Tracing the origin of SPM is more complicated, since secondary particles are formed through chemical reactions in the atmosphere among substances that are emitted as gases. Key among these gases are SO_2 and NOx from industrial sources and ammonia from agricultural sources. Nevertheless, the GAINS model is able to trace the contribution of various sources to the total weight of the ambient SPM in the GDA. A higher resolution "deep dive" model run with GAINS shows the spatial contributions of different sources within the GDA (figure 2.5).

5 The results in figure 2.4 are only as good as the input data that went into the model and could possibly see minor adjustments with input data that are more current. However, the results in figure 2.4 do show very clearly the importance of sources outside Dhaka City and the Dhaka Division on air quality within Dhaka, and those results do show the key sectors that need to be addressed.

6 These estimates consider the typical brick-kiln technologies prevalent in the GDA in 2020 and the use of emission factors that have been measured for these technologies in other South Asian countries.

Figure 2.5 Annual Ambient $PM_{2.5}$ Concentrations Originating from Key Emission Sectors in GDA, 2019–20



Source: Lima et al. 2023.

Note: The colors in the legend represent a range of annual ambient $PM_{2.5}$ concentration. For example, blue represents a sector contribution between 0 and 5 µg/m³.

The GAINS model shows that about half of the total weight of the ambient SPM in the GDA is from sources within the GDA—mainly from power plants (SO_2 and NOx emissions) and some from brick kilns (SO_2 emissions). Nearly one-third of the total weight of ambient SPM in the GDA is from outside Bangladesh (mainly India) and the remainder is from the rest of Bangladesh—mainly ammonia (NH_3) from agriculture. To control the generation of SPM, an equal effort must be done in neighboring countries and the rest of Bangladesh beyond inside the GDA itself, and a better understanding must be achieved about where and when SPM formation is ammonia limited or SOx/NOx limited[7].

7 The limiting factor in the formation of SPM depends on which of the ammonia or SOx/NOx is in short supply in the atmosphere. This means that the atmospheric system is qualified as ammonia limited when there is not enough ammonia in the atmosphere, so fewer particles will form, regardless of how much SOx or NOx are present. On the other hand, if the air has plenty of ammonia but not enough SOx or NOx, the formation of secondary particulate matter will be limited by the availability of these sulfur or nitrogen compounds, consequently the atmospheric system is qualified as SOx/NOx limited.

3

STRENGTHENING AIR QUALITY GOVERNANCE[8]

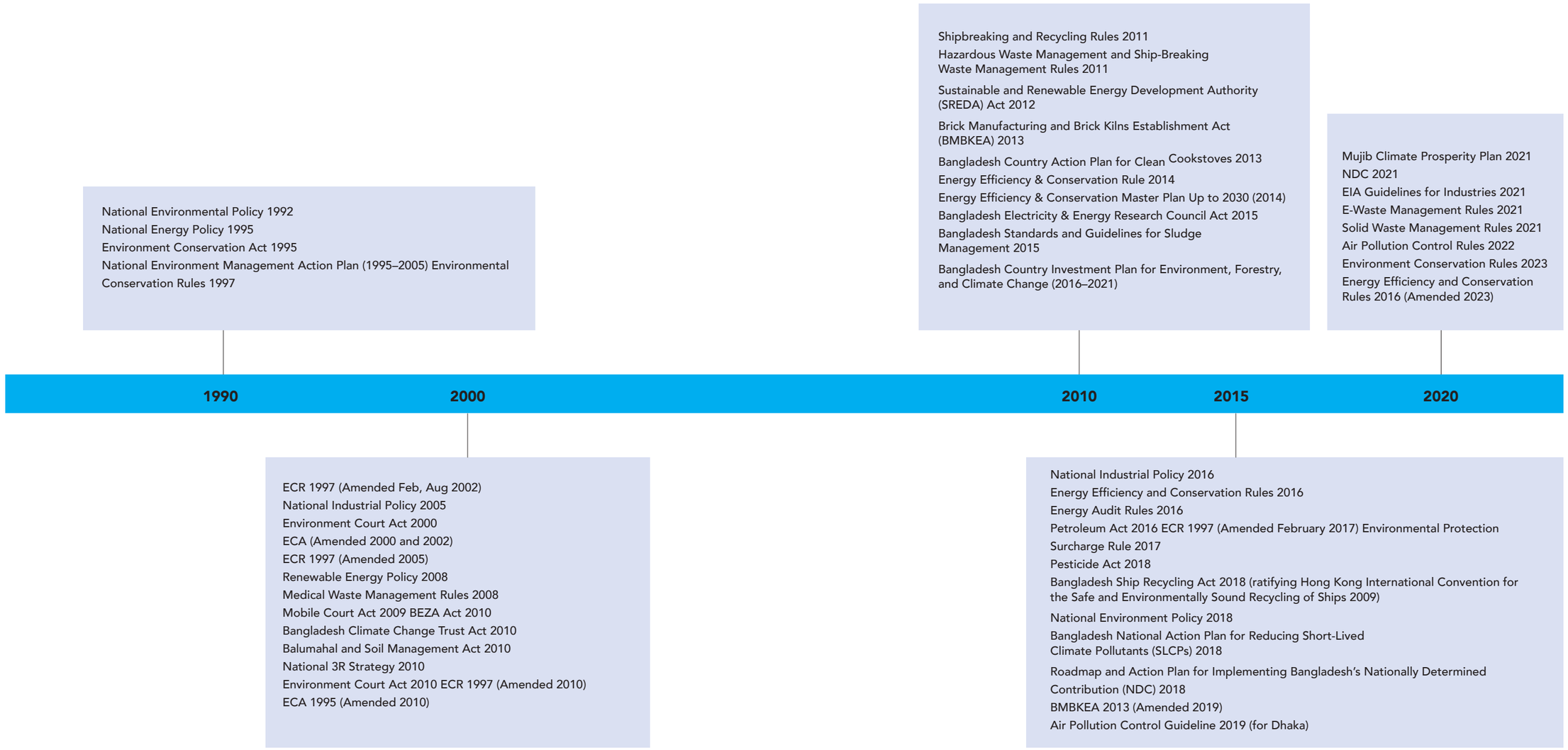
8 The air quality governance criteria used in the gap analysis and actions proposed for Bangladesh in this section were based on trends identified in the following countries/region: Australia, Canada, the European Union, Germany, Mexico, and the United States. Appendix C summarizes these trends.

While Bangladesh has a long history of **environmental governance**, managing air pollution—an often-invisible problem that spans across sectors and across scales from microscopic to continental—requires strengthening the country's **legal framework and institutional capacity** in several areas.

3.1 ENHANCING THE LEGAL FRAMEWORK

Bangladesh's environmental legal framework is shaped by more than 100 acts, rules, policies, and plans. Article 18A of Bangladesh's Constitution, introduced in 2011 through the 15th Amendment, recognizes environmental protection as a fundamental right. Article 18A establishes that the state must "endeavor to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests and wildlife for the present and future citizens." The country's legislation covers a wide range of environmental and natural resource issues, including air quality. Additional instruments that focus on climate change, agriculture and livestock, solid-waste management, labor and occupational risks, pesticides, renewable energy and energy efficiency, industry, trade, and other areas are also relevant for air quality management. Figure 3.1 summarizes the chronological development of major environmental policies and regulations since the adoption of Bangladesh's first environmental policy in 1992. The list is not exhaustive but focuses on air quality management.

Figure 3.1 Development of relevant environmental policiesand regulations in Bangladesh



Sources: Faroque and Hasan 2014; Lima et al. 2023; MoEFCC

The Environment Conservation Act (ECA) 1995 (amended in 2000, 2002, and 2010) remains the backbone of the legal framework for environmental protection in Bangladesh. The law aims to (a) promote environmental conservation, (b) improve the country's environmental quality standards, and (c) control and mitigate environmental pollution. The ECA includes provisions, among other, on (a) environmental standards, including limits on air pollution emissions; (b) environmental clearance of industries, infrastructure, and development projects; and (c) remedial measures and damage compensation from those responsible for emitting air pollutants above permissible levels. The act also sets forth sanctions for noncompliance with its provisions.

Effective environmental regulations are essential to address air pollution. To enhance air quality management (AQM) and overall environmental sustainability, a new amendment to the ECA and the corresponding rules will be made and will include provisions to (a) expand the DoE's services and incorporate a new environment cadre in the Bangladesh Civil Service (BCS); (b) promote circular economy, eco-design, and market-based policy instruments; (c) modernize and make enforcement activities more efficient, including clear provisions to implement the polluter pays principle and set adequate sanctions and incentives for compliance with the ECA's provisions, based on the magnitude of the risk or actual damage, recidivism, and the polluter's payment capacity; (d) mobilize green financing by establishing a permanent environment fund, which might receive resources from the compensation for environmental damage envisaged in Section 7 of the ECA and eventually, with the additional reforms, from environmental taxes and imposed fines; (e) improve stakeholder engagement in environmental decision-making; (f) require Strategic Environmental Assessment (SEA) for policies, plans, and programs; and (g) set the mandates and foundations for further regulations on Extended Producer Responsibility (EPR), among other themes.

The Environment Conservation Rules (ECR) 2023 strengthened requirements and clarified procedures for industries and project units to assess and manage environmental and social impacts associated with their activities—including impacts from air pollution. While the ECR 2023 will improve the environmental clearance (EC) process, additional necessary guidelines will be prepared. Those additional guidelines will clarify the assessment criteria and procedures for monitoring and enforcement after an EC certificate is issued, and provide for stakeholder consultations and access to information, including through information and communication technology (ICT) tools.

The Air Pollution Control Rules (APCR) 2022 is a foundational step to strengthen AQM in Bangladesh. The APCR sets (a) national air quality standards based on WHO AQG, particularly Interim Target 1 (table 3.1), (b) emissions limits and technical specifications for key sectors, and (c) mandates and coordination mechanisms among relevant line ministries to control both household and outdoor air pollution. Throughout implementation of this first NAQMP, the Government of Bangladesh (GoB) expects to amend the APCR to incorporate lessons learned and, among other changes, to gradually tighten current air quality standards.

The APCR have elevated the management of air quality beyond the environment sector by establishing the National Committee on Air Pollution Control (NCAPC). This is a multi-sector decision-making body presided over by the Cabinet Secretary to coordinate the APCR's implementation—and consequently this NAQMP—and instruct relevant agencies on specific interventions to comply with the new rules. For example, the NCAPC is mandated to impose emergency measures in case of heavy air pollution.[9] Building on the ECA, the APCR details the responsibilities of local governments and some sectoral agencies (Clauses 9, 10, 11, 12, and 15). The APCR also envisage the objectives and minimum requirements of implementation management tools, such as (a) a national air quality management plan, (b) degraded airsheds declaration and management plan, (c) publication of a list of highly air polluting industries and activities, (d) prevention plans, and (e) monitoring and control systems.

9 These contingency measures will be reflected in the Heavy Air Pollution Contingency Plan (HAPCP), which will focus on the management of air quality during times of peak pollution and emphasizes short-term restrictions on activities, movement, and production to reduce exposure to extreme pollution levels (APCR Clause 15(2)(e)).

Table 3.1 National Ambient Air Quality Standards for Bangladesh and WHO Interim Target 1

Pollutants	WHO Interim Target 1	APCR Standard	Average
CO, mg/m³	7	-	24 hours
	10	5	8 hours
	35	20	1 hour
	100	-	15 minutes
Pb, µg/m³	0.5	0.25	Annual
	-	0.5	24 hours
NO_2, µg/m³	40	40	Annual
	120	80	24 hours
	200	-	1 hour
PM_{10}, µg/m³	70	50	Annual
	150	150	24 hours
$PM_{2.5}$, µg/m³	35	35	Annual
	75	65	24 hours
O_3, µg/m³	100	-	Peak season[a]
	160	100	8 hours
	-	180	1 hour
SO_2, µg/m³	125	80	24 hours
	-	250	1 hour
	500	-	10 minutes
NH_3, µg/m³	-	100	Annual
	-	400	24 hours

Source: WHO 2021; APCR 2022, Schedule 1

Note: - = not available. a = Average of daily maximum 8-hour mean O3 concentration in the six consecutive months with the highest six-month running-average O3 concentration.

Moving forward, the GoB plans to diversify and strengthen its environmental policy instruments, going beyond the typical command-and-control approach for enforcement and policy implementation. The GoB will conduct analytics and further develop a wider range of environmental instruments relevant to AQM, including the following:

Economic and market-based instruments such as the repurposing of energy subsidies, carbon tax, and green credit guarantees, as well as incentives for household use of cleaner fuels and industry use of cleaner technologies	Litigation-based instruments to enhance mechanisms for public interest lawsuits regarding environmental issues and allow legal standing for any citizen at environment courts	Information-based instruments, such as awareness campaigns on the health effects of air pollution, and regular dissemination of air quality data, such as user-friendly alert systems on air quality and pollution hotspots, publication of lists of highly polluting industries, and detailed results of enforcement activities (Section 3.3)

Source: WHO 2021; APCR 2022, Schedule 1.

Note: - = not available. a = Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

As for command-and-control, additional regulations will be adopted for technical specifications to control emissions in highly polluting activities and sectors. The APCR sets forth criteria for stack height in several industries, and mandatory technical specifications for reducing emissions from coal-based power plants and battery-manufacturing industries.[10] Following international good practices, the DoE will expand the mandatory technical requirements to other highly polluting sectors and activities, moving away from imposing those specifications on a case-by-case basis through the EC process.

Additional regulations will be adopted for applying the polluter pays principle effectively. This includes, for example, criteria for setting the value of fines, precautionary measures, and more severe penalties such as confiscation of equipment, suspension of construction and productive activities, and payment of daily fines for not complying with court orders. Furthermore, the GoB will adopt guidelines on (a) integration of air quality concerns into sector strategies, policies and programs to incentivize the adoption of cleaner technologies and procedures; (b) specific requirements, practices, and technologies for air pollution control in targeted industries and projects, as per Section 8 and Schedule 5 of APCR; (c) air quality planning and management at local governments; and (d) enforcement activities related to AQM, particularly on-site inspection by the DoE and mobile courts.

The NCAPC will also adopt its rules of procedures, including provisions on (a) thematic working groups (by region or sector); (b) participation of additional local governments and representatives of the Parliament,[11] private sector, scientific community, and civil society in specific meetings; and (c) formal mechanisms for reporting NCAPC's work to the public. After appropriate analytics to be led by the MoEFCC and the DoE, the NCAPC will formally designate the country's airshed and its sub-areas.

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10 The APCR requires (a) the use of flue-gas desulphurization (FGD), electrostatic precipitator (ESP), and advanced low NOx burner technology for coal-based thermal power plants; and (b) installation of stacks with hoods and fans, bag filters, and venturi scrubbers for battery-manufacturing industries. Technology and other technical specifications are not mentioned for other sectors.

11 For example, members of Parliament's Standing Committee on Environment, Forest and Climate Change.

3.2 STRENGTHENING INSTITUTIONAL CAPACITY FOR AQM

Several government organizations have important roles in the management of air quality in Bangladesh, with the MoEFCC and the DoE holding the primary responsibility for environmental protection and the NCAPC in charge of interagency coordination. A structured institutional framework is in place at the MoEFCC and the DoE for air quality management in Bangladesh. However, the operation of this framework is currently limited by (a) gaps and shortcomings in its organizational structure, (b) insufficient budgetary and human resources, (c) challenges with coordination across agencies and with local governments, and (d) limited data management and evidence-based decision-making. Other key agencies responsible for implementing this NAQMP face similar constraints, performing their mandates with limited financial, human, and technical resources. To address these challenges, key actions will be taken across four pillars:

Setting evidence-based priorities and decision-making.

The GoB will adopt a systematic evaluation of its AQM interventions, with regular reports to measure progress in achieving indicators and assess institutional performance (Section 6 of this NAQMP). Additionally, the DoE will set up a research and development unit, equipped with laboratories and other analytical tools, to identify air pollution sources and pilot interventions to reduce emissions. The analytics, possibly done in partnership with other government agencies and development partners, will inform air quality planning through, for example, modelling and economic analyses, and pilots of potential interventions, among others. An integrated system of reliable data collection, management, and dissemination will thus inform decision-making (see Section 3.3 below).

Strengthening organizational structure and institutional capacity.

Adequate institutional presence in the field with sufficient and well-trained staff is required for the MoEFCC, the DoE, and all relevant sectoral agencies in charge of emissions-abatement measures. A cadre of environmental specialists will be established at the DoE, while increasing the agency's headcount to allow more and better qualified professionals to reach senior official positions and to attract and retain talented individuals (who will be trained on key AQM topics). In parallel, to deal with staff constraints, the GoB will explore systems of certified third parties that can perform some monitoring and enforcement functions. One example of such a system would be a PPP model for operating inspections centers to address vehicle emissions, with services paid by the users. A second example of a system for the GoB to explore is the use of information technology, such a continuous emissions monitoring system (CEMS) whereby monitoring devices are installed on the premises of highly polluting industries, such as in stacks of power plants and industries. These monitoring devices would transfer data on a regular basis to a DoE-managed information system. While raising the public budget is essential to strengthen its AQM capacity, the GoB will maximize those resources by developing mechanisms for green financing such as bonds, loans, equity, microfinance, insurance, carbon markets. For developing mechanisms for green financing, the Bangladesh Bank will play a key role implementing its green financing policy and guidelines.

Strengthening citizen-driven accountability.

There will be (a) a more systematic effort to raise awareness and social accountability regarding air quality issues, with strategic partnerships between government and NGOs such as academia (box 3.1); and (b) mechanisms to incorporate the concerns of groups most severely affected by environmental degradation into the GoB's planning processes (see Section 3.3.3 below).

Enhanced interagency coordination.

The GoB will strengthen its capacity to coordinate AQM actions across its agencies at both the national and local levels. As an immediate action under this NAQMP, the NCAPC will establish its rules of procedures. Those rules will have provisions on thematic and geographic-based subcommittees, bilateral coordination of specific activities, and requirements for its member agencies to assign focal points and adequate resources for carrying out their activities under the Plan. The NCAPC will promote additional collaboration across government institutions, providing instructions and time-bound targets for designing and adopting specific interventions. For example, the Ministry of Finance (MoF) and the Ministry of Power, Energy and Mineral Resources (MoPEMR) will develop a carbon tax and other relevant market-based instruments for the energy sector. The MoEFCC, the Ministry of Industries (MoI) and, when applicable, the MoPEMR will implement joint actions to (a) improve the environmental performance of industries by promoting resource-efficient and cleaner production (RECP); (b) strengthen testing and standards on measurement methods for air pollutants through the Bangladesh Standards and Testing Institution (BSTI); and (c) foster stronger environmental management systems in the public corporations it oversees in the chemical, sugar and food, steel, and vehicle sectors, as well as in the industrial estates for cottage industries that it manages. The Ministry of Agriculture (MoA) will support the development of new technologies to enhance agricultural productivity and distributing agricultural inputs (for example, urea and non-urea fertilizers). In addition, the MoEFCC and the Ministry of Commerce (MoC) will enhance coordination to attract sustainable investment in export-oriented industries. The DoE, the Directorate General of Health Services (DGHS), and the Department of Inspection for Factories and Establishments (DIFE) will coordinate their efforts for policy formulation, on-site inspections, training, awareness campaigns, and other activities related to work conditions and the health effects of air pollution.

Strengthening coordination with and among local governments.

Effectively addressing air pollution will require improved coordination among all levels of government. With regard to emissions-abatement measures, local government institutions (LGIs) are responsible for overall city planning. Such planning can reduce pollution by, for example, improving mobility and expanding green areas; and providing sanitation and solid-waste management, dust control in streets and from construction, among other services (see APCR Clause 10). Because of air pollution's transboundary nature, locally led actions influence air quality in neighboring cities—or countries. Well-coordinated actions are also essential for imposing restrictions in case of heavy air pollution. For Bangladesh, the NCAPC will create needs-based subcommittees to coordinate actions among specific municipalities (for the GDA, for example); incentivize LGIs to create special clean air commission,[12] and in partnership with the MoEFCC and the Ministry of Local Government, Rural Development and Co-operatives (MoLGRDC), develop templates of AQM plans and other relevant instruments for LGIs. A key action under this NAQMP is the adoption of a clean air program for the GDA.

12 As a good practice, the NCAPC will consider the experience of the Mexico City Metropolitan Area (MCMA). The Megalopolis Environmental Commission (CAMe) encompasses not only Mexico City but 224 municipalities across the neighboring states of Mexico, Hidalgo, Morelos, Puebla, and Tlaxcala. Together, they established a common comprehensive airshed in Central Mexico and implemented programs to improve air quality to address high pollutant concentrations and facilitated coordination between state and federal authorities for the design and enforcement of emission-control programs.

Box 3.1 Role of Academia and Research

Academic institutions have a key role in Bangladesh's ability to successfully address air pollution. First, successful management of a problem as complex, multi-scale, and multi-sector as air pollution requires thorough, nuanced, and evolving understanding. Professors and students need to carry out research on a wide variety of relevant topics, from the meteorology, atmospheric chemistry, and atmospheric physics to engineering and urban planning, to social science research on behavior and incentives. The GoB will incentivize the country's universities to grow the number of faculty members and to expand research facilities that focus on air-pollution issues. It will create special research funds for graduate students to obtain research funds to carry out thesis research on urgent relevant questions. Second, ensuring that data produced by government agencies are of high quality requires a group of energetic independent people who keep monitoring the data and ensure that they are of high quality. The best people to do so are students who depend on the data for their research. To avoid issues with student turnover, permanent staff at those academic institutions must lead and coordinate the work. The GoB will enter into agreements with academic institutions to partner in the operation and maintenance of stations to monitor air quality. Third, Bangladesh needs to increase its pool of technical staff to address air pollution: Engineers working in various fields, as well as technicians to take care of monitoring stations. The GoB will work with academic institutions to ensure capacity to produce sufficient appropriately skilled graduates, while making sure that graduates are attracted to jobs in air quality management.

3.3 IMPROVED AIR QUALITY DATA AND ITS MANAGEMENT

3.3.1 AMBIENT AIR QUALITY MONITORING

An important component of air quality management (AQM) is the availability of real-time air quality data. The operation of a reliable nationwide network of air quality monitoring stations that provide continuous, high quality, trustworthy data with little or no disruption allows the government and other key stakeholders to (a) monitor diurnal, seasonal, and interannual changes and long-term trends in air quality; (b) track the evolution and impacts of specific pollution events; (c) identify hotspots and major sources air pollution (when combined with other analytics); and (d) evaluate atmospheric models and pollution forecasting system. Such a network provides essential data to (a) inform policy decision-making by assessing the impacts of abatement measures on air quality and the progress towards meeting WHO interim targets and other goals, and (b) providing an objective basis for triggering pre-agreed restrictions during air-pollution emergencies. By disclosing such information, the GoB also raises public awareness, fosters citizen-driven accountability, and provides reliable data to research and academic projects.

Gradually established since 2001, Bangladesh's air quality monitoring network has 31 stations (figure 3.2). The 16 continuous air monitoring stations (CAMS) managed by the DoE provide hourly measurements of PM2.5 and PM10, along with ozone, carbon monoxide, sulfur dioxide, and nitrogen oxides. The stations are also equipped with meteorological sensors. Data from each station's instrument are logged by a station computer, from which the data are sent to a central server at the DoE. In addition, there are 15 compact monitoring stations spread across Bangladesh that measure the same parameters, but whose data are not yet reported. While the CAMS network provides a broad overview of spatial patterns and trends across Bangladesh, the DoE will make significant improvements to increase the network's effectiveness for air quality management:

The DoE will conduct a detailed evaluation of the current measurement network,[13] along with a detailed study of locations for future stations, to produce a decade-scale expansion plan for the monitoring network. The expansion plan will include (a) a mix of CAMS, compact monitoring stations, mobile monitoring stations, and other sensors depending on the availability of resources; and (b) a list of future station sites, ranked by priority. The DoE will own administerthis list, and stations being brought into Bangladesh by various development partners or the GoB's own budget will be set up following the priorities set by the DoE.

The DoE will add stations in rural areas and near the country's border, especially at the western border. While there is at least one station in each division, most of the current stations are in urban locations, thus providing a less clear picture of background air quality in rural Bangladesh. Similarly, more stations will be set up to quantify the varying but significant flux of pollutants entering Bangladesh from other countries, as well as to measure additional parameters such as lead (Pb) and black carbon.

13 As part of this assessment, the location of existing CAMS and other stations will be evaluated to ensure data accuracy. Stations need to be sited in places where their measurements are less affected by local sources of, or obstacles to, airflow because the stations must be able to measure representative air from the broader surrounding area. For example, stations should not be placed near construction sites, which produce significant construction dust locally, or in sites where the airflow is blocked by buildings.

The gas analyzers that are installed at each station can produce data at time resolutions as high as every minute (except when the instruments are being zeroed/calibrated). However, the Beta Attenuation Mass Monitor (BAMM) instruments that measure PM10 and PM2.5 use an approach that makes it impossible to generate higher-resolution data, which are useful for conducting more-detailed process studies at the sites. As older instruments approach retirement and replacement, the DoE will assess whether to replace them with the same technology, or whether newer systems could provide better data without compromising on reliability and ease of operation. Experiences in neighboring countries using alternative technologies will be considered.

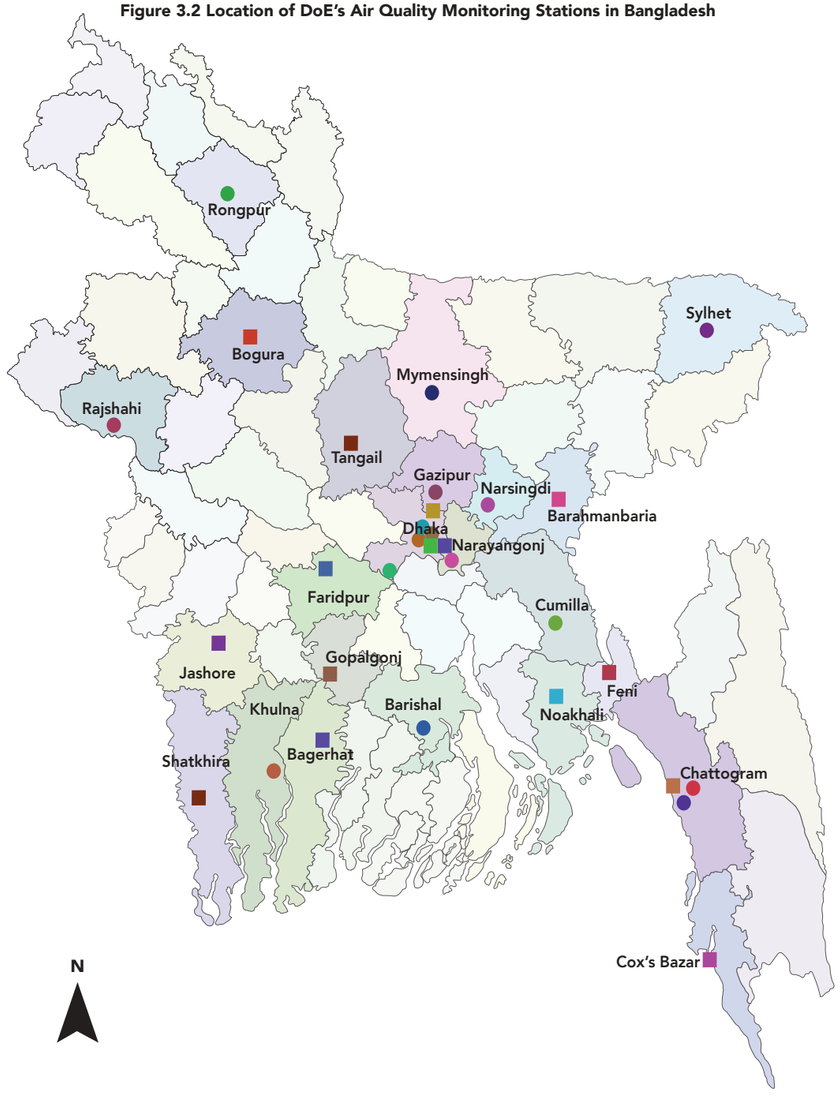
The DoE will replace the station computers and its data server, which are reaching the end of their lifespans, and update all software. Devices will be procured that improve the quality of data, as well as data back-ups at stations and mirroring of the DoE data server. The new systems will also log instruments' internal diagnostic data (such as temperatures, airflow, pressure, and various voltages) and, in case of any defect, send maintenance alerts to the DoE for discarding problematic data and deploying the repair team.

To reduce data gaps and expedite equipment repairs, the DoE will adopt quality control and maintenance protocols to flag suspicious data points, invest in a central repair facility (possibly in partnership with an academic institution), conduct more frequent procurement of spare parts and consumables (compared to the current practice of procuring annually), and ensure a continuous stable supply of electricity and internet connectivity for each station.

The fraction of high-quality data coming from each station will be increased. Station staff will be trained and incentivized to spot problems (such as a faulty calibration) and to quickly fix smaller issues. A system of maintaining regular station logs will be introduced, as well as a system of flagging and communication data affected by unusual local events.

To ensure data accuracy, the DoE will proceed with daily checks of data received on its Data Acquisition System to flag outliers through an established data-validation protocol. Final data validation will be conducted at a second stage and corrected as per the protocol.

Figure 3.2 Location of DoE's Air Quality Monitoring Stations in Bangladesh



Source: DoE

3.3.2 EMISSIONS INVENTORY

Building on its network for monitoring air quality, the DoE will develop high-quality gridded emissions inventories for criteria air pollutants and short-lived climate pollutants (prioritizing $PM_{2.5}$, SO_2, NO2, NH_3, black carbon, and methane). These inventories will (a) enhance the DoE's overall understanding of air quality in Bangladesh and the major emissions sources, (b) monitor and evaluate policies, (c) support international reporting, and (d) inform modeling/forecasting to address air pollution. The DoE will conduct and regularly update those inventories incorporating four elements: mobile, point, area, and biogenic sources. In this context, the DoE will develop a data-management system for compiling and processing emissions data from satellite observations, environmental clearance certificates and other permits, modeling, national statistics, industry reports, fuel consumption data, and ongoing work to characterize emissions.

3.3.3 AIR POLLUTION FORECASTING AND MODELING

Even the most comprehensive network of stations for monitoring air quality cannot cover all locations in Bangladesh, forecast future air quality, explain why pollution is at a certain level in a certain place, or give answers to "what if" questions. To complement its CAMS network and address those issues, Bangladesh will build its capacity in atmospheric modeling. Two types of models will be used:

First, the DoE will adopt (in-house or subcontracted to an academic institution) chemistry-transport models that use meteorological forecasts and time-evolving emissions databases to forecast air quality 2–3 days into the future. These can be built using widely available models such as WRF-Chem or CAMx, through collaborations with and between universities in Bangladesh and abroad. Running these models requires high-quality gridded emissions inventories for Bangladesh, as well as for surrounding countries. It also requires trained human resources and sufficiently powerful computer systems. Air-pollution forecasts are particularly relevant in the management of peak pollution events, as covered by the APCR's Clauses 5 and15(2)(e).

Second, a modeling system such as the widely used GAINS model is needed as a policy-support tool when choosing abatement measures. The GAINS model allows easy disaggregation of the influences of individual source sectors and source regions on the annual average air quality of any given place. The model also allows easy scenario analysis, showing the air quality resulting from the (de)activation of individual abatement measures or from other activity changes. GAINS requires high-quality information about emissions sources in Bangladesh, as well as access to a full year's worth of meteorological model runs. Building on the GAINS City model tailored to the GDA, the DoE will expand the modeling to other geographic areas of Bangladesh.[14]

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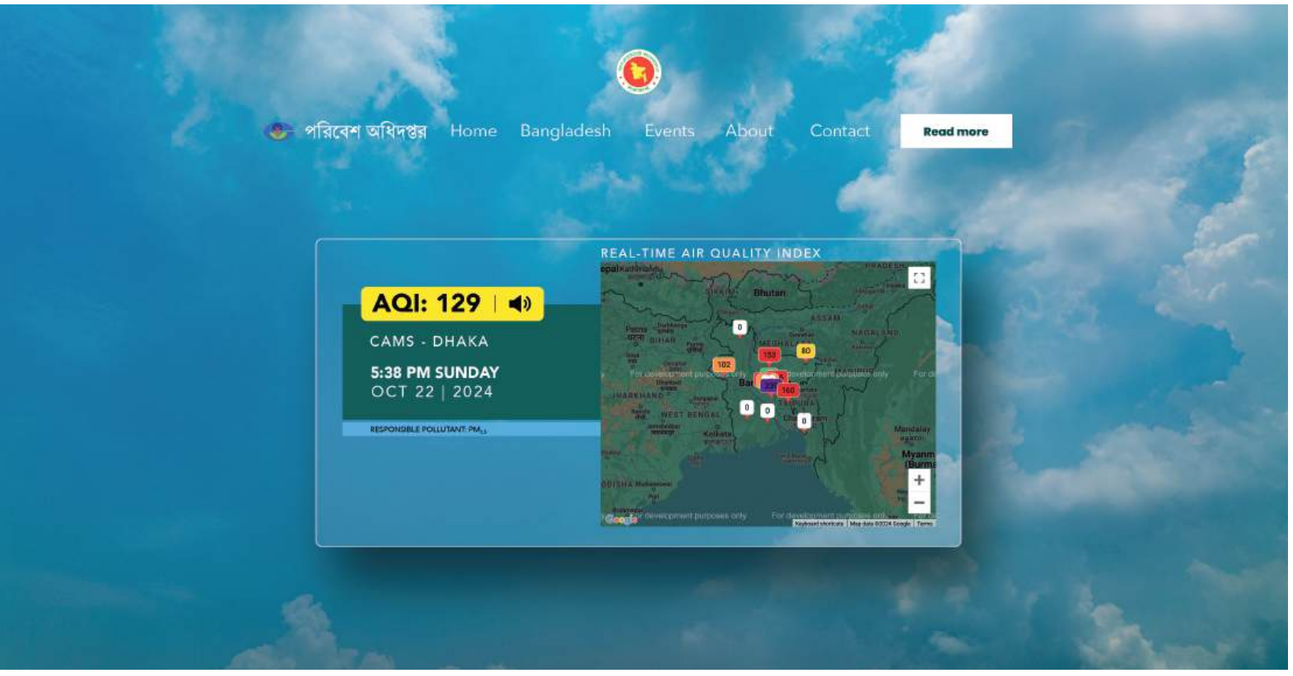
14 The expansion of the GAINS model tailored for Bangladesh is financed by a Technical Assistance from the World Bank.

3.3.4 DATA DISCLOSURE AND INTEGRATION TO DECISION-MAKING

A first step for making the data available to the public has already been undertaken. Since November 2023, the DoE website has provided real-time air quality index (AQI) data updated every hour, along with a daily PDF report containing the average and daily range of AQI at each station. Following are the next steps to make a reliable system:



- Replacing or supplementing the current server at the DoE with a more modern system, including a front-end webserver (with mirroring elsewhere);
- Setting up software to auto-generate web pages that provide real-time, preliminary data for each station in a tabular format as well as on a clickable map, along with daily, weekly, monthly, and annual summaries;
- Better description of how the conversion between measurement units and AQI occurs, and dissemination of information on health effects and preventive measures along with the real-time AQI, and
- Webpages and mobile apps that provide easy online access to full data archives for students, researchers, decision-makers, and app developers

Additionally, the GoB will produce and distribute not just real time data, but also reports and analyses conducted by multiple public agencies and needed by various stakeholders. Disclosure mechanisms will be added at all government levels and sectors from continuous emissions monitoring to ambient air quality concentrations, to all data acquired for transparency purposes. For example, the Bangladesh Bureau of Statistics (BBS) will play a key role in gathering and processing relevant data for AQM, such as on types of fuel used for household cooking. Health agencies will support gathering and processing community-level data on the incidence of diseases associated with air pollution, especially at hotspots.

Improved data will only be useful if it helps in decision-making. Apart from decision-making in the context of degraded airsheds and heavy air pollution events, data and models can and will also be used to help in making decisions about where and how to allocate resources for abatement measures, and to evaluate the impacts on air quality of individual abatement measures. For that, the GoB will regularly conduct the following actions:

- In-depth analytics to prioritize, select, and design AQM interventions. These can include cost-effectiveness, cost-benefit, institutional and stakeholder analyses, and strategic environmental assessments for policies, plans, and programs, including assessment of potential social, poverty, and distributional impacts.
- For the selected interventions, the GoB will facilitate stakeholder participation throughout the entire policy or investment cycle—from formulation to evaluation. This includes consultations to identify the data, information, and knowledge needs of a variety of stakeholders, from public officials at national and subnational levels of government, to private-sector investors, media, school leaders and teachers, patients, youth groups, workers associations, researchers, and many others.
- Systematic monitoring and evaluation of the NAQMP's implementation (Section 6), including a midterm evaluation and regular reports on the intermediate and outcome-oriented indicators.

In parallel, to promote meaningful stakeholder participation in AQM, the GoB will create further communication channels and awareness campaigns, including the following:

- Training of journalists (TV, radio, and print), agreements with media to report air quality, and direct communication channels to provide relevant numbers to them to report;
- Partnerships with youth groups and social media influencers;
- Development of apps that provide real-time air quality information to the public, and apps whereby the public can upload photographs and other evidence of environmental offenses;
- Awareness campaigns in simple language on the effects of air pollution, preventive measures, and the GoB's actions to improve air quality;
- Integration of air pollution and AQI into school curricula and other educational programs; and
- Tracking and assessing the public's understanding through surveys.

3.4 MANAGEMENT OF AIR QUALITY ON DAYS WITH HAZARDOUS AIR

While this NAQMP focuses on bringing long-term average pollution levels into compliance with WHO's Interim Target I and Bangladesh's own air quality standards, special attention is needed for those times and places that face pollution levels many times higher than the annual averages. The complementary HAPCP provides a detailed blueprint for Bangladesh to reduce both the emissions and people's suffering during times of extreme pollution, including requirements and procedures for triggering a graded set of restrictions. In this context, managing degraded air quality effectively can only occur if DoE's air quality network has sufficient reliability and coverage to inform the public and decision-makers about real-time air quality. At a first stage, the HAPCP will depend on being triggered by air quality reaching certain AQIs. Later, when forecasting systems are in place, restrictions can be imposed days in advance based on forecasts for those days.

4

REDUCING EMISSIONS FROM INDIVIDUAL SOURCES

While some of the emissions sources that affect air quality in Bangladesh are outside Bangladesh's borders, the GoB can and will adopt multiple policies and investments within its jurisdiction to reduce emissions and make a substantial improvement in the country's air quality. This section presents the GoB's plans for air pollution abatement in targeted sectors. To complement this section, Appendix D gives examples of longer-term planning changes that alter the importance in the economy of individual emitting sectors, while providing examples of good practices in other countries.

The economic case for AQM interventions. The interventions were selected based on cost-effectiveness and cost-benefit analyses; previous experiences from Bangladesh and other countries; alignment with the country's development strategies; and their potential to generate co-benefits such as climate change mitigation, green jobs, and infrastructure.

Recent GAINS model runs provide a first set of cost-effective measures to control emissions nationwide and in the GDA to achieve an annual $PM_{2.5}$ concentration of 35 µg/m³ by 2030 and reduce 50 percent of annual premature deaths from air pollution in Bangladesh. If implemented nationwide, this package of cost-effective measures can improve annual population weighted ambient $PM_{2.5}$ by about 20 µg/m³ nationwide. Implementation of similar cost-effective measures by the neighboring countries in the IGP region is expected to bring population-weighted nationwide ambient $PM_{2.5}$ in Bangladesh to its national standard, showing the relevance of regional collaboration for achieving results faster and cheaper. Implementation of the cost-effective measures available within the GDA alone is expected to improve population weighted ambient $PM_{2.5}$ within the GDA by 40 µg/m³.

The benefits relative to the costs (benefit-cost ratio, BCR) of the identified measures nationwide and within the GDA are estimated to range from about 2 to 230 with an overall BCR of 8.8 for the nationwide measures and an overall BCR of 10.1 for the measures within the GDA. These BCRs are likely to be conservative as benefits only include health improvements, and the benefits of the measures within the GDA do not include benefits that will accrue nationwide because of emissions reduction from sources in the GDA. Additionally, some of the cost-effective interventions are expected to yield net cost savings. This is the case for several waste management options (for example, waste recycling and landfill gas recovery) and investment in modern brick kiln technologies.

The GAINS model runs have identified six priority sectoral sources of primary and secondary $PM_{2.5}$ with the largest cost-effective emission reduction potential (table 4.1). Full implementation of control measures in these sectors is expected to improve nationwide ambient $PM_{2.5}$ by 17 µg/m³ and in the GDA by 37 µg/m³.Three sectors in particular stand out in terms of cost-effective emissions control measures: clean cooking, power generation and waste management (table 4.2). Implementation of cost-effective measures in these three sectors alone can by 2030 improve population-weighted annual average ambient $PM_{2.5}$ by (a) 15–21 µg/m³ in the GDA, and (b) 6–10 µg/m³ nationwide.Full implementation of the measures in these three sectors can improve ambient $PM_{2.5}$ by (a) 26 µg/m³, or 65 percent of the identified cost-effective improvement potential in the GDA, and (b) 15 µg/m³, or 75 percent of the identified cost-effective improvement potential nationwide.

Table 4.1 Priority Sectoral Sources of $PM_{2.5}$

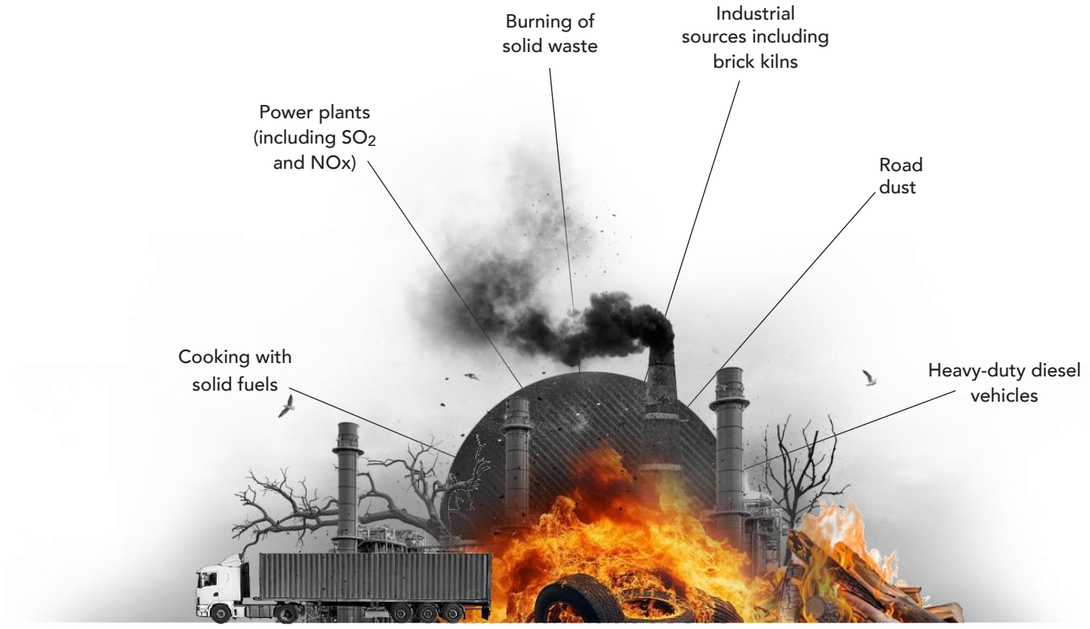


Table 4.2 Improvements in Annual $PM_{2.5}$ from Fully Implementing Cost-Effective Measures In Selected Sectors

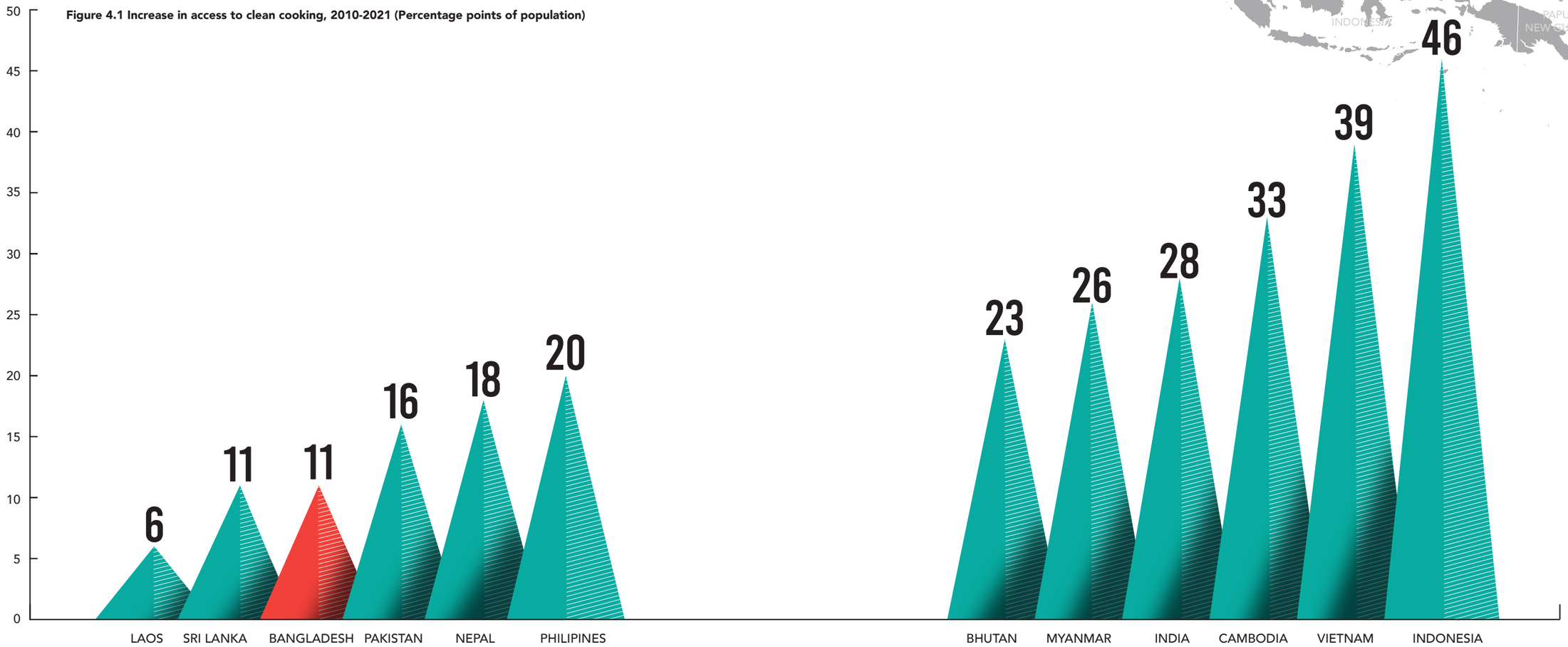
Sector of Interventions	GDA	Nationwide
	Improvements in annual $PM_{2.5}$ (up to)	
Switching from solid fuels to clean cooking (LPG, gas, electricity, or renewables)	10 µg/m³	10 µg/m³
Control of $PM_{2.5}$ emissions from power plants	10 µg/m³	4 µg/m³
Proper waste management	6 µg/m³	1 µg/m³

Additionally, the interventions under this NAQMP can not only contribute to reduce the health impacts of air pollution. The proposed measures are essential to improve livability and competitiveness in Bangladesh's cities, by reducing traffic congestion, enhancing waste management, improving clean, reliable energy supply, generating green jobs, among other benefits. As air pollutants and GHGs often come from the same sources, by targeting these sources the NAQMP will contribute to climate change mitigation, creating opportunities of additional proceeds from carbon markets.

4.1 HOUSEHOLDS

Most of the Bangladesh's rural and peri-urban population relies on solid fuels for cooking; as cooking smoke escapes into the ambient air this becomes a large contributor to increased ambient $PM_{2.5}$ concentrations. From 2010 to 2021, access to clean cooking increased by 11 percentage points from 15 percent to 26 percent of the population in Bangladesh (figure 4.1). This is a slow pace compared to other countries in the region. Approximately 74.2 percent of Bangladesh's population use solid fuels as the primary cooking fuel, among which two thirds cook indoors. Solid fuels include the following categories: (a) straw, leaves, bran, and husk (10.5 percent); (b) wood, chalk, and chopped wood (58 percent); and (c) wood-coal, charcoal, and dried dung (5.2 percent) (BBS 2022). While 8.8 million improved biomass cookstoves have been distributed to poor households—an important step in reducing household air pollution—at least 53 percent of households still relied on traditional cookstoves. As a result, HAP accounted for 69,000 premature deaths in 2019, and the use of solid fuels for cooking was also responsible for about 15 percent of ambient $PM_{2.5}$ deaths (13,500 deaths) (Lima et al. 2023).

Figure 4.1 Increase in access to clean cooking, 2010-2021 (Percentage points of population)



Note: Clean cooking is mainly LPG (Liquefied petroleum gas), and large percentage of population using electricity for cooking in Bhutan and Myanmar.

Source: World Development Indicators (World Bank) and MICS household surveys.

Interventions in clean cooking can make the largest impact on both ambient and household air pollution (Lima et al. 2023), especially for households that cook indoors using solid fuels and traditional cookstoves. Additional benefits include reduced demand for scarce wood fuel and the return of agricultural crop residues to the soil to address nutrient depletion. Building on the Action Plan for Clean Cookstoves (2013), Bangladesh plans the following interventions to mitigate the impacts of degraded air quality in households:

Further assess price and non-price obstacles and incentives for adoption of clean cooking and identify areas and types of households where each type of clean cooking (or improved cookstoves) could be adopted.

Evaluate the Action Plan for Clean Cookstoves (2013) and, based on its results and lessons, adopt a National Action Plan for Clean Cooking, covering interventions beyond promotion of improved cookstoves.

Incentivize the transition to clean cooking fuel, particularly to LPG and electric induction stoves. The GoB will consider fiscal and market-based instruments such as tax exemption, repurposed subsidies, revised electricity block tariff structure, free or for-borrow LPG cylinders, availability of smaller LPG cylinders (3–5 kg) especially for rural households, rural LPG delivery and safe refill stations.

Incentivize the design and development of locally appropriate biomass cookstoves—especially with double burner and chimney—and incentivize their adoption by families that have no access to cleaner fuel.

Promote off-grid solutions, particularly rooftop solar installations - solar PV for lighting and fan, solar thermal for hot water supply; and domestic biodigesters for clean cooking (instead of kerosene).

4.2 POWER GENERATION

Power generation is a major source of both primary and secondary $PM_{2.5}$ in Bangladesh, particularly in the GDA where 37 percent (2276 MW) of all power plants were run on heavy fuel oil in 2020.A second major source of air pollution related to power generation are the diesel generation sets extensively used in the residential, commercial, industrial and agriculture sectors during loadshedding. Not only does power generation emit primary PM2.5 directly, but it is also among the largest sources of NOx and SO_2— key precursors for SPM.

THERMAL POWER PLANTS

Thermal power stations in Bangladesh are fueled by natural gas, coal, or liquid fuel (furnace oil and diesel) with the latter two contributing significantly to air pollution. The use of coal and liquid fuel (furnace oil and diesel) in power generation raises environmental concerns due to the emission of pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NOx), particulate matter, and carbon dioxide (CO_2). SO_2 and NOx, while emitted as gases, contribute significantly to the formation of secondary $PM_{2.5}$.

To reduce the impact of thermal power plants on air quality, the GoB will implement the following measures in the light of Integrated Energy and Power Master Plan, Mujib Climate Prosperity Plan and NDCs:

Mandate the use of low sulfur fuel and enforce the use of emission control devices to reduce PM, NOx and SO_2 from thermal power plants. Extend these measures to natural gas power plants as applicable.

Strictly enforce the emissions standards and stack height standards for thermal power plants listed in Schedule 5(1) of the APCR, including through a continuous emissions monitoring program (CEMP).[15]

Gradually increase the share of renewables such as wind and solar as well as clean energy and move towards 40 percent clean energy blended with diversified fuel mix by 2041, including renewables, nuclear power, hydrogen, hydro pump storage, ammonia co-firing in coal-based power plants, and so forth.

Gradually decrease the share of liquid fuel-based power generation, considering grid stability and security.

Assess feasibility of emerging renewable energy technologies, such as hydrogen blended fuel, and promote ocean energy innovation, such as tidal power and ocean thermal energy conversion.

Work towards a cross-border renewable energy trade, such as by importing a larger quantity of excess hydropower from the neighboring countries like Bhutan and Nepal.

Repower/convert inefficient steam-turbine and gas-turbine power plants to higher-efficiency combined cycle power plants and install new combined cycle power plants with high-efficiency machines to save primary fuel and reduce carbon emission, while considering grid stability and security.

Implement smart grid through SCADA, GIS, Advanced Distribution Management System (ADMS), smart prepaid meters, Advanced Metering Infrastructure (AMI), Energy Management System (EMS), and so forth to increase system efficiency and reduce system loss whereby reducing the end-user demand and emission.

Enforce environmental clearance regulations and conduct regular, unannounced inspections in power plants after the DoE issues the environmental clearance certificate (ECC).

15 The coal-based power plants are already required to install an automated emissions-monitoring system in their facilities. Those systems will be further integrated into the proposed CEMS network.

DIESEL GENERATORS

Diesel generators are employed in nearly all high-rise buildings in Dhaka. To mitigate the impact of diesel generators on air quality, following measures are planned:

- Mandate the use of low sulfur diesel (see section 4.4).
- Ensure quality and reliable electricity supply in the national grid to reduce loadshedding (power outages) and the need for diesel generators.
- Encourage the transition from conventional diesel burning generators to generators burning cleaner fuels such as biodiesel, liquified natural gas (LNG), liquified petroleum gas (LPG).
- Mandate the use of advanced emission control technologies, such as particulate filters in diesel generators to minimize the release of harmful pollutants.
- Enforce regular maintenance schedules for diesel generators to ensure optimal performance and efficiency.
- Advocate for the use of energy-efficient generators and the incorporation of smart technologies to optimize power output, reducing the need for prolonged generator operation.
- Establish zoning regulations to restrict the use of diesel generators in densely populated areas.

FUEL PRICING AND QUALITY

The GoB will phase out energy subsidies, starting with a price adjustment system for diesel, heavy fuel oil and octane adopted in March 2024. This will be key to address inefficient use of fuels in irrigation systems, motorized transport, and power generation. In the medium-term, the GoB will continue policy reforms to repurpose other fossil fuel subsidies—considering redistribution measures to avoid negative impacts on poor households that could, for example, move back to cooking with solid fuels if LPG prices increase—and adopt a carbon tax focused on the energy sector. Another key measure to reduce air pollution from power generation, during the country's transition towards renewables, is to promote the use of low-sulfur fuel, starting with a switch to fuel oil with 0.5 percent sulfur and then moving to 0.1 percent sulfur, or alternatively to flue gas desulfurization technologies for all types of power plants—not only for coal power plants. Low sulfur fuel is also crucial to reduce emissions in the transport sector (Section 4.4).

4.3 INDUSTRIES

Brick kilns. In Bangladesh, the substantial demand for bricks arises from the country's rapid economic growth and the absence of stone aggregate essential for construction during infrastructure development. There are more than 7,000 brick kilns in the country, mostly fixed chimney bull's trench kilns or zigzag kilns with various levels of adoption of zigzag technologies (Haque et al. 2022). As a key step to reduce emissions from brick production, the 2019 Amendment of the Brick Manufacturing and Brick Kilns Establishment Act (BMBKEA) 2013 set targets to reduce the use of clay-fired bricks in public works from 2019 to 2025, except for the construction of the base/sub-base of the highways. However, implementation of this phased reform is delayed. To reduce the impact of brick kilns on air quality, the GoB plans the following measures:

- Strictly enforce the BMBKEA, including restrictions for installing brick kilns in specific areas, and emissions standards for brick kilns listed in Schedule 5(13) of the APCR.
- Create incentives, credit guarantee schemes and tax breaks for investment in less polluting, more modern, but more capital-intensive brick making, such as Hoffman and tunnel kilns.
- Develop guidelines and technical specifications, finance pilots and demonstration projects, and build awareness among kilns owners and employees for cleaner and more efficient practices for brick production. These practices include complete conversion of fixed chimney bull's trench kilns to zigzag, with measures such as altered brick stacking, changing coal feeding procedures, increased kiln insulation, and installation of fans.
- Encourage the use of LPG rather than coal and firewood for the initial firing of the kilns at the start of the season.
- Incentivize the use of building materials with smaller environmental footprints than fired bricks.

CEMENT FACTORIES

Several aspects of the cement manufacturing process, including crushing, clinker cooling, product loading, and kiln processing, are associated with the production of air pollutants. Elevated concentrations of particulate matter are released during cooling of clinker, handling final cement product, vehicular movement, and crushing of rocks. In addition, coal combustion at cement factories contributes to the emission of NOx and SO_2, precursors of SPM. The GoB plans to reduce the impacts of cement industries on air quality are as follows:

Mandate and enforce the installation and operation of CEMS, requiring cement factories to install monitoring devices connected to the DoE network, and strictly enforce emissions limits for cement factories as listed in Schedule 5(2) of the APCR.

Adopt and enforce technical requirements for dust management in cement factories, such as installation of electrostatic precipitators (ESPs), bag filters, water spraying systems and dust suppression techniques (for example, storage of stockpiles in hangars).

Promote green financing and technical assistance to replace or upgrade manufacturing facilities and processes to comply with environmental regulations.

Incentivize the investment in energy-efficient technologies, such as high-efficiency kilns and preheaters.

Integrate renewable energy sources such as solar and wind power to reduce reliance on conventional energy sources.

IRON AND STEEL MILLS

The GoB proposed the following measures to reduce the impact of steel and iron industries on air quality:

Set specific technical requirements to control emissions in iron and steel mills, such as ESPs and bag filters, to be verified by the DoE as part of the environmental clearance process (new applications or renewal process) and in further enforcement activities.

Mandate and enforce the installation and operation of CEMS, requiring industries to install stack monitoring devices connected to the DoE network, and strictly enforce emissions limits for iron and steel mills as listed in Schedule 5(3) of the APCR.

Promote green financing and technical assistance to replace or upgrade manufacturing facilities and processes to newer and advanced systems that align with environmental regulations, including adoption of ultra-low emission technologies.

Accelerate the process of relocating, renovating, or shutting down steel plants in urban areas to improve urban living conditions, and prohibit the addition of new production capacities for steel in areas with high population density.

Revise industry standards and guidelines to eliminate excess production capacity in crucial regions—that is, ensuring production capacities align more closely with demand and do not exceed what is deemed necessary or sustainable in specific key areas.

Implement a nonuniform or phased approach to production schedules, especially in autumn and winter seasons by enforcing plans that shift production peaks to different times, to manage emissions during periods when air quality is challenging to maintain.

4.4 TRANSPORT

Inland waterway transport and railways account for 7 percent and 4 percent, respectively, while heavy commercial vehicles are responsible for 73 percent of freight activity. Additionally, the transport sector is the largest consumer of petroleum products (63 percent) in Bangladesh (World Bank 2022). By the end of 2023, there were 0.32 million heavy duty vehicles (buses, trucks, tankers, tractors, and other vehicles such as bulldozers, graders, and so forth) registered in Bangladesh, along with 4.3 million motor vehicles, 0.34 million three wheelers and 0.97 million light duty 4-wheelers (BRTA 2024). The heavy reliance on road transport in Bangladesh, combined with the transport sector being the primary consumer of liquid fuels, significantly contributes to air pollution in the country.

Improvement of fuel quality. In this context, as a first step to reduce emissions from the transport sector, the GoB will revise the diesel fuel standards to Euro 4 (with maximum of 50ppm of sulfur), and further to Euro 5 and Euro 6 (with maximum 10ppm of sulfur). While the standard is being revised, the government will (a) keep importing diesel fuel with a sulfur content of maximum 50 ppm; and (b) renovate refineries with latest technologies to produce low-sulfur fuels.

Emissions from heavy duty vehicles. In Bangladesh, heavy duty vehicles, including trucks and buses, play a significant role in air pollution, primarily due to an older vehicle fleet, poor fuel quality, and limited emission control measures. Several effective measures to alleviate the impacts of heavy-duty vehicles on air quality comprise the following:

Implement and enforce stringent emission standards and regulations for heavy-duty vehicles, with a stepwise goal of restricting imports to Euro 6 vehicles.

Incentivize the modernization of heavy-duty vehicle fleets, promoting the adoption of newer and more fuel-efficient vehicles. Detailed measures to modernize the country's fleet will be part of a scrappage and retrofitting program.

Promote multimodal freight initiatives that focus on optimizing logistics and transportation routes to reduce fuel consumption and emissions. Building on the recently adopted National Logistics Policy 2024, the GoB will mobilize private sector financing (including through PPPs) for creating green distribution networks for freight and expanding inland waterway and rail transport.

Enforce and regulate vehicle weight limits to prevent overloading.

EMISSIONS FROM LIGHT DUTY VEHICLES (LDVS).

By the end of 2023, 1.1 million out of 4.3 million motorcycles registered in Bangladesh were in Dhaka, along with 22 thousand out of 338 thousand three wheelers and 753 thousand out of 974 thousand light duty four-wheelers. Over 80 percent of the vehicles routinely operating on the streets of Dhaka city exhibit defects, and these vehicles emit significantly higher amounts of black smoke than permissible (Nurunnahar, Shariful Islam, and Rahman 2022). To mitigate the impact of LDVs on air quality, the GoB suggests the following measures:

- Promote a shift from private passenger vehicles to public transport through a shift to newer, more comfortable buses, expansion of metro rail services, and increase in costs of operation and parking of private cars.
- Optimization of urban layout strategies and incentives for sustainable, multimodal public transportation, including green corridors, pedestrian bridges, and exclusive lanes for buses and for nonmotorized vehicles.
- Enforce traffic controls and effective traffic management systems to reduce congestion.
- Introduce road pricing mechanisms to manage and control vehicle usage.

Additionally, the GoB will adopt the following measures for all types of vehicles:

- Enforce mandatory vehicle inspection and maintenance procedures, ensuring they meet the emissions standards set by the Schedule 2 of the APCR as a condition of fitness certificate.
- Establish new vehicle inspections centers (VICs), with adequate equipment and trained staff. BRTA will also develop a PPP model for construction and management of VICs. The new centers will prioritize the inspections of the most polluting vehicles, such as buses, trucks, and other heavy-duty vehicles.
- Restrict high-emission vehicles from the road by (a) adopting a phase out program for old, highly polluting vehicles and economic life expired vehicles; and (b) during the phase out process, restrict high-emission vehicles from roads in priority areas.

PROMOTION OF MASS AND ELECTRIC MOBILITY

As key measures to expand mass and electric mobility in Bangladesh, the government will adopt the following interventions:

- Expand and operate metro rail services (MRT-Line 1 to MTR-Line 6) in Dhaka as per schedule.

- Strengthen the city bus system for improved connectivity, install bus queue shelters, post signs, electronic payment, and bus-tracking systems for users.
- Adopt fiscal incentives for manufacturers, importers, and owners of electric vehicles, such as rebates of customs duty and VAT; discount in electricity tariff, road tax and vehicle registration fee.
- Expand installation of public and private charging stations as part of the EV charging policy.

4.5 MUNICIPAL SOLID WASTE

Waste generation in Bangladesh has increased four-fold over the last three decades. Inadequate waste management, with an average of 55 percent of solid waste remaining uncollected in urban areas, contributes to heightened air pollution. Burning of municipal solid waste, containing up to 12 percent plastic, releases toxic gases and airborne particulate emissions into the atmosphere, adding to the poor air quality in Dhaka (Khatun, Saadat, and Ashraf 2023). Several impactful measures to mitigate the effects of municipal waste on air quality include:

- Enforce the Solid Waste Management Rules and ensure that waste incinerators meet the standards prescribed by Schedule 5(14) of the APCR.
- Enforce the ban on open burning of solid waste and the open storage of all types of waste next to roads, houses, schools, construction sites, and other buildings. Enforcement activities will start with most populated areas at times of bad air quality.
- Immediately clean up from roads any waste collected during drain cleaning activities.
- Strictly monitor and penalize the dumping of waste onto roads and into rivers.
- Promote proper centralized waste collection and transport, with source separation and treatment.
- Enhance waste collection rates, ensuring timely and efficient removal of waste from urban areas.
- Integrate multiple disposal processes, including composting of biodegradable waste and recycling of plastics and electronics.
- Improve management practices for landfill sites to minimize the generation of harmful emissions and potentially generate energy.

4.6 AGRICULTURE AND LIVESTOCK

Agricultural practices are also a large source of $PM_{2.5}$ through two very different pathways: first, the direct emission of primary PM when farmers burn crop residue on the fields, and second, the formation of secondary particles when ammonia gas (NH_3) escaping from manure and fertilizers

combines chemically in the atmosphere to nitrate (NO_3) particles and sulfate (SO_4) particles that originated from as NOx and Sox gas from industrial sources. In Bangladesh, most emissions from the agriculture sector refer to SPM from the application of mineral fertilizers and manure management. Emissions from heavy-duty vehicles used in agriculture activities are referred to in section 4.4.

Ammonia from fertilizers. Ammonia emissions from agricultural fertilizers significantly contribute to $PM_{2.5}$ concentrations globally. Primary particulate pollutants arise from fertilizer particles becoming airborne. The interaction between ammonia and nitrogen oxides in the aftermath of fertilization leads to the formation of secondary organic aerosols through photochemical reactions. Several measures to mitigate the effects of fertilizer use on air quality include the following:

- Enforce the adoption and build capacity among farmers for precise techniques to ensure efficient application of fertilizers and minimizing excess usage.
- Promote the use of urease inhibitors in conjunction with urea fertilizers to mitigate the release of ammonia during fertilizer application process.
- Promote substitution of traditional fertilizers like urea with alternatives such as ammonium nitrate, which contribute to lower emissions.
- Repurpose subsidies for fertilizer use to discourage excessive application and support farmers with other agriculture inputs.

Ammonia from manure. Livestock in Bangladesh significantly contributes to air pollution through improper disposal of manure. The prevalent practice of storing manure in liquid form leads to substantial methane (CH_4) emissions. Additionally, the utilization of dung as a fuel for heating and cooking release black carbon, further exacerbating household (and ambient) air pollution. Several measures to mitigate the effects of manure use on air quality are listed below:

- Encourage adoption of anaerobic digestion systems for livestock manure for efficient decomposition and production of biogas.
- Promote use of enclosed storage facilities for manure to prevent the release of pollutants into the atmosphere.
- Conduct training sessions to raise awareness about circular economy approaches and sustainable manure management practices, including proper storage, handling, and treatment to minimize emissions.
- Provide incentives or subsidies to farmers who adopt sustainable manure management practices.
- Implement guidelines that promote environmentally sound practices and penalize improper disposal methods.

Crop-residue burning. While crop residue burning is less in Bangladesh than in other neighboring countries, Aman rice residue in low-lying areas is susceptible to burning, with 0.22 million tons of residue burned in 2020–21, out of 73.36 million tons generated (Hossain 2023). Interventions to control air pollution in Bangladesh due to crop residue burning include these:

- Enforce the ban on open burning of agricultural residue.
- Implement initiatives to raise awareness among farmers about the impact of crop residue burning and provide training on sustainable practices and circular economy options.
- Assess feasibility and, if applicable, pilot and scale up financial and technical assistance to farmers to use newer machinery and techniques for the on-field management of agricultural residue, including Kubota harvesters, shredders, happy seeders, and super seeders.

4.7 CONSTRUCTION AND ROAD DUST

Bangladesh's rapid economic growth also means that the country experiences a lot of construction activity, both buildings and public infrastructure. At the same time many of the roads are still unpaved or have wide unpaved shoulders. While construction and road dust is generally coarse, a fraction of it is smaller than 2.5 micrometers and thus contributing to ambient $PM_{2.5}$. To reduce the impacts of construction dust, the GoB will strictly do the following:

- Enforce the measures outlined in Sections 10 and 11 and Schedule 6 of the APCR for all types of construction—buildings and infrastructure. Developers will be required to adopt dust control measures throughout the construction process, including closed storage or wind and dust protection facilities; protection walls around the construction sites; low-dust practices such as regular road and site watering (preferably automated); seal of sediment transport vehicles, among other actions.
- Enforce environmental clearance requirements and halt illegal construction projects.
- Actively promote green construction and expand green areas.

To reduce road dust, the GoB will carry out the following interventions:

- Phase out manual street sweeping and phase in mechanical, vacuum-based street sweeping wherever feasible; introduce wet, mechanized vacuum sweeping of roads.
- Enforce dust-control measures for dug up areas and proper restoration after the work (applicable for all utility and other service companies).
- Adopt street design guidelines for paving of roads and footpaths (hard and soft paving) with vegetative barriers.
- Introduce water fountains at major traffic intersections, wherever feasible.

4.8 ENERGY EFFICIENCY

Demand-side energy efficiency in various end-user segments, such as industry, buildings, and appliances, represent a significant and often low-cost opportunity reduce carbon emissions and, in some cases, air pollutants—for example, by reducing consumption of coal and diesel fuels. The Energy Efficiency and Conservation Master Plan (EECMP) estimates that energy efficiency solutions will be able to reduce energy consumption in the Ready-Made Garment and textile sector by around 30 percent and increase productivity by 10–15 percent. The solutions include switching to more efficient machinery, automation, and better management of heat supply and reduction of energy loss. Further downstream in the energy value chain, the GoB has recently started to introduce prepaid metering systems for gas use residential consumption.

The GoB has adopted the (a) the Buildings Energy Efficiency and Environment Rating (BEEER) to benchmark the energy and environmental performance of buildings based on the Bangladesh National Building Code (2020) and (b) Energy Efficiency Labeling Regulation for Appliances (EELRA) that ensure minimum energy efficiency standards to perform a specific task and prohibit the marketing of equipment and appliances that do not meet the required performance level. These policies will improve energy efficiency of buildings and appliances, incentivize the construction sector to become greener by applying sustainable building practices, as well as improve awareness of building users on the benefits of energy efficiency. To implement the BEEER and EELRA, the GoB will proceed with the following:

- Issue guidelines and standards to implement the EECMP.
- Enforce the EELRA and encourage appliance manufacturers' participation in the EE Labelling Program.
- Encourage the trading of (high) energy efficient products, including removal of NTB (Non-Tariff Barrier) in collaboration with foreign countries.
- Promote trainings, advisory services and pilots for government agencies, the private sector, and nongovernmental organizations.

4.9 MANAGING INDOOR AIR QUALITY

The APCR emphasizes that the NAQMP must address "effective management of indoor air quality", within households and other facilities. While cooking smoke contributes to both indoor and ambient air pollution, heavily polluted outdoor air also affects indoor spaces. Except when windows are sealed and air purifiers are running, indoor air is seldom less polluted than ambient air. This is the case not only for residences, but also for schools, offices, and industries, where poor air quality reduces productivity and affect academic performance.

As Bangladesh continues its transition from an agrarian to an industrial country, an increasing fraction of the population is spending the working day indoors. Workers are exposed to both indoor sources of air pollution (for example garment manufacturing does produce significant levels of fabric dust), and the inflow of pollutants from outdoors into the workspace. A study revealed that factories equipped with air purifiers experienced a significant 37 percent reduction in indoor air pollution (IAP), leading to a notable decrease to 25 μg/m³ in indoor $PM_{2.5}$ concentrations compared to those without air purifiers (mean=68 μg /m3). The impact of

improved IAP on productivity was striking, with workers in firms with air purifiers exhibiting a remarkable 27 percent increase in productivity compared to those in firms without air purifiers. This boost in productivity, calculated through a basic cost-benefit analysis, indicated average firm-level gains of $5,710 per month in a favorable benefit/cost ratio of 8.15. These findings suggested that air purifiers could serve as a cost-effective solution to enhance air quality and foster increased productivity among workers (Gang et al. 2013).

Workers in the cement industry are also exposed to elevated indoor air pollution. Critical phases during cement manufacturing where workers face elevated pollutant concentrations include clinker cooling, product loading, kiln processing, coarse crushing of rocks, and fine crushing of aggregates, with heighted concentrations of PM_{10}, $PM_{2.5}$, SO_2, and NO_2 in the clinker cooling area. Few simple but effective measures to manage indoor air quality and mitigate personal exposure include minimizing open storage of materials, especially clinker and alkaline dust, and stabilizing production areas using suitable materials like cement mortar or asphalt to prevent dust resuspension. The GoB plans to address indoor air quality by adopting and enforcing standards and technical guidelines for indoor air quality management in selected sectors (including for occupational health and safety, OHS), starting with schools, and cement and garment industries.

5

MANAGING BANGLADESH'S AIR QUALITY IN THE CONTEXT OF A POLLUTED NEIGHBORHOOD

Air pollution does not recognize international borders and travels freely between countries, whichever way the wind takes it. The IGP, where much of Bangladesh is located, is not just one of the most populated places in the world, but also one of the most polluted. With prevailing westerly winds during the polluted dry season, Bangladesh receives significant pollution from other countries. In fact, even in Dhaka more than one fifth of ambient $PM_{2.5}$ is from beyond the country's borders. Even if Bangladesh did a perfect job cleaning up its domestic emissions, it would still have very polluted air if neighboring countries did nothing. To address this issue the GoB will build up strength in two areas: (a) increase scientific capacity and international collaboration to be able to quantify the transboundary inflow of pollutants, and (b) play a more active role in regional and international fora to seek reductions in emissions beyond Bangladesh's borders.

Building scientific capacity. To address the impacts of transboundary air pollution, and to have a credible voice on the issue in international fora, Bangladesh will invest in strengthening scientific understanding and the production of data on the issue. Ultimately, the GoB needs to know the daily quantity of pollutants that have entered through its borders and the impacts that these pollutants are having in Bangladesh. To reach there, the priority will be given to the following:

Research on the science and impacts of air pollution will be strengthened through the creation of additional faculty positions and allocation of funds for student and faculty research.

Collaboration between local institutions and relevant foreign researchers will be encouraged and facilitated. Regional scientific consensus building will be encouraged through co-authored peer-reviewed papers with authors from around the region.

Bangladesh will play a more active role in regional organizations that support research and research collaboration in Bangladesh.

When establishing new CAMS, the DoE will prioritize stations near Bangladesh's western border.

Losses and damages in Bangladesh due to imported air pollution will be quantified and reported, in preparation for the day when actual invoices can be sent to neighboring countries.

Active participation in global and regional fora. Coordinated actions across the IGP countries will not only generate mutual benefits across the region, but also allow the countries to achieve clean air targets faster and cheaper. Getting this to happen more quickly will become part of Bangladesh's foreign policy. The GoB will work to both strengthen relevant regional fora and to have a louder voice at them. These include the Male Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia, and the Better Air Quality (BAQ) conference series. Bangladesh will also ensure that air pollution and its co-benefits are sufficiently addressed at regional Climate Parliament meetings and will play an active role in moving forward and strengthening the regional Kathmandu Roadmap that as signed in December 2022. In addition, Bangladesh will strengthen its presence in global fora such as the WHO summits on air pollution and health, while pushing for more action to reduce SLCP through the Climate and Clean Air Coalition and the UNFCCC COPs.

IMPLEMENTATION PLAN

Table 6.1 summarizes the policies, investments, and capacity building activities of the NAQMP. It also describes the timeline (including preparatory work for studies, policy formulation, procurement, civil works, among other) and the agencies mandated to implement those interventions. To measure progress in achieving the NAQMP's objectives, **table 6.2 and Appendix F set forth key results indicators in the following areas**:

- Air quality monitoring
- Environmental fiscal instruments
- Access to clean cooking
- Emission reductions from power plants and industries (as targeted by the CEMP), and heavy-duty vehicles.

By June 2025, each implementing agency will present a detailed action plan for their respective interventions to the NCAPC, describing the activities, outputs, estimated costs, sources of financing (confirmed or planned), and **sector-specific results indicators (complementing table 6.2 and Appendix F) to measure implementation progress and outcomes**. Appendix E includes a template for the action plan.

The NCAPC will hold **semi-annual meetings to discuss the implementation status of the NAQMP**, its challenges and remedial actions to address potential delays and shortcomings. In advance of those meetings, the NCAPC Secretary (MoEFCC) will prepare and distribute to the committee a progress report, compiling the information provided by all responsible agencies. The progress report and the minutes of the NCAPC meeting will be made public at MoEFCC's and DoE's websites.

By December 2027, the NCAPC will carry out a **midterm review (MTR) of the NAQMP**. The assessment will be conducted by an independent firm procured by DoE. All implementing agencies will provide inputs to the MTR, highlighting progress and challenges in the NAQMP implementation, status of targets and outcomes, and lessons learned. The MTR results will inform not only the final years of implementation of the first NAQMP, but also the drafting process of the APCR amendment and the second NAQMP. The information flow and corresponding deadlines for the implementing agencies to submit the required information to the NACPC, including a template for providing inputs to the progress report, will be included in the **NACPC Rules of Procedures**.

Table 6.1 Summary of Interventions

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
A. Enhancing air quality management										
1. Strengthening the legal and policy framework										
1.1 Amendment to the Environmental Conservation Act and corresponding rules (as per Section 3.1 of NAQMP).	•	•	•	•				MoEFCC, Parliament	Cabinet, DoE, Min. Laws	WB: BEST Project [a]
1.2 Additional guidelines to the 2023 ECR for monitoring and enforcement after environmental clearance certificate issuance.	•	•	•					MoEFCC, DoE		WB: BEST Project [a,b]
1.3 Proceed with a comprehensive reform of Environment Court Act, expanding legal standing to all citizens and creating the roles of environmental prosecutors and technical experts.	•	•	•	•				MoEFCC, Parliament	Cabinet, DoE, Min. Laws	WB: GCRD Credits [c]
1.4 Adopt guidelines to APCR on specific requirements, practices, and technologies for emissions control in targeted industries and projects, as per Section 8 and Schedule 5 of APCR (including power generation, cement, brick, iron and steel, and waste management).	•	•	•					MoEFCC, DoE	MoI. FBCCI	WB: BEST Project [a] , JICA
1.5 Adopt guidelines to APCR on air quality planning and management at local governments.	•	•	•					MoEFCC, DoE	MoLGRDC, city corporations	WB: BEST Project [a]
1.6 Amend the APCR to incorporate lessons learned from NAQMP implementation, tighten the current national air quality standards and emissions limits, and specify technology and other technical requirements for emissions control.				•	•			MoEFCC, DoE		WB: Proposed BCAP, JICA
1.7 Adopt Rules of Procedures of the NCAPC.	•	•						NCAPC	MoEFCC	WB: TA and Proposed BCAP, JICA
1.8 Issue a formal designation of Bangladesh's airshed and its subregions for planning and management purposes.	•	•	•					NCAPC, MoEFCC, DoE		WB: TA and Proposed BCAP [a]
1.9 Adopt guidelines to APCR for (a) declaring the airshed degraded, (b) development of degraded airshed management plans, and (c) pollution prevention plans.	•	•	•					NCAPC, MoEFCC, DoE		WB: TA and Proposed BCAP [a]
1.10 Procedures for and implementation of periodic disclosure of a list of highly air polluting industries and activities.	•	•	•					DoE, MoEFCC		WB: TA and Proposed BCAP [a]
1.11 Adopt the Heavy Air Pollution Contingency Plan (HAPCP).	•	•	•					NCAPC, MoEFCC, DoE		WB: TA and Proposed BCAP [a]

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
1.12 Engage city councilor to design ward-based model (WBM) for abatement of local air pollution focusing on capacity development, awareness campaign, and other necessary means.	•	•	•	•	•	•	•	city corporations, municipalities	DoE, LGD, MoEFCC	
1.13 Adopt a fuel-pricing formula for diesel, octane, petrol, and kerosene.	•							FD, EMRD		WB: GCRD [c] IMF [c]
1.14 Increase the environmental protection surcharge applied to sales of and regularly update and disclose the list of highly polluting companies not complying with emissions standards.	•	•★	•	•	•	•	•	NBR, FD	MoEFCC, DoE	WB: GCRD [c]
1.15 Adopt carbon-pricing instruments, combined with redistribution measures to the poor.	•	•	•					FD, NBR, MoEFCC	DoE	WB: TA and Proposed BCAP [a]
1.16 Analyze feasibility of, and adopt, other fiscal instruments, such as emission tax for vehicles, tax breaks for electric vehicles and green technology, tax credits for small business to improve indoor air quality in their facilities, and emissions charges.	•	•	•	•	•			FD, NBR, BB, FID	DoE, BRTA	WB: TA and Proposed BCAP [a]
1.17 Establish and operate a green credit guarantee facility to support investments to reduce pollution from target sectors (starting with brick kiln, municipal waste management, clean cooking, and rooftop solar systems).	•	•	•	•	•	•	•	FD, BB, FID	DoE	AFD/WB: BEST Project [d]
1.18 Establish and operate an environment endowment fund to finance research and development, pilots of green technology, and other technical assistance for environmental conservation, prioritizing grants for emissions control initiatives.	•	•	•	•	•	•	•	DoE, MoEFCC	FD, BB, FID	WB: BEST Project [d]
1.19 Establish City Clean Air Fund (C-CAF) to use local and central government financial resources to implement Clean Air supported projects.		•	•	•	•	•	•	City corporations, municipalities	DoE, LGD, MoEFCC, FD	
2. Strengthening institutional capacity for AQM										
2.1 Approval of DoE's new organogram.	•	•	•	•				MoPA, CD, MoEFCC, FD	DoE	WB: BEST Project [c]
2.2 Continuously increase the number of staff at DoE, especially at district offices and laboratories.	•	•	•	•	•	•	•	MoPA, CD, MoEFCC	FD, DoE	WB: BEST Project [c]
2.3 Establish a research and training unit at DoE.	•	•	•	•				MoEFCC, DoE		WB: BEST Project
2.4 Establish the Environment and Climate Centre of Excellence under MoEFCC.	•	•	•	•				MoEFCC, CD	FD	WB: BEST Project

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
2.5 Establish and operate new offices and laboratories for DoE, with adequate staffing and equipment (five divisional offices, five district offices, six divisional labs, and 32 district labs).	•	•	•	•★	•			MoEFCC, DoE	FD	WB: BEST Project
2.6 Establish and operate new AQM units in key institutions, with environmental science / engineering background and adequate staffing and equipment at BRTA, RAJUK, CDA, UDD, and city corporations (at least in GDA districts and Chattogram).	•	•	•	•				BRTA, city corporations, RAJUK, CDA, UDD	LGD, RTHD, MoHPW, MoPA, FD, CD	
2.7 Supply existing DoE offices with monitoring and laboratory equipment, IT tools, and other inputs to enhance their analytical, monitoring, and enforcement capacity.	•	•	•	•				MoEFCC, DoE	FD	WB: BEST Project
2.8 Expand and enhance air quality monitoring network (as per Section 3.3.1 of NAQMP). Decade-scale Monitoring Network Expansion Plan.	•★	•	•	•	•			MoEFCC, DoE	FD	WB: BEST Project; Proposed BCAP. JICA
2.9 Enhance inspections and monitoring of stationary sources.		•	•	•	•	•	•	DoE	MoEFCC, MoI	JICA
2.10 Establish and operate an air quality forecast system (as per Section 3.3.2 of the NAQMP).		•	•	•	•	•	•	DoE	MoEFCC	WB: BEST Project; Proposed BCAP
2.11 Conduct and regularly update emissions inventories. First inventory due by June 2026.	•	•★	•	•	•	•	•	DoE	MoEFCC	WB: BEST Project
2.12 Complement and regularly update source apportionments.	•	•	•	•				DoE	MoEFCC	WB: TA and Proposed BCAP
2.13 Continue disclosure of real-time Air Quality Index, with improvements in DoE's webserver, format/description of disclosed data, including alerts and messages in case of heavy air pollution. DoE will also adopt a mobile app for data sharing, alerts, and other health-related messages.	•	•★	•	•	•	•	•	DoE	MoEFCC, DGHS	WB: BEST; UHNP; proposed BCAP
2.14 Regulate, pilot, and scale-up continuous emissions monitoring program (CEMP) for measuring and managing air pollutants emitted from stacks of targeted industries and power plants. CEMS will automatically send information to DoE's data-acquisition system. Pilot to start by December 2025 with high-polluting sectors.	•	•	•★	•	•	•	•	DoE	MoEFCC, MoI, FBCCI	WB: GCRD; TA and proposed BCAP
2.15 Enhance inspections and monitoring of stationary sources.	•	•★	•	•	•	•	•	DoE	MoEFCC, MoI	JICA

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
2.16 Advanced training program (face-to-face and on-line) on key topics of AQM for officials of MoEFCC, DoE, and other selected government agencies.	•	•★	•	•	•	•	•	DoE	MoEFCC	WB: BEST; proposed BCAP, JICA
2.17 Establish training program (face-to-face and on-line) and awareness campaigns on AQM themes tailored to relevant audiences: students, teachers, women's associations, workers and business owners in targeted industries, magistrates, law enforcement agents, and journalists, among other.	•	•★	•	•	•	•	•	DoE	MoEFCC	WB: BEST; UHNP; proposed BCAP
2.18 Integrate air pollution and AQI into school curricula and other educational programs.		•	•	•	•	•	•	DoE, DSHE, NCTB	MoEFCC, MoE, MoPME, DPE, DTE, BTEB, NSDA	
2.19 Conduct capacity building and close coordination for research among relevant agencies and education and research institutions.		•	•	•	•	•	•	MoEFCC, MoE	UGC, universities, MoST, MoA	
2.20 Continuously monitor and evaluate the NAQMP, including progress in achieving outcome indicators and institutional performance of environmental agencies. Midterm evaluation in December 2027.	•	•	•	•★	•	•	•	NCAPC, MoEFCC	All NCAPC members	WB: proposed BCAP
2.21 Continuously monitor and evaluate HAPCP. Midterm evaluation in December 2027.		•	•	•★	•	•	•	NCAPC, MoEFCC	All NCAPC members	WB: proposed BCAP
2.22 Collaborate with neighboring countries to address transboundary air pollution, especially $PM_{2.5}$ emissions, through knowledge exchange, harmonized policies, and agreements for enabling imports of clean energy, e-vehicles, among other collaborations.	•	•	•	•	•	•	•	MoEFCC, DoE, RTHD, BRTA, PD	MoPEMR, MoFA, SAARC	WB: proposed BCAP
B. Reducing emissions from targeted sectors										
3. Households										
3.1 Adopt and implement a national action plan for clean cooking, covering interventions to promote improved cookstoves and clean fuels.	•	•	•★	•	•	•	•	PD, EMRD, SREDA, IDCOL, NGOs	MoEFCC, DoE, MoF, DGHS, ERD	Proposed BCAP [a] SNV
3.2 Incentivize the transition to clean cooking fuel, particularly to LPG and electric induction stoves. The GoB will consider fiscal and market-based instruments such as tax exemption, repurposed subsidies, revised electricity block tariff structure, free or for-borrow LPG cylinders, availability of smaller LPG cylinders (3–5 kg) especially for rural households, and rural LPG delivery.	•	•	•	•	•	•	•	FD, SREDA	MoEFCC, NBR, IDCOL, and other financing institutions	WB: proposed BCAP SNV

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
3.3 Incentivize the design and development of locally appropriate biomass cookstoves—especially with double burner and chimney—and incentivize their adoption by households that have no access to cleaner fuel.	•	•	•	•	•	•	•	FD, SREDA, MoC	DoE, IDCOL, NGOs	WB: proposed BCAP
3.4 Promote off-grid solutions, particularly rooftop solar installations and domestic biodigesters, for clean cooking, hot water supply, and lighting.	•	•	•	•	•	•	•	MoPEMR, SREDA, FD, RAJUK	DoE, PD, IDCOL	
3.5 Implement awareness campaigns, tailored for families, on health benefits of clean cooking and other solutions to improve indoor air quality at their homes.	•	•	•	•	•	•	•	DGHS, LGD, SREDA, IDCOL	MoEFCC, DoE	WB: proposed BCAP
4. Power generation										
4.1 Thermal power plants										
4.1.1 Mandate the use of low-sulfur fuel and enforce the use of emission-control devices to reduce PM, NOx, and SO_2 from thermal power plants, such as FGD, low-NOx burner, baghouse filter, ESP, and so forth. Extend these measures to natural gas power plants as applicable.	•	•	•★	•	•	•	•	PD, EMRD, BPDB, SREDA, MoI, MoEFCC, DoE, BPC	MoC, NBR	WB: BEST [b], GCRD [c], proposed BCAP
4.1.2 Strictly enforce emissions standards and stack-height standards for thermal power plants listed in Schedule 5(1) of APCR, including through CEMS.	•	•	•	•	•	•	•	DoE, MoEFCC	MoC, NBR, PD	WB: BEST [b], proposed BCAP
4.1.4 Increase investments in renewables such as wind, solar and biogas for electricity generation.	•	•	•	•	•	•	•	PD, EMRD, BPDB, SREDA	FD, IDCOL	EU/EIB
4.1.5 Assess feasibility of emerging renewable and clean energy technologies, such as hydrogen and its derivatives, ammonia, and carbon capture, utilization, and storage (CCUS).		•	•					MoFA, FD, PD, BPDB	BERC	
4.1.6 Work towards cross-border renewable energy trade.	•	•	•	•	•	•	•	MoFA, FD, PD, BDPB	BERC	
4.1.7 Enforce environmental clearance regulations and conduct regular, unannounced inspections of power plants after the DoE issues the environmental clearance certificate (ECC).	•	•	•	•	•	•	•	DoE	MoEFCC	WB: BEST [b], proposed BCAP
4.1.8 Repower/convert inefficient steam-turbine and gas-turbine power plants to higher- efficiency combined cycle power plants and install new combined cycle power plants with high-efficiency machine to save primary fuel and reduce carbon emission, while considering grid stability and security.	•	•	•	•	•	•	•	PD, BPDB	FD, BERC	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
4.1.9 Implement smart grid through SCADA, GIS, Advanced Distribution Management System (ADMS), smart prepaid meter, Advanced Metering Infrastructure (AMI), Energy Management System (EMS), and so forth to increase system efficiency and reduce system loss, thereby reducing the end-user demand and emissions.	•	•	•	•	•	•	•	PD, BPDB		
4.2 Diesel generators										
4.2.1 Increase quality and reliable electricity supply in the national grid to reduce load shedding (power outages) and the need for diesel generators.	•	•	•	•	•	•	•	BPDB, PD, FD		
4.2.2 Encourage the transition from conventional diesel-burning generators to generators using cleaner fuels such as biodiesel, liquefied natural gas (LNG), and liquefied petroleum gas (LPG).	•	•	•	•	•	•	•	EMRD, PD	BERC	
4.2.3 Mandate the use of advanced emission-control technologies, such as particulate filters in diesel generators, to minimize the release of harmful pollutants.	•	•	•					PD	BPDB, BERC	
4.2.4 Enforce regular maintenance schedules for diesel generators to ensure optimal performance and efficiency.	•	•	•	•	•	•	•	SREDA, BERC, DoE	PD	
4.2.5 Encourage the use of energy-efficient generators and incorporation of smart technologies to optimize power output, reducing the need for prolonged generator operation.	•	•	•	•	•	•	•	SREDA, BERC, DoE	PD	
4.2.6 Establish zoning regulations to restrict the use of diesel generators in densely populated areas.		•	•					BERC	PD, BPDB, DoE	
5. Industries										
5.1 Brick and block production										
5.1.1 As per gazette notification, ensure the use of 100% blocks in phases as an alternative to bricks in all government construction projects, repair, and renovation work, excluding base and sub-base of roads and highways.	•	•	•	•	•	•	•	LGED, PWD, EED. HED, DoE, RAJUK, CDA, KDA, UDD, city corporations, municipalities	MoEFCC, LGD, MHPW, Planning' Commission, MOHFW, HBRI, MoE, BSTI	
5.1.2 Assess and establish financial incentives to realize sustainable transition from clay-fired brick kilns to non-fired green bricks or blocks (for example, credit guarantee scheme).	•	•	•	•	•			FD, FID, DoE	BB, NBR	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
5.1.3 Strictly enforce emission standards for brick kilns and provisions of the Brick Manufacturing and Brick Kilns Establishment Act, particularly restrictions on kiln installation in specific areas.	•	•	•	•	•	•	•	DoE	District Administration	
5.1.4 Develop guidelines and technical specifications, finance pilots and demonstration projects, and build awareness among kiln owners and employees for cleaner and more efficient practices for brick production, including the use of post-dredging soil in brick kilns.	•	•	•	•				DoE	District Administration	WB: BEST [d]
5.2 Cement factories										
5.2.1 Enforce technical requirements for dust management and, when applicable, CEMS/CAMS installation and operation as part of DoE's remote monitoring network. Technical requirements may include installation of ESPs, bag filters, eco hoppers, water-spraying systems, and so forth.	•	•	•	•	•	•	•	DoE	MoI, FBCCI	WB: BEST [b], proposed BCAP
5.2.2 Promote green financing and technical assistance to replace or upgrade manufacturing facilities and processes to comply with environmental regulations.	•	•	•	•	•	•	•	FD, FID, MoI	DoE, BB, NBR	WB: proposed BCAP EU/EIB
5.2.3 Incentivize investment in energy-efficient technologies, such as high-efficiency kilns and preheaters.		•	•	•	•	•	•	FD, FID, MoI	DoE, BB, NBR	EU/EIB
5.2.4 Integrate renewable energy sources such as solar and wind power to reduce reliance on conventional energy sources.	•	•	•	•	•	•	•	PD, MoI, SREDA, BPDB	DoE	EU/EIB
5.3 Iron and steel mills										
5.3.1 Set specific technical standards to control emissions in iron and steel mills, to be verified by DoE as part of the environmental clearance processes (new applications or renewal process) and in further enforcement activities.		•	•	•	•	•	•	DoE	MoI, FBCCI	WB: proposed BCAP
5.3.2 Enforce emission limits and technical requirements for emissions control in iron and steel mills, including by installing CEMS as part of DoE's remote monitoring system, ESPs, bag filters, among other approaches.			•	•	•	•	•	DoE	MoI, FBCCI	WB: BEST [b], proposed BCAP
5.3.3 Promote green financing and technical assistance to replace or upgrade manufacturing facilities and processes to comply with environmental regulations.		•	•	•	•	•	•	FD, FID, MoI, BIDA, MoFA	DoE, BB, NBR	WB: proposed BCAP, JICA
5.3.4 Accelerate the process of relocating, renovating, or shutting down steel plants in urban residential areas, and prohibit the addition of new production capacities for steel in areas with high population density.		•	•	•	•	•	•	DoE	MoI, FBCCI	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
5.3.5 Revise industry standards and guidelines to eliminate excess production capacity in crucial regions.		●	●					DoE	MoI, FBCCI	
5.3.6 Implement a nonuniform or phased approach to production schedules to manage emissions during periods when air quality is challenging to maintain.		●	●	●	●			DoE	MoI, FBCCI	
6. Transport										
6.1 Vehicle performance and fuel quality										
6.1.1 Establish a specialized unit/team at BRTA for enforcing vehicle emissions standards and technical requirements for engines, such as diesel particulate filters for PM and selective catalytic reduction for NO_x.	●	●★						BRTA	RTHD, MoPA, FD, CD,	
6.1.2 Equip existing fitness permission centers with portable devices for vehicle emissions inspections.	●	●	●	●	●	●	●	BRTA	RTHD, DoE	WB: proposed BCAP
6.1.3 Establish new vehicle inspections centers (VICs), with adequate equipment and trained staff, for conducting emissions and other performance testing as a condition for annual fitness certificates.	●	●	●	●	●	●	●	BRTA	RTHD, DoE	WB: BEST [d]
6.1.4 Restrict import and phaseout of old, highly polluting vehicles and of vehicles whose "economic life" has expired. During the phaseout process, restrict high-emission vehicles on roads in priority areas.	●	●★	●	●	●	●	●	BRTA, MoC, Chief Controller of Imports & Exports (CCI&E), Bangladesh police	RTHD, DoE	WB: GCRD [a]
6.1.5 Revise diesel-fuel standards to Euro 4 (with maximum 50 ppm of sulfur). Keep importing diesel fuel with a sulfur content equal to or less than 50 ppm, while the standard is being revised.		●★	●	●	●	●	●★	BPC	EMRD, DoE, BSTI, MoC	WB: GCRD [c]
6.1.6 In preparation for adopting diesel-fuel standards to Euro 4, renovate refineries with latest technologies to produce low-sulfur (50 ppm) fuels.	●	●	●	●	●	●	●★	BPC	EMRD, DoE, BSTI, FD	
6.1.2 Enforce MARPOL Annex VI to reduce international ship emissions in Bangladesh waters.	●	●	●	●	●	●	●	BIWTA, BIWTC, Ministry of Shipping	DoE, port authorities, District Administration	
6.2 Light-duty vehicles										
6.2.1 Optimize urban layout strategies to prioritize sustainable, multimodal public transportation, including nonmotorized mobility. These measures include expanding green corridors for pedestrians, bicycles. and other nonmotorized vehicles.	●	●	●	●	●	●	●	DTCA, RTHD, BRTC, BBTOA	city corporations, DoE	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
6.2.2 Enforce traffic controls and effective traffic-management systems to reduce congestion.	•	•	•	•	•			Bangladesh police, BRTA, DTCA, city corporations	PSD, BBTOA, District Administration	
6.2.3 Introduce road-pricing mechanisms to manage and control vehicle usage.		•	•	•	•			DTCA, BRTA, BBTOA	Bangladesh police	
6.3 Heavy-duty vehicles										
6.3.1 Adopt and enforce stringent emission standards and regulations for heavy-duty vehicles.		•	•★	•	•	•	•	DoE, BRTA, NBR	DTCA, BBTOA	
6.3.2 Adopt a program for modernizing heavy-duty vehicles fleets, with options for newer and more fuel-efficient vehicles (or retrofitting).	•	•	•	•				DoE, BRTA, FD, NBR, BBTOA	Bangladesh Bank, BRTC, Bangladesh police	WB: TA; GCRD [c]
6.3.3 Adopt and implement a national logistics development policy.	•	•★	•	•	•			NLDCC, PMO, MoC, RTHD, MoI	Railway Division, Bangladesh police	
6.3.4 Promote multimodal freight initiatives for optimizing logistics and transportation routes to reduce fuel consumption and emissions.		•	•	•	•	•	•	DTCA, BRTA, BBTOA, Bangladesh Railway	Bangladesh police	
6.3.5 Regulate and enforce vehicle-weight limits.	•	•★	•	•	•	•	•	DTCA, BRTA, BBTOA	Bangladesh police, city corporations, District Administration	
6.4 Mass mobility										
6.4.1 Expand and operate metro rail services (MRT-Line 1 to MTR-Line 6) as per schedule.	•	•	•	•	•	•	•	DMTCL , RTHD	city corporations, DTCA	JICA
6.4.2 Strengthen the city bus system for improved connectivity, implement bus rapid transit (BRT) system, and install bus queue shelters, post signs, electronic payment, and bus tracking systems for users.	•	•	•	•	•	•	•	city corporations, DTCA, BRTC, RTHD		
6.4.3 Adopt and enforce stringent emission standards and regulations for locomotives.		•	•	•★	•	•	•	Bangladesh Railway	Ministry of Railway, MoEFCC, DoE	
6.4.4 Adopt a program for modernizing the railway sector, with options for newer and more fuel-efficient locomotives (or retrofitting).		•	•	•	•	•	•	Bangladesh Railway	Ministry of Railway, MoEFCC	
6.5 Electric mobility										
6.5.1 Adopt tax exemption and temporary discount in electricity tariff for EV manufacturers (vehicle and battery).	•	•	•	•	•	•	•	BRTA, FD, NBR, PD	FID, BB, BPDB, RTHD, BERC	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
6.5.2 Regulate battery licensing, used-batteries disposal and recycling, especially lead-acid batteries.		•	•★	•	•	•	•	MoI, BRTA, RTHD	ABMEAB, BIDA	
6.5.3 Waive the road tax and reduce the registration fee for EVs owners.	•	•	•	•	•	•	•	FD, NBR, BRTA	FID, PDB, RTHD	
6.5.4 Install public EV charging stations and incentivize private stations as part of the EV charging policy.	•	•	•	•	•	•	•	FD, NBR, BPDB	FID, BB, PD	
6.5.5 Develop and implement a policy to improve environmentally friendly disposal of batteries used in EVs.	•	•	•	•	•	•	•	ICTD, RTHD	BRTA, DoE, PD	
7. Municipal waste management										
7.1 Enforce the ban on open burning of solid waste, and strictly monitor and penalize the dumping of waste onto roads and into rivers.	•	•	•	•	•	•	•	DoE, city corporations, municipalities, DESCO, DPDC, Titas, WASA, ICT Division, PWD, REHAB	LGD, MoEFCC	WB:BEST [b] EU/EIB
7.2 Immediately clean up any waste collected during drain cleaning activities.	•	•	•	•	•	•	•	city corporations, municipalities	LGD	JICA
7.3 Promote proper centralized waste collection and transport, with source separation and treatment.	•	•	•	•	•	•	•	city corporations, municipalities, DESCO, DPDC, Titas, WASA, ICT Division, PWD, REHAB	LGD, MoEFCC	JICA
7.4 Enhance waste-collection rates, ensuring timely and efficient removal of waste from urban areas.	•	•	•	•	•	•	•	city corporations, municipalities	LGD, MoEFCC	JICA
7.5 Integrate multiple disposal processes, including management of e-waste, chemical waste, composting and anaerobic digestion of biodegradable waste, and recycling of plastics, glasses, metals, papers, and electronics.	•	•	•	•	•	•	•	city corporations, municipalities, High Tech Park Authority	LGD, MoEFCC, ICT, BHTPA	JICA
7.6 Improve management practices for landfill sites to minimize the generation of harmful emissions and potentially generate energy. The GoB will take necessary steps to extract landfill gas and generate power using modern technologies.	•	•	•	•	•	•	•	city corporations, municipalities	DoE, LGD, MoEFCC	JICA
7.7 Enforce the Solid Waste Management Rules 2021 and ensure that waste incinerators meet the standards prescribed by APCR Schedule 5(14).	•	•	•	•	•	•	•	DoE, city corporations, municipalities	LGD, MoEFCC, District Administration	WB:BEST [b]
7.8 Encourage people to segregate waste at source as per Solid Waste Management Rules 2021.	•	•	•	•	•	•		city corporations, municipalities	DoE, LGD, MoEFCC	
7.9 Modernize waste-collection fleet to support clean air initiatives.		•	•	•	•	•	•	city corporations, municipalities	DoE, LGD, MoEFCC	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
7.10 Collect and periodically disclose data relating to proper waste management, as per SWMR 2021		•	•	•	•	•	•	city corporation, municipalities	DoE, LGD, MoEFCC	
8. Agriculture and livestock										
8.1 Ammonia from fertilizers										
8.1.1 Enforce the adoption and build capacity among farmers for precise techniques to ensure efficient application of fertilizers and to minimize excess usage.	•	•	•	•	•	•	•	DAE, BARC	DoE, MoA	WB: LDDP, SACEP
8.1.2 Promote substitution of traditional fertilizers like urea with appropriate alternatives such as ammonium nitrate; DAP; ammonium sulfate; neem-coated urea; sulfur-coated urea; organic fertilizers (compost, tricho- compost, farmyard manure, among others); urease inhibitors; biofertilizers; and nano fertilizers; and so forth, which contribute to lower emissions.	•	•	•	•	•	•	•	DAE, BARC, BADC	MoA	WB: LDDP, SACEP
8.1.3 Introduce innovative mechanisms in agriculture including precision agriculture and revisit subsidies for fertilizer use to discourage excessive application and support farmers with other agriculture inputs to adopt sustainable management practices.	•	•	•	•	•	•	•	DAE , BARC	MoA	WB: PARTNER, SACEP
8.1.4 Provide incentives and subsidies to farmers who adopt sustainable management practices that reduce air pollutant emissions.	•	•	•	•	•	•	•	DAE , BARC	MoA	
8.2 Ammonia from manure										
8.2.1 Encourage adoption of appropriate technology for livestock manure for efficient decomposition and production of biogas.	•	•	•	•	•	•	•	DLS, BLRI	MoFL	WB: LDDP
8.2.2 Conduct training sessions to raise awareness about circular economy approaches and sustainable manure-management practices, including proper storage, handling, and treatment to minimize emissions.	•	•	•	•	•	•	•	DLS, BLRI	MoFL	WB: LDDP
8.2.3 Provide/repurpose incentives or subsidies to farmers who adopt sustainable manure-management practices.	•	•	•	•	•	•	•	DLS, BLRI	MoFL	
8.2.4 Implement guidelines that promote environmentally sound practices and penalize improper disposal methods.	•	•	•	•	•	•	•	DLS, BLRI	MoFL	
8.3 Crop-residue burning on crop fields										
8.3.1 Enforce the ban on open burning of agricultural residue on crop fields.	•	•	•	•	•	•	•	DoE, DAE	MoEFCC, MoA, District Administration	WB:BEST [b,]

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
8.3.2 Implement initiatives to raise awareness among farmers about the impacts of burning crop residues and provide training on sustainable practices and circular economy options.	•	•	•	•	•	•	•	DoE, DAE, BARC	MoEFCC, MoA	
8.3.3 Analyze feasibility, pilot, and scale up financial and technical assistance to farmers to use newer machinery and techniques for on-field management of agricultural residue.	•	•	•	•	•	•	•	DAE, BARC	MoA, FD	ICIMOD
8.3.4 Analyze feasibility, pilot, and scale up transformation of crop residue for marketable products.		•	•	•	•	•	•	DAE	MoA, FD	
9. Construction and road dust										
9.1 Enforce the measures outlined in Sections 10 and 11 and Schedule 6 of APCR, including closed storage or wind and dust protection facilities, protection walls around construction sites, low-dust practices such as regular road and site watering (preferably automated), and sealing of sediment transport vehicles, among other.	•	•	•	•	•	•	•	city corporations, municipalities, RAJUK, CDA, KDA, Development Authority, UDD, ICTD, DESCO, DPDC, WASA, Titas Gas, DoE	MoEFCC, LGD, MHPW, Bangladesh police, PSD	WB:BEST [b]
9.2 Enforce environmental clearance requirements and halt illegal construction projects.	•	•	•	•	•	•	•	DoE, city corporations, municipalities, RAJUK, CDA, KDA, municipalities, Bangladesh police, REHAB	MoEFCC, MHPW, DESCO, DPDC, Titas, WASA, ICT Division, PWD,	WB:BEST [b]
9.3 Actively promote green construction and expand green areas.	•	•	•	•	•	•	•	city corporations, municipalities. RAJUK, CDA, KDA, UDD	LGD. MoEFCC, MHPW	GIZ
9.4 Establish a system of developing a coordinated annual plan by utility service departments led by city corporations for implementing their respective physical works that require cutting and digging up of roads.	•	•	•	•	•	•	•	city corporations, municipalities, UDD	LGD, MoEFCC, DoE	
9.5 Enforce the restriction on entry and movement of uncovered trucks carrying sand, soil, cement, and garbage to Dhaka City.	•	•	•	•	•	•	•	Bangladesh police	BRTA	
9.6 Enforce ban on open burning of waste at construction sites.	•	•	•	•	•	•	•	city corporations, municipalities, DoE, RAJUK, CDA, KDA, UDD	MoEFCC, LGD	WB:BEST [b]
9.7 Phase out manual street sweeping and phase in mechanical, vacuum-based street sweeping wherever feasible; introduce wet, mechanized vacuum sweeping of roads.	•	•	•	•	•	•		city corporations, municipalities	LGD	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
9.8 Enforce dust-control measures for dug-up areas and proper restoration after the work (applicable to all utility and other service companies) and promote precast construction instead of in situ construction.	•	•	•	•	•	•		city corporations, municipalities, DESCO, DPDC, Titas, WASA, ICT Division, PWD, REHAB, UDD	LGD	
9.9 Gradually replace open cut utility service with closed duct utility service.	•	•	•	•	•	•		city corporations, municipalities, DESCO, DPDC, Titas, WASA, ICT Division, PWD, REHAB, UDD	LGD	
9.10 Adopt street-design guidelines for paving of roads and footpaths (hard and soft paving) with vegetative barriers.	•	•	•	•	•	•		city corporations, municipalities, RTHD, UDD	LGD	GIZ
9.11 Introduce water fountains at major traffic intersections, wherever feasible and discourage the use of crashing machines in construction site to avoid the dust emissions	•	•	•	•	•	•		city corporations, municipalities, DESCO, DPDC, Titas, WASA, ICT Division, PWD, REHAB, UDD	LGD	
9.12 Prepare and introduce Environmental Pay System for public construction procurement and contract management.		•	•	•	•	•	•	city corporations, municipalities, PWD, DESCO, DPDC, RAJUK, CDA, KDA, GDA, Titas, WASA, ICT PWD, REHAB, UDD	LGD, MHPW, MoEFCC, DoE	
9.13 Incorporate environmental risk management (or environmental safeguards) requirements in all tender documents related to construction works.	•	•	•	•	•	•	•	city corporations, municipalities, PWD, DESCO, DPDC, RAJUK, CDA, KDA, GDA, Titas, WASA, ICT, PWD, REHAB, UDD	LGD, MHPW, MoEFCC, DoE	
9.14 Upgrade Road Digging Policy 2019		•	•	•				LGD, city corporations, municipalities		
10. Energy efficiency										
10.1 Issue guidelines and standards to implement the Energy Efficiency and Conservation Master Plan (EECMP) 2023.	•							SREDA, PD, EMRD	BPDB	
10.2 Enforce the EELRA and encourage appliance manufacturers' participation in the EE Labelling Program.	•	•	•	•	•	•	•	SREDA	BPDB, EMRD, DoE	
10.3 Encourage the trading of products that are (highly) energy efficient, including removal of NTB (Non-Tariff Barrier) in collaboration with other countries.	•	•	•	•	•	•	•	SREDA, MoFA, MoC, FD, BIDA, BEZA,	MoEFCC, PSD, SREDA, PD, EMRD	

Action	Timeline							Primary responsibility	Contributing agency	Support by development partners funding (in addition to public budget)
	2024	2025	2026	2027	2028	2029	2030			
10.4 Promote training, advisory services, and pilots for government agencies, the private sector, and NGOs as well as ensure public awareness by organizing awareness programs like seminars and dissemination workshops that would appeal to large numbers of people.	•	•	•	•	•	•	•	SREDA, PDB, PD	DoE, MoEFCC, EMRD	
11. Indoor air pollution										
11.1 Adopt and enforce indoor air quality standards and technical guidelines (including on OHS) in relevant sectors.	•	•	•★	•	•	•	•	DoE, DGHS, DIFE		WB: proposed BCAP [a]
11.2 Increase awareness of effective strategies like minimizing open storage and stabilizing production areas to manage indoor air quality.	•	•	•	•	•	•	•	DoE, DGHS, DIFE		WB: proposed BCAP

Note: a = The project finances the analytics and training to design the intervention; b = The project contributes to enhance DoE's overall enforcement capacity; c = Lending as budget support linked to the adoption of policy reform but the operation does not finance the policy implementation; d = The project finances a pilot or small portion of investments needed; additional funds needed to scale-up/ fully implement the intervention.

• Design and preparation (analytics, consultations, planning, drafting, among other activities)

• Implementation period

•★ Milestone in implementation (adoption of policy reform, launch of investment, or start of operations)

Development Partners: ADB = Asia Development Bank; AFD = French Development Agency; EIB = European Investment Bank (EIB); EIIB = European Islamic Investment Bank; EU= European Union; GIZ = Deutsche Gesellschaft für Internationale Zusammenarbeit; IMF = International Monetary Fund; JICA = Japan International Cooperation Agency; KfW = Entwicklungsbank; SIDA = Swedish International Development Cooperation Agency; SNV = Netherlands Development Organisation; UNICEF = United Nations Children's Fund; USAID = United States Agency for International Development; WB = World Bank.

Projects: BCAP = Bangladesh Clean Air Project (in preparation); BEST = Bangladesh Environmental Sustainability and Transformation Project; GCRD = Green and Climate Resilient Development Credits; ICMDN = Integrated Corridor Management Dhaka North Project (in preparation); LDDP = Livestock and Dairy Development Project; PARTNER = Program on Agricultural and Rural Transformation for Nutrition, Entrepreneurship, and Resilience in Bangladesh; UHNP = Urban Health, Nutrition and Population Project.

Table 6.2 NAQMP Results Indicators

	Reporting Agency	December 2024	December 2025	December 2026	December 2027	December 2028	December 2029	December 2030
1	MoEFCC / DoE	Dissemination of Air Quality Index (AQI) hourly, with guidance to the public on mitigation measures to address health effects.	Adoption and start implementation of decade-scale air quality monitoring expansion plan (by December 2025).	Minimum new 15 CAMS (or other monitoring devices) are installed and generating ambient air data in rural areas and closer to borders, as per decade-scale air quality monitoring network expansion plan. Increase in the annual number of days with AQI marked as good and moderate (green and yellow-green color) across the country by (a) 5 days in [districts with higher AQI], and (b) 5 days in [districts with lower AQI] (cumulative).	Increase in annual number of days with AQI marked as good and moderate (green and yellow-green color) across the country by (a) 10 days in [districts with higher AQI], and (b) 10 days in [districts with lower AQI] (cumulative).	Increase in the annual number of days with AQI marked as good and moderate (green and yellow-green color) across the country by (a) 15 days in [districts with higher AQI], and (b) 20 days in [districts with lower AQI] (cumulative).	Increase in the annual number of days with AQI marked as good and moderate (green and yellow-green color) across the country by (a) 20 days in [districts with higher AQI], and (b) 30 days in [districts with lower AQI] (cumulative).	Increase in the annual number of days with AQI marked as good and moderate (green and yellow-green color) across the country by (a) 25 days in [districts with higher AQI], and (b) 35 days in [districts with lower AQI] (cumulative).
2	MoEFCC / DoE	Design of CEMP, identifying targeted sources, responsibilities, equipment, infrastructure, and implementation timeline.	Adoption of CEMP regulations; completion of dissemination campaign on CEMP.	CEMS in targeted sources installed and operational, and control center at DoE operational.	Real-time data from monitored sources disseminated by CEMP platform, and emissions standards immediately enforced by DoE.	60% of monitored facilities under CEMP complying with emissions limits on PM, SO_2 and NO_X (from baseline – December 2025).	70% of monitored facilities under CEMP complying with emissions limits on PM, SO_2 and NO_X (from baseline – December 2025).	85% of monitored facilities under CEMP complying with emissions limits on PM, SO_2 and NO_X (from baseline – December 2025).
3	MoF / NBR	Analytics and stakeholder consultations for identifying and designing appropriate fiscal instruments.	Analytics and stakeholder consultations for identifying and designing appropriate fiscal instruments.	One new environmental fiscal instrument adopted, targeting major source(s) of air pollution (cumulative).	Two new environmental fiscal instruments adopted, targeting major source(s) of air pollution (cumulative).	Three new environmental fiscal instruments adopted, targeting major source(s) of air pollution (cumulative).	Four new environmental fiscal instruments adopted, targeting major source(s) of air pollution (cumulative).	
4	MoPEMR / EMRD / SREDA / IDCOL	n.a.	Approval of Clean Cooking Program (CCP), with incentives for households to switch from solid fuels to electric or LPG induced cookstoves, and improved cookstoves (single/double burners).	1 million households have adopted improved clean cooking solutions from CCP (cumulative), with at least 50% switching to electricity, LPG, or solar.	3 million households have adopted improved clean cooking solutions from CCP (cumulative), with at least 52% switching to electricity, LPG, or solar.	6 million households have adopted improved clean cooking solutions from CCP (cumulative), with at least 55% switching to electricity, LPG, or solar.	10 million households have adopted improved clean cooking solutions from CCP (cumulative), with ate least 60% switching to electricity, LPG, or solar.	15 million households have adopted improved clean cooking solutions from CCP (cumulative), with ate least 65% switching to electricity, LPG, or solar.
5	MoRTB / BRTA	n.a.	National scrappage program established for heavy-duty vehicles through a graded incentive based on vehicle age, fuel type, and retrofitting options.	10% of heavily polluting heavy-duty vehicles (a) retrofitted to comply with emissions standards, or (b) scrapped and taken off the road (cumulative).	20% of heavily polluting heavy-duty vehicles (a) retrofitted to comply with emissions standards, or (b) scrapped and taken off the road (cumulative).	30% of heavily polluting heavy-duty vehicles (a) retrofitted to comply with emissions standards, or (b) scrapped and taken off the road (cumulative).	40% of heavily polluting heavy-duty vehicles (a) retrofitted to comply with emissions standards, or (b) scrapped and taken off the road (cumulative).	50% of heavily polluting heavy-duty vehicles (a) retrofitted to comply with emissions standards, or (b) scrapped and taken off the road (cumulative).

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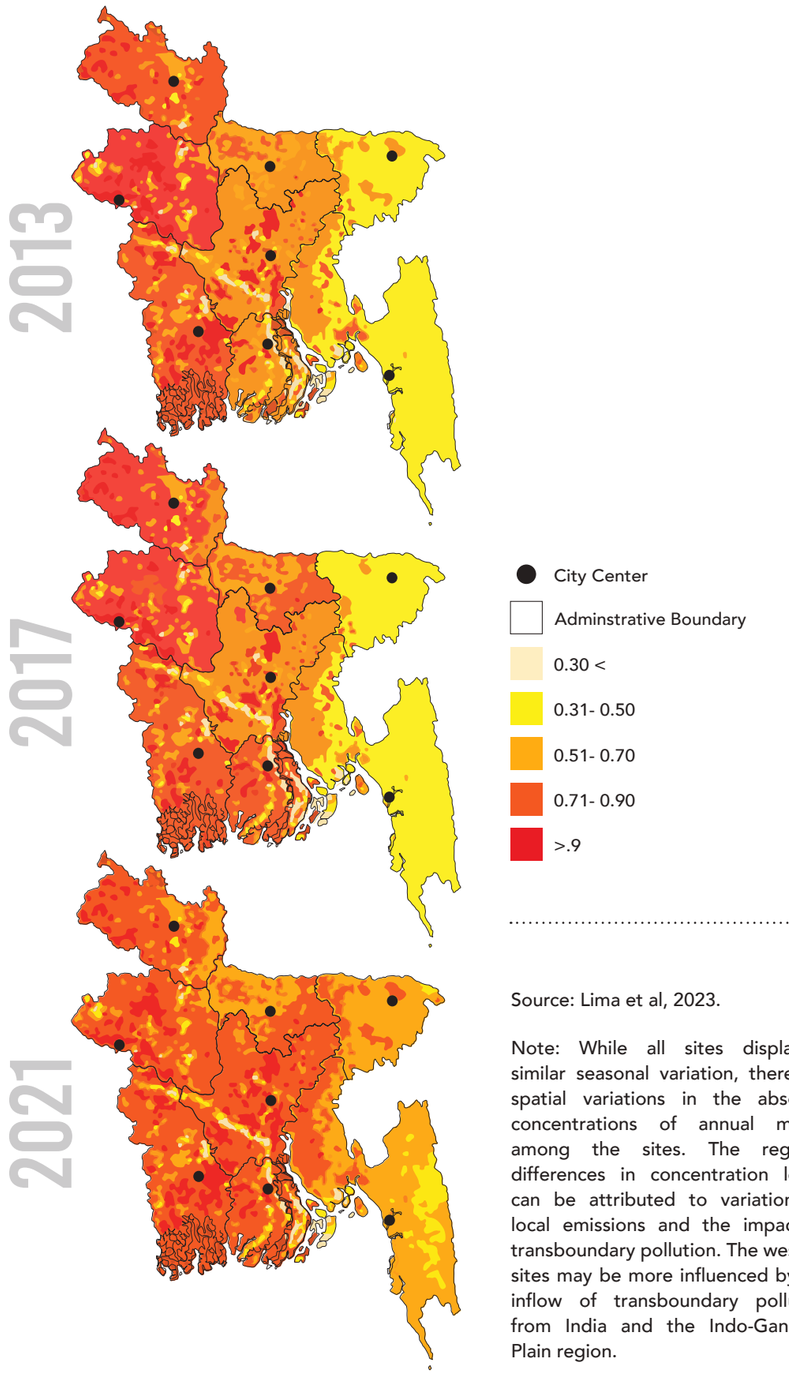
APPENDIX

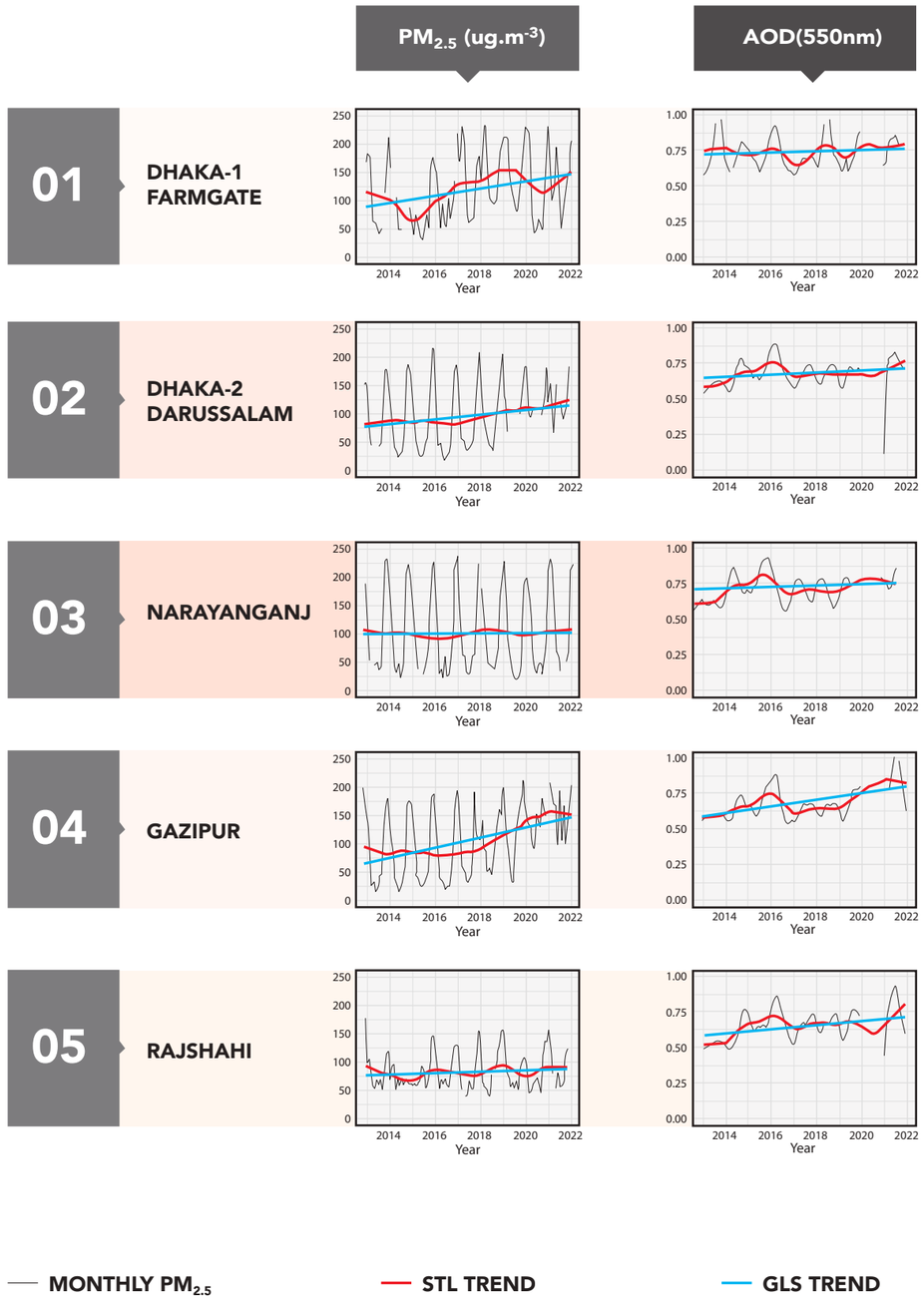
APPENDIX A. TRENDS IN SATELLITE-OBSERVED AEROSOL OPTICAL DEPTH (AOD) OVER BANGLADESH, 2013–21

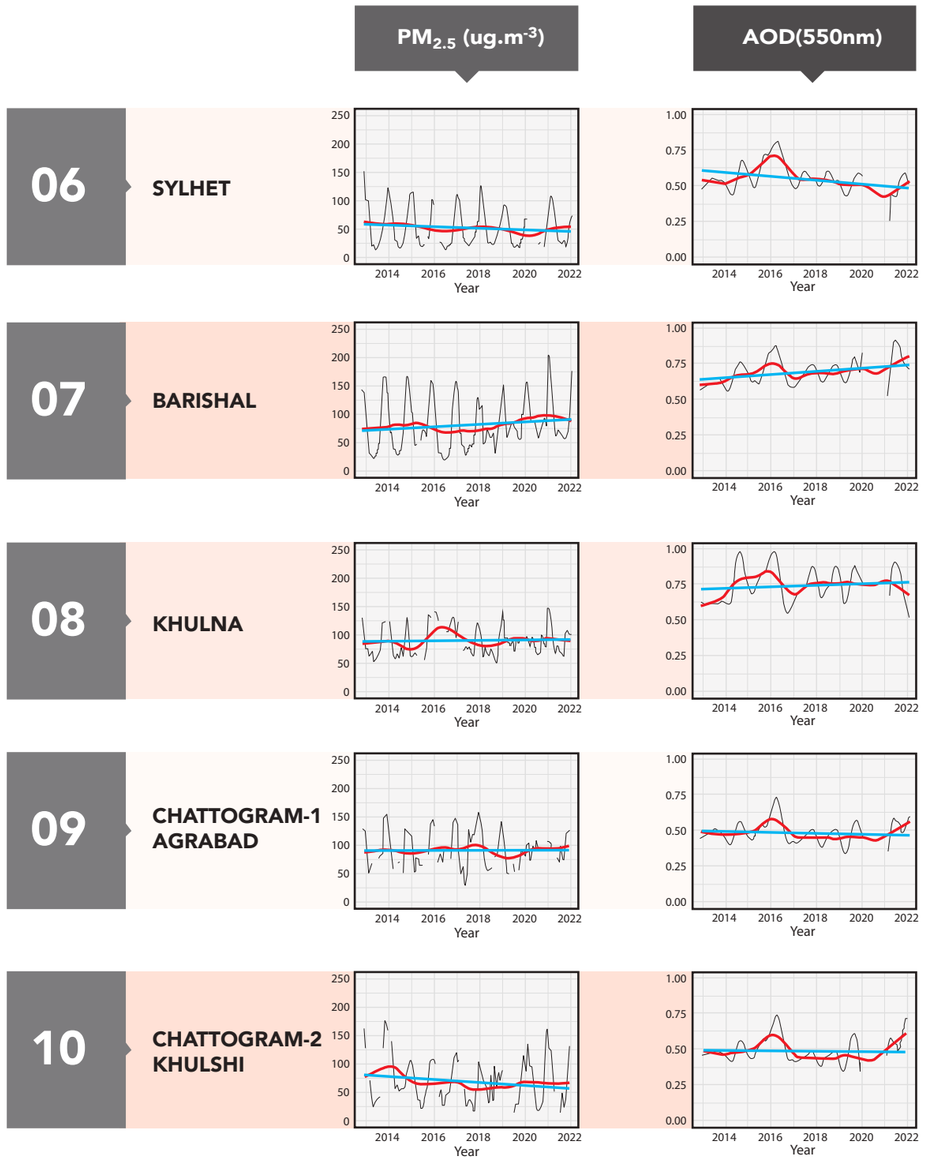


Source: Lima et al, 2023.

Note: While all sites display a similar seasonal variation, there are spatial variations in the absolute concentrations of annual means among the sites. The regional differences in concentration levels can be attributed to variations in local emissions and the impact of transboundary pollution. The western sites may be more influenced by the inflow of transboundary pollution from India and the Indo-Gangetic Plain region.

Appendix B. Trends in Ground-Monitored $PM_{2.5}$ and Satellite-Measured Aerosol Optical Depth (AOD), 2012–22





Source: World Bank.

Note: The figure shows the temporal trends of air pollution in more detail, providing ground monitoring PM2.5 concentrations from 10 sites across Bangladesh from 2012 to 2022, along with AOD values within a 5-kilometer buffer around each ground site. Both ground PM2.5 and satellite AOD measurements exhibit a pronounced seasonal pattern.

Appendix C. Institutional Trends for AQM in Selected Countries

Legal and regulatory framework

- A legal framework is in place, comprised of national standards for ambient air quality and sector pollution control, with a clear mandate to protect the health of the population in accordance with World Health Organization (WHO) guidelines.
- The framework's content includes clear roles and responsibilities for each level of government, for both environmental and sectoral agencies.
- Enforcement and compliance mechanisms are in place, covering jurisdictions, companies, and/or citizens, using a variety of instruments.
- The framework allows for both command-and-control and market-based instruments for enforcement and policy implementation.
- It establishes pollution reduction targets for key pollutants.
- Air-quality standards are regularly reviewed and revised.

Committed executive

- A long-term AQM strategy is in place, championed at the highest level, with a clear strategic vision that has well-defined objectives, indicators, and targets and is backed by sufficient medium-term budgetary funding.
- Across sector ministries, air quality concerns are integrated into sector strategies, and there are policies and programs in place to incentivize the adoption of cleaner technologies and procedures.
- Diverse policy and legislative instruments are in place to incentivize compliance and penalize noncompliance.
- Technical capacity across the relevant government agencies and coordination bodies is adequate.
- Executive institutions have the power to influence and convene sectoral departments on air quality strategy and implementation.

Nested planning

- There has been a formal designation of airsheds.
- Planning is mandatory and contains targets, prioritized actions, and clearly assigned roles and fund allocations.
- There are official air quality planning and management units at multiple jurisdiction levels that follow an airshed approach.
- A formal process is in place to classify regions that are out of compliance.
- A nested and well-correlated vertical planning process is informed by independent, timely, and quality scientific research and data.

Institutional coordination

- A coordination mechanism is in place with a strong mandate and effective political leadership to oversee progress and implementation.
- The mechanism can carry out horizontal and vertical coordination and has some level of fiscal and administrative autonomy and decision-making power.
- Its main functions include monitoring air quality, advising on plans, coordinating actions, and pooling scientific research.
- This mechanism often has wide participation, including from the scientific community, the private sector, and civil society, and participants generally disclose all data.
- In federations, formal mechanisms at the central executive level (housed at the cabinet office) that have autonomy tend to be the most effective coordination bodies.

Accountability and transparency

- There is a robust air quality monitoring and emissions information system in place.
- Emissions from stationary sources are regularly captured and reported.
- There are web-based platforms that gather real-time monitoring and publicly available data on the state of air quality, including an Air Quality Index.
- Audit, control, and accountability institutions examine AQM plans, programs, and data.

Appendix D. Integrating Long-Term Air Quality Improvements in Broader Planning

Multiple factors influence how many vehicles are running, how much power is needed to be produced by thermal power plants, and how many bricks are needed each year. Longer-term planning of the country's infrastructure can result in long term emission reductions by changing the activity patterns that drive the country's activity patterns and people's lives. This section describes three such ways.

1. Urban planning, congestion reduction, public transport, and bicycle infrastructure

While motor vehicles are only responsible for a small fraction of Bangladesh's total air pollution, they do contribute a significant fraction of the pollution inhaled by the inhabitants of the country's major cities. In Dhaka and other large cities, streets are clogged with traffic jams, where many vehicles stand idle with engines running. Not only does the time spent sitting in traffic carry a huge economic cost, but also ends up emitting far more pollutants per trip than if the traffic were free flowing. Most of the street space is taken up by personal vehicles carrying wealthier passengers in lower density, while stranding buses carrying far more people in heavy traffic jams. Very little space remains on the sides of the road for walking and bicycling, while the risk of crossing roads discourages walking.

Unlike in many other cities, though, Dhaka's traffic jams are not limited to morning and evening rush-hour. The city's trunk routes are packed with distances trucks at night. While excluding the trucks from city traffic during the day does remove their contribution to making day-time traffic congestion worse, transferring truck congestion to the night-hours increases their impact on air quality. Vertical ventilation is suppressed at night, so the emitted diesel smoke from trucks at night stays much closer to the ground than during the day.

It is necessary for Bangladesh to make decade scale plans for clean, efficient, and attractive public transport in Dhaka, while making the city more walkable and more pedal power friendly. That will improve its traffic flow, air quality, and livability. The GoB will assess potential interventions and introduce appropriate ones into Bangladesh in the coming years. These include the following:

- Improving the comfort, convenience, and quality of public buses.
- Creating dedicated bus lanes, and along some more stretches of road bus rapid transit systems such as the one currently under construction between Dhaka and Gazipur.
- Making driving private vehicles more expensive (through road pricing or raising the cost of parking, as well as further restrictions on the import of second-hand cars).
- Making walking safer by building better, smoother sidewalks and safer road crossings.
- Allocating road space to dedicated bicycle and rikshaw lanes at the expense of private vehicles.
- Expanding rail-based mass-transit: continuing with construction of the Dhaka metro, as well as improving infrastructure and train frequency on existing surface railroads.
- At critical intersections, constructing more flyovers and expanding elevated expressways, but in ways that do not encourage more people to start driving and keep heavy truck traffic out of the city.

In this context, there is a lot that Bangladesh can learn from the solutions that have worked in other countries/cities. A good example is Copenhagen, Denmark, one of the greatest pedestrian-friendly cities in the world. Until a few decades ago, Copenhagen was filled with traffic jams like many other cities. Copenhagen's urban evolution from car-dependent chaos to pedestrian-friendly cityscape illustrates a series of valuable lessons and highlights the multi-faceted approach to reduce automobile dependence.

The city's transformation began in 1962 with the decision of Copenhagen's City Council to convert the narrow medieval streets into pedestrian zones, demonstrating a shift in priorities, emphasizing people over cars. Designated car-free pedestrian zones served as catalysts for a more people-friendly urban environment. In 1995, pay parking was implemented, followed by a renewed parking strategy in 2009 that included construction of three underground car parks to create 4,000 additional parking spaces in the inner city by 2014. Subsequently, the policy has been revised to expand on-street parking in locations where an increased demand for more parking exists.

To combat the challenge of increased traffic and congestion, Copenhagen embraced a transportation planning strategy that prioritized integrated transport interchanges. These interchange nodes include railway stations, bus terminals, and bus stops comprising of wait and relax zones to facilitate constant flow and seamless transitions between various modes of transportation.

The city's urban design policies became a powerful tool for change. Promotion of the walking strategy while discouraging car use in downtown areas, coupled with the creation of pedestrian-friendly spaces reshaped the way people interacted with their city. Copenhagen's cycling strategy stands out as a great example of how a city can embrace sustainable commuting. As early as 1970, a substantial number of bus priority lanes were implemented, accompanied by the establishment of extensive network of dedicated cycle paths. By investing in cycle infrastructure, providing ample parking facilities, and setting ambitious goals for cyclist safety and comfort, the city showcased that cycling can be a viable and attractive alternative to car travel.

2. Building materials

Just like elsewhere across much of South Asia, construction of durable permanent buildings in Bangladesh has traditionally relied on fired clay bricks, produced the thousands of family-owned brick kilns dotting the landscape on the outskirts of Bangladesh's growing cities. While Section 3 covered ways to reduce emissions from brick kilns and cement production, there are also ways to reduce the consumption of bricks. While attempts have been made to promote cement blocks, despite their climate footprint, there are also other changes that are needed in building materials:

- Enforce the 2020 Bangladesh National Building Code and 2024 Building Energy Efficiency and Environment Regulation (BEEER).
- The promotion of rat trap bonds and other building techniques that achieve better insulation using less bricks.
- The promotion of alternative insulation materials, along with reductions in the thickness of brick walls.
- The promotion of machine made non-fired bricks for outdoor paths and non-structural walls.
- The promotion of compressed earth construction for 1–2 story buildings.
- The promotion of more efficient building designs, such that the same functions can be achieved with less waste space.

In this context, there are several alternative construction materials to traditional fired bricks and cement blocks that are gaining popularity worldwide due to their sustainability, energy efficiency, and reduced environmental impact. Some alternatives are:

Compressed Earth Blocks (CEBs) are made by compressing a mixture of earth, sand, and stabilizers that offer good insulation properties and are produced with minimal energy requirements.

Plastic bricks made from recycled plastics offer a solution for plastic waste and are lightweight and durable.

Bricks made from hemp plants offer efficient temperature and humidity regulation, acoustic insulation, and fire resistance.

Fly ash bricks made from industrial waste provide benefits such as increased compressive strength, reduced weight, and smooth surface that eliminates the need for plastering, thereby reducing construction costs.

In India, fly ash generated by coal/lignite based thermal plants has increased nearly fourfold, from 6.6 million tonnes in 1996–97 to 270 million tonnes in 2021–22. While the production of fly ash has surged, there has concurrently been a substantial increase in fly ash utilization. The utilization rate, calculated as fly as utilized per unit of fly ash produced annually, has risen from 10 percent in 1996–97 to 95.5 percent in 2021–22 (Government of India 2022).

The Government of India has actively promoted comprehensive and eco-friendly utilization of fly ash, specifically in the production of bricks, blocks, pipes, and tiles. For instance, the Ministry of Environment has introduced regulations mandating 100 percent utilization of fly ash, emphasizing its application in various construction materials. A "polluter pays" principle has also been introduced, imposing an environmental compensation of INR 1,000 per ton on unutilized ash for noncompliant power plants. Additionally, the government has issued mandates requiring all agencies engaged in construction activities, within 300 kilometers of power plants, to incorporate fly ash into their processes such as road laying and building embankments.

3. Clean energy, energy efficiency, and regional power trade

Ultimately, cleaning up transport, cooking and industry in Bangladesh will require a greater shift towards electrification, but that only makes sense if the electricity comes from clean sources. While Bangladesh has significant potential to increase the production of rooftop solar power, it has limited potential to increase domestic hydropower production. However, the country sits downstream from two neighbors, Bhutan and Nepal, both of which have—at least seasonally—a hydropower surplus. As parts of India sit between Bangladesh and these other two neighboring countries, this will require a multiparty negotiation, perhaps best carried out by Bangladesh, Bhutan and Nepal negotiating as a joint block.

A similar experience has been implemented by the Nordic countries. Denmark, Finland, Norway, and Sweden have developed an extensive network of interconnected power systems that facilitate seamless exchange of electricity across borders including into other nearby countries. Countries in this region have made significant strides in integrating renewable energy into their grids and each country contributes to the regional grid with its unique energy sources.

For instance, Norway has abundant hydropower, Sweden and Denmark have substantial wind power, and Finland relies on a variety of energy sources. Based on supply and demand, these interconnectors allow for the energy to be efficiently distributed so that the countries can benefit from each other's strength in terms of energy production. In 2023, Norway's power exchange capacity to other countries is approximately 9,000 MW, distributed with 4,000 MW to Sweden, 1,400 MW to Germany, 1,400 MW to the United Kingdom, 1,600 MW to Denmark, and 700 MW to the Netherlands. Cross-border projects such as the Nordlink, which connects Norway with Germany, and the North Sea Link, which connects Norway with the United Kingdom, are also parts of the broader European efforts to create a more interconnected energy market. Therefore, the Nordic power system provides a suitable model for sustainable energy practices and collaboration among neighboring countries for a low-carbon energy future.

Appendix E. Template for Detailed Action Plan for Implementing NAQMP

Sector:	
Action Number:	Action:
2030 target (outcome related):	
Agencies with primary responsibility for this action:	
Contributing agencies:	
Division of responsibilities among agencies:	

YEARLY ACTION PLAN:

Year	Agency	Activities/Outputs	Results Indicators	Cost	Financing Sources
2024					
2025					
2026					
2027					
2028					
2029					
2030					

Appendix F. Monitoring And Evaluation Plan: Results Indicators

This appendix presents details on the methodology for monitoring and evaluating the NAQMP. In coordination with relevant line agencies, the MoEFCC will track the progress of the NAQMP's implementation based on the results indicators set forth in table 6.2. In case of any conflict or inconsistency, the text of appendix F should prevail over table 6.2. At the midterm review of the NAQMP, the government may refine some indicators, especially considering the additional studies planned for the first years of the NAQMP's implementation.

Indicator Name	Definition/Description	Baseline	Targets						Methodology
			2024	2025	2026	2027	2028	2029	2030	
Results Indicator 1 – Air Quality Monitoring and Data Dissemination										
Adoption and start of implementation of decade-scale air quality monitoring expansion plan.	The expansion plan will include (a) a mix of CAMS, compact monitoring station, mobile monitoring stations, and other sensors depending on the availability of resources, and (b) a list of future station sites, ranked in priority order. CAMS network must measure Bangladesh's criteria air pollutants (Schedule 1 of APCR). Some CAMS must also measure black carbon.	No	No	Yes	Yes	Yes	Yes	Yes	Yes	**Frequency:** Annual. **Data source:** DoE order approving expansion plan, procurement documents of new CAMS, and O&M reports of CAMS. **Data collection:** Review of DoE documents, site visits, and interviews. **Responsible Agency:** MoEFCC/DoE.
Minimum 15 new CAMS (or other monitoring devices) are installed and generating ambient air quality data in rural areas and closer to borders, as per decade-scale network-expansion plan for monitoring air quality.	CAMS data coverage must be at least 75% of the time during a year for the different averaging/measurement periods (that is, 1-hour, 8-hour, 24-hour, 1-year). "Data coverage" refers to the proportion of the measurement period for which valid measurement data are available, expressed as a percentage—for example, 75% of all 1-hour measurement periods of a year are valid and available.	16 CAMS	16	16	21[a]	21[a]	26[a]	26[a]	31[a]	**Frequency:** Annual. **Data source:** DoE-approved expansion plan, O&M reports of CAMS, and monitoring reports from CAMS. **Data collection:** Review of DoE documents, site visits and interviews, and midterm review of this NAQMP. **Responsible Agency:** MoEFCC/DoE.
Dissemination of Air Quality Index (AQI) hourly, from each of the existing monitoring stations, with guidance to the public on mitigation measures to address health effects.	AQI is calculated as per the US EPA methodology available at *https://www.airnow.gov/aqi/aqi-basics/* and in the US Code of Federal Regulations 40 CFR 58. AQI must be disclosed for each of the existing monitoring stations, focusing on $PM_{2.5}$ in the first years and expanding to NO_2 by 2027. CAMS data coverage must be at least 75% of the time during a year for hourly values to inform the AQI. "Data coverage" refers to the proportion of the measurement period for which valid measurement data are available, expressed as a percentage—for example, 75% of all 1-hour measurement periods of a year are valid and available.	AQI disseminated without user-friendly guidance on mitigation measures.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**Frequency:** Annual. **Data source:** DoE website. **Data collection:** Review of AQI reports disclosed on DoE's website. **Responsible Agency:** MoEFCC/DoE.

Indicator Name	Definition/Description	Baseline	Targets						Methodology
			2024	2025	2026	2027	2028	2029	2030	
Increase in the annual number of days with AQI marked as good or moderate (green and yellow-green color) across the country.	Number of days per calendar year in which the AQI is below 100. AQI scores of 0–50 are marked as good and refer to $PM_{2.5}$ levels up to 9.0 µg/m³. AQI scores of 51–100 are marked as moderate and refer to $PM_{2.5}$ levels of 9.1 µg/m³ to 35.4 µg/m³. Beginning 2027, the expansion to NO2 uses the following breakpoints: 0 to 100 µg/m³ for the "good" category, and 101 µg/m³ to 188 µg/m³ for the "moderate" category. Districts have been grouped by geographic region, trends in AQI since 2019, location of DoE CAMS, and air pollution sources, as follows: **Group A:** Dhaka, Gazipur, Narajanganj, and Narsingdi districts, measurements from seven CAMS. **Group B:** Mymensing, Rangpur, and Rajshahi districts, measurements from three CAMS. **Group C:** Sylhet, Cumilla, Khulna, Barisal, and Chattogram districts, measurements from six CAMS.	A: 77 days B: 54 days C: 114 days	A: 77 days B: 54 days C: 114 days	A: 77 days B: 54 days C: 114 days	A: 87 days B: 60 days[b] C: 119 days	A: 97 days B: 66 days[b] C: 125 days	A: 107 days B: 72 days[b] C: 130 days	A: 117 days B: 80 days[b] C: 135 days	A: 127 days B: 93 days[b] C: 141 days	**Frequency:** Annual. **Data source:** DoE CAMS network. **Data collection:** Review of monitoring data from DoE CAMS located in different divisions and districts, and review of AQI reports. **Responsible Agency:** MoEFCC/DoE.
Results Indicator 2 – Continuous Emissions Monitoring Program										
Adoption of Continuous Emissions Monitoring Program (CEMP).	Adoption refers to (a) completion of the design of the CEMP; (b) approval of all legal instruments required to implement and enforce the CEMP, including rules, quality assurance, and procedures for information disclosure; and (c) completion of dissemination campaign on CEMP.	No	CEMP Designed	CEMP Adopted	-	-	-	-	-	**Frequency:** Annual. **Data source:** DoE reports on CEMP design, consultations, and dissemination campaigns; CEMP regulations published in gazette. **Data collection:** Review of DoE reports and review of GoB's official gazette. **Responsible Agency:** MoEFCC/DoE.
Number of facilities with real-time monitoring devices installed, operational, and maintained.	Installation of the monitoring devices and their operation by targeted facilities, as per the CEMP regulations. Devices will be connected to DoE's CEMS network. To be operational, third parties must adequately maintain devices. The CEM Data Acquisition & Management System must be able to detect malfunctioning of devices and send maintenance alerts to both the third-party firms and DoE.	0	0	0	15[c]	TBD[d]	TBD	TBD	TBD	**Frequency:** Annual. **Data source:** DoE progress reports on CEMP implementation; reports generated by the CEMS. **Data collection:** Review of DoE progress reports, review of CEMS reports, and site visits and interviews. **Responsible Agency:** MoEFCC/DoE.

Indicator Name	Definition/Description	Baseline	Targets						Methodology
			2024	2025	2026	2027	2028	2029	2030	
Real-time data from monitored sources disseminated through the CEMP platform, and emissions standards immediately enforced by DoE. [e]	Real-time data collected by monitoring devices at facilities are processed through DoE's CEM Data Acquisition & Management System. The data will be analyzed and validated by DoE. For disclosure purposes, real-time data to be disclosed at the CEMP website are considered provisional since such data have not gone through a confirmation process. Such data cannot be used as legal evidence. After processing and validating the real-time data from monitoring devices, DoE will immediately trigger its enforcement protocol to the facility that is not complying with the emissions limits set forth in the APCR 2022. The steps comprising such enforcement processes will be detailed in the CEMP regulations.	No	No	No	Yes	Yes	Yes	Yes	Yes	**Frequency:** Annual. **Data source:** CEMP website; DoE progress reports. **Data collection:** Review of DoE progress reports; review of CEMS reports, site visits and interviews. **Responsible Agency:** MoEFCC/DoE.
Results Indicator 3 – Fiscal instruments for air quality management										
Number of fiscal instruments adopted, targeting major sources of air pollution (cumulative).	Fiscal instruments will be preceded by analytics and stakeholder consultations. Fiscal instruments can be (a) charges, taxes, and fees to deter polluting activities, or (b) fiscal incentives for companies/individuals to adopt RECP and greener practices.	0	0	1[f]	2	3	4	4	4	**Frequency:** Annual. **Data source:** Official gazette and website(s) of relevant government agencies; progress reports by FD, NBR, and MoEFCC. **Data collection:** review of official gazette and progress reports. **Responsible Agency:** MoEFCC, FD, and NBR.
Results Indicator 4 – Clean Cooking										
Households have adopted clean cooking solutions from the Clean Cooking Program (CCP) (number in millions, cumulative).	SREDA will design the CCP, and the Power Division will approve the resulting program by 2025. This national program for clean cooking will envisage time-bound interventions for access to clean cooking solutions, such as incentives for households to switch from biomass to electric and gas cookstoves. The CCP may include provisions on improved biomass cookstoves of higher tier, as a transitional solution for households that do not have access to cleaner options. The policy instrument establishing the CPP will state the institutional arrangements for implementing, monitoring, and evaluating the program.	0	0	0	1m	3m	6m	10m	15m	**Frequency:** Annual. **Data source:** CCP approved in gazette, SREDA progress reports, BBS surveys, reports from financing intermediaries and development partners, site visits, and interventions. **Data collection:** Review of SREDA and BBS reports, and review of reports and interviews of financing intermediaries and development partners. **Responsible Agency:** SREDA.

Indicator Name	Definition/Description	Baseline	Targets						Methodology
			2024	2025	2026	2027	2028	2029	2030	
Households completely switching to electricity or LPG under the CCP (percentage, cumulative).	This sub-indicator refers to households under the CPP and excludes households that switched to improved cookstoves but continued to use biomass as primary cooking fuel.	0	0	0	50%	52%	55%	60%	65%	**Frequency:** Annual. **Data source:** SREDA progress reports, BBS surveys, reports from financing intermediaries and development partners, site visits, and interventions. **Data collection:** Review of SREDA and BBS reports, review of reports, and interviews of financing intermediaries and development partners. **Responsible Agency:** SREDA.
Results Indicator 5 – Reducing emissions from heavy-duty vehicles										
National scrappage program established for heavy-duty vehicles, through graded incentives based on vehicle age, fuel type, and retrofitting options.	Program for modernizing the fleets of heavy-duty vehicles (buses and trucks), with options for (a) newer and vehicles that are more fuel-efficient, and (b) retrofitting technology to reduce pollutant emissions and comply with emissions standards. The program will also include provisions to benchmark, assess, and publish fuel economy and emission trends of heavy-duty vehicles every three years, starting in 2026.	No	No	Yes	Yes	Yes	Yes	Yes	Yes	**Frequency:** Annual. **Data source:** Official gazette and website of relevant government agency. **Data collection:** review of gazette publication and website. **Responsible Agency:** MoRTB / BRTA.
Heavily polluting heavy-duty vehicles (a) retrofitted with particulate control technologies to comply with emissions standards, or (b) scrapped and taken off the road (percentage, cumulative).	Heavily polluting heavy-duty vehicles are defined as buses and trucks that no longer comply with the emissions standards.	0	0	0	10%	20%	30%	40%	50%	**Frequency:** Annual. **Data source:** Progress report by MoRTB, BRTA's VICs reports on test and fitting certificates. **Data collection:** Review of reports from MoRTB and BRTA, site visit, and interviews. **Responsible Agency:** MoRTB / BRTA.

Note:

[a] If needed, this results indicator will be refined after approval of the decade-scale air quality monitoring expansion plan.

[b] If needed, the description of the results indicator will be refined after approval of the decade-scale expansion plan for monitoring air quality. Data from new monitoring stations/devices will be reflected in the methodology. Since transboundary emissions are high in the country, particularly in Group B, MoEFCC and DoE may revise these targets after updating the source apportionment studies.

[c] This target may include the devices acquired, installed, and operated during the pilot stage of the CEMP.

[d] This results indicator will be refined after DoE completes the design of the CEMP. DoE will specify the targets of number of facilities required to install, operate, and maintain the monitoring devices.

[e] This results indicator will be refined after DoE completes designing the CEMP. DoE will specify the targets on the enforcement of emissions limits.

[f] The first fiscal instrument will be the amendment to the Environmental Protection Surcharge Rules 2017.

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Ministry of Environment, Forest and Climate Change
Department of Environment