

Asian and Pacific Centre for Transfer of Technology

Assessment Report

City Action Plans and Technology
Adoption Strategies in
Dhaka, Bangladesh



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for Transfer of Technology



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FOREWORD

It is with great pleasure that I introduce this document: *City Action Plans and Technology Adoption Strategies in Dhaka, Bangladesh*.

The Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), has long been dedicated to fostering innovation and facilitating the transfer of technology across our diverse member countries. APCTT's key mandate is to strengthen the technology transfer capabilities in the Asia- Pacific region and to facilitate exchange of new, emerging and environmentally sound technologies between the member countries.

This document was produced under the project "Enhanced capabilities to adopt innovative technologies for city air pollution control in select countries of the Asia Pacific" supported by the Korea ESCAP Cooperation Fund. The project objective was to support three ESCAP member States (Bangladesh, India and Thailand) to strengthen policies and city level action plans to facilitate adoption of innovative technologies for controlling air pollution. The project aimed to improve the availability of technical knowledge regarding innovative technologies, and good practices and enabling policies for air pollution control in three cities (Bangkok, Dhaka and Gurugram).

This report, a collaborative effort involving experts and stakeholders, presents a detailed analysis of existing measures and proposes strategic approaches for technology adoption. The findings herein serve as a valuable resource for policymakers, city planners, and technologists in Dhaka and other cities, providing insights into the effectiveness of current initiatives and recommending future policy pathways for enhancing air quality. We hope that this report significantly advances our understanding of air quality dynamics and stimulates further discourse and evidence-based actions for a cleaner and more resilient urban environment in Asia Pacific.

Preeti Soni
Head
Asian and Pacific Centre for Transfer of Technology
Economic and Social Commission for Asia and the Pacific

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This publication was prepared by Dr. Md. Ali Ahammad Shoukat Choudhury, Department of Chemical Engineering, Bangladesh University of Engineering and Technology, Dhaka and Dr. Mohammed Abdul Motalib from the Department of Environment (DOE) under consultancy assignments with ESCAP-APCTT. Support was received from Mr. Shamsul Islam of the Local Government Division, Ministry of Local Government, Rural Development and Co-operatives, Bangladesh; Engr. Abul Hasnat Md Ashraful Alam from Dhaka North City Corporation (DNCC); Engr. Baker and Engr. Faim from Dhaka South City Corporation (DSCC) and other officials from the Ministry of Science and Technology, Bangladesh. The report benefited from comments and suggestions from Mr. Satyabrata Sahu and Mr. Pankaj Kumar Shrivastav from the ESCAP-APCTT.

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1. BACKGROUND

Toward strengthening the capacity of member States, the Asian and Pacific Centre for Transfer of Technology (APCTT) of ESCAP is implementing a project titled “Enhanced capabilities to adopt innovative technologies for city air pollution control in select countries of the Asia-Pacific”. The project will strengthen the capacity of city officials and stakeholders through improved availability of knowledge regarding innovative technologies and good practices; a better understanding of technology needs and gaps in three selected cities, namely Bangkok (Thailand), Dhaka (Bangladesh), Gurugram (India); and an enhanced capacity to strengthen action plans for adoption of innovative technologies to control air pollution in the target countries. Report 1 assessed the technological options for controlling air pollution in Dhaka. This report (Report 2) presents an assessment of Dhaka city action plan and other policies on air pollution control and provides recommendations for the way forward.

2. SCOPE OF WORK

2.1. Objectives

The main objectives of this study are:

1. To facilitate availability of technical knowledge regarding technologies, innovations, and good practices on air pollution in Dhaka, and
2. To increase the knowledge of stakeholders for a better understanding of technology gaps and needs for air pollution control.

2.2. Activities

This assessment report preparation was based on the following activities:

1. Study of the technological interventions and assessment of technology gaps/needs for air pollution control in Dhaka, Bangladesh
2. Review and examination of the city-level action plan of Dhaka and its alignment with national plan of Bangladesh; and assessment of the strengths and challenges of current strategies for adopting air pollution control technologies
3. Conduction of the assessments in close coordination with the relevant city stakeholders and national policymakers of the country
4. Support in the organisation of a multi-stakeholder consultation at the city level to discuss the outcomes of assessment report; and develop draft recommendations for strengthening the city action plan to enable mechanism for innovative technologies to combat air pollution

3. AIR POLLUTION PROBLEMS OF DHAKA CITY

3.1. Air pollution situation of Dhaka city

Dhaka (latitude 23° 45′ 39.18″N, longitude 90° 23′ 21.55″E) is the capital of Bangladesh. It ranks seventh in terms of population density and is the sixth-largest city in the world. As of census 2022, greater Dhaka has a population of over 22.4 million people, making Dhaka a megacity with a population of 10.2 million living in the main city. It is widely considered to be the most densely populated built-up urban area in the world. This high population density and exponential growth of the industries and economic activities, like unrestrained urban development, subsequent rapid industrialization and automobile traffic, have collectively created a huge issue of ambient air pollution in this megacity (Rahman et al.,2021).

Foy et al. (2021) recently analysed the hourly fine particulate matter of aerodynamic diameter $\leq 2.5 \mu\text{m}$ ($\text{PM}_{2.5}$) data from two monitoring sites in Dhaka (the U.S. Embassy monitoring site and the Darus-Salam site operated by the Ministry of Environment and Forest in Bangladesh) and one monitoring site in Kolkata, India (the U.S. Consulate site in Kolkata, India) for dry months (November to March). The 24-hr averaged $\text{PM}_{2.5}$ concentrations from November to March exceeded the local ambient air quality standards on 863 out of 914 days at Darus-Salam ($> 65 \mu\text{g}/\text{m}^3$), 621 out of 685 days at the Dhaka embassy ($> 65 \mu\text{g}/\text{m}^3$), and 726 out of 814 days at the Kolkata consulate ($>65 \mu\text{g}/\text{m}^3$) (Figure 1.1.1). There is a very strong seasonal component to the concentration variability, with low concentrations during the monsoons, and peak concentrations during the cooler dry season. The mean concentrations of $\text{PM}_{2.5}$ from November to March are around 140 to 150 $\mu\text{g}/\text{m}^3$ at all three sites.

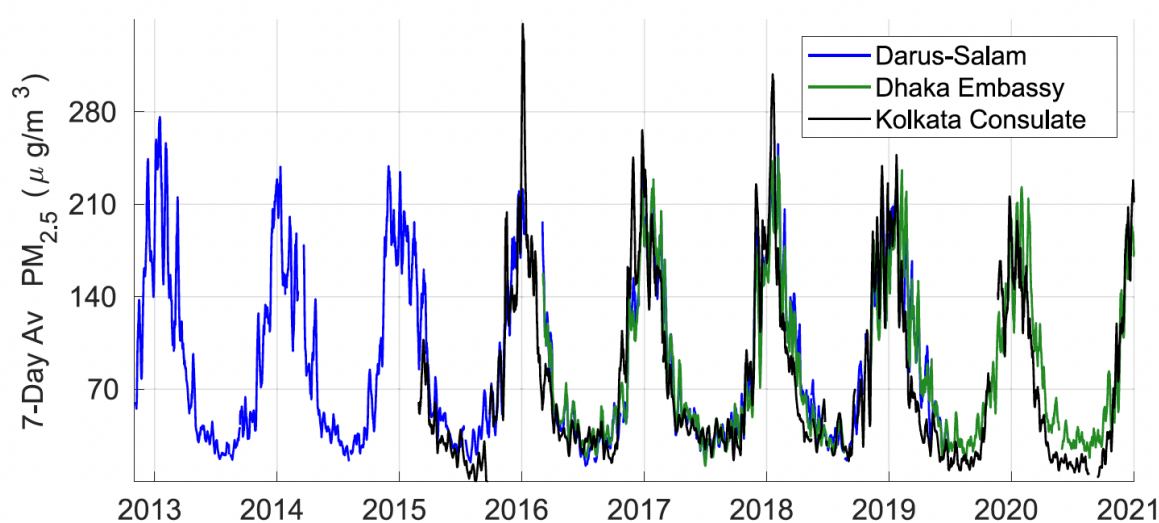


Figure 1.1.1: Time series of 7-day running average of $\text{PM}_{2.5}$ concentrations at Darus-Salam, Dhaka embassy, and Kolkata consulate

The main sources of air pollution in Dhaka city are brick kilns, steel re-rolling mills, boilers and other industries, open biomass/waste burning, residential, construction and transport. The apportionment study performed in 2013 attributed about 58, 10.4 and 15.3 % of fine particles in Dhaka city to brick kilns, and vehicles and dusts, respectively (Bangladesh Air Pollution Studies (BAPS) PO98151, DoE-S13, 2015). However, the scenarios have changed significantly due to huge construction activities for a large number of mega projects such as MRT, BRT, elevated expressway, other developmental works and a huge increase in the number of vehicles. Therefore, the current contributions from these sectors could not be found as there are no recent apportionment studies. There are seven criteria of pollutants considered in determining the ambient air quality in Bangladesh, namely Carbon monoxide, Lead, Nitrogen dioxide, Particulates Matter (PM), Ozone (O_3), Sulphur dioxide (SO_2) and Ammonia (NH_3). Gaseous pollutants remain within the limits most of the days of the year [AQMP report]. The primary pollutant responsible for Dhaka's poor air quality during the dry season is Particulate Matter (PM). Accordingly, between 2018 and 2021, the annual mean daily average for PM_{10} and $\text{PM}_{2.5}$ concentrations was 156.40 $\mu\text{g}/\text{m}^3$ and 96.71 $\mu\text{g}/\text{m}^3$ respectively; both values were three folds more than the national yearly limit (See Table 1.1 below).

Table 1.1: National Ambient Air Quality Standards (NAAQS) [Ref. Bangladesh Air Pollution (Control) Rules 2022]

Sr No	Parameters	Concentration	Averaging Time
1	Carbon Monoxide (CO)	5 mg/Nm ³	8 hour
		20 mg/Nm ³	1 hour
2	Lead (Pb)	0.50 µg/Nm ³	24 hour
		0.25 µg/Nm ³	Annual
3	Nitrogen dioxide (NO ₂)	40 µg/Nm ³	Annual
		80 µg/Nm ³	24 hour
4	Particulates Matter (PM ₁₀)	50 µg/m ³	Annual
		150 µg/m ³	24 hour
	Particulates Matter (PM _{2.5})	35 µg/m ³	Annual
		65 µg/m ³	24 hour
5	Ozone (O ₃)	100 µg/Nm ³	8 hour
		180 µg/Nm ³	1 hour
6	Sulphur dioxide (SO ₂)	80 µg/Nm ³	24 hour
		250 µg/Nm ³	1 hour
7	Ammonia (NH ₃)	100 µg/Nm ³	Annual
		400 µg/Nm ³	24 hour

After examining the trends and characteristics of the air quality of Bangladesh, it was found that the intensity of air pollution is highly affected by the meteorological changes happening across different seasons. Particularly the urban areas or big cities of Bangladesh have been suffering from a heightened level of PM in the air, especially during the dry season when the region experiences scarce rainfall, the wind flow is north-westerly, and the relative humidity is at its lowest. It is evident that the measured PM_{2.5} and PM₁₀ exceed the respective Bangladesh National Ambient Air Quality Standards (BNAAQS) during the dry season (Figure 1.1.2). As per BNAAQS, the official standards of PM_{2.5} and PM₁₀ daily averages (24 hours) are 65 µg/m³ and 150 µg/m³ respectively. On the contrary, the rainfall in the wet season helps improve the air quality of the cities substantially. It is also to be highlighted that the concentration of other gaseous pollutants (i.e., SO₂, CO, NO_x and O₃) are meeting the prescribed air quality standards across the city, with few exceptions.

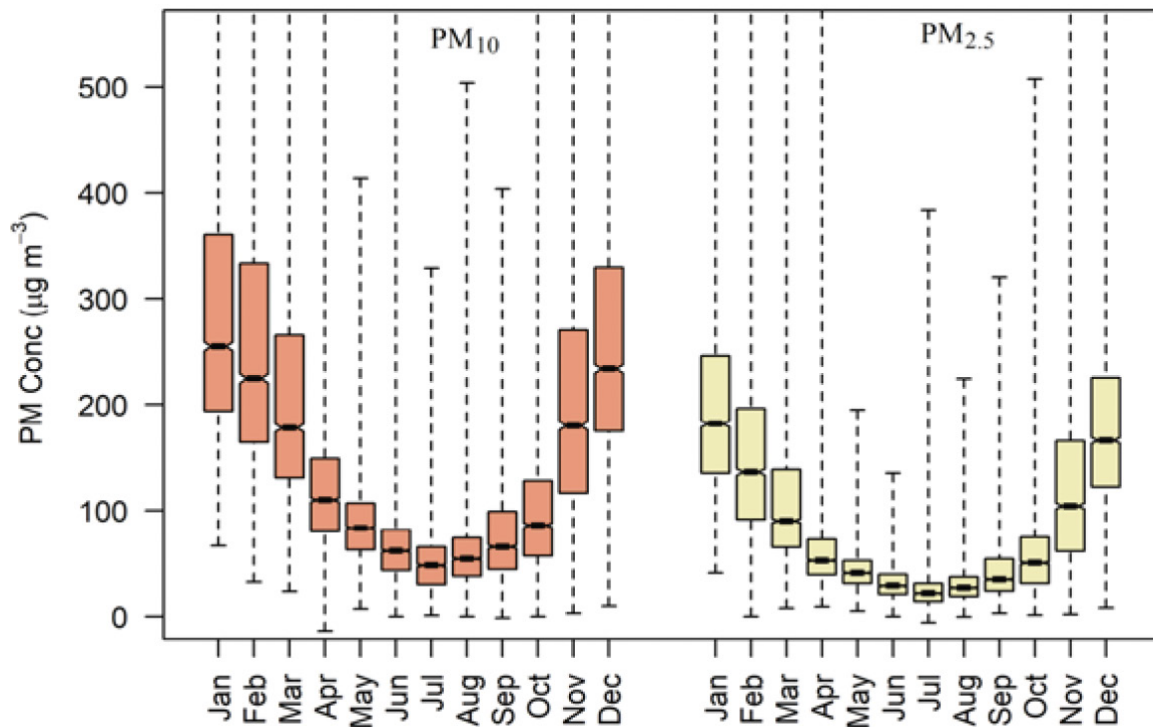


Figure 1.1.2: 24-hr Average PM10 and PM2.5 pollution in Dhaka City during different months of the years 2013 to 2018 (Source: Rana, M.M. and Biswas, S.K. (2018))

With regards to the health-related impacts, just like how air pollution is one of the biggest public health problems in the world, it is also a significant issue in Bangladesh. Of the approximate 2 million deaths per year reported in South Asia (World Bank, 2022), a total 160,000 deaths per year takes place in Bangladesh (McDuffie et al., 2021). Among the top 10 diseases which cause death in Bangladesh, five diseases including lung cancer (13%), lower respiratory tract infections (7%), chronic obstructive pulmonary disease (COPD) (7%), ischemic heart disease (IHD) (6%) and strokes (5%) are related to air pollution. Both ambient as well as indoor air pollution are collectively responsible for about 21% of all deaths in Bangladesh, making it the highest among all South Asian countries. The short-term effects have been observed to be plenty and include irritation of the eyes, throats, and the skin; allergies; coughing; sneezing; high fever; asthma; conjunctivitis; fatigue; anxiety; nausea; and headache—all emanating from the extensive dust pollution (SOGA, 2019). Clean air can improve well-being of people, reduce morbidity rate and cause fewer premature deaths.

3.2 Sources of Air Pollution

Major sources of air pollution in Dhaka city are identified as industries, including industrial emissions mainly from brick kilns, vehicular emissions, residential cooking, soil dust from construction activities, road dust caused by sweeping and resuspension, transboundary air pollution and open solid waste/ biomass burning (BAPS, 2015). The apportionment study performed in 2013 attributed about 58, 10.4 and 15.3 % of fine particles in Dhaka city to brick kilns, and vehicles and dusts, respectively (Bangladesh Air Pollution Studies (BAPS) PO98151, DoE-S13, 2015). However, the current scenarios are completely different due to a large number of ongoing construction activities of mega projects such as MRT, BRT, elevated expressway, other developmental works and an increase in the number of vehicles since 2013. Therefore, the current contributions from these sectors will be different. However, there is no recent apportionment study to ascertain this.

3.2.1 Transport/vehicular emission

Vehicular emission has also emerged as another major air pollution source in Dhaka. The inadequate roads network along with the old and low-quality vehicle engines have collectively resulted in regular and prolonged traffic congestion, further exacerbating the air pollution situation, leading to economic losses (3.8 billion USD per year) and man-hour cost. (Annual Report, 2022, DMRCL). It is evident from the fact that, as of June 2022, a total of 187,7474, registered vehicles are plying on a road area that is only 6.12% of the total city area.

In Bangladesh, of the total vehicular fleet, the percentage bifurcation between the diesel vehicles and the petrol vehicles is of the order 19-20% to 80% respectively. (ABM. S.R. Khan, 2003). The diesel vehicles mostly include buses, mini-buses, trucks, and light and medium-duty vehicles (like jeeps, pickup-vans, human haulers, light trucks, minibuses, etc.) (ABM. S.R. Khan, 2003). In Dhaka, where only about 40% of the vehicles imported into the country are registered, aspects such as old fleet, improper traffic, and parking management, overloading, lack of maintenance, adulterated fuel, etc., have driven the vehicle sector, thereby contributing to the air pollution in Dhaka city. A huge number of vehicles plying on an inadequate number of roads generate traffic congestion, resulting in excessive vehicular emissions and high air pollution in Dhaka city. Most of the city buses are old and run with inefficient engines, thus emitting black smoke and unburned fuels, further adding to the air pollution (Figure 3.2-1). The average speed of vehicles on Dhaka roads is no more than 6 to 7 km per hour. This has caused huge economic losses (3.8 billion USD per year) (Annual Report, 2022, DMRCL).



Figure 3.2.1: Black smoke emitting from old, dilapidated bus

Various reasons, such as an old fleet, improper traffic and parking management, overloading, lack of maintenance, and nonstandard adulterated fuel have collectively driven the vehicular sector's contribution to air pollution in Dhaka city. By measuring the sustainability of Dhaka city's transport sector, it has been identified that its footprint on the environment, impacted by poor physical transportation network and vehicular emission, is seventy times larger than the biocapacity of the city (Noor E Alam 2018, UNESCAP).

As per the recently promulgated Air pollution (Control) Rules 2022 by the Government of Bangladesh, the emission standards for both new and reconditioned vehicles need to be equivalent to EURO - IV standards, and that of in-use vehicles is equivalent to EURO– II standards.

3.2.2 Brick kilns and Industrial emission

The industries located in and around the city contribute to the ever-growing air pollution level. Brick kilns in the vicinity (within 2 km from the periphery) of the city are contributing significantly to Dhaka's elevated levels of pollution. Some other small and medium industries, such as textile, steel re-rolling mills, cement industries and tanneries, are located in and around the city's periphery as well; and, therefore, they also contribute to the increased emissions load within the city (Report, 2022 World Bank).

Since the Dhaka division is the core industrial zone in Bangladesh, with most industries operating perennially, there is a surge in the critical levels of harmful emissions within the micro airshed of the city and the surrounding areas, which is further exacerbated by the region's rapidly growing industries. The areas around the periphery of Dhaka, such as Savar, Keraniganj, Dhamrai, Gazipur, Narayangang, and Munshiganj, house many of the major industries including the brick kilns, textile mills, steel re-rolling mills, cement industries, and tanneries. These industries are notorious for spilling massive amounts of air pollutants into the city's micro airshed. During the dry season, the brick kilns are in operation, causing high levels of air pollution in the region; this is also the time when the air pollution level increases excessively in Dhaka city as well as all across the country.

3.2.3 Construction Activities

Dhaka city has recently witnessed enormous construction work in the form of a few mega-projects that include metro-rail, elevated expressway, and the third terminal of the Hajrat Shahjalal International airport. Emissions of $PM_{2.5}$ or flying dust from all the construction sites had caused some major environmental havoc during the construction phase. Each year, with the onset of winter, the air quality dips to its worst as $PM_{2.5}$ fills the air around the city roads, especially areas where construction work is in progress. Unfortunately, there is hardly any safeguard in sight to protect public health in such places.



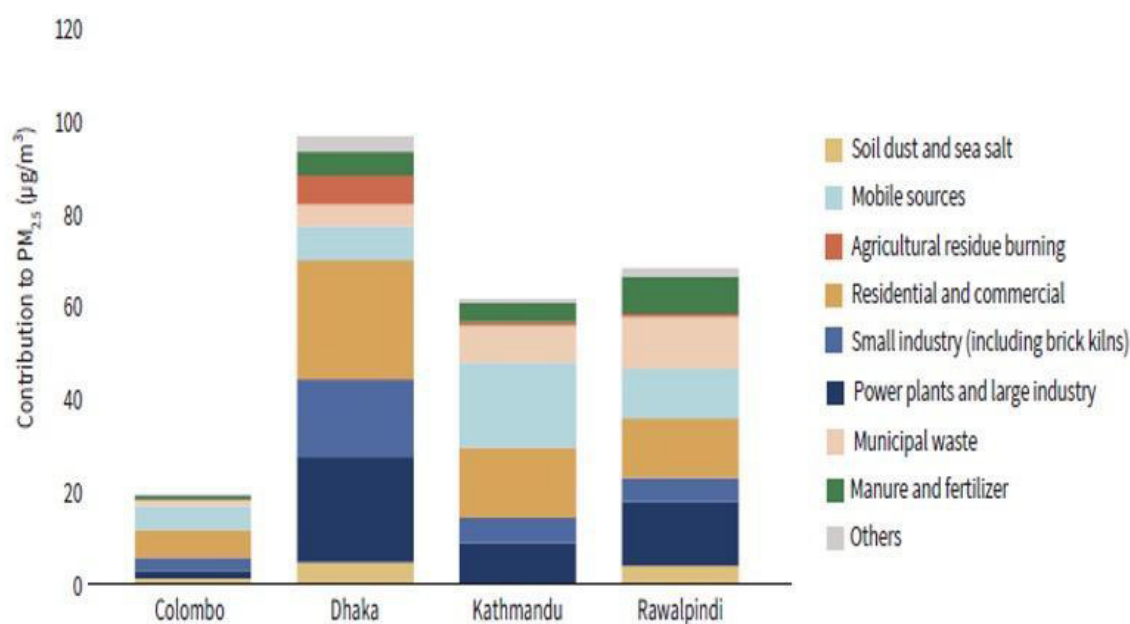
Figure 3.2.2: Severe dust pollution in construction sites

3.2.4 Waste Burning

In 2020, the daily per capita waste generation in Dhaka was 0.61 kilograms (kg)—and with a population of 10,596,475 residing in the Dhaka metropolitan area, the estimated waste generated per day is 6,464 tons. Only 73% of the waste is going to the city corporation’s existing waste disposal system, and the rest of the waste is either burned in the open, or finds its way into the canals, water bodies, low landfilling areas, etc. (Report, 2021, World Bank). Various sources of biomass burning emissions (e.g., waste, residential cooking, winter heating, crop residue, fuel wood, cow dung, etc.) contribute loads of black carbon (BC). In Dhaka city, 44% of BC is produced from biomass burning (Salam et. al, 2021).

3.2.5 Transboundary pollution

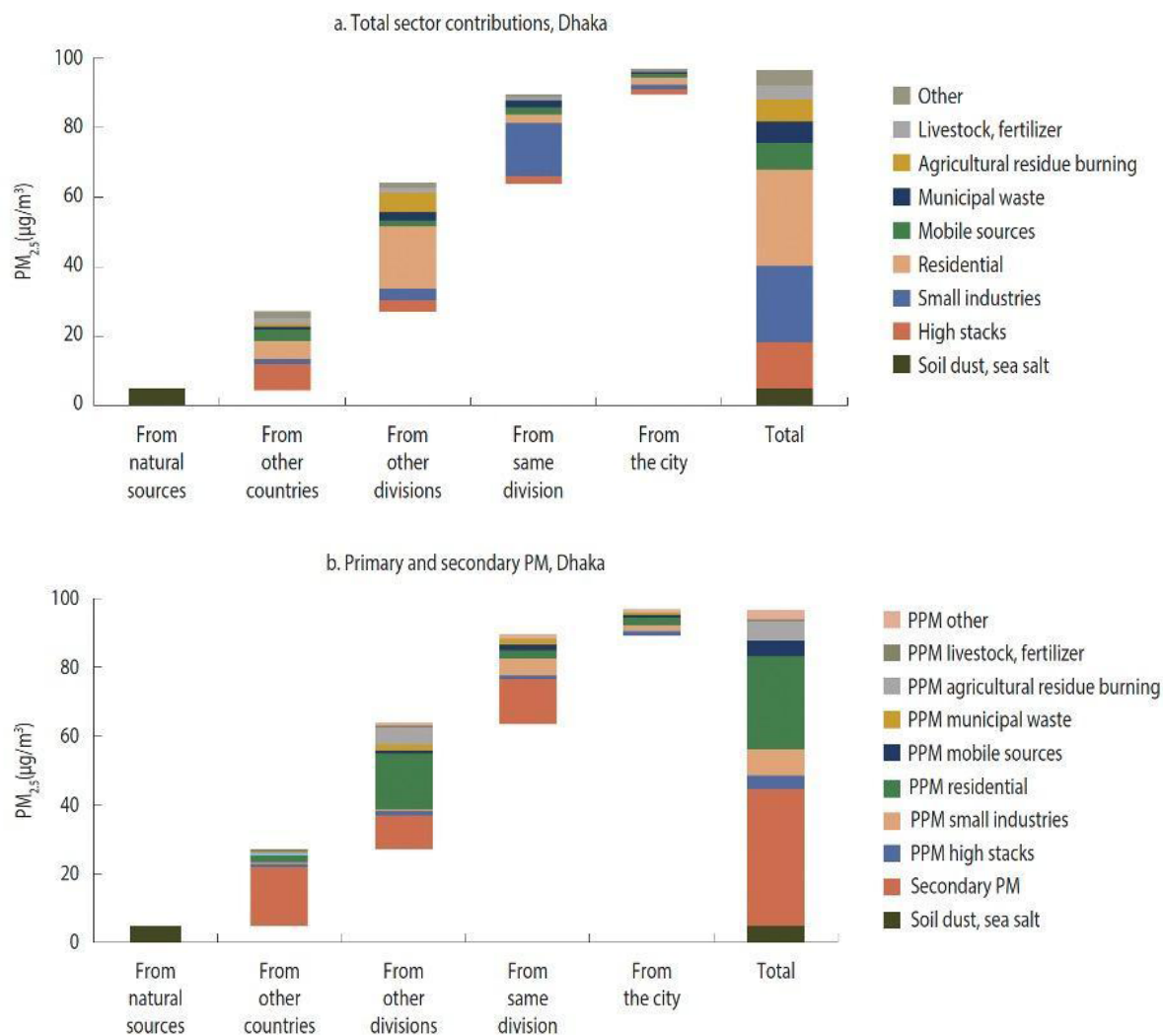
The share of local sources in ambient $PM_{2.5}$ varies over South Asia, depending on the topography; meteorology; the intensity, temporal and spatial patterns of emissions; and the size of the administrative regions. Figure-3.2.3 compares sources across the South Asian cities, namely Colombo, Sri Lanka; Dhaka, Bangladesh; Kathmandu, Nepal; and Rawalpindi, Pakistan. As can be seen, the sources vary significantly within and across the major cities in South Asia. Figure -3.2.4 shows that Dhaka city itself produces only 10% of $PM_{2.5}$ pollution within the city and the rest of the pollution comes from outside of Dhaka, i.e., from the Dhaka division, other adjoining divisions, and countries in the upwind direction. The major sources in the city itself are industries, high stacks, residential areas, mobile sources, construction and municipality waste. The trans-boundary pollution is responsible for about 25% of the total pollution in Dhaka (Report 2022 World Bank, Dihan et. al (2020)).



Source: GAINS calculations/IIASA (2021).

Note: Fine particulate concentrations are in $\mu g/m^3$.

Figure 3.2.3: Spatial origin of population-weighted fine particulate matter exposure in selected cities in South Asia (2018, Report, 2022 World Bank)



Source: Calculations using GAINS model developed by the International Institute for Applied Systems Analysis.
 Note: PM = particulate matter; $PM_{2.5}$ ($\mu\text{g}/\text{m}^3$) = fine particulate matter measured in micrograms per cubic meter; PPM = parts per million.

Figure 3.2.4: a) Total sectoral contributions of Dhaka City in air pollution, b) Source allocations of population exposure to total fine particulate matter in Dhaka, Bangladesh in 2018 (Report, 2022 World Bank).

4. Policies and Programmes

The government has taken action against major sources of air pollution, such as industrial emissions including brick kilns, road and soil dust that comes up from construction activities, vehicular emissions, and solid waste/biomass burning.

Various policies and programmes have been implemented in Bangladesh to address the issue of air pollution. Like any other policy measure, the success and efficacy of these programs have been contingent upon collaboration and coordination across various stakeholders.

Bangladesh Environment Conservation Act 1995, (Amendment 2010) and Environment Conservation Rules, 1997 accompanying the air quality standards have been updated, and a new Bangladesh Environment Conservation Rules 2023 has been promulgated. DoE accelerated the enforcement activities against pollution-causing transport and construction activities.

The Government banned two-stroke 3-wheeler baby taxis from Dhaka city in 2001, resulting in 40% reduction in the PM₁₀ concentrations across the city (Begum et al. 2006). Besides, several other measures were also implemented within the transport sector, of which the introduction of cleaner fuel, compressed natural gas (CNG) and lead-free diesel in the early 1990s were the major ones. Such reforms in the transport sector have helped in reducing its overall emission load.

One of the most recent policies launched to tackle air pollution is the Air Pollution Control Rules, 2022. The rule helps to develop city-level Clean Air Plans to implement mitigation strategies for ambient PM concentrations. Under the rule, there is an option to develop a National Air pollution Management Plan to control air pollution sources of various sectors.

To address industrial pollution (brick kilns), the government has enacted Brick Manufacture and Brick Kiln Set-up (Control) Act, 2013 (Amendment 2019). Fixed Chimney Kilns (FCK) are banned. More than 80% FCK Brick Kilns are transformed to adopt less polluting ZigZag technology. Setting and running clay-fired brick kilns is restricted. Environment-friendly alternative building materials, including blocks, are being promoted. Government has issued a gazette notification in November 2019 putting mandatory 100% use of blocks in all construction activities implemented by government agencies/departments in phases (from 2019-2020 to 2024-2025), except for the construction of base/sub-base of highways.

Bangladesh Road Transport Act, 2018 mandated Bangladesh Road Transport Authority (BRTA) to withdraw unfit and economic-life expired vehicles from the road. The Act has also given the mandate to regulate vehicle emissions to control air pollution. Local Government (City Corporation) Act, 2009 has the option to control air and waste pollution. Bangladesh Petroleum Corporation ensures compliance of its petroleum products with the government's fixed standards. The Sustainable and Renewable Energy Development Authority (SREDA) Act - 2012, Energy Efficiency and Conservation Rules - 2016, Renewable Energy Policy of Bangladesh, Country Action Plan for clean cookstoves - 2013 provided the scope to develop renewable energy and energy efficient technologies to reduce fossil fuel and increase clean fuel uses.

5. NATIONAL AIR QUALITY PLAN AND ACTION

Clean air is a 'matter of right' for citizens. Degraded Air Quality has an adverse effect on human health and environment. Bangladesh does not have any published National Clean Air Plan other than the recently promulgated Air Pollution (Control) Rules, 2022.

Air pollution is one of the major environmental threats Bangladesh has been experiencing for the last three decades. The Bangladesh government is actively working on it by taking up several projects with the aim of reducing air pollution. In 1999, the government introduced the AQMP (Air Quality Management Project), and it continued until 2006. This was a Learning and Innovation Loan (LIL) project. The objective of this Learning and Innovation Loan (LIL) project was to learn about available options; and develop components of urban air quality management by means of pilot activities and

institutional support, with the ultimate goal of reducing human exposure to vehicular air pollution in a cost-effective manner. The components were designed to generate consistent and reliable data, develop institutional capacity for air quality management, test technical options for financial, environmental and social viability, and raise stakeholder awareness of the issues and options related to vehicular air pollution. The activities under this LIL focused primarily on Dhaka, with some components replicated in other cities [WB Report No PID 7359].

In 2005, the Government of Bangladesh issued a set of limit values for the criteria air pollutants (PM, Pb, SO₂, CO, NO_x and O₃), which have been subsequently revised in the Clean Air Rules of 2022. Several measures were taken at different times to improve the air quality in urban areas of the country. The main measures were (a) removal of lead from gasoline in 1999; (b) phase-out of 2-stroke 3-wheeled baby taxis from Dhaka in early 20's; (c) introduction of cleaner fuel CNG to transport sector in the early 90's; (d) enlargement of the chimney height of the fixed chimney kiln (FCK) for brick production; and, recently, (e) adoption of new Brick Manufacturing and Brick Kiln Establishment (Control) Law – 2013 (Amended 2019), which prohibits energy-extensive FCKs in brick manufacturing sector. These interventions instantly improved the air quality during the time of implementation; however, the massive influx of populations in urban centres in the following years, and the consequent requirement and use of excessive fuel cancelled out the benefits gained from those interferences.

The Ministry of Environment, Forest and Climate Change (MOEFCC) of the Government of Bangladesh implemented Clean Air and Sustainable Environment (CASE) project using financial assistance from the World Bank; this was done with a view to identify the gross air polluting sectors to design and demonstrate cleaner technologies in brick manufacturing and to study the emissions from other major sources like vehicles, industries, etc., and the means to curb emissions. The project started in 2010 and ended in 2019. Three agencies, Department of Environment (DoE), Dhaka City Corporation (DCC) and Dhaka Transport Coordination Authority (DTCA) executed their respective part of the project; while the DoE component was building the infrastructure for continuously monitoring the air quality, tracking sources and finding ways of reducing industrial emissions, the DCC and DTCA components were trying to find solutions to lessen the vehicular emissions by modernising traffic systems, building up facilities for pedestrians' movement, and facilitating smooth traffic flow and mass transit. The CASE project established 16 continuous Air Monitoring Stations (CAMS) in 8 major cities and 15 compact monitoring systems. The monitoring network encompasses all the regions of the country - Dhaka, Narayanganj, Gazipur in the centre, Chittagong in the south-east, Khulna and Barisal in the south, Rajshai in the west, and Sylhet in the north-east regions of the country. Five (05) criteria air pollutants (PM, SO₂, NO_x, O₃, and CO) and meteorology parameters are being monitored every minute in the CAMS. All of the stations are connected via GPRS with a central server system at Dhaka office where the historical data at 15 minutes average are stored and analysed. A massive air quality database for 8 cities from 2012 to 2018 was generated from this project.

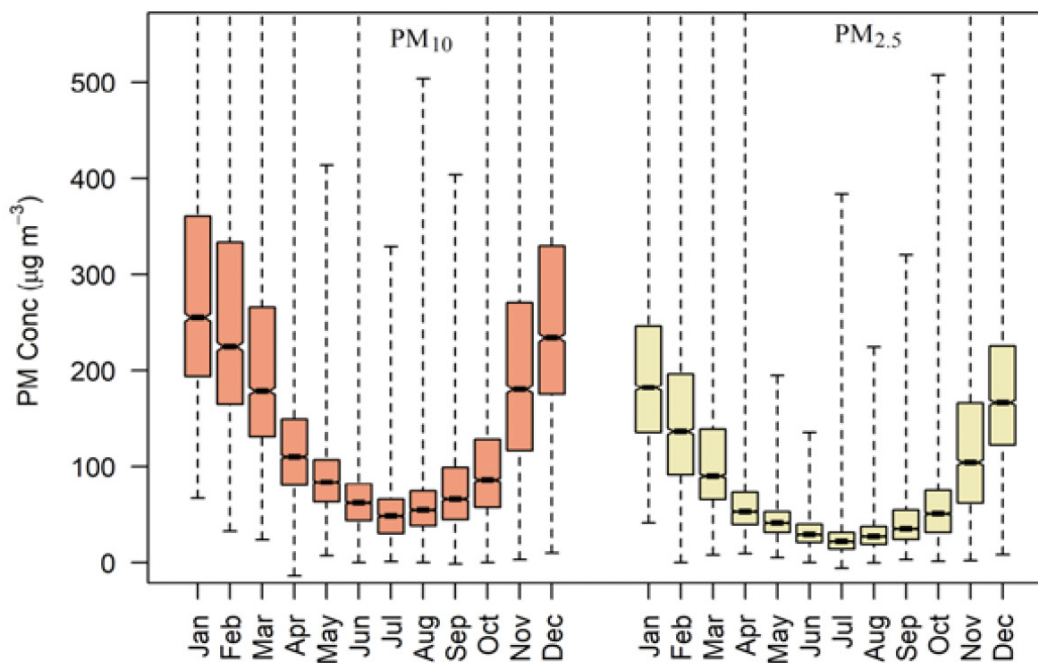
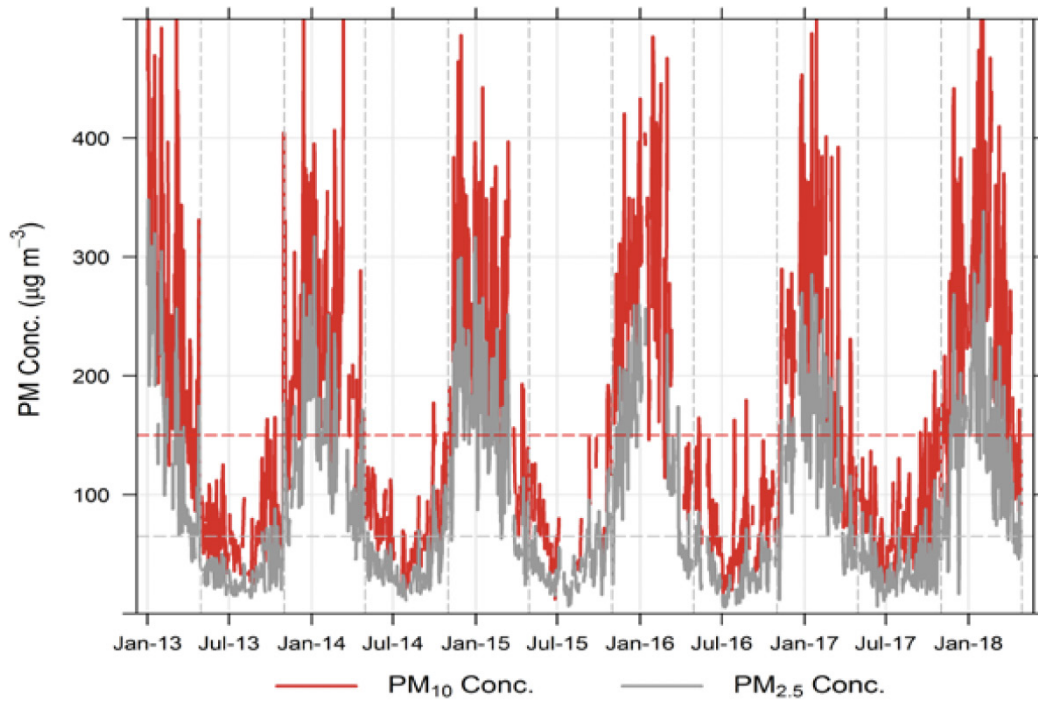


Figure 5: 24-hour average PM_{10} and $PM_{2.5}$ data for Dhaka City. Top – Temporal variation, bottom – box chart. [Reference: CASE Project report]

As shown in Figure 5, air pollution caused by Particulate Matter is a matter of grave concern, especially during the dry months, namely, November to March. During these months, the country sees very little rainfall and, at the same time, this is the brick-burning season for brick kilns. The CASE project found that all major cities, namely Dhaka, Gazipur, Narayanganj, Chittagong, Rajshahi, Sylhet, Khulna and Barishal, are experiencing high levels of air pollution during the dry months. Among them, Dhaka is the worst-hit because of its huge population and large number of transport vehicles. Its citizens are suffering from various diseases and health issues arising due to air pollution. The honourable High

Court of Bangladesh ordered the Ministry of Environment, Forest and Climate Change (MOEFCC) of the Government of Bangladesh to take necessary steps to find the causes of air pollution and take required measures to prevent and reduce air pollution in Dhaka and its surrounding area. Acting upon the order of the honourable High Court, MOEFCC has prepared a guideline for Air Pollution Control in 2019. The government also promulgated Air Pollution (Control) Rules, 2022 to tackle air pollution. This rule defines the National Ambient Air Quality Standards (NAAQS) and sets multiple schedules narrating standard emission limits for pollutants from different industries, such as brick kilns, power plants, steel mills, cement mills, textile mills, fertilizer, boilers, battery industries, ceramic and tiles, pesticide manufacturers, engine emissions for different engines used in automobile industries, odour limits, fugitive emissions, and emissions from construction industries, etc. However, the government is yet to prepare a detailed national plan to achieve these emission limits to ensure clean air for all.

The Road Transport Act, 2018 and Air Pollution (Control) Rules, 2022 have given authority to BRTA to phase out old economic life-expired vehicles, ensure vehicle emission testing, enhance inspection and maintenance (I&M) systems and modernise vehicle fleets. The existing pollution testing centres should be replaced with modernised and automated centres that can be effectively monitored by BRTA. Freight transport should be shifted from road to lower-emission modes such as rail and water. All Metro Rail Service (MRT) 1 to 6 lines will be in operation by 2035. After the 6 METRO lineS come into operation, the number of private vehicles and buses plying on the city road is expected to drop significantly. Government has a target to aggressively introduce electric vehicles in Dhaka city, and it is expected that the share of EVs on Dhaka roads will be 30% by 2030. The share of electric vehicles and hybrid vehicles will increase significantly.

To address industrial pollution including brick kilns, the Brick Manufacture and Brick Kiln Set-up (Control) Act, 2013 (Amendment 2019) was gazetted, whereby setting and running clay-fired brick kilns is restricted, environment-friendly alternative building materials, including block, are promoted and the rules for the emission standards of different industries are set.

Considering the environmental and economic issues, the government started the promotion of gas as residential and transporting fuel after the 2000s; but the reserves of gas are on a decline. The government is exploring LPG as a new source of energy that is sustainable, environmentally friendly and economically viable. The demand for LPG has increased 400% from 2015 to 2019 (Khan et al., 2021). The demand has mostly increased for cooking. It is legally facilitated by the country's Action Plan for Clean Cooking Development, 2013.

Sustainable and Renewable Energy Development Authority (SREDA) Act, 2012 has given 21 responsibilities and functions to the SREDA. They include taking necessary measures to create public awareness; to promote the efficient use of power and energy; to use energy-efficient equipment; to set EE standard and labelling of equipment and appliances; to implement energy- efficient building code; to ensure appointment of energy managers and auditors and selection of accredited energy auditor firm; to create commercial market for sustainable energy in private sector through demonstration; to identify energy inefficient equipment and take necessary measures to stop their production; to assist in identifying sources of financing and make necessary arrangement to provide financial incentives to attract and encourage private investment in renewable energy sector; and to coordinate with different Ministries, Divisions and organisations in matters related to sustainable energy, etc.

Energy Efficiency and Conservation Master Plan up to 2030 and other SREDA policies support installation of rooftop solar systems to meet a certain amount of electrical load, identification of target institutional/industrial/residential consumers for faster adoption, and identification of open areas in the

city where solar power generation is possible, etc. Energy Efficiency and Conservation Master Plan has suggested an increase in penetration of high-efficiency vehicles, electric vehicles and mass transportation systems in urban areas.

6. CITY LEVEL ACTION PLAN AND THEIR ALIGNMENT WITH NATIONAL PLAN

6.1 Existing plans and policies to control air pollution in Dhaka

The major published documents on air pollution control in Dhaka City are Air pollution Control Guidelines, 2020, prepared by MOEFCC following the High Court Order on 26/11/2019 and the New Clean Dhaka Master Plan 2018-2032 for solid waste management by Dhaka North City Corporation (DNCC). Through Air Pollution Control Rules, 2022, the Ministry of Environment, Forest and Climate Change issued comprehensive guidelines or directives to relevant government and non-government entities to control and reduce air pollution, particularly emissions from brick kilns, construction activities, vehicles, waste/biomass burning, waste handling, and others.

Air Pollution Control Rules, 2022, the Air Pollution Control Guidelines, 2020, Solid Waste Management Rules, 2021 and the New Clean Dhaka Master Plan 2018-2032 for solid waste management defined the City Corporation's duties, responsibilities, and actions on open burning, waste management, construction activities, and construction materials transportation, road, and soil dust control duties and responsibilities. Both Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) have started waste-to-energy projects.

Urgent steps are required to improve air quality in Dhaka city. It requires a multi-pronged, sustained and integrated approach, including close monitoring, control, implementation and enforcement. The following table summarises the current actions/activities/policy measures to improve air quality of Dhaka City as directed by Air Pollution Control Guidelines (2022).

Table 1: Summary of activities and responsible organisations

Sr.	Action	Activities	Lead or Co-lead ministry/department/institute/agency	Relevant Policies
1	Transport Sector Emission Control	<ul style="list-style-type: none"> Phase out the old, economic life-expired vehicle. Ensure vehicle emission testing before issuing fitness certificates Strengthen the existing vehicle testing centres, which should be replaced by modernised and automated centres that can be effectively monitored by BRTA. Enhance inspection and maintenance (I&M) systems. 	RTHD, BRTA, Bangladesh Police	Bangladesh Environment Conservation Act, 1995; Bangladesh Road Transport Act, 2018; Air Pollution Control Rules, 2022, Dhaka Air pollution Control Guideline, 2020

Table 1: (Continued)

Sr.	Action	Activities	Lead or Co-lead ministry/department/institute/agency	Relevant Policies
		<ul style="list-style-type: none"> • Ensure service providers enforce compliance with the latest emission standards. It should require the emission test as a part of registration and annual fitness checks. • Enforce standards for engine emissions which require tail-pipe controls like diesel particulate filters (DPF) for PM and selective catalytic reduction (SCR) for NO_x • Install automatic traffic signal systems and take necessary measures to reduce traffic jam. • Reduce private cars and increase public transport. • Introduce Euro-3 and Euro-4 cars. • Remove muds from vehicle wheels by washing them before entering city roads. • Training and awareness on the importance of using unadulterated fuel, emission, and vehicle servicing. 		
2	Switch to low sulphur fuel (50 ppm) and implement standards similar to Euro-V)	<ul style="list-style-type: none"> • In order to use Euro-V/VI equivalent vehicle diesel engines, renovate the refineries with latest technologies to produce low-sulphur (10 ppm) fuels by 2030 . • Stop importing high sulphur (more than 50 ppm sulphur) containing diesels. • Shift freight transport from road to lower-emission modes such as rail, water, etc. 	EMRD, BPC, RTHD, BRTA, BSTI, ERL and development partners	BSTI

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/agency	Relevant Policies
3	Introducing Mass transport system, Electric vehicles, public transport development	<ul style="list-style-type: none"> • Ensure the metro rail service, MRT 1 to 6 lines, is in operation at the target time of 2030. • Increase the distribution of electric and hybrid vehicles and expedite the transition to electric mobility, achieving 30% as the target. • Exemption of the duty/tax on electricity tariff for an initial period of 10 years for EV manufacturers (vehicle and battery) • Waive the road tax and reduce the registration fee for the EV. • Target provision of public and private EV charging stations as part of the EV charging policy. • Improve existing public transport service infrastructure for access by installing Bus Queue Shelters, Bus Post sign, etc. • Strengthen the city bus system for connectivity. 	<p>MORTB, Bridges Division, RTHD, LGD, City Corporation</p> <p>BRTA, MRTA and development partners</p>	<p>DMTCL target; Air Pollution Control Guideline, 2020; Electric Vehicle Charging Guidelines, 2022</p>
4	Construction works, Construction materials transportation and management	<ul style="list-style-type: none"> • Undertake control measures for fugitive emissions from material handling, conveying and screening operations through water sprinkling, curtains, barriers and dust suppression units. • Transport and store all dust-producing construction materials such as sand, soil, stones, cement, aggregates, bricks, etc. under covered condition. • In all Development Project Proposals, include water spraying provision on the construction sites. • Water must be sprayed outside the barriers two times a day 	<p>LGD, Dhaka North and South City Corporation (DNCC and DSCC),</p> <p>RAJUK, WASA, DESA, DESCO, ICT division</p>	<p>Dhaka Air Pollution Control Guidelines, 2020, Air Pollution Control Rules, 2022</p>

Table 1: (Continued)

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/agency	Relevant Policies
		<ul style="list-style-type: none"> • Introduce steeper penalties for non-compliance. • Establish a protocol for using cleaner fuels and technology for asphalt mixing and minimising the number of hot-mix plants. • Adapt truck loading guidelines; use of appropriate enclosures for haul trucks; gravel paving for all haul routes. • Mandate restoration according to the guidelines after the completion of all infrastructure projects. • Adopt preventive measures as mentioned in air pollution control guidelines. Construction agencies to be made liable. Impose penalty for non-compliance. 		
5	Dust Control Measures	<ul style="list-style-type: none"> • Phase out manual street sweeping and Phase in mechanical / vacuum-based street sweeping wherever feasible; introduce wet / mechanised vacuum sweeping of roads. • Adopt dust control measures for dug-up areas and proper restoration after the work. Applicable for all utility and other service companies. • Do not leave the solid waste reclaimed from drain during drain-cleaning on the road/street for a long time. Remove them quickly. • Wall-to-wall paving and repair broken roads and pavement. 	LGED, Dhaka North and South City Corporation (DNCC and DSCC), RAJUK, WASA, DESA, DESCO, ICT division, Developer companies	Dhaka Air pollution Control, Guideline, 2020, Air Pollution control Rules, 2022

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/agency	Relevant Policies
		<ul style="list-style-type: none"> • Adopt street design guidelines for paving of roads and footpaths (hard and soft paving) with vegetative barriers. • Adopt and implement dust control measures for all types of construction — buildings and infrastructure. For materials handling, building/infrastructure construction/demolition, it should be mandatory on part of the developers to take appropriate measures to control dust and dispose of them properly at designated sites. • Introduce water fountains at major traffic intersections, wherever feasible. • Increase green cover in the region. Undertake greening of open areas, gardens, community places, schools, and housing societies. 		
6	Pollution from brick kilns.	<ul style="list-style-type: none"> • Phase out polluting brick kilns in the surrounding areas of Dhaka. • Achieve the target of alternative building materials (non-fired Block) for government works by 2025. • Provide incentives and increase use of non-fired blocks instead of bricks wherever possible. • Stop burning high sulphur and ash-containing coals. • Stop importing high sulphur/ash-containing coals. • Increase awareness on using non-fired blocks and their benefits. 	MOEFCC, DoE, DC offices	Brick production and Kilns Establishment (Control) Act, 2013 (amended 2019), Air Pollution (control) Rules, 2022

Table 1: (Continued)

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/agency	Relevant Policies
7	Municipality solid waste management	<ul style="list-style-type: none"> • Stop solid waste storing and burning beside the streets, roads and highways. • Disallowing any type waste storing in open conditions, whether beside the house/ educational institutes or the roads/streets. House-owners must keep the surrounding areas of their houses clean. • Wastes collected from drains during clean-up activities must be removed before they dry up. • Strictly control open waste burning. • Strictly control open biomass (stems, leaves, wastes) burning. • Implement the waste-to-energy (incineration) project timely. • Properly manage and transport the municipality/ drainage/roadside waste. • Improve the proper collection, segregation and sanitary landfill management system in the source. • Adapt the Reduce, Reuse and Recycle (3R) policy. • Strictly monitor and enforce penalty for the road and roadside waste polluter. 	<p>Local Government Division</p> <p>Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC)</p>	<p>New Clean Dhaka Master Plan 2018-2030,</p> <p>Solid waste management Rules, 2021, Air Pollution Control Rules, 2022, Dhaka Air Pollution Control Guideline, 2020</p>

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/agency	Relevant Policies
8	Formation of Monitoring and Vigilance Team	<ul style="list-style-type: none"> Surveillance and monitoring team should be formed to monitor and ensure that all construction activities under different ministries/organisations are being carried out properly following environmental guidelines to control air pollution. Each and every emission source has to be under surveillance by the concerned authority. Enforcement of penalties on those who violate the rules and regulation. 	DOE, Bangladesh Police, DMP, DNCC, DSCC, District Administration, PWD, BRTA, LGD, MOI, MES	Air Pollution Control Rules, 2022, Relevant Acts Rules and policies
9	Lack of Public Awareness	<ul style="list-style-type: none"> Public awareness regarding source, impact and control of air pollution needs to be enhanced through print and electronic media. Public awareness needs to be enhanced through display of air quality indices and spatial air quality maps using print and electronic media. Concerned ministry, department and agency should lead awareness programmes to control air pollution. 	Ministry of LGED, Information Ministry, BRTA, RHD, MOEFCC, DNCC, DSCC; electronic and print media	Air Pollution Control Rules, 2022
10	Inclusion of Civil Societies	<ul style="list-style-type: none"> Civil Society members must be included in the vigilance and surveillance team. In order to ensure accountability, Facebook/WhatsApp group must be formed to collect public feedback or remarks. 	DOE, Bangladesh Police, DMP, DNCC, DSCC, District Administration, PWD, BRTA, LGD, MOI, MES	Air Pollution Control Rules, 2022

6.2. Additional Activities for Controlling Air Pollution

Additional activities that are important but are currently missing in the Air Pollution Control Guidelines (2022) can be listed as below:

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/ agency	Relevant Policies
1	Pollution from industries	<ul style="list-style-type: none"> • Ensure compliance of the emission standards by cement, steel re-rolling mills, garments and other air polluting factories. • Ensure the operation of an emission monitoring system: A Continuous Emission Monitoring System (CEMS) and self-reporting by major industrial sources should be made mandatory. • Adopt cleaner and efficient technologies. 	DOE, MOEFCC, MOI, Bangladesh Police, DMP	Air Pollution Rules, 2022
2	Clean technologies (Solar)	<ul style="list-style-type: none"> • Install solar rooftop systems to meet a certain amount of electrical load, linked with transition from diesel genset to solar power. • Identify open areas in the city where solar power generation is possible. • Where there is a lack of rooftop space or single grid-connection for multiple houses), encourage regulatory measures such as virtual and group metering. • Set up a Solar Command Centre (SCC) within the SREDA that provides guidance, facilitates redressals and acts as a watchdog for solar rooftop adoption, especially tracking progress under schemes and mandates (including renewable purchase obligation). • Electric public transport can also be linked with solar power plans to shift to a zero emission target. Identify and target institutional/industrial and residential consumers for faster adoption. 	Power Division SREDA, MOI, MOST, MOC, IDCOL, NGOs and development partners	Sustainable and Renewable Energy Development Authority Act, 2012; Country Action Plan Clean Cooking, 2013; Energy Audit Regulations, 2018; Energy Efficiency and Conservation Master Plan up to 2030

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/ agency	Relevant Policies
3	Energy efficiency technology and cleaner production	<ul style="list-style-type: none"> • Ensure energy efficiency in generation, exploration, production, transmission and distribution levels of the related sectors. • Issuance of Bangladesh Standards Certificate related to the EE Labelling Program. Conduction of energy efficiency tests required for the EE Labelling Program. • Enforce the energy management and EE Labelling Program with SREDA, especially on encouraging appliance manufacturers' participation in the program. • Encourage the trading of (high) energy efficient products, including removal of NTB (Non-Tariff Barrier) in collaboration with foreign countries. • Provide training for capacity development at institutional levels • Provide advisory services to the private sector, government and non-government organisations. 	Power division, PDB, SREDA, MOST, Energy Regulatory Authority and development partners	Sustainable and Renewable Energy Development Authority Act, 2012; Country Action Plan Clean Cooking, 2013 Energy Audit regulations, 2018, Energy Efficiency and Conservation master Plan up to 2030
4	Launching a National Clean Air Mission of Dhaka for Multi-Scale and Cross-sectoral Coordination	<ul style="list-style-type: none"> • Focus on developing regional scale plans for air quality improvement with annual targets. • To achieve the Clean Air target, look for ways to integrate efforts to take targeted actions recommended by the regional scale air quality management plans. • Investments for mitigation actions should be sought through subsidy reallocation and Corporate Social Responsibility (CSR) activities. 	All concern ministry/ division/ institute/ Authority	Relevant Plan and Policies

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/ agency	Relevant Policies
5	Source apportionment study and emission inventory	<ul style="list-style-type: none"> • Need to develop a national database of high-resolution source emission inventories with lower uncertainties • Academic courses specialising in air pollution science • Air pollution research done at academic institutions and government and laboratories needs to be well-coordinated • Air quality modelling tools should be used to predict current and future air quality to enable informed policy decisions • These should be a basis for assessment of strategies for their potential in reducing air pollution. Emergency Response Plan (ERP) needs to be developed to reduce emissions during episodes and avoid exposure of high pollutant concentrations to the public. 	DoE and Academia	Air Pollution (Controls) Rules, 2022
6	Ambient air quality and industrial emission monitoring	<ul style="list-style-type: none"> • Enhance the ambient air quality monitoring network, urban and rural areas, to compare the intensity of air pollution. • Develop web-enabled real-time air quality monitoring and forecasting system to make public aware to take precautionary measurements in extreme pollution levels. • Develop alarm and sms systems for public to take precautionary measurements in extreme air pollution situation. 	MOEFCC, DoE, industries and academia	Environmental Conservation Act, 1995; Air Pollution (Controls) Rules, 2022

Sr.	Action	Activities	Lead or Co-lead ministry/ department/ institute/ agency	Relevant Policies
		<ul style="list-style-type: none"> • A Continuous Emission Monitoring System (CEMS) and self-reporting by major industrial sources should be made mandatory. • For the small industries, ensure quarterly air pollution monitoring and reporting. • Concerned ministry, department and agency should enhance their monitoring program to control air pollution • Each and every emission source has to be monitored by the concerned authority. 		

6.3. Alignment of City-level Action Plan with National Plan

The Government of Bangladesh recently promulgated Air Pollution Control Rules 2022 and Solid Waste Management Rules 2022. These rules are applicable for the whole nation including Dhaka city. Additionally, acting on the honourable High court order dated 26/11/2019, the Ministry of Environment, Forest and Climate Change (MOEFCC) of the Government of Bangladesh prepared Air Pollution Control Guidelines (2022) to take necessary steps to find the causes of air pollution and take required measures to prevent and reduce air pollution in Dhaka City and its surrounding area. It provides a regulatory framework and policy guidelines for controlling air pollution of Dhaka city. This cannot be deemed a city-level action plan. City corporations are the lead agencies of the cities in Bangladesh. They are yet to prepare city-level time-bound action plans and implementation roadmaps to achieve the targets and comply with the regulatory guidelines. It is to be noted that Air Pollution Control Rules – 2022 and Air Pollution Control Guidelines – 2022 are complementary to each other and they do not have any conflict.

In 2022, the Government of Bangladesh published a gazette notification of Solid Waste Management Rules 2022. This rule is applicable for the entire nation. In the meantime, Dhaka North City Corporation (DNCC) prepared the New Clean Dhaka Master Plan 2018-2032. This provides a future vision of solid waste management of Dhaka North City. Many of the rules and guidelines provided in this document appeared in the Solid Waste Management Rules 2022. Again, they are complementary to each other.

7. THE STRENGTHS AND CHALLENGES OF CURRENT STRATEGIES FOR ADOPTING AIR POLLUTION CONTROL TECHNOLOGIES IN DHAKA

Table-2: The strengths and challenges of current strategies for adopting air pollution control technologies in Dhaka

Component	Strengths	Challenges
Transport Sector Emissions	<ul style="list-style-type: none"> The Road Transport Act, 2018, Air Pollution Control Rules, 2022 and Air Pollution Control Guidelines, 2021 are already enacted. CNG and LPG conversion facilities are available. 	<ul style="list-style-type: none"> Phasing out the old economic life expired vehicles needs political will and cooperation of bus/vehicle owners Setting up new modern automated vehicle emission testing centres and upgrading the old ones with new technologies. Ensure vehicle emission testing Ensure the emission tests are performed before any registration or fitness certificate is issued Enhancement of inspection and maintenance systems Equip the mobile-court with mobile automotive tail-pipe emission tools Limited Manpower and skilled technicians for emission testing and enforcement Confirming installation of diesel particulate filters (DPF) for PM and selective catalytic reduction (SCR) for NOx to control tail-pipe emission Setting up more LPG and CNG pumps Enforce compliance with the latest emission standards for all

Component	Strengths	Challenges
Switch to low sulphur fuel (less than 50 ppm, but 10 ppm is preferable)	<ul style="list-style-type: none"> BSTI (Brake Transmission Shift Interlock) has fixed standards, BDS 344:2020 of high speed diesel (50 ppm) for sulphur content in diesel. 	<ul style="list-style-type: none"> Renovation of Eastern Refinery Limited (ERL) so that it can produce 50 ppm and 10 ppm sulphur content diesel Requires substantial financial investment Euro-5 diesel engine requires max 10 ppm sulphur HSD
Shift freight transport from road to lower-emission modes such as rail and water	<ul style="list-style-type: none"> Dhaka Mass transit Company Limited (DMTCL) has been established. Government has set a target to develop 1 to 6 MRT lines across the City by 2030 Already MRT Line 6 is in operation and MRT 1 and 5 under construction. Government has set a target EV operable 30% by 2030 and 100% by 2041. 	<ul style="list-style-type: none"> Completion of the MRT works on time Resource availability Overhauling railway systems Increasing water vehicles such as ships and tankers Achieve the EVs target within due time
Municipal solid waste management	<ul style="list-style-type: none"> Solid Waste Management Rules 2021 is already in place. Both Dhaka North and South City corporations have started waste-to-energy (incineration) projects. 	<ul style="list-style-type: none"> Ensure proper segregation and collection of MSW Ensure sanitary landfill management system as per Solid Waste Management Rules 2021 Timely completion of the waste-to- energy (incineration) projects Strictly control open waste and biomass burning Properly manage and transport the municipality/drainage/ roadside waste Stop burning wastes to produce asphalt mix Strict monitoring of the road and road side waste producers

Component	Strengths	Challenges
Construction and dust control & management	<ul style="list-style-type: none"> • Air Pollution Control Rules, 2022 and Air Pollution Control Guidelines, 2021 are already enacted. • Have regulatory support to control the construction pollution. 	<ul style="list-style-type: none"> • Ensure water spraying in and around the construction sites • Proper storage, handling and transportation of construction materials • Clean/wash/sweep the road to remove the soil and road dust • Lack of coordination among the concerned implementation authorities, e.g., DESCO, WASA, RAJUK, DPDC, BTRC, BRTA, etc. • Lack of planning among the concerned authorities • Unplanned city development
Brick kilns and Other industries	<ul style="list-style-type: none"> • Manufacture and Brick Kiln Set-up (Control) Act, 2013 (Amendment 2019) • Already, the government has set a target to transform the use of fired brick to non-fired building material (Block) in all government development works by 2025 	<ul style="list-style-type: none"> • Dismantle or convert all FCKs to zigzag kilns • Create demand of non-fired bricks in all sectors • Ensuring production and supply of the alternative non-fired Blocks • Financial support such as loan and incentive for producing and using non-fired blocks • Ensure compliance with emission standards set by Air Pollution Control Rules 2022 by all industries • Ensuring sufficient manpower and logistics for the regulatory and enforcement authority

Component	Strengths	Challenges
Provide cleaner fuel (LPG, Electricity) and biomass stoves with an efficiency of 50% or more.	<ul style="list-style-type: none"> • Clean fuel and easy to handle 	<ul style="list-style-type: none"> • Provide easy and affordable access to clean fuels (such as LPG; electricity) for the households that are reliant on solid/biomass fuels • Lack of availability of resources and implementation mechanism • Setting up biogas plants • Transformation to induction stoves (powered by solar or gas) and introduction of subsidy mechanisms and resource availability
Clean technologies (Solar)	<ul style="list-style-type: none"> • Bangladesh already has a policy to install solar rooftop systems to meet a certain amount of electrical load. • Policy support to set up a Solar Command Centre (SCC) within the SREDA is already in place. 	<ul style="list-style-type: none"> • Adequate space for setting up solar system • Proper monitoring linked with transition from diesel genset to solar power • Public motivation and developing the goodwill in people
Energy efficiency technology	<ul style="list-style-type: none"> • Energy Efficiency and Conservation Master Plan is already in place • Cost-effective and environment-friendly technology • Government has policy to introduce energy efficient technology 	<ul style="list-style-type: none"> • Primary investment is very high • For replacing the existing setup with a new EE set up, extra budget is required • Lack of budget and incentive option • Developing more standards for BSTI and the EE Labelling Program and energy efficiency tests • Ensuring the Energy Management and EE Labelling in all manufacturing sectors • Develop public awareness

Component	Strengths	Challenges
Institutional strengthening, capacity and technology development	<ul style="list-style-type: none"> • Have an existing setup in the different ministry, department and institution 	<ul style="list-style-type: none"> • Develop enough trained manpower and logistics • Develop coordination among the concerned implementation authorities
Source apportionment study and emission inventory	<ul style="list-style-type: none"> • Air pollution Control Rules, 2022 has given the mandate to DOE to carry out the study 	<ul style="list-style-type: none"> • Enough trained manpower, logistic support and resource availability • Availability of enough budget
Ambient air quality and industrial emission monitoring	<ul style="list-style-type: none"> • Air pollution Control Rules, 2022 has given mandate to DOE to monitor the ambient air quality and industrial emission. • DOE monitors the ambient air quality of the country through its 16 Continuous Air Monitoring Stations (CAMS) and 15 Compact CAMS installed across the country. 05 criteria air pollutants namely Particulate Matter (PM10 and PM2.5), Carbon Monoxide (CO), Oxides of Nitrogen (NOX), Sulphur DiOxide (SO2), and Ozone (O3) are continuously monitored by these stations. Daily Air Quality Index (AQI) values are also calculated based on the available air quality data that refers to the situation of air pollution in terms of health impacts, and this daily AQI is presented on the DOE website. • Current practices include industries quarterly monitoring their emission and submitting the report to DoE. 	<ul style="list-style-type: none"> • Difficult to keep the CAMS under proper operating conditions due to lack of skilled manpower and resources such as spare parts and maintenance • Enough trained manpower, logistic support and resource availability • Develop a Continuous Emission Monitoring System (CEMS) and self-reporting by major industrial sources should be made mandatory

Component	Strengths	Challenges
Monitoring and enforcement	<ul style="list-style-type: none"> • Acts, Rules and Policies are available. • The Department of Environment has continued regular mobile courts and enforcement activities against polluting sources. 	<ul style="list-style-type: none"> • Lack of trained manpower, logistic support, and resource availability • Need for launching a multi-scale and cross-sectoral coordination action against the air pollution sources.
Awareness	<ul style="list-style-type: none"> • Print and electronic media are in favour of strategies, policies and plans related to reducing air pollution. 	<ul style="list-style-type: none"> • Lack of available budget, planning and coordination • More programmes for creating public awareness needed • Introduction of awareness education in school-level curriculum to be done

8. RECOMMENDATIONS

1. To ensure clean air for all citizens, both the National level Clean Air Plan and City level Action Plan are to be prepared and approved by the relevant authorities as soon as possible.
2. Gradually improve public practices and behaviour to enforce the use of at least 3 bins for in-house waste storage in segregation and the collection system.
3. In order to reduce the use of biomass (wood, agricultural residues) in cooking, all concerned authorities including the Ministry of Power, Energy and Mineral Resources, Bangladesh Petroleum Corporation (BPC) and SREDA should take initiatives regarding the promotion of improved cook-stoves and the use of clean alternative fuels such as LPG, biogas and NG
4. All relevant departments and agencies (e.g. City Corporation, WASA, DESA, DPDC, TITAS) in the case of digging roads and footpaths for construction or repair activities related to ongoing development projects and various utility services in cities, such as water, telephone, electricity, internet, gas, etc. The Directorate of Information and Communication Technology should take effective measures to control air pollution including dust control. A common utility duct should be laid for all mutual coordination.
5. Ensure prompt repair of the broken road, footpath and divider, and monitor the contractors to ensure environment-friendly operation of their activities
6. Total ban on open waste burning with strong monitoring and enforcement activities is necessary.
7. Strict control of the roadside waste production and open storages is needed
8. Strict monitoring and control of the polluting brick kilns in the periphery of Dhaka City and ensuring compliance with emission standards by all industries are needed.
9. Enhance the monitoring and enforcement activities.
10. Develop training/awareness among all stakeholders and the public to combat air pollution.

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