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Addis Ababa City Air Quality Policy and Regulatory Situational Analysis

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SECTION I

1.0 INTRODUCTION

This section provides the overall background to the project as well as general background information about the City of Addis Ababa.

1.1 Overview of the Project

The Addis Ababa City Air Quality Policy and Regulatory Situational Analysis was conducted as part of a pilot project led by UN Environment to support three African cities – **Addis Ababa**, Kigali and Nairobi – to develop better air quality management strategies.

The overall objective of the project was to build the capacity of relevant national and city officials to develop, implement and enforce better policy and regulatory frameworks for air quality management and support the development of strategies for air quality management in these cities. Specifically, the project sought to:

- Generate knowledge and raise awareness on air quality;
- Develop tools and methodologies to better address air quality issues in Addis Ababa, Kigali and Nairobi according to the their unique situations and air pollution apportionment;
- Provide policy recommendations on sectoral solutions that bring air quality co-benefits as well as recommendations on effective implementation, enforcement and/or compliance with policy and regulatory framework.

1.2 Purpose and Scope of the Situational Analysis

The purpose of this situational analysis was to obtain a better understanding of the governance framework for air quality management in Addis Ababa City in terms of policy, legislative and regulatory mechanisms, including the state of compliance and enforcement, with a view to documenting any existing and/or apparent gaps and proposing recommendations to address the same.

The analysis covers all relevant federal and regional/city policies, laws and regulatory mechanisms – including standards, implementation mechanisms and infrastructure. The analysis was carried out between April and December 2018.

1.3 Methods

In compiling this situational analysis, relevant federal and regional State policies, legislative and regulatory instruments and strategy documents were reviewed and analysed. Several published and unpublished reports were also reviewed. In addition, semi-structured key informant interviews consisting of a series of questions designed to help identify gaps and needs were administered upon selected officials of the Ministry of Environment and Forests (MEFCC) and Addis Ababa Environmental Protection Agency (AAEPA).

1.4 Addis Ababa City Background Information

1.4.1 Location, Size, and Administration

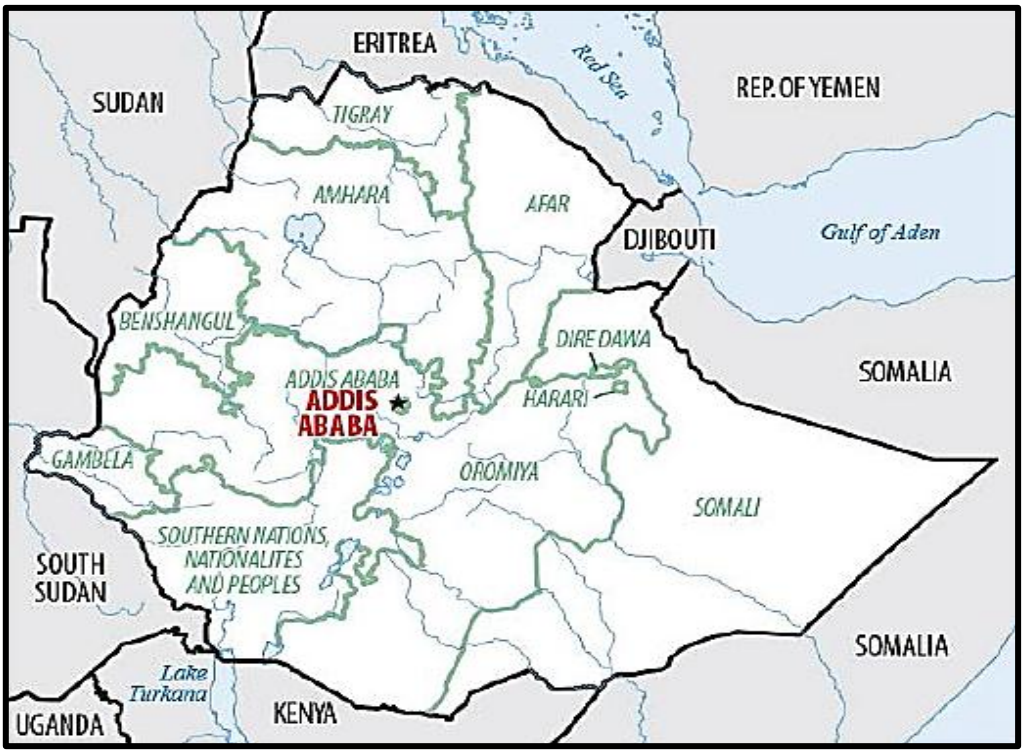
Addis Ababa is the capital city of Ethiopia and is located on latitude 9^0 1' 48"North and on longitude 38^0 44' 24" East. The city lies at the foot of Mount Entoto with an elevation of 2,355 meters above sea level, and covers about 540 km^2 [1]. Addis Ababa hosts the headquarters of the African Union (AU) and the United Nations Economic Commission for Africa (UNECA). The city is divided into 10 sub-cities, namely: Addis Ketema, Akaky Kaliti, Arada, Bole, Gullele, Kirkos, Kolfe Keranio, Lideta, Nifas Silk-Lafto and Yeka. The city is further divided in to 28 *Woredas* and 328 dwelling associations *(Kebeles)*. The City Council is made up of 18 bureaus, offices and authorities[2].

Addis Ababa has the status of both the federal capital city and an autonomous state. Under the 1995 Federal Constitution of Ethiopia, the Cities of Addis Ababa and Dire Adwa have same autonomy as State governments. The Mayor is the head of the City's executive branch, while the City Council is the legislative branch responsible for enacting city regulations[3]. However, the Federal Legislature enacts laws that are binding in Addis Ababa. Members of the City Council are directly elected by the residents of the city while the Mayor is elected by the Council among its members. Despite its autonomy, under the Constitution the Federal Government has powers to dissolve the city administration and replace it by a temporary administration in instances of underperformance or other reasons stipulated in the law.

Figure 1 below is a map showing Ethiopia's administrative boundaries and the position of Addis Ababa and the respective Regional States, while Figure 2 is the map of Addis Ababa metropolitan area showing the sub-cities.

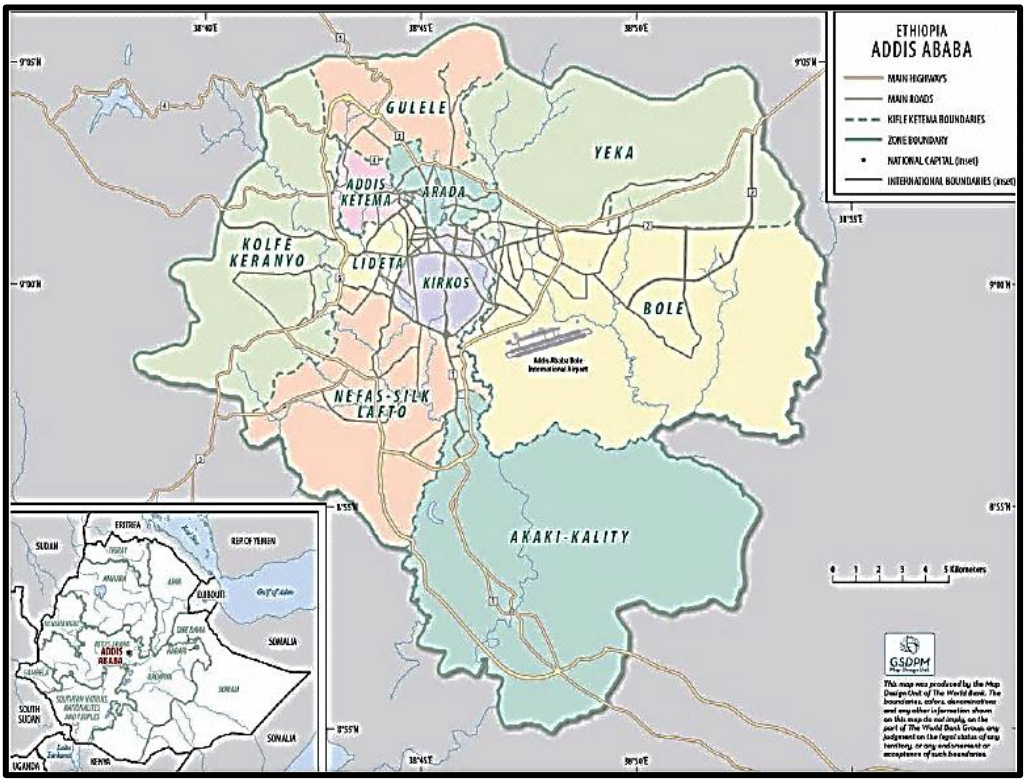
[1] *Addis Ababa Administration official website, July, 2018*
[2] *Ibid*
[3] *The Federal Constitution of Ethiopia, 1995*

Figure 1: Administrative map of Ethiopia showing the position of Addis Ababa



Source: World Bank Group, 2015

Figure 2: Map of Addis Ababa Metropolitan Area



Source: World Bank Group, 2015

1.4.2 Population

According to 2015 estimates by the Central Statistical Agency (CSA), Ethiopia's total population was about 90 million people. Addis Ababa is home to an estimated 3,434,000 inhabitants, which is 17 per cent share of Ethiopia's total urban population. The City has a population density of 6,516 people per square kilometre[4,5]. Addis Ababa's current population growth rate is about 3.8 per cent per annum with a projected population of 4.7 million inhabitants by 2030[6].

1.4.3 Climate and Topography

Addis Ababa lies between 2,200 and 2,500 meters above sea level. Because of its high altitude, Addis Ababa experiences a subtropical highland climate climate with annual average temperature range of between 10°C and 24°C. The city experiences short rainy season from February to May with the long wet season experienced from June to mid-September.

1.4.4 Land use distribution

Land use in Addis Ababa has been changing over the years due to the impacts of urbanization related developments such as from transportation, industrialization and settlements. Addis Ababa is experiencing rapid urban and metropolitan growth. However, a key challenge to date is poor planning and land-use, inadequate infrastructure, and chronic housing shortage. The absence of proper planning makes it difficult to establish the actual land use distribution within the city and its metropolis[7].

1.4.5 Socio-Economic Situation

Ethiopia's Real GDP grew by 8 per cent in 2015/16, a slowdown from the 10.4 per cent in 2014/15 and is projected to remain steady at 8.1per cent in 2018. Addis Ababa has a GDP growth rate of about 14 per cent. According to the State of Ethiopian Cities 2015 report, Ethiopian cities generated about 227.3 billion Ethiopian Birr (ETB). In the same year, Addis Ababa's GDP was about ETB 66.3 billion, well above 29 per cent of the overall GDP of Ethiopian cities. According to the city's Bureau of Finance and Economic Development report, 2016, Addis Ababa's per capita income grew from USD 788.48 in 2010 to USD 1,359 in 2015.. The economy of Addis Ababa is mainly dominated by the services sector at 63 per cent, followed by the industrial sector at 36 per cent[8]. In terms of employment, trade contributed 31 per cent of the urban jobs, whereas the manufacturing sector accounted for 23 per cent, community services 14 per cent, and the construction sector 12 per cent in 2015[9]It is estimated that 22 per cent of the population in Addis Ababa lives below the

[4] *World Bank Group: Ethiopia Urbanization Review: Urban Institutions for a Middle-Income Ethiopia, 2015*
[5] *Central Statistical Agency; Ethiopia population estimates by Region, 2016 (estimates based on 2007 census)*
[6] *UN HABITAT (2017) The State of Addis Ababa 2017: The Addis Ababa We Want.*
[7] *World Bank Group, Addis Ababa Urban and Metropolitan Transport and land Use Linkage Strategy, 2014*
[8] *UN HABITAT, The State of Addis Ababa 2017: The Addis Ababa We Want., 2017*
[9] *CSA, Urban Unemployment Survey. Addis Ababa, 2017*

poverty line and that 29 per cent of households are unemployed (higher than the national urban average of 15 per cent)[10].

1.4.6 Transport

Over the past decade, Addis Ababa has made deliberate efforts to improve the urban transport situation, largely through large investments in new infrastructure, including roads, a new Light Rail Transit (LRT) system (under construction) and a new Bus Rapid Transit (BRT) system, as well as improved pedestrian facilities[11]. Despite these improvements, the city of Addis Ababa still lacks adequate and affordable mass transportation system. The expansion of the city, increasing population size coupled with rapid economic growth means increased demand for transport services. It is estimated that 2.2 million people in Addis Ababa use public transport with about 3.6 million trips in the city daily. The dominant modes of transport in Addis Ababa include public bus, minibus, taxis, Light Rail Transit (LRT) and walking. In the peripheries, walking and animal carts are the predominant modes. Public transport accounts for about 48 per cent while private cars and walking account for 9 per cent and 43 per cent respectively[12].

1.4.7 Energy situation

Ethiopia has set a target to achieve universal access to electricity by 2025. Power generation for the electric grid currently depends almost entirely on hydropower. In Addis Ababa, about 87 per cent of the population have access to electricity – mainly for household lighting and for industries. However, majority of the Addis population still rely on biomass fuel for cooking and heating[13].

1.4.8 Waste Management and Sanitation

Waste management:

The estimated daily solid waste generated in Addis Ababa City is about 765 tons with a daily per capita generation of 0.45 kg. Of the total solid waste generated, 76 per cent is from residential sources, 9 per cent from commercial areas, 6 per cent from street sweeping, 5 per cent from industries, 3 per cent from hotels and 1per cent from hospitals. There is very low solid waste segregation, re-use or recycling, with up to 80 per cent of waste being disposed without any re-use or recycling[14]. Only 65 per cent of the daily solid waste generated is collected, 5 per cent recycled and 5per cent composted. The remaining 25per cent is simply dumped on open sites, drainage channels, rivers, and valleys as well as on the streets and a small percentage is incinerated. Open

[10] *CSA, 2017*

[11] *World Bank Group, 2014*

[12] *Fenta, T.M., Demands for Urban Public Transportation in Addis Ababa, 2014, Journal of Intelligent Transportation and Urban Planning Vol. 2 Iss. 3, PP. 81-88. College of Business and Economics, Wollega University, Ethiopia*

[13] *Mondal, et.al., Ethiopian energy status and demand scenarios: Prospects to improve energy efficiency and mitigate GHG emissions, Energy Journal, Vol.149, 2018, Pages 161-172*

[14] *Mohammed & Elias, Domestic Solid Waste Management and its Environmental Impacts in Addis Ababa city, 2014, Journal of Environment and Waste Management Vol. 4(1), pp. 194-203*

burning of refuse in backyards and other open places also remains a major problem in the city[15]. However, the waste management situation in Addis Ababa is expected to improve particularly with the new 50MW Reppie waste to energy plant that is expected to incinerate approximately 1,400 tonnes of waste per day[16].

Sanitation:

One of the most critical challenges facing the city of Addis Ababa today is the provision of adequate and reliable sanitation services to its populace. According to the 2012 CSA Welfare Monitoring Survey, an estimated 72.27per cent of Addis Ababa residents lack access to adequate toilet facilities. The current sewerage system of Addis Ababa city is not adequate hence large segments of the city rely mostly on pit latrines and septic tanks. The current standardized sewage system only covers about 10 per cent of the population hence urgent need to scale up investments in sewage infrastructure for both solid and liquid wastes[17].

1.5 Why air pollution is a major concern

Today, air pollution presents the world's greatest environmental health risk with cities recording dangerously high levels of air pollution. World Health Organization (WHO) estimations show that 90 per cent of people worldwide breathe air containing high levels of pollutants. Air pollution causes 1 in every 9 deaths globally. The WHO estimations reveal an alarming death toll of 7 million people every year caused by exposure to fine particles ($PM_{2.5}$) in polluted air that penetrate deep into the lungs and cardiovascular system, causing diseases such as stroke, heart disease, lung cancer, chronic obstructive pulmonary diseases and respiratory infections, including pneumonia. Of the total annual air pollution related deaths, 4.2 million result from exposure to ambient (outdoor) air pollution and 3.8 million from exposure to household air pollution in smoke from dirty cookstoves and fuels[18, 19,20].

There are limited published health studies relating to ambient air pollution in Ethiopia generally. However, the few available studies show worrying morbidity and mortality impacts of ambient air pollution in the country. According to the World Health Organization, in 2012 alone Ethiopia recorded 13,257 premature deaths (7,995 male, 5,262 female) attributed to ambient air pollution – mainly from acute respiratory diseases, heart diseases and stroke[21]. Compared to other Eastern Africa countries, Ethiopia's health burden from ambient air pollution is the biggest based on the reported number of deaths attributed to ambient air pollution in the region as shown in the Table 1 below.

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[15] Ibid

16 Climate Action official website, accessed June 2018

[17] Ibid footnote 14

[18] WHO, Ambient Air Qulaity and Health Fact Sheet, 2018

[19] WHO, Household Air Pollution and Health Fact Sheet, 2018

[20] According to the WHO, many people are exposed to both indoor and outdoor air pollution. Due to this overlap, mortality attributed to the two sources cannot simply be added together, hence the total estimate of around 7 million deaths annually.

[21] WHO, Ambient Air Pollution: A global Assessment of Exposure and Burden of Diseases Report, 2016

Table 1: Deaths attributed to ambient air pollution in Eastern Africa by country

Country	Number of Deaths
Burundi	3,001
Djibouti	212
Eritrea	1,243
Ethiopia	**13,257**
Kenya	5,102
Rwanda	2,227
South Sudan	2,632
Sudan	8,093
Tanzania	5,765
Uganda	7,989

Source: WHO AAP database, 2016

Ministry of Health (MOH) data also point to acute respiratory infections and pneumonia – often linked to air pollution – as being among the top 10 causes of morbidity in Ethiopia (See Table 2 below).

Table 2: Top 10 causes of morbidity (EFY 2007)

Rank	Diagnosis	Cases	Per cent
1.	**Acute Febrile Illness (AFI)**	**3,181,813**	**9.21**
2.	Acute upper respiratory infections	3,180,754	9.21
3.	Pneumonia	2,904,406	8.41
4.	Diarrhoea (non-bloody)	2,152,190	6.23
5.	Trauma (injury, fracture etc.)	1,662,865	4.81
6.	Dyspepsia	1,627,482	4.71
7.	Urinary tract infection	1,471,078	4.26
8.	Helminthiasis	1,389,747	4.02
9.	Infections of the skin and subcutaneous tissue	1,211,620	3.51
10.	Malaria (confirmed with P. falciparum)	1,165,843	3.37
	Total of leading causes	**19,947,797**	**57.74**
	Total all causes	**34,547,276**	**100**

Source: MOH, 2015

Besides the adverse health impacts, some of the air pollutants also have serious immediate and long term environmental effects. Air pollution negatively affects plant biodiversity and their attendant ecosystem services, destroys cultural heritage and contributes to global warming[22]. Table 3 below provides a summary of the key air pollutants that have significant health and environmental impacts.

[22] *Gurjar, B.R., et al., Air Pollution: Health and Environmental Impacts, CRC Press, Tylor & Francis Group, Boca Raton, 2010*

Table 3: Air pollutants of great impact on health and environment

Emission	Description	Sources	Harmful Effects
Carbon monoxide (CO)	CO is a colourless, odourless toxic gas produced by incomplete or inefficient combustion of carbon-based fuels and by biological and industrial processes.	Anthropogenic Sources Fossil fuel combustion for power generation or transport, agricultural burning, wood burning for heat and cooking fuel Natural sources Forest fires, emissions from plants and oceans and oxidation of methane and non-methane hydrocarbons	Health impacts Can cause dizziness, confusion, unconsciousness and death
Nitrogen oxides (NO_x)	Nitrogen Oxides (NO_X) is a collective term for nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colourless and tasteless gas while NO_2 is a yellowish-orange to reddish-brown gas with a pungent, irritating odour and is a strong oxidant.	Anthropogenic Sources combustion of fossil fuels in vehicles (predominantly road traffic) and power generation units Natural Sources wildfires, lightning, and microbial activity in soils	Health Impacts • Eye and lung irritation • May contribute to the susceptibility/ aggravation of respiratory diseases Environmental impacts • Accelerates eutrophication • Makes soils and freshwater ecosystems more acidic • Affects visibility due to formation of haze in the air
Ozone (O_3)	Major urban air pollutant caused by NOx and VOCs combined In sunlight and is usually at Earth's surface (Tropospheric Ozone)	Secondary pollutant of VOCs and NOx	Health Impacts Respiratory and cardiovascular problems Environmental problems Affects sensitive vegetation and ecosystems such as forests, parks, wildlife refuges and wilderness areas
Sulphur dioxide (SO_2)	SO_2 is a colourless, non-flammable gas, with an unpleasant, pungent odour.	Anthropogenic Sources Fossil fuel combustion for power generation, industry, shipping and road transport Natural Sources Volcanoes	Health effects Affects the respiratory system and irritation of the eyes, nose, throat and airways Environmental impacts • Reduces growth in plants • Accelerates loss of foliage, aging and premature death of vegetation • Causes stain and damage stone and other materials, including culturally important objects such as statues and monuments. • Can reduce visibility due to formation of haze in the air •
Particulate matter (PM10, PM2.5)	Particulate matter (PM) refers to a mixture of solid particles and liquid droplets found in the air such as dust, dirt, soot, or smoke that are large or	Anthropogenic Sources Combustion from vehicle engines, power plants, domestic heating and cooking,	Health impacts Respiratory and cardiovascular problems (mainly associated with $PM_{2.5}$)

	dark enough to be seen with the naked eye and can be primary or secondary. PM10 refers to particles with diameter less than 10µm and cannot be inhaled PM2.5 refers to fine inhalable particles with diameter less than 2.5µm	mining, quarrying and fugitive dust emissions from construction activities <u>Natural Sources</u> Erosion of natural materials, wind suspension of soils and constituents of sea spray	<u>Environmental impacts</u> • Nitrogen and sulphur containing particles can lead to acidification of soils and water course • High levels of dust deposition onto vegetation can affect plant health and reduce growth • $PM_{2.5}$ particles can reduce visibility in cities

SECTION II

2.0 STATE OF AIR POLLUTION IN ADDIS ABABA

This section gives a broad overview of the current state of air pollution and air quality monitoring in the City of Addis Ababa.

2.1 State of ambient air pollution in Addis Ababa

Ambient air pollution is a major global environmental health problem and affects low, middle, and high-income countries. Exposure to ambient air pollution increases hospital admissions and emergency room visits as well as the risk of premature death in many countries. According to World Health Organization (WHO), ambient air pollution causes an estimated 4.2 million premature deaths annually worldwide due to exposure to small particulate matter ($PM_{2.5}$), which causes cardiovascular and respiratory disease as well as cancers. It is estimated that 91 per cent of these premature deaths occurred in low- and middle-income countries[23]. Whereas there are limited long term studies on ambient air pollution in Addis Ababa, the available data so far indicate that level of air pollution in the city is increasing.

2.2 Key air pollutants of concern in Addis Ababa City and their Sources

The air pollutants of concern in Addis Ababa include;

i. Particulate matter (PM_{10} and $PM_{2.5}$)
ii. Nitrogen oxides (including oxides of nitrogen (NOx) and nitrogen dioxide (NO_2)
iii. Sulphur dioxide (SO_2)
iv. Carbon monoxide (CO), and
v. Ozone (O_3)

2.2.1 Particulate matter (PM_{10} and $PM_{2.5}$)

The main sources of PM in Addis Ababa are motor vehicles, domestic heating and cooking, open burning of waste as well as fugitive dust emissions from construction activities and unpaved roads. PM_{10} levels have been found to be higher in urban areas during dry months as opposed to sub-urban areas in Addis Ababa, and have also been found to coincide with the peak traffic hours of the day. For instance, a pilot study conducted in 2004 found that PM_{10} levels were <100 µg/m^3 and 40 µg/m^3 in urban and sub-urban areas respectively[24]. PM_{10} levels are however reported to be below the WHO guidelines as well as the federal EPA air quality standards. For $PM_{2.5,}$ annual concentration in Addis Ababa is between 26-35 µg/m3, which is almost four times the WHO recommended limit of 10 µg/m[25].

[23] *WHO, Ambient Air quality and heath fact sheet, 2018*
[24] *Etyemezian et al. Results from a pilot-scale air quality study in Addis Ababa, Ethiopia, 2005*
[25] *Ibid*

2.2.2 Nitrogen oxides (NOx)

Emissions of NO_X in Addis Ababa are mainly from traffic, open burning and industrial sources, as well as domestic cooking and heating. Studies have pointed to higher concentrations of NO_X at roadside locations as well as highly populated areas and industrial areas compared to rural areas.[26]

2.2.3 Sulphur dioxide (SO_2)

The main contributors of SO_2 emissions in Addis Ababa city are traffic as well as industrial processes such as cement production.

2.2.3 Carbon monoxide (CO)

CO emissions in Addis Ababa are mainly from transportation sector with peak concentrations occurring in early mornings and late afternoons as a result of traffic density. Studies have reported CO levels below the WHO as well as the Ethiopia Addis EPA air quality regulations. A study conducted in 2008 that investigated the magnitude and variation of traffic air pollution of CO for instance found that the mean CO concentration was 5.4 ppm, which was below both the 1-hour and 8 hours standard[27].

2.2.4 Ozone (O_3)

Ozone is not usually emitted directly into the air, but at ground-level is created by a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. The main contributors to O_3 in Addis Ababa are motor vehicles and industrial processes. A pilot study conducted in 2004 reported O_3 concentration of <45ppb[28]. This is below the 70 parts per billion (ppb) standard for US EPA which is one of the most stringent ambient air quality standards in the world.

2.3 Major sources of ambient air pollution in Addis Ababa City

The major sources of ambient air pollution in Addis Ababa are:

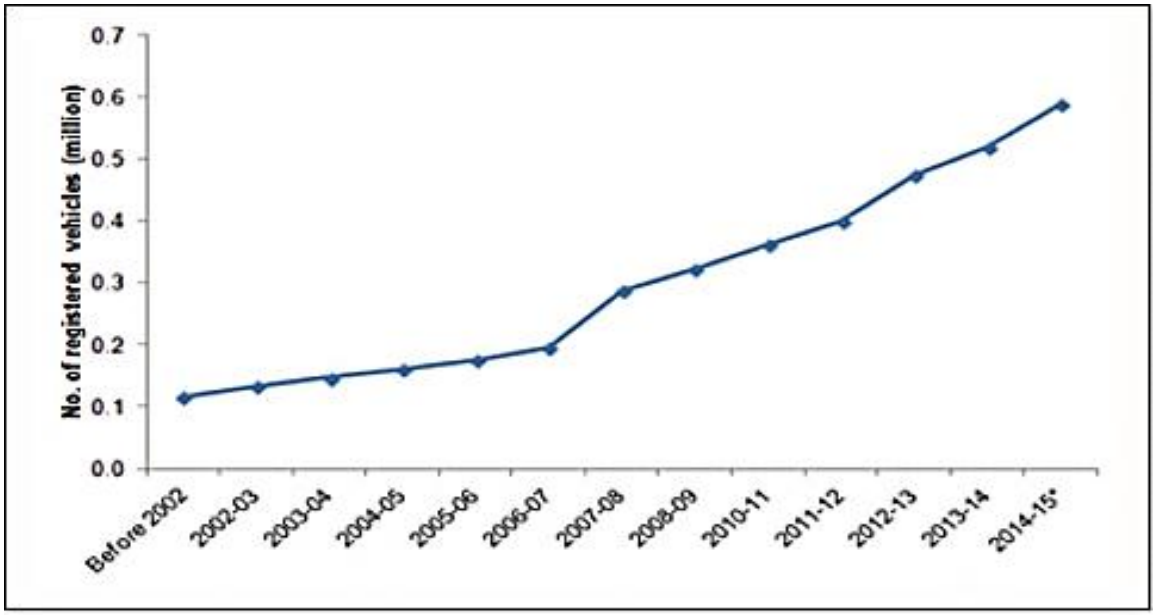
i. Emissions from road traffic;
ii. Emissions from industrial sources;
iii. Emissions from open burning of waste.

[26] *Kumie et al. Magnitude of indoor NO2 from biomass fuels in rural settings of Ethiopia. Indoor Air, 2009*
[27] *Ibid*
[28] *Ibid*

2.3.1 Emissions from road traffic

It is estimated that motor vehicles account for up to 80 per cent of urban air pollution in some cities, especially in developing countries and countries with economies in transition such as Ethiopia[29]. Ethiopia's total in-use vehicle population currently stands at about 600,000 with an annual growth rate of 10 per cent in vehicle registrations[30]. Figure 3 below shows the trend of vehicle registration in Ethiopia up to 2015.

Figure 3: Trend of vehicle registration in Ethiopia

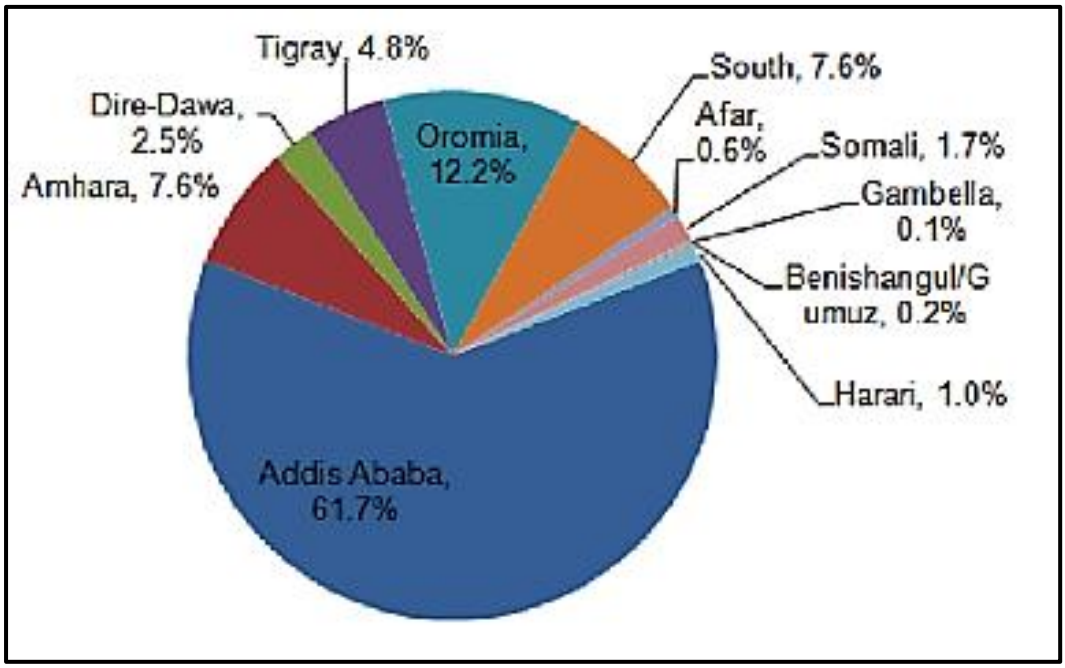


Source: CSE based on data provided by Addis Ababa Transport Authority, 2016

As shown in Figure 4 below, majority of these vehicles, about 62 per cent, are in Addis Ababa City alone. About 48 per cent of the vehicles are diesel powered (and more polluting) while 45 percent are petrol powered vehicles, with an insignificant number of electric vehicles (only 4 in the country – 3 in Addis and 1 in Tigray)[31].

[29] *Partnership for Clean Fuels and Vehicles, 2014*
[30] *GFEI,CSE*
[31] *CSE, 2017*

Figure 4: Vehicle registration in various administrative zones



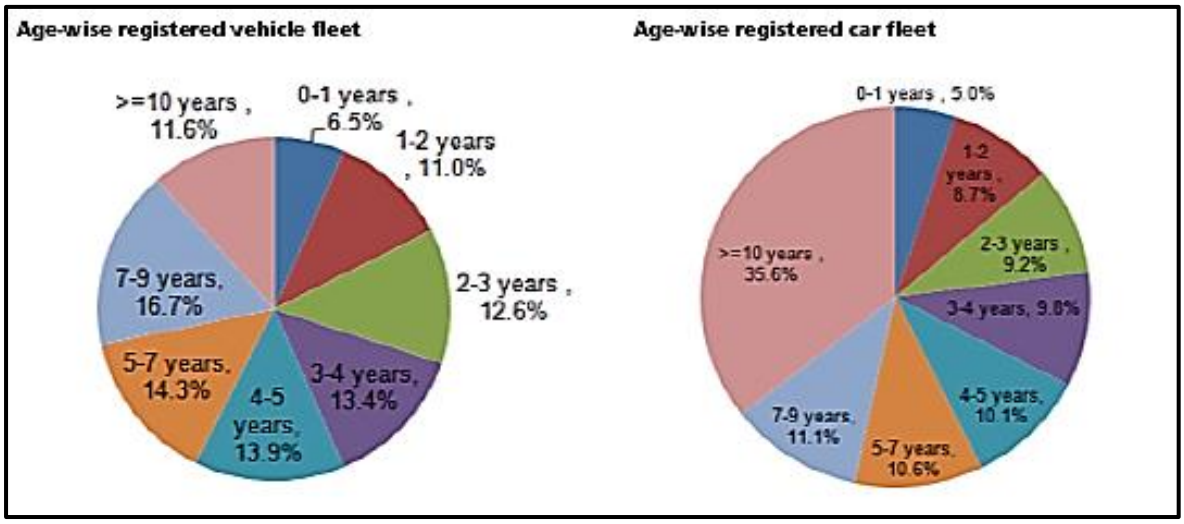
Source: CSE 2017, based on data from Addis Ababa Transport Authority

Most of the rapid motorization in Ethiopia (and Addis Ababa) is based on very old and polluting technology. According to the Addis Ababa City Transport Authority, about 31 per cent of the overall vehicle fleet lack catalytic converters. The high number of aged vehicles, mostly imported used vehicles, coupled with poor fuel quality, poor vehicle maintenance as well as poor road infrastructure is responsible for the high level of vehicle emissions in Addis Ababa. Estimates of the pollution load from the increasing vehicle numbers in the city point to diesel powered heavy duty vehicles (freight and buses) as the biggest contributors to both PM and NO_X[32].

Figure 5 below shows the breakdown of registered vehicles by age

[32] *Centre for Science and Environment, Urban Air Quality Management in Ethiopia: A Guidance Framework, 2017*

Figure 5: Breakdown of registered vehicles by age



Source: CSE, 2017

2.3.2 Emissions from industrial sources

The industrial sector is the second contributor to Addis Ababa City's GDP, contributing about 36 per cent of the city's GDP[33]. The growth in this sector is mainly driven by the booming construction industry as well as manufacturing, both of which account for the industrial sector emissions in Addis Ababa. Emissions of concern from the industrial sector include particulate matter ($PM_{2.5}$ and PM_{10}), SO_2, and NO_X.

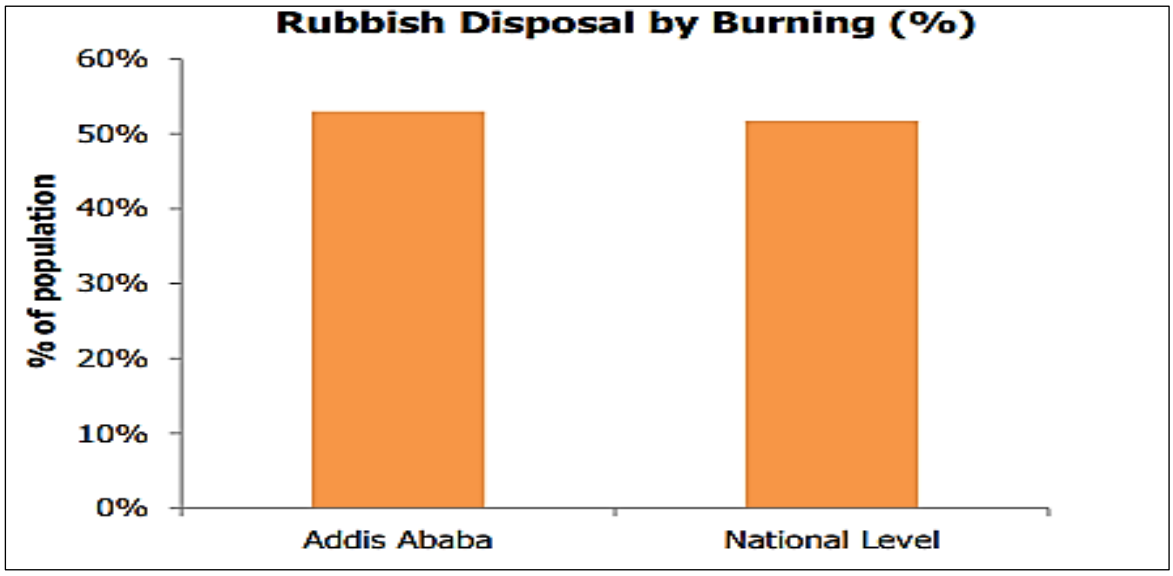
2.3.3 Emissions from open burning

Open burning of waste is a common problem in Addis Ababa owing to lack of an efficient integrated waste management system for the City. Some earlier studies showed that about 55 per cent of the population in Addis Ababa use open burning as their primary means of waste disposal, a figure slightly higher than the overall national population using open burning as their primary waste disposal means (See Figure 6 below)[34].

[33] *UN HABITAT, 2017*

[34] *Matthew Cheever. Waste Management in Ethiopia. Environmental Policy Review: Waste Management in Ethiopia. 2011*

Figure 6: Percentage of population disposing of waste by burning



Source: Matthew Cheever, 2011

Open burning of waste releases dangerous pollutants into the air. Such pollutants include carbon dioxide (CO_2), Carbon monoxide (CO), Sulphur Oxide (SO), Nitrogen Oxides (NO_X), and particulate matter (PM_{10} and $PM_{2.5}$). A 2017 study on domestic waste management and its environmental impacts in Addis Ababa showed that poor waste management can lead to severe cases of respiratory disease and other hygiene related illnesses as shown in Table 4 below [35].

Table 4 Reported cases of solid waste related diseases and morbidity in Addis Ababa

Diseases	2010	2011	2012
Parasitic infection	7,887	36,827	36,845
Bronchitis	38,100	28,849	28,780
Skin diseases	34,426	27,119	27,047
Broncho pneumonia	30,219	25,744	25,158
Dysentery	20,782	13,596	14,631
Bronchial asthma, allergic	11,607	7,677	6,291
Other respiratory diseases	7,932	3,845	7,532
Typhoid	6,596	3,622	4,046
Influenza	3,593	1,905	1,858
Trachoma	1,619	1,015	1,346
Total	**132,542**	**150,199**	**153,534**

Source: Mohammed et al, 2017

[35] *Mohammed et al, Domestic Waste Management and its Environmental Impacts in Addis Ababa City, 2017*

A recent study conducted to review Paper Burning and Associated Pollution Problems in Higher Educational Institutions in Addis Ababa, found that the concentrations of CO, SO_2 and NOx from open burning of assessment papers were higher than the levels recommended by WHO[36].

2.3.4 Other emission sources: Emissions from power generation

Air pollution by emissions from power generation is not a major concern in Ethiopia at the moment. Whereas aggressive power generation is at the core of Ethiopia's Growth and Transformation Plan (GTP) that aims at transforming the country into a middle-income economy by 2025, currently 97 per cent of installed electricity generation is from renewable sources (hydropower 89 per cent; wind 8 per cent). Thermal sources only account for 3 per cent of total generation[37]. However, the government is currently diversifying its electricity generation mix as a result of droughts that have severely affected the hydro dominated systems with other sources such as solar, wind, geothermal and thermal power plants. The thermal plants may result in some level of increased emissions. For instance, the 50MW Reppie waste to energy plant that is expected to incinerate approximately 1,400 tonnes of waste per day will result in emission to air[38].

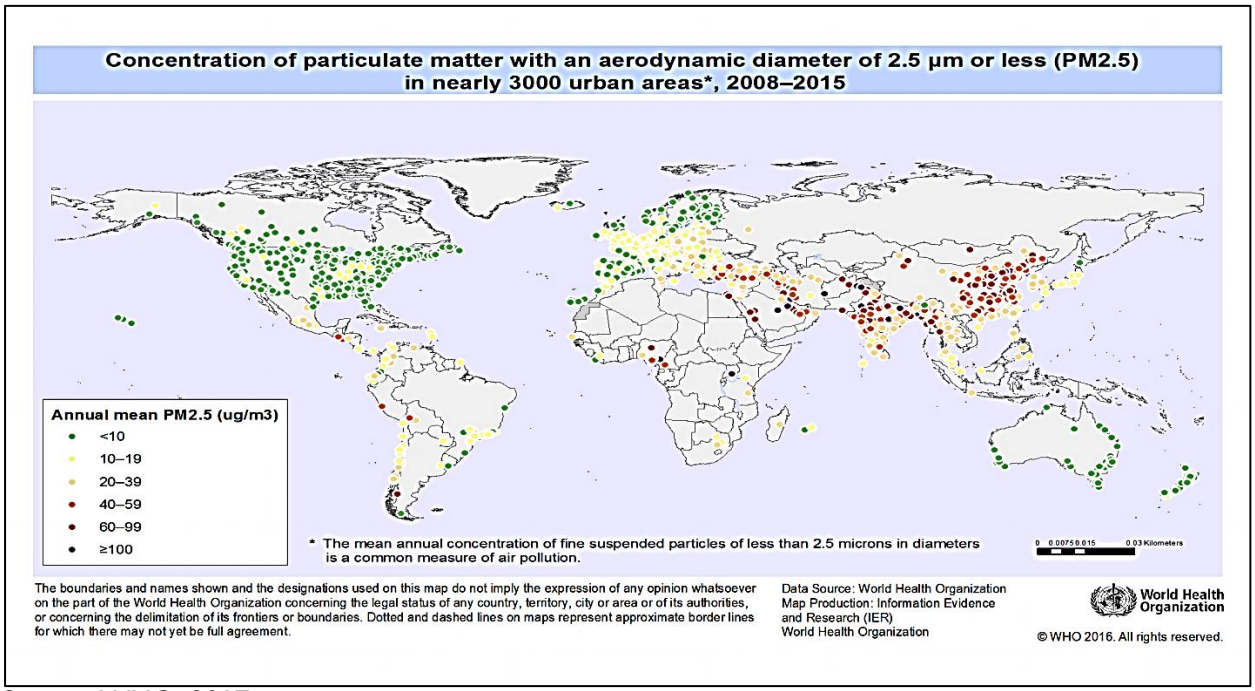
2.4 State of air quality monitoring in Addis Ababa

2.4.1 Overview

Ambient air quality monitoring in Addis Ababa is not very well developed just like in most African cities. This is mainly because most of these cities lack the necessary monitoring infrastructure and capacity to collect and analyse air quality data[39]. For example, as of 2017, Ethiopia was still classified by the World Health Organization as being among the countries with no data on urban monitoring of ambient $PM_{2.5}$ (See Figure 7 below)[40].

36 Amberber et al., Paper Burning and Associated Pollution Problems in Higher Educational Institutions of Ethiopia: The Need and Potential for Recycling, 2017
37 CSE, 2017
38 Climate Action official website, accessed June 2018
39 WHO, Air Pollution Ranking, 2014
40 WHO, Global Urban Ambient Air Pollution Database , 2016

Figure 7: Countries with PM2.5 monitoring studies



Source: WHO, 2017

However, over the years there have been some short term pilot studies in Addis Ababa that have mainly monitored PM, CO, TSP, $PM_{2.5}$, SO_2 and O_3. Table 5 below gives a snap-shot of some of the pilot ambient air quality monitoring studies in Addis Ababa between 2005 – 2015.

Table 5: Summary of ambient air pollution monitoring studies in Addis Ababa

Study	Pollutant	Sampling period	Mean concentration	Conclusion
Van Donkelaar et al., 2016	PM2.5	Time-series analysis using satellite imagery between 2011-2015	-	Satellite imagery showed spatial variations in $PM_{2.5}$ concentrations within the Addis metropolitan area
Abate, 2015	$PM_{2.5}$ CO NO_2 SO_2	2015	129.18 µG/m^3 (Mean 24 hour average)	PM 2.5 values were higher than WHO recommended daily maximum concentration limits. In addition, wet season $PM_{2.5}$ concentrations were lower than dry season concentrations

Kume et al., 2010	CO PM10	July 2007 (wet season) and January 2008 (dry season)	5.4ppm	CO concentration on all roads for 15 minutes, 1 hour, and 8 hours were below the WHO limits
Gabre et al., 2010	PM10, TSP	22nd February - 15th April 2008 and 17th June 2008 23 July 2008	80±61 195±141	The high PM_{10} levels were attributed to unpaved roads and construction works around all sites. Variance of wet season and dry season concentrations were attributed to rainfall scavenging of aerosol during the wet season
Etyemezian et al., 2005	PM_{10} CO and O_3	26th Jan.-28th Feb. 2004	35-97µg/m3 <35ppm <45ppb	The levels of PM_{10} and CO were generally below the WHO 24hr limits but were found to be closer to the Ethiopia EPA air quality limits. The highest levels of these pollutants were observed at early morning and late afternoon hence attributed to motor vehicles and household cooking and heating.

2.4.2 Real-time Air Quality Monitoring

Ethiopia has made some progress towards real-time air quality monitoring in recent years. Currently, there are three real-time $PM_{2.5}$ monitors in Addis Ababa – one maintained by the Addis Ababa University (College of Health Sciences) through the GeoHealthHub network and located at the Black Lion Hospital; and the other two maintained by the United States Embassy and located at the Embassy and the International Community School, referred to as Central and School sites respectively[41]. Data from the Addis Ababa University air quality monitor is not publicly available but may be accessed upon request. On the other hand data from the US Embassy monitors is publicly available online on the USEPA AirNow website. Besides the US Embassy and University of Addis Ababa maintained monitors, the National Meteorology Agency (NMA) has an air quality monitoring station within its campus that monitors ambient concentrations of NO_x, O_3, and CO. This station however faces some operational challenges such as difficulties in obtaining reference gases for calibration of the instruments hence compromising the accuracy of the data collected at this station. Data from the NMA monitor is also not publicly available but may be obtained from the Agency upon request.[42]

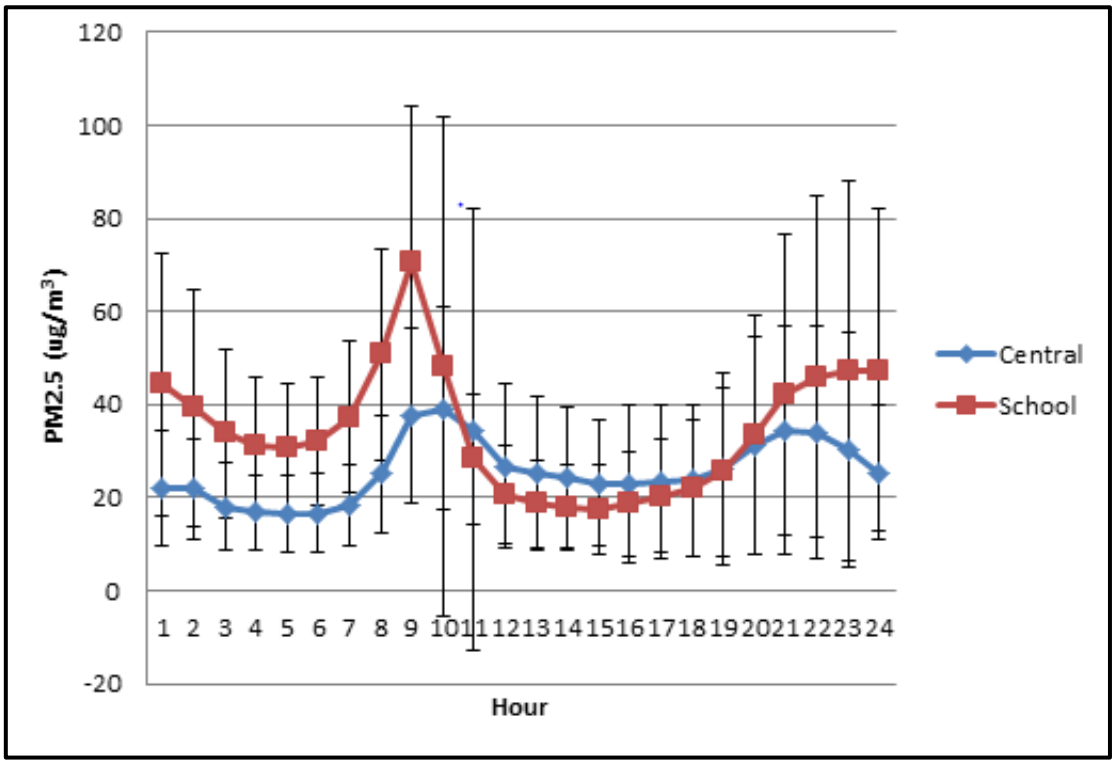
[41] *USEPA, Information Collection Report and Preliminary Inception Report, 2018*

[42] Ibid, ref 29

According to the USEPA Information Collection Report[43], diurnal patterns at both of the US Embassy maintained sites show elevated concentrations of $PM_{2.5}$ during morning and afternoon rush hours, pointing to motor traffic as the main source of $PM_{2.5}$. However, overnight concentrations at the School site are higher than at the Central site, pointing to likely day time dispersal of pollutants and overnight trapping of the same potentially due to local emissions sources near the school that are unrelated to motor vehicles (e.g. emissions from waste burning).

Figure 9 below shows the average daily $PM_{2.5}$ concentrations at the US Embassy maintained air quality monitors.

Figure 8: Average daily $PM_{2.5}$ concentrations at the US Embassy maintained monitors

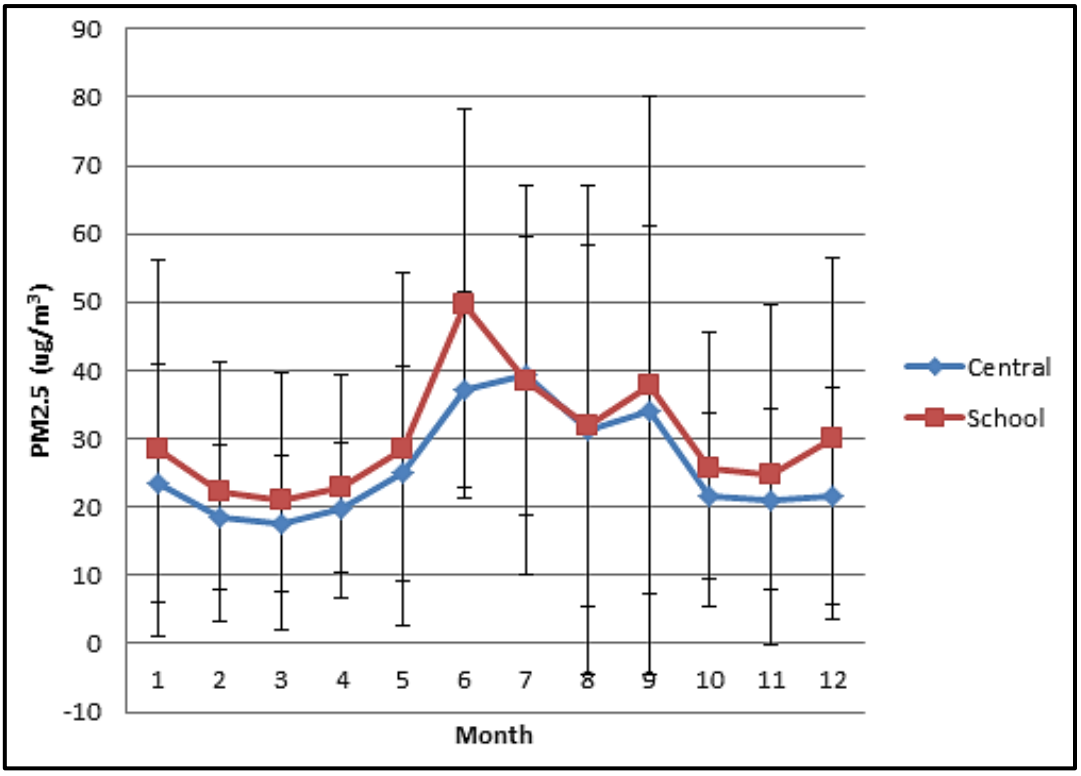


Source: USEPA, 2018

The trend is the same for monthly $PM_{2.5}$ concentrations at both the Central and School sites, as shown in Figure 10 below:

Figure 9: Average Monthly $PM_{2.5}$ concentrations at the US Embassy maintained monitors

[43] *Ibid*



Source: USEPA, 2018

Despite having ambient air quality standard, Ethiopia is yet to put in place a vibrant air quality monitoring systems for Addis Ababa as well as other cities. Effective air quality monitoring is further hampered by the limited, technical, human and institutional capacities, such as lack of proper reference laboratories for analysing air quality data among others.[44]

2.5 Challenges and threats to future ambient air quality in Addis Ababa

Rising vehicle fleet

Transport sector remains the biggest threat to air quality in many cities of the world including Addis Ababa. The main challenge to air quality faced by many countries is stemming the rising vehicle emissions owing to the ever increasing vehicle fleet in these countries[45]. The vehicle fleet in Addis Ababa is now growing at 10 per cent annually with the majority being old vehicles[46]. Whereas the rising motor vehicle emissions presents a challenge to air quality in Addis Ababa, motor vehicle emission testing is yet to take shape despite being one of the inspection criteria for annual vehicle inspections. Tackling motor vehicle emissions will require measures to reduce congestion, promote fuel efficiency and investment in sustainable urban transport.

[44] *CSE, 2016*
[45] *Ibid,*
[46] *Ibid*

Energy mix

Whilst electricity production in Ethiopia is mainly from renewable energy sources – currently at 97per cent[47], the rate of access to electricity is still low. Despite Addis Ababa having electricity access of over 90 per cent, majority of the population is still using biomass for cooking and heating. As such, emissions from residential heating and cooking remain a significant source of air pollution in the city. Intensification of the on-going universal access to electricity program as well as promotion of clean energy cook stoves will help reduce emissions associated with heating and cooking that may impact on local air quality.

Increasing construction projects

Major construction projects in Addis Ababa have contributed to ambient air pollution especially from PM10 and those emissions associated with energy use during construction and demolition of such projects over the last decade. Emissions from this sector will continue to be a challenge to air quality in the city as Ethiopia grows towards becoming a middle income country by 2025.

Uncontrolled open burning

Open burning of waste is a major problem in Addis Ababa, with about 55per cent of the population using open burning as their primary means of waste disposal. Open burning is also associated with culture such as during coffee ceremonies and thus will continue to be a challenge to air quality in the city if controlling emissions from open burning is not prioritized.

Climate change

Climate change risks to public health and the environment are substantial and far-reaching. It can lead to more frequent flooding, increased drought, and more severe wildfires among others - events that can cause deaths, injuries, and billions of dollars of damage to property and the nation's infrastructure. Climate changes can also impact on ambient air quality by for instance, ground-level ozone thus may be a challenge for compliance with the ozone standards in the future[48].

Limited air quality data

There is very limited data on ambient air quality monitoring in Addis Ababa up to date. The limited available data has only monitored very few pollutants, and has not integrated all potential pollution sources. The lack of adequate monitoring data presents a challenge for

[47] *Ibid*
[48] *USEPA official website, accessed June 2018.*

development of air quality management strategies for the city. Though a lot is expected in the coming years with regards to air quality monitoring in Ethiopia, there is need to develop a national air quality monitoring network and introduce more sophisticated means of monitoring for a wider range of pollutants to improve the knowledge base of air quality to inform policy actions.

Weak enforcement

Proper coordination among enforcement agencies in air pollution management still remains a challenge in Addis Ababa. Poor coordination among enforcement agencies will remain a challenge to air quality management if a coordinated implementation plan for enforcement of various policies, standards and laws on management and control of air pollution is not developed.

Limited technical capacity

There are limited laboratories, equipment and technical expertise for air quality monitoring in Ethiopia. For example, air quality data from NMA is currently faced with accuracy and reliability challenges due to difficulties in calibration of measurement instrument[49]. In addition, the lack of adequate technical capacity makes it very difficult for MEFCC, Addis Ababa EPA and other designated bodies to property discharge their mandates.

[49] *Ibid*

SECTION III

3.0 POLICY, LEGISLATIVE AND REGULATORY FRAMEWORK FOR AIR QUALITY MAMAGEMENT IN ADDIS ABABA

This Section provides a detailed analysis of various policies, legislations and regulatory instruments for air quality management in Addis Ababa.

3.1 Constitution of the Federal Democratic Republic of Ethiopia[50]

The Constitution of the Federal Democratic Republic of Ethiopia is the foundation for all development-related policies, laws and related outcomes within the country. The Constitution creates a governance structure comprising of the Federal Government and member States with clear division of powers and functions[51]. Whereas Addis Ababa is located within the State of Oromia, the Constitution grants it special status by establishing it as the capital city of the Federal State with a full measure of self-government, and with its administration responsible to the Federal Government[52]. The Federal Government is responsible for, inter alia, formulation and implementation of the country's policies, strategies and plans in respect of overall economic, social and development matters; national standards and policies for public health; and enactment of national laws for the utilization and conservation natural resources. In this regard, the formulation of environmental policies, laws and standards fall within the domain of the Federal Government. The States on the other hand are obligated to administer the environment and natural resources in accordance with Federal laws.

The Federal Constitution guarantees every person in Ethiopia the right to a clean and healthy environment[53]. For the attainment of this right, the Constitution outlines the following four environmental objectives[54]:

i. Government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment.
ii. The design and implementation of programmes and projects of development shall not damage or destroy the environment.
iii. People have the right to full consultation and to the expression of views in the planning and implementation of environmental policies and projects that affect them directly.
iv. Government and citizens shall have the duty to protect the environment.

[50] The current Constitution was adopted by the Nations, Nationalities and Peoples of Ethiopia through elected representatives in the State Council on 08 December 1994
51 Chapter 5 of the Constitution
52 Article 49 of the Constitution
53 Article 44(1) of the Constitution
54 Article 92 of the Constitution

Whereas the Federal Constitution generally guarantees the right to a clean and healthy environment, it does not lay sufficient obligations upon the State to ensure this right is realized. Unlike the trend in most national constitutions within the Eastern Africa region, e.g. Kenya, Rwanda and Uganda, there are no specific obligations of the State outlined in the Ethiopian Constitution with respect to specific aspects of the environment such as air pollution and air quality management. However, the Constitution still provides a strong foundation for the enactment of various laws, regulations and standards for sound environmental management, including air pollution control.

3.2 Environmental Policy of Ethiopia

The overall goal of the policy is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through sound management and utilization of natural, human-made and cultural resources and the environment. The policy outlines several specific objectives, key among them being the prevention of pollution to land, air and water in the most cost-effective way. Among the key policy statements is that environmental laws should be consistent with Article 44 of the Constitution and assure all people living in the Ethiopia of their fundamental right to an environment adequate for their health and well-being.

A clear shortcoming in the Policy worth noting is in the section covering atmospheric pollution and climate change. The section majorly delves into the subject of greenhouse gas (GHG) emissions and climate change but does not cover air pollution and its impacts from an air quality perspective and its attendant health and environmental impacts. As such, the policy mostly outlines climate change objectives with no express mention of air quality objectives even though both are related and sometimes complimentary.

3.3 Health Policy of Ethiopia[55]

The Health policy lists several priorities; inter alia, the promotion of environmental health and occupational safety and health. One of the general strategies for achieving these priorities is the prevention of environmental pollution with hazardous chemical wastes.

Whereas the focus of the Health policy is majorly on prevention of pollution from chemical wastes, a positive point of note is that the policy emphasizes inter-sectoral collaboration among various actors and governmental agencies towards promoting environmental health and occupational safety and health. Such collaboration among agencies, if well implemented, can help in tackling the rising air pollution in Addis Ababa.

[55] *Established by the Transitional Government in 1993*

3.4 Public Health Proclamation[56]

The Public Health Proclamation aims at promoting the health of the society and creating a healthy environment for present and the future generations.

Whereas the Proclamation has no express provisions on air pollution and air quality management, it has positive and complimentary provisions for the safe handling and disposal of all forms of waste. It requires all waste to be collected and dispose of in designated places according to set standards in a manner that does not adversely affect public health or the environment. This may, for example, be construed to cover the issue of open burning of waste which is a major problem in Addis Ababa. Enforcement of this requirement however seems weak.

3.5 Environmental Protection Organs Establishment Proclamation[57]

This Proclamation establishes a system for coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels.

The Proclamation establishes the Environmental Protection Authority (EPA) as an autonomous public institution of the Federal Government responsible for, inter alia, formulation, implementation and enforcement of environmental policies, strategies, laws and standards. One of the duties of the EPA is to coordinate measures to ensure that the environmental objectives provided under the Constitution and the basic principles set out in the Environmental Policy of Ethiopia are realized.

The Proclamation allows the regional States to establish regional environmental agencies to be responsible for among others ensuring the implementation of federal environmental standards. The regional agencies may where necessary issue and implement their own standards provided the same are no less stringent than the standards. The Addis Ababa City Administration has established the Addis Ababa Environmental Protection Agency to be responsible for implementation and enforcement of environmental laws and standards within the city. However, the Addis Ababa City Administration has not yet set any city-specific air pollution control regulations and/or standards.

3.6 Environmental Impact Assessment Proclamation[58]

This Proclamation establishes the framework for assessment of possible impacts on the environment, prior to the approval, of social and economic development projects by providing an effective means of harmonizing and integrating environmental, economic, cultural and social considerations into a decision making process in a manner that promotes sustainable development. It obligates all persons engaged in any project that requires environmental impact assessment (EIA) as determined in a directive issued pursuant to this Proclamation, to seek authorization from the EPA (MEFCC) or from the relevant regional

[56] *Proclamation No. 200/2000, Federal Negarit Gazeta, 6thYear No. 28 of 09 March 2000*
[57] *Proclamation No. 259/2002, Federal Negarit Gazeta, 9th Year No.7 of 03 October 2002*
[58] *Proclamation No. 299/2002, Federal Negarit Gazeta, 9th Year No.11 of 03 December 2002*

environmental agency. Such authorization is only grantable upon submission by the project proponent of an EIA study report, which as a minimum must contain: a description of: the nature of the project, including the technology and processes to be used; the content and amount of pollutant that will be released during implementation as well as during operation; source and amount of energy required for operation; information on likely trans-regional impacts; characteristics and duration of all the estimated direct or indirect, positive or negative impacts; measures proposed to eliminate, minimize, or mitigate negative impacts; contingency plan in case of accident; and procedures of self-auditing and monitoring during implementation and operation.

Upon review of the EIA study report, and taking into account public comments, the EPA (MEFCC) or the regional environmental agency e.g. Addis Ababa EPA, may make any of the following decisions:

a) approve the project without conditions and issue authorization if it is convinced that the project will not cause negative impacts;
b) approve the project and issue authorization with conditions that must be fulfilled in order to eliminate or reduce adverse environmental impacts or reduce adverse impacts to insignificance if it is convinced that the negative impacts can be effectively countered; or
c) Refuse implementation of the project if it is convinced that the negative impact cannot be satisfactorily avoided.

The EPA (MEFCC) or the relevant regional environmental agency is mandated with monitoring the implementation of an authorized project in order to evaluate compliance with all commitments made by, and obligations imposed on the proponent during authorization. Violations of the provisions of the Proclamation and/or conditions of authorization amount to offenses punishable by administrative action and/or imposition of fines.

The EIA Proclamation is a powerful tool available to MEFCC and the Addis Ababa EPA for controlling air pollution from new facilities and projects. However, the EIA process in Ethiopia currently faces numerous challenges that impede its effectiveness[59]. These challenges include:

- *Lack of a legally binding list of projects requiring EIA*
- *Weak institutional capacity (expertise, staff and other resources) for EIA administration at both MEFCC and AAEPA*
- *Weak monitoring and enforcement of EIA requirements and conditions*
- *Inadequate public participation.*
- *Conflicts with national investment priorities.*

[59] *Ruffeis, et.al., Evaluation of the environmental policy and impact assessment process in Ethiopia, 2010*

3.7 Ethiopia Investment Proclamation[60]

This Proclamation places the responsibility for encouraging and coordinating entrepreneurship and investment in Ethiopia with the Ethiopian Investment Commission (EIC). The objective of the Proclamation is to accelerate economic development in Ethiopia by promoting investment in several sectors including manufacturing. Such investments invariably come with potential pollution. The EIC acts as a one-stop where an investor can get government approval for a project through one office, the EIC. This means that EIC must undertake to coordinate with all other government agencies such as EPA/MEFCC on behalf of the investor to get the project approved, for example by processing an EIA licence. According to the EIA Proclamation, a project proponent must have authorization from the federal EPA/MEFCC or regional environment agency before the project starts, if it is a project that requires EIA.

Whereas the Investment Proclamation seeks to vigorously promote economic transformation in Ethiopia, it lacks any specific references to environmental safeguards that would ensure that industrial enterprises, for example, do not significantly pollute the environment. A major shortcoming of the Investment Proclamation is that it has omitted any reference to EIA or other environmental and related permits. Instead, it states that the EIC "shall, after issuing the investment permit, notify the concerned government institutions so that the latter could conduct the necessary follow up". This has been interpreted by the EIC to mean that the Investment Proclamation, being the latter one, overrides the requirement in the EIA Proclamation so that EIC can issue an investment permit without the EIA authorization from EPA/MEFCC or AAEPA, and that EPA/MEFCC or AAEPA may follow up for EIA compliance in the field after the investment permit has been approved[61]. This situation may prove detrimental for overall pollution control prospects in Ethiopia/ Addis Ababa as potentially polluting enterprises may obtain investment permits from EIC before EIA authorization.

3.8 Environmental Pollution Control Proclamation[62]

This Proclamation aims to eliminate, and where not possible, mitigate the impacts of pollution as an undesirable consequence of social and economic development activities. It prohibits persons from engaging in any activities that pollute the environment by violating the relevant environmental standards. The Federal EPA/MEFCC or the relevant regional environmental agency, e.g. Addis Ababa EPA may take administrative or legal action against a person who violates the law by releasing any pollutant into the environment. Persons engaged in any activity which is likely to cause environmental pollution is required, upon a decision to that effect by the EPA or the relevant regional environmental agency, to install appropriate technology that avoids or reduces, the generation and emission of pollutants.

The Proclamation mandates the EPA in consultation with competent agencies to formulate environmental standards based on scientific and environmental principles. Among the priority areas listed as requiring standards include air quality standards that specify the ambient air quality and give the allowable amounts of emission for both stationary and mobile air pollution

[60] [60] Proclamation No. 280/2002, Federal Negarit Gazeta, 8th Year, No. 27 od 02 July 2002
[61] Krueger, et.al., Environmental Permitting in Ethiopia: No Restraint on "Unstoppable Growth?", 2012
[62] Proclamation No. 300/2002, Federal Negarit Gazeta, 9th Year No.7 of 03 December 2002

sources. National regional states may, based on their specific situation, adopt environmental standards that are more stringent than those determined at the Federal level. However they shall not adopt standards which are less rigorous than those determined at the Federal level.

3.9 Prevention of Industrial Pollution: Council of Ministers Regulation[63]

This Regulation (is subsidiary legislation to the Environmental Pollution Control Proclamation

The Regulation imposes general obligations on factories subject to it to:

- Minimize the generation of every pollutant to an amount not exceeding the limit set by the relevant environmental standard and dispose of the same in an environmentally sound manner;
- Handle equipment, inputs and products in a manner that prevents damage to the environment and to human health.

This Regulation emphasizes self-monitoring and reporting by the factories subject to it. Such factories are required to keep written information describing the equipment and inputs used, the products produced, the pollutants generated, and the disposal mechanisms for such pollutants and wastes. In addition, every factory is required to submit to the competent environmental organ an annual report describing how it is complying with the provisions of the Regulation. However, currently there is no proper mechanism in place to ensure all the factories submit the relevant data. In addition, the mechanism for verifying the self-monitoring data is also lacking.

3.10 Guideline Air Quality Standards for Ethiopia[64]

The Guideline Air Quality Standards are part of the Ambient Environmental Quality Standards set by the Federal EPA with the goal of safeguarding public health and protecting the environment. The standards provide guideline values for priority ambient atmospheric pollutants, namely sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$) and lead (Pb).

The guideline values are as per table 6 below:

[63] *Reg. No. 159/2008, Federal Negarit Gazeta, 15thYear No. 14 Addis Ababa, 7th January, 2009*

[64] *The Guideline Standards were set in 2003 by the Federal EPA*

Table 6: Guideline standards for priority ambient atmospheric pollutants

Compound	Guideline Value [µg/m^3]	Averaging time
Sulphur dioxide	500	10 minutes
	125	24 hours
	50	1 year
Nitrogen dioxide	200	1 hour
	40	1 year
Carbon monoxide	100 000	15 minutes
	60 000	30 minutes
	30 000	1 hour
	10 000	8 hours
Ozone	120	8 hours
Suspended Particulate Matter		
PM_{10}	50	1 year
	150	24 hours
$PM_{2.5}$	15	1 year
	65	24 hours
Lead	0.5	1 year

The standards were based on existing international guidelines for ambient air quality as at the time of preparation since at that time there was insufficient baseline data available within Ethiopia to allow modification. As such many of the guideline standards were adopted directly as recommended for developing countries.

These guideline standards are applicable throughout the country. However the regional States including Addis Ababa City Administration can establish more stringent standards taking into consideration particular ecological conditions in their localities provided EPA/MEFCC standards are used as the minimum. So far there are no specific standards for Addis Ababa, hence the national guidelines apply.

3.11 Standards for Industrial Pollution Control in Ethiopia[65]

These Standards establish emission limit values for discharges to receiving waters in the case of effluents and to the atmosphere for gaseous emissions for manufacturing industries. The standards have been structured on the basis of the following key industrial sectors in Ethiopia:

i. Tanning and the production of leather goods;
ii. Manufacture of textile;
iii. Extraction of mineral ores, the production of metals and metal products;
iv. Production of food products including beverages, meat and meat products;
v. Manufacture of cement and cement products;
vi. Preservation of wood and the manufacture of wood products including furniture;
vii. Production of pulp, paper one paper products; and
viii. Manufacture and formulation chemical products including pesticides.

The guidelines go further to prescribe gaseous emission limits for different types of industries under each industrial sector.

Besides the specific sector limits, the guidelines prescribe general emission limits from combustion sources as outlined in Table 7 below:

[65] *Ibid*

Table 7: General emission limits from combustion sources

Substance	Concentration (mg/Nm^3)
Total Particulates	
Coal	500
Fuel oil	250
Gas	50
Nitrogen Oxides (as NO_2)	
Coal	700
Fuel oil	1000
Gas	400
Sulphur Oxides (as SO_2)	
Coal	4300
Fuel oil	5100
Gas	100
Carbon Monoxide	150
Smoke	<2 (Ringlemann Shade)

The Guidelines also prescribe vehicle exhaust emission standards as shown in Table 8 below.

Table 8: Vehicle exhaust emission standards

Parameter	Maximum permissible limit		Measuring method
Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode.		To be compared with Ringlemann Chart at a distance of 6 meters or more.
Carbon Monoxide	**Emission Standards**		
	New Vehicles.	Used Vehicles.	
	4.5 %	6 %	Under idling conditions: Non dispersive infrared detection through gas analyzer.

The standards for industrial pollution control are quite detailed and should if fully implemented assure the control of air pollutants from industrial activities. However, the standards for motor vehicle emissions may require some refreshing to include more pollutants, coverage for different vehicle categories and fuel types. In addition, there will be need for clear implementation guidelines in addition to the general capacity deficiency of relevant institutions such as the EPA/MEFCC and the Addis EPA to implement and enforce the standards. These institutions lack sufficient know-how and infrastructure/equipment to effectively implement and enforce the standards.

3.12 Vehicles Identification, Inspection and Registration Proclamation[66]

This Proclamation aims at putting in place an internationally acceptable standard to implement uniform vehicles registration and annual inspection procedure at the national level. Any vehicle may not be operated on any road in Ethiopia unless inspected and an annual inspection sticker is displayed on it. Besides the requirement for road worthiness inspection, the Proclamation stipulates that the annual inspection shall also include the vehicle's compliance with environment pollution protection standards as per the appropriate law.

3.13 Solid Waste Management Proclamation[67]

This Proclamation aims at enhancing solid waste management capacities at all administrative levels in order to prevent any adverse impacts to health and the environment. The Proclamation requires different administrative units to set up appropriate solid waste management facilities, and that all waste generators should only dispose of their waste at the provided facilities. *The Proclamation is however silent on open burning of waste, a common practice in Addis Ababa city with adverse air quality impacts*.

3.14 Ethiopia's Climate-Resilient Green Economy Strategy[68]

The Climate-Resilient Green Economy (CRGE) Strategy follows a sectoral approach and has so far identified and prioritised more than 60 initiatives, which could help the country achieve its development goals while limiting 2030 GHG emissions to around today's 150 Mt CO2e – around 250 Mt CO2e less than estimated under a conventional development path. The green economy plan is based on four pillars:

i) Improving crop and livestock production practices for higher food security and farmer income while reducing emissions;
ii) Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks;
iii) Expanding electricity generation from renewable sources of energy for domestic and regional markets;

[66] *Proclamation No. 681/2010*
[67] *Proclamation No. 513/2007*
[68] *http://www.undp.org/content/dam/ethiopia/docs/Ethiopia%20CRGE.pdf*

iv) Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

As part of the strategy, the federal government has selected four initiatives for fast-track implementation: exploiting the vast hydropower potential; large-scale promotion of advanced rural cooking technologies; efficiency improvements to the livestock value chain; and Reducing Emissions from Deforestation and Forest Degradation (REDD). Successful realization of these initiatives will all have far reaching positive impacts on overall emissions and air quality in Ethiopia.

3.13 State of Air Quality Enforcement and Compliance in Addis Ababa

Effective implementation of the wide array of policies, laws, regulations and standards outlined above, even with some of the shortcomings pointed out, would still guarantee some level of improved air quality in Addis Ababa. However, a review of various studies coupled with interviews with relevant MEFCC and AAEPA officials reveal that the levels of air quality enforcement and compliance and are still relatively low. This situation is attributed to various factors, namely:

- There is no proper coordination mechanism between various government agencies at federal and city level for implementation and enforcement of the various environmental, public health and air quality policies and regulatory instruments, leading to uncoordinated and disjointed efforts with little impact;
- Up to date air quality and health data, including, for example, data on air pollution source apportionment, is not readily available making it difficult to design and implement evidence-based interventions. For example the National Meteorology Agency is faced with difficulties in obtaining reference gases for calibration of measurement instrument, and this may affect the accuracy and reliability of their monitoring data;
- Low awareness among key policymakers and the public about air quality management hinders efforts to implement better air quality management interventions;
- Relevant institutions lack sufficient resources (qualified staff, equipment, laboratories, finances, etc.) to effectively carry out air quality monitoring activities and enforcement;
- Most of the established air quality related standards lack clear implementation guidelines hence difficult to implement and enforce.

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

This section outlines the conclusions and policy recommendations arising from the Addis Ababa City Air Quality and Regulatory Situational Analysis.

4.1 CONCLUSIONS

1. General Policy and Regulatory Landscape for Air Quality Management

Ethiopia's current policy, legal and regulatory landscape has a wide array of instruments that aim at ensuring clean air for all. The Constitution of the Federal Democratic Republic of Ethiopia provides good foundation for air quality management by guaranteeing everyone the right to a clean and healthy environment. There are also in place some policies, proclamations, regulations, standards, guidelines and strategies that provide for different aspects of air quality management. However, the scattered nature of these instruments makes it difficult to coordinate implementation of air quality interventions by relevant agencies.

2. Conflicting policy objectives (environment vs. development)

Ethiopia has on the one hand a set of policies and regulatory instruments that aim at assuring a clean and healthy environment by, for example, controlling air pollution from diverse sources. On the other hand, the country has another set of policies and regulatory instruments that seek to vigorously accelerate economic growth by attracting both local and foreign investors, while not giving much attention to environmental concerns. A case in point is the clear conflict in the provisions of the Environmental Impact Assessment Proclamation and the Investments Proclamation, a situation that may see polluting enterprises being granted business permits to set up operations without first seeking EIA clearance. This divergence in the policy objectives makes it difficult to effectively regulate air quality in Addis Ababa, the country's capital that has significant contribution to the national GDP.

3. Ambient Air Quality Standards

Ethiopia has established national ambient air quality standards for various pollutants with reference to WHO guideline targets. At the time of developing the standards in 2003, there was no national baseline air quality data in place hence the reliance on the WHO guidelines. The standards mostly range in between the WHO interim targets 1 & 2 that are meant to help countries progressively to develop their own air quality management standards and demonstrate improvement over time. The Ethiopian ambient air quality standards have been in place since 2003 and need refreshing based on current air quality situation.

4. Air Pollution from Industrial Sources

Ethiopia's standards for industrial pollution control were developed by the federal EPA in 2003 based on international best practice as at that time. There was no national baseline data at the time to guide the development of national targets, hence the reference to international best practice. The standards require refreshing based on current national and city level air quality status as well as air quality goals.

5. Vehicle Exhaust Emissions

Available pilot air quality studies and current monitoring data point to motor traffic as one of the key sources of $PM_{2.5}$, CO and NO_X in Addis Ababa. The Ethiopian Vehicles Identification, Inspection and Registration Proclamation require all vehicles to undergo annual inspection for road worthiness inspection as well as inspection for the vehicle's compliance with environmental pollution protection standards as per the appropriate law. Current vehicle exhaust emission standards (covered under the Industrial Pollution Control Standards) only cover smoke and CO (HC, NO_X and PM limit values not provided for). The standards also do not make any distinctions based on vehicle categories and fuel type. Finally, the standards are not enforced at the moment.

6. Emissions from open burning

Open burning of waste is a common problem in Addis Ababa. Some studies have suggested that that about 55 per cent of the population in Addis Ababa use open burning as their primary means of waste disposal, a figure slightly higher than the overall national average of the population using open burning as their primary waste disposal means.

7. Compliance & Enforcement

The levels of air quality law enforcement and compliance in Addis Ababa are relatively low despite the existence of various proclamations and standards for air quality management. . This situation is attributed to various factors including:

- Poor coordination between various government agencies at federal and city level leading to disjointed efforts with little impact;
- Lack of coherent, reliable air quality and health data;
- Low awareness among key policymakers and the public;
- Most of the established air quality related standards lack clear implementation guidelines hence difficult to implement and enforce;
- Relevant institutions lack sufficient resources (qualified staff, equipment, laboratories, finances, etc.) to effectively carry out air quality monitoring activities and enforcement.

4.2 POLICY RECOMMENDATIONS

The following are the key policy recommendations of the Addis Ababa City Air Quality Policy and Regulatory Situational Analysis, ranked in order of priority by stakeholders during the validation workshop on 18th September 2018:

Gap/area of intervention	Short Term (1-2 yrs.)	Medium Term (3-5 yrs.)	Long term (>5yrs)
General policy landscape	▪ *Enhance coordination between relevant regulators at federal and regional/city level* ▪ *Strengthen monitoring and enforcement capacity*	▪ *Establish a clear institutional framework for air quality regulation at federal and regional/city level*	▪ *Enact and implement a unified and coherent framework federal air quality legislation for Ethiopia*
Conflicting policy objectives (development vs. environment)	▪ *Set clear federal and regional/city policy objectives that strike an acceptable balance between socio-economic development and environmental concerns*	▪ *Review and harmonize current development and environmental policies and laws with a view to eliminating any existing conflicts.*	
Ambient Air Quality Standards	▪ *Establish federal and regional/city air quality baseline to guide the review and updating of the Ambient Air Quality Standards* ▪ *Set federal and regional/city level ambient air quality goals*	▪ *Develop specific city level ambient air quality standards* ▪ *Develop enforceable city level ambient air quality regulations for Addis Ababa to back up the standards*	
Air Pollution from Industrial Sources	▪ *Establish federal and regional/city level baseline for industrial emissions*	▪ *Review and update current industrial emission targets based on baseline data and overall federal and Addis Ababa City air quality goals* ▪ *Develop specific city level standards for industrial pollution control for Addis Ababa*	▪ *Provide economic incentives for industries that invest in air pollution control systems* ▪ *Promote cleaner production and resource efficiency in all industries*

		▪ *Develop enforceable city level industrial pollution regulations to back up the standards*	
Vehicle exhaust emissions	▪ *Establish federal and regional/city level baseline for on-road motor vehicle emissions*	▪ *Review and update current vehicle emission standards to provide emission limits for new vehicles, imported used vehicles and on-road vehicles of different categories and fuel type* ▪ *Develop specific city level vehicle emission standards for Addis Ababa* ▪ *Develop mandatory city level vehicle emissions regulations*	▪ *Develop appropriate infrastructure for vehicle inspection and maintenance* ▪ *Establish an age restriction on imported used vehicles* ▪ *Provide incentives for purchase of new vehicles and/or investment in cleaner vehicle technologies* ▪ *Implement a scrappage programme for old polluting vehicles*
Emissions from open burning of waste	▪ *Carry out aggressive education and awareness among the citizens on the perils of open burning of waste*	▪ *Enact and enforce city level ban against open burning of waste*	▪ *Implement an integrated solid waste management program for Addis Ababa City*
Compliance & enforcement	▪ *Carry out an aggressive education and awareness campaign on air quality management in order to obtain the support of policy makers and the public on current and future air quality interventions* ▪ *Strengthen the monitoring and enforcement capacity of relevant institutions such as MEFCC and AAEPA* ▪ *Establish a clear institutional framework for air quality regulation at both federal and regional/city level to ensure effective coordination of air quality interventions*	▪ *Develop clear guidance for the regulated community on what they must do to comply with existing air quality policies, laws, regulations and standards* ▪ *Develop clear guidance for enforcement officials on what they must do to enforce compliance*	▪ *Continuously improve the monitoring and enforcement capacity of relevant institutions such as MEFCC and AAEPA*