BENEFITS OF URBAN CLIMATE ACTION

C40 Cities Technical Assistance Report 2020

ADDIS ABABA

CLIMATE, AIR QUALITY AND HEALTH

C40 and Johnson & Johnson are working in partnership to connect the dots between climate action, improved air quality in cities and better health amongst citizens.

C40 has undertaken cutting-edge research, working with 30 cities to date to measure the air quality and health benefits of climate action, and use this to make a stronger case for action.

The time for urgent climate action

Cities are responsible for about 70% of global CO_2 emissions and play a leading role in limiting global temperature rise to 1.5°C, in line with the Paris Agreement. Simultaneously, cities need to take adaptation measures to protect themselves against current and future extreme weather events, such as extreme cold and hot weather, floods and droughts. Finally, cities need to attend to local issues of air pollution, including pollutants and toxic compounds.

In order to tackle both air quality and climate change, cities need clean and efficient transport, buildings and industry solutions.

ADDIS ABABA

Addis Ababa is the largest city in Ethiopia and is home to 3.4 million residents. As the city's population grows, emissions may also increase as household incomes rise and the economy develops.

The ageing vehicle fleet, waste and industries are the main sources of air pollution and greenhouse gas (GHG) emissions in the city. Currently, transportation represents 68% of the city's scope 1 emissions.[1]

68% OF GHG EMISSIONS FROM **TRANSPORT**

THE NEED TO TACKLE AIR QUALITY

In Addis Ababa, the annual average concentration of fine particulate matter ($PM_{2.5}$) is three times the World Health Organisation (WHO) guidelines, which is raising serious health concerns for citizens in the city.[2]

The Ethiopian Constitution grants the right for every citizen to have access to a healthy environment, ensuring that the government develops measures to prevent pollution. This is why the city is developing its Air Quality Management Plan in pursuit of a cleaner and healthier environment for all citizens.

$PM_{2.5}$ CONCENTRATION IS 3 TIMES GREATER THAN THE WHO RECOMMENDED VALUE

THE HEALTH BURDEN

A recent Global Burden of Disease study showed that air pollution is the second greatest risk factor for death and disability in Ethiopia. In 2017, it is estimated that 21% of non-accidental deaths were due to exposure to poor air quality, representing 2,700 deaths in the city.[3] Without action to control air pollution, by 2025 this figure is estimated to rise to 6,200 and account for 32% of deaths.[4]

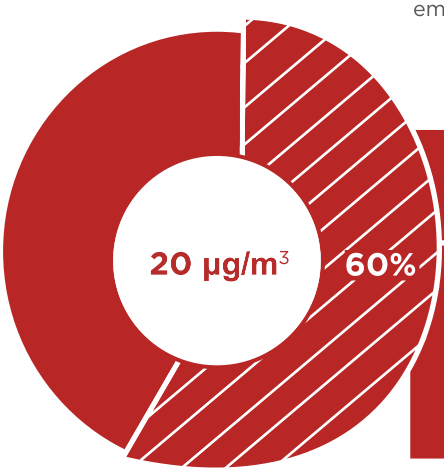
Pollutants such as $PM_{2.5}$ represent a major risk to people's health, particularly affecting children and older people. Often used as an indicator of air pollution, $PM_{2.5}$ can penetrate deep into the lungs and is linked to respiratory and cardiovascular morbidity and mortality, even at low concentrations.

2,700 PREMATURE DEATHS EACH YEAR IN ADDIS ABABA ARE DUE TO $PM_{2.5}$ LEVELS

Understanding the problem

Transportation accounts for 60% of the non-background $PM_{2.5}$ concentration in Addis Ababa, due to the city's aged diesel vehicle fleet. No vehicle standards have been set in the city and the average age of the fleet is estimated to be between 15 to 20 years. The number of vehicles is growing quickly at a rate of 16% per year and tackling transport emissions is a priority for the city.[6]

As 60% of the national vehicle fleet is found in Addis Ababa, addressing transport emissions in the city is an opportunity to contribute to the national effort towards emission reductions and air quality improvements in the sector.[7]



ADDIS ABABA VEHICLES

60% OF PM2.5 CONCENTRATION COMES FROM TRANSPORT

16% VEHICLE GROWTH PER YEAR

The action

Currently, every car in Ethiopia must undergo an annual inspection to ensure the vehicle meets safety standards, but there are yet to be any standards on emissions. The city is currently undertaking emission testing to understand the current state of the fleet, through C40's Empowering Cities with Data (ECWD) Programme. The aim is to draft emission standards for the city, which will progressively ban the oldest and more polluting vehicles from the city, with additional incentives for adopting for recent models.

In an effort to curb emissions, Addis Ababa banned commercial vehicles during daylight hours and implemented recurring car-free days. The city's transport plan also includes measures to improve bikeability and walkability by providing adequate footpaths and road crossings, increasing accessibility to public transport by developing the current light rail service, and a new Bus Rapid Transit (BRT) with dedicated bus lanes. In order to support its future transport network, Ethiopia is committed to improving the share of renewable energy in the energy grid, which will underpin any future work towards electric transportation.

TRANSPORT PLAN

BAN OLD & POLLUTING VEHICLES	REDUCE CONGESTION	IMPROVE BIKING AND WALKING LANES	INCREASE PUBLIC TRANSPORT

The benefits

With support from C40, the city analysed the social and economic impacts of implementing several standards for its 520,000 vehicles. The results show an improvement in air quality, leading to health improvements for the city's population and a reduced economic burden.

There is an improvement in air quality, both within the intervention area and across the whole city, for the indicator studied ($PM_{2.5}$).

The improvement in air quality reduces the health burden of cardiovascular- and respiratory-related diseases and deaths. Hospital admissions are used as an indicator for morbidity, while the change in premature deaths, life expectancy and life-years gained are used to quantify mortality impacts.

The economic impact is associated with the monetary value of averting a hospital admission and gaining an extra year of life.

Scenario 1: Older vehicles (before 1992) are replaced by more recent vehicles (from 2000-2005)

104,000 POLLUTING VEHICLES REPLACED

20% of the vehicles, aged before 1992 are banned. The assumption is that the number of vehicles will remain constant and the eldest will be replaced by more recent vehicles (from 2000 to 2005).

AIR QUALITY & CLIMATE

9% PM2.5 REDUCTION IN THE CITY CONCENTRATION

1.93 µg/m³ reduction in the city's annual non-background $PM_{2.5}$ concentration

100 PREMATURE DEATHS AVERTED PER YEAR

+23 DAYS IN LIFE EXPECTANCY PER CITIZEN

HEALTH

+3,745 LIFE YEARS GAINED

235 AVERTED HOSPITAL ADMISSIONS PER YEAR

235 averted hospital admissions per year, including 185 for respiratory diseases and 50 for cardiovascular diseases.

USD 27K HEALTHCARE COSTS AVOIDED PER YEAR

Healthcare costs saved due to the reduced hospital admissions.

Scenario 2: Older vehicles (before 2000) are replaced by more recent vehicles (from 2000-2005)

179,000 POLLUTING VEHICLES REPLACED

34% of the vehicles aged before 2000 are banned. The assumption is that the number of vehicles will remain constant and the eldest will be replaced by more recent vehicles (from 2000 to 2005).

AIR QUALITY & CLIMATE

11% PM2.5 REDUCTION IN THE CITY CONCENTRATION

2.40 µg/m³ reduction in the city's annual non-background $PM_{2.5}$ concentration

130 PREMATURE DEATHS AVERTED PER YEAR

+30 DAYS IN LIFE EXPECTANCY PER CITIZEN

HEALTH

+4,660 LIFE YEARS GAINED

292 AVERTED HOSPITAL ADMISSIONS PER YEAR

295 averted hospital admissions per year, including 231 for respiratory diseases and 61 for cardiovascular diseases.

USD 34K HEALTHCARE COSTS AVOIDED PER YEAR

Healthcare costs saved due to the reduced hospital admissions.

Scenario 3: Older vehicles (before 1992) are replaced by new vehicles (age from 2014)

104,000 POLLUTING VEHICLES REPLACED

20% of the vehicles aged before 1992 are banned. The assumption is that the number of vehicles will remain constant and the eldest will be replaced by new vehicles.

AIR QUALITY & CLIMATE

15% PM2.5 REDUCTION IN THE CITY CONCENTRATION

3.3 µg/m³ reduction in the city's annual non-background $PM_{2.5}$ concentration

180 PREMATURE DEATHS AVERTED PER YEAR

HEALTH

+6,520 LIFE YEARS GAINED

+40 DAYS IN LIFE EXPECTANCY PER CITIZEN

410 AVERTED HOSPITAL ADMISSIONS PER YEAR

11,150 averted hospital admissions per year, including 10,170 for respiratory diseases and 970 for cardiovascular diseases.

USD 47K HEALTHCARE COSTS AVOIDED PER YEAR

Healthcare costs saved due to the reduced hospital admissions.

Scenario 4: Older vehicles (before 1996) are replaced by new vehicles (age from 2014)

130,000 POLLUTING VEHICLES REPLACED

25% of the vehicles aged before 1992 are banned. The assumption is that the number of vehicles will remain constant and the eldest will be replaced by new vehicles.

AIR QUALITY & CLIMATE

19% PM2.5 REDUCTION IN THE CITY CONCENTRATION

4.2 µg/m³ reduction in the city's annual non-background $PM_{2.5}$ concentration

225 PREMATURE DEATHS AVERTED PER YEAR

HEALTH

+8,110 LIFE YEARS GAINED

+50 DAYS IN LIFE EXPECTANCY PER CITIZEN

510 AVERTED HOSPITAL ADMISSIONS PER YEAR

505 averted hospital admissions per year, including 404 for respiratory diseases and 106 for cardiovascular diseases.

USD 60K HEALTHCARE COSTS AVOIDED PER YEAR

Healthcare costs saved due to the reduced hospital admissions.

DRIVING ACTION

DESIGN POLICY	BUILD THE CASE	BOOST COLLABORATION
Improving the air quality of the city is reflected in the city's transport policies, strategies and plans. These include the city's Transport Development Plan, Transport Strategy, Climate Action Plan and Air Quality Management of the city. The findings from this study will be used as a baseline and is evidence of the effort to tackle the city's challenges on transport and air quality.	The health and economic impact of transport measures will be communicated to the public to explain the rationale for the policies.	The study will help boost collaboration between city departments and international organizations. The aim is to strengthen air quality monitoring in the city to measure the impact of transport actions once implemented.

NEXT STEPS

Prepare a vehicle standard at the city level which gears towards improving air quality and achieving GHG emission reductions in the transport sector.	Start to implement air pollution reduction actions from the transport sector by engaging stakeholders at the national and city level. These include increasing the fuel efficiency of vehicles and promoting mass transit, as outlined in the city's air quality management and climate action plan.	Strengthen the city's air quality monitoring system by increasing the sources of data acquisition from monitoring equipment and satellite data, which are able to track the improvements achieved by implementing air pollution mitigation actions.

METHOD AND ASSUMPTIONS

Key assumptions:

• *The air quality monitoring inputs are based on the average annual concentration at Addis Central Site in 2019.*

• *$PM_{2.5}$ concentration coming from transport comes from a proxy from Nairobi, Kenya.*

• *Population and mortality data are from Ethiopia Central Statistics Data projected population for 2016.*

• *Vehicle data comes from the number of registered vehicles in 2016. The modelling takes the assumption of a constant total number of vehicles across all scenarios. The emission factors are generic from the European Environment Agency and do not reflect the traffic congestion nor the state of the roads.*

• *As hospital admissions were not available for cardiovascular and respiratory diseases, the proxy was taken from UK hospital admissions breakdown per age and gender. This may underestimate the morbidity results. Hospital costs are based on a proxy from Kenya, illustrating the costs of inpatients due to influenza in 2016.*

• *Burden of air pollution on mortality was calculated by using the relative risk from published studies that relate air pollution concentrations to health outcomes. This was applied to the difference between city-wide annual average $PM_{2.5}$ concentration and the Global Burden of Disease's theoretical minimum exposure (5.8 µg/m³), and to the mortality rate in the local population. This is assuming impacts only in adults (ages 30+). The analysis has been carried out following the methodology outlined in the online Methodology. The mortality multiplier is based on UK Government /European Union validated methodologies for calculating air quality and health.*

Notes [1] *C40 Cities, Global Protocol for Community-scale GHG Emission Inventories (GPC).*

[2] *Global Burden of Diseases, 2016, IHME.*

[3] *The annual average concentration is 20 µg/m³ for the Central Site in 2019, while the WHO recommendation in 10µg/m³.*

[4] *Estimate from the AAEPGDC/USEPA team using the USEPA's BenMAP-CE tool to assess health effects of air pollution, for a population between 25 to 99 years old, using exposure in 2017 and 2025 and with population data from Ethiopia's Central Statistical Agency and the Addis Ababa City Health Bureau.*

[5] *Proxy from Nairobi, Atmos. Chem. Phys., 2014.*

[6] *Ministry of Transport, 2019.*

[7] *Addis Ababa Transport Bureau, 2019.*

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