# CLIMATE, AIR QUALITY AND HEALTH

Addis Ababa is rapidly urbanizing, with its population doubling in size every decade since the 1980s. Despite the city's low motorization rate, rapid economic growth has increased the rate of vehicle registrations. Today, transport represents 68% of the city's total greenhouse gas (GHG) emissions, the major share of which is from on-road transport. The vehicle fleet in Addis Ababa is characterized by old and inefficient vehicles. Public transport includes public buses and privately-owned minibuses, which are predominantly powered by unregulated diesel engines. For urban residents, air pollution is one of the top causes of death with diesel exhaust responsible for a large share of air toxins. In 2017, the transport sector was responsible for 60% of the city's non-background $PM_{2.5}$ concentration.

The demand for affordable and modern mass transit services has increased faster than the city is able to provide it. In turn, mounting gridlock is creating health and safety risks, producing more pollutant emissions and impeding economic development. In response to these challenges, Ethiopia has turned its attention to shifting its capital towards sustainable mass transit solutions.

## TRANSPORT IN ADDIS ABABA

Approximately 62% of the cars present in Ethiopia are registered in Addis Ababa. In spite of high import taxes on cars, the number of vehicles is rapidly increasing, with 110,000 cars imported in 2016 - a 50% increase on the import levels of the previous two years.

Many of the imported cars in Addis Ababa are highly-polluting vehicles. The negative impacts of an outdated and poorly maintained vehicle fleet are significant. Traffic congestion, localised air pollution and noise have become an inescapabale part of daily life in Addis Ababa.

**62% OF VEHICLES IN ETHIOPIA** CIRCULATE IN ADDIS ABABA

## THE NEED TO TACKLE AIR QUALITY

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 alone, 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]

In the city center, 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 as the particulate can penetrate deep into the lungs.[4] Transport is responsible for 60% of the city's non-background $PM_{2.5}$ concentration: it is the responsibility of the city to address its biggest source of air pollution. [5]

**2,700 PREMATURE DEATHS EACH YEAR** IN ADDIS ABABA ARE DUE TO THE CURRENT AIR POLLUTION LEVELS

## PUBLIC TRANSPORT IN ADDIS ABABA

The development of 2 BRT corridors is already underway in Addis Ababa, with a total of 15 BRT corridors planned as stated in the city's master plan 2017-2027. As buses have yet to be tendered or procured for the BRT systems, the introduction of zero emission buses, such as battery-electric buses, on defined BRT corridors or other alternate routes provides an excellent opportunity for Addis Ababa to avoid locking-in local and global emissions from diesel fuelled buses for the next 20+ years.

The city also has Sub-Saharan Africa's first Light Rail Transit (LRT) system, which opened in 2015 and cost US$ 475 million. 34 kilometres of north-south and east-west lines link 23 newly built stations, connecting inner city business and transport hubs with rapdidly developing commercial centres and new housing developments at the urban periphery.

**19% OF TRANSPORT EMISSIONS** COME FROM THE CITY'S 39,000 DIESEL BUSES AND MINIBUSES[6]

# BENEFITS OF BRT IMPLEMENTATION AND E-BUSES IN ADDIS ABABA

C40's Benefits team has conducted a benefits analysis of the social and economic impacts of implementing the BRT and electrifying the city's public and private bus fleet in 2033. The study identified significant results in terms of reduction in premature deaths; increase in life expectancy; reduction in hospital admissions for cardiovascular and respiratory diseases and healthcare costs saved.

**15 BRT** LINES

**39,000** BUSES AND MINIBUSES ELECTRIFIED

AIR QUALITY & CLIMATE

FEWER GHG EMISSIONS PER YEAR

REDUCTION IN NOISE COMING FROM BUSES

**7.3%** REDUCTION IN THE CITY'S NON-BACKGROUND $PM_{2.5}$ concentration

**86** PREMATURE DEATHS AVERTED PER YEAR

**+19** DAYS IN LIFE EXPECTANCY PER CITIZEN

HEALTH

ECONOMY

**190** AVERTED HOSPITAL ADMISSIONS PER YEAR

**USD 22.5 K** HEALTHCARE COSTS AVOIDED PER YEAR

The implementation of a BRT improves traffic congestion by taking around 8,000 private vehicles off the road. An electric bus drastically reduces the emissions of exhaust pollutants (E.g. $PM_{2.5}$ constituents such as black carbon, and $NO_x$), as electric buses create on average 75% fewer $PM_{2.5}$ emissions than diesel vehicles.

Together, both actions improve air quality in the city, reducing the concentration of $PM_{2.5}$ by up to 1.5 µg/$m^3$ (7.3% of the city's non-background concentration). Vehicle electrification also reduces traffic noise pollution, which can improve citizens' wellbeing.

The improvement in air quality reduces the health burden of cardiovascular- and respiratory-related diseases and deaths. 86 lives and 190 hospital admissions (150 from respiratory and 40 from cardiovascular diseases) could be prevented each year. This could improve every citizen's life expectancy by 19 days.

The reduction in hospital admissions brings savings to the healthcare system, which increases the city's resilience. The reduction in traffic congestion can also bring economic benefits through time savings.

## DRIVING ACTION

### DESIGN POLICY

Improving the city's air quality is reflected in its transport policies, strategies and plans. These include the 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 commitment to tackling the city's transport and air quality challenges.

### BUILD THE CASE

The health and economic impact of transport measures will be communicated to the public to explain the rationale for the policies.

### BOOST COLLABORATION

The study will help boost collaboration between city departments, the private sector, and international organizations. The aim is to strengthen air quality in the city and to measure the impact of transport actions once implemented.

## NEXT STEPS: THE CSP CHALLENGE

## 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 uses the number of registered vehicles in 2016 for the number of buses and minibuses (39,000), and the future planned 15 BRT lines.. The model does not measure the vehicle growth, but accounts for the modal shift from private vehicles to BRT provided by the transport department using the 4 Step traffic demand forecasting method.*

*• 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] 2Merkato*

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

*[3] 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.*

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

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

*[6] Study calculations*

***Cover page picture** : Photo by kaleab on Unsplash*