C40 CITIES
CLIMATE LEADERSHIP GROUP

BENEFITS OF URBAN CLIMATE ACTION

C40 Cities Technical Assistance Report 2019

RIO DE JANEIRO

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.

RIO DE JANEIRO

With an area of 1,204 km² and a population of approximately 6.7 million people, Rio de Janeiro is the second biggest city in Brazil. Air circulation is significantly influenced by the Tijuca Forest and the Pedra Branca mountain range that divide the city into different air quality zones.[1]

The city's road transport sector is the second greatest contributor to greenhouse gas (GHG) emissions, accounting for 35.9% of Rio's total GHG emissions.[2]

35.9% OF GHG EMISSIONS FROM **TRANSPORT**

THE NEED TO TACKLE AIR QUALITY

When preparing to host the Olympic Games in 2016, the city started taking bolder action on air quality. Additional monitoring stations were installed, which allowed for the development of new studies on air quality.

Brazilian air quality standards are still higher than WHO guidelines, which defines that the annual average concentration of $PM_{2.5}$ should not exceed 10 µg/m³. In Rio, the annual average is between 11 to 17 µg/m³, showing that citizens are exposed to harmful levels of air pollution.

$PM_{2.5}$ CONCENTRATION JUST ABOVE THE WHO RECOMMENDED VALUE

THE HEALTH BURDEN

Pollutants such as $PM_{2.5}$ and NO_2 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 lungs and is linked to respiratory and cardiovascular morbidity and mortality, even at low concentrations.

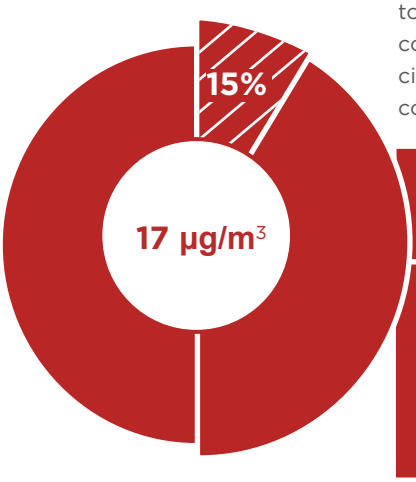
In Rio de Janeiro, it is estimated that 7,250 premature deaths every year are attributable to the current ambient $PM_{2.5}$ level.[3]

7,250 PREMATURE DEATHS EACH YEAR IN RIO DE JANEIRO ARE DUE TO $PM_{2.5}$ LEVEL

Understanding the problem

In Rio de Janeiro, the road transport sector is responsible for 30 to 60% of the total concentration of primary and secondary $PM_{2.5}$. Within this sector, buses account for 15% of emissions.

Mass transit is the main mode of transport in Brazilian cities and represents up to 60% of trips in urban areas. In Rio, the city's buses are operated by private companies, with most of the 7,000 circulating buses operating on fossil fuels. The city opened 3 BRT lines from 2012 to 2019 and is planning to open the TransBrasil corridor in 2020, in order to improve connectivity and reduce road congestion.



RIO DE JANEIRO BUSES

15% OF PM2.5 WITHIN THE ROAD TRANSPORT SECTOR **COMES FROM BUSES**

60% OF TRIPS IN BRAZILIAN CITIES ARE TAKEN BY BUS

The action

In June 2019, the city signed the Green and Healthy Street declaration, committing to procure only zero-emission buses in contracts and concessions signed from 2025 and ensuring that a major area of the city will be zero emission by 2030.

"As one of the busiest and most populous cities in the world, we are taking vital steps to improve Rio's transport system to reduce air pollution, make the roads safer, and provide high-quality, efficient public transport for our citizens." said the Mayor of Rio de Janeiro, Marcelo Bezerra Crivella.

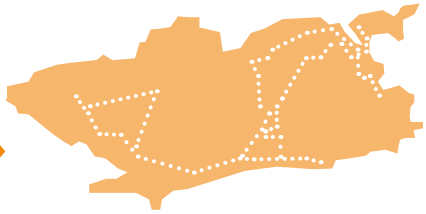
The electrification of public urban buses is currently being planned by the Mayor's office, with support from C40 Cities and the Brazilian federal government's Energetic Research Company. In order to be in line with the declaration, the city will have to switch its entire bus fleet to electric.

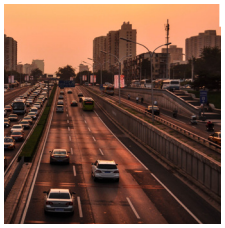
GREEN AND HEALTHY STREETS

CLEAN PUBLIC TRANSPORT

L O W EMISSION ZONE

ACROSS THE **WHOLE CITY**





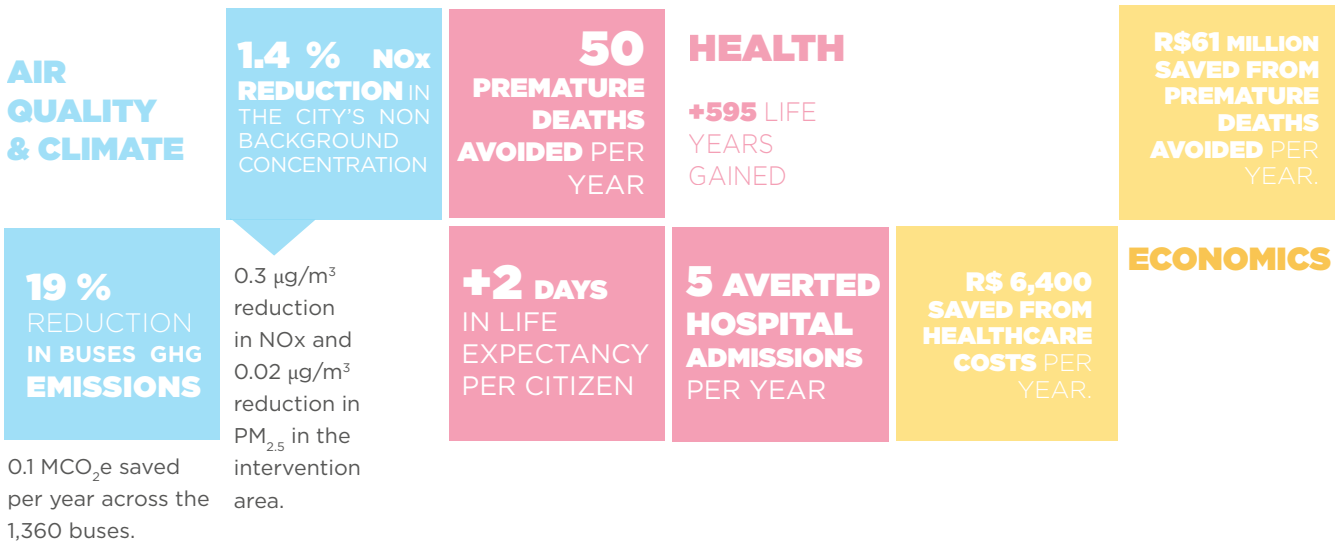
The benefits

With support from C40, the city analysed the social and economic impacts of switching the city's buses from diesel to electric vehicles. The scenarii look at two potential levels of electrification, and adding the BRT fleet in the 2050 scenario. The results showed a massive improvement in air quality for the two indicators studied ($PM_{2.5}$ and NO_2).

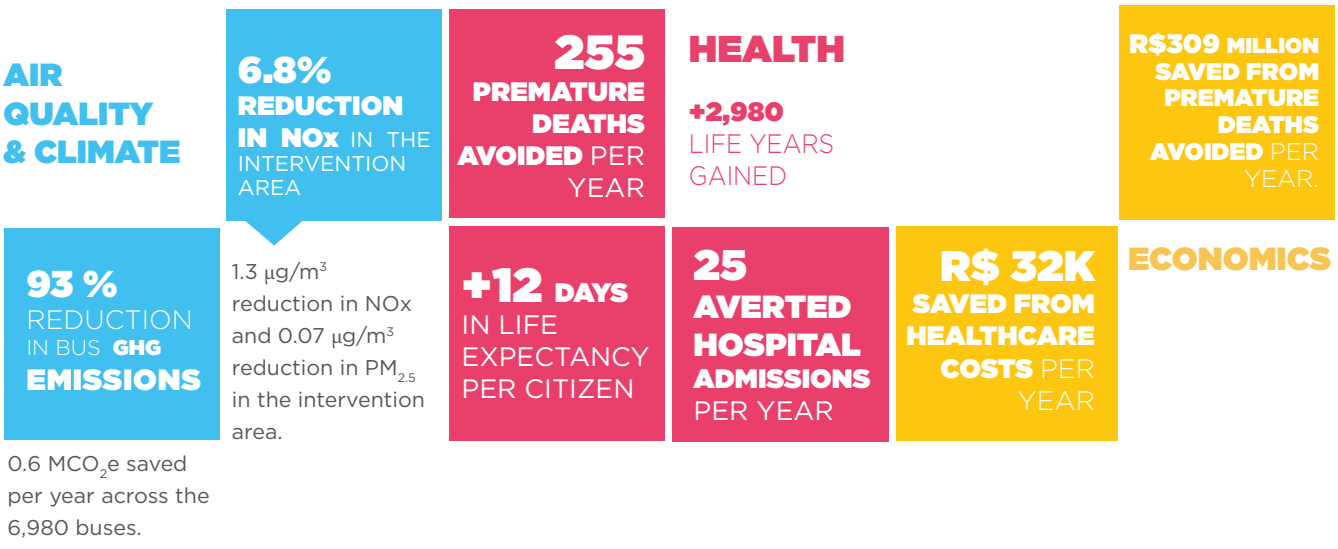
The air quality improvement leads to a reduction in the health burden of cardiovascular- and respiratory-related diseases and deaths. Hospital admissions are used as an indicator for morbidity, while the change in premature deaths, life expectancy and life years gained are used to quantify mortality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

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

Scenario 2030 : Electrification of 20% of the bus fleet (1,360 of 6,830 vehicles)



Scenario 2050 : Electrification of 100% of the bus fleet (6,980 vehicles)



DRIVING ACTION

BRING TECHNICAL SUPPORT

This report will provide the city with a more comprehensive understanding of the wider impacts of taking action on buses. In order to better fit Rio's evolving situation, a working group could be created to coordinate health and environment data.

GET BUY-IN

The city's buses are operated by private companies switching the bus fleet to electric will demand operational changes for the operators. In order to support the transition, the report results can be shared with the companies. The report can also help to raise support on air quality issues at the state level.

NEXT STEPS

This will feed into wider technical support to help the city take action on GHG and air quality emissions. The city is part of the ZEBRA project, a C40 initiative to support Latin American cities in implementing electric buses.

Action on clean transport needs to be underpinned by a decarbonised grid in order to maximise the impact on climate. The report needs to be shared with both the state government and the private sector to make the case for action.

METHOD AND ASSUMPTIONS

Methodology available here.

Key assumptions:

- *The air quality monitoring is based on the average of 9 monitoring stations.*
- *The background concentration was taken from the Joao XXIII station, under the assumption that the concentration was representative of the non-city concentration.*
- *Hospital admissions were provided for the 3 million insured citizens, representing 50% of the total population. In order to represent the total effect on morbidity, the count of hospital admissions was doubled.*
- *The mortality and morbidity data are based on the NOx reduction due to the action. In order to avoid double counting, the effect of the $PM_{2.5}$ reduction is not included in the report.*
- *Primary Transport emissions are responsible for 30% of the $PM_{2.5}$ concentration, while secondary and primary transport emissions are responsible for 60% of $PM_{2.5}$ concentration. As the effect of secondary emissions is less known, only primary emissions were considered in the analysis.*
- *The $PM_{2.5}$ and NOx emission factors are generic from the European Environment Agency and do not reflect the traffic congestion nor the state of the roads. It considers the percentage of bus electrification as the only variable between the scenarios and does not account for other changes in emission, health or population data. The expected increase of the buses by 2050 are due to the implementation of BRT lines.*
- *The GHG savings have been calculated based on an energy grid emission factor of 0.0814 from the Institute for Global Environmental Strategies (2019). List of Grid Emission Factors version 10.4.*

The analysis has been carried out following the methodology outlined in the BUCA Guidance Manual.

Future data collection activities based on the data gaps in the analysis include:

- *Improving data source apportionment and background concentration for NO_x and NO_2*
- *Development of a local VOLY.*

Notes

[1] *J. Braz. Chem. Soc. vol.29 no.6 São Paulo June 2018 - Air Quality Indexes in the City of Rio de Janeiro During the 2016 Olympic and Paralympic Games.*

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

[3] *IHME (2019) Global Burden of Disease for Brazil, data from 2017.*

***Cover page picture** : Photo by Agustín Diaz on Unsplash*

This June 2020 report is an updated version of February 2020 report, including new scenarios on the buses.

Johnson & Johnson

BUROHAPPOLD ENGINEERING

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