



Decarbonising Transport in Latin American cities: A review of policies and key challenges

Transport Division

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The DTLA project is part of the IDB's Regional Public Good programme 'Support to the planning of low-carbon transportation systems'² and the ITF's Decarbonising Transport (DT) initiative³. More specifically, the project is part of the DT initiative's work stream on the development of transport decarbonisation pathways for regions, countries or metropolitan areas.

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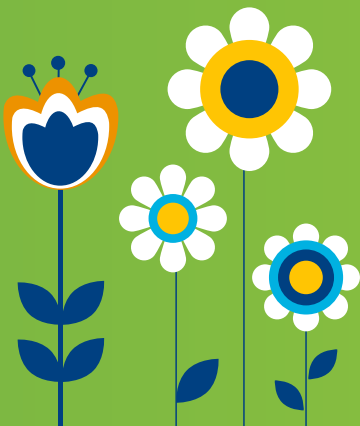
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¹ IDB/ITF (2022). Decarbonising Transport in Latin American cities: Assessing scenarios to 2050

² To learn more about this initiative, please see: <https://www.iadb.org/en/project/RG-T3102>

³ <https://www.itf-oecd.org/decarbonising-transport>

⁴ The quantitative part of the DTLA project is summarised in a separate publication (IDB/ITF, 2022).





Introduction and key findings

Ambitions and provides options on how to enhance further policy making to achieve this goal in line with other transport-related priorities, such as increasing access to opportunities. Beyond decarbonisation, the report only briefly addresses other environmental challenges that might be linked to the transport sector, such as pollutant emissions.

Global urban transport demand is set to grow – especially in Latin America

Global transport demand and related emissions are set to grow. Total passenger-kilometres and freight demand (measured in tonne-kilometres) will double by 2050 under current policies, even if their growth rates diminish as a result of the global pandemic. Global *urban* passenger demand will increase by a factor of 2.6, and urban freight demand by a factor of 1.9 under the so-called Recover scenario – a scenario developed by the ITF for its Transport Outlook 2021 (ITF, 2021), see Box 1. This urban transport demand growth is mainly driven by urbanisation, GDP and population growth – factors that develop differently across the world regions.

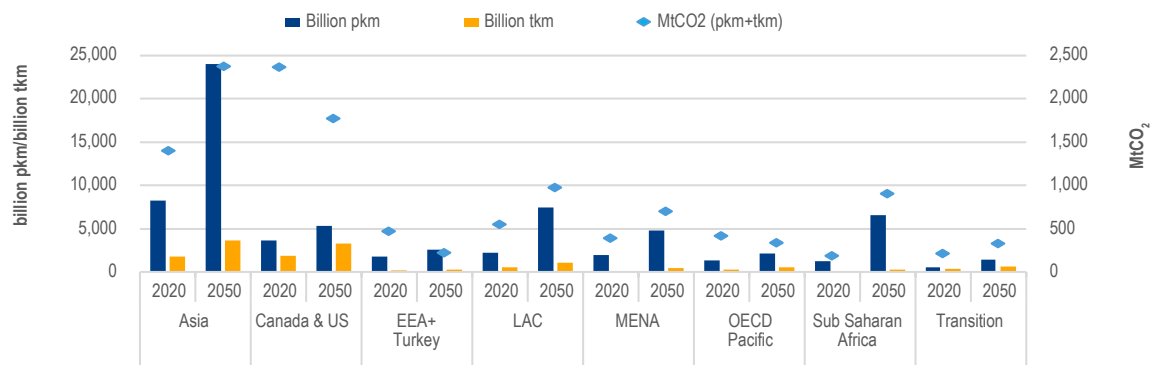


Box 0: Definition of the ITF Recover scenario

The *Recover scenario* assumes that governments prioritise economic recovery from the years of the pandemic by reinforcing established economic activities. They continue to pursue existing (or imminent) commitments to decarbonise the transport sector. Alongside these, governments take action with policies that ensure some of the transport trends that hinder decarbonisation observed during Covid-19 revert back to previous patterns by 2030. These trends include a shift to greater private car use, and reduction in public transport ridership, for example. Changes in behaviour such as reduced business travel or greater shifts to active mobility which have lowered CO₂ emissions, also revert back to pre-pandemic norms by 2030. Due to limited policy action on technology innovation, cost reduction in clean energy and transport technologies do not take place to the extent they could. The Recover scenario is an updated version of the *Current Ambition* scenario in the *ITF Transport Outlook 2019*, accounting for Covid-19 related changes and policies announced since.

In Latin America and the Caribbean, the growth rates of urban passenger and freight transport demand surpass the global average. Urban passenger transport demand will grow by a factor of 3.5 in this region; freight transport demand will grow by a factor of 1.9 (see Figure 0). This urban passenger transport demand growth is the second highest around the globe, only surpassed by the six-fold demand growth forecast for sub-Saharan Africa. Given the environmental impact of transport activity, and on CO₂ emissions in particular, such developments are concerning in the context of climate change.

Figure 0: Demand for transport in urban areas and related direct CO₂ emissions by region, 2020 and 2050



Note: EEA refers to the European Economic Area. LAC refers to Latin America and the Caribbean. MENA refers to the Middle East and North African countries. OECD Pacific countries include Australia, Japan, New Zealand and South Korea. SSA refers to Sub Saharan Africa. Transition economies include countries that were part of the Former Soviet Union and non-EU south-eastern European countries. Source: ITF (2021)

CO₂ emissions from urban transport can be decoupled from growth in transport demand

However, increased transport activity does not necessarily need to translate into CO₂ emissions. Especially urban passenger transport has the potential to decarbonise if the right measures are put in place. Measures can encourage the shift of travel away from private cars to other modes, stimulate the adoption of low-emission vehicles, and tilt fuel demand towards low-carbon sources of energy such as electricity from renewable sources. Densification of cities through land use policies and increased teleworking can reduce demand for transport and directly tackle the very source of emissions from the sector.

ITF's recover scenario shows that the increase of urban passenger and freight transport activity in the Latin America and the Caribbean may 'only' result in a 1.8-fold increase in direct (tailpipe or tank-to-wheel) CO₂ emissions. While this may sound encouraging, such an increase is not in line with the global objective of reducing CO₂ emissions to a level that will limit global warming to below 1.5 degrees, as set out in the Paris Climate Agreement. Rather, urban transport emissions have to fall significantly by 2050, if not reduce to zero entirely, irrespective of any potential transport demand increases during that period.

Latin American cities face similar challenges to deliver on a sustainable transport system

The work presented in this report helps to understand better the challenges that Latin American cities face in terms of transport decarbonisation and beyond, based on the analysis of the three case study cities of Bogota, Buenos Aires and Mexico City.

The findings show that the case study cities share some of the challenges in their pursuit to enhance the (environmental) sustainability of their transport systems:

- All three cities have been subject to significant transport demand growth in the past decade – a trend that is set to continue. This has put extreme pressure on their transport systems that need to keep the cities' economies running. If not managed carefully, this demand increase will also result in increases in transport CO₂ emissions.
- Much of the demand for passenger transport relies on the cities' public transport systems, which have become increasingly over-crowded. They have been longing for funding to maintain service levels and to expand and enhance their coverage across the cities and the different income groups –which is essential also for keeping in check the uptake of private motorised vehicles as alternatives.
- Increasing income levels and insufficient public transport provision have been accelerating the uptake of personal motorised mobility across the three cities. Motorcycle ownership and use is particularly on the rise. This has been leading to increasing congestion levels and air quality issues across the cities that authorities have been trying to tackle with measures such as driving restriction policies and increasingly stringent vehicle emissions standards.
- Funding for public services is scarce and has been put under additional pressure during the recent Covid-19 crisis. This puts many policy plans –whether concerning the enhancement of public transit networks, the build of alternative fuel infrastructure or other– at risk.
- The metropolitan areas of the cities stretch far beyond the administrative boundaries of the cities themselves. Effective transport policy making – whether concerning the build of new public transit infrastructure, the setting of standards for public transit vehicle or other – requires alignment across the relevant jurisdictions. However, governance levels taking responsibility over transport policy making across the entire metropolitan areas do not exist or are equipped with only insufficient authority. This can result in incoherent policy action.
- Understanding of urban freight movements and related data availability is very limited, as are measures to increase the sustainability of urban freight movements.

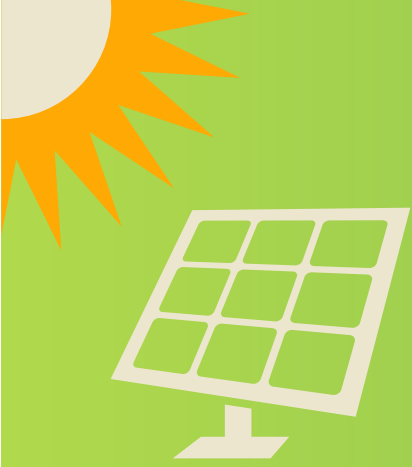
Long term planning efforts will be a relevant element in the pursuit of achieving carbon-neutral transport

Policy responses to tackle the above issues will be specific for each city. However, the analysis allows also here for some recommendations that are common to all case study cities. Notably, the assessment of policy plans shows that planning timeframes for policy measures and infrastructure plans barely go beyond 2030. Long-term planning to 2050 and beyond would, however, provide more clarity as to what actions need to be taken when to attain transport decarbonisation targets. Such long-term planning should ideally happen at the metropolitan level, to ensure measures are aligned across the different relevant jurisdictions. Such planning may then also provide more clarity as to what funding needs to be secured and different options to do so. Options such as the involvement of the private sector or reliance on international funding streams may be better assessed with such long-term planning in place.

The further work on the Decarbonising Latin American cities project, aiming to provide a modelling tool for each city to assess the impact of policy measures on passenger transport activity and related CO₂ emissions across their whole metropolitan areas, provides help in the design of such long-term strategies to achieve transport decarbonisation ambitions.

The following chapters provide more insights into the findings for each city. Each chapter deals with one city (metropolitan area) in turn and provides an overview of the city and its transport system first. The chapters then follow on with an overview of the current policy landscape, focusing on policies most relevant for tackling CO₂ emissions from transport. It then discusses the main challenges for each city, again focussing on the issues most relevant for reducing transport CO₂ emissions.

This report is based on the findings of three stakeholder workshops – one in each of the focus cities of this report – that took place in 2019, and on a comprehensive review of the available literature up until mid-2020. Findings of this report informed the further work on the Decarbonising Transport in Latin American Cities project. This second part of the project focused on quantitative assessments of policy options for decarbonising passenger transport and scenario building exercises for each of the three cities. This quantitative part of the project is summarised in a separate publication (IDB/ITF, 2022).



Chapter 1: Bogota



Key Characteristics of the Urban Area and its Transport System

The area of analysis of this work will be the Bogota region as defined in the 2019 Mobility Survey of Bogota. The area encompasses the 20 boroughs inside of the Bogota Capital District (Bogota D.C.), administrative capital of the country, as well as 18 municipalities in the surrounding department of Cundinamarca. These municipalities are: Bojacá, Cajicá, Chía, Cota, El Rosal, Facatativá, Funza, Gachancipá, La Calera, Madrid, Mosquera, Sibaté, Soacha, Sopó, Tabio, Tenjo, Tocancipá and Zipaquirá (Figure 1).

The use of the term ‘Bogota region’ in this work does not make reference to any form of existing legal, administrative or planning area bearing this name. As of August 2020, no common transport policy is implemented across the whole region. Authorities of Bogota D.C., of the Cundinamarca department and of municipalities within it plan and regulate the transport services within their area of influence. However, there is currently a legislative proposal to establish the Bogota–Cundinamarca region that could enable the creation of a single transport authority for the wider capital region of Colombia.

This chapter presents the main characteristics relevant for decarbonising transport in the Bogota region as understood in this work. To this end, it first describes the city and transport activities for jurisdictions within it, with an emphasis on BogotaD.C.. It then highlights the existing policy landscape relevant for transport decarbonisation at the national and local levels. A final section sheds light into the main challenges and some potential solutions for decarbonising transport activities in the Bogota region, both passenger and freight.

Figure 1: Bogota D.C. and neighbouring municipalities of the Bogota region, as highlighted in the Bogota 2019 mobility survey



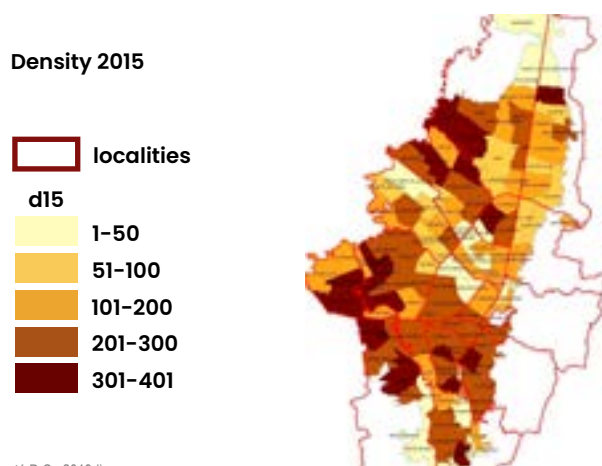
Source: (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d)

The City

The Bogota region is situated in the centre of Colombia on a mountain plateau in the eastern part of the Andes, known as the Sabana de Bogota. At an altitude of around 2 625 metres (CGLU, 2016), the plateau comprises flat land with 3,000-metre mountains delimiting the urban area along its entire eastern edge. Watered by Chingaza (mainly), the Bogota River and Sumapaz, the region is in a basin where all the micro-basins from the Sabana converge.

Around nine million people live in the Bogota region, representing around one fifth of Colombia's total population. More than 80% of inhabitants of the Bogota region live in the densely populated Bogota D.C.. The capital district has one of the highest population densities in the country: 21,000 inhabitants/km² (Secretaría Distrital de Planeación de Bogota, 2018). The highest densities are found in the south-west and north-west of Bogota D.C. (Figure 2).

Figure 2: Population density distribution in Distrito Capital



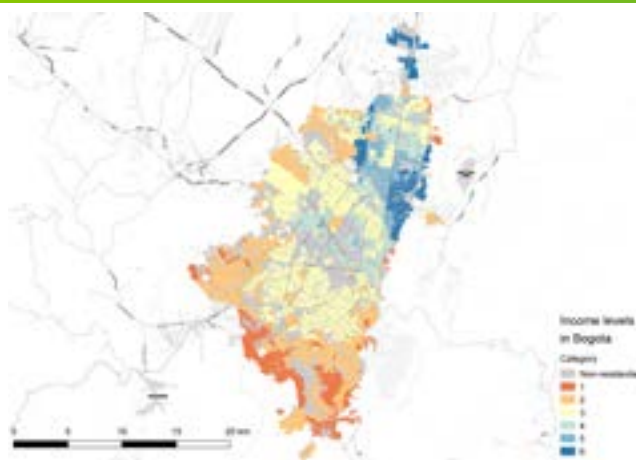
Source: (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d)

According to the National Statistics Department, Bogota D.C.'s per capita GDP was COP 30 628 794 (USD 9,438) in 2019. This is noticeably higher than the national per capita GDP of COP 19 634 627 (USD 6,051) (DANE, 2018). As a whole, Bogota D.C. contributes to more than a quarter of national GDP (DANE, 2019). The Gini coefficient, which indicates income inequality, was 0.504 in Bogota D.C. in 2018 (DANE, 2019), slightly higher than the national coefficient of 0.49 (El Banco Mundial, 2019).

Differences in the spatial distribution of socioeconomic strata in Bogota reflect inequalities in the city. Colombian authorities have developed a stratification system to subsidise public services according to the needs of different groups. For each residential block in the city, the system assigns a rank from stratum 1 (the poorest) to 6 (the wealthiest) based on the characteristics of the built environment. Characteristics of the physical environment are considered a more reliable and stable proxy for inequalities than, for instance, average income.

Figure 3 shows the categorisation of residential areas in Bogota D.C. by socioeconomic strata. Almost 60% of blocks in the city belong to strata 1 and 2, a proxy for lower-income groups in the city (Secretaría Distrital de Planeación, 2019). Strata 1 and 2 are mainly found in the southern boroughs and peripheral areas to the North. These boroughs are some of the densest in the Bogota region (Figure 3) and exhibit a high rate of informal housing units (Secretaría Distrital del Hábitat de Bogota D.C., 2019). Strata 3 and 4 (nearly 40% of the city's residential blocks) represent the city's middle-income groups. They are mainly found around the city's central corridors. Higher income residents reside in the remaining 5% of Bogota D.C.'s residential areas, demarcated as strata 5 and 6. These high-income blocks are mainly located in the northern and centre-eastern parts of the city.

Figure 3: Socio-economic stratification in Bogota D.C.



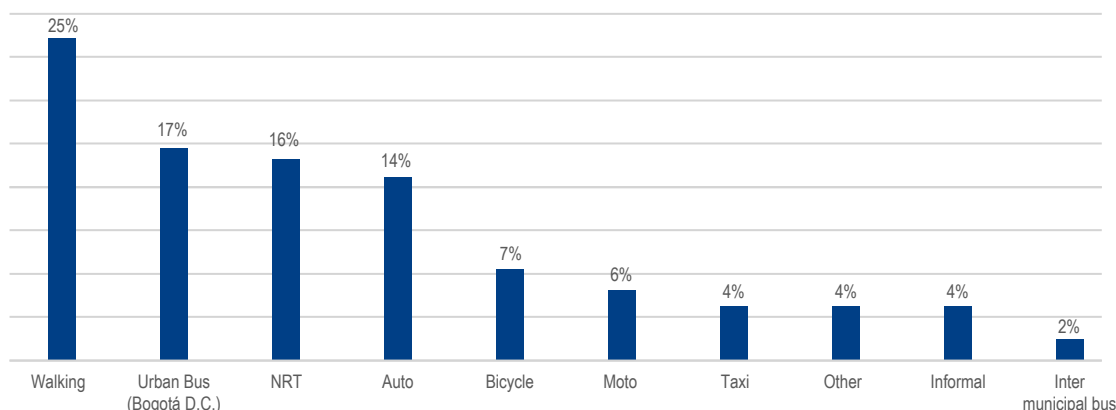
Source: (International Transport Forum, and Inter-American Development Bank, forthcoming)

The Transport System

Passenger Transport

Inhabitants of the Bogota region make around 16 million trips every day, excluding walking trips of less than 15 minutes (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). Out of these, more than 13 million trips are made by inhabitants of Bogota D.C. Walking is the most common mode of transport in the Bogota region, followed by urban bus, BRT, private car, bicycle, motorbike and taxi, in descending order (Figure 4). The use of sustainable modes, such as walking, cycling and public transport, has declined from over 72% in 2011 to 67% in 2019 (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). Although low-carbon modes still dominate, the trend is worrisome.

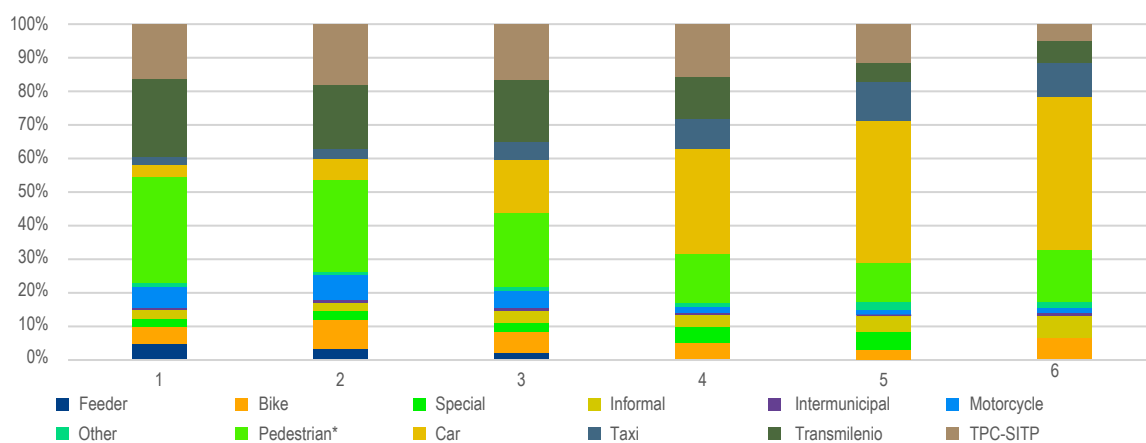
**Figure 4: Passenger transport mode share in Bogota region
(excluding walking trips under 15 minutes)**



Source: ITF based on (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d)
Note: urban bus (Bogotá D.C.) refers to SITP bus services (SITP zonal, SITP provisional and SITP feeder services)

The mode shares correlate with socioeconomic strata (see Figure 5). For example, the share of walking was less than 15% of trips for individuals in strata 5 versus 35% for those in strata 1.

**Figure 5: Transport mode according to socioeconomic strata
(excluding walking trips under 15 minutes)**



Source: (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d)

Walking

In the Bogota region, the mode share of walking has remained near 25% since at least 2015 (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d; Secretaría Distrital de Movilidad de Bogotá D.C., 2015). Many walking trips are carried out to access (or egress) other modes of transport. On average, walking trips linked to public transport use are the longest. Users of Transmilenio, the city's mass transport system, walk on average for around 20 min to access the system. This includes 10 minutes to reach stations and 10 to get to their final destination (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d).

Public transport

Approximately 35% of trips in the Bogota region are made by mass public transport, down from over 40% in 2015. This number takes into account trips done by BRT and by urban bus services inside of Bogota D.C., as well as inter-municipal buses serving the rest of the Bogota region. This drop in public transport use has occurred mainly among traditional buses, while ridership on the city's BRT system has grown. Between 2011 and 2019, feeder bus trips decreased by around 25% inside of Bogota D.C. (Secretaría Distrital de Movilidad de Bogota D.C., 2019c). Lower income groups use public transport more than higher income groups. For example, inside of Bogota D.C. more than 45% of residents of strata 1 and 2 use public transport, but only 20% of residents of strata 5 and 6 use public transport (Secretaría Distrital de Movilidad de Bogota D.C., 2019d). The following analysis of public transport services mainly concerns the public transport system and infrastructure within the capital district.

Bogota D.C.'s integrated bus public transport system (SITP) was conceived in 2009 as a way of reorganising and integrating existing public transport supply in the city. Transmilenio S.A., a public company headed by the district's Secretary of Mobility, organises and manages SITP's infrastructure, as well as contracts private companies to operate services. The SITP network extends throughout the whole city (Figure 6) and includes almost 140 BRT stations and more than 7,000 bus stops, served by almost 8,000 buses (Araujo, 2019).

Figure 6: SITP lines in Bogota



Source: (Araujo, 2019)

Public transport supply is divided into two main bus systems: a *trunk network* of high-capacity BRT lines created in 2,000, referred to as *Transmilenio*, and a *zonal network*. The trunk lines run along 12 main corridors passing through the central areas of the city. *Transmilenio* includes two types of buses: articulated buses, with a capacity of 150 passengers each; and bi-articulated buses, with a capacity of 250 passengers each (Figure 7). Around 13% of daily trips in the city take place in these BRT services.

Figure 7: Transmilenio articulated and bi-articulated buses



Source: (Araujo, 2019)

Zonal bus services include various types of feeder and intra-urban services in Bogota D.C. (Box 1). These services complement the trunk network by connecting areas with no access to *Transmilenio* stations. Since 2012, zonal services are organised into 14 zones (Figure 8), 13 of which have been tendered. Routes serving the remaining “neutral” zone, which corresponds to the city’s Central Business District (CBD) and historical centre, all originate in other zones and thus do not need to be tendered separately. The zonal system serves almost 30% of all daily trips in Bogota D.C.

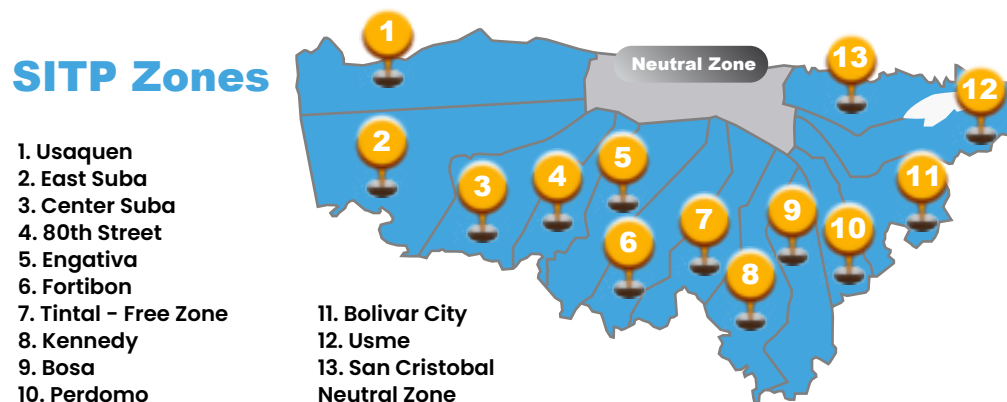
Box 1: Zonal bus services in Bogota D.C.

In Bogota D.C., various types of zonal bus services complement the action of the main BRT lines of the city. These services are:

- **Feeder services:** They allow users to move from and towards the main and intermediary stations of the BRT trunk lines. These services are provided by green buses. The average capacity of each bus is around 90 people.
- **Urban services:** These services allow users to move between the 14 different zones of the city. They circulate along the main roads of Bogota D.C., and travel using mixed, and sometimes dedicated, lanes. Average capacities for urban bus services go from 19 passengers (micro-bus) to larger 80-passenger buses.
- **Complementary services:** These services allow users to move from or towards neighbouring areas to some *Transmilenio* BRT stations. They give services inside one specific zone. Buses are orange and have an average capacity ranging from 50 to 80 passengers.
- **Special services:** These services permit users to move from and towards the city’s peripheral zones. Special buses are dark red and have an average capacity of 19 people (microbuses).
- **Provisional services:** Since 2015, provisional buses temporarily replace services from two bankrupted operating companies in the city. They are remnants of the previously informally and privately managed systems. Provisional buses tend to be old and highly pollutant. They do not have a set signage, but rather show the “SITP provisional” sign. Authorities are working on replacing these provisional lines to integrate them fully inside the SITP, network.

Source: ITF based on (SITP, 2019)

Figure 8: Public transport zones in Bogota D.C.



Source: (SITP, 2019b)

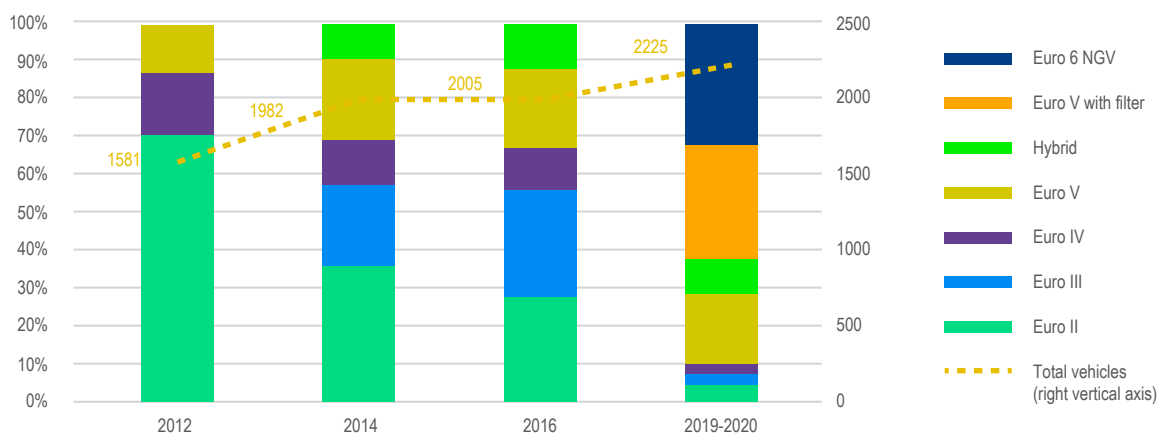
The “TuLlave” smart card provides an integrated ticketing service for most of SITP, but does not include “provisional services” which only accept cash and thus cannot offer free or discounted transfers. As Box 1 indicates, these services are a particular type of zonal service, which were allowed to continue operating after 2015 to meet demand in areas where two of the main bus operators ceased operations due to bankruptcy. It is expected that these services will be integrated into SITP in the future.

Full fare integration is guaranteed for trips starting in trunk BRT lines and going towards zonal services. This also applies for zonal-to-zonal services. Nonetheless, an extra 200 COP (less than USD 0.1) extra charge is required for trips connecting zonal services to trunk BRT ones (Tullave, 2020). These conditions apply within a 110 minutes time window. Outside of this timeframe, the user needs to pay the full price of the new connecting ride. There is not fare integration between SITP and public transport services provided by municipalities in the Cundinamarca department.

Physical integration between SITP and services of different municipalities, however, is more common. Some routes from outside of the capital district connect directly to *TransMilenio* bus terminals and others terminate at intermunicipal bus terminals located within walking distance of BRT stations. This includes four *Transmilenio* stations within the Soacha municipality. Integration with some routes has changed due to overcrowding at *TransMilenio* terminals.

Authorities have put in place a policy to renew the fleet of SITP buses, which will feature newer and cleaner technologies. Between 2012 and 2019 the total number of *Transmilenio* buses increased by more than 40% (Figure 9). At the same time, the average age of the trunk BRT fleet reduced from 11.2 years to 1.9 (Bocarejo, 2019). All new vehicles are Euro V or higher. By 2020, more than 90% of the BRT fleet is expected to consist of Euro V, Euro 6 and Hybrid vehicles (Alcaldía Mayor de Bogotá, 2020b). These cleaner vehicles have replaced more polluting buses. The share of EURO II buses in the BRT fleet fell from 70% in 2012 to 5% in 2019. Renewing the fleet reduced emissions of particulate material by 95% from *Transmilenio* buses (Araujo, 2019). Meanwhile, the zonal system will receive 4 400 new buses rated Euro V or higher. More than half will be Euro VI and at least 483 will be electric.

Figure 9: Technological distribution in the *Transmilenio* BRT trunk network (2012–2020) (in % of total vehicle fleet and in total absolute number of vehicles)



Source: ITF based on (Araujo, 2019)

Alongside fleet renewal, authorities have promoted the expansion of the SITP network. The mass public transport infrastructure of Bogota D.C. is expected to almost double between 2018 and 2030. Major projects include the expansion of the *Transmilenio* BRT infrastructure, a new cable car line in operation, a metro line, and a regional tram connecting Bogota D.C. with its surrounding area. Proposed infrastructure improvements have also included the transformation of 'carrera séptima', one of the main avenues in the city, into a green corridor that prioritises public transport and active modes (Concejo de Bogotá D.C., 2020).

SITP expansion will include the development of a cable car system as a sustainable mode for increasing access of lower income areas of the city. The city's first cable car, TransMiCable, was put in service in 2018. The 3.6km line connects one of the lowest income neighbourhoods in Bogota, Ciudad Bolívar, directly to the BRT system. The cable car system has reduced travel times on the mountainside on which it operates, with top to bottom trips reduced from around 1.15 hours to 13 minutes (International Transport Forum, and Inter-American Development Bank, 2022). It is seen as SITP's first fully electric line and is expected to lead to annual reductions of 756 tCO₂eq (Araujo, 2019). The new elected mayor, Claudia López, has proposed to create two other cable car lines to support SITP (Plan de Gobierno de Claudia López, 2019).

Bogota D.C.'s first metro line is expected to provide additional environmental benefits. After various attempts over the past 50 years, Mayor Peñalosa's administration completed the tendering process for the line in 2019, which is scheduled to be built between 2020 and 2025. The 23.9 km line is expected to include 16 stations, 10 of which will be physically integrated with *Transmilenio* BRT stations. The infrastructure cost in 2017 was estimated at COP 12.9 billion (USD 3.7 billion). Out of these, the Colombian government committed to cover COP 9 billion, and the city government the remaining COP 3.9 billion (DNP, 2017). The project is expected to reduce emissions by 1.3 million tCO₂eq in its first 30 years of operation (Consortio Metro de Bogotá, 2019a). The project might have further modifications in the future; Mayor López has proposed to extend the metro line to the northwestern area of Bogota D.C., improving access for more than two million residents of the Engativá and Suba boroughs (Plan de Gobierno de Claudia López, 2019).

Cars

Around 14% of all journeys in the Bogota region are taken by private car (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). More than 1.8 million private vehicles (cars and trucks) were registered in Bogota in 2019 (Secretaría Distrital de Movilidad de Bogotá D.C., 2019g). Ownership levels in the city increased by 81% between 2008 and 2016 (Observatorio de Movilidad de Bogotá D.C., 2017). Nonetheless, annual growth rates for vehicle ownerships are decreasing. Between 2013 and 2017 the average annual car ownership growth rate was only of 5.9%. This is less than half of the annual growth rate of 12.9% between 2007 and 2012. In 2017, the average vehicle age for private cars in the city was of 12.9 years (Observatorio de Movilidad de Bogotá D.C., 2017).

The presence of cars across the region varies according to the borough or municipality. In 2019, the average motorisation rate was 238 vehicles (cars, trucks, pick-ups or motorcycles) per every 1,000 inhabitants (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). This compares to 160 vehicles per 1,000 inhabitants in 2015 (Secretaría Distrital de Movilidad de Bogotá D.C., 2015). Motorisation rates in the Bogota region vary according to different zones (Figure 10). As an example, the highest motorisation rates can be found in the north-west of Bogotá D.C., where levels can be equal or higher than 459 vehicles per 1,000 inhabitants. Lowest levels are found in the southern, lower income boroughs and municipalities, where in some cases it is possible to reach levels lower than 36 vehicles for 1,000 inhabitants. Rates also vary according to strata. While strata 1 and 2 inside of Bogotá D.C. have motorisation rates of around 127 and 184 vehicles per 1,000 inhabitants respectively, there are around 600 vehicles per every 1,000 inhabitants of strata 6 (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d).

Figure 10: Motorisation rate in Bogota in 2019



Source: (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d)

Cycling

The Bogota region has the highest cycling mode share among Latin American capital cities. Over 7% of daily trips in the Bogota region are made by bike, which is higher than the cycling mode shares of Mexico City and Buenos Aires combined. Most cycling occurs within the capital district. Residents in stratum 2 cycle the most, reporting 0.18 daily bicycle trips on average. Meanwhile, those in stratum 6 cycle the least, making only 0.05 daily bicycle trips on average. Cycling trips are particularly prevalent for commuting and studying purposes; almost 10% of commuting and studying trips are made by bike (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). There are high gender inequalities in cycling

patterns in the city. Almost 80% of cycling trips are carried out by men (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d).

Major infrastructure investments have been essential in increasing the cycling mode share in Bogota D.C. One first major investment was done for building “ciclorrutas”, the cycling lanes network of the city. Between 1998 and 2019, the length of cycling lanes increased from 10km to 500 km (Alcaldía Mayor de Bogotá, 2019b). They have been deliberately designed to run through both low income and wealthy areas in order to promote socioeconomic integration. Additional infrastructure investments in the city include more than 5,000 bicycle parking spaces in main *Transmilenio* BRT stations (Araujo, 2019). Between 1998 and 2008, the construction of bicycle infrastructure cost USD 200 million. These investments were considered cost-effective in comparison to other forms of mobility. The average cost of one kilometre of cycle path built in Bogota is a fraction of the same length of a 30-metre-wide road: USD 600,000 compared to about USD 6.5 million (World Economic Forum, 2014). The network has been publicly funded through fuel surcharges, traffic fines and a land-value tax. Other sources, such as *Transmilenio* fares, have contributed to the building of cycling parking within select *Transmilenio* stations.

Beyond infrastructure investment, education campaigns have promoted sustainable and safe cycling. Between 2018 and 2019, the *Vidas reflectivas* campaign handed out 7 800 reflective vests in different points of the city. A further campaign, *Juego de roles* (role play) sought to put freight and private vehicle drivers in the position of a cyclist so as to enhance understanding of their safety needs (Secretaría Distrital de Movilidad de Bogotá D.C., 2020a). A safe cycling behaviour manual has also been developed (Secretaría Distrital de Movilidad de Bogotá D.C., 2017).

The Bicycle Public Policy, which is expected to be adopted by the end of 2020 and expire in 2038, includes a range of measures aimed at making Bogota “The World’s Capital for Cycling”. Between 2015 and 2019, the cycling share in the Bogota region almost doubled. Mayor López has proposed to further increase the cycling share in the region by 50% by 2024, in which case cycling would account for more than 10% of trips in the Bogota region. Meanwhile, the city is working to make cycling safer as part of a broader effort to reduce fatal accidents by 20% across all transport modes by 2024. These ambitions are expected to be fulfilled in part thanks to new infrastructure investments. Among others, Mayor López proposes to increase cycling lanes by 60%, reaching 830 km of lanes by 2024. Her administration also aims to increase cycling parking spaces by more than 80%, reaching capacity for 11,000 bikes by 2024 (Concejo de Bogotá D.C., 2020). Other policies to promote mode share will include enhancing cycling education programmes (Plan de Gobierno de Claudia López, 2019). These projects also aim to reduce the gender gap in cycling. All of these measures will be framed in the Bicycle Public Policy (Política Pública de la Bicicleta), which is in the latest stage of its formulation process. It is expected to be formulated and adopted by the end of 2020 and will be valid until 2038.

Motorcycles

Almost 6% of trips in the Bogota region are made by motorcycle, which is more than 20 times rates for Buenos Aires and almost five times those of Mexico City. Motorcycle use in Bogota has been increasing rapidly, with the number of motorcycle trips having doubled within Bogota D.C. between 2011 and 2019 (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). Although Bogota has one of the largest motorcycle fleets in Colombia (ANDI, 2018), motorcycle shares in other cities such as Cali are about three times higher (Metro Cali, 2015). The proliferation of motorcycles in Bogota D.C. is relatively recent. In 2007, there were only 110,000 motorcycles registered in the city, which represented less than 10% of total motorised fleet in Bogota D.C. Ten years later, the number of motorcycles more than quadrupled and motorcycles represented more than 20% of motor vehicles (Observatorio de Movilidad de Bogotá D.C., 2017). This sudden increase aligns with a major increase in motorcycle ownership in Colombia. Between

2,000 and 2010, motorcycles motorisation rates across the country grew from 1.8 motorcycles per 100 inhabitants to 5.5 (Universidad Nacional de Colombia, 2017).

Most motorcycle users in the Bogota region belong to lower-income groups. In low-income municipalities or boroughs of the region, there can be more than 70 motorcycles per 1,000 inhabitants (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). This is around 50% higher than the average motorisation rate of motorcycles of the region (55 vehicles per 1,000 inhabitants) (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). High adoption of motorcycles in lower-income groups has been linked to the relative affordability of motorcycles as compared to other modes. Motorcycles in Bogota grant similar levels of access to employment opportunities as cars while costing less than public transport for some (International Transport Forum and Inter-American Development Bank, 2022).

Taxis

In 2019, taxis accounted for around 4.3% of the total daily journeys taken in the Bogota region. Taxi use is more intense among higher income strata; the highest stratum makes seven times as many taxi trips as the lowest (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d). Since 1993, there has been a cap on the maximum number of taxi vehicles in circulation. The 50,000 taxis permitted in December 2017 had an average age of eight years. Only three of the 59 taxi enterprises permitted to operate owned 60% of the fleet (Observatorio de Movilidad de Bogotá D.C., 2017).

Inside Bogota D.C., city authorities are responsible for regulating taxi fares, operations and permits. Decree 172 of 2001 defines taxis as a form of public transport in the city (MinTransporte, 2001). It also gives the district authority to grant taxi permits. To obtain a permit, a vehicle needs to be a) new; b) yellow; c) affiliated with a registered company; and to d) provide information such as the taxi company name and its plate number (Rodríguez-Valencia, 2013). Registered vehicles need to be used as taxis (public transport service deliverer) for at least 5 years before they can switch to other types of functions (e.g., for private use). Permits are officially free, so cost linked to it do not go to public authorities. Nonetheless, due to the scarcity of permits, a market has been developed on the basis of transfer of permits to operate taxi services. By the end of 2019, those interested in obtaining a taxi permit would need to pay around COP 90 million (close to USD 25,000) for such a taxi permit. They need to pay an additional annual affiliation fee of around COP 840,000 (USD 230) to the taxi company they belong to. Drivers also need to pay an extra COP 1 million (USD 274) to authorities. This fee includes an annual operational permit and a life insurance for drivers (La Republica Colombia, 2018).

The arrival of ride-hailing apps in Bogota D.C. has likely increased the number of for-hire vehicle trips taken in the city. Since 2013, various ride-hailing enterprises, such as Uber, Cabify and DiDi, have begun operations in the city without authorisation from taxi authorities. In 2017, 57,000 Uber X vehicles in circulation had already outnumbered the 50,000 official taxis (Panampost, 2017). By circumventing the permitting process, ride-hailing services have approximately 30% lower operational costs than registered taxis (El Espectador, 2019). This is perceived as a source of unfair competition by registered taxi drivers and owners.

While members of parliament and Uber (Uber, 2019) have proposed regulations for app-based ride-hailing platforms, none have been implemented. Apps have adapted to this legislative void in various ways. Cabify connects users with registered taxi, generating less controversy. Uber has faced various degrees of opposition and support for its operations. In December 2019, Colombia's Superintendent of Industry and Commerce (SIC), the department responsible for consumer protection and transparency, ruled that Uber was operating illegally in the country. The app ceased operations in Colombia on February 1ST (2020), but returned within a month with a new, temporary business model that, Uber claims, complies

with Colombian law (Uber, 2020). In April 2020, the Higher Court of Bogota (Tribunal Superior de Bogota), overruled the SIC's decision. As of July 2020, the situation remains unresolved.

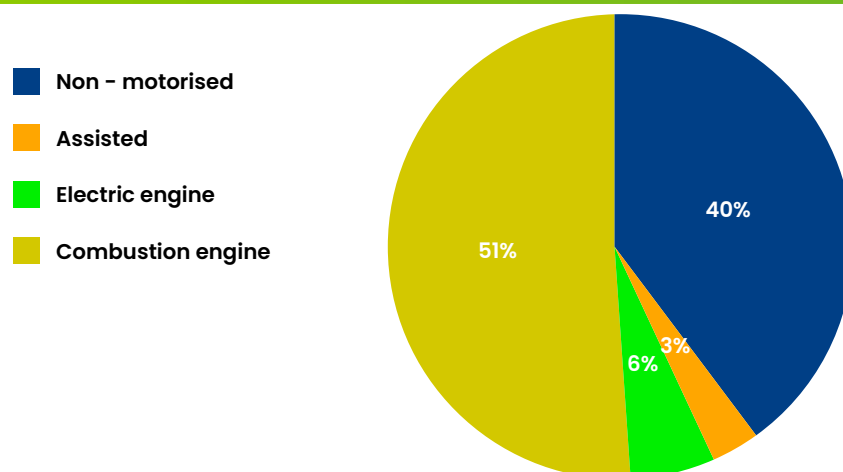
Bogota D.C. authorities aim at improving the competitiveness of registered taxis against newcomers. Since 2018, city authorities have promoted the use of a new "smart taxi" type of service for registered taxis. Taxi companies have been asked to develop their own apps or enable payments through third-party platforms. By November 15TH (2018), 16% of taxis in Bogota had this option (Alcaldía Mayor de Bogotá, 2018a). The smart taxi programme also allows users to view the estimated cost of the trip at the time of departure, to access data from the driver and to evaluate the service (Alcaldía Mayor de Bogotá, 2019c). Authorities are able to obtain data stemming from platform use to improve services.

Public transport – informal

In 2019, 3.4% of trips in the Bogota region involved some sort of informal transport mode. Informal transport use has increased significantly in the past 5 years with its share quadrupling between 2015 and 2019 (Secretaría Distrital de Movilidad de Bogota D.C., 2019d). Within Bogota D.C., informal transport is a particularly important in southern, lower-income boroughs. Since these boroughs are among the least well connected to the SITP system, demand for affordable and flexible mobility to act as a feeder for the city's mass transit is high (Salazar Ferro and Behrens, 2015). In some of these areas, informal transport services can increase levels of access to job opportunities in the city by 40 percent and more (International Transport Forum and Inter-American Development Bank, 2022).

One of the main forms of informal transport is the bicycle rickshaw. Known locally as bicitaxis, they are most prevalent in the poorer southern and peripheral districts of the city. There are 4 646 bicitaxis in Bogota D.C. (Secretaría Distrital de Movilidad de Bogotá D.C., 2019h). There are three types of bicitaxis operating: non-motorised, assisted and motorised (Figure 11). Assisted rickshaws refer to vehicles equipped with an auxiliary electric engine with a nominal continuous power no larger than 0.5 kW. More than 5,000 people are involved in one way or another in bicitaxis operations. For 90% of them, bicitaxis are their only source of income, and 84% of them do not contribute to pension funds. Almost 40% lack social security (Secretaría Distrital de Movilidad de Bogotá D.C., 2019h).

Figure 11: technology distribution in Bogota D.C.'s bicitaxis fleet



Source: (Secretaría Distrital de Movilidad de Bogotá D.C., 2019h)

The National Government has not yet finalised a legal framework to regulate rickshaws in Bogota D.C. Until 2018, national authorities did not consider non-motorised vehicles as public transport. This was mainly because the vehicles did not meet established safety and quality criteria. Resolution number 003256 of August 3rd (2018) included, under certain conditions, rickshaws as part of the public transport category in Colombia. It indicates that only non-motorised and assisted rickshaws should be allowed to operate, mandates that no electric assistance be provided after reaching a 25 km/h speed, and sets a vehicle weight limit 270kg (MinTransporte, 2018). Consequently, city authorities can regulate bicitaxi services and grant permits to operators. However, the regulation does not include fully motorised rickshaws, which leaves more than half of bicitaxis in Bogota D.C. extra-legal. Mayor López has proposed to address this regulatory gap during her mandate (Plan de Gobierno de Claudia López, 2019).

Beyond informal transport activities, authorities have also aimed at regulating emerging micro-mobility services. Electric scooter leasing companies, such as Lime, Muvo and Green, had started operations in Bogota by 2019. Authorities have aimed at regulating activities of these services providers so as to ensure that their activities comply with urban development and road safety objectives of the city. Resolution 336 of 2019, for instance, regulates the conditions under which operation permits are granted (Secretaría Distrital de Movilidad de Bogota D.C., 2020b). As an example, the resolution requires operators to provide a strategic road safety plan, as well as a plan on how it will manage and distribute the vehicle fleet across the city. Authorities have delimited parking spaces for scooters owned by approved service providers (Secretaría Distrital de Movilidad de Bogota D.C., 2019a). However, the city has lacked the capacity to enforce regulations, allowing unfair competition from non-compliant competitors to persist. In January 2020, Lime, one of the city's first operators, decided to stop operations in Bogota, allegedly partly due to unfair competition (El Espectador, 2020). However, due to the Covid-19 pandemic, authorities started emitting temporary, one-year permits under less strict conditions as a measure to reduce crowding in public transport.

Freight transport

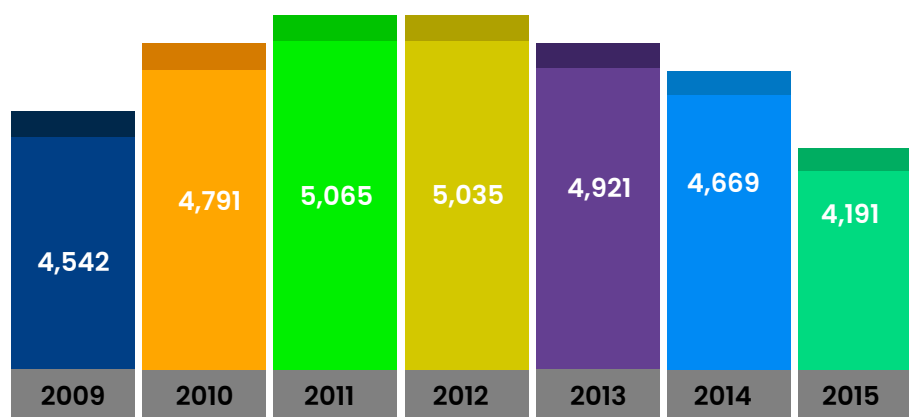
The Bogota region as a whole works as a vast consolidation hub for all freight within the country, regardless of the cargo's origin or destination (Wilmsmeier, Jallow and Johansson, 2015). As summarised in Figure 13, two of the three main national transport corridors originate in Bogota; the Transversal Bogota - Cali - Buenaventura (Bogota to the Pacific coast) and the Ruta del Sol (Bogota to Barranquilla and Cartagena, in the Atlantic coast) (DNP, 2018). Most freight trips are generated by activity in Bogota D.C. In 2015, 65% of all daily freight trips in the Bogota region stemmed from activity in the capital district, as opposed to only 35% from the Cundinamarca department (Cámara de Comercio de Bogota, 2016a). Agricultural goods, such as flowers, coffee and cape gooseberries, and natural resources, such as copper and ceramic, account for 92% of total exports from Bogota-Cundinamarca. Since 2012, the region has seen a fall in the economic value of its exports at an average rate of 6% yearly. As shown in Figure 14, the economic value of exports from Bogota dropped to USD 4,192 million in 2015, compared to USD 5,035 in 2012 (Cámara de Comercio de Bogotá, 2016a).

Figure 12: The distribution of cargo between the major cities and the corresponding transport corridors

ORIGIN	DESTINY							
	Barranquilla	Bogota D.C.	Buenaventura	Cali	Cartagena	Medellin	Santa Marta	Generation
Barranquilla	-	974,357	39,272	472,122	695,144	1,131,363	141,118	3,453,976
Bogota D.C.	1,167,150	-	674,745	1,525,541	1,301,582	850,985	246,559	5,766,562
Buenaventura	97,133	2,487,171	-	2,149,435	74,582	1,014,160	13,139	5,835,620
Cali	672,179	1,873,929	782,638	-	527,662	1,022,133	102,407	4,980,948
Cartagena	831,903	2,027,237	46,460	692,902	-	2,061,820	99,952	5,760,247
Medellin	594,009	825,515	239,666	791,435	1,132,400	-	314,615	3,897,640
Santa Marta	399,416	446,748	11,393	92,469	55,033	252,841	-	1,257,900
Attraction	3,761,790	8,634,957	1,794,174	5,723,904	3,786,403	6,333,302	917,790	30,952,320

Source: (DNP, 2018)

Figure 13: Economic value of total exports from Bogota by year



Source: (Cámara de Comercio de Bogotá, 2016a)

Inter-urban and inter-national freight transport

Road transport is the main mode for inter-urban and inter-national freight movements from and towards the Bogota region. There are nine major road routes in and out of Bogota D.C., which witness 80 444 cargo vehicles entering and leaving each business day on average. More than 80% of all entries and exits in the city occur on 4 of these routes located in the west of Bogota D.C. where freight activity is concentrated (Observatorio de Movilidad de Bogotá D.C., 2017). All in all, vehicles make around 50,000 cargo trips per day.

Local and national authorities seek to promote railways as a more sustainable freight transport option for national trips. The 257km-long Bogota-Belencito track is the main railway line of the Bogota region. While the line transported an average 170,000 tonnes/year, operations stopped in 2011 a meteorological phenomenon caused severe damage (DNP, 2013). National authorities have since invested almost COP

210 thousand million (around USD 60 million) to renew the line and it reopened in August 2018. Since then, over 40 thousand tonnes of cargo have been moved along the corridor. Freight flows in this line are expected to increase, as it has an estimated capacity of approximately 3 million tonnes per year (MundoMarítimo, 2019).

Authorities are also aiming at increasing freight air transport for national and international freight. Bogota is home to El Dorado International Airport (AIED), the most important freight airport in Latin America. In 2018, AIED transported almost 670 thousand tonnes of freight, almost double the volume transported by Sao Paulo airport, its closest competitor (Alcaldía Mayor de Bogotá, 2018b). To further increase freight capacity, authorities are planning to build a second airport in Bogota, *Aeropuerto El Dorado II*. Infrastructure expansion could benefit the export of niche goods found in the region, such as flowers and electronics (Alcaldía Mayor de Bogotá, 2018b). Nonetheless, it can also come at high environmental costs due to increased emissions linked to heightened air traffic.

Freight transport inside of Bogota D.C.

Urban logistics inside of Bogota D.C. are the most important source of freight activity in the Bogota region. Around 62% of freight trips in the Bogota region start and finish inside of Bogota D.C. (Observatorio de Movilidad de Bogotá D.C., 2017).

Although the volume of cargo transported across Bogota has generally decreased, the number of cargo trips has increased (Figure 14). This trend is partly due to the recent increase in “nano-stores”, small and often informal commercial establishments (Cámara de Comercio de Bogotá, 2016a). Compared to 2008, a larger proportion of cargo is now moved in smaller vehicles that make more frequent trips; a nano-store can receive over 30 deliveries per week (Wilmsmeier, Jallow and Johansson, 2015). In Bogota D.C., there are up to 140,000 nano-stores and over 100,000 distribution locations in the city (Wilmsmeier, Jallow and Johansson, 2015), leading to distribution logistics that are less structured and consolidated. The pattern is also linked to efficiency losses; 40% of freight trips are made with empty vehicles.

Figure 14: annual volume of trips and of transported freight tonnes per enterprise in Bogota D.C.

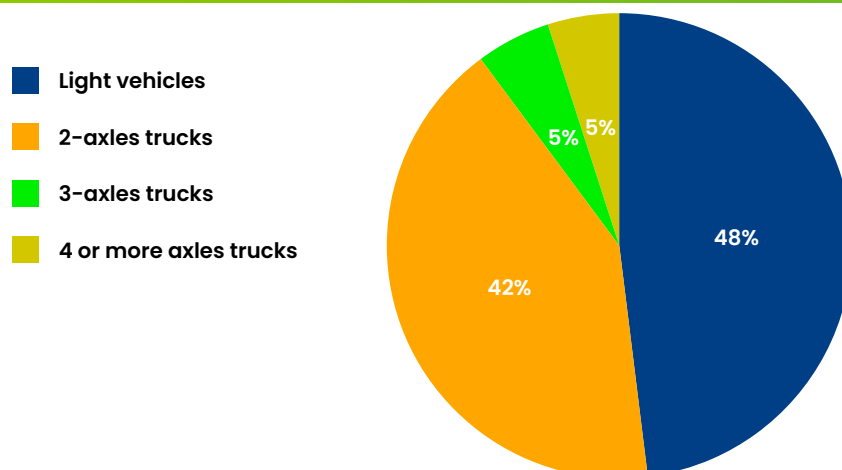


Source: (Cámara de Comercio de Bogotá, 2016a)

Trucks are the main means of freight transport in Bogota D.C. As shown in Figure 16, 48% of all truck trips are made in light-duty vehicles – in vans or pick-up trucks – whilst 42% are made by trucks with 2 or more axles (Observatorio de Movilidad de Bogotá D.C., 2017). The country only produces light-duty

trucks (less than 5 tonnes), and imports most heavy-duty trucks from Mexico. Much of the fleet is highly polluting, with 84% of vehicles rated below Euro III and 18% at least 20 years old (Alcaldía Mayor de Bogotá, 2020a). About 55% of trucks only use diesel and 35% only use gasoline. The remainder use either natural gas or a mix of gas and gasoline. More than 80% of trucks operating in the city are registered outside of the capital district, limiting regulatory options.

Figure 15: Percentage of the types of cargo vehicles in an average business day in Bogota



Source: (Observatorio de Movilidad de Bogotá D.C., 2017)

Non-conventional cargo vehicles, including motorcycles, cargo-motorcycles, cars, taxis and cargo bikes, are increasingly important for freight activity inside of Bogotá D.C. (Wilmsmeier, Jallow and Johansson, 2015). Cargo bikes, especially prevalent in informal, lower-income areas in the city, offer an affordable way to address last-mile logistics (Wilmsmeier, Jallow and Johansson, 2015). New apps for delivery services have also promoted an increase in the use of motorcycles and bicycles in Bogotá. One of Latin America's main apps for food and service delivery, Rappi, was born in Colombia in 2015. About two thirds of "Rappitenderos", as the app's deliverers are called, use bicycles; the remaining third use motorcycles (LaboUR, 2019). New, non-conventional cargo vehicles raise concerns in the city, particularly regarding safety.

Cargo activity is highly polluting, accounting for 9% of all CO₂ emissions and 39% of all PM₁₀ emissions in Bogotá D.C. (Secretaría Distrital de Ambiente de Bogotá D.C., 2020). The high emissions are partly due to the age of the fleet. In 2019, 27% of trucks were over 15 years old (Secretaría Distrital de Movilidad de Bogotá D.C., 2019i). Traffic congestion, which trucks exacerbate, further increases emissions. In 2013, trucks represented between 1% and 13% of the daily total traffic, depending on the hour (Ballesteros Larrotta, 2013). In key corridors, trucks can account for almost 20% of traffic (Rodríguez Durán and Cano Torres, 2018). In order to face these challenges, authorities are currently developing a low-carbon logistics plan in collaboration with the NGO Despacio and ICLEI, as part of their Ecologistics programme. The city has also developed a new regulation restricting the access of the most polluting freight vehicles to Bogotá D.C. (Alcaldía Mayor de Bogotá, 2020e). This regulation, framed in Decree 077 of 2020, will be further described in the challenges section of the chapter.

Current Policy Landscape

National Policy

National climate change policy

In 2011, Colombia published its Low Carbon Development Strategy (*Estrategia Colombiana de Desarrollo Bajo en Carbono*, ECDBC) that aims at decoupling GHG emissions from economic growth. Between 2013 and 2014, and in line with the objectives of the ECDBC, Colombia continued to develop eight sectorial mitigation action plans (*Planes de Acción Sectorial – PAS*). The PAS aim to maximise the carbon efficiency of economic activities while contributing to social and economic development and collectively contain around 100 mitigation measures (Umweltbundesamt, 2018). They were an important basis for the development of the country's Nationally Determined Contribution (NDC) submitted to the UNFCCC in the aftermath of COP21 in Paris, where Colombia committed to reducing its economy-wide CO₂eq emissions by 20% compared to a business-as-usual scenario by 2030 (or by 30% with international support) (United Nations Framework Convention on Climate Change (UNFCCC), 2015).

Moving towards NDC implementation, and under the mandate of the Intersectorial Commission of Climate Change (*Comisión Intersectorial de Cambio Climático*, CICC, established in 2016), different line ministries have identified prioritised mitigation measures based on the PAS and on regional climate change plans that fed into the National Climate Change Policy (*Política Nacional de Cambio Climático*, PNCC) of 2017 (*Ministerio de Ambiente y Desarrollo Sostenible*, 2017a). It brings together all previous climate change initiatives and adds new elements to guide all efforts towards achieving the country's pledges under the Paris Agreement.

The Ministry of Transport proposed targets for the uptake of electric taxis, bikes and private cars and the promotion of rail freight as an alternative to trucking. For urban areas, the ministry has proposed to promote natural gas vehicles; introduce electric and hybrid vehicles in the public transport fleets of the main cities; establish national days without cars (6 days per year for major cities); and enhance public infrastructure to support multi and inter-modality (IDEAM et al, 2017). The prioritised mitigation measures across all sectors are expected to surpass the 20% conditional mitigation pledge put forward by the government in its NDC by around 2% (United Nations Framework Convention on Climate Change (UNFCCC), 2017). Overall, mitigation plans appear to be most advanced for the transport and waste sectors, where, for example, also respective nationally adapted mitigation actions (NAMAs) have been developed (see below). Table 2 shows a summary of the indicative mitigation potential of the transport sector, compared to a reference scenario.

Table 2. Indicative transport sector mitigation potential according to National Climate Change Policy

Action	CO ₂ eq savings (compared to reference scénario, 2010-2040, transport sector)
Freight transport – mode shift from road to rail (savings of 600 million gallons Diesel)	1%
Freight transport – mode shift from road to water (savings of 2,200 million gallons Diesel)	1%
Build of bicycle lanes (replacement of 23 million motorised trips)	1%
Electrification of public transport (replacement of 130,000 conventional buses)	1%
Projects under the Clean Development Mechanism	2%
NAMAs	5%
Total	11%

Source: (Minambiente, 2017)

Carbon Tax on fossil fuels

Road transport represents the largest share of fossil fuel consumption in Colombia (followed by industry, residential, commercial and agricultural users) (Briscoe, I. et al., 2016). In 2017, the country introduced a carbon tax on fossil fuels at USD 5 per tonne CO₂, adjusted by inflation each year. While this tax reform came mainly in response to declining oil prices and hence reduced fuel tax revenues, it is now seen to be a key policy measure to steer the country towards a low carbon development path. It has the potential to mitigate the effects of falling costs of mining coal (of which Colombia has about 90 years' worth of reserves) and of reaching the limits of hydroelectric power potential in the future (EfD, 2018). However, as climate change policies around the world will reduce the demand for coal and oil on the global market, the country's energy exports are likely to fall, which will increase the risk of coal entering the national energy mix (Conservation Finance Network, 2019). Solutions to mitigate this risk, such as extending the carbon tax to coal, will therefore be essential to ensure clean electricity generation in the long run, especially in view of increased electricity demand that will result from policy measures that support the uptake of electric vehicle technologies.

Promotion of electric vehicles

Besides uptake targets for hybrid and electric vehicles (as defined in the sectoral action plan and prioritised mitigation measures), decree 1116 of June 2017 temporarily reduces import tariffs of electric vehicles to 0% and of hybrid electric vehicles to 5% until 2027. These tax reductions apply to a limited number of imported vehicles by year (e.g., in the case of electric vehicles, the reduced tariffs may apply to up to 2 300 vehicles for the years 2020 to 2022 and to up to 3,000 vehicles for the years 2023 to 2027) (Mincit, 2017). In line with the Indicative Action Plan 2017 - 2022 of the Program for the Rational and Efficient Use of Energy (adopted by Resolution 41286 of December 2016), Resolution 1988 of September 2017 defines an energy efficiency target for transport. An improvement of 5.49% shall be achieved by 2022 (compared to 2017).

The same resolution also defines which vehicles may benefit from sales tax exemptions. These are i) natural gas vehicles used the public passenger transport sector, ii) electric vehicles used in official public sector fleets and iii) electric vehicles used for public passenger transport, electric motorcycles, automobiles and taxis, if in the main cities of the country. Sales tax exemptions also apply for the acquisition of electric and hybrid vehicle charging infrastructure (fast and slow chargers, regardless of whether they are for public or private use) (Minambiente, 2017b).

Colombia's Green Growth Policy (Política de Crecimiento Verde) of July 2018 defines the objective of having 600,000 electric vehicles on Colombia's roads by 2030 and of elaborating a national electric mobility strategy (DNP, 2018c).

In 2018, the policy for improving air quality (Política para el mejoramiento de la calidad del aire) promotes the reduction of air pollutant sources from mobile sources. In this respect, it defines three strands of action, i.e., (i) the renovation and modernisation of the automotive fleet, (ii) the updating of fuel quality parameters and (iii) monitoring and control. Especially the first strand of action, fleet renovation and modernisation, will also highly benefit the reduction of CO₂ emissions from vehicles. It explicitly encourages the uptake of low and zero-emission vehicle technologies (DNP, 2018d).

The law on the promotion of electric vehicles (Law 1964 of July 2019) promotes the use of (full battery or hydrogen fuel cell) electric vehicles to mitigate CO₂ and pollutant emissions from road transport. Among other measures, the law limits the motor vehicle tax for EVs to 1% of the commercial vehicle value; requires 10% discounts to insurance premiums for EVs; encourages local or regional authorities

to apply financial incentives for EVs to boost their uptake (such as discounts or exemptions from registration taxes, vehicle taxes or parking fees); requires exemptions from any vehicle restriction schemes for EVs; mandates that all new residential and commercial buildings include electrical connections to eventually support EV charging infrastructure; sets quotas for EVs for official vehicle fleet purchases (30% by 2025); and requires municipalities to set up fast charging infrastructure. Cities with mass public transit systems need to comply with electric vehicle deployment targets for the respective vehicle fleets. These gradually increase in two-year steps from 10% of new vehicle acquisitions in 2025 to 100% in 2035 (Congreso de la República de Colombia, 2019).

On 28 August 2019, President Duque launched the National Strategy for Electric Mobility [*Estrategia Nacional de Movilidad Eléctrica*] that aims at improving air quality and promoting efficient transport. The goal is to achieve 600,000 electric vehicles by 2030 (in line with the objective set in Colombia's Green Growth Policy – see above) and deploy five fast charging stations in main urban areas by 2022 (and 20 in Bogota) (Minambiente, 2019).

Nationally appropriate mitigation actions (NAMAs) in transport

Colombia has been implementing three NAMAs in the transport sector that support the country's Strategy for Low-Carbon Development (NAMA Database, 2019):

- One NAMA on the renovation and improvement of the freight vehicle fleet (funded by GIZ and IDB, supported by the Ministry of Transport);
- NAMA *TOD* on transit-oriented development targets investments in pilot projects in Cali, Medellín, Pasto and Manizales as a basis for replication of the TOD model across the country (funded by the NAMA Facility, supported by FINDETER); and
- NAMA *TAnDem* on active transport and demand management is to improve the quality of urban life and contribute to climate change mitigation through increasing use of bicycles and a responsible use of motorized transport, for instance by implementing parking management schemes in the country's urban areas. In Bogota, this programme has supported the increase in cycling lanes in the city (funded by GIZ, supported by FINDETER).

One further NAMA, supported by FINDETER, is currently under development:

- NAMA *MovE* is to promote the development of financial and regulatory instruments to promote the use of electric vehicles in Colombian cities.

Further work will be required to monitor and evaluate the impacts of the NAMAs. This will facilitate funding for similar initiatives in the future (Guerrero, 2019).

Vehicle emission standards

Colombia has not introduced vehicle efficiency standards to reduce CO₂ emissions from fuel combustion. Vehicle efficiency labelling for light duty vehicles is currently under consideration – and could lead to efficiency standards in the future (ICCT, 2018). Pollutant emissions standards (that will also drive CO₂ emission reductions because of the way they are formulated) are in place and have become increasingly stringent over the past two decades. Law 1972 of July 2019 requires all diesel vehicles imported to or manufactured in Colombia to meet Euro VI emission standards starting January 2023. It also requires that all diesel vehicles in operation are Euro VI by 2035 – a measure that may be difficult to implement.

New motorcycles must meet at least the EURO 3 standard by January 2021; by January 2030, a minimum of 20% of the public transport vehicle fleet shall be zero emission vehicles. The same law also introduces sulphur standards for diesel fuel: 10–15ppm by 2023 and 10 ppm by 2025 (Ministerio de Justicia, 2019). The law does not mention any standards for gasoline vehicles. It is expected that gasoline vehicles will be subject to similar standards with a few years delay (ICCT, 2018).

Climate change elements of national transport policy

The above-described initiatives are in line with actions defined in the National Development Plan (NDP) 2018–22 Pact for Colombia, Pact for Equity, DNP [*Pacto por Colombia, Pacto por la equidad*] that aims to boost equality, entrepreneurship and legality. One of its cross-cutting areas is transport and logistics. Here, the main climate-related objectives are to modernise public transport systems and to increase the efficiency and integration of different transport modes. More specific climate-related goals are to increase the length of existing cycle paths by 60% (to 255 km), more than double the commercial rail network (to 1077 km) and to increase freight transport by waterways by 30% (DNP, 2019a). Regarding transport in urban agglomerations, the plan emphasises, among other items, the importance of high-quality public transport services, active travel and efficient urban freight movements. For example, it requires a National Program of Active Mobility to be developed, as well as master plans for mobility and parking. A comprehensive strategy or specific goal regarding transport CO₂ emissions reductions is not stated. However, the sustainability section of the plan clearly sets out that measures for achieving the country's pledges under the Paris Climate Agreement will be implemented. All transport-related measures in this section, such as the increased uptake of clean vehicles, are in addition to the transport section. One quantified goal is to have 6 600 electric vehicles on Colombia's roads by 2022 (DNP, 2019a).

City level climate change and air pollution policies

Climate change policy

Agreement 391 of 2009 requires establishing a district plan for climate change mitigation and adaptation (Concejo de Bogotá D.C., 2014). The plan is to guarantee the sustainable development of the city and cover all different socio-economic sectors. Regarding transport, the plan should promote clean transport fuels. It should also facilitate the identification of projects that can be financed by international sources under the clean development mechanism by establishing a system for monitoring and evaluating greenhouse gas emission impacts of proposed climate change mitigation or adaptation actions.

In line with agreement 391, a district management plan for risks and climate change [*Plan Distrital de Gestión de Riesgos y Cambio Climático para Bogotá D.C., 2015–2050*] was published in 2015. In November 2018, this plan was replaced by the District Disaster Risk and Climate Change Management Plan for Bogotá 2018–2030 [*Plan Distrital de Gestión del Riesgo de Desastres y del Cambio Climático para Bogotá 2018–2030*] (Alcaldía Mayor de Bogotá, 2018d). It serves as the basis for future development plans and as an instrument for prioritizing future investments. Component two of the report addresses mitigation of climate change and defines the objective of promoting Bogotá as a sustainable, efficient, and low-carbon city. Sustainable mobility measures are the first to be addressed. Table 3 provides the measures that are listed under the sustainable mobility program and the relative indicative CO₂ emissions reduction goal for 2030 (compared to 2014 CO₂ emission levels). The city's environmental department [*Secretaría del Medio Ambiente*] and mobility department [*Secretaría de Movilidad*] are responsible for achieving that goal (Alcaldía Mayor de Bogotá, 2018d).

Table 3. Bogota's Climate Change Management Plan 2018–2030

Strategic lines of actions for sustainable mobility	
Development and introduction of sustainable means of transport	
Implementation of zero or low emission technologies for the city's integrated transport system	
Promotion of environmental self-regulation in means of transport (1)	
Implementation of measures that discourage private vehicle use	
Promotion of bicycle use	
Improvements in the road network for improved modal integration	
Logistic management for freight transport	
Indicative goal with regards to transport (compared to 2014 transport sector emissions of 4.8 million tons)	
In 2020	reductions of 0.2 million tons (or 4%)
In 2030	reductions of 1.9 million tons (or 40%)

Notes: (1) a voluntary program in which freight and public transport companies commit to an integral maintenance program for their vehicles, aiming to reduce their diesel emissions up to 20% less than the established standard set up by Resolution 910 de 2008. If standards are achieved, respective vehicles are exempted from vehicular restriction. Source: (Alcaldía Mayor de Bogotá, 2018d)

Air pollution policy

In 2011, Bogota launched the air pollution plan *Plan Decenal de Descontaminación del Aire de Bogotá* for the period 2010 to 2020. The plan, which is currently being updated and improved, proposed a number of strategies to alleviate air pollution from transport, mainly focusing on diesel buses, trucks and motorcycles and prescribing catalysts or particulate filters for the vehicles (Vassallo, Bueno and Rivas, 2018).

In addition to the 10-year plan, the city has started various other initiatives that aim at reducing air pollution and/or congestion issues. In 1998, the vehicle restriction scheme *pico y placa* was first launched (Vassallo, Bueno and Rivas, 2018). Since then, its scope has extended from private vehicles to public transport and freight vehicles. The number of days and times during which the vehicle restrictions apply (depending on the last digit of the vehicles' number plate) have also been expanded. Figure 21 shows the *pico y placa* restrictions for July 2019 for different vehicle types (public transport vehicles with and without environmental restrictions; taxis; special transport vehicles (cars and trucks); and private vehicles). No restrictions apply on public holidays or Sundays. In case of pollution alerts, the restrictions may be more stringent and/or extended over the whole weekend. Figure 22 shows an example of an emergency *pico y placa* restriction of March 2019. In addition to *pico y placa*, there is also at least one car free day (*día sin carro*) per year that applies to all private vehicles since 2001.

Figure 16. Pico y placa scheme Bogota – July 2019

M E S	Día	Fecha	Pico y placa Transporte Público Colectivo: Ambiental	Pico y placa Transporte Público Colectivo	Pico y placa Transporte Público Individual - Taxi	Pico y placa Transporte Especial (automóvil, camioneta o campero de 4 pasajeros - sin incluir conductor)	Pico y placa Vehículo particular
J U L I O	FESTIVE	1	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY
	TUESDAY	2	7	3-4	5-6	5-6	0,2,4,6 Y 8
	WEDNESDAY	3	9	5-6	7-8	7-8	1,3,5,7 Y 9
	THURSDAY	4	8	7-8	9-0	9-0	0,2,4,6 Y 8
	FRIDAY	5	0	9-0	1-2	1-2	1,3,5,7 Y 9
	SATURDAY	6	1	1-2	3-4	3-4	DOES NOT APPLY
	SUNDAY	7	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY
	MONDAY	8	2	3-4	5-6	5-6	0,2,4,6 Y 8
	TUESDAY	9	3	5-6	7-8	7-8	1,3,5,7 Y 9
	WEDNESDAY	10	4	7-8	9-0	9-0	0,2,4,6 Y 8
	THURSDAY	11	5	9-0	1-2	1-2	1,3,5,7 Y 9
	FRIDAY	12	6	1-2	3-4	3-4	0,2,4,6 Y 8
	SATURDAY	13	7	3-4	5-6	5-0	DOES NOT APPLY
	SUNDAY	14	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY
	MONDAY	15	8	5-6	7-8	7-8	1,3,5,7 Y 9
	TUESDAY	16	9	7-8	9-0	9-0	0,2,4,6 Y 8
	WEDNESDAY	17	0	9-0	1-2	1-2	1,3,5,7 Y 9
	THURSDAY	18	1	1-2	3-4	3-4	0,2,4,6 Y 8
	FRIDAY	19	2	3-4	5-6	5-6	1,3,5,7 Y 9
	FESTIVE	20	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY
	SUNDAY	21	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY
	MONDAY	22	4	7-8	9-0	9-0	0,2,4,6 Y 8
	TUESDAY	23	5	9-0	1-2	1-2	1,3,5,7 Y 9
	WEDNESDAY	24	6	1-2	3-4	3-4	0,2,4,6 Y 8
	THURSDAY	25	7	3-4	5-6	5-6	1,3,5,7 Y 9
	FRIDAY	26	8	5-6	7-8	7-8	0,2,4,6 Y 8
	SATURDAY	27	9	7-8	9-0	9-0	DOES NOT APPLY
	SUNDAY	28	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY	DOES NOT APPLY
	MONDAY	29	0	9-0	1-2	1-2	1,3,5,7 Y 9
	TUESDAY	30	1	1-2	3-4	3-4	0,2,4,6 Y 8
	WEDNESDAY	31	2	3-4	5-6	5-6	1,3,5,7 Y 9

Source: (Secretaría Distrital de Movilidad de Bogotá D.C., 2019e)

Figure 17. Pico y placa scheme during pollution alerts – example March 2019



Source: (Noticias Caracol, 2019)

Since 2013, the Technological Promotion Plan [*Plan de Ascenso Tecnológico*] promotes the substitution of public transport vehicles powered by fossil fuel for hybrid, electric or LNG vehicles to reduce pollutant emissions and CO₂. One of the plan's measures is to promote pilot projects, such as the testing of electric taxis – a project that was launched in 2016 and has contributed to the development of the city's electric vehicle policy (NDC Partnership, 2016). The pilot introduced 43 BYD electric vehicles with a range of more than 225km. At the same time, 4 main charging stations with 34 charging points were made available across the city. Between 2013 and 2019, 13 400,000 km have been travelled by the electric fleet in the city. This has allowed CO₂ savings of 3 350 tCO₂eq. Authorities have exempted electric taxis from vehicle restriction regulations in the city, in order to increase their attractiveness (Secretaría Distrital de Movilidad de Bogotá D.C., 2019b).

Electric and zero emission vehicle policy

Agreement 732 of December 2018 (partly referring to agreement of 619 of 2015) promotes electric mobility and the uptake of zero emission technologies with the objectives to improve air quality, environmen-

tal sustainability and public health (Concejo de Bogotá D.C., 2018). Table 4 shows the quantified targets of this agreement. The measures mentioned to achieve these targets include promoting the uptake of electric taxis, installing electric (or zero emission) vehicle charging points in strategic points of the city (in parking areas on- and off-road); implementing the strategy for battery recycling and final disposal; awareness campaigns; potential financial benefits for electric-vehicle owners; and incentives of public transport operators that take up electric vehicles in their fleet.

Authorities are currently in the process of formulating the respective policy instruments to achieve these objectives.

Table 4. Bogota's zero emission policy

Year	Target
2025	All new vehicles of the city's BRT system are electric/zero emission vehicles
2030	All new official vehicles for public use are electric/zero emission vehicles All new cargo vehicles registered in Bogota are electric/zero emission vehicles
2036	All new vehicles of the public bus system are electric/zero emission vehicles
2040	All vehicles of the public and private service fleet are electric/zero emission vehicles

Source: ITF based on (Concejo de Bogotá D.C., 2018)

Mobility Master Plan

Bogota's mobility master plan [Plan Maestro de Movilidad], adopted by Decree 319 of 2006, dedicates one section specifically to sustainable development and defines objectives ranging from accessibility to finance-related challenges (Secretaría Distrital de Movilidad de Bogotá D.C., 2019f). The objectives particularly relevant regarding CO₂ emissions reductions include the following:

- Prioritisation of most sustainable transport systems, such as public transport, walking or cycling.
- Promotion of technologies that support the development of efficient road and traffic regulation and control systems.
- Promotion of inter-modal transport to optimise traffic flows and encourage the use of environmentally friendly modes;
- Establishing environmental criteria in the planning of transport systems.
- Improving accessibility in the suburban and rural areas of the city.

All objectives are supported by a comprehensive list of actions by transport sub-sector. Since 2017, Bogota has been in the process of updating its Mobility Master Plan.

Assessment of CO₂ Mitigation Plans

Colombia has taken an exemplary comprehensive approach to assessing CO₂ mitigation actions and respective potentials across the whole economy by developing its sectorial mitigation action plans. These efforts feed into the national climate change policy as well as the country's NDC. However, these efforts have not yet led to the definition of a transport sector-specific mitigation objective. For example, the indicative transport sector mitigation potential stated in the national climate change policy

does not appear to take all considered mitigation efforts into account; the NDC does not provide a transport-specific CO₂ reduction objective. Further efforts should be undertaken to define such a transport-specific objective that accounts for all sub-sector pledges or intermediate goals that have been expressed in the policy documents identified above. This will give all stakeholders a clearer view on where the whole sector is heading and will facilitate the communication of transport-sector objectives at the international level.

Identified transport mitigation potentials and related efforts are comprehensive. They span the different transport sectors (passenger and freight transport) and modes and provide a comprehensive portfolio of actions that are to be followed. Several Nationally adapted mitigation actions (NAMAs) have been developed to support CO₂ mitigation efforts in the transport sector. A focus is put on limiting the use of private motorised vehicle, e.g., via improvements to the public transport system, enhancing walking and cycling infrastructure, and promoting inter-modality in both freight and passenger transport sectors.

Ambitious goals have been set for the uptake of electric vehicles, with requirements for public authorities to renew their vehicle fleets and public transport fleets with zero emission vehicles. These requirements could be combined with vehicle efficiency standards for conventional vehicles to further accelerate the uptake of low (or zero) emission vehicles. It is not clear that the funding for these investments will be available given the existing strains on budgets for public transport in Bogota.

The introduction of the carbon tax on fuel has provided a mechanism that will allow driving zero-emission vehicle uptake in the future, especially if tax levels are increased accordingly when alternative vehicle types are readily available on the market. The carbon tax should be extended to coal-based energy sources, to ensure that alternative fuel vehicles that will enter the fleet run on green energy and do indeed decrease CO₂ emissions from a vehicle well-to-wheel perspective.

Bogota's climate change management plan provides a comprehensive CO₂ reduction strategy across the whole economy of the city. CO₂ reduction goals have been identified for 2030; intermediate goals for 2020 can be assessed in the near future. The city's electric vehicle policy follows best practices around the world. It provides a balanced portfolio of both regulatory and financial measures to incite the uptake of electric vehicles. It also provides measures that target the build of recharge infrastructure and shows that the topic of battery recycling has been considered. The city's new mobility master plan that has been drafted since 2017 will be most relevant for defining the future of the city's transport system and respective CO₂ emissions. Ideally, the master plan should address challenges regarding the institutional integration that have been a barrier to CO₂ mitigation efforts in the past.

It would also be desirable if the plan provided a specific transport CO₂ reduction objective for 2030 and beyond. Authorities are currently working on establishing a baseline scenario for projecting Bogota's GHG emissions from transport (in cooperation with most relevant transport operators in the city). Such efforts should be further pursued to enable assessments of transport mitigation measures and alternative policy scenarios in general. This will be necessary to be able to assess the CO₂, but also other environmental and social impacts of initiatives aiming to tackle challenges for decarbonising transport in line with other policy objectives.

Main challenges for decarbonising transport activities in the Bogota region

Challenges for public transport: facing the increase of motorised private vehicle use by enhancing public transport provision and quality

Private vehicle use is increasing in the Bogota region

Authorities face the challenge of decreasing the use of private motorised modes in Bogota and of promoting the use of vehicles with cleaner technologies. Between 2008 and 2019, private vehicle ownership increased by 120% in Bogota D.C. (Secretaría Distrital de Movilidad de Bogota D.C., 2019g). Car use is likely to continue to grow unless effective policies are put in place to curb it. Without such policies, estimates indicate that the share of car trips in Bogota could multiply by eight between 2008 and 2040. In that scenario, the mode share of car would be the highest of all modes in Bogota by 2040 (Bocarejo, 2019).

Environmental concerns around the use of private motorised vehicles are high, as 61% of transport CO₂ emissions in Bogota D.C. stem from car, SUV, and motorcycle use (Secretaría Distrital de Ambiente, 2017). Emissions are directly linked to the unsustainable fuels of the motorised fleet. In 2020, 95% of private vehicles in the city were fully fuelled by gasoline, while around 3% of them were diesel vehicles. Less than 1% of motorised vehicles in Bogota D.C. were fuelled by low-emission fuels such as natural gas (Secretaría Distrital de Movilidad de Bogotá D.C., 2020). Electric vehicles currently only represent less than 0.1% of the fleet.

The current fleet composition and expected electrification rate of the fleet makes it so attention should be given to reducing overall traffic growth, more than just increasing electric vehicles penetration. Electric vehicles currently account for less than 0.1% of the fleet, in spite of major increases in electric vehicle numbers over the past 10 years. Numbers went from 9 vehicles in 2011 to 1 466 in 2019 (Secretaría Distrital de Movilidad de Bogotá D.C., 2019g). Regulatory incentives at the national and at the local levels aim to increase these numbers. For instance, Mayor López' administration has set a goal of taking the fleet to 6 500 low and zero-emission vehicles by 2024 (Concejo de Bogotá D.C., 2020). Nonetheless, proposed developments do not represent a significant enough increase to curve GHG and local pollutant emissions. Due to this, emphasis in reduction of traffic growth rather than in vehicle fleet electrification would potentially bring higher decarbonisation gains. For further clarifications on electric vehicle incentives at the local and national levels, see the previous section on policy landscape.

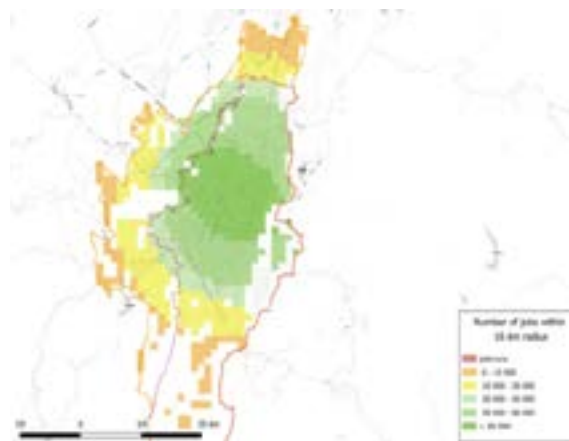
A considerable increase in motorcycle ownership and use amplifies policy concerns. The motorcycle motorisation rate in Bogota multiplied by 8 in a decade, increasing from only 5 motorcycles per 1,000 inhabitants in 2005 to 40 in 2015. The highest motorcycle motorisation rates can be found in low-income boroughs of the city, where there can be more than 80 motorcycles per 1,000 inhabitants (Secretaría Distrital de Movilidad de Bogotá D.C., 2019d).

Motorcycles are directly responsible for 9% of annual CO₂ emissions, as well as for almost 8% of all transport-related PM emissions in Bogota D.C. (Alcaldía Mayor de Bogotá, 2019f; Secretaría Distrital de Ambiente de Bogotá D.C., 2017). They are also an indirect contributor of pollution in the city by increasing congestion. Furthermore, they are a strong competitor of the public transport system, as most users are from lower-income groups who would travel by public transport if they did not have access to a motorcycle. The attractiveness of motorcycles in Bogota is linked to their relative affordability when compared to public transport. According to CAF, the daily cost of using a motorcycle was around USD 2.5, while one round trip with one connection in Bogota's public transport network exceeds this price (Rodríguez, Santana and Pardo, 2015). Authorities will need to address these concerns and seek to increase the relative competitiveness of public transport with respect to motorised private modes in order to decarbonise transport effectively.

Enhancing public transport provision and quality is a necessary in the Bogota region

Public transport services do not adequately meet existing transport demand in the outskirts of Bogota D.C. Some of the highest daily transport demand in the city is from populations living in peripheral, low-income boroughs to the west, as well as from surrounding municipalities in the Cundinamarca department. In both of these areas, up to 1,000,000 trips are generated daily. Most of these trips are directed towards central areas of Bogota D.C. where formal job opportunities are concentrated (Figure 20). Existing public transport infrastructure is insufficient to ensure adequate access to job opportunities. In some locations of the highly dense periphery, public transport only gives access to around 6% of the total job opportunities in the city within 30 minutes. This is 10 times less than the average values for Bogota (International Transport Forum, and Inter-American Development Bank, forthcoming). The disparity in access to jobs exacerbates social exclusion and emissions in the city. Service gaps in SITP are partly covered by informal transport services, which typically operate very old and highly polluting vehicles (International Transport Forum, and Inter-American Development Bank, forthcoming). An alternative to these services is motorcycles, which generate additional CO2 emissions and air pollution.

Figure 18: proximity to transport opportunities in Bogota D.C. and its close municipalities



Source: (International Transport Forum, and Inter-American Development Bank, forthcoming)

Note: the area of analysis reflected in this figure corresponds the urban centre of Bogota, based on the European Union-OECD definition of a functional urban area (Dijkstra, Poelman and Veneri, 2019)

Concerns for public transport service availability increase with the city's future urban expansion. Population growth in the Bogota region will mainly stem from Bogota D.C.'s peripheral boroughs, as well as from its neighbouring municipalities. The population of Bogota D.C. will grow 1.3% per year on average between 2020 and 2030, while municipalities such as Soacha and Funza will grow at 6% (Alcaldía Mayor de Bogotá, 2018c). As a result of this expansion, around 1,000,000 housing units are expected to be built in the Bogota region by 2040, mostly in the periphery (Bocarejo, 2019).

Needs for increasing public transport availability are the highest in low-income areas with insufficient public transport infrastructure, where private means of transport are a common fall-back. In such areas, rapid improvements of the public transport system –for example by expanding the network or increasing service levels via the introduction of priority lanes for buses– are required to keep private vehicle uptake, especially regarding motorcycles, in check. This could be combined with measures that incite the uptake of electric motorcycles. Transmicable has proven to be a successful remedy to accessibility issues in the lowest-income areas.

Improving public transport availability and quality will be crucial to meet mobility demands in a sustainable and equitable manner. Between 2016 and 2018, public transport patronage in the periphery of Bogota D.C. decreased by 11% (Veeduría Distrital de Bogotá D.C., 2019). Decreased use has been linked to a poor perception of service quality. In 2016, around two thirds of users felt that service quality of public transport had decreased. Crowding and increased travel times were seen as two of the main issues (Cámara de Comercio de Bogotá, 2016b). Women are particularly affected by low service quality, highlighting equity concerns behind the necessary improvements (Box 2). The projected metro and BRT expansion in the city will be an essential part of the solution for increasing public transport quality. For instance, the first line of the Bogota metro is expected to be able to transport one million users from Bosa, at the south-west of Bogota, to the city centre, in half of the time it takes by existing public transport. The fully electric metro is expected to reduce CO₂ emissions, albeit by only 1.3 million t CO₂eq in its first 30 years of operation (Consortio Metro de Bogotá, 2019a).

Box 2: Gender Gaps in Bogota

Women's mobility in Bogota can be characterized according to the mobility patterns and the gender-based violence they experience. Data from the 2019 Mobility Survey, reveals that (Arteaga, 2021a):

- Women travel more than men, and women engage more in trip-chaining every day. This can correlate with care-related trips that mostly women perform. The travel rate positively correlates with the income-level for both men and women.
- A larger percentage of female respondents (59.34%) are immobile than men (40.66%).
- More than 60% of immobile women are very-low income.
- 66% of women do not hold any type of driver's license, which means less access to motorized vehicles.
- Women are the main pedestrians, while men are the main users of private vehicles including cars and motorcycles.
- Whereas women's average travel time is 3 minutes less than men per trip, it is more when walking or when using mass transit.
- Women spend less per trip stage, which can be due to the subsidies they receive.

Moreover, the Transport Gender Lab financed a mixed-methods study in Bogota to analyse the mobility characteristics of adults who use the bicycle to take children to school in the districts of Bosa, Kennedy, Suba, and Engativá. The study revealed that 55% of the people taking their kids to school were women (Movilidad Sostenible Ltda., 2019). Both men and women considered that women are more vulnerable when cycling with children to school, in part since some segments lacked segregated bicycle infrastructure to execute this type of trips (Movilidad Sostenible Ltda., 2019).

Regarding sexual harassment, a study conducted by the Thomson Reuters Foundation in 2014 in 15 cities worldwide revealed that Bogota is one of the most dangerous cities for women, since more than 60% of women had suffered sexual harassment in public transportation (Thomson Reuters Foundation, 2014).

Bogota has implemented various initiatives against sexual harassment and to respond to care-related trips. The Transport Gender Lab study in Bogota included recommendations that the city is currently working on, particularly on a project called Care Circuit in Scholar Environments (Circuito de cuidado en entornos escolares for its name in Spanish) (Ávila, 2020). This project aims at improving road safety for children and caregivers through mechanisms that include tactical urbanism, and adapting the infrastructure in the territory to respond to care-related mobility in active transportation modes. Likewise, the city implemented an interinstitutional protocol against sexual harassment. Safetipin, an application developed in India to evaluate and geo-locate unsafe spaces for women in the cities, was also implemented in Bogota (Banco Interamericano de Desarrollo & Ministerio de Transporte de Colombia, 2020).

Authorities face the challenge of financing public transport activities and improvements

Maintaining operation of the SITP represents a major financial challenge for authorities. Profits from trunk lines that run large buses on dedicated lanes are more than offset by losses from feeder routes and the zonal system of traditional buses. Many of these routes suffer from low demand since they were designed to provide coverage rather than needed capacity, and because traffic congestion hinders their service quality. Furthermore, fare evasion throughout the system undercuts revenue. Of the nine operators contracted in 2010, two have sought contract renegotiation with local authorities and three have fallen into bankruptcy and been liquidated. In the areas affected by these liquidations, the provisional system that has been allowed to operate has not managed to meet existing demand. This has considerably reduced services for more than 3 million users in the city's periphery. Authorities have also faced unexpected budget strains. For example, the city has had to buy 2 300 buses, which had not been fully paid for by bankrupt operators, in order to maintain services (Alcaldía Mayor de Bogotá, 2017).

In 2019, TransMilenio S.A. signed an "otrosi" agreement with remaining operators in order to guarantee the financial sustainability of the system. The agreement modifies concession contracts signed in 2009 and lasts from 2012 to 2036. Operators are asked to seek to decrease operational costs and renegotiate with their loan holders. The agreement also sets new service quality and safety requirements for operators. A monthly evaluation system allows Transmilenio to track service quality in a comprehensive manner, by taking into account criteria such as road safety, service delivery, frequencies, the cleanliness of vehicles, the driving behaviour and user satisfaction. This aims at increasing public transport patronage, in order to increase fare revenue (Alcaldía Mayor de Bogotá, 2019a). An evaluation of the effectiveness of this new contractual configuration will be useful in the future in order to eventually adjust measures and respond to new challenges faced by operators. It could also be of help for the design of four new sources of funding for SITP, as proposed by Mayor López's administration in an attempt to decouple user cost from funding.

In 2017, the local government transferred almost USD 150 million annually, or around 25% of total operating costs to TransMilenio S.A., to a Fare Stabilization Fund in order to cover the operating deficit. This funding helps subsidize fares for selected populations, support low-demand bus services that ensure coverage, and tolerate fluctuations in fuel prices and overall demand. In 2018, subsidies represented approximately USD 0.029 (86 COP) per BRT trip and USD 0.39 (1 105 COP) per zonal trip (Bocarejo, 2019).

Fare discounts for three user groups account for over a fifth of operating subsidies in Bogota D.C. (Veeduría Distrital de Bogota D.C., 2018). The elderly – users who are 62 years old or older – pay around 86% of the ticket fee for trunk and feeder services. People older than 16 years old, who qualify for the national social programmes system (Sisbén), also receive a discount of 40% for up to 30 trips for both the trunk and feeder SITP services (Veeduría Distrital de Bogota D.C., 2018). People with proven permanent disabilities receive a monthly aid of COP 24,000 (around 5.4 EUR for 2020 exchange rates) in their TuLlave card (Transmilenio S.A., 2020).

City authorities will need to develop funding mechanisms to meet budgetary challenges. The national law 1955 of 2019 opens the door for new financial tools, as its article 97 gives cities the capacity to develop sources of revenue for funding public transport systems such as land-value capture and pricing mechanisms – measures that have proven to be highly effective in shifting motorised private transport onto public transport modes. Such alternative funding options can help ensure public transport subsidy levels can be maintained at current levels. Other possibilities allowed by the law include raising funds from paid parking, as well as using up to 60% of fines for traffic offences for public transport improvement purposes (Minjusticia, 2019). The possibility of having paid on-street parking in Bogota D.C. was introduced in 2019. Early evaluation of this new scheme by Bogota D.C. authorities have indicated that the implementation process has not yet been successful, and would need to be furthered. Even if the measure has yet to be formally implemented, it could open the door for a new source of funds.

Beyond paid on-street parking, other financial mechanisms could be considered. One idea put forward has been to ask for drivers to pay an annual fee in order to avoid car restrictions (*pico y placa*). Nonetheless, when thinking about this measure, authorities will need to consider potential negative externalities of this measure for air quality or for the uptake of alternative fuel vehicles. A potential option would be to direct these eventual funds towards public transport improvements. Finally, tackling rampant fare evasion in public transport can provide a further remedy for funding bottlenecks.

Collaboration with sector will be essential – both, for identifying possible avenues of funding for transport infrastructure projects, but also for tackling CO2 emissions from freight transport and building a network of electric vehicle recharge infrastructure. The recent fleet renewal pilot for the trunk BRT system has been a successful example of cooperation with private operators to reduce emissions. Nonetheless, the credibility of the public sector to carry major infrastructure projects alongside private actors has been undermined by delays to tender processes. An example of this is the unsuccessful attempts of authorities to tender the construction of the Metro. Increasing trust in authorities' capacities to develop partnerships with private actors will be necessary to garner support for the required infrastructure projects for the city. Partnerships with private entities will also be required to deploy electric vehicle charging infrastructure across the city. (Bocarejo, 2019).

Challenges for decarbonising freight transport activities

Sustainable inter-urban freight movements will be essential for transport decarbonisation in Colombia and the Bogota region will remain at the centre of the sector for the foreseeable future. Most freight transport going to and from the Bogota region occurs by road and emissions from this mode are expected to almost double by 2040 (Cámara de Comercio de Bogota, 2016a).

One challenge is to reduce the fleet age, as almost 50% of road freight vehicles in Colombia are 16 years or older (DNP, 2019). For this, it will be necessary to assess the effectiveness of measures applied by authorities to foster fleet renovation. National authorities made available a fund in April 2019 to subsidise the replacement of vehicles that weigh over 10.5 tonnes and are more than 20 years old with newer, cleaner vehicles (MinTransporte, 2019). At a more local level, Bogota D.C. authorities have brokered an agreement with freight fleet vehicle owners operating in the capital. Under such an agreement, around 1,000 vehicles are expected to be renewed per year until 2030.

A second challenge will be to promote multi-modality. For this, infrastructure investments and price incentives will be needed to increase the relative affordability of railways of the Cundinamarca region. Recent investments to reopen the Bogota-Belencito railway line are positive improvements, and more than 40,000 tonnes have been transported via the line since its reopening in 2018 (MundoMarítimo, 2019).

Increasing airfreight transport activity in the Bogota region will be particularly challenging from a decarbonisation perspective. The El Dorado International Airport (AIED for its Spanish initials) is a key asset for freight in Bogota and the primary gateway for exporting goods produced in the region. AIED is also the main recipient of airfreight in Colombia and Latin America by volume (Alcaldía Mayor de Bogota, 2018b). Authorities aim at turning the airport into the main air hub in the region, and AIED's freight infrastructure has been expanded to this end (Avella Zambrano et al., 2012). For all its economic benefits, increased airfreight raises multiple environmental concerns. Increased GHG emissions from flights are just some of them. More airfreight activity also puts further pressure on existing infrastructure connecting the airport with the Bogota region. The required increase in truck trips from the airport to Bogota could increase congestion levels on Calle 26, the main avenue connecting the airport to the city (Avella Zambrano et al., 2012). This could lead to indirect GHG emissions in the Bogota region.

Local authorities have the challenge of furthering data-gathering efforts to better understand and manage urban freight. Bogota's Mobility Secretariat has developed sophisticated modelling techniques and data sources for evaluating freight policies. For instance, an origin-destination matrix for truck freight operations was estimated in 2015 (Alcaldía Mayor de Bogotá, 2018e). Nonetheless, existing information does not give visibility on the actual road freight movements inside of Bogota (Hidalgo, 2019). It also lacks inputs on the movements and behaviour of new entrants of urban logistics, such as services and food deliverers. Finally, little to no data are available concerning the way in which urban logistics functions in informal settlements. This raises social, but also environmental concerns. Failing to understand freight activities in informal spaces can lead to ineffective transport management (Ribotta Hirakawa, Roman Rodrigues and Fontes Lima, 2018), and thus to increased emissions in low-income areas.

There is also the need to further engage with private actors across the Bogota region. Due to the private nature of freight activities, cooperating with freight generators and with logistic companies is essential for decarbonising the sector. Cooperation can lead to increasing data-availability for public authorities. For instance, city authorities have developed Memorandums of Understanding with some major companies in the Bogota region for data-sharing purposes (Alcaldía Mayor de Bogotá, 2018e). It can also enhance sustainability efforts by enterprises, such as eco-driving or off-peak deliveries. In Bogota, a voluntary urban logistics network has been led by city authorities since 2017 to promote this type of effort. Its participants have mainly been big enterprises attracted by benefits such as "good practices" labels (Alcaldía Mayor de Bogotá, 2018e). Today, 163 organisations are part of the network. Authorities have the challenge to engage with smaller operators who may see few benefits from corporate social responsibility practices (Garros, 2019). A way forward may be to emphasise potential productivity and cost efficiency gains of sustainability efforts. For instance, a joint eco-driving training programme between Colombian authorities and MIT researchers decreased fuel consumption by around 7% (Díaz-Ramirez et al., 2017).

Challenges for air quality: decarbonising while also decreasing local pollutants emissions

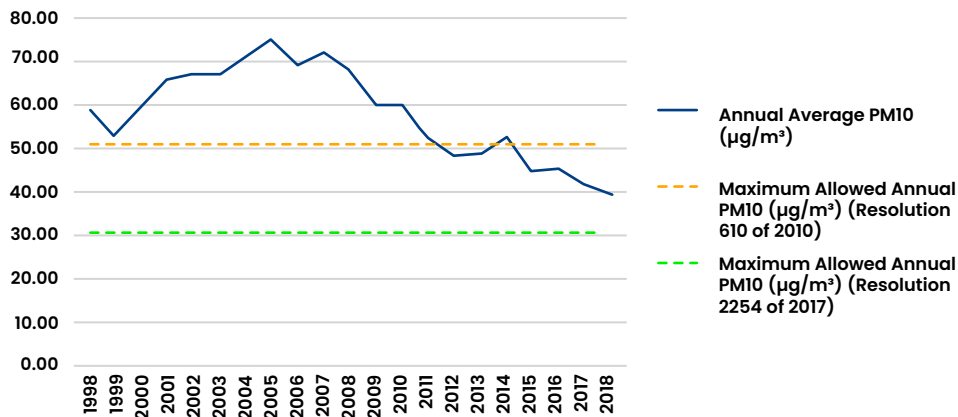
Air quality is one of the main policy priorities in Colombia, and particularly in Bogota. In 2017, almost half of Bogota's citizens considered air pollution to be the most important environmental issue in the country (DNP, 2018). In 2017, more than 2 165 (7%) of deaths in Bogota D.C. were attributed to urban air pollution (Secretaría Distrital de Salud de Bogotá D.C., 2017). Health concerns are mostly linked to exposure to particulate matter. WHO guidelines indicate that an average annual concentration of $70 \mu\text{g}/\text{m}^3$ PM_{10} is linked to an increase of 15% in long-term mortality risk (Box 2). In Bogota, the average annual concentration of PM_{10} between 1998 and 2010 was of $65 \mu\text{g}/\text{m}^3$ PM_{10} , peaking at $75 \mu\text{g}/\text{m}^3$ in 2005 (Alcaldía Mayor de Bogota, 2019d).

Table 5: Air quality guidelines of the WHO and intermediate objectives for particulate matter

	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	Basis for the selected level
Interim target-1 (IT-1)	70	35	These levels are associated with about a 15% higher long-term mortality risk relative to the AQG level
Interim target-2 (IT-2)	50	25	In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to the IT-1 level.
Interim target-3 (IT-3)	30	15	In addition to other health benefits, these levels reduce the mortality risk by approximately 6% [2–11%] relative to the IT-2 level.
Air quality guideline (AQG)	20	10	These are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to PM _{2.5}

Source: (WHO, 2005)

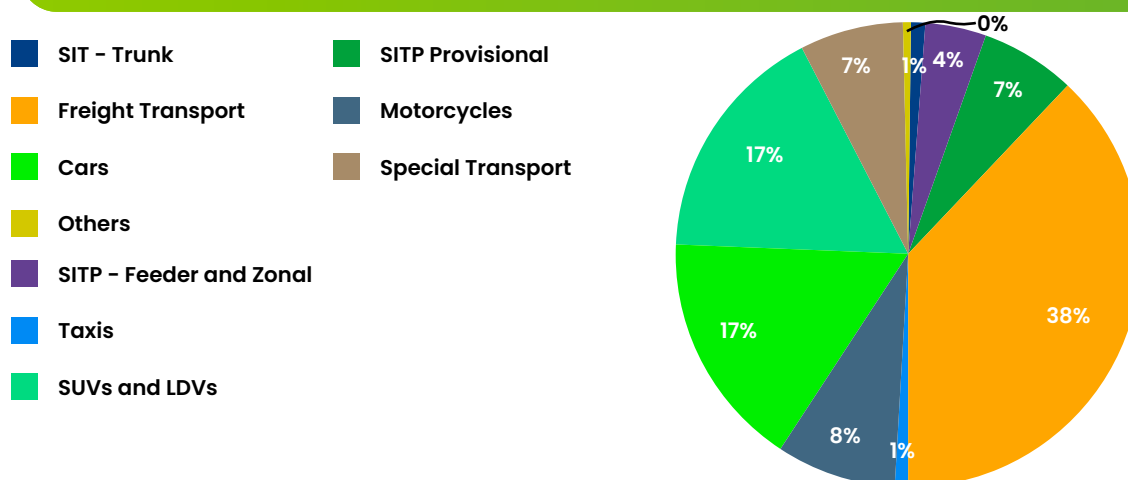
National and local authorities have made efforts to reduce air pollution in Bogota D.C. In 2010, national Resolution 610 limited annual PM averages allowed in cities to 50 µg/m³. In 2017, Resolution 2254 expanded these ambitions by setting a target of a maximum concentration of 30 µg/m³ by 2030 (DNP, 2018a). These two limits correspond respectively to the Interim target-2 and interim target-3 of WHO Guidelines (Box 2). Since 2011, local authorities in Bogota have been meeting 2010 targets, and concentrations have decreased from 60 µg/m³ in 2010 to 39 µg/m³ in 2018 (Alcaldía Mayor de Bogota, 2019d) (Figure 19).

Figure 19: Annual average PM10 (µg/m³) in Bogota (1998–2018)

Source: ITF, based on (Alcaldía Mayor de Bogotá, 2019d) and on (Departamento Nacional de Planeación (DNP), 2018a)

Transport activities generate 1 847 t PM₁₀ annually in Bogota D.C. (Secretaría Distrital de Ambiente de Bogotá D.C., 2020b). As Figure 20 illustrates, private motor vehicles are responsible for more than 40% of all transport related PM₁₀ emissions in the city. Freight transport activities are the second highest source of PM₁₀ emissions from transport, contributing just short of 40%. Public transport contributes less than 20% of total transport related PM₁₀ emissions in the city (Secretaría Distrital de Ambiente de Bogotá D.C., 2020).

Figure 20: Share of PM10 emissions for different transport modes in Bogota D.C. (2018 values)



Source: ITF based on (Secretaría Distrital de Ambiente de Bogotá D.C., 2020)

Policy efforts for reducing air pollution tend to focus on the industry and transport sectors. Nonetheless, pollution stemming from fires from eastern Colombia, and Venezuela, also contribute strongly towards decreased air quality levels in the whole Bogota region. Effective policy responses for reducing fire-produced air pollution in Bogota could require cooperation between all relevant national and international authorities.

Bogota D.C. local authorities have promoted various transport policies as part of their actions for improving air quality in the city. Since 1998, authorities have enforced Pico y Placa, a policy that restricts cars from circulating depending on their plate numbers and the day of the week (see the section on current policy landscape for details). Additionally, maximum opacity levels have been set for the exhaust from diesel freight and public passenger transport vehicles (Table 1). Linked to these policies, authorities have promoted a voluntary scheme of “self-regulation” for operators of public passenger and freight transport with diesel vehicles. The programme requires enterprises to carry out maintenance to achieve emission levels 20% below the imposed limit in order to earn exemption from Pico y Placa restrictions (Alcaldía Mayor de Bogotá, 2019e).

Table 6: Maximum exhaust opacity levels for diesel public transport and levels for enterprises in the “self-regulated” scheme

Year/Model	Opacity (%)	Self-regulated opacity (%)
1970 and before	50	40
1971-1984	26	20
1985-1997	24	19
1998-2009	20	16
2010 and beyond	15	12

Source: ITF based on (Alcaldía Mayor de Bogotá, 2019e)

The impacts of pico y placa are contested. There is no clear evidence of an improvement in air quality or a reduction in car use stemming from the implementation of the initial scheme. In fact, research suggests that the policy has encouraged households to purchase a second car and has not reduced vehicle activity (Vassallo, Bueno and Rivas, 2018). The extended pico y placa policy, which also includes

the most polluting diesel vehicles from the public transport and cargo fleets, has, however, shown to be effective in reducing air pollution.

Authorities have developed new regulations to reduce local air pollution from freight. Decree 840 of 2019 and Decree 077 of 2020 restrict the circulation of freight vehicles inside Bogota D.C. It splits the city in three main zones (Figure 21). In Zone 1, the regulation only permits the circulation between 6 and 8 am and 5 to 8 pm of vehicles with, at most, two axes and a maximum weight of 8 500 kg. The free circulation of freight vehicles is allowed in Zone 2, depending on the signalling and other road hierarchy regulations. A third area in Candelaria, the city's historic centre, only allows, at all times, vehicles with 2 axes at most and a maximum weight of 3 500 kg. Added to these restrictions, vehicles of more than 20 years of age are not allowed to circulate within the city at peak hours during the week. On Saturdays, only half of vehicles of more than 20 years of age are allowed within the boundaries of Bogota D.C., depending on whether the last number of their plate is an odd or even number. Certain vehicles are exempted from these restrictions, including those delivering essential goods such as medical supplies, as well as low and zero-emissions freight vehicles (Alcaldía Mayor de Bogotá, 2020e).

Figure 21: Road freight restriction zones in Bogota D.C. as per Decree 077 of 2020



Source: (Alcaldía Mayor de Bogotá, 2020e)

Other policies for promoting the adoption of sustainable mobility have had varying, indirect, results in terms of air quality improvements. The *Días sin Carro* (Days without Cars) policy has aimed at increasing the use of sustainable mobility in the city by banning the use of cars and motorcycles on selected days. During these days, forms of collective transport, be it official or informal, become virtually the only forms of motorised transport. Official analyses indicate that this measure can have slight indirect air quality benefits for Bogota D.C. as a whole. Other studies, however, highlight that the measure could deteriorate air quality levels on implementation days in some areas due to increased use of more polluting, diesel-powered vehicles found in informal and public transport services fleets (Hernández, 2019). Eventual negative externalities of *Días sin Carro* could be decreased with fleet renewal and formalisation of existing public transport supply in Bogota.

Including air quality improvement in policies aimed at reducing GHG emissions is challenging. Authorities have put forward policies such as transit-oriented development (TOD) around TransMilenio stations as a way to contribute to sustainable mobility and mitigate CO₂ emissions. However, recent data points towards a potential link between TOD projects and increased exposure to exhaust emissions around public transport stops. This increase stems from the increased movements of diesel buses around stations and higher population densities around these areas (Espinosa Valderrama, 2019). Likewise, a

comparison of air quality levels for different modes in Bogota indicates that the worst air quality is experienced inside public transport vehicles. The best air quality out of all modes – including walking and cycling – is found inside cars. This fact raises equity concerns as higher income commuters, using their own cars, enjoy better air quality than lower income groups that use public transport (Betancourt and Contreras, 2017). Renovating the public transport fleets with cleaner vehicles will help mitigate all of these air-quality side-effects of the system. TransMilenio authorities have analysed the impact of air quality within BRT stations before and after renovating 778 BRT buses and found a reduction in exposure to particulate matter of around 50%.

Air pollution is an environmental justice issue in the Bogota region. Lower income boroughs to the south and south-west of the city tend to be exposed to worse air quality due to a higher presence of industries and heavy vehicles. Boroughs to the east have the best air quality of the city (García Aguirre, 2018). In 2019 alone, there have been three yellow alert days with concentrations of more than $154 \mu\text{g}/\text{m}^3 \text{PM}_{10}$ in 24h in the city. On these days, south-western boroughs suffered an orange alert, which indicates concentration levels of at least $255 \mu\text{g}/\text{m}^3 \text{PM}_{10}$ over a 24h period. On days with particularly severe pollution, the city has temporarily restricted traffic of certain vehicle types in the most affected areas (Alcaldía Mayor de Bogotá, 2020c; Alcaldía Mayor de Bogotá, 2020d).

Governance challenges: developing an institutional framework at the regional scale

Today, there is no effective governance framework for the Bogota region. Three main authorities co-exist in the same area: the National State, the Bogota Capital District and the Cundinamarca Department. Additionally, each municipality within Cundinamarca has its own governing body. The municipal governments and capital district typically plan and implement their own transport policies. As such, there are no defined cooperation frameworks for regional-wide services. Because of this, planning and implementation processes for regional transport projects are defined on a case-by-case basis and do not always include all relevant stakeholders. For instance, mobility surveys in the region are carried out exclusively at the request of the Bogota Capital District's Mobility Secretariat (Secretaría Distrital de Movilidad de Bogotá D.C., 2015).

The new Regiotram provides another example of low cooperation for major infrastructure projects. Regiotram is a USD 600 million railway project to connect by train the Bogota D.C. with municipalities in the rest of the Cundinamarca department. As of late 2019, the project was being led by Cundinamarca, the national government and Empresa Ferrea Regional (EFR), the partnership created for the project. Coordination with Bogota D.C. authorities has been low, mainly being limited to discussions of intersections with important roads and the level of integration with the first metro line and BRT. Although authorities from Cundinamarca have indicated that the train will adopt Bogota's smart card system, negotiations on revenue sharing and fare integration are still in discussion.

A lack of a regional body responsible for transport policy and planning limits capacity to implement environmental protection measures. As an illustration, some measures of the Decennial Air Quality Improvement Plan for Bogota 2010–2020 have had limited effectiveness due to its limited geographic scope. The plan was set in 2010 as a roadmap for improving air quality in the administrative Bogota D.C., but did not extend to the rest of the region. One of the measures put forward by the plan was to require all freight vehicles circulating in Bogota to have catalysers (Alcaldía Mayor de Bogotá, 2010). However, the effectiveness of the measure was limited due to the fact that most of the freight vehicles circulating in the Bogota region are not registered within the Bogota Capital District (Alcaldía Mayor de Bogotá, 2017).

Region-wide challenges present opportunities to revive previously proposed regional governance initiatives. In 2001, efforts from the National government and UNDP led to the creation of a regional nego-

tiation forum made of authorities of Bogota and the Cundinamarca department. The forum was never formalised and disappeared, as it largely relied too heavily on the political will of the mayor and the governor that created it (Jaramillo et al., 2003). Nonetheless, there were suggestions at the forum for wider regional cooperation and even mentions of a formal entity to coordinate policies and promote competitiveness at the regional level (Secretaría de Planeación de Cundinamarca, 2009). The promotion of region-wide initiatives, such as the future Regiotram, could be an opportunity for fostering wider regional cooperation such as previous proposals linked to the negotiation table.

Promoting an effective transport authority for the Bogota region could be an asset for its transport decarbonisation agenda. Such institutions have proved their potential for enhancing sustainable mobility at the metropolitan and regional scales in urban areas such as Paris, London and Barcelona (International Transport Forum, 2018). Bogota D.C. authorities have included in their District Development Plan the creation of such a regional authority (Concejo de Bogotá D.C., 2020). Furthermore, a nearly approved Constitutional reform would permit the formation of a regional governing body that comprises representatives from Bogota D.C., Cundinamarca and willing municipalities inside of the department to address select policy issues. The governing body could serve as a framework for a regional transport authority.

Chapter 2: Mexico City



Key Characteristics of the Urban Area and its Transport System

The area of study of this chapter is the Metropolitan Zone of the Valley of Mexico (Zona Metropolitana del Valle de México, ZMVM). In 2005, the Federal and State authorities agreed to the establishment of ZMVM, comprising Mexico City (CDMX), 59 municipalities in the eastern arm of the State of Mexico that surrounds CDMX to the east and northwest, and one municipality in the State of Hidalgo in the north.

Figure 1 shows the administrative boundaries of the municipalities that make up the ZMVM. Although there are many institutional mechanisms for metropolitan coordination, including a number of Commissions for coordinating planning, in practice coordination across the different states and municipalities has not been effective, undermining planning of infrastructure investment and the regulation of transport services.

This chapter discusses some of the main characteristics relevant for transport decarbonisation within the ZMVM. To this end, it briefly describes the city and transport activities for jurisdictions within it, with an emphasis on CDMX. It then highlights the existing policy landscape relevant for transport decarbonisation, insisting on those of CDMX and the City's Secretariat of Mobility (SEMOVI) and Secretariat of Environment (SEDEMA). Relevant policies of the Federal Government and of the State of Mexico

Figure 1. The Metropolitan Zone of the Valley of Mexico (ZMVM)

-  State limit
-  Metropolitan area
-  Metropolitan zone

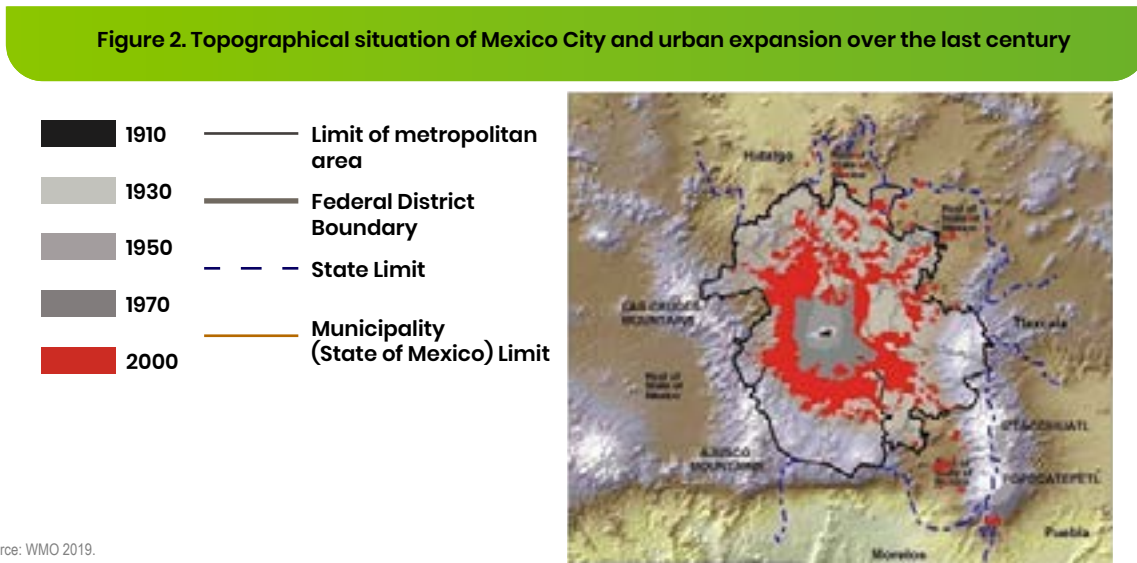


are covered, and identified as such where they are mentioned. A final section sheds light into some of the main challenges and potential solutions for decarbonising transport activities in the ZMVM.

The city

ZMVM spreads over three States, with a total population of over 21 million. This is equivalent to around 16% of the country's population. The City of Mexico (CDMX) is comprised of 16 municipalities (*alcaldías*) and has a population of 8.9 million people. It has a similar level of autonomy to the 31 Federal States of the country. Prior to a change in legal status in 2016, CDMX was the Federal District of Mexico City (Distrito Federal). To the east, north and west lies the State of Mexico (Estado de Mexico) where many of the lower income commuters in the City of Mexico reside. Today, roughly half of the built-up area lies in CDMX and half in the State of Mexico.

Much of the urban area is flat land, former lake beds, surrounded by mountains reaching 4,000 m to the west, south and east. Figure 2 shows the geographical situation of the ZMVM and the rapid spread of urbanisation in the latter half of the 20th century.

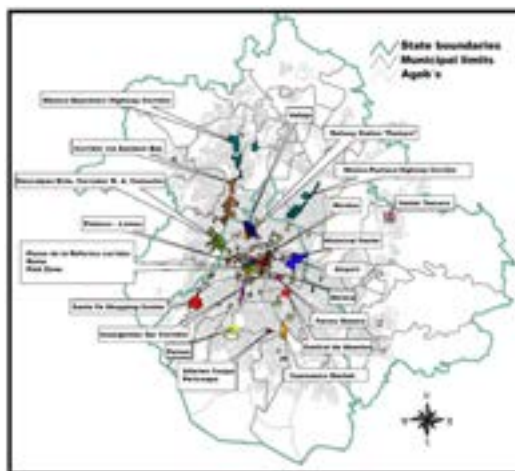


ZMVM concentrates a high share of the Mexican economic activity, but income inequalities remain high within it. ZMVM accounts for about 22% of national GDP and the CDMX alone for about 16%. Annual median household income in CDMX is around MXN 316,000 (USD 16,000) compared to around MXN 200,000 (USD 10,000) nationally (INEGI 2018). Median income in the State of Mexico is just below the national average. Most formal job opportunities are concentrated within central parts of CDMX. Some of the highest value-added services, as well as higher income residential areas, are located on the western mountain slopes, within CDMX. Lower income areas are mostly found at the periphery of ZMVM, particularly to the north and east, far away from central areas. High inequalities are also present within CDMX. Up to 40% of homes in some neighbourhoods within Mexico City are not connected to basic services, such as water, drainage or electricity network. Some of these neighbourhoods can be adjacent to high income ones, or even encompass them (OECD, 2015).

The Transport System

Transport accounts for 49% of the anthropogenic CO₂ emissions of CDMX, with 16% emitted by industry and 35% from buildings and other dispersed sources (SEDEMA 2014). Figure 3 identifies areas generating and attracting the most intense transport activity, both passenger and freight trips. The data is old, from 1994, but these areas persist as trip generators with activity spreading and intensifying along the corridors already apparent in the figure.

Figure 3. Principal areas generating and attracting trips in the ZMVM



Source: UNAM 2006.

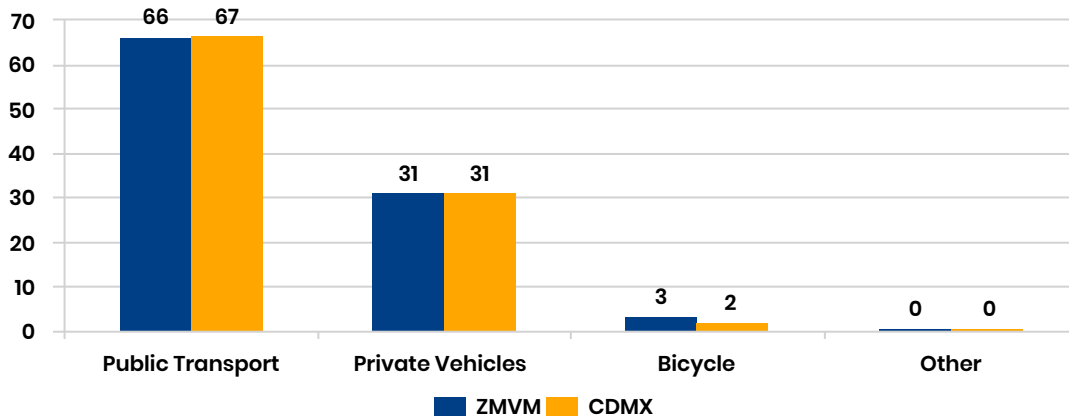
Transport is predominantly road based. The road network is extensive with most of the roads paved (%). There is a mix of asphalt and concrete pavements. Unrepaired cracks, potholes and broken culverts are common. The urban streets and some of the highways are calmed with frequent, large speed humps. An extensive network of urban motorways has been constructed, with toll motorways on viaducts added on some of the expressway alignments at the turn of the century. In many places the road system creates hostile conditions for pedestrians and non-motorised users, severing neighbourhoods and creating unsafe conditions on carriageways and at junctions. Vulnerable users of all kinds are particularly affected.

Passenger transport

A very high proportion of passenger trips are undertaken by public transport (Figure 4). The National Statistics Institute's 2017 travel survey found that two thirds of weekday motorized trips in the ZMVM are by public transport (INEGI 2017). Of these the majority, 55%, are by loosely regulated minibuses (Figure 5); in Mexico City these account for 48% of all trips on public transport, in the State of Mexico the figure is 65%.

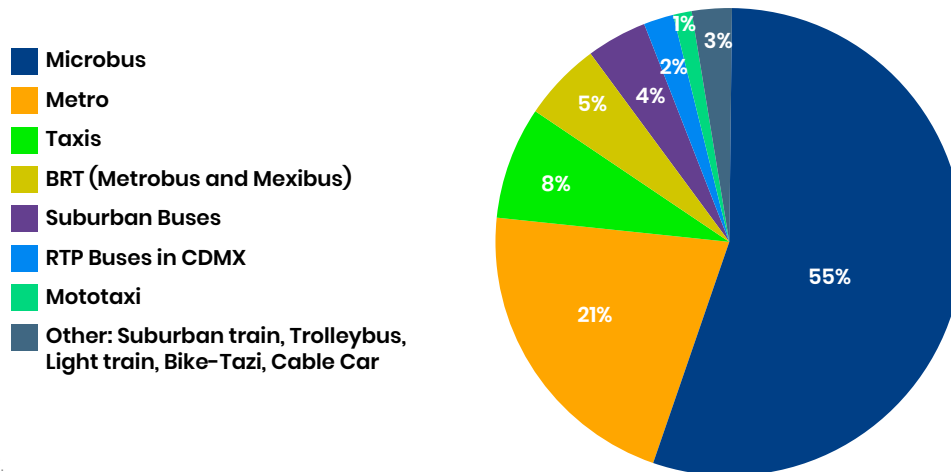
Congestion on the roads and crowding on public transport are severe in peak hours. This reflects sprawling urban development with weak transport planning and underinvestment in transit systems. Expansion of the road system has tended to induce demand rather than relieve congestion, with average speeds on central roads estimated at 11 km/h (IDB 2018), half the 20 to 30 km/h optimum for urban roads of theoretical models (ITF 2018).

Figure 4. Modal split of trips in the Metropolitan Area of Mexico City (excluding walking)



Source: INEGI 2017.

Figure 5. Distribution of weekday trips in the Metropolitan Area of Mexico City by public transport



Source: INEGI 2017.

Microbuses (also known as peseros, colectivos, micros or combis) (see Figure 5) carry the largest share of all motorised passenger traffic, accounting for 55% of weekday trips by public transport and 37% of all motorised trips (INEGI 2017). In Mexico City fares are regulated, set at a low level for affordability between MXN 2 (USD 0.10) and MXN 7 per trip (USD 0.35). Only the most basic vehicle standards are enforced and the low fares, and absence of subsidies for private microbus services, limit investments that could improve the quality of the vehicles or enhance services overall. Vehicles vary greatly in condition with an average age of 18 years (SEMOVI, 2019). Operators grouped in associations (*rutas*) hold individual concessions that set loosely regulated routes. Under the business model usually employed, drivers pay a rent to vehicle owners and are remunerated by retaining any surplus from the fares they collect. In practice, drivers deviate from the set routes to search out additional passengers. Competition for demand, which translates into high-speed races in the streets are commonplace, and stops can be long while drivers maximise the number of passengers carried. Microbus stations, often adjacent to RTP bus stations and metro stations, can be chaotic and severely congested. Together these factors, driven by the overriding incentive to maximise passengers carried per vehicle trip, greatly lengthen journey times and the vehicles are frequently severely overloaded. Nevertheless, the system is the basis for mobility in the city.

The Metro (Figures 5 and 6), known as the Sistema de Transporte Colectivo, STC, is the busiest in Latin America and second largest in North America. It now carries around 1.6 billion passengers a year, around 4.9 million each weekday. 202 million of these passengers travel free under concessionary fare provisions. Twelve metro lines were constructed between 1967 and 2012 with Federal funding. The system totals 226 km of track and 195 stations. Coverage of the system is largely limited to the territory of CDMX (Figure 1), with only 11 stations along 2 lines (A and B) beyond its borders. These lines mainly serve municipalities in the State of Mexico, but responsibility for funding maintenance was passed from the Federal Government to CDMX in 1997, complicating prospects for further extension of the lines.

The lines vary in quality and operational reliability with age and with the rehabilitation work undertaken. Line 12, the last to be built, was shut down for a time because of technical issues with some of the works undertaken. Generally, the system suffers from inadequate investment in maintenance and renewal. Of STC's 374 trainsets, around 101 were out of operation in 2018 due to maintenance problems. This greatly undermines performance and exacerbates overcrowding. The surroundings of some stations have recently been redeveloped to improve access and the security of users. The low-priced metro system (fare MXN 5 / USD 0.25 since 2013) requires USD 500 million per year in subsidies from the government of CDMX, representing 60% of its budget. Farebox revenue accounts for only about half of operating costs (Gonzalez-Navarro and Turner, 2015 and 2018).

The government of CDMX published a masterplan for the Metro in 2018 (CDMX 2018), which included the results of demand modelling to determine potential projects for extension of the network and adding links between existing lines. Ten projects were identified, including major extensions into the State of Mexico to the northeast, southeast and northwest. The Federal Government planned to fund the two latter extensions. CDMX plans to implement two of the ten projects under its new four year strategic mobility plan. The first is a 4.6 km extension to line 12 to link it to the terminus of line 1 at Observatorio, where the partly built suburban rail line from Toluca is due to terminate. The second is a 7 km link from the terminus of line 8 to line A in the east of CDMX.

Mexico City has seven Bus Rapid Transit (BRT) lines, known as Metrobus (Figure 6). These carry around 1.5 million passengers a day. The State of Mexico has three BRT lines, known as Mexibus, totaling 32 km with 95 stations. CDMX's Line 1 started operations in 2005, running the length of Insurgentes Avenue, a key north-south axis, replacing 372 standard buses and minibuses with 212 articulated and double articulated buses. The operating company was formed, after protracted negotiations, by a consortium of some of the previous bus operators (Flores 2016). A public company (Red de Transporte de Pasajeros) also operates a small percentage of the fleet. The system has expanded slowly, given the need to negotiate with existing bus operators on each of the routes. Line 1, which has a ridership of more than half a million passengers a day, has been overcrowded since its inception, despite running very large vehicles with very short headways. This heavily trafficked route would have benefited from the higher capacity of a metro line. Density of traffic varies greatly between the lines, the latest of which opened in 2018. It runs along the Reforma Avenue on segregated lanes with double decker buses rather than the usual multi-carriage articulated vehicles.

CDMX's buses and minibuses (Figures 6 and 7) carry 80% of passenger traffic. Large regular buses carry a higher proportion of this traffic in CDMX than in the metropolitan area as a whole. As with BRT corridors, the City authorities have negotiated with traditional operators the creation of professionalised companies for the operation of bus corridors, replacing minibuses with standard buses, running to more regular schedules on more direct routes, with partially protected bus priority lanes. Currently, the city has 23 of these corridors, operated with a fleet totalling 2,000 buses.

Regular buses (Figure 7) are operated by RTP (Red de Transporte de Pasajeros), a public company that has a fleet of 800 buses operating 98 routes. In the case of RTP, fares depend on the technology of buses. For those services operated with old units (more than 10 years old), the fare is MXN 2 per trip (USD 0.10). In the case of routes operated with higher standard buses, the fare is usually MXN 5 (USD 0.25). Standard 35 plus seat single deck buses are used. Two lines operate low emission natural gas vehicles from the city to the Santa Fe business district. As part of a fleet renewal process, almost 200 new buses (diesel Euro V and Euro VI) were added to the fleet in 2019 and 2020. The goal is 800 new buses by 2024.

Eight trolleybus lines (Figure 8) operate within the CDMX area, totalling 204 kilometres, with 290 vehicles in operation. Most of the vehicles are over 20 years old and the fleet has contracted in the last two years as the vehicles in poorest condition are retired. The system was first developed in the 1950s and is operated for the government by the Servicio de Transportes Eléctricos (STE). The modernisation process started in 2019 added 193 new trolleybuses in 2019 and 2020. The goal is to add 500 new units by 2024.

A suburban rail line (Figure 9) began operation in 2008, running north 27 km from the Buenavista station in CDMX (that served intercity passenger services until 1997) to Cuautitlán in the State of Mexico, with 7 stations. Ridership grew more slowly than projected but reached 184,000 a day in 2015, close to the planned 192,000 a day. Services, operated by a private company, are run on the pre-existing freight rail alignment, which is suboptimal in terms of access to centres of population, accounting for the initial shortfall in passengers carried. Two further suburban train services along freight rail alignments were planned initially but have not been built. A light train service operates also in the south of the city extending line 2 of the Metro system to Xochimilco, a notable leisure destination. This line is operated by STE.

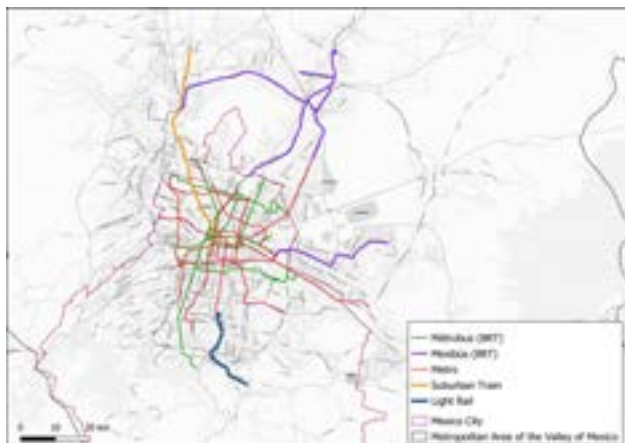
Informal mototaxis, three wheeled auto-rickshaws, account for 1% of public transport trips in the ZMVM. These are unregulated services and operate mainly in the more peripheral areas. In some of the smaller towns of Mexico, these vehicles provide the mainstay of local public transport services in the typically narrow streets, using recently manufactured vehicles.

Figure 6. Extent of metro, BRT and bus services (black) and microbus services (red)



Source: Whereismytransport for ITF/IADB 2019.

Figure 7. Mass Transit Systems in Mexico City and the State of Mexico (excluding Trolleybuses)



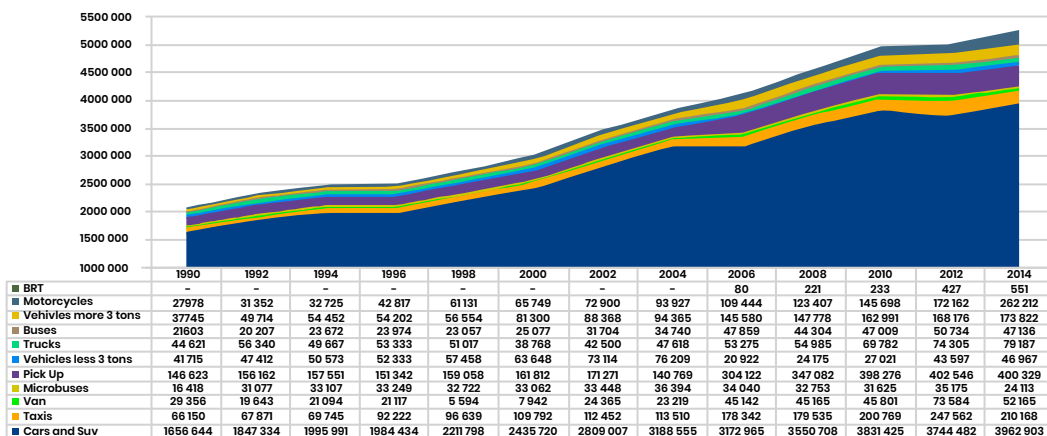
Source: OpenStreetMaps (OSM) (<https://www.openstreetmap.org>)

Figure 8. Trolleybus system in Mexico City



Source: Moovit, https://moovitapp.com/index/en/public_transit-Offline_maps_Trolleybus_Lines_Map-map-Ciudad_de_Mexico-822-809

Figure 9. Registered vehicles by type in ZMVM 1990–2014



Source: SEDEMA (2017).

A third of all weekday trips are made by private passenger cars and motorcycles. Vehicle numbers in each of these categories have grown strongly over the last 20 years, and growth continues. Figures for vehicles registered in the ZMVM are summarised in Figure 9. This is a substantial underestimate of the total fleet of cars used by households in the metropolitan area as many are registered in the neighbouring State of Morelos, which no longer applies a vehicle registration tax.

New vehicles sold in Mexico comply with either US or EU criteria pollutant emission standards. Both standards are valid, and manufacturers can choose which to follow. For cars and heavy trucks both regimes are used in practice, but most buses are manufactured in compliance with the European standards. CO₂ emissions standards for both light and heavy-duty vehicles are under development. CO₂ emissions and the fuel economy equivalent for new passenger vehicles (cars, pickup trucks, and SUVs) were adopted in 2013 (NOM-163), mandating an average new car fleet average fuel economy of 14.9 km/L (6.7 L/100km, 35 mpg) for model years to 2016. The standard was patterned on U.S. National Highway Transportation Safety Administration (NHTSA) 2012–2016 standards.

Motorcycles are a small (5%) but growing proportion of the motorised vehicle fleet. Their relatively low cost makes them a ready substitute for poor quality public transport as soon as income permits purchase. CO₂ emissions from motorcycles are relatively small but they have a disproportionate impact on air pollution.

Cycling accounted for 3.0% of trips in the ZMVM according to the 2017 travel survey but just 1.4% in CDMX. The City government has promoted cycling over the last decade, establishing 332 km of designated cycle lanes by June 2020. The bike lanes are protected by intermittent separators and marking some of the relatively few protected bus lanes also for use by cyclists. The goal of the current administration is to implement 400 kilometres of bike lanes between 2019 and 2024, so the city will have a total of 600 kilometres by 2024 (88 km. were implemented in 2019, and 69 more are to be built in 2020). *Muévete en bici*, weekly car-free Sunday mornings in the central part of the city, have attracted more than one million cyclists in the seven years since they were first introduced.

The Environment Ministry of CDMX (SEDEMA) established Ecobici, a subsidised, docked bike share system, in 2010. This is operated under concession in the central western part of the city, with responsibility for the system transferred to the Mobility Ministry, SEMOVI, in 2019. The system currently operates 6 500 bikes, of which 340 are electric, with docking stations at 480 locations. The expansion plan for the system foresees that by 2021 Ecobici will have a fleet of 10,000 bicycles. Ecobici is estimated to have avoided 232 tons of CO₂ equivalent emissions from 2010–2012, expected to reach 3 641 tons of CO₂e in total for the period 2010–2020 (SEDEMA,2013.)

Micro-mobility services – dockless bikes and e-bikes and electric push-scooters – have been introduced by private operators over the last three years, but are restricted to the same central western zone as Ecobici operations under licence conditions. Rights to operate were concessioned in 2019 through competitive bidding, resulting in a high charge per vehicle operated by the small number of winning bidders, up to MXN 14,000 (USD 720) per scooter per year (see Table 1).

Table 1. Taxes on micro-mobility in CDMX by operator

Company	Units	Annual fee per unit	Total annual payment
Bikes			
Dezba (electric)	500	MXN 1,800	MXN 900,000
Jump (electric)	1,900	MXN 1,300	MXN 2 470,000
Mobike	2,400	MXN 2,600	MXN 6 240,000
Total for 3 companies	4,800		MXN 9 610,000
Electric micro scooters			
Lime	1,750	MXN 7,200	MXN 12 600,000
Grin	1,750	MXN 14,000	MXN 24 500,000
Total for 2 companies	3,500		MXN 37 100,000

Source: SEMOVI (2019c).

Walking is fundamental to mobility and a component of most trips. According to the Origin -Destination Survey of 2017, 25% of trips are made exclusively on foot. Pedestrianisation of the city's historic centre has improved accessibility and is seen as supporting local businesses as well as taking cars off the road. Pedestrian environments have been improved by small scale interventions across the city to calm traffic, particularly in dangerous road intersections. The goal of the current administration is to intervene at 600 of these crossings by 2024. There are also investments to remodel some Metro, Metrobús and Light Rail stations to improve access and create a more secure environment.

Freight transport

CDMX's Environment Secretariat, SEDEMA, estimates that freight vehicles contribute 16% of CO₂ emissions from transport, 36% of PM₁₀ emissions, 45% of PM_{2.5} emissions and 28% of NOx emissions. Pollution from heavy vehicles is most intense in the northern districts of CDMX (SEDEMA, 2016).

Supply and demand for freight transport in the ZMVM was assessed for the Federal District (DF), the Federal Government and the State of Mexico in 2006 by the Metropolitan Environment Commission (CAM) and the Autonomous National University (UNAM 2006). CDMX commissioned a study of urban logistics in 2019 (Steer 2019), which provides updated figures revealing the scale of expansion of freight activity through the growth of freight vehicle fleets (Table 2). The reports also document the migration of vehicle registrations out of CDMX to the neighbouring States and the Federal register, driven principally by the stricter inspection and maintenance regime for vehicles registered in CDMX. The 2009 study reports 6.4% annual average growth in the freight vehicle fleet in the ZMVM over the 10 years to 2017. In the State of Mexico the rate was 13.3% whilst CDMX saw a decline of 0.9% per annum.

Table 2. Freight vehicles registered in the ZMVM

Registering Authority	Type of Service	2004	2017
DF (2004) CDMX (2018)	Local public service	16 906	82 170
	Commercial freight / private	194 149	
State of Mexico	Local public service	na	1 269 900
	Commercial freight / private	148 365	
Federal	Public service and commercial	81 260	1 137 930
Total		440 680	2 490,000

Source: UNAM 2006; Steer 2019.

Most freight vehicles are under 3.5 tonnes. In 2004, 70% were small 2 axle vehicles. The great majority of private operators are small, with fewer than 5 vehicles in 2004. This pattern has changed little. The 2006 report found that 30% of the heavy goods vehicles registered in the ZMVM were used entirely for trips with origins or destinations outside the ZMVM, half of these with neither origin nor destination in the ZMVM, and the majority of the heavy vehicle trips are on trunk roads in the periphery. The 2009 study reports 512 thousand freight vehicles in transit, entering/leaving CDMX per day, which is 10% of the total light and heavy-duty freight fleet. It also found that 48% of the heavy-duty freight vehicles transiting CDMX use the trunk routes north to Queretaro and west to Toluca.

The average age of freight vehicles is high compared to other OECD capital cities, at 12 years in 2004, with a long tail of very old vehicles. 60% of the local public service vehicles in DF averaged 29 years old in 2004. In 2017 the average age of heavy goods vehicles was 15 years. A number of programmes have been introduced to promote fleet improvement and renewal for diesel heavy duty vehicles (the Clean Transport Programme, the Auto regulation Programme, the Vehicle Substitution Scheme, and the Programme for Modernising the Federal Road Transport Fleet). Most of these were Federal government programmes, scrapping relatively small numbers of old vehicles to remove highly polluting trucks and replace them with cleaner, safer new vehicles. Improvement of fuel economy and CO₂ emissions is likely to have been achieved in addition to the more significant reductions in PM and NO_x emissions.

Freight vehicle fleets can be roughly characterised as split between a small number of large commercial operators with modern fleets, mainly own-account transport companies (such as Coca Cola's transport subsidiary and the baker Bimbo) and a large number of small operators, generally operating older vehicles. This distribution in the ZMVM reflects the national pattern (Table 3). Whilst the larger fleet operators may use reserved loading spaces the small operators load, unload and park on the streets. There are also a large number of informal freight vehicles on the city's streets, rickshaws, converted motorcycles and non-motorised handcarts, which are important to the livelihoods of people working in markets, street food stalls and itinerant crafts.

Table 3. National freight fleet by type of owner

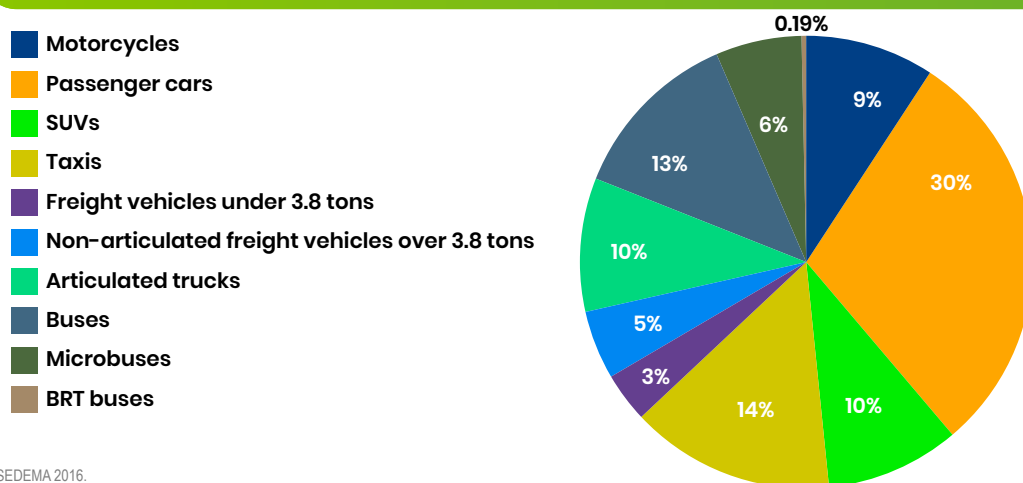
Type of firm	Units	Proportion of firms %	Proportion of vehicles %
Micro (hombre camion)	1 to 5	82	26
Small	6 to 30	16	30
Medium	31 to 100	2	16
Large	> 100	1	28

Source: Road Statistics of the Ministry of Communications and Transport 2015, reported in OECD 2017.

Emissions of CO₂ and other pollutants from road transport in CDMX

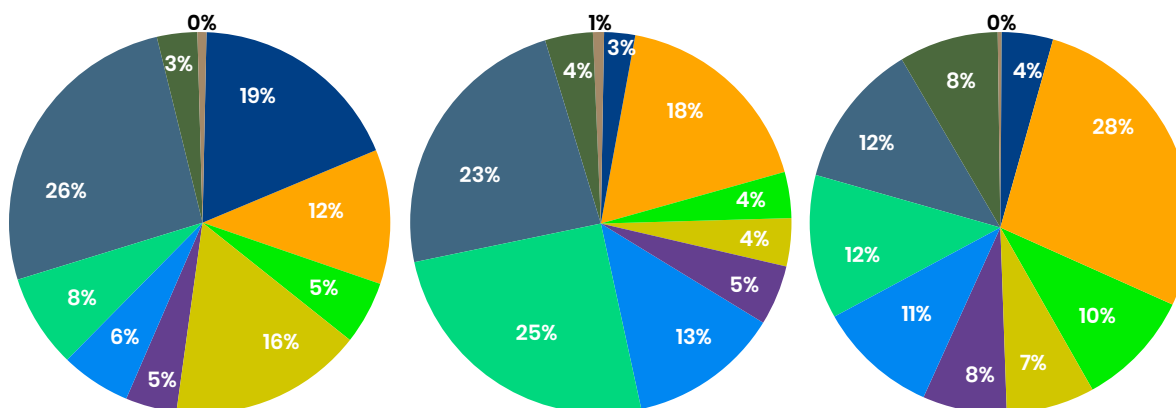
SEDEMA estimates that road transport accounts for more than 60% of total energy use in CDMX, and is the largest contributor of the end use sectors to emissions of CO₂, PM₁₀, PM_{2.5} and NOx (SEDEMA, 2016). Passenger cars (including taxis, sports utility vehicles and pickups used primarily for passenger transport) account for over half the emissions (Figure 9). Freight transport accounts for 19% and motorcycles and similar vehicles a rather large share at 10%. Public buses account for only 14% despite the large share of total trips carried. Figure 10 shows the share of total road transport PM₁₀, PM_{2.5} and NOx emissions by vehicle type.

Figure 10. Road transport CO₂ emissions in CDMX (% of t/year total emissions according to vehicle type)



Source: SEDEMA 2016.

Figure 11. Road transport air pollutant emissions in CDMX (from left to right, share of PM₁₀; PM_{2.5} and NOx emissions in % per vehicle type)



Source: SEDEMA 2016.

Current Policy Landscape

National Policy

National climate change policy

In 2012, the General Law on Climate Change (GLCC) made Mexico the first large oil-producing emerging economy to adopt climate legislation. The GLCC provides the institutional framework for implementation of climate change policy at the national level. In 2018 Mexico passed a decree amending some of the provisions of the GLCC to make it more consistent with the Paris Agreement, setting emission reduction targets for transport, electricity generation, buildings, oil and gas, industry, agriculture and waste sectors (Cámara de Diputados, 2018). Based on the National Strategy on Climate Change (NSCC), announced in 2013 (Government of the Mexican Republic, 2013), the Mexico's Climate Change Mid-Century Strategy, adopted in 2016, develops general guidance for mid-term and long-term national climate change strategies to achieve Mexico's NDCs submitted to UNFCCC (Government of the Mexican Republic, 2016). The GLCC also establishes that the Programme on Climate Change (PECC 2014–2018), which indicates quantified mitigation measures will be developed with every incoming administration (Cámara de Diputados, 2018); however, the PECC 2019–2024 is not announced yet.

In the National Development Plan (PND) 2019–2024, the current government reaffirmed the commitment to reach 35.8% of renewable energy generation by the end of the period (Government of the Mexican Republic, 2019). However, the current governmental decisions bring questions if the Mexican government can achieve its clear energy targets. For example, the national budget for 2019 shows its policies favoured fossil fuel electricity generation over renewables (Solís, 2018). The 'modernisation' of coal, diesel, oil and gas power plants is the main destination of the budget allocation to the Federal Electricity Company (CFE in Spanish), and some projects were planned to retire by the previous administration's long-term electricity plan (Sigler, 2018). Since the election campaigns, the current government focused on the energy sector rather than taking clear position on climate change. To achieve energy security to replace oil and gas imports from the United States, the governmental proposal was focused on the sectoral changes that foster national extraction of oil and gas, building new refineries, maintenance of old refineries and increasing the electricity production. In addition, after two months into the new administration, the Mexican government announced the cancellation of the 2018 long-term electricity auction, which could foster renewable energies (Centro Nacional de Control de Energía, 2019).

In the tax reform in 2014, Mexico implemented a carbon tax that is set differentiated by fuel type (SEMARNAT, 2014). At the end of 2017, the regulation for the use of emission reduction credits for compliance under the carbon tax in Mexico entered into force. This regulation establishes the allowance of Certified Emissions Reductions (CERs) from Clean Development Mechanism projects in Mexico as well as Green Certified Emission Reductions in the EU Emission Trading Scheme (ETS) as payment means under the carbon tax (Diario Oficial de la Federación, 2017). In addition, Mexico announced that it will begin its pilot phase of the carbon market of the Americas in 2019 and it will be operated completely by 2022 (SEMARNAT, 2018).

Fuel economy and CO₂ emission standards for new vehicles

The Federal government published standards regulating CO₂ emissions and fuel economy for new passenger vehicles in 2013. This covers cars, pickup trucks and SUVs. The standard applies to vehicle model years 2014 through 2016 (ICCT, 2013). These standards were based on the 2012–2016 fuel economy standards developed by the U.S. Environmental Protection Agency (EPA) and the National

Highway Traffic Safety Administration (NHTSA). In 2016, an agreement extended the 2016 standard to model year 2017 (ICCT 2017). The Secretariat for Environment and Natural Resources (SEMARNAT) continues to work on the next phase of passenger vehicle standards and is also considering heavy duty vehicle standards. The standard was expected to result in a new car fleet average fuel economy of 14.6 km/L in 2016.

Table 4. Estimated savings from light duty vehicle CO₂ emission standard

Savings	Estimate for period 2013–2030
CO ₂ emissions avoided	170 million tons of CO ₂
Reduction in fuel consumed	70 billion litres
Fuel savings	513 billion pesos (USD 39 billion)
Federal government savings associated with fuel subsidies	103 billion pesos (USD 8 billion)
Health benefits from reduced upstream pollutant emissions	4,170 million pesos (USD 314 million)

Source: Instituto Nacional de Ecología 2012, reported in ICCT (2013).

ICCT has evaluated the potential savings achievable if Mexico were to extend its standards to 2025 with full alignment to U.S. standards. This would achieve a model year 2025 fleet-average test cycle fuel economy of 22 km/litre and emissions of 108 gCO₂/km, with fleet-average costs per vehicle between USD 1,153 and USD 1,821, similar to the anticipated costs in the rest of the North American market. Adoption of 2025 standards could reduce fleet-average energy consumption on the test cycle by 28% from 2016 levels. Coupled with measures to reduce GHG gases from air conditioning refrigerants, this would represent a 38% reduction in fleet average GHG emissions with respect to 2016 (ICCT, 2017).

Climate change elements of national transport policy

The 2019 work programme under the National Development Plan (PND) 2019–2024 covers infrastructure in the road, rail, maritime ports and airport sectors. There is an explicit link to health policy through plans for transportation of medicine to provide more secure access for low-income groups but there is no specific mention of climate change policy (Government of Mexican Republic, 2019).

City-level climate change and air pollution policies

Climate change policy

The City began to develop climate change policy in 2000, adopting its first Climate Action Strategy in 2004. An emissions inventory was established in 2006 and a Climate Action Program adopted for the period 2008–2012. Programs were renewed in 2014 with a Local Climate Action Strategy and Mexico City's Climate Action Programme (PACCM) 2014–2020. This focussed on the energy transition, containing urban sprawl, sustainable management of natural resources and biodiversity, and building resilience. A progress report was issued in 2016 reviewing measures that in the transport sector covered modernisation of the metro system, establishing a fleet of 20 electric taxis, low energy consumption lighting in public transport, expansion of the Ecobici docked shared bike system, improvement of public transport transfer stations including investment in bike parking facilities, expansion of BRT corridors, and replacement of 30 old diesel buses with CNG buses. The bulk of greenhouse gas emissions mitigation was achieved, however, from the vehicle inspection and emissions testing system coupled with the no driving day programme outlined below (SEDMA 2016).

Table 5. CDMX Climate Change Action Programme 2014–2020, estimated CO₂ mitigation in 2016	
Action	Tons CO₂ equivalent saved
Vehicle inspection and emissions testing and No driving day programmes	931,422
Contaminating vehicles program – on street testing and enforcement	183,364
Metro system modernization	80,778
Electric taxis – 20 vehicles	22
High efficiency lighting in public transport	28
Ecobici shared bike system – 179 bike stations added, 23 M trips, 30 M km	2,419
Metrobus BRT expansion, additional 30 km of lines (mitigation over 3 years)	433,984
Clean bus procurement, 50 buses replaced with Euro V vehicles	728
CNG buses, 30 vehicles replaced	20,590
Total	1,653,335

Source: SEDEMA (2016)

The law on Climate Change Mitigation and Adaptation and Sustainable Development for Mexico City, published in 2011, was revised in 2017 to be in line with documents submitted to the UNFCCC at national level (SEDEMA, 2017). This law states that the implementation and evaluation of the Climate Action Programme of Mexico City 2014–2020 (PACCM) must be monitored with measurable, reportable and verifiable indicators. These have yet to be developed.

Restrictions on the use of vehicles – Inspection and emissions program and no driving days

Mexico City has developed a Mandatory Vehicle Inspection Programme (Programa de Verificación Vehicular Obligatorio, PVVO) and a No-driving Day Programme (Hoy No Circula, HNC) to limit air pollution. These are linked and create incentives to renew vehicle fleets. Combined with the 2013 fuel economy standards this drives a moderate degree of mitigation of CO₂ emissions.

Inspections are mandatory twice a year for passenger cars, except for new vehicles, and the result of emissions inspection determines the way in which a vehicle has to comply with the provisions of the HNC system. Compliance with emission limits and an on-board diagnostic system check is made at authorised Vehicle Inspection Centres. Additionally, inspections are carried out in the street on visibly polluting vehicles with remote sensing equipment. Penalties for not complying with the PVVO are significant. Vehicle owners that present their cars late receive a penalty and, in case they are detected by a traffic officer, their vehicle can be detained, and the owner is fined. Vehicles that fail inspection can repeat the inspection after repair, but if they fail to comply with the established dates, they are sanctioned. Vehicles from other states can undergo inspection procedures voluntarily under the Mexico City scheme and be granted corresponding windscreen stickers for compliance. This is not mandatory, but verification allows them to circulate every day under the No-Driving Day provisions.

The HNC system is applicable across all of Mexico City together with 18 municipalities in the State of Mexico. Traffic police are in charge of compliance and impound non-compliant vehicles. A fine must be paid to retrieve the vehicle and if violation took place on an environmental alert day, the vehicle is only released when the alert is over.

Vehicles with number plates that come from states that do not have an agreement with Mexico City and that have not been subject to voluntary inspection in Mexico City cannot be driven in the City Monday through Friday from 5:00 to 11:00 or on Saturdays from 5:00 to 22:00 and, according to the last number on their plates, one day of the week, from 5:00 to 22:00 hours. Circulation restrictions are stricter when the Atmospheric Environmental Alert Program is activated.

During pollution alerts for NO_x or PM concentrations that exceed health guidelines, restrictions are also applied to vehicles registered with the PVVO system. At alert level 1 the oldest vehicles (class 2) are not allowed to circulate on any day and class 1 vehicles are restricted on alternate days. Class 0 and 00 vehicles are generally exempt restriction but, in some alerts, have also been restricted on alternate days. Freight vehicles are prohibited from driving between 06.00 and 10.00. At alert level 2, Class 1 and 2 vehicles are entirely prohibited from driving and freight vehicles restricted to alternate days.

Although it has been observed that the HNC system might encourage some households to purchase additional vehicles to escape restrictions (Gallego et.al.,2016) and thus increased the total number of vehicles circulating in the city, the vehicle fleet in Mexico City is cleaner and more modern than that in the rest of the country (ITF, 2017). This program, along with the PVVO, has probably resulted in an accelerated renewal of the vehicle fleet (due to the advantages accorded the most recent vehicles). SEDEMA estimates a reduction in emissions of 0.9 Mt of CO₂ equivalent between 2014 and 2016 as a result of inspection and no driving programmes (SEDEMA, 2016).

Urban Mobility Strategy

The Secretariat for Mobility of CDMX published its Strategic plan for mobility – One city one system in December 2018 (SEMOVI, 2018). Its objective is to improve quality of life, reduce social inequalities, cut emissions of air pollutants and greenhouse gases, and increase productivity through creation of an integrated mobility system that will improve accessibility with services that are decent, safe and secure. It also aims to optimize the efficiency of freight transport. The plan is based on the latest origin-destination travel survey undertaken by the National Statistics Institute (INEGI, 2017) and consultations with citizens during 2018 that characterized the city's transport system as fragmented and highly inefficient, reinforcing profound social inequalities. The plan focuses on measures to improve accessibility, cut travel times and provide safe and comfortable trips for all public transport users. It takes a cross-cutting approach to redistribute traffic between the modes, redistribute urban space and redistribute resources for investment to promote public transport and non-motorised mobility.

The priority is to preserve the large share of public transport in daily mobility. The previous administration established a hierarchy of users for sustainable mobility, putting pedestrians and non-motorised transport first, followed by public transport, then freight and last, private motorised transport. The new strategic plan reinforces this by aiming to accelerate the reallocation of space to the modes that carry the most people and pollute least, with the establishment of networks of exclusive lanes for public transport and for cycling. This will be accompanied by traffic calming measures that will also improve the fluidity of traffic flows. Funding for infrastructure investment will be reallocated to focus on improving the circulation of public transport and non-motorised modes, whilst ensuring fares remain affordable. Six times the conventional road budget will be directed to investment in infrastruc-

ture for public transport, cycling and walking. Mobility will be treated as an integrated system, with a single payment system to be introduced for all public transport systems, including the Ecobici docked shared bike system.

Measures under the Strategic Plan are structured under three headings: Integrate the different systems of urban transport to promote travel on foot, by bicycle and by public transport; Improve existing transport infrastructure and services; and Protect users, with services that are inclusive, decent and safe. The measures outlined in the plan under each of these headings are summarised in Table 6.

Table 6. Summary of strategies proposed by the Strategic Mobility Plan of Mexico City 2019

Heading	Strategy	Objectives for 2019
Integrate	Integration of the public transport system	Single prepayment system for all public transport managed by the Mexico City (Metro, Metrobús, RTP buses, Trolleybuses) with an integrated map and improved interconnections at stations.
	Expansion of the coverage of the PT	5% increase in the mass transit network, and construction of the new Cablebús cable car system.
	Route monitoring for microbus concessions	All concessioned microbuses to be equipped with GPS to enable tracking by users and verification and control that designated routes are adhered to by operators.
	Integration of bicycle use into the mobility system	Expansion of the bike lane network by 15% and doubling of space at bike parking facilities at mass transit stations
Improve	Maintenance and improvement of public transport	Purchase of 500 new electric trolleybuses, 800 new RTP buses by 2024, and improved maintenance of Metro trains. Redesign of 2 transfer stations and investment to relieve crowding in at least 5 BRT stations. Recovery and/or establishment of protected bus lanes.
	Traffic and parking management	Integration of automated traffic light systems; integration of parking meter systems.
	Regulation of private mobility services	Proposal for comprehensive regulation of taxi services and publication of guidelines for the operation of dockless bicycle and electric micro scooter systems.
	Freight transport	Publication of a Strategic plan for freight transport in Mexico City.
	Improved citizen information	Expansion of coverage of information centres.

Table 6. Summary of strategies proposed by the Strategic Mobility Plan of Mexico City 2019

Heading	Strategy	Objectives for 2019
Protect	Safe infrastructure to provide universal access on foot and by bike.	Investment to improve 32 intersections and add 40 km of cycleways and rehabilitation of 15 pedestrian for safe use night and day.
	Road safety policies to improve driver behaviour.	Implementation of penalty point system with sanctions and publishing of a good driving manual.
	Improved planning from a gender perspective and prevention of harassment.	Improvement of security and perception of security and safety for public transport users through strategies developed from the perspective of gender equality and prevention of harassment.

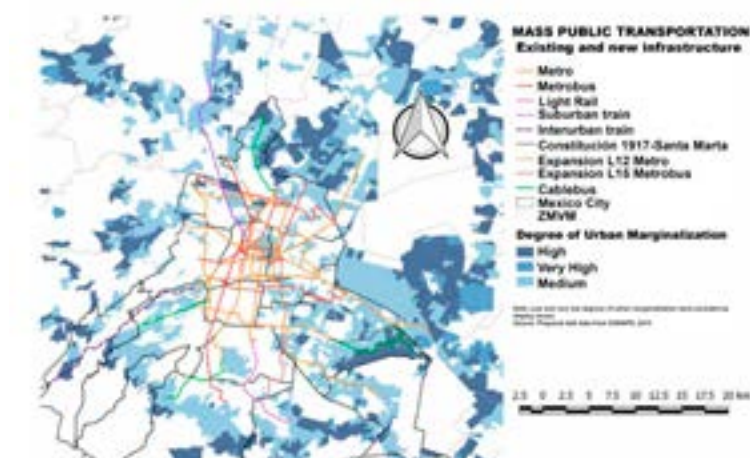
Source: SEMOVI (2019b)

Expansion of mass transit networks

A 5% increase in the length of metro and BRT lines is planned, with construction to start before 2022. There are currently 349 km of metro and BRT lines. A short extension to line 12 of the metro is planned to link it to the terminus of line 1 at Observatorio, where the partly built new suburban rail line from Toluca is due to terminate. Line 8 and line A of the metro will be interconnected in the southeast of the city with a BRT corridor operated with trolleybuses. A new BRT line is planned, and extension of BRT line 3 and 5 to the south will be completed by 2020. Extension of line 4 is estimated to be completed by 2021.

Four cable cars are planned to serve peripheral areas affected by severance resulting from highway infrastructure or by steep gradients. These will link marginalised areas to the mass transit system. Their capacity is smaller than a BRT line, but Cablebús Line 1 is expected to carry 30k pax/day.

Figure 12. Extensions to the mass transit network and the new Cablebus system



Source: SEMOVI (2019b)

Investment in infrastructure for non-motorised mobility

By 2018, CDMX had 194 kilometers of bike lanes. They are limited to the wealthier central and western areas of the city but create a reasonably favourable environment for cycling in this limited area despite being fragmented. Junctions are a particular weakness. Outside of these central areas large numbers of bicycle trips are made with elevated exposure to crash risk. Under the strategic mobility plan, 88 kilometres of protected lanes were built in 2019, most of them in peripheral areas, like Tláhuac and Xochimilco, where bicycle use is higher than in the rest of the city. The goal is for 600 kilometres of bike lanes by 2024. In addition, 100 junctions are expected to be treated every year until 2024 to improve walking and cycling safety over a wider area.

Parking facilities for large numbers of bicycles at a small number of public transport transfer stations were built by the previous administration and the strategic plan includes construction of 16 more large parking facilities by 2024.

The area served by the Ecobici shared bike system will be expanded gradually to neighbouring districts and additional docking stations built. According to the Ecobici expansion plan, the system will have 10,000 bicycles and 700 stations by 2021.

Freight transport

While a strategic freight transport strategy is developed, some large own account freight distributors such as Bimbo and Coca Cola are piloting electric delivery vehicles to reduce emissions.

Parking pricing

On street parking is metered in the more prosperous central western wards of the city. Under the strategic plan a single payment system will be introduced for all the concessions that operate in the city. The opportunity might be taken for more differentiation of prices in relation to demand. In the longer run extending payment for on street parking to more areas is indicated to maintain incentives for the use of public transport.

Road safety and driver behaviour

Improving the safety of roads for cycling, and improving the perception of safety, is critical to increasing the use of bicycles and micromobility. The strategic plan questions the incentives created by the governance model for the existing system of speed cameras, traffic light cameras and automatic fines, which is concessioned to private operators, and suggests that fines for exceeding speed limits and jumping red lights have a discriminatory effect in favour of high-income car users. Fines are to be replaced by a penalty points system on driving licences and civic sanctions (*fotocívicas*) together with preparation of a ten point good driving guide.

Gender policy and prevention of harassment

Sexual harassment and exposure to crime are major concerns on public transport and in public spaces including station entrances and microbus stations. Improving security will be important to maintaining public transport modal share. Investments included in the strategic plan include remodeling pedestrian overpasses and station access ways to remove obstacles and improve lighting. More broadly efforts will be made to systematically incorporate a gender perspective in mobility planning and policy.

Policy integration and implementation

The Government of CDMX aims to integrate all of its planning tools to deliver on its equity, access and sustainability goals. The Strategic Mobility Plan will be translated into a Mobility Programme (Programa Integral de Movilidad – PIM) for 2020–2024 following evaluation of progress in implementing the PIM for 2013–2018. These will be aligned with the other main planning instruments for the metropolitan area: the General Programme for Development of the City; the Programme for Urban Development of the City; the Directive for Ecological Protection of the City; the Programme for Coordination of the ZMVM; and the Road Safety Programme. Integrated mobility is also one of the seven main axes in the Environmental and climate change program in Mexico City 2019–2024, published in June 2019. This aims to reduce air pollution 30% and capture CO₂ equivalent to 10% of the emissions of 2018 (Mexico City government, 2019).

Assessment of CO₂ Mitigation Plans

Mexico City's Strategic Plan for Mobility provides a solid basis for gradually decarbonising mobility along with its principal objectives of improving the wellbeing of citizens and achieving an equitable system of mobility. The policies outlined to favour non-motorised mobility and improve public transport will reduce CO₂ emissions substantially in the long term. Plans focus on enhancements to the public transport system to retain its high modal share and include vehicle renewals and extension of the electric trolleybus and BRT systems. The scale of ambition in the plans for improvement is, however, handicapped by the resources available for investment from general taxation and complementary approaches to improvement will need to be harnessed.

Planned investments in rehabilitation of metro trains and new buses and trolleybuses, to improve conditions of travel and reduce outages for unplanned maintenance, are rightly identified as the first priority and vital for restoring scheduled frequencies of service and improving quality and reliability of service. This is central to retaining public transport ridership levels. The rate of improvement will, however, also be constrained by the limited public funding available.

Recourse to the betterment charges provided for under existing law might increase the speed of renewal and expansion of public transport services. A review of fares policy is indicated, especially if additional public funding cannot be made available to achieve a stable financial operating environment to design standards. At the same time, it is vital that public transport remains accessible to users regardless of their income. Given the limited funds available and the large share of overall expenditure by CDMX accounted for already by subsidies, targeted support for concessionary fares might prove more effective than current low fares for all. There are also risks to such an approach, of overlooking some of the most vulnerable users and of cumbersome administration. All in all, if additional resources for reinvestment are not made available through subsidy or through fare box revenues, public transport services are condemned to vicious circle of poor performance and declining ridership.

Comprehensive reform of regulated bus services could also offer improvements to the user experience. Restructuring of concessions in Mexico City under earlier initiatives, for example establishment of the BRT network, has required protracted negotiation and been achieved only incrementally. Currently the approach to improving passenger experience is limited to introducing GPS monitoring of minibuses for enforcement of routes held by operators under their concessions, although it is unclear what sanctions might be applied in practice. The incentive to overload and deviate from concessioned routes, created by very low regulated fares with no subsidy, will be difficult or impossible to overcome. Systemic reform is likely to require tax-payer support to reconcile improved service quality

with low fares. In the meantime, the scope for innovation and incremental improvement in service quality, including through private sector initiative, should not be neglected. The scope for building on recent experience with improved services through app-based reservation services with a modest price increment should be capitalised on in the short term. Retaining public transport ridership is highly dependent on improved services in the microbus sector.

Providing alternatives to the use of private cars and motorcycles is central to the government's objectives. The city has achieved impressive results in improving the quality of pedestrian environments and fostering the use of bicycles, both private and shared bikes. Planned investments in extending the protected bike lane network, and the policy of stitching-in protection at critical junctions where there are gaps in the network, extending safe cycling routes rapidly despite a shortage of funding, will make a significant contribution to promoting cycling and micro-mobility.

More could be made of the potential for shared micro-mobility to add to the low carbon alternatives for short and medium length trips. Dockless systems extend the potential geographical coverage of shared systems and electric bikes, and push-scooters make significantly longer commutes feasible than on bikes for most users. These dockless modes will be handicapped, however, by regulatory charges and restrictions on operating areas. Charging for the consumption of road and parking space ought to be generalised to cars and motorcycles before being applied to these modes that consume much less space than conventional vehicles.

The planned approach to traffic calming and congestion management through traffic light coordination should be complemented by a revision of speed limits. Better targeted limits can produce immediate emission reductions at very low cost. The speed limit of 80 km/hr on primary roads and controlled access roads, introduced in Mexico City in 2015, should be reinstated and adopted throughout the Metropolitan Area of the Valley of Mexico, with enforcement to ensure that vehicles on urban highways operate mostly in the range of 50 to 90 km, the speed at which emission control technologies work best. Emissions of CO₂, other greenhouse gases and criteria air pollutants are exacerbated by stop-go traffic. On heavily used urban highways, reducing speed limits is effective in smoothing traffic flow, mitigating congestion as well as emissions. This is a technique used on Smart Motorways in the UK and reductions in highway speed limits are an integral part of air pollution response measures in many cities. A study conducted on highways in Southern California shows, for example, that under typical driving conditions the implementation of a combination of measures to reduce congestion, traffic smoothing, and speed management could generate CO₂ emission reductions of around 30% (Barth & Boriboonsomsin, 2009).

Main challenges for decarbonising transport in ZMVM

Challenges for public transport: improving quality and availability for all in line with land-use planning policies

Land use planning

CDMX aims to contain urban sprawl, as set out in the Climate Action Programme for 2014–2020, through urban planning instruments to improve the management of real estate development and public infrastructure investment. Initiatives under this plan included initiating work on a territorial planning programme and creating more green spaces in the city. One of the successes was modification to building regulations to reduce the obligatory provision of parking spaces in new office developments, but coordination of commercial development with the capacity of public transport to meet new demand remains ineffective. This is evident, for example in the marked expansion of office space along

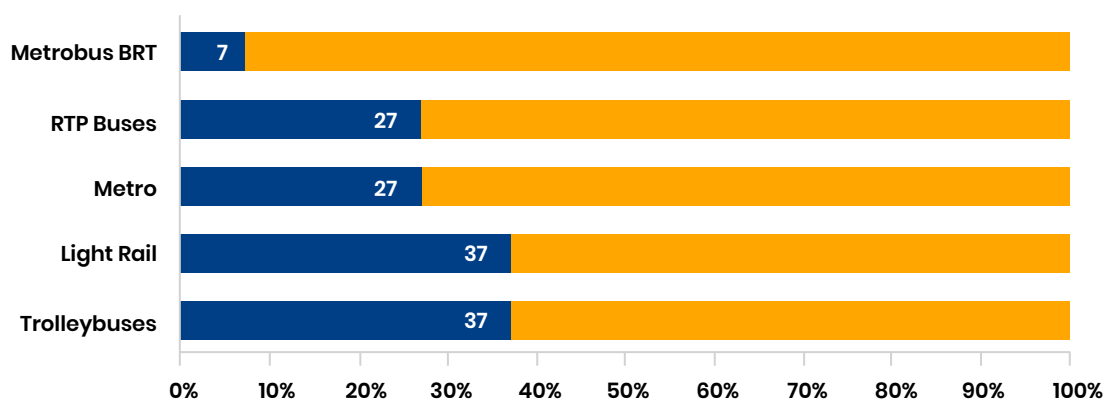
BRT corridor 1 despite overcrowding on the line. Further from the centre, most large new office developments are almost entirely dependent on access by private cars and taxis. Without intervention to link urban development to investment in mass transit, through planning controls and fiscal mechanisms, the share of trips made by public transport will inevitably decline.

Maintenance and Investment in Public Transport

Transit vehicle fleets are relatively old and the performance of much of the metro and rail system infrastructure suffers from chronic underinvestment. This results in high levels of out-of-service vehicles and unplanned outages for maintenance (figure 13), seriously undermining frequency of service on all the transit systems (except BRT) including the microbus colectivos. This greatly reduces quality of service with severe overcrowding on many peak hour services, creating a strong incentive to switch mode by acquiring cheap, used cars and motorcycles when income allows. The poor condition of the vehicles also exacerbates air pollution and increases greenhouse gas emissions.

The current priority is investment in new trolleybuses as the system is fully electric, with very low criteria pollutant emissions and low CO₂ emissions. New RTP buses are to be procured with a decision to be made on the current local industry norm, Euro V standard vehicles, or the much cleaner second-generation Euro VI standard vehicles which are fitted with much more effective NOx control systems and options for low maintenance de-pollution systems. The price increment means replacement of older vehicles at a slower pace, but the long-term benefits might outweigh this sacrifice depending on how polluting the vehicles to be replaced are.

Figure 13. Proportion of CDMX public transport vehicle fleets out of service in 2018.



Source: SEMOVI, 2018, based on communications with fleet operators.

Funding investment in public transport and operation of services

The government is investing in new buses and expansion of the electric trolleybus system. The limited availability of public funds limits the scale of these vital improvements to the overall public transport system. Metro system infrastructure and signalling systems need upgrading on most of the lines to operate more reliably and at shorter headways, and the expansion of the system along densely trafficked corridors would bring considerable emissions reductions. However, current pricing policy and the availability of funding for subsidies and investment severely limit the improvements that can be made.

Improving the quality of services is essential if public transport mode share is to be maintained. For this funding will need to increase over the longer term. If public funding cannot be increased, higher fares will eventually be necessary. The size of subsidies and the impact of price rises would be mitigated if subsidies can be targeted to low-income users rather than generalized, for example along the lines of Bogota's Sisben travel card rebate system linked to social security records.

In all other OECD countries public transport for commuting in large urban areas is subsidised to a greater or lesser extent. In some cities, for example Paris, payroll taxes (versement transport) on larger employers contribute to the cost of public transport services. In others, for example London, a business property tax supplement has been used to fund specific infrastructure (Crossrail metro line). More broadly in London, planning regulations were amended to limit the density of office and multi-storey housing developments to the capacity of the public transport system in the vicinity of the development. Construction is not authorised where accessibility scores badly on a public transport accessibility level (PTAL) indicator. However, developers are entitled to make proposals to fund investment in expansion of public transport infrastructure to bring the accessibility indicator to the required level as part of their planning application.

Mexico City urgently needs recourse to some kind of specific funding mechanism of this sort. Mexico's Federal tax code provides for betterment charges (contribuciones de mejora) to be levied on property development for some types of infrastructure investment. The charge is levied on owners of property close enough to the infrastructure project to benefit from it. It is calculated in relation to rentable values and paid after completion of the project for six two-month periods. The overall contribution to project costs is limited to 50% maximum. The scope of investments was extended in 2014 to include public transport, cycling facilities, pedestrian bridges and multimodal transfer stations (OECD 2015). The mechanism was first used in CDMX in 2014 with collection of charges to begin in 2015. A property development mobility impact assessment procedure was provided for under Mexico City's 2015 Mobility Law and should be fully implemented. This could be linked to the betterment charge system to provide the basis for systematic participation by property developers in investments to enhance public transport.

Improvement in microbus service quality

Under the business model employed in the microbus sector, drivers are not salaried but have to pay rental on vehicles and make an income from the fares they collect. As a result, drivers compete in the streets for customers and make circuitous deviations along their licensed routes to maximize passenger numbers. This results in very long trip times on overloaded vehicles, creating strong incentives to desert public transport and switch to motorcycles or old used cars as soon as incomes allow. In the ZMVM this is exacerbated by restrictions on crossing State-City administrative borders. Many passengers are obliged to change vehicles at transfer stations. These are generally chaotic and congested, creating additional delays and additional fare payments (OECD, 2015; Flores Dewey, 2018). The one regulation enforced effectively is the pricing cap on fares. Vehicle standards and operating regulations are ignored to a large degree.

Prices are regulated and have been held at a very low level for many years with no adjustment for inflation. This forces owners and operators to cut expenditure, with the result that vehicles are old and poorly maintained. It adds to the pressure to seriously overload vehicles, carrying as many passengers as possible to maximise profit regardless of safety or comfort (OECD, 2015). Overcrowding also creates exacerbated conditions for petty crime and sexual harassment. Successive governments have aimed to systematically restructure and modernise traditional services, aiming to group operators into formally structured companies capable of running conventional buses to strict routes and

formal timetables. Without an injection of public funding that is beyond the current capacity of government such system restructuring appears unlikely to be achieved.

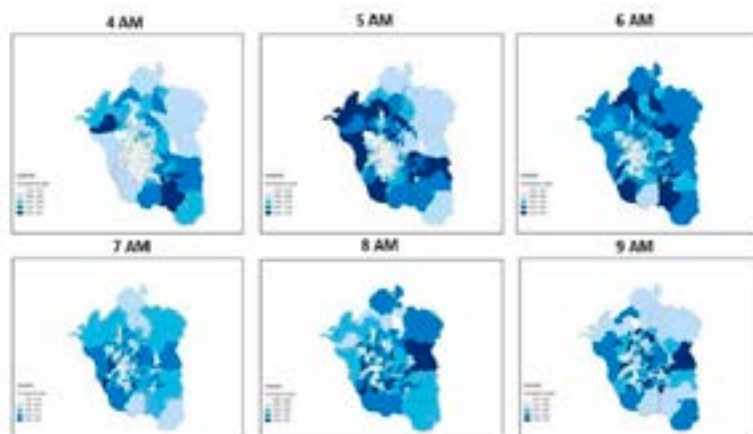
Some small-scale initiatives have, nevertheless, been successful in providing improved service in return for higher fares. Innovation in this direction appears a promising route for improvement in the short term, but lacks a stable regulatory framework. A number of companies offer these services, including Bussi, Urbvan and Jetty, which works in cooperation with some of the incumbent operators (Flores 2018). The companies initially took advantage of regulatory changes that opened the taxi market to ride hailing services like Uber to offer app-based van-pooling services in the microbus market. Users book a seat at pick up points upstream of transfer stations and are guaranteed a seat without queuing. Routes are direct to commuting destinations and are adjusted periodically according to demand. Travel times are substantially reduced, with comfort and security guaranteed. The company enters agreements with operators to provide new vehicles that conform to all safety, design and environmental standards and pay drivers a salary, ending the perverse incentives to overload vehicles. Despite fare mark-ups reaching as much as 10 times alternative services, demand has grown rapidly. Incumbent operator opposition has been tough and regulatory restrictions introduced as a result. Some agreements have been reached with key operators and regulatory differences between jurisdictions exploited to maintain service continuity, but agreement the public authorities have not been reached. Regulatory facilitation is merited, given the importance of maintaining the share of public transport services and the risk of losing ridership in the short term, until sufficient investments in concessioned services can be made. Research on conventional bus services in OECD countries finds that users are even more sensitive to service quality (trip time cost, travel time reliability, comfort and security) than to price (ITF 2014). Where prices are low and quality poor this trend is more pronounced.

Access and Equality

In common with many other cities Mexico City suffers from high levels of income inequality. Pronounced social divisions between high and low-income groups are reflected in spatial segregation and inequalities in access to jobs and services. Central locations of Mexico City, due to high proximity to most income-generating activities, attract affluent and high-income households, which are more likely to own cars despite the availability of public transport options in these areas. Low-income households have been forced to settle on cheaper land on the periphery of the metropolitan area (i.e., in the State of Mexico and South and Eastern municipalities inside Mexico City), with fewer job opportunities in proximity.

There is a deficit of affordable public transport options, especially on the periphery, which has accentuated existing spatial and social inequalities. Although only 43% of population can afford to own a private vehicle, the car remains the most competitive option for reaching job opportunities: on average, 400 thousand jobs can be reached by car in 60 minutes compared to only 150 thousand by public transport (ITF/IDB forthcoming). Peripheral low-income areas lack adequate public transport links to the centralised concentration of employment. The only available commuting option is microbuses and mototaxis, often of poor quality. Lower income commuters endure long and costly trips, reflected in earlier departure times (Figure 14).

Figure 14. Proportion of CDMX public transport vehicle fleets out of service in 2018.



Source: SEMOVI, 2018, based on communications with fleet operators.

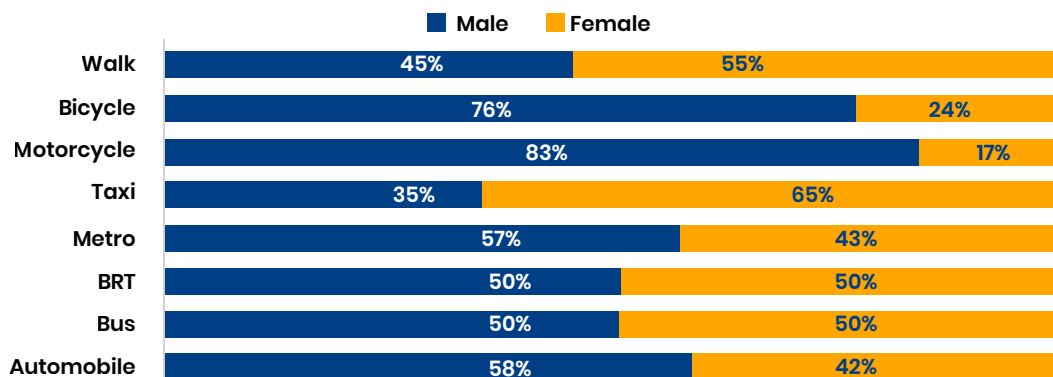
Given the essential role of the micro-bus sector in providing access, there is a recognised need to engage with these operators on a path towards operational reform. In particular, the quality of service needs to be radically improved. More generally, the object of urban and transport policy should be improving accessibility rather than just improving the performance of individual modes of transport. This implies an integrated approach to transport and land-use planning. In such an approach, transport investments are combined with denser urban development close to public transport stops. This in turn contributes to increasing proximity with space reserved for access by non-motorised modes in the denser areas. Many monolithic low-cost housing developments on the periphery urgently need bus services and investment in other local community facilities.

Box 1: Gender Gaps in Mexico City

Average travel patterns for women differ greatly from those of men. These differences can be analysed in two separate categories. First, they reflect occupational differences –including care-work– that impact commuting schedules, disparity in average incomes, and disparity in access to private vehicles. According to the 2017 Origin-Destination Survey (EOD in Spanish) (Arteaga, 2021c), which mirror some results from the INEGI in figure 14 below:

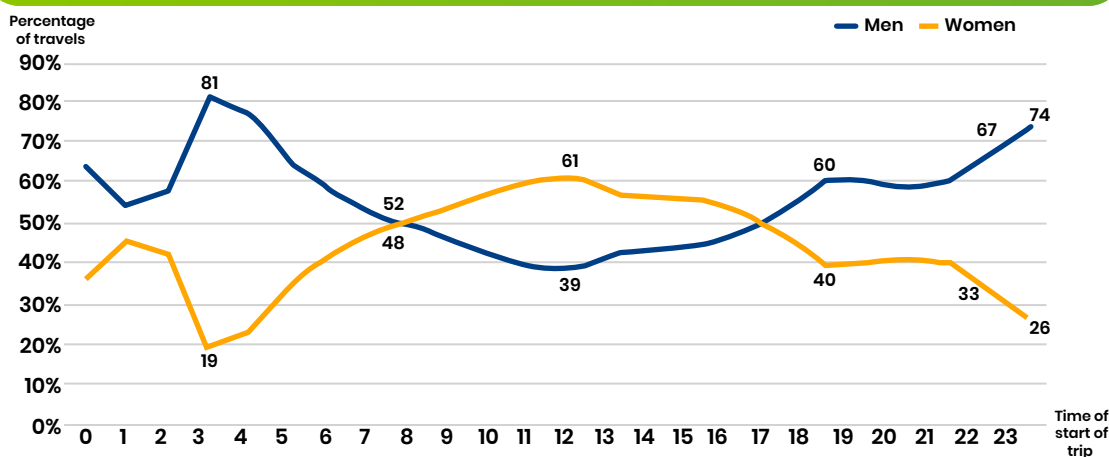
- Women engage in 2.31 trips on an average day, while men execute 2.11 trips per day. This average responds to women's engagement in trip chaining to execute care-related trips.
- Women's third travel motive is shopping.
- Women tend to be more immobile than men, with 57.19% of women vs. 42.81% of men having reported that they had not conducted any trip on an average day. Immobility, in this case, correlates with women's lower-income levels compared to men.
- Men use more private vehicles and collective buses than women, while women are the main pedestrians.
- Both men and women use less public transit and more private vehicles, as their income level increases.
- While men travel more during morning and afternoon peak hours, women travel more along the day, tied to their specific paid and unpaid occupations.

Figure 15. Trips by gender and mode



Source: INEGI 2017.

Figure 16. Split of trips by gender and departure time



Source: INEGI 2017.

A study financed by the Transport Gender Lab in Mexico City, revealed that the second travel purpose for women was mobility related to home tasks (22%) (Soto Villagrán, 2019). However, women reported limited space to walk and to travel with strollers in the pedestrian paths around the Modal Transfer Centers (CETRAM in Spanish), absence of functioning public restrooms, lack of resting spots, among others (Soto Villagrán, 2019).

Women face exacerbated safety and security risks and have a worst safety perception. According to the CETRAM study almost half of the women had been catcalled, more than half had been looked in sexually unwanted ways, 3 out of every 10 had been groped, and a close number had feared a sexual attack (Soto Villagrán, 2019). Besides, almost 80% did not know how to report sexual harassment in public transit.

Many of these inequalities are beyond the transport sector, but transport authorities are addressing inequitable travel conditions by reserving vehicles and sections of carriages for women, by funding consciousness raising campaigns against harassment on public transport, by promoting technology

to call for help or report incidents, by building and fixing mobility infrastructure to ensure safer and more accessible trips, and by including video vigilance and panic buttons inside public transit vehicles and stations (Granada et al., 2018b).

Challenges for decarbonising freight transport: better managing freight flows and replacing freight fleets

Having an integrated policy for freight transport that also allows for cooperation with private actors could facilitate management of freight flows within ZMVM. Management of freight logistics to consolidate distribution and reduce overall vehicle kilometres travelled has been the object of several studies, the most recent and most comprehensive of which is report prepared in 2019 for CDMX by Steer Group (Steer 2019). This concludes that the City currently lacks an integrated policy for freight transport, oriented towards improving logistics management, reducing conflicts with other modes of transport and mitigating impacts on congestion, pollution and climate change. The report reviews international best practice in reducing vehicle km travelled through the use of freight load consolidation and distribution centres and congestion charges, but focuses its recommendations on reducing traffic conflicts and congestion through designated freight routes and restricted hours of operation. Easing congestion will also reduce CO₂ emissions by cutting travel times, reducing the amount of engine idling and especially by reducing stop-go cycles of acceleration and braking. CDMX's strict inspection and maintenance regime for vehicle road worthiness is a critical measure for managing CO₂ emissions by ensuring vehicles operate to design standards. It also provides an incentive for vehicle renewal as the costs of maintaining vehicles increase with age. The efforts to harmonise inspection programmes across the ZMVM to meet CDMX standards in all States, discussed earlier, are equally relevant to freight vehicles. Cooperation with private actors could facilitate better understanding freight flows, as well as the planning and implementation of policies for improving their management. As the report mentions, having consultative bodies that gather relevant public and private stakeholders, could help in these areas.

Replacement of freight delivery vehicles with electric vans is also a promising avenue to mitigating emissions. This measure is being explored by SEMOVI and experimented with by some of the larger own account fleet operators. For instance, Bimbo aims to introduce 1,000 new electric vans for last mile delivery during 2020, which are made by Bimbo itself in its own factory located in the State of Mexico. Incentives for increasing the use of electric vehicles are available through the Hoy no Circula restrictions on vehicles during pollution episodes (discussed in the 'City-level climate change and air pollution policies' section) and through potential exemptions to restrictions on freight traffic as and when these are introduced to manage conflicts with other traffic.

Challenges for air quality: improving vehicle technologies and better managing traffic

Mexico City experiences regular episodes of ozone and particulate matter concentrations in the air that exceed health limits even though air quality has improved substantially in since the 1980's. The geography of the conurbation, situated in a bowl surrounded by mountains, frequently traps air over the city allowing pollutants to accumulate. Updating of pollution alert limits in 2012 and 2014 to reflect international health standards revealed the full extent of the problem. In the first half of 2016 ozone concentrations exceeded the acute exposure health limit on 115 days, with 16 days exceeding pollution alert levels. This led to the implementation of temporary restrictions on the use of vehicles in May, extended through to July. Subsequent years have also seen alerts, albeit for shorter periods.

The transport sector contributes the largest share of criteria air pollutants today; one third of particulate matter emissions, 82% of NO_x emissions, 19% of volatile organic compounds and 90% of carbon

monoxide emissions (SEMOVI 2019). Emissions of volatile organic compounds from non-mobile sources remain a key factor in the formation of ozone in the Valle de Mexico but as in all large cities, substantial reductions in emissions from road vehicles are a key strategy for achieving clean air.

The factors that drive excess emissions from vehicles in the real-world traffic conditions of the city are critical to determining priorities among the potential measures available to mitigate air pollution. In Mexico City, traffic is dense and frequently heavily congested. Average speeds are low and stop-go conditions standard. Emission control technologies must be effective in these conditions if they are to be of relevance to improving the air of the city. Diesel emission control technologies in particular have had a poor record in cutting emissions in these circumstances. The latest generation of standards for heavy duty vehicles (US EPA 2010 and Euro VI standards for heavy duty vehicles) and the monitoring and control systems they require represent a major advance. Early results of testing on the road suggest that unlike previous control systems they perform as well in the real world as in laboratory testing for type-approval (ITF 2017).

Traffic management measures to achieve more fluid conditions, including by restricting the number of vehicles on the road, are the other main approach to mitigating emissions. In the short term, reducing speeds on motorways and trunk roads in the metropolis is the single most effective measure for cutting air pollution available to State governments. Emissions rise steeply at higher speeds and enforcing a maximum 80 km/h limit cuts emissions significantly. Lower limits also tend to make traffic more fluid and increase the overall capacity of the road and variable speed limits are employed in many cities to manage both congestion and air pollution.

Restrictions on the use of vehicles are a key part of the emergency response to pollution alerts in the ZMVM. These are based on Mexico City's strict vehicle inspection and maintenance programme, which relies on best-practice techniques of exhaust emissions testing, including checks of the on-board diagnostics system, similar to the approach used in California. Restrictions on vehicle use depend on the certified emissions class of each vehicle after inspection. The system is also employed to restrict the use of more polluting vehicles on a routine basis one day a week and on Saturdays (Hoy no Circula program). Exemptions from restrictions provide a strong incentive for the purchase of cleaner vehicles. Vehicle ownership taxes could similarly be differentiated by emissions class. Providing good quality public transport services as an alternative to the use of private cars and taxis is an essential complement to measures that restrict the use of private vehicles (more details are provided above in the section on Restrictions on the use of vehicles).

Governance challenges: improving coordination with neighbouring States

The Environment Commission for the Megalopolis (CAME) has proved the most effective of ZMVM's institutional coordinating mechanisms and has cut air pollution in Mexico City. It was first established as the Metropolitan Environment Commission for the authorities of the ZMVM in 1996 and expanded in 2013 to encompass CDMX and the five States around it. In 2014, for example, the Commission was successful in harmonising all vehicle inspection and maintenance programmes with the strict control system adopted in the ZMVM. Harmonising the programmes has long been an objective because in addition to the benefits to the population in each of the States of bringing procedures and emission standards up to the level of the ZMVM, a large number of vehicles from the area travel through the ZMVM on a daily basis. Moreover, there was a strong incentive to register vehicles outside Mexico City in States with less stringent I&M procedures.

The success of the CAME contrasts with the failure of many of the other 50 coordinating commissions that exist for the ZMVM. Metropolitan governance for transport in the ZMVM was supposed to be led by

the Metropolitan Commission for Transport (COMETRAVI), created in 1994 with objectives to improve transport services and road infrastructure, standardise regulatory frameworks and provide information for the development of a Transport Master Plan for the ZMVM. A failure of the States to delegate sufficient powers and inadequate staffing and funding meant this commission fell short in meeting its objectives and was suspended. Extending the responsibilities of the CAME in addressing issues of mobility related to air pollution might offer a way to improve coordination quickly.

Reciprocal arrangements for enforcement and collection of fines for contravening restrictions ought to be agreed between the CAME States. Although vehicles in contravention of the rules can be fined by any of the jurisdictions, collection of the fine is not automatically pursued across borders. The annual tenencia tax on vehicle ownership ought to be differentiated on the basis of the emissions characteristics of the vehicle rather than its value. This would provide incentives to purchase cleaner vehicles in every segment of the market. The six States that cooperate in the CAME should also end exemptions to the tax and consider earmarking revenues to investment in public transport, which might improve acceptance of this tax as well as generating a revenue stream to support alternatives to the use of the car.

Responsibilities for mobility master planning and coordination might also be entrusted to the CAME. For the long term more integrated land-use and transport planning is essential to containing air pollution and CO₂ emissions. Planning tools to assess the impact of development on traffic and fund necessary enhancements to public transport have been introduced in Mexico City but these now need to be linked explicitly to planning consents. The property development mobility impact assessment procedure provided for under Mexico City's 2015 Mobility Law needs to be implemented fully and linked directly to the process of awarding construction authorisations. This planning framework for ensuring developers contribute to investment in public transport should be extended across the Metropolitan Zone of the Valle de Mexico and other options for diversifying funding for investment in public transport explored. A Mobility Master Plan for the Zone, linking funding allocation to priorities established jointly by the State and Federal authorities should be established. The CAME appears to be the most effective regional institution available to establish such a plan (ITF 2017).

Chapter 3: Buenos Aires

Key characteristics of the transport system

The area of analysis of this chapter is the metropolitan area of Buenos Aires. There are various ways to define this metropolitan area (Box 1). For the purpose of this study, the metropolitan area examined is the Región Metropolitana de Buenos Aires (RMBA). This covers the Autonomous City of Buenos Aires (CABA), the Capital and one of the Federal Provinces of Argentina, and the 15 municipalities within it. It also includes 42 municipalities surrounding the CABA. These 42 municipalities form what is referred to as the Greater Buenos Aires, and are part of the Province of Buenos Aires, another Federal Province. RMBA has an area of 13 285 km² and a population of around 15 million inhabitants. This represents more than one third of the country's population (CABA, 2019). The RMBA also accounts for more than half of the country's GDP.



Box 1: Different demarcations for Buenos Aires' urban area

There are different ways of defining the metropolitan area of Buenos Aires:

- **The Metropolitan Area of Buenos Aires (AMBA)** refers to the area formed by the CABA and 24 surrounding municipalities belonging to the Province of Buenos Aires. It was defined and demarcated by a joint agreement of authorities from the Province of Buenos Aires and the CABA in 1984. It only serves as a planning reference point.
- **The Agglomeration of the Greater Buenos Aires (AGBA)** is a statistical unit defined in 2003 by the National Institute for Statistics and Census (INDEC for its Spanish initials). It is one of the 31 urban agglomerations in the country. AGBA covers the urban footprint of the metropolitan area of Buenos Aires. This urban footprint is determined by the limit of continuous urban housing. This evolves with time, and with urban sprawl. In 2003, AGBA included the total area of CABA and of 14 neighbouring municipalities. It also included various parts of neighbouring municipalities.
- **The Metropolitan Region of Buenos Aires (RMBA)** is the term used to describe the wider economic region formed by AMBA and the urban agglomerate of La Plata. It includes CABA along with 42 neighbouring municipalities of the Province of Buenos Aires. This region is responsible for more than half of the GDP of Argentina, and gathers more than one third of its total population.
- Source: ITF, based on Lanfranchi et al. (2017); Observatorio Metropolitano (2019); Autonomous City of Buenos Aires (2012); Argentinian Government (1986)

This chapter presents the main characteristics relevant for decarbonising transport in RMBA. To this end, it first describes the city and transport activities for jurisdictions within it, with an emphasis on CABA. It then highlights the existing policy landscape relevant for transport decarbonisation at the national and local levels. A final section sheds light into the main challenges and some potential solutions for decarbonising transport activities in RMBA, both passenger and freight.

The city

Spatial dynamics of the metropolitan area

The CABA is the economic centre of the RMBA. The CABA has the highest population density of the metropolitan area, with around 15 378 inhabitants per square km. The CABA provides three million formal jobs, the majority of the employment opportunities in RMBA (Quirós & Mehndiratta, 2015). Most of the job opportunities inside of CABA are found around the traditional city centre (Ciccolella & Vecslir, 2012). Levels of employment inside CABA vary with the economic sector. Jobs in services to enterprises are highly concentrated in the traditional city centre. In contrast, employment in services to private households and trade activities are evenly distributed across the city. Manufacturing industry is mainly located in eastern areas of the city; the employment density here is lower than in most other parts of the city (Alves et al, 2018).

The urban agglomeration in Argentina's capital area has sprawled beyond CABA's boundaries and into its periphery in a radial manner, forming three concentric rings ("coronas") (Figure 1). The first ring started to develop thanks to the expansion of railways in the metropolitan area. It was then con-

solidated between the 1930s and 1950s as a result of the development of the textile, automobile and mechanical engineering industries in the metropolitan area. This was facilitated by the development of highways and an increase in car use. The second ring emerged between the 1960s and 1980s as a result of migration flows from other Latin American countries, such as Paraguay, Bolivia and Perú (PEC, 2019). Housing units in this ring include a considerable number of informally built structures, as well as of formal social housing units. The third ring emerged during the 1980s and 1990s, partly as the result of the relocation and creation of industrial parks. The ring allowed enterprises to benefit from the closeness to the urban agglomeration while also having space for larger industrial sites.

Residential areas spread all through the three metropolitan rings. Most high-income developments, including gated communities, are found in the north of RMBA, in the first and second rings. The south of the first and second rings is home to lower-income settlements. The urban sprawl of the third ring has extended to the administrative city of La Plata, the third most populated municipality in the metropolitan area. In all rings, urban sprawl has followed the main road infrastructure built by the Federal government to facilitate the mobility of goods and of people through, and around, the capital area (Argentinian Government, 2007).

Figure 1: RMBA



Source: Innovaes (20177)

Between 2001 and 2014, the built-up area of Buenos Aires grew each year by 2%. During 2000 and 2010, RMBA's population grew annually by 13.2%. This is bigger than Argentina's overall population increase, of 11.2%. RMBA's population growth is mainly driven by increases in its two rings. While CABA only had an annual population growth of 4.5% between 2001 and 2010, the population living in the first two rings increased overall by more than three times that amount each year (Fernández, 2010). Yet, growth is not uniform in the first two rings. The population of the first ring develops similarly to CABA with an average annual population increase of 6.0 % between 2001 and 2010. Over the same period, the population of the second ring increased by more than four times that amount. Population in the third ring increased at a slower pace compared to the second ring, but still grew on average 18% each year from 2000 to 2010.

Inequalities in RMBA

On average, poverty levels in CABA are the lowest in the metropolitan area. In Argentina, poverty levels are measured through an Index of Unmet Basic Needs (NBI for its Spanish initials). This index reflects the percentage of people with at least one unmet need in a given area (Box 2). An analysis of NBIs in RMBA shows that only 6% of households have at least one unmet need in CABA. Yet, inequalities exist between the northern part of the city, where a maximum of 2% of households have at least one NBI, and the south, with more than five times that amount (DINREP, 2014).

Poverty levels increase as one goes outside of CABA and into the periphery. On average, 9% of inhabitants of the first two peripheral rings have at least one NBI. The northern part of the first ring has similar poverty levels that CABA, and only around 6% of the population has at least one unmet need. Municipalities in the southern part of the first ring have a higher concentration of poor households. Here, in the worst-off municipality in terms of NBI, 12% of inhabitants have at least one unmet need. Poverty is starker in the second ring: in more than half of the municipalities in the area, more than 10% of the population has at least one unmet need. In the municipality with the worst percentages of NBIs, almost 20% of inhabitants have at least one unmet need. In the third ring, poverty levels remain high, as in most municipalities more than 10% of the population has at least one unmet need. La Plata and its surrounding municipalities have slightly lesser degrees of poverty, with around 8% of households of these municipalities having at least one unmet need.

Municipalities in the three rings have a stronger presence of unsuitable living conditions than that found in CABA. More than 100,000 people in the three rings live in unsuitable lodgings, which is more than twice as many as in CABA. Precarious living conditions are partially explained by the considerable number of informal settlements in these areas, as most informal built environments in RMBA are found in the three rings (Blanco & Apaolaza, 2018). This is associated with a lower provision of public services infrastructure, such as the availability of proper drainage, roads and public transport infrastructure.

Box 2: Measuring unmet needs in Argentina

Argentina uses an index of Unmet Basic Needs (NBI for its Spanish initials) to reflect structural poverty in the country. This is done by setting minimum wellbeing thresholds for what are considered to be basic needs. NBIs show the percentage of people with at least one basic need in one given area.

Some of the factors taken into account for NBIs include the quality of the physical infrastructure of the house, as well as individual characteristics of the members of the household. More specifically, NBIs refer to:

- Unsuitable housing (NBI 1): it refers to the type of housing inhabited by households living in hostels, hotels or pensions. It also includes housing arrangements unsuitable for housing purposes, precarious housing units and other types of lodgings. Housing units excluded from the analysis include houses, apartments or farms.
- Sanitary deficiencies (NB 2): includes housing units which do not have lavatories.
- Crowding conditions: it refers to the ration between the total number of household members and the quantity of rooms for exclusive use of the household. Technically, it considers that critical crowding exists when there are more than three people per room in the household.
- School non-attendance (NBI 4): there is in the household at least 1 school-age kid (6 to 12 years old) who does not attend school.
- Capacity to subsist (NBI 5): Includes all households with four or more people per each working member, and whose head of household has not completed three years of the first cycle of primary education (ages 6–9).

Source: ITF, Based on: DINREP, 2014

The transport system

Passenger transport

More than 90% of CO₂ emissions linked to the transport sector in RMBA stem from road transport, with cars being the main source (Argentinian Government, 2017). Infrastructure for passenger transport in the metropolitan region includes the rail, subway and road infrastructure networks (Figure 2). Similarly, more than 90% of passenger trips in the Metropolitan Region use road transport. The RMBA has almost 48,000 km of roads. Four main highways serve as the main arteries and connect the CABA with municipalities in Greater Buenos Aires in a radial manner, with the CABA at the heart of the system. There are three cross-cutting roads to connect the four main highways. Together, these seven main arteries have a length of almost 600 km. They are concessioned to private operators (UNTREF, 2015).

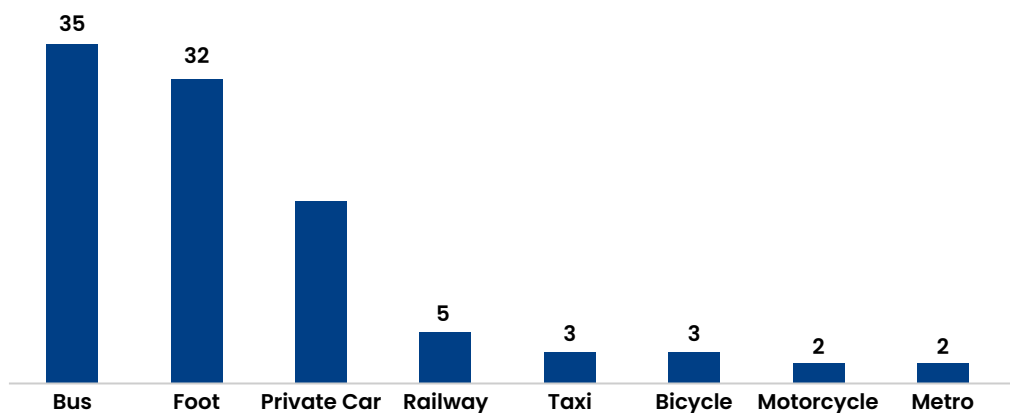
Figure 2: Main passenger transport network in RMBA (excluding buses)



Source: ATM (2019)

The following section will briefly explore some of the main characteristics of the main transport modes in the metropolitan area. Modes will be described in order of their importance for metropolitan mobility, given by results of the latest mobility survey (Figure 3).

Figure 3: Passenger transport mode share in RMBA (in %)



Source: ITF, based on ENMODO (2018)

Buses

With a mode share of 35%, buses are the main passenger transport mode in the RMBA. There are 9 9726 operating buses. Out of these, 1 813813 are deployed in the CABA. Buses transport around 7.9 million passengers perper day, covering an average of 565 million km perper year. They run on a route network of almost 8,000 km in the whole of RMBA. The different types of buses are (Turturro & Ubogui, 2016):

- National buses: They refer to all lines that provide transport services between the CABA and the Province of Buenos Aires. There are 1377 lines covering both the Province and CABA (Figure 4). 32 lines are exclusive to CABA, while the rest operate outside. For historical reasons, all bus lines in CABA are national bus lines. They are all concessionned by the Ministry of Transport.

- Provincial buses: Provincial buses pass through municipalities inside the Province of Buenos Aires. There are 107 lines, all of which do not enter the CABA (Turturro & Ubogui, 2016). They are tendered by the Province of Buenos Aires.
- Municipal buses: These are buses that provide services inside of one municipality. There are around 80 municipal bus lines in the Province of Buenos Aires. They are tendered by the municipal authorities of municipalities where they operate. There are not any municipal buses in the CABA, as they are all regulated and tendered by the National Government's Ministry of Transport.

Figure 4: Bus services in the RMBA



Source: ATM (2019)

Bus is the preferred mode for traveling inside the rings of the metropolitan region, as well as inside the CABA itself. More than two thirds of trips stemming from CABA, as well as the first two rings, are directed towards municipalities of the same ring they originated from. Users from all income groups use buses for their daily commutes. However, residents from the first and second income quintiles have a slight predominance on this mode, and make up around 45% of bus users in the RMBA (EN-MODO, 2010).

CO₂ emissions from the diesel buses amount to 4.3% of total transport CO₂ emissions in the metropolitan region. Authorities aim at reducing CO₂ and local pollutant emissions in the city by incorporating cleaner technologies into the bus fleet. As an illustration, by 2030, the national government aims at electrifying around 30% of the fleet (Argentinian Government, 2017). In CABA, city authorities have put in place pilot projects with two electric buses, two GNC and two 100% biofuel buses. Such trials have sought to shed light onto the operational and economic viability of cleaner technologies and inform the wider scale implementation of new vehicle technologies for public transport. A further initiative aims at promoting the replacement of Euro III buses with Euro V buses. For this, authorities will subsidise the interest rates for the purchasing and import of cleaner vehicles. So far, the initiatives do not consider scrapping of vehicles (Argentinian Government, 2017).

BRT

Metrobus, a Bus Rapid Transit (BRT) system, opened in the CABA in 2011. Since then, the system has extended to the metropolitan region. The current network is 81.3 km long; and operates on seven lines in CABA and on three lines in the Greater Buenos Aires region. Authorities aim at expanding the network

to up to 22 lines by 2030. The system provides a regular service and decreases travel time for users. Certain BRT lines in the metropolitan region are said to have reduced travel times by more than 50% for its users. In RMBA, the planned expansions of the BRT system are estimated to reduce more than 450,000 tCO₂eq between 2011 and 2030 (Argentinian Government, 2017).

Walking

More than one third of trips in RMBA are done by non-motorised modes. 95% of these trips are made on foot. Pedestrian mobility has been widely promoted as part of CABA's Sustainable Mobility Plan. Pedestrian priority areas have been developed to increase walking in the city. These "macroman-zanas" (macro blocks) are characterised by larger sidewalks, enhanced public lighting and overall better walking conditions. (CABA, 2019). Macroman-zanas are defined by "Basic Sustainability Units" or blocks - areas that are surrounded by a main transport infrastructure (main highways). There are five such areas in CABA at the moment, located in the city centre (Buenos Aires Ciudad, 2019). All in all, pedestrian priority areas in the city centre amount to more than 10,000 m². City authorities aim at expanding these areas in the future. CABA authorities have also implemented other measures to promote pedestrian-friendly streets. These include the setting of regulations, like stricter speed limits for motorised traffic to make walking safer and the environment more adapted to walking (Buenos Aires Ciudad, 2019).

Private Cars

By 2010, only around 35% of households owned a car. Levels of car ownership varied with income levels. Almost 90% of households in gated communities had a car, while less than 13% of households living in "villas", Buenos Aires' slums, had a car (ENMODO, 2010). At the metropolitan scale, in 2012, the highest motorisations rates were found in CABA, in La Plata, and in selected municipalities in the first and third ring. In these areas, there are more than 30 private cars per 100 inhabitants. These municipalities also have some of the highest number of gated communities in the metropolitan area. The situation is contrasted with the second ring, where most municipalities have a motorisations rate of less than 15 private cars per 100 inhabitants, or less than twice the highest value found in CABA (Blanco y San Cristóbal, 2012). In total, only around one third of car trips were made by low-income inhabitants of the metropolitan region, while almost half of them were made by higher-income groups. Most car trips in RMBA (70%) finish in the same ring as they start.

Private cars are responsible for almost two-thirds of road passenger transport emissions in RMBA (Turturro & Ubogui, 2016). CABA and national authorities have aimed at promoting mode shift from private cars to more sustainable modes. These include active mobility and various forms of public transport. Authorities are complementing policies that promote mode shift with policies seeking to improve technology in the private car fleet. The ultimate objective of these vehicle technology-oriented policies is that, by 2030, around 1.5% of RMBA's car fleet has low emissions technologies. The considered car fleet includes here private cars, as well as light utility vehicles, the government fleet and fleets of car-sharing services (Argentinian Government, 2017).

Policies to support vehicle technology change include the reduction of federal import tax for cleaner cars and light utility vehicles, as well as the purchase of cleaner technology vehicles for government fleets have also been considered. The CO₂ reductions of these measures have been estimated to be 650 TCO₂eq annually (CABA, 2010). Cleaner technology vehicles also benefit from policies aiming at reducing the administrative period for importing foreign cars. This period has been reduced from eight to two months (CABA, 2018). Nonetheless, this measure targets car imports in general and not those with cleaner technologies exclusively. Such decreases for import periods could potentially also lead to a

higher adoption of internal combustion engine cars (ICE), and thus to higher CO₂ emissions.

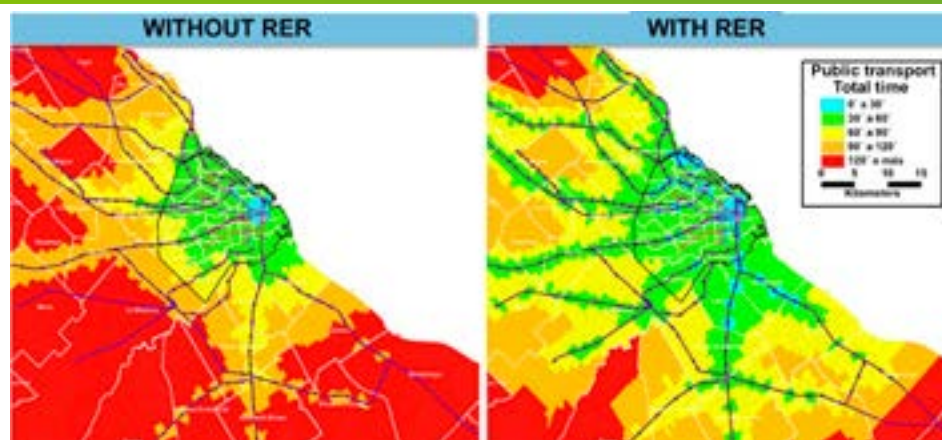
Railways

Around 6% of trips in the metropolitan region were made by rail in 2010. Buenos Aires has one of the most extensive metropolitan railway networks in Latin America. Nonetheless, low usage rates are the result of policies favouring private car use since the 1970s. This trend accentuated after 1999 due to falling demand and the financial hardships encountered by operators following the 2001 economic crisis. While in 1999, the metropolitan rail trips amounted to 479 million trips, in 2011 there were only 344 million trips (UNSAM-ITF, 2013). Yet, rail transport is still relevant at the metropolitan scale and investments since 2012 have aimed at increasing its mode share in RMBA (Szenkman, 2015). Today, the railway network has eight lines with a total length of around 967 km on 24 branches. 11 of these are electrified (CNRT, 2018).

The railway network is designed to facilitate commuter mobility from CABA's periphery towards the centre. It is designed in a radial manner, with CABA at its centre. There is poor connectivity between the lines themselves, with only one transversal line (out of the eight existing ones) providing that connection. Out of the network's 301 stations, most are located outside of CABA, with only 41 being in CABA to provide transfer services with the subway or bus networks. As a result, more than half of rail trips are done between the CABA and its peripheral rings (AMT, 2018). The system, however, has difficulty in meeting overall transport demand due to outdated and overloaded rolling stock. This is particularly the case in the first ring (UNSAM-ITF, 2013). From 2002 to 2015, only around 10% of annual maintenance needs were met (Barbero, 2015). This lack of investment has contributed to major quality issues of the system, resulting in an increased number of delays and accidents.

Various initiatives have been undertaken by the national government to address such challenges. In 2013, 709 cars replaced rolling stock that had reached its end-of-life on the main lines of the network. The passenger rail infrastructure has also been improved. In 2019, authorities carried out replacement and improvement works for more than 100 km of railways in the metropolitan area. These improvements mainly targeted two of the main lines in RMBA: Mitre and San Martín. The Ministry also launched a plan to create a Regional Express Network (RER), as included in the National Action Plan for Transport and Climate Change. The USD 14 billion project seeks to triple urban rail capacity in the metropolitan area. It also seeks to complement the existing radial structure of the network by providing better connections between route segments outside the CABA. It is planned to build 16 km of tunnels, four underground stations and one surface station, while eliminating 49 (out of 120) level crossings of road and rail infrastructure. The project is expected to reduce peak hour commuting times from more than 120 minutes to only 30 minutes in the areas benefitting from most of the RER investment (ATM, 2019) (Figure 5). However, financial difficulties have stalled the project.

Figure 5: Travel time savings from RER in RMBA



Source: ATM (2019)

Taxis and paratransit

There are around 50,000 taxi licences in RMBA (ATM, 2018). They account for around 3% of trips in the metropolitan region. Trips can be done by regular taxi, combis (charter-type services) or “remis”. Combis are a particular type of taxi services which mainly transport daily commuters from the Greater Buenos Aires to CABA. “Remis” services are on-demand para-transit services that offer private collective transport, mainly for inhabitants of the metropolitan rings. Vehicles are typically mini vans, which offer higher comfort than regular public transport buses. In municipalities of the rings, “remis” tend to compete with existing public transport services, partly due to comfort and quality differences. They can also serve as a complement for public transport in municipalities with service gaps. Depending on the service provider, they can operate door-to-door services or follow a pre-established route (Gutiérrez, 2012). Around 50% of the “remis” fleet operates under informal conditions.

Taxis are responsible for around 4.5% of all passenger transport emissions in the metropolitan region (Turturro & Ubogui, 2016). Potential measures to decrease emissions from taxis include the use of cleaner technologies. The city’s ultimate objective is a clean vehicle share of 35% in the total taxi fleet by 2035 (Argentinian Government, 2017). Authorities have led pilots to estimate the feasibility of electrifying part of the taxi fleet to support this objective. The pilots highlighted that cleaner technologies (i.e., electric vehicles) are, for the time being, not economically viable. On the hand, compressed natural gas (CNG) vehicles – that have had a significant share in the taxi fleet, are becoming increasingly interesting for taxi operators. This is thanks to decreasing CNG prices and an increased availability of this technology. New forms of unregulated app-based services such as Uber bring high competition to traditional taxis. CABA authorities have launched BA Taxi, an app to help regulated taxi drivers compete in digital platforms against these new services.

Cycling

Only 3% of trips in the metropolitan area are done by bike. According to the last mobility survey, most cycling trips were made in the rings of RMBA. In these rings, cycling is a traditional transport mode, especially as part of longer trip chains (ENMODO, 2018).

CABA authorities have been developing the Ecocycles programme for promoting cycling mobility. Since 2009, the City of Buenos Aires has been working on a network of protected cycle lanes on secondary streets. Lanes are also connected with public transport nodes to promote multi-modality. In addition, the program allows for the free loan of shared, docked municipal bicycles. Today, there are 400 stations, with 1200 available bicycles and a total of 238 km of bike lanes (Figure 6).

Figure 6: Cycling network of the CABA



Source: CABA (2019)

Subway

Only around 2% of travellers use Buenos Aires' subway (commonly known as 'subte') as their main mode of transport (ENMODO, 2010). The city's subway has six lines (A; B; C; D; E; and H). A further three lines are in planning (F; G and I). The network also includes one tram line (pre metro). Overall, the system has a length of 61.3 km and includes 78 subway stations and 16 tram stations. The system is limited to the boundaries of CABA, and is managed by the city authorities. Six out of ten subte users belong to middle- or high-income groups. Around two-thirds of subte trips are multi-modal.

Since 2018, multi-modality with buses and railways has been facilitated with the SUBE smart card. The fare system subsidises multi-modal trips. Subsidies apply for up to five legs of a trip done within two hours. On a multi-modal trip, the user pays the full fare for the first leg, receives a 50% subsidy for the second leg, and a 75% subsidy for any further leg that they might do (up to three). Further, subsidies of 55% are available for pensioners, domestic workers, or people on social benefits. 3.8 million people benefitted from such additional subsidies in 2018 (Argentinian Government, 2018).

Freight transport and urban logistics in RMBA

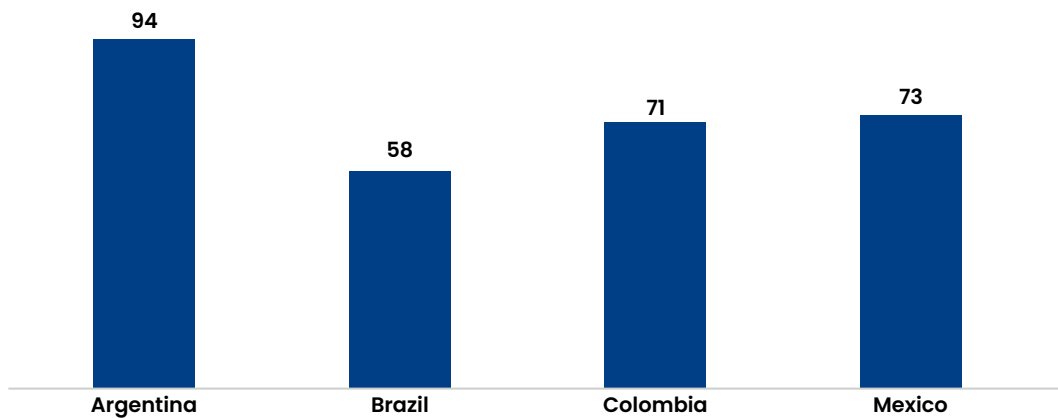
Freight transport in RMBA includes a complex set of activities, due to Buenos Aires' economic importance in Argentina. The Buenos Aires metropolitan region is at the heart of Argentina's freight activity, and it is the main centre for the country's imports and exports of manufactured goods. The high demand for goods in the metropolitan region itself, as well as the region's industrial importance also generates considerable freight movements within the area.

RMBA as the main centre of freight activity in Argentina

The metropolitan area has the highest concentration of maritime container activity in the country. Three of Argentina's main ports lie in the metropolitan region: Buenos Aires, Exolgan PSA and La Plata ports (Figure 8). Buenos Aires is the third most important port of the South American Eastern Coast (ECSA), and the Buenos Aires and the Exolgan PSA ports concentrate more than 80% of the country's freight container traffic.

RMBA is also connected to the six main national routes of Argentina, through which around half of the tons of freight export of the country move (Barbero & Castro, 2013). This follows a general trend in the country: 94% of freight transport inside Argentina moves by road. This mode share is considerably higher compared to other countries in the region, such as Mexico, Colombia and Brasil (Figure 7). The dominance of road transport for freight in the country, as well as in the metropolitan region, raises environmental concerns. In 2012, around 60% of road emissions in the country stemmed from freight activities (Barbero & Rodríguez Tornquist, 2012).

Figure 7: Share of road transport in total freight transport in the country (in % of transported tkm)



Source: ITF based on LEDS LAC (2019)

The three main railway lines for freight in Argentina, Belgrano, San Martín and Urquiza, start inside the RMBA. Railways are one of the cleanest transport options for freight in the country (Barbero et al, 2015). However, only 4% of freight loads is transported through railways, causing 2% of CO₂ emissions from freight transport in Argentina. Enhancing mode shift from road to rail for freight movements is a country-wide challenge.

Figure 8: Port throughput (in TEU) in Argentina in 2018



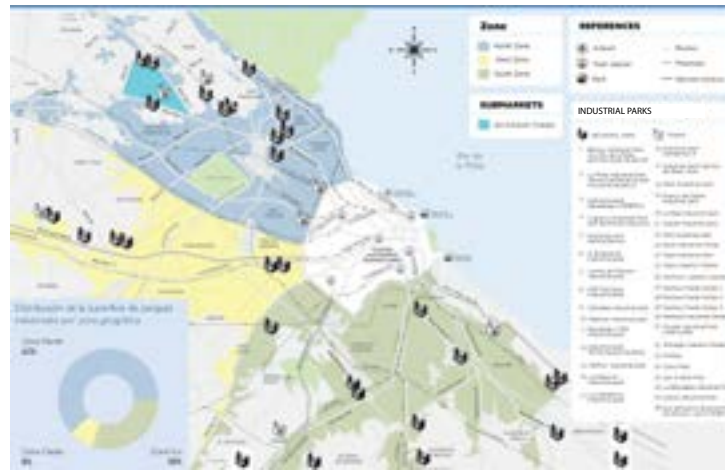
Source: Argentinian government (2019)

RMBA as a complex space for urban logistics

Beyond its relevance for Argentinian freight transport, the Buenos Aires metropolitan region is a major source of freight movements due to the high demand of goods of its population. As an illustration, more than 120 million kg of chicken, 72 million litres of wine and 393 million litres of soda are consumed in the capital region each year (Selva, 2018). Goods, particularly those linked to agricultural activity, mostly stem from outside of the metropolitan region. The transport of goods coming into the city is mainly done by road. Around 45% of heavy-goods vehicles in Argentina are found in CABA and in the Buenos Aires province. Out of these, about one in every five vehicles are lorries. The remaining four are smaller freight vehicles, such as vans and smaller trucks. Overall, the weight of products entering the metropolitan area by road equals more than three times that of goods leaving the area (Fiadone, Filadoro & Sánchez, 2018).

Urban freight transport is facilitated through a grid of industrial parks and logistic centres located in the rings of RMBA. In 2014, there were 38 built and projected industrial parks in the metropolitan region (Figure 9). More than 62% of them were found in the northern part of the Metropolitan region (Cushman & Wakefield, 2014). Logistic centres are in, and around, industrial parks. In 2014, a study by the consultancy Cushman & Wakefield estimated the number of centres in the metropolitan region with at least 40% of built infrastructure dedicated to manoeuvre yards. It found that in RMBA there were 88 such centres, resulting in a total of 982,000 m² of logistical space. 45% of them are located within industrial spaces; 55% are outside of such spaces. 72% were located in the north of the metropolitan region, mainly in the 3rd ring, while 26% were found in the south. Only 2% were found in the west of RMBA. Additional 50 centres were being built in the RMBA (Cushman & Wakefield, 2014). Most of these centres are built by private initiative, with little participation from public authorities (Cámara Argentina de la Construcción, 2014). One main exception was the creation of the Centro de Distribución Mercado Central (Central Market distribution centre). Mercado Central was built during the 1980s to serve as the main logistics centre for food products in RMBA and to reduce truck congestion in the metropolitan region (Mercado central, 2019). It is located just outside of the southern part of CABA. Most of its traffic is directly linked to the administrative city, with 650 daily trucks leaving to CABA every day (Albornoz, et al, 2015)

Figure 9: Industrial parks and logistic centres in RMBA



Source: Cushman & Wakefield (2014)

Freight transport in RMBA generates main sustainability challenges for the whole metropolitan region. A first concern is linked to emissions linked to heavy vehicles activity. No data for the metropolitan region is available regarding emissions. Nonetheless, data from CABA can serve as a proxy to understand the scale of the issue. Around 25% of all transport CO₂ emissions in CABA stem from freight transport, most of which from heavy-goods vehicles. Heavy-goods vehicles are also responsible for more than 40% of NO_x and PM₁₀ in CABA (CABA, 2019). Emissions also result from congestion. High congestion due to the presence of heavy vehicles in Buenos Aires, and in particular in the vicinities of the Port of Buenos Aires, has been identified as a pressing issue of the Metropolitan area for more than ten years (Barbero, 2007). Authorities aimed at addressing this issue through the project of Paseo Del Bajo. The project seeks to optimise road transport flows in the main freight corridor of the city. An exclusive lane for trucks was implemented. This has allowed increasing connectivity on the north-south axis in CABA, as well as pulling heavy transit away from the urban road network. Since its opening in the second half of 2019, the policy has reduced travel times for trucks from more than 1 hour to only 7 minutes (Bussi, 2019). Overall, the measure is expected to reduce more than 15,000 tCO₂eq in the period from 2020 to 2030 (Argentinian Government, 2017).

At the CABA level, policies are being put in place to mitigate freight transport emissions by electrifying the fleet in partnership with local delivery providers. As part of its Clean Mobility programme, the city has conducted pilots to promote electrification of the truck fleet of one of its own services and of one private company. The main objective of the pilot has been to produce evidence-based data and to shed light on the opportunities and challenges for vehicle electrification for private companies. Results show that, on average, the total cost of ownership (TCO) of electric vehicles remains more than 30% higher than that of diesel vehicles, even when accounting for the tax incentives for such vehicles provided by local authorities (CABA, 2019).

CABA authorities also aim at promoting the delivery of goods for commerce in off-peak hours. A first pilot for this has been put in place in the city's mostly pedestrian, financial district. 75% of heavy vehicle deliveries in that area are done between 8am and 12pm (Albornoz et al, 2015). Most of the heavy vehicles coming into the area are from Mercado Central. They are mostly utility vans. Delivery hours often conflict with passenger transport flows in the morning. In order to enhance efficiency of freight delivery in the area, CABA authorities have allowed and given incentives for off-hour/night-time deliveries in the area. Likewise, "blue boxes", have been made available. These are delivery-bespoke park-

ing spaces. For the time being, the programme has had rather negative results. The number of blue boxes put in place has not been enough to meet demand, as there is around one blue box for every seven blocks. As a result, vehicles parked in blue boxes have become informal and small distribution hubs from which the deliverer distributes the parcels. This has increased delivery times and congestion, and consequently also logistics costs (Hidalgo, 2019). The uptake of night deliveries has been difficult, due to concerns regarding crime and the potential related risks for employees or those receiving the charge. There have also been concerns regarding noise in the partly residential delivery areas (Hidalgo, 2019).

The limitations shown by the two pilots implemented by CABA authorities highlight the difficulty of successfully addressing transport externalities. This applies to both passenger and freight transport. Nonetheless, they also show the potential of innovation in public action for addressing pressing policy issues. The implementation of pilots, particularly in a matter such as urban logistics, where little data is available, is a way of fostering local expertise to better tackle urban transport problems. Developing evidence-based policies in RMBA, as well as in other Latin American cities, will be key for addressing the transport challenges ahead.

Current Policy Landscape

National Policy

The Government of Argentina constitutionally adopts the form of a representative, republican and federal democracy. Due to its federal nature, Argentina has two government structures: The National, or Federal Government; 23 provincial governments, and the Autonomous City of Buenos Aires (CABA). The provincial governments, as well as that of CABA exercise all powers not expressly delegated to the Federal Government. Additionally, the CABA is governed by a system of autonomy, while the provinces have administrative subdivisions and municipalities (Argentinian Government, 2019).

The institutional framework regulating Argentina's governmental and ministerial processes is robust. The main governmental body in charge of climate policy is the Secretariat for Environmental Policy, Climate Change and Sustainable Development, under the Ministry of Environment and Sustainable Development (MAyDS). The Secretariat has adequate human and fiscal resources to undertake its mandated tasks and there is a suitable breadth of decarbonisation analyses to aid government decision makers.

In 2016, the government created a National Cabinet for Climate Change (GNCC for its Spanish initials) for inter-ministerial and inter-secretarial cooperation among all ministries, including the Ministry of Transport, as well as public engagement for climate change policy. GNCC also engages with the provinces, through the Federal Environment Council (COFEMA). GNCC is tasked with developing national and sectoral initiatives to reduce GHG emissions. GNCC formulates commitments in line with international agreements – in particular, the development of the country's Nationally Determined Contributions (NDCs) (Argentinian Government, 2016b).

National climate change policy

Argentina is one of the few countries which updated its NDC after the initial submission for the Paris agreement in December 2015. In the revised NDC, Argentina announced its unconditional commitment not to exceed net emissions of 483 million tCO₂eq by 2030 (Argentinian Government, 2016a). According to the National inventory of greenhouse gases in 2014, the total national emissions were 368 million tCO₂eq. Of these, 28% came from energy production; 43% from agriculture, livestock & deforestation; 15% from transport; 10% from industry; and 4% from waste (Argentinian Government, 2017b).

Aiming to achieve this commitment, Argentina announced the National Climate Change Action Plan 2016 –2019. In 2017, the national government published National Climate Change Action Plans for six sectors; energy, forests, transport, industry, agriculture & livestock, and infrastructure & territory, which lay the foundations for the development of the National Mitigation Plan and the National Adaptation Plan. These two plans are due to be published and will be inputs for the development of the National Climate Change Response Plan (Argentinian Government, 2017b).

Development of the renewable energy sector

To reduce GHG emissions, Argentina is focusing on diversifying its energy matrix to boost renewable energy use and to improve energy efficiency. The National Energy and Climate Change Action Plan defines the unconditional target to increase the renewable energy share of total energy demands to 25% by 2030 (Argentinian Government A, 2017c). Policies such as the 'Biofuels Law' and the 'Renewable Energy Law' will contribute to that objective. In 2017, the government adopted a carbon tax covering all fossil fuels sold in Argentina (FARN, 2017).

The government is also seeking to diversify the supply of energy while promoting environmental conservation and rural development (Argentinian Government, 2017c). According to the National inventory of greenhouse gases in 2014, 46.4% of transport energy source came from gasoline, while just 2.8% from biofuels (Argentinian Government, 2017b). To increase the share of biofuels as energy supply, a modification to the Biofuels Law was adopted in March 2016 through Decree 543/2016. Originally, the Biofuels Law of 2006 mandated a 5% blend of ethanol in gasoline and a 5% blend of biodiesel in diesel in 2010 (Argentinian Government, 2006). Since 2016, the new law requires a minimum blend of 12% of bioethanol in transport fuels (Argentinian Government, 2016d).

Further efforts aim at harnessing Argentina's potential for renewable energy, mainly through the generation of wind and solar energy. A Presidential Decree (Decree 140/2007) declared the rational and efficient use of energy a national priority. The decree has the ambitious goals of reducing energy consumption and promoting the use of renewable energy in the public sector. This includes public transport and lighting, as well as private industries and private residencies (Argentinian Government, 2007a). For this, it launched a National Program for Rational and Efficient Energy Use under the authority of the Energy Secretary.

On a similar note, Law 27 191 of 2015 on the National Support for the Use of Renewable Sources of Energy aims at a minimum 12% share of renewable energy sources in Argentina's total electricity consumption by the end of 2019, and at a 20% share by 2025 (Argentinian Government, 2015). This is an ambitious target, as renewable energies only accounted for approximately 2% of total energy consumption in 2017. To achieve this goal, the government launched the renewable energy auction programme of Argentina (RenovAr). RenovAr sets the framework for an auction process for Power Purchase Agreements (PPA) for renewable electricity in the country (Argentinian Government, 2016f). Further actions on this topic could include incentives for promoting overall reductions in energy consumption from citizens, both in the transport and in other relevant sectors such as infrastructure. Objectives of the different sectors need to be better aligned so as to ensure efficiency energy use and overall emissions decreases.

At national level, a carbon tax on all fossil fuels was set in 2017 (Argentinian Government, 2017). The tax consists of a fixed sum according to the type of fuel with the possibility of increasing it to 25% and lowering it to 10%. The amounts vary according to the type of fuel shown in Table 1. The reach and level of the current carbon tax is likely to expand in the future to more effectively address CO₂ concerns. The current tax levels are seen to be starting point in that process.

Table 1: Type of fuel for Carbon tax

Fuel type	USD	Measure unit
Natural Gas	n/a	Kg
Mineral Carbon	0.429	Kg
Liquid Natural Gas	n/a	Kg
Petroleum coke	n/a	Kg
Aero kerosene	n/a	Liter
Oil Fuel	0.519	Liter
Unleaded Naphtha, Natural Gasoline, Solvent, Turpentine,	0.412	Liter
Gasoil, Diesel oil	0.473	Liter

Sources: Law 27430 (Argentinian Government, 2017a) and (FARN, 2017)

Expansion of authorisations to import hybrid and electric cars

In 2019, the Argentinian Government extended the authorisation to import hybrid and electric vehicles from abroad through Decree 230/2019, while, at the same time, making efforts to reduce high import costs, especially for hybrid and electric vehicles.

National Transport and Climate change Action Plan (PANTyCC)

Based on the National inventory of greenhouse gases in 2014, the transport sector is one of the key focus areas for Argentina for climate change policies. The transport sector emits around 54 MtCO₂eq per year, or 15% of total national CO₂ emissions (Argentinian Government, 2017b). In 2017, the National mitigation plan of the transport sector (PNMT) and the National Transport and Climate Change Action Plan (PANTyCC) were announced within the framework of GNCC as part of the Government's actions to promote sustainable development and fulfil its international commitments. The PANTyCC represents a set of initiatives that Argentina has planned for reducing greenhouse gas emissions and adapting to the effects of climate change in the transport sector, in accordance with its NDC. The preparation of the Action Plan was coordinated by the National Directorate of Climate Change (DNCC) of the MArDS together with the Ministry of Transport, with the support of the United Nations Development Program (UNDP). PANTyCC's target is to mitigate almost 6 MtCO₂eq of transport emissions in 2030 compared to a business-as-usual scenario (a mitigation of almost 8%). How the respective estimates were obtained is not further detailed in the plan.

Table 2. Estimated CO₂ emissions mitigations by transport sub-sector and by measures by 2030, compared to business-as-usual scenarios

Mitigation strategies and measures	2030 (tCO ₂ eq)	Cumulative 2011-2030 (tCO ₂ eq)
Freight transport	3,958,150 (67%)	27,992,741 (60%)
Efficiency improvement in road freight transport	2 084,993	14,008,388
Railway prioritisation (Freight)	1,873,157	13,984,353
Urban passenger transport	1,918,991 (32%)	18,600,025 (40%)
Railway prioritisation (RMBA)	773,960	7,220,261
Low emission mobility development	684,167	4 645 602
Prioritisation of Public transport	457,856	6,689,472
No-motorised mobility development	3,008	44,690
Interurban passenger transport	33,022 (1%)	360,928 (1%)
Railway re-establishment	29,784	325,894
Air commercial modernization	3,238	35,034
Total	5,910,163 (100%)	46,953,694 (100%)

Source: National Transport and Climate change Action Plan ((Argentinian Government, 2017b)

Freight transport

Around 67% of the total transport-related emissions reductions are planned to come from freight transport in 2030. Railway prioritisation (freight) is achieved through a Rail Freight Investment Plan (PIF), which aims at dedicated road transport charges to rail infrastructure and vehicle improvements. This aims to contribute 47% of the total freight transport emissions reductions in 2030 (Argentinian Government, 2017b). The other 53% of freight transport emissions reductions are planned to come from efficiency improvements in road freight transport (Argentinian Government, 2017b).

Urban passenger transport

Urban passenger transport is aimed at contributing 32% of the total transport-related emission reduction targets in 2030 (Argentinian Government, 2017b).

Development of the Regional Express network (RER)

PANTyCC plans 38% of the total urban passenger transport emissions reductions to come from the planned Metropolitan Train Network (RER). RER will expand existing infrastructure and connect RMBA rail lines with inner CABA. Some of the main improvements will be linked to new tunnels, stations and viaducts within the Autonomous City of Buenos Aires. It will cost around USD 14 billion by 2030 (Argentinian Government, 2017b).

Development of Low emission mobility

PANTyCC foresees that the development of low emission mobility could contribute 36% to the total urban passenger transport CO₂ emissions reduction by 2030. Focus is put on the promotion of low-emission light-duty vehicles and of the use of renewable energies for buses. Other measures are energy efficiency labelling for vehicles and collective fleet renewal schemes to shift from Euro III vehicles to EURO V for public vehicles in the RMBA, 1.5% of light-duty vehicles are to be low-emission vehicles by 2030; 30% of buses are to run on renewable energy by the same year (Argentinian Government, 2017b).

Prioritisation of Public Transport

Urban passenger transport improvements are seen to contribute almost 40% of transport-related CO₂ emissions mitigation by 2030 in Argentina. Mitigation efforts are linked to public transport infrastructure improvements in RMBA and in other metropolitan areas in the country. One of the projected measures is to extend the Metrobus network. National authorities aim at building 22 new metrobus corridors in the country by 2030. New corridors will be located in RMBA and in other metropolitan areas across the country. This measure is expected to lead to 14.4% of total CO₂ emissions savings in the transport sector between 2011 and 2030 (Argentinian Government, 2017b).

Interurban passenger transport

1% of total transport-related CO₂ emission reductions are expected to come from interurban passenger transport in 2030. Improvement of capacity and traffic management at airports is a key focus area mentioned in the PANTyCC. Railway investments between Buenos Aires and Mar del Plata, and Buenos Aires and Rosario are also a main focus (Argentinian Government, 2017b).

City-level climate change policies

Climate change policy

Buenos Aires Climate Change Action Plan for 2030

In 2009, the city launched the Climate Change Action Plan Buenos Aires for 2030 (CABA, 2009). It sets out a Business as Usual (BAU) scenario to evaluate mitigation strategies. The goal is to reduce CO₂ emissions by 30% by 2030 compared to 2008 levels (CABA, 2009).

Next to the power and waste sectors, transport was selected as one of the three priority sectors for GHG emissions reductions. Highlighted measures include the construction of car parking areas at peripheral areas (to discourage private car use in the metropolitan area), and improvements to the pedestrian, cycle and public transport networks. Vehicle efficiency improvements and clean vehicle technologies, such as hybrid and electric vehicles are also mentioned (CABA, 2009).

City transport policy with climate elements

Sustainable Mobility Plan (SMP)

Since 2010, Buenos Aires city has been working to implement their Sustainable Mobility Plan (SMP). SMP was elaborated by closely consulting with authorities of the province and of the National Government (CABA, 2019).

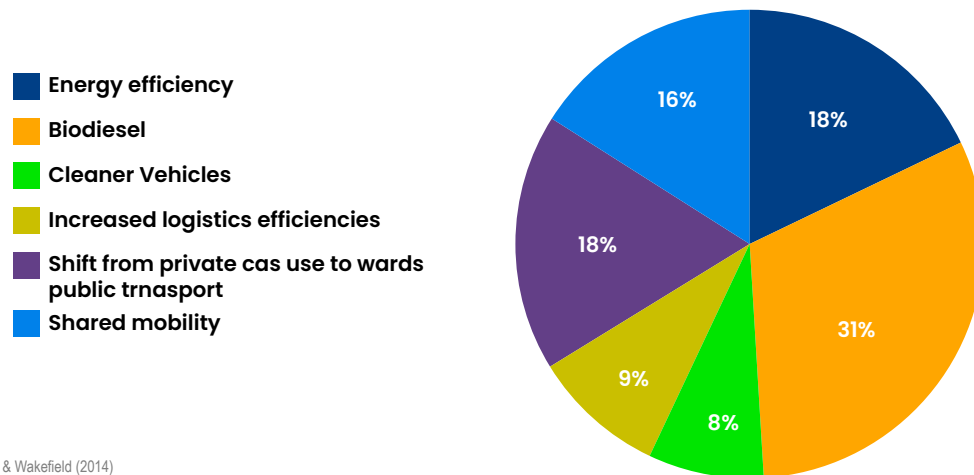
Focus is put on the promotion of public transport and non-motorised modes. The SMP further emphasises investments for cycling and pedestrians' infrastructure. It also highlights the importance of awareness raising among the public to encourage soft modes.

Clean Mobility Plan (CMP)

In 2018, Buenos Aires city also announced a Clean Mobility Plan. This document serves as the main planning framework for policies linked to transport decarbonisation and reduced local pollutants in CABA. The two main emission objectives set out in the plan include reducing CO₂ emissions by 14% in the period from 2015 to 2035; as well as reducing 50% of NOx and of PM emissions in the same period. Regarding CO₂ emissions reductions, the plan includes a policy mix that integrates measures for reducing motorised mobility (shared mobility); shifting towards more sustainable modes such as public transport; and improving energy technology of vehicles, such as by promoting the use of cleaner technologies for private and utility vehicles, buses and taxis.

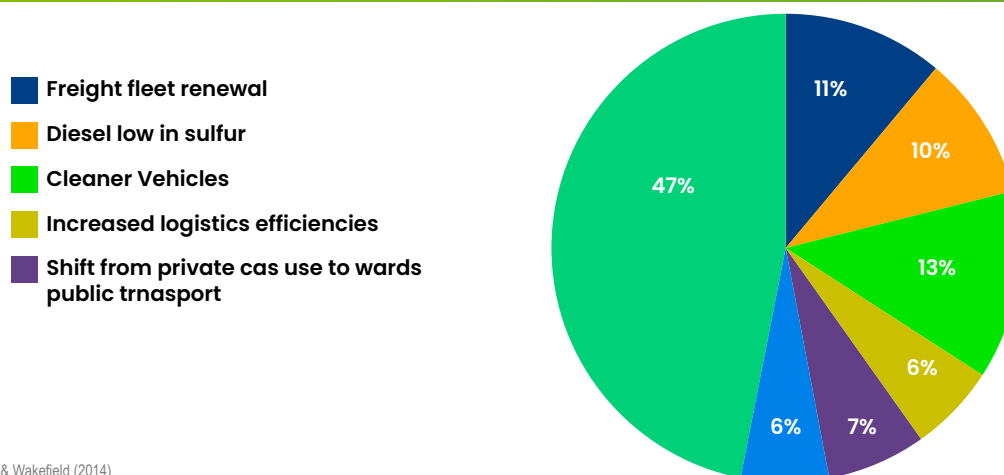
Figures 10 to 12 reflect the estimated contributions of these different policies for the aimed CO₂, NOx and PM reductions by 2035. The potential of various policies in the plan for reducing emissions are worth noticing. Nonetheless, implementation concerns might arise linked to the economic crisis present in the country since august 2019. Further work will be required in the future in order to clarify funding and capacity availability for carrying policies to term.

Figure 10: role of policy actions in CO₂ emission reductions between 2015 and 2035



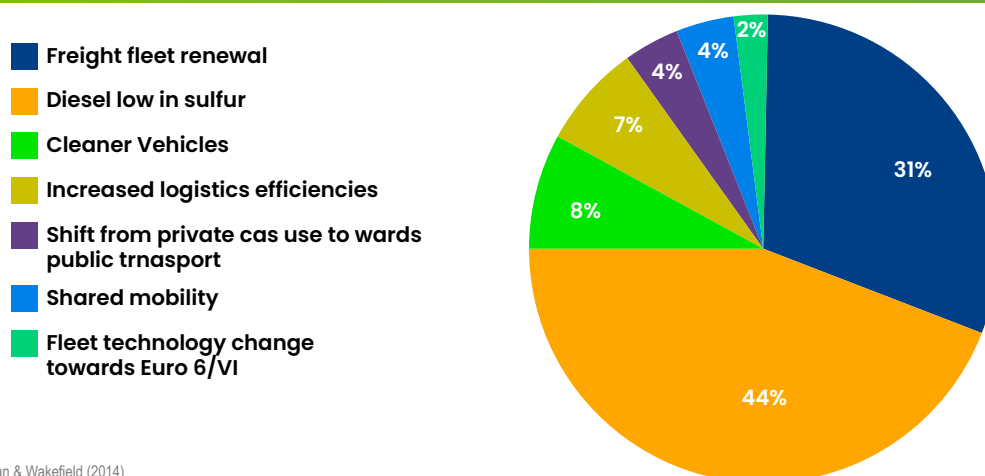
Source: Cushman & Wakefield (2014)

Figure 11: role of policy actions in NOx emission reductions between 2015 and 2035



Source: Cushman & Wakefield (2014)

Figure 12: role of policy actions in PM emission reductions between 2015 and 2035



Source: Cushman & Wakefield (2014)

Authorities have conducted initial pilots in line with the Cleaner Mobility Plan to assess the feasibility of a wider adoption of measures. Trials provide one of the largest local sources of evidence-based analysis on policies. For the time being, authorities have run pilots by using 2 electric buses, 2 CNG buses, 2 biofuel buses; 1 electric vehicle in LGV and 1 CNG vehicle included in the city government fleet. Tests with these vehicles include estimates on the impacts of driving on fuel consumption. They also serve as a basis for cost-benefit analyses to estimate the trade-offs between environmental benefits and overall costs for authorities (CABA, 2017).

Metropolitan level transport decarbonisation policies

There is a lack of a legally binding sustainable mobility plan at the regional metropolitan level. The Master Transport Plan (PDT) is the only metropolitan-wide transport-related policy document set for the metropolitan area. The Plan serves as a 5-year guiding tool for interjurisdictional transport interventions. It is developed by the Metropolitan Transport Agency (ATM). However, it is not legally binding

in any of the three main jurisdictions in the area (the National State, the Province of Buenos Aires and CABA). The guiding document includes objectives for improving the energy efficiency of the transport system. For this, it aims at helping the setting up of common methodologies across the RMBA for analysing energy consumption. The PDT also sets the objective of reducing GHG emissions, air and sound pollution. For this purpose, it promotes a homogeneous method at the metropolitan level for analysing mitigation impacts, as well as developing minimum quality standards for common strategies (ATM, 2018).

Assessment of CO₂ Mitigation Plans

At the national level, Argentina has shown explicit political commitment towards climate mitigation by scaling up climate mitigation policy domestically. Through the institutional reform to create the National Cabinet for Climate Change (GNCC), top-level cabinet ministers and secretaries regularly consider climate mitigation policies, well linked to the six sectorial action plans including transport. However, much of Argentina's processes for policy development, implementation and review around climate change mitigation are still under development. A national mitigation plan and a national adaptation plan are expected to be released soon.

Furthermore, while medium-term policy planning in Argentina is comprehensive and detailed, and sectoral plans are developed in a systematic and coordinated way, long-term policy planning of national climate strategies is not fully developed. For example, there is no quantified emissions reduction target for 2050.

Continuing to enhance coordination through the Metropolitan Transport Agency (ATM) is crucial. There is no other institution with policy capacity in transport or transport decarbonisation at the Regional Metropolitan level. Metropolitan-wide action and coordination will be particularly important for aligning land-use and transport policies across the metropolitan area. It will also be necessary for budgetary planning across the metropolitan region.

Buenos Aires city has formulated a Sustainable Mobility Plan that establishes the principles of decarbonising mobility as well as a Clean Mobility Plan, which frames implementation of pilot projects to introduce clean energy in the transport sector. However, the key challenge is going to be the economic sustainability of the measures proposed. Private sector actors will be key partners, also concerning the enhancement of public transport services. In this respect, continuing proactive public engagement is important. Buenos Aires city engages with the public through opinion polling, awareness campaigns and the launch of a dedicated educational website.

Main challenges for decarbonising transport in RMBA

The following section highlights the main challenges that Argentinian authorities face in decarbonising transport in RMBA. Discussed challenges stem from the three main pillars of sustainability (environmental, economic and social).

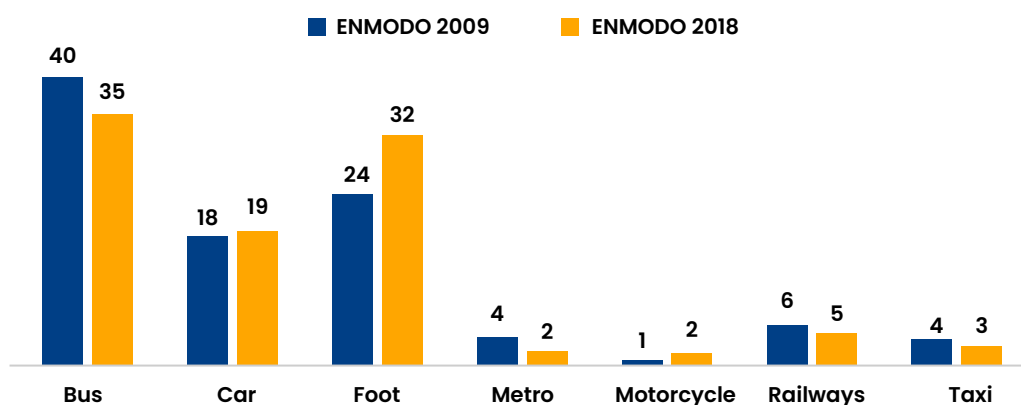
Challenges for public transport: financing improvements for increasing access to opportunities in a sustainable manner

Mode shift towards sustainable modes offers an opportunity for transport decarbonisation

Decarbonising passenger transport in RMBA will require mode shift towards more sustainable modes. From 2009 to 2018, the share of walking increased from 28% to 32% of all trips in the metropolitan re-

gion (Terrile, 2019). However, this shift did not come from car or motorcycle use, but rather from other sustainable modes (Figure 13). Bus usage decreased by 12.5%; railways usage by 16% and metro usage was halved. Car use, on the other hand, increased slightly and motorcycle use doubled. Unless the availability and quality of sustainable transport offer in the city are increased, mode shift will be difficult to achieve.

Figure 13: Mode shares in RMBA in 2009 and 2018 in RMBA (in %)



Source: ITF, based on ENMODO (2009) and Terrile (2019)

Increasing public transport availability and making it attractive to car users in the metropolitan rings is challenging. The city's urban growth pattern has not been aligned with public transport infrastructure developments (Peralta Quirós & Mehndiratta, 2014). For example, growth in the peripheries has partly been driven by an increase of low-density, gated communities with a high reliance on the use of the private car, partly due to a low public transport connectivity. Increasing public transport availability in peripheries, particularly by bus, can also promote social sustainability in the metropolitan region. Transport can contribute to inequalities, as it can facilitate or hamper access to essential opportunities such as jobs, education or health care (ITF, forthcoming). In Latin American cities, such as Buenos Aires, there is a correlation between lack of access to public transport and hardship to integrate into the formal work market (IDB, 2018). In RMBA, levels of access to job opportunities in the second and third ring – areas with highest concentrations of low-income inhabitants – tend to be lower than those in CABA. For example, in the municipalities with the highest share of inhabitants with at least one unmet basic need (NBI), public transport provides access to at most 20% of all existing formal job opportunities in RMBA in 30 minutes (Quirós & Mehndiratta, 2015). Partly this is driven by a lack of paved roads, restricting bus access in particular.

Among other policies, authorities need to respond to the lack of infrastructure in peripheries by furthering already existing road pavement programmes. Between 2015 and 2019, the Federal Government carried out road pavement works to improve public transport infrastructure. Between 2015 and 2019, more than 400km roads were paved. Works also included providing for bus stops, BRT systems and transport hubs in the rings around CABA. These measures aimed at increasing access to transport infrastructure in affected areas (Argentinian Government, 2019d). Measures aimed at furthering increases in accessibility should be oriented by planning objectives for the future evolution and expansion of RMBA. Potential income sources for funding these projects could also stem from eventually earmarking funds stemming from private transport activity for public transport improvements. These

policy actions and strategic perspective would require coordination between all relevant public authorities at the metropolitan level.).

A lack of provision of good quality and affordable sustainable modes, especially public transport, can create equity concerns. In lower income areas where public transport is unavailable or is not affordable, inhabitants could be forced to purchase private vehicles to access essentials. This has been the case of Bogota, where lower income groups have increased their ownership and use of motorcycles to respond to a lack of sustainable transport alternatives (CAF, 2015). In Buenos Aires, the doubling of motorcycle use between 2009 and 2018 is also likely to have been caused by the poor performance of public transport services in lower income areas. Low public transport availability and affordability can affect lower income women the most (Dominguez Gonzalez et al, 2020). It increases their exposure to risk, as they face longer walking times or informal transport trips. Low availability also creates gender disparities in terms of access to job opportunities: in some areas of Buenos Aires metropolitan region, men without children have twice as much access as women (Dominguez Gonzalez et al, 2020). Increases in availability and in quality of public transport offer will need to take into account these gender concerns (Box 5).

Box 3: Gender Gaps in Buenos Aires

In Buenos Aires, women and girls travel patterns differ from men's, mostly because they execute many trips to exercise unpaid care work, and because of the service's unsafe conditions, mostly connected to the gender-based violence they suffer. With regards to their commuting patterns, the latest mobility survey evidenced that (Arteaga, 2021b):

- Women perform less trips per day (2.47) than men (2.55).
- Women have the highest share of immobility: 37.38% of the female survey respondents did not travel on an average day versus 31.91% of men. One of the main reasons is unemployment. Thus, the lower the income of women, the smaller number of trips they perform, which mirrors the situation in Mexico City.
- 65.53% of the female respondents do not hold a driver's license one, versus 39.25% of men.
- Women are the main public transit users on a typical day and the main pedestrians, while men use more private vehicles. These findings correlate with income: the higher income, the more trips both men and women execute using more private vehicles.

Transportation infrastructure in Buenos Aires' public transit system is not designed to respond to the care-related trips that often women execute. A mixed-methods study conducted in Buenos Aires in 2019, evidenced that the infrastructure of public transportation systems is not designed to respond to the care-related duties. The study revealed that on a typical week (Julio Aurelio Aresco & Banco Interamericano de Desarrollo, 2019):

- Women spent 42% of the total commuting time executing care-related duties.
- The time-share was higher for women with dependents, particularly those between the ages of 25 and 50.

- The primary transportation mode they used to perform these activities was the collective bus (79%).
- Low-quality infrastructure was visible in the lack of baby changers in the restrooms of public transport stations, non-operating electric stairs, lack of accessibility ramps, and non-existent infrastructure to travel with strollers, wheelchairs, and bags.

Regarding safety, young women and girls in Buenos Aires are more prompt to experience sexual harassment in public transit than women in different age groups. The abovementioned study revealed that 83,9% of younger women (between the ages of 18 and 24) had been sexually harassed in the last year while using public transportation. This was the group of women with the greatest victimization rate (Julio Aurelio Aresco & Banco Interamericano de Desarrollo, 2019).

Buenos Aires has implemented various policies to respond to women's travel needs as well as to gender-based violence. Initiatives include consciousness raising and reporting campaigns on sexual harassment, surveys on gender-based violence, and video surveillance systems in vehicles (Banco Interamericano de Desarrollo & Ministerio de Transporte de Colombia, 2020; Granada et al., 2018a). At the beginning of the pandemic, the government implemented a measure that allowed women and other victims of this violence to use public transportation to get to a safe place or report the crime to the authorities, making an exception to the locomotion restriction that the government implemented during COVID-19 (Peker, 2020).

Fund and finance public transport enhancements and the shift towards cleaner fleets

Investments for public transport enhancement will become increasingly difficult given the country's current economic difficulties. The RER project alone, as presented in the National Transport and Climate Change Action Plan, will require USD 14,000 million until 2023 (Argentinian Government, 2017b). Concerns are particularly high for provincial authorities, where budgets are relatively tighter. CABA and the Province of Buenos Aires are required to promote fleet upgrades for more energy efficient and cleaner vehicles and to respond to day-to-day transport needs. In particular, since 2019 it is the provinces, not the State, that need to cover the 60% subsidies for public transport fares (Perfil, 2018). Shifting such financial responsibilities from the State to the Provinces limits their capacity to fund policies that foster public transport improvement programmes, needed for mode shift, or other CO₂ mitigation policies.

Policies that foster engagement with private actors are needed for successfully promoting high-cost policies, such as the promotion of cleaner vehicles. Meeting policy objectives, such as the electrification of 30% of RM bus fleet by 2030 (i.e., introducing 4 500 electric buses within 10 years), will require considerable high investments from private operators. Public authorities can provide financial incentives that target private operators that invest into the electrification of their fleet. For instance, the electrification and renewal of the fleet proposed in the National Transport and Climate Change Action Plan will need to be funded by private operators. These electrification goals and actions for the longer term can go in hand with more recent actions that promote other less carbon intensive technologies. Shorter term, and sometimes less costly, actions can include, for instance, giving subsidies for diesel in order to increase the adoption of diesel vehicles in the private and public transport fleets.

Electrification of the fleet would also require adjustments in the energy distribution network in RMBA to avoid a potential saturation of the energy grid. Finally, regulations and standards for cleaner vehicles still need to be adapted. For example, standards to facilitate vehicle-infrastructure communication standards for inter-operability are not yet defined (Argentinian Government, 2017b). Such issues will need collaboration from public authorities in their wider policies and plans, to effectively include cleaner technology vehicles in the national and RMBA market.

Challenges for freight transport: increasing data for better freight management

Address data and policy gaps in freight transport

As shown above, freight transport is the main potential source of future transport CO₂ emissions in CABA. Nonetheless, due to certain limitations, such as data on freight flows, this has been a mostly unattended area in decarbonisation policies in the Buenos Aires area until recently. A new initiative aims at setting a 'digital ring' in entries and exits of CABA. The project seeks to use cameras to register the actual flows in an out of the city proper. Once implemented, the digital ring will allow having better data on vehicle movements, both for passenger and freight transport in RMBA.

Further engagements with private actors

Authorities need to engage with private freight actors of all sizes to better implement existing soft measures for transport decarbonisation. In 2016, the National government launched a Smart Transportation plan, aiming at reducing CO₂ emissions from heavy-goods vehicles. Because of the importance of road freight traffic in the metropolitan region, this programme has particular relevance for RMBA. The initiative includes soft measures, such as eco-driving lessons for drivers (Argentinian Government, 2017). Measures in the programme are expected to bring about a reduction of 30% of fuel consumption in vehicles, as well as its linked CO₂ emissions – all at a low cost for operators and authorities alike (Campra, 2019). Nonetheless, the effectiveness of the programme relies on the capacity of authorities to clearly evaluate its results and to show its advantages; as well as to engage with smaller truck owners who have not participated in pilot trials of the programme. It will also require proper policy evaluation.

Engaging with private stakeholders is also required for promoting a holistic Urban Logistics Programme at the metropolitan level. Such a holistic programme is required for meeting the challenges raised by increasing freight activity in the metropolitan area, in part pushed by an increase in e-commerce. Private stakeholders can help in furthering data collection processes, as well as in better recognising the impact of freight flows in the metropolitan region. Developing relationships with enterprises is also a requirement for understanding the motivations of private stakeholders for decarbonising their activities. CABA authorities are conducting working groups and roundtables with private enterprises on sustainable urban logistics. This initiative is framed under the city's Smart Transportation programme. Two main roundtables have been carried out so far. They have allowed to increase understanding of the needs and motivations of the sector's private actors, as well as some of their main challenges for electrification. Further efforts are needed to expand engagement of smaller private actors across the metropolitan region. This is especially the case concerning freight transport of agricultural products. Around 90% of agricultural goods in the metropolitan region are transported by small truck owners coming from outside of CABA (Campra, 2019).

Better manage urban freight transport

Policies across the RMBA need to manage urban freight traffic flows instead of restricting them. The co-existence of freight and passenger transport activities can lead to increased congestion and even accidents. In Argentina, heavy goods vehicle drivers were involved in one out of five road traffic deaths in 2011 (Luchemos por la Vida, 2012). Because of this, governments around Latin America have implemented policies aiming at restricting freight transport in favour of promoting passenger flows (Hidalgo, 2019). In CABA, the pedestrian area of micro centro is one example of where a restriction of vehicle flows led to increased logistics costs. A recent pilot project sought to address this issue by permitting off-peak deliveries and allocating special "blue boxes" for heavy-weight deliveries inside of micro-centro. None-

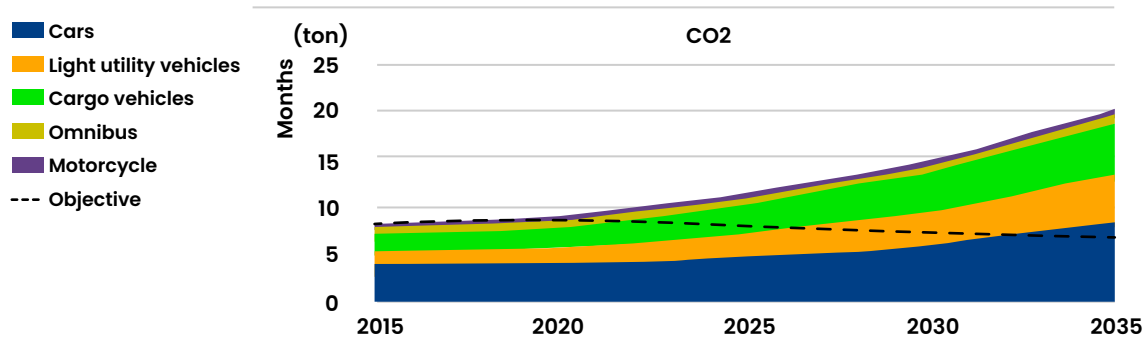
theless, the lack of wide success of this pilot showed further issues, such as insufficient parking facilities in the area. Further efforts are needed to better track, understand and control the impacts of urban logistic policies in transport flows at the metropolitan scale.

Authorities will need to face the recent expansion of motorcycle deliveries in Buenos Aires. Motorcycle delivery will change traffic flows and generate new CO₂ challenges. In RMBA, in 2015, the number of motorcycle deliverers was estimated to be around 15,000 (compared to around 25,000 bus drivers for all national buses in the metropolitan area) (Domecq & Sarmiento, 2015). The increase in the number of motorcycle deliveries is partly due to the increased availability of motorcycles, thanks to their relatively low price (i.e., around USD 1,000 in 2104 (CAF, 2015)). Policies will be required for transitioning from the mostly diesel-fueled motorcycles (Domecq & Sarmiento, 2015) towards the use of cleaner technologies and less pollutant modes. One main challenge for urban logistics will be to set policies that are cost effective, in times of high budgetary constraints. A potential idea in this front would be to promote incentives for the use of cheaper, low emission vehicles such as bikes or e-bikes for urban delivery, while creating deterrents for the use of motorcycles.

There are also concerns linked to delivery patterns of motorcycles. They tend to operate in smaller distance perimeters than trucks, mostly carry out intra-urban trips, and are thus often operated from informal “logistical centres” in high density urban areas (Domecq & Sarmiento, 2015). An unplanned or uncoordinated increase of such centres, e.g., led through private action, can result in unsustainable freight flows. A remedy may be to develop formal urban supply centres inside of CABA (Albornoz et al, 2015) that aim at facilitating urban logistics operations while reducing negative externalities, both for enterprises (in terms of loss of time and productivity) and for society as a whole (in terms of congestion or vehicle emissions).

Challenges for air quality: Improving the alignment between GHG and local pollutants mitigation policies

Transport decarbonisation is one of the main environmental challenges for the Argentinian capital. Transport is responsible for almost one third of CO₂ emissions in CABA (CABA, 2019). This percentage is likely to be bigger in the whole RMBA, due to relatively higher passenger and freight transport flows. More than half of transport emissions in CABA come from the use of private cars, and almost 40% are linked to freight activities. If no action is taken, transport CO₂ emissions in CABA are expected to more than double by 2035 compared to 2015. Although individual car emissions would remain significant, the biggest contributor to this increase would come from freight activities, which would account for more than half of all transport emissions in 2035, as opposed to around one third in 2015 (Figure 14). Reducing total transport CO₂ emissions of CABA by 14% by 2035, in line with national commitments, will be challenging (CABA, 2014).

Figure 14: CO₂ emissions projections for CABA 2015 to 2035 and respective reduction targets

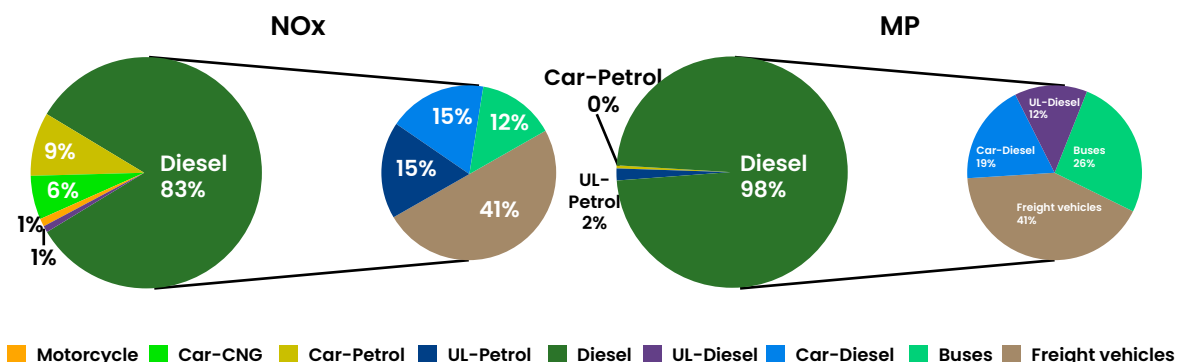
Main Message: 14% reduction of emissions by 2035 as compared to 2015. This goes in line with the conditional contributions for the Paris Agreements

Source: CABA, 2017

Buenos Aires has the lowest concentration of PM_{2.5} out of the three explored cities within this project. Nonetheless, the concentration is still more than 20% above the standards set by the World Health Organisation (BreatheLife, 2019). Currently, most PM emissions and 83% NO_x emissions in CABA are a result of diesel vehicles. Out of these, more than half of emissions stem from freight transport activity (Figure 15). Similar to CO₂ emissions, NO_x emissions are expected to increase in CABA by 25% between 2015 and 2035 if no actions are taken (CABA, 2019).

Decarbonising transport will need to go in hand with improving air quality concerns. Promoting fuel efficiency measures and shifting towards cleaner technologies are, for instance, potential ways forward. Nonetheless, certain technological shift promoted by authorities for decarbonisation can jeopardize air quality improvements. As an illustration, different levels of government in Argentina have promoted the use of natural gas vehicles as a relatively affordable way to decrease local pollutants generated from the public transport fleet of the city. However, these vehicles do not necessarily bring benefits in terms of decarbonisation objectives. Balancing out the two needs is thus necessary for developing a policy that addresses the health concerns of urban dwellers, all while providing viable solutions for decarbonisation.

Figure 15: Fuel contributions to air quality: percentages of NOx and MP10 per fuel and per category for the road transport vehicles in CABA



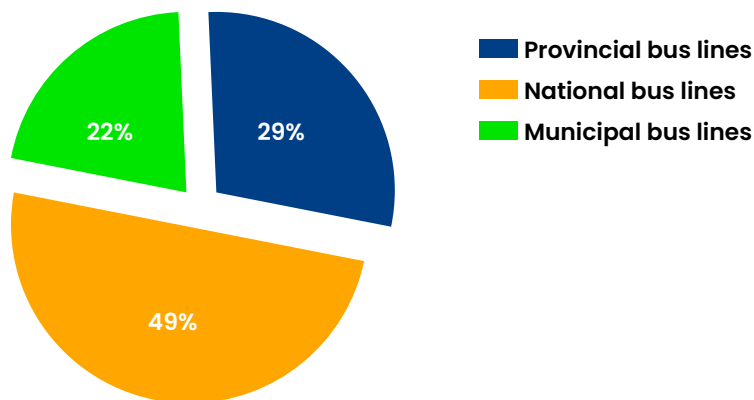
Source: ITF, based on ENMODO (2009) and Terrile (2019)

Governance challenge: increasing coordination at the metropolitan level

In the Buenos Aires metropolitan region, no single authority has the capacity to plan, coordinate and put in place metropolitan-wide policies required for decarbonising transport. This affects policy feasibility, as well as their ultimate potential for mitigation.

Public transport responsibilities in RMBA are split between three main governance levels. The CABA authorities are responsible for the subway network inside the city, as well as by their cycling network. The national authorities are responsible for national buses, which represent about half of the bus lines of RMBA (Figure 16). They are also responsible for the RER in construction. The province is responsible for almost one third of bus lines. Remaining bus lines fall under the planning and management of 42 municipalities. No clear effective coordination for public transport planning exists between these authorities at the metropolitan level.

Figure 16: Share of total bus lines in RMBA according to controlling planning authority



Source: ITF, based on Argentinian Government (2018)

Environmental and road network planning are also split between different levels of authority. Due to the federal nature of Argentina, each province is responsible for their environmental policies. In this respect, they have the capacity of refusing to adhere to a law in environmental matters taken at the national level. Road network planning is in a similarly difficulty, as municipal, provincial and national roads fall each under the supervision of its corresponding authority. No clearly defined planning co-operation framework exists between various authorities.

This lack of coordination could potentially lead to ineffective policy implementation for transport decarbonisation. An illustration of this is the limited success of the freight component of the smart transport programme (led by the national government). As part of the programme, the national government passed a law to permit double trucks in national roads. This aimed at increasing freight transport efficiency, indirectly reducing emissions. Nonetheless, ten provinces have not yet passed a similar law. Because of this, double truck traffic is limited to national roads and selected provincial roads. This limitation can lead to an increase in trip lengths for operators using double trucks, and thus to increased emissions.

Efforts to address metropolitan coordination have so far been ineffective. A metropolitan transport agency (ATM for its Spanish initials) was created in 2012 to address coordination issues. At its creation, it served as a platform for policy dialogue between politically opposed authorities in CABA, the national government and the Province of Buenos Aires. In 2014, the three authorities signed a tripartite agreement to give ATM a consultative role for the coordination and the planning of transport policies and infrastructure (ATM, 2018). One of the roles given to the Agency was to develop a common data bank on transport activities at the RMBA level. The Agency was also given the task of developing the Master Transport Plan (Plan Director de Transporte) of the metropolitan region as a five-year guiding tool serving to identify and to support policies aiming at improving transport at the metropolitan scale. The document is not legally-binding, and thus does not have any compulsory planning character vis-à-vis authorities in RMBA. In 2015, the agency was defined as a department of the National Transport Ministry. The agency published its first plan in 2018, two years after it was expected to do so. The Agency does not have a budget on its own, and is hosted at the heart of the Ministry of Transport.

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Decarbonising Transport in Latin American cities:

A review of policies and key challenges

Transport Division