

Mexico City, Mexico

The role of public transport in tackling air pollution and accessibility

Over the last two decades, Mexico City has implemented many successful mobility projects to partly relieve its saturated public transport system and diminish air pollution generated by vehicles, while also providing more transportation options for people in peripheral locations or vulnerable situations.

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The CDMX 'in context'

Mexico City (Ciudad de México, or CDMX) is the largest city and capital of the United Mexican States. Sitting at an altitude between 2,240 and 3,930 meters above sea level, the CDMX is a cultural, political and economic hub in the country and the whole Latin American region. The country witnessed high urbanization rates during the 20th century, with the urbanization rate jumping from 43% to close to 78% between 1950 and 2010. The City of Mexico itself counts a population of approximately 9 million inhabitants, whereas the overall Metropolitan Area has more than 21 million inhabitants.

The important influx of people in the metropolitan region increased demand and pressure on municipal infrastructure and housing, leading to the construction of poorly-designed, low-quality infrastructure that could be easily and quickly built. In Mexico City, where most employments are located in the central areas and in business districts hard to reach by public transport, this translated to an overcrowding of the existing infrastructure and a major increase in traffic. In 2017, every weekday, more than

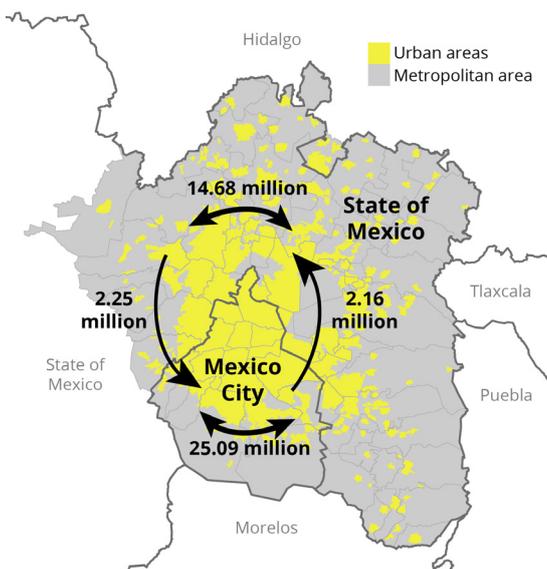


Figure 1. Daily trips within and between Mexico City and the State of Mexico. Source: ICLEI, based on Encuesta Origen-Destino, INEGI, 2017.

17.36 million trips are being made within and towards Mexico City, with 2.25 million trips originating from urban areas in the State of Mexico and Tizayuca, where housing is cheaper. Meanwhile, 2.16 million trips per day are done from the CDMX towards the conurbation municipalities, and 14.68 million trips are done within the State of Mexico and



Facts & Figures

Population (2015)

Mexico City: 8,985,339

Mexico Valley Metropolitan Area: 20,892,724

Land area

Mexico City: 1,485 km² (2018)

Metropolitan Area: 7,866 km² (2015)

Modal split (2017)

Mode	Mexico City	Metro Area	
Walking (exclusively)	26.01%	32.26%	
Cycling	1.39%	2.08%	
Overall	49.83%	45.05%	
Public transport	Excluding taxis	N/A	39.52%
	Taxi (including applications and mototaxis)	N/A	4.75%
Overall	23.47%	21.09%	
Private automobile and trucks	Private	21.73%	19.10%
Private vehicles	Motorcycle	0.87%	1.07%
	School and personnel transportation	0.84%	0.93%
Other (e.g. boat, skateboard, etc.)	0.12%	0.12%	

Tizayuca. Of these trips, 4.34 million are being made by car, while 18.98 million are made by public transit. While public transportation is saturated in the central areas, peripheral areas of the CDMX and the State of Mexico rely on a very poor public transportation offer, resulting in long commuting times for residents on both sides. Indeed, commuting times of two to three hours each way are common. On top of that, people with lower incomes can spend up to a third of their overall income on transport.

The increase in congestion, combined with an increase in industrial activities in the region, has contributed to air pollution and a degradation of air quality. The phenomenon is accentuated by the city's altitude and location in a valley, which retains smog and pollution. The Mexico City Metropolitan Area figures amongst the most congested cities worldwide, and in 2016 air quality experts estimated that breathing Mexico City's air during bad air quality days equalled to smoking forty cigarettes a day, affecting especially children, who breathe faster than adults.

With transportation being the main source of CO₂ emissions in the city, the authorities decided to implement major policies, programmes and measures targeting the sector. One of them is the programme "Hoy No Circula," which has been restricting vehicle use during weekdays based on their licence plate number since 1989. Other initiatives include banning taxis older than 10 years, forcing car owners to have their vehicles tested every six months for emission levels, and ordering traffic cutbacks up to 40% during high smog days. Other recent policies targeted transport, such as the 2014 Mobility Law (Ley de Movilidad), which emphasized the need for a more integrated, socially-inclusive, resilient and people-focused mobility system. The City's 2019 Strategic Mobility Plan (Plan Estratégico de Movilidad de la Ciudad de México 2019) focuses on the redistribution of road space and investments towards sustainable transportation modes, with the aim of integrating the different transport systems in the city, improving infrastructure and services, and increasing accessibility and security for all users.

A public transport revolution

Until the beginning of the 2000s, Mexico City's public transportation system consisted mostly of a fragmented and disorganised network of dangerous and polluting microbuses (peseros), as well as its vast but overcrowded metro system. New transportation options and networks were implemented over the last two decades to diversify the offer in both the CDMX and the State of Mexico, as shown in the following two tables.

Transportation systems in Mexico City (2019)								
System	ECOBICI	Peseros	Bus	Metro	Metrobús	Tren ligero	Trolebús	Tren Interurbano Toluca - Valle de México
Type	Bike-sharing system	Microbuses	Buses	Subway	BRT	LRT	Trolleybuses	Train
Authority	Secretaría de Movilidad (SEMOVI) 	Individual concessions	Red de Transporte de Pasajeros (RTP) 	Sistema de Transporte Colectivo 	Metrobús 	Servicio de Transportes Eléctricos 		Under construction (federal government's budget)
	Publicly funded		Decentralized state-owned companies					

Table 1. Transportation systems in Mexico City, 2019.

Transportation Systems in the State of Mexico (2019)				
System	Peseros	Mexibús	Mexicable	Tren Suburbano
Type	Microbuses	BRT	Cable car	Train
Authority	Individual concessions			
		Decentralized state-owned company		Private concessionaire

Table 2. Transportation systems in the State of Mexico, 2019.

Bus Rapid Transit

One of the government’s most emblematic public transportation projects was the implementation of a bus rapid transit (BRT) system in 2005, the Metrobús. The system was preferred to other alternatives like trolleybuses and metro because of its cheapest costs, smaller infrastructure implications and greater flexibility, allowing connectivity to other transportation modes like metro or bike-sharing stations. The system’s large-capacity buses replaced more than 2,300 polluting microbuses, and authorities estimate that the Metrobús system replaces overall 270,000 trips that would be made otherwise by cars, preventing more than 180,000 tons of GHG every year. The project has been highly successful and praised for increasing the place and visibility of transportation within the political agenda. In late 2018, close to 1.8 million passengers used the Metrobús on a daily basis, and this is expected to increase as the network continues to expand. It is accessible for free to people with reduced mobility, elderly and children under 5, while others pay a low tariff (US\$ 0.32/trip) that encourages an easy access for all.

There are also three BRT lines present in the State of Mexico. The system, called Méxibus and operated by a decentralized state-owned company, was implemented between 2010 and 2015, with new lines being planned for 2019.



Figure 2. Metrobús in Mexico City. Source: M.E. Assunção-Denis

Nochebús

The Nochebús service consists of night buses running between midnight and 5:00am on 11 routes covering a network of 319 km. The service started in 2013, and in 2018, a new route service with fix stops and schedules was implemented. This pilot project is the first route with fix schedules to be implemented in all public transport in Mexico, and is set to be replicated if successful. This system allowed for an increase in security and efficiency of transport at night in the city. It also works toward the implementation of an integrated transport system in the whole Metropolitan Area.

Metro

Opened in 1969, the metro system now counts 12 lines, the last one having opened in 2012. It covers a network of 226.5 km and 195 stations, with some of them being located in the State of Mexico. In 2016, more than 1.66 billion people travelled using the metro, and as of August 2018, an average of 4.55 million people used the metro on a daily basis.

Trolleybus and light rail

CDMX's authority Servicio de Transportes Eléctricos is in charge of the city's eight trolleybus lines, which cover a total of 203 km, including the latest "Zero Emissions Bus-Bike Corridor" (Corredor Cero Emisiones Bus - Bici) inaugurated in 2012. It is also in charge of the city's electric taxis program, as well as the 13-km Xochimilco Light Rail system, or Tren Ligero, which opened in 1986 reusing old streetcar tracks. Tariffs for the Tren Ligero (US\$0.16) and the trolleybuses (US\$0.21) are very low to increase accessibility. The current administration (2018-2024) has set an ambitious plan to expand and renew the trolleybus network.



Figure 3. Metro station.

Suburban train (Tren Suburbano)

An electric suburban train (Tren Suburbano) was inaugurated in June 2008, linking the CDMX to Cuautitlán in the State of México. The project, led by the federal transport authority, reduced commuting time for people travelling the full 27-km length from 2.5 hours to 25 minutes. However, the use of already existing railway infrastructure and government-owned right of ways meant that trains mostly passed through industrial and insecure lands far away from residential areas, making their access difficult for people without a car, especially pedestrians. Although microbus services were added around the stations, integration between the different services was not optimal for users, with no integration of fares and microbus companies not being interested in feeding a competitive service. The train fares were also more expensive than those of the peseros. This led to lower ridership levels than predicted, and to major financial repercussions. The prioritization of infrastructure over accessibility and system integration resulted in failures in terms of operations and cooperation between stakeholders.

Commuter rail (Tren Interurbano)

Another electrified commuter rail (the Tren Interurbano de Pasajeros Toluca-Valle de México) is currently under construction and aims to connect the CDMX with the neighboring city of Toluca and the business district of Santa Fe. This commune project between the federal and CDMX governments is expected to serve 230,000 commuters every day and to reduce CO₂ emissions by almost 28,000 tons per year. It will cover the total length of 58 km in less than 40 minutes, reducing commuting time one way by 50 minutes, while people moving from the CDMX to Santa Fe will be able to cover the 9-km distance in 5 minutes instead of 35, for the cost of US\$0.63. That being said, the higher tariffs might stop some users, and the project, which faced several administrative, financial and logistical problems, is said to be delayed by more than two years, opening in 2021 instead of 2018.

Cable cars (Mexicable and Cablebús)

Residents of the northern suburb of Ecatepec and its surroundings, in the State of Mexico, have access to the Mexicable, a cable car system that opened in October 2016. The project, which might be replicated in other municipalities in the State of Mexico, was criticized by a part of the local community for acting as a face-lift and hiding the problems faced by the local population, and for not connecting directly with the metro system, forcing users going to the center to transfer to buses or a partly-operational Mexibus line in order to reach the metro stations. The government of the State of Mexico announced the finalization of the Mexibus Line 4 in the State of Mexico in 2019, thus better linking the Mexicable to a metro station. The project considerably reduced travel times for local commuters, while reducing GHG emissions by relying on electrical and solar energies.

Mexico City's government is planning to launch a new cable-car system, the Cablebús, with four lines that will improve the overall mass transport network. It is aimed at connecting mountainous areas located in the boroughs of Gustavo A. Madero, Iztapalapa and Alvaro Obregon. The first line of the system will have a length of 9.4 km and will directly connect with the metro station Indios Verdes. It is expected to open in July 2020.

Shared mobility

Shared mobility has boomed in the last decade in Mexico City, with major ride-hailing players like Uber, Easytaxi, Cabify or Didi Chuxing taking the streets by storm since 2013. In fall 2018, cash fares were allowed for ride-hailing services, opening a new market in a country where approximately 60% of the population does not own a bank account. Other local vanpool services like Jetty, Urbvan, Via or car-sharing company Carrott are also quickly spreading across the city.



Figure 4. ECOBICI bike-sharing station.

Mexico City's public bike-sharing system ECOBICI comprises of 480 stations and 6,800 bikes, including 28 stations and 340 bikes which are part of a newly implemented electric, pedal-assisted bike network. Fares are kept low, with an annual membership costing US\$21, and users also have access to free cycling school programs. Since its launch in February 2010, the system has registered more than 58.5 million trips and has prevented the emission of 4,541 tons of CO₂. By bringing upfront a new transportation option, ECOBICI greatly increased the visibility of cycling and helped legitimized it as a transportation mode, countering the social perception of cycling as being reserved for low-income populations. The system also encourages multimodality, and 87% of its users use it in combination with other modes like walking or taking the metro.

Electric scooter-sharing companies have also entered the city market, with Mexican company Grin launching the ball, followed by micromobility companies Lime and Bird in October 2018. Competition is also intense between dockless bike-sharing companies like Mexican VBike, Mexican dockless pedal-assisted bicycles Dezba and Chinese Mobike, which launched in February 2018. The companies also face major bicycle thefts. Electric moped rental system Econduce is also spreading in the city. The authorities are starting to regulate microtransit companies, including scooter and dockless bike-sharing systems, through the collection and use of data as well as the emission of permits.

Results

The city's transportation projects and changes have had great economic, social and urban benefits over the last decades. For instance, mobility improvements in the historical city center led to major increases in economic activity in the area. The Metrobús project went hand in hand with good institutional development, and it allowed the relocation of informal commerce and parking, the redesign of public spaces and other good urban development projects.

These initiatives have also put public transport back on the political agenda and demonstrated an interest from the government towards daily challenges faced by the majority of its residents, no matter their social classes. These projects have also considerably increased accessibility for vulnerable populations, such as people with

reduced mobility and those with low incomes. For instance, Metrobús stations and buses are all equipped with ramps and special equipment for people in wheelchairs, and public transport tariffs have been kept low over the years to ensure accessibility for a majority of residents. The different networks' coverage and services have also been expanded to improve transportation options for residents living outside of the city center.

The current Ministry of Mobility (Secretaría de Movilidad) recently introduced a strategic plan for the year 2019 with specific targets to be reached within the first 100 days. These objectives include a series of initiatives that will impact both public transport and pedestrian infrastructure, from radar speed signs near schools to the implementation of new bike racks near transit nodes and the relocation of turnstiles at metro stations to create safer 24-hour pedestrian corridors. It also put forward strategies for auditing transport operations, raising awareness and capacitating bus drivers on road regulations for strategic routes.

The city's tremendous changes have earned it its share of praise worldwide. The CDMX won ITDP's 2013 Sustainable Transport Award, which recognized, among others, the success of the Metrobús and ECOBICI systems, as well as the opening of a new metro line. ECOBICI also won the first prize in WRI EMBARQ México's competition "Movilidad Amable," as well as the ITDP's 2013 Ciclociudades Award.

Challenges

The public transport system has long been suffering from its popularity, despite the government's effort to increase coverage and services. The heritage left by decades of lack of funding and political interest towards sustainable transportation in the 20th century accentuated the pressure on the already existent infrastructure. While the metro system covers a large part of the city's territory, it also suffers from the increasing demand and is saturated at rush hours, causing inefficiency and safety issues. These led to the creation of segregated sections in metro wagons and Metrobús vehicles for women, children and elderly people.

There is still an important gap to fill in terms of transit coverage in peripheral areas, where low or medium-low income populations mostly live. Many recent public transport investments and projects are located in the central



Figure 5. Metro wagon reserved for women, children and elderly.

areas of the CDMX and do not reach the populations living or working in these peripheral districts and in the State of Mexico. As a result, these communities continue to suffer from terrible commuting conditions, mostly in polluting, unregulated and inefficient peseros. Nowadays, 74.1% of trips done by public transport in the city are still done using the 29,000 microbuses in service.

Moreover, public transport still has to fight for receiving money, with 30% of the budget allocated to transportation in 2012 being used towards car infrastructure, compared to 13% for public transport, 1% to cycling infrastructure and 6% to pedestrian infrastructure. This is not logical considering that 49.83% of commuting trips in the city in 2017 were done by public transport, against 21.73% by car. The lack of funding has deeply affected the maintenance of the different vehicle fleets, leading to operational and efficiency issues. Recognizing this, the City invested US\$15.77 million in 2017 for the acquisition of 33 new Metrobuses, increasing the daily capacity of Line 1 by 100,000 passengers, or 20%.



Figure 6. Percentage of fleet vehicles in operation (blue) and out of service (grey) for each public transport system operated by the City of Mexico, 2018. Sources: Secretaría de Movilidad (SEMOVI), Gobierno de la Ciudad de México, 2019, Sistema de Transporte Colectivo (STC-Metro), Metrobús, Servicio de Transportes Eléctricos de la Ciudad de México (STE) and Red de Transporte de Pasajeros (RTP), 2018.

Institutional and operational fragmentation between the different services in the CDMX and the State of Mexico is also important, with more than nine different types of services (ECOBICI, Metro, Metrobús, peseros, Tren Ligero, Trolebus, Mexibus, Tren Suburbano and Mexicable) being provided. There is also no integrated fare between the different systems. This fragmentation can make connections between the different systems harder for users, and it brings elements of challenges regarding planning, integration and operations. Sometimes users might need to walk more than a kilometer between two transportation options and have to pay several fares for each trip. The 2019 mobility strategic plan addresses these issues and includes the development of an integrated fare card, the Tarjeta de Movilidad, that would group all public transport systems in the city as well as some concessionaries. A new map including all systems will also be created, and initiatives are being prepared to improve safety in multimodal transit nodes and other stations.

Other accessibility issues can be found. For instance, the ECOBICI bike-sharing system is not available for people who do not own a credit card. To register for the system, people also have to present themselves in one of four service centers, which can be complicated for residents living far away. There are also great disparities when it comes to the systems' demographics; in 2014, only one user out of three (38%) was a woman, 88% of users were university graduates, 87% were workers and only 15% of users lived in the State of Mexico. These results can be partly explained by the absence of stations in several peripheral neighbourhoods, as well as the absence of cycling infrastructure in many areas of the city.

The implementation of new infrastructure can also prove complicated due to political forces, agenda and instability. For instance, the Metrobús' first line faced a lot of opposition due to the concessionaires' political powers and weak regulations in place at the time. The creation of a decentralized state-owned concession for Metrobús helped to strongly establish the project and make it an independent body.

Governance in the whole metropolitan region must also be improved. Indeed, current relationships between the governments of the CDMX and the State of Mexico regarding transport management and development are

minimal, and there is a need for them to better communicate and work hand-in-hand with local administrations and agencies towards more integrated urban development. Fortunately, a metropolitan planning commission is currently being reactivated for the whole Mexico Valley region.

Lessons learned

Mexico City has shown that it is possible to transform a city's streets and public transportation system over a matter of a few years with good political will and planning, as well as a coordinated and people-oriented policy agenda. It has also succeeded in increasing people's access to public transport, while also tackling air pollution. By implementing different mass transit options in several parts of town, the Municipality has been able to reach more communities and to provide more efficient transport options for its residents, while also keeping service costs at a low rate. It did not refrain from reallocating space usually dedicated to cars towards public transportation, completely transforming some major arteries and intersections in the city. The City is also actively working towards the integration of different transportation modes and networks to better suit the needs of the metropolis' residents living in peripheral areas and the State of Mexico.

The City's decision to diversify its public transport offer and to invest in new mobility options such as BRTs and bike-sharing systems proved successful and allowed to partially relieve the pressure put on the saturated metro system. The government has also learned from its previous errors, such as the Tren Suburbano's lack of accessibility. This project showed the importance of taking into account user accessibility and the involvement of stakeholders in a transportation project, instead of focusing mainly on feasibility and infrastructure.

There are many challenges that still need to be tackled by the City, such as insecurity issues in buses and metro wagons, as well as accessibility in farther and low-income communities. Considering the size of the metropolis and its growth rate, it will always be a continual challenge for the City to cope with the large number of commuters and trips made every day, despite of all efforts made to increase the transportation offer. That being said, the impressive amount of changes made over the last two decades shows great promise for the future of this vibrant metropolis.



Figure 7. Highway in the city.

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