TUMI E-bus Mission City Network - Profile

MEDELLÍN, COLOMBIA

CITY FEATURES

Medellin, along with nine other smaller municipalities, comprises the Metropolitan Area of the Aburrá Valley (AMVA), the second-largest urban agglomeration in Colombia (over 3,7 million inhabitants and an urban area of about of 340 km²). The city lies on a narrow and elongated natural valley, and it has grown, following a relatively compact and high-density development along the river. During the second half of the twentieth century, however, accelerated migration from rural areas and an increase in road infrastructure prompted the expansion towards hilly peripheral areas. This in turn, triggered a land use imbalance in service, industrial and commercial areas concentrated along the river, whereas residential use prevails in the outer centre and the periphery.

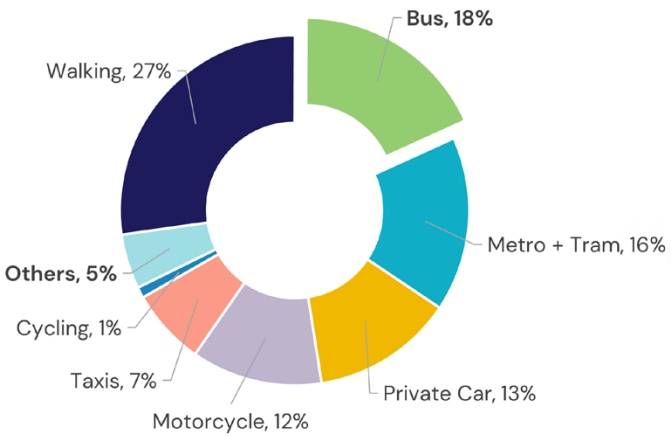
Population
2,455,072
(2018)

Land area
382 km²

Average temperature
22°C

TRANSPORT FEATURES

Modal Split[1]



GHG Emission Levels[2]

Total GHG emissions
6,110,286 tCO_{2eq}

From road transport
4,456,974 tCO_{2eq}

Air Pollutant Levels[3]

PM 2.5 **25**	NO_2 **48.5**
PM 10 **46.9**	SO_2 **28.3**

Over 6 million daily trips took place in the AMVA at an average distance of 7 km in 2017. Most trips were made using sustainable transport modes: Walking covered a quarter of the trips (27%), whereas public transport (metro, tram, Bus Rapid Transit (BRT) and traditional buses) accounted for 34%. Despite this trend, motorization rates and use of individual motorized vehicles skyrocketed in recent years. Between 2008 and 2018, annual registration of cars and motorcycles rose by 170% and 340%, respectively. By 2017, roughly a quarter of total daily trips, were made using these modes. As a result, cars and motorcycles have become the primary source of GHG emissions (72%) and over 90% of air pollutants, leading to more frequent environmental contingencies throughout the year.

1 AMVA Mobility Master Plan, Area Metropolitana del Valle de Aburra (AMVA), 2020
2 Aburrá Valley Atmospheric Emissions Inventory Update, 2018
3 Annual Air Quality Report, Area Metropolitana del Valle de Aburra (AMVA), 2021

BUS SYSTEMS OUTLOOK

Bus Trips Features[4]

Number of bus trips (non-BRT)
8,418,115 (2019)
6,370,948 (2021)

Average distance
8.2 km

Average time
47 min

Trips by purpose

Return home	48%
Work	26%
Study	8%
Errands	6%
Shopping	3%
Others	2%

Trips by gender

Men	45%
Women	54%

By 2017, public buses accounted for almost a fifth of total trips. The most vulnerable urban city inhabitants rely heavily on buses for daily utility trips. Compared to men, women used buses more often and for a wider variety of trips besides commuting. Women's trips were also more uniformly distributed across different times of the day, with less pronounced increases at peak hours. Buses were reported to be the primary source of transport for people over 51 years old. Similarly, buses represented the second most frequent mode of transport for low and lower to middle income inhabitants, who account for approximately 87% of bus trips.

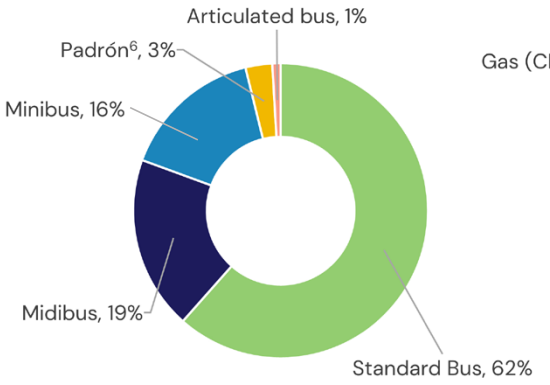
Fleet and Infrastructure

Number of buses
3,311 part of TPC[5] system
512 part of METRO system

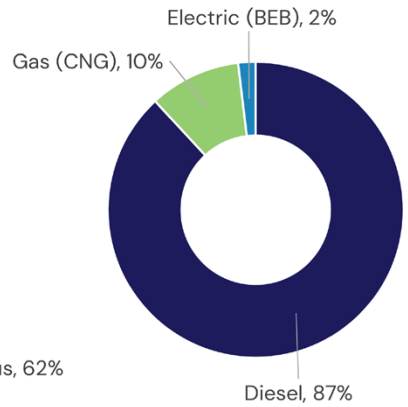
293 Non-BRT routes
2 BRT routes

4,231 bus stops
36 bus depots

Buses by fleet type



Buses by fuel type



Quality of Service

Given the existing pendular pattern in most routes, buses are an inconvenient means of transport for many daily users in the city. They are forced to make one or more transfers when making trips from origins outside the city's Central Business District (CBD). This significantly hinders those undertaking multiple destinations and non-commuting trips outside CBD, usually women, kids, adolescents, and the elderly. Moreover, few dedicated bus lanes and a lack of enforcement of bus stops make bus trips longer than the average trip taken by private motorized vehicles. Lack of fare integration adds up to route design problems. In most bus routes, cash-based and single payments prevail, impeding not only fare integration with other traditional bus routes but also with the public mass transport system (card-based payment). This compels most users to pay multiple times when using buses for their daily trips, primarily affecting low and middle-income urban citizens.

4 Origin-Destination survey, Area Metropolitana del Valle de Aburra (AMVA), 2017
5 TPC - Privately-run public transport system
6 Padrón - non-articulated bus with capacity for 90-100 persons; 12 meters length

Existing Business Model[7, 8]

A	B	C	D	E
Model A: *Vertically integrated, private operator in BRT/integrated system*	***Model B:*** *Divided responsibilities in BRT/ integrated system*	***Model C:*** *Large, more formal, private operator in traditional service*	***Model D:*** *Small, informal, private operator in traditional service*	***Model E:*** *Government-run system*

C	(Model C) variation implemented to operate bus feeder lines of Medellin's mass transport system (BRT, metro, and aerial cable) through concessions. Compared with permits, concessions to private operators are subject to higher standards. Fare collection is electronic based on allowing integration, and fleets need to comply with higher emission requirements, meaning most buses are EURO VI. Due to the local government's tariff stabilization fund, private operators secure revenues regardless of the number of passenger variations on each route.
C-D	Private operators not only run the system but also own and maintain the fleet. The type and size of private operators vary widely: from large companies to individuals/small groups (e.g., family businesses) associated with cooperatives. Payment systems mostly remain cash-based. Route permits are awarded by the Medellin and AMVA's mobility departments with no end date. Both authorities also define fare cost, which is adjusted yearly.
E	Consortium of government institutions, Metro de Medellin (public TPO - Transport Public Operator), and some of AMVA's municipal governments to operate Metroplús, the metropolitan BRT system. Metro de Medellin and municipalities own buses and other assets, whereas operation was granted to Metro de Medellin exclusively.

E-BUS ADOPTION APPROACH

2017
Medellin signed C40's GHS declaration and commited to procure only 0 emission buses by 2025

2019
Medellin's local government bought 64 E-buses

December 2019
20 E-buses started operation as part of Line O of mass public transport system

July 2020
Private transport operator followed suit and included 4 E-buses in its fleet

July 2021
Inaugurated BRT Line 2 stations on Avenida Oriental where 25 E-buses operate

7 New business models for electric bus deployment, P4G, Zebra, Dalberg (2020), and info provide by city directly

8 Based on Accelerating a market transition in Latin America: New business models for electric bus deployment, P4G, Zebra and Dalberg, 2020

E-Bus Fleet Technical Features

Number of e-buses

	Type A	Type B
	68 Type A *(BYD-2912TZ-XY-A, BYD)*	64 Type B *(LCK6780EVG, Zhongtong)*

Passenger capacity

	Type A	Type B
	80 pax	40 pax

Battery features

	Type A	Type B
Capacity	348 kWh	169 kWh
Range	365 km/charge	– km/charge

E-Bus Business Model

The electric vehicles were acquired under a mandate from the Mayor's Office of Medellín and were delivered for operation in 2019. The contract for the electric buses is an inter-administrative contract for the operation of the 80 corridor (line O) with the operator Empresa de Transporte Masivo del Valle de Aburra - Metro de Medellín (a public company in which the municipality of Medellín has a 50% share). Fare collection is electronic based (card) allowing integration with other means of transport part of the METRO system, namely cable cars, trams, metro and BRT. Afterwards, in 2020 a private bus operator (Masivo de ccidente s.a.) acquired and started operating 4 e-buses under the previously described C model, which applies to Metro's bus feeder lines.

Opportunities and Challenges to Scaling E-Bus Fleets

Opportunities

- Previous experiences implementing e-buses at the local level have left lessons learned, technical capacities installed, and first-hand evidence that e-buses are not only a clean but also more cost-effective technology.
- The current city's bus fleet has already reached or will soon reach its lifetime. Therefore, there is an opportunity for both public and private stakeholders to join efforts to ease an accelerated deployment of e-buses.
- Ongoing efforts to improve, streamline and formalize bus operations through, for instance, the implementation of electronic fare collection will enable bus operators to get access to funding and technical support for acquiring and operating e-buses.

Challenges

- The greatest challenges at the local and national level to have a greater number of electric vehicles, starting from a lack of clear regulation and financial enbalers (e.g., tax reliefsor subsidies) of the national government that prioritizes and guarantees investors to migrate to this technology.
- As bus operator remains primarily funded by number of passengers and it is still cash-based. It is difficult for the most traditional bus operator to show enough stable sources of income to get a loan for acquiring e-buses.
- A widespread lack of detailed technical and operational knowledge on e-buses prevails among operators, who still feel the technology is risky and challenging to operate.

Acknowledgements

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Disclaimer

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About the TUMI E-Bus Mission

Funded by the German Ministry for Economic Cooperation and Development (BMZ), a core group of organizations supports cities in their transition toward electric bus deployment. For more information please contact: tumi-network@iclei.org or visit https://sustainablemobility.iclei.org/tumi-ebus-mission-2/

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