CLIMATE SMART CITIES CHALLENGE

Bogotá challenge brief

Partners

Challenge leads

Viable Cities

UN HABITAT FOR A BETTER URBAN FUTURE

Funding partners

VINNOVA Sweden's Innovation Agency

Swedish Energy Agency

Teknikföretagen

City leads and partners

Alcaldía Mayor de Bogotá D.C. | Bogotá

Bristol City Council

Bristol Housing Festival

Bristol One City

Goram Homes

Curitiba

IPPUC

aguia Agência Curitiba de Desenvolvimento e Inovação

Delivery partners

nesta Challenges

Ignite Sweden

Competition challenge partners

Business Sweden

MI Mission Innovation

SEK

Smart City Sweden

Swedish Agency for Economic and Regional Growth

SI. Swedish Institute

Expo 2020 Sweden Sverige السويد Official Organisation

Scania

Contents

Figures

Tables

Glossary

CONPES: National Council for Economic and Social Policies

DANE: National Administrative Department of Statistics

GHG: Greenhouse gases

ICTs: Information and Communication Technologies

IPCC methodology: Methodology of the International Panel on Climate Change

PM: Particulate matter

WHO: World Health Organization

RLU: Urban Logistics Network

Foreword

Freight transport is one of the largest contributors of emissions in Bogotá, accounting for 16% of all particulate matter emissions and more than 10% of greenhouse gas emissions, a factor negatively associated with climate change. On an average day, it is estimated that around 67,000 freight vehicles circulate in the city, and almost 40% of trips are empty searching for cargo. 95.2% of vehicles use ACPM (diesel), followed by gas and petrol with 2% and 1.7% respectively, and 55% are more than 10 years old.

In addition, the freight transport sector is highly fragmented, with more than 70% of vehicles belonging to small businesses and a significant portion operating under informal conditions. Therefore, articulation between the main stakeholders, cargo generators and transportation companies is difficult and demanding, even more, when there is no national regulation for urban freight trips. Current atomization of the sector makes standardization and scaling up very challenging.

The 2020-2024 Development Plan 'A new social and environmental contract for the Bogotá of the 21st Century' seeks to "Change our living habits to green Bogotá and adapt to and mitigate climate change" and "Make Bogotá-Region a model of multimodal, inclusive and sustainable mobility". Within this framework, Bogotá is building the New Mobility, with a supportive, resilient and conscious city that allows us to inhabit a living, green and healthy city where the Government and citizens change the way we move: with safety and health, with access to more opportunities, with efficiency and quality.

We are working to make urban logistics, and especially micro-logistics, visible in regulations, policies and public plans, as it is one of the sectors that most affects mobility, the environment and where there are more opportunities to improve efficiency, productivity and economic competitiveness.

The City has the need to integrate and enhance collaboration between multiple stakeholders and the public sector to optimize district freight transport and mitigate the polluting emissions of this sector, through technological and innovative solutions.

One of the collaboration strategies already being developed by the City is the Urban Logistics Network, which has more than 160 members including generators, transporters and receivers of cargo, willing to work hand in hand with the public sector to understand and address needs of the sector so that both sides benefit.

In this city context, Bogotá is pleased to invite innovators, organizations and academics to participate in UN Habitat's Climate Smart Cities Challenge, to build, create and test innovative solutions to this global challenge.

Carolina Urrutia,
Secretary of Environment, City of Bogotá

Nicolás Estupiñán,
Secretariat of Mobility, City of Bogotá

1.

Introduction

1.1 About the City of Bogotá

Bogotá, the capital city of Colombia, is in the country's geographic centre. The city lies on the highest plateau of the Colombian Andes at about 2,600 metres above mean sea level. Bogotá's nearly 8 million inhabitants, represent 22 per cent of the country's total population. The city hosts 18,881 residents per km,^{2} and 28 per cent of the companies in the country. In 2019, the city's gross domestic product (GDP) accounted for 26 per cent of Colombia's total. The Bogotá-Cundinamarca Metropolitan Region is the engine and core of the Colombian economy, accounting for about 32.1 per cent of the country's GDP (2020). The metropolitan region has a little over 10 million inhabitants, and accounts for 60 per cent of the companies in the country.

On a typical day, there are at least 15 million trips between Bogotá and the region. Of these trips, 36 per cent are by foot; 14 per cent by the bus rapid transit system, TransMilenio, just exceeding 2 million daily trips; and by car with about 2 million journeys that represent 13 per cent of total trips (see table 1).

Table 1: Modal share for Bogotá households

Main transport mode*	Number of trips	Modal share
Pedestrian	5,659,063	36%
TransMilenio (BRT System)	2,185,464	14%
Car	1,986,760	13%
Integrated Public Transport System bus	1,483,030	9%
Provisional Integrated Public Transport System Bus	898,208	6%
Bike	880,367	6%
Motorcycle	741,072	5%
Taxi	651,165	4%
School transport	421,108	3%
Informal transport	409,819	3%
TransMilenio feeder buses	266,566	2%
Other	120,315	1%
Inter-municipal buses	89,378	1%
Rickshaw	25,585	0%
Scooter	12,975	0%
Cable car	949	0%
Total trips	**15,831,824**	**100.00%**

Source: 2019 Household Mobility Survey for Bogotá and its surroundings

*For Bogotá households

It is worth mentioning that the 2019 Household Mobility Survey, does not contemplate the freight trips. These were not part of the study.

1.2 Bogotá's climate challenge

Bogotá faces significant traffic congestion due to the inefficient use of transport alternatives and resources, as well as the lack of an intelligent traffic management system based on real-time data and information and communications technologies (ICTs).

Traffic congestion also affects the city's competitiveness and productivity as it increases travel times and costs. Several studies have also suggested that atmospheric pollution increases with bottlenecks and traffic jams. As an example, a study conducted by IADB (Inter American Development Bank) in which vehicle congestion in Latin American cities is analysed (Calatayud et.al, 2021), highlights that traffic jams have a significant impact on emissions as vehicles consume additional fuel. Moreover, the study acknowledges that driving at very low or very high speeds increases emissions when compared with medium and constant speeds.

This situation aggravates Bogotá's GHG emissions. Within this context, freight transport, which is mainly privately managed and decentralized, contributes significantly to traffic congestion. Moreover, freight transport presents major barriers to the achievement of Bogota's climate mitigation goals, as freight traffic accounts for 10 per centof GHGs and 38 per cent of particulate matter in emissions in the city.

Consequently, there is a significant need to improve the efficiency of freight transport, which is vital for the city's productivity and recovery after the COVID-19 pandemic. Effective freight transport would also contribute to the city's climate mitigation goals and improve the health of residents. Therefore, the challenge is to design a solution for integrating logistics operations, mobility data sources, and the use of ITSs to optimize freight transport, improve travel and delivery times, and reduce congestion-based pollutant emissions.

Overcoming the challenge

Existing solutions to this problem in Bogotá can be narrowed down to freight management based on traffic restrictions and schedule changes in some areas. Evaluation of these policies has shown a small reduction in emissions and congestion, and has shown the need to integrate management measures throughout Bogotá Region.

Nonetheless, through Bogotá's Urban Logistic Network, the city has made concerted efforts in creating an ecosystem to work with the private sector to improve freight transport. However, these efforts have been voluntary, and there has not been a technological or ICT-based approach to unified freight management.
Private companies have developed their own strategies to optimize and manage their logistics. Yet still missing is a technological solution that integrates public and private data, generates public information with which the city can manage freight trips, optimizes the use of resources in real time, produces statistics and improvements, and monitors emissions of freight GHG and particulate matter.

Thus, beyond the development of new technological tools that manage logistics operations and mobility data, there is need to create a sustainable business model attractive enough for private sector participation and thus enhance a collaborative ecosystem that improves the city's competitiveness and reduces GHG as well as local pollutant emissions.

2.

Carbon emissions characteristics

2.1 Total emissions in the city

2.1.1. GHG emissions

Bogotá produces around 5 per cent of the country's GHG emissions, of which the transport sector accounts for 48 per cent. The city's 2017 GHG inventory update, its latest, complies with the Global Protocol for Community-Scale GHG orientations and the methodology of the International Panel on Climate Change. Moreover, the inventory takes into account the main sectors of stationary energy consumption, transport and waste.

In the energy sector, scope 1 emissions in the stationary energy and transport sectors refer to emissions due to fuel and biomass consumption, while scope 2 emissions correspond to those generated due to electricity consumption. In the waste sector, scope 1 includes all emissions due to the disposal and treatment of the city's waste, while scope 3 includes emissions due to waste treatment that occurs outside the city limits.

Total GHG emission in 2017 was 11,421,724.32 tons of carbon dioxide equivalent (tCO2e), with 95 per cent due to road transport, manufacturing industries, solid waste disposal, residential commercial and institutional buildings, as follows:

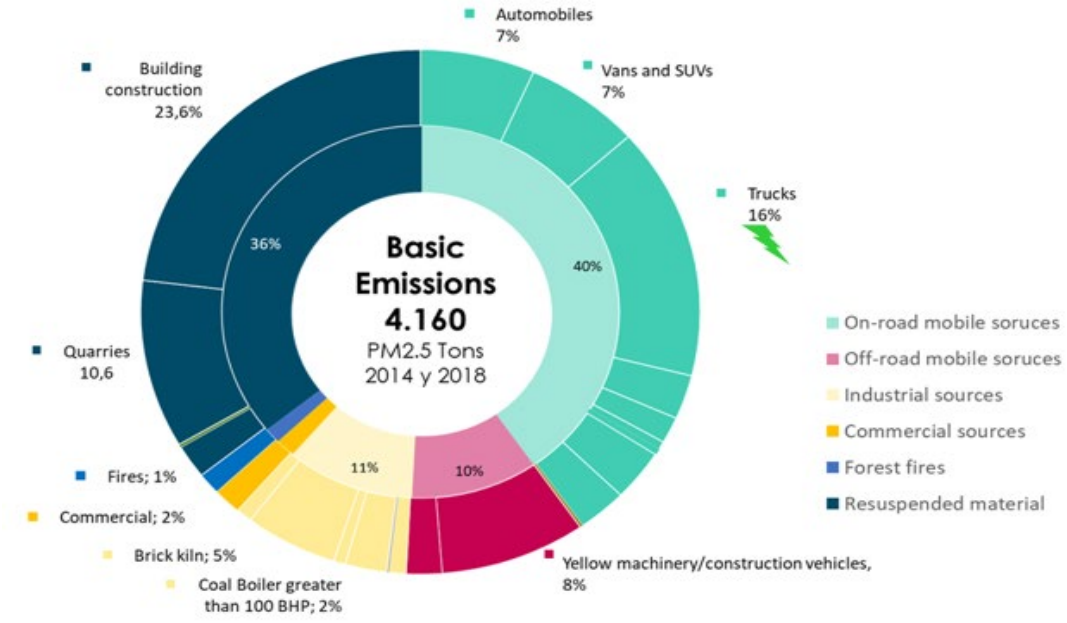
- Fuel consumption (gasoline, diesel, compressed natural gas, biodiesel, ethanol) in road transport accounted for 47.7 per cent of GHG emissions (scope 1), while electricity consumption for road transport accounted for nearly 1 per cent (scope 2).

According to the city's Secretariat of the Environment, freight transport in Bogotá accounts for at least 10 per cent of GHGs.

2.1.2. Air pollutant emissions

The city faces a significant challenge in reducing air pollution, especially of particulate matter, whose levels often surpass recommendations of the World Health Organization, and national guidelines. Air pollution accounts for at least 2,100 deaths per year. According to the city's Environment Secretariat, freight transport in Bogotá accounts for 16 per cent of particulate matter 2.5. Figure 1 shows the inventory of air pollutant emissions in the City in 2018.

Figure 1: Charging challenges for pollutant emissions



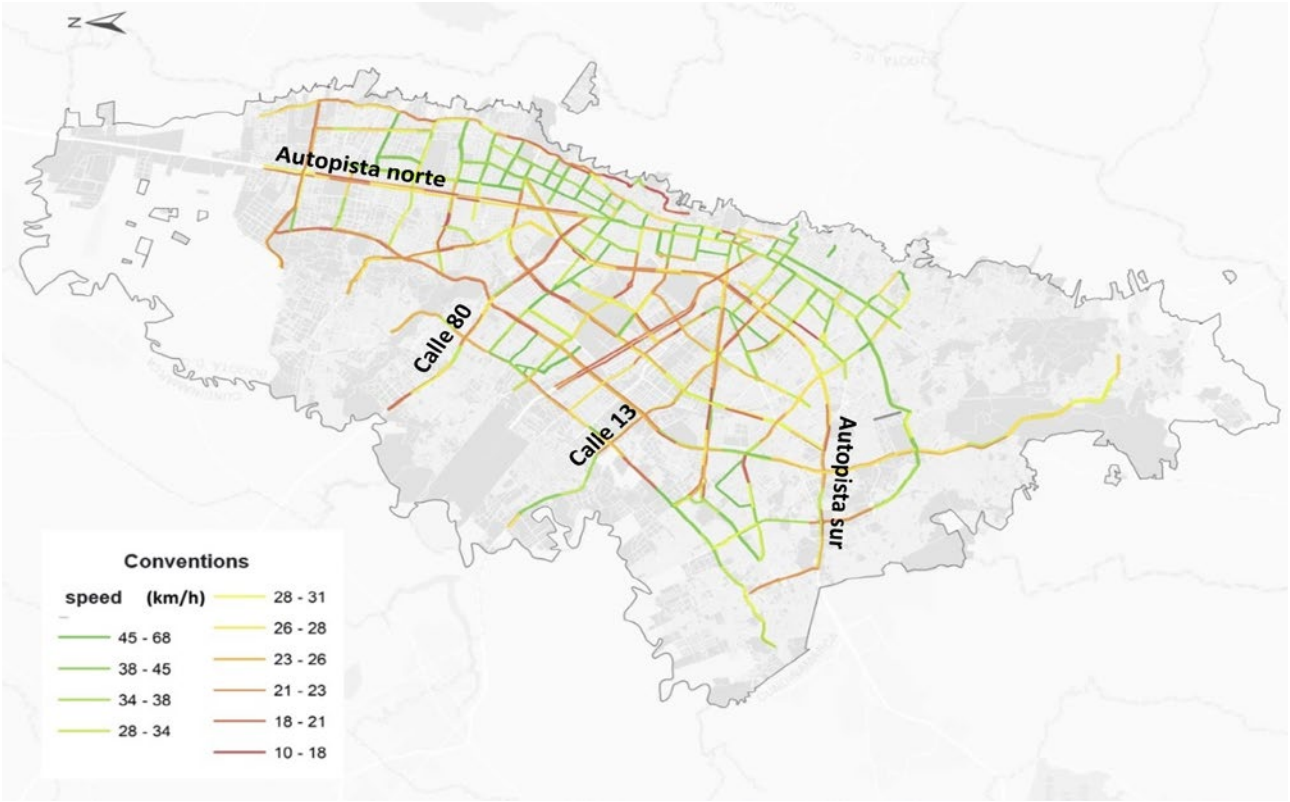
Source: Inventory of air pollutant emissions. SDA. 2018

2.2 Drivers of emissions and demand

A key driver of increased emissions from the transport sector and for traffic congestion in the city is the hike in motorization rates in the city. For example, the number of registered vehicles in the city has almost doubled from 1,257,449 in 2009 to 2,491,323 in 2020. This also applies to freight demand. As can be seen in section 3.1, the demand for transport logistic movements and the amount of freight vehicles in the city is increasing, which may result in increased vehicle congestion and, therefore, emissions. Additionally, obsolete technologies present in goods vehicles is a significant contributor of emissions. For instance, the average age of goods vehicles above the 10.5 ton capacity in Colombia is 22.8 years.

The greatest emissions are along main roads such as Avenida Calle 13, Autopista Sur and Autopista Norte. These are roads that carry a high volume of freight traffic, and are highly congested due to low vehicular speeds (see figure 2).

Figure 2: Road segments speed



Source: BitCarrier, Feb-Mar 2021.

3.

About Bogota's urban freight logistics status

3.1 Sector Profile

Bogotá-Cundinamarca is home to one third of the companies operating in the country, 60 per cent of imports, and 8.5 per cent of its exports. A population growth of 18 per cent is expected in Bogotá Region, projected to reach approximately 11.09 million in 2030. The housing needs for this population will be difficult to meet given the city's existing land space. This will likely ignite the clamour for additional homes, a more even supply and the distribution of commerce, all of which will generate greater consumption and demands for better transport logistics. The scenarios are either to continue with unplanned and uncontrolled growth of freight transport, or to be able to collect and plan the growth and organisation of urban distribution of goods based on information.

Currently, at least 85 per cent of the freight transport that moves through the city consists of vehicles of less than 10 tons capacity, with an average utilization of less than 55 per cent of their capacity. They operate mostly in an informal economy, where technology and innovation are not recognized as differentiating elements in the contracting of the service, and where lack of information remains a drawback for efficient public and private administration and planning.

Additionally, there is a national programme for the renewal of freight vehicles older than 20 years with gross vehicular weight greater than 10.5 tons. There is insufficient detailed and reliable information on the age of the freight vehicles operating in Bogotá and the region. However, we now it is vehicles under 10.5 tons that dominate urban distribution and there are no national or local statistics on how many there are or their technical characteristics. However, the average age of trucks over 10.5 tons in Colombia is estimated to be 22.8 years in 2021. (see Figure III)

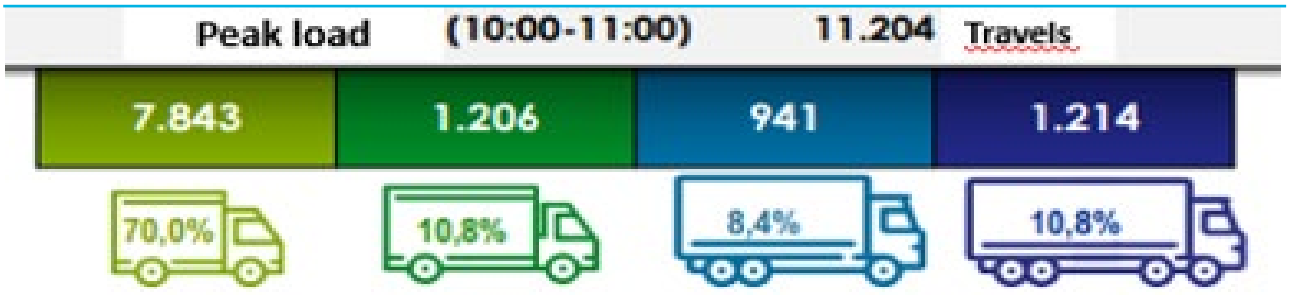
Regarding the fuel used by truck-type vehicles, 95.2 per cent of them use diesel fuel known by the Spanish acronym ACPM (*aceite combustible para motores*), followed by gas 2 per cent and gasoline 1.7 per cent. In 2020, the greatest user of gas and gasoline fuel was the small two-axle truck-type vehicle.

The freight characterization study conducted from January 2020 through July 2021 in Bogotá and surrounding municipalities, showed the following:

- The peak loading period in the city was between 10 a.m. and 11 a.m. During this period, 11,204 trips were generated in the city, 70 per cent of which were made by small two-axle trucks. Of the movements made by freight vehicles, 74.8 per cent actually transported cargo, the rest of the trips were by empty vehicles (see figure 3).

Figure 3: Truck Movements

Truck trips per hour



- In the last five years there has been an 11 per cent increase in the volume of trucks entering and leaving Bogotá. When compared by type of truck, two-axle trucks have increased by 22 per cent, while three-axle trucks have decreased by 29 per cent, and four-axle trucks and more decreased by 5 per cent (see figure 4).

Figure 4: Vehicule Volumes

Percentage change in volumes (years 2015 –2020)

	External (4:00 – 20:00)			Intermediate (5:30 – 13:30)			Internal 5:30 – 13:30)		
	2015	2020	VARIACIÓN	2015	2020	VARIACIÓN	2015	2020	VARIACIÓN
C2	33.516	40.894	22%	27.500	30.382	10%	14.742	16.530	12%
C3	5.557	3.951	-29%	2.981	1.642	-45%	1.080	546	-49%
C4	8.730	8.301	-5%	2.048	2.188	7%	219	154	-30%
TOTAL	47.803	53.146	11%	32.529	34.212	5%	16.041	17.230	7%

Figure 5: Freight traffic generated

Generated

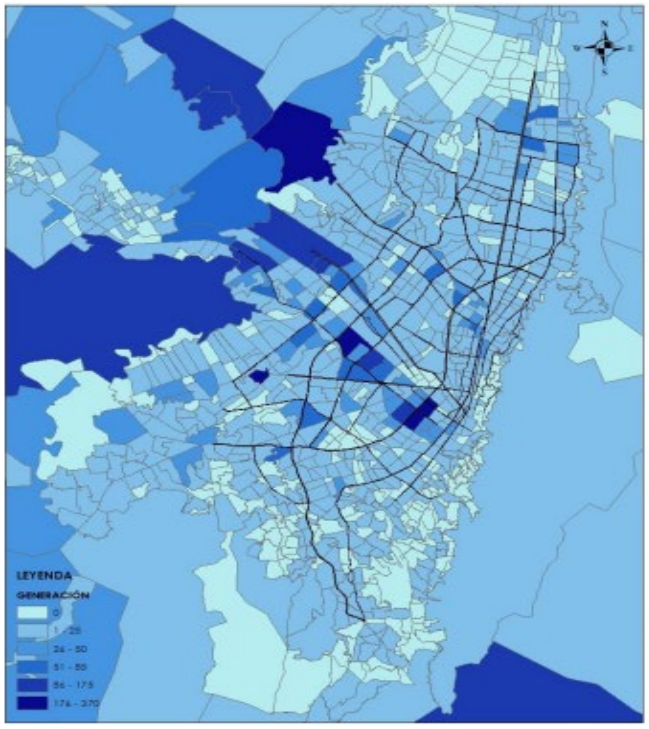
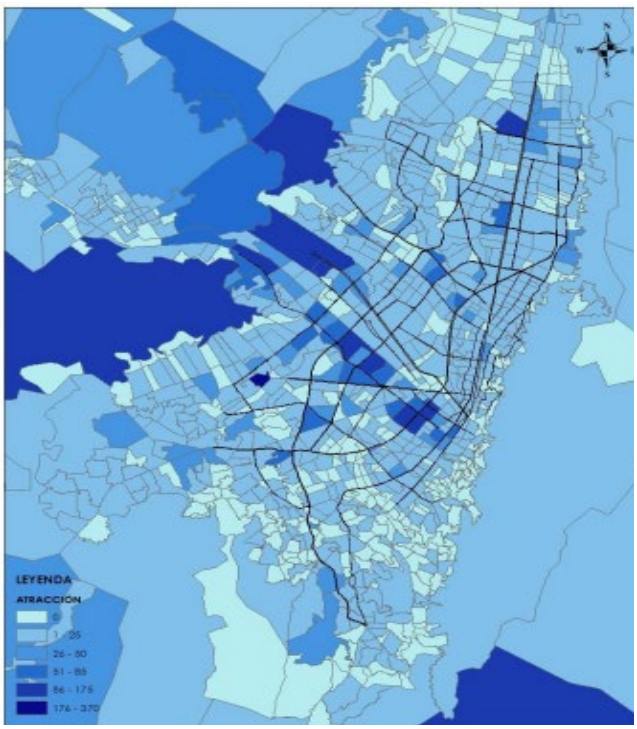


Figure 6: Freight traffic attracted

Attracted



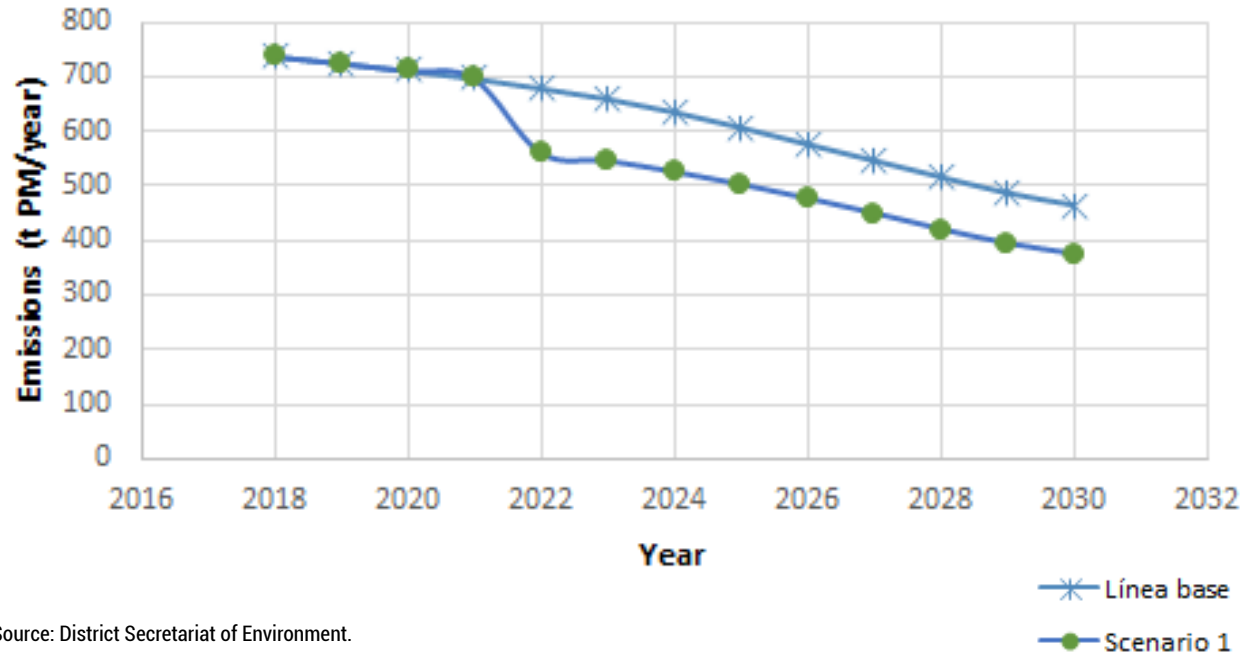
Source: Freight transport characterization in Bogota and surrounding municipalities, Consorcio ICOVÍAS-TPD, 2021

- Of the trucks entering and leaving Bogotá, 50 per cent did so along the main corridors of Calle 13 and Calle 80. This shows how the sectors from Calle 13 to Mosquera and Calle 80 to La Punta along Siberia Road (surrounding municipality) generated and attracted a significant number of trips, which demonstrates high cargo activity between Bogotá and its region. Figure 5 shows freight trips generated and attracted by areas in the city within the peak freight hour.

- Of the trucks that transited through Bogotá, 19 per cent carried manufactured food products, 12 per cent moved construction supplies and 11 per cent transported agricultural products.
- In relation to unloading for refuelling, about 37 was done on public roads, 35 per cent in private areas and 28 per cent in bays or authorized parking areas, with average times of 68.2 minutes. In the case of distribution, 35 per cent took place on the road, 34 per cent in bays or authorized areas and the remaining 31 per cent in private areas, with average times of 52.3 minutes for loading and 50 minutes for unloading.
- In relation to the frequency of trips, as relevant data, it was found that for supply 27 per cent of the trips were made daily, 22 per cent two to three times a week, 15 per cent weekly, 13 per cent depending on demand. In the case of distribution, 52 per cent was done daily, 14 per cent two or three times a week, 13 per cent depended on demand, and 10 per cent was done at clients' request.

Although the city has conducted a full characterization of freight transport in Bogotá and its surrounding region, this just captures the situation at a specific moment, which is repeated every five years. Additionally, there is no up-to-date, reliable or regular data on how many vehicles, what type, age, characteristics, load transported, fuel consumed, loaded or empty movements, movement patterns, among others. The information that exists is a small sample of a study that is carried out every five years. In this sense, there is a lack of permanent, complete and reliable information. Such information is essential for making public policies in the generation of analysis and management for improving competitiveness, social aspects, infrastructure, policy, and project decisions. Moreover, if there is something that characterizes freight transport in Colombia, it is the high degree of informality, which at the urban level is further increased by the lack of regulations regarding information. However, there is no social characterization of those who work or are affected by, directly or indirectly, freight transport in the city.

Figure 7: Emission reduction for freight transport and self-regulation programmes



Source: District Secretariat of Environment.

3.2 Emissions from the freight sector

As mentioned, the freight sector accounts for at least 10% of GHGs in the city and 16% of PM emissions in the city, which includes all emissions sources. Within the transport sector, freight transport accounts for 38 per cent of particulate matter emissions in Bogotá, making it the greatest contributor of this pollutant.

Regarding particulate matter 2.5, a framework exists with which to determine the impact of the estimated 67,000 freight vehicles circulating within the city. In 2018, these vehicles accounted for 731 tons of total emissions (4160 tons, figure 1) of particulate matter in the city.

Within the Strategic Plan of Air Management 2030, also called the Air Plan , which contains 45 projects for the next 10 years. A reduction of GHG and particulate emissions was projected until year 2030. Success for the Air Plan will depend on actions taken to improve emission standards as required by Law 1972 of 2019. These projections can be seen in figure 7 where scenario 1 contemplates the actions included in Air Plan for these two projects, which will increase the impact of this law and accelerate its implem entation in the Capital District.

3.3 Existing data collection/monitoring systems

The Secretariat of Environment has produced the Air Plan, which defines actions the city must take to reduce air pollutant emissions during years 2020 and 2021. The Secretariat has taken the following activities under this planning tool:

- GHG Emissions Inventory 2017, reviewed in 2020, and the Climate Action Plan. District Secretariat of Environment. Available at https://drive.google.com/file/d/1ulBE79D9zTAH8cCzIqdr-xIoe1JQOql8/view
- Local Emissions Inventory 2018. District Secretariat of Environment. Available at http://www.ambientebogota.gov.co/c/document_library/get_file?uuid=1417a184-2e1c-412b-9872-31ad4dd3bb3e&groupId=10157
- Bogota Air Quality Monitoring Network – RMCAB. District Secretariat of Environment. Available at http://iboca.ambientebogota.gov.co/
- Anonymized data from the Automotive Diagnostic Centres. District Secretariat of Environment - September 2021 - will be published

District Secretariat of Mobility:

- Intelligent transport systems in Bogotá capture and integrate information from various sources for mobility management, including on-road sensors, cameras, and crowdsourcing tools. However, none provide information specific to freight vehicles
- Characterization of freight transport is conducted every five years. The most recent information corresponds to the year 2020–2021. The city does not have a more frequent data source nor real time freight data

Available at https://drive.google.com/drive/folders/1dsf7eetMdqCAOxWX4LiWhkccFpSxHL5P

- The Urban Logistics Network is a platform that gathers over 140 freight-related organizations. It is a potential source of information from the private sector. However, the platform is not representative and is voluntary. Available at www.simur.gov.co/transporte-de-carga

3.4 Important existing research into the sector

- Characterization of Freight Transportation in Bogotá and Surrounding Municipalities - Contract 2019-1816 - Icovias - TPD Consortium - June 2021
  ➲ The study consisted of characterizing cargo transport in Bogotá and its surrounding municipalities. This includes characterization of the main points in the city that generate cargo, together with specific vehicular volumes of cargo transport. (Main conclusions are in point 4.1)
- Consultancy to Evaluate and Propose a Regulation for the Circulation of Cargo Transport Vehicles in Bogotá D.C. - Consulting Contract No. 2018-1654 - Epypsa - December 2019. Available at https://simur.gov.co/biblioteca-digital/documents/644.pdf

With respect to the evaluated baseline formed on current regulations (Decrees 520 of 2013 and 690 of 2013), the main conclusions are as follows:

1. Efficiency of the operation:
- Morning peak period for mixed vehicles increases one hour, and in the afternoon peak it remains the same
- There is increased traffic of two-axle vehicles and a decrease in vehicles with more than three axles
- Saturday speeds are lower than on weekdays on all accesses outbound from Bogotá

2. Environmental sustainability:
- Vehicles older than 20 years are those with the highest emission factor, corresponding to 18 per cent of the circulation of freight vehicles (see figure 8)
- Vehicles with technology lower than Euro II account for 56 per cent of all vehicles (see figure 8)

3. Road Safety:
- Total casualty rates (injuries and fatalities) have decreased from 2,013 to 2,018
- The accident rate for tractor-trailer type vehicles has increased by 25 claims per thousand vehicles according to the above-mentioned contract.
- Vehicles older than 10 years are more likely to be involved in road accidents
- Saturday has a higher accident rate than weekdays

4. Control and monitoring:
- The highest number of summonses associated with offending vehicles coincides with when the environmental restriction is in force: 9 a.m. to 10 a.m.

Figure 8: Vehicle technology and age

Transportation Vehicles in Bogotá D.C. - Consulting Contract No. 2018-1654 - Epypsa - December 2019

4.

Social and development challenges

4.1 Profile of communities impacted by freight system

There is no detailed characterization in Bogotá of the communities impacted by the freight transport system or logistics. However, the population within the city's main freight or vehicle corridors or activity areas may be greatly affected by the traffic jams, pollution, noise, and road casualties. In this sense, this population comprises that closest to the origin and destination of the movement of freight transport within Bogotá and its surrounding areas, whose main corridors are Autopista Norte, Calle 80, Calle 13, Autopista Sur, Carrera 7ª, Suba-Cota, La Calera, Choachí, Via Villavicencio.

In more recently developed projects, social aspects have been contemplated from the design stage, with an identification of social actors and their needs. Additionally, different social groups have been involved in the planning and development of the projects. This has enabled design adjustments and allowed for greater participatory processes. Therefore, when entering each borough, neighbourhood or commercial area where a project is to be undertaken residents to be engaged will be identified; there is not a detailed or city-level characterization.

Additionally, within the planning and application of solutions for freight transport, it is also important to acknowledge and include the informal character of the sector.

4.2 Residents and equity issues in the city

Slightly more than 70 per cent of vehicles in the city belong to small businesses, which operate with just one vehicle. Additionally, the coordination and communication between the main stakeholders, generators and transport companies is scarce.

A significant part of the freight sector functions under conditions of informality, with operators owning few (between 1 and 5) freight vehicles from which they derive their daily subsistance. Employees in the sector do not have minimum wages, a permanent contract, and social security. Although transporters offering these conditions exist, there is no measurement, control or characterization that enables them to be regulated so that their activities are visible. This deficiency affects the city's social make up, pollution level and residents' mobility.

The land use assigned to each part of the city does not guarantee the necessary conditions for its proper functioning. Thus, there are commercial zones where the demand for parking or loading and unloading areas exceed the demand during certain hours, while during most of the day the supply exceeds the demand, se there is no balanced use of resources for managing logistic operations.

In areas where commercial and industrial activities are carried out, it is also common to find informal cargo transporters who invade public spaces while waiting for clients. This category of transporters does not earn minimum wages or have social security. There is no measurement, control or characterization of these transporters that allows for their regulation. This affects the city's social, pollution and mobility outlook.

In Colombia, the plans, information and goals of freight transport are at the national level. These do not exist at the regional, city and community levels. Some of the impacts of freight transport are known by observation, intuition, and isolated environmental measurements. There are no comprehensive studies measuring or generating data on how residents in different areas of the city are impacted.

Historically, the southwestern Bogotá neighbourhoods of Bosa, Ciudad Bolivar, Kennedy, Puente Aranda, and Tunjuelito have suffered yearly from high levels of air pollution, such as particulate matters 10 and 2.5, which have affected public health seriously. In its 2018 reports, the city's Health Secretariat said in the southwest area alone 273 people died from chronic lower respiratory disease in people under 70 years of age, representing 36% of mortality for this age range, with respect to the rest of the city, with Kennedy the most affected locality.

This situation is a consequence of the different problems that plague this part of the city, due to the large agglomeration and high movement of cargo transport on the southwest's roads. This has been a setback for efforts aimed at reducing emissions.

According to the emissions inventory, cargo trucks of all mobile sources account for the greatest emissions of particulate matter. This is because they are old, lack maintenance, and therefore do not have the technical, mechanical means with which to comply with regulatory standards. Moreover, their heavy loads have had a deteriorating effect on the southwest's streets. The lack of development in its road infrastructure has increased levels of contamination by resuspended particulate matter.

Despite the existence of traffic restriction measures, such as the *Pico y placa*, several of the most important cargo transport corridors cross the southwest, such as the Autopista Sur. Cargo vehicles enter this route and Calle 13, from Buenaventura port to Bogotá and to the country's northeast.

This agglomeration of cargo transport is due to the number of commercial and industrial companies in localities such as Kennedy and Puente Aranda. These are industrial areas or those with specific zones earmarked for industrial development.

In this sense, land use and urban development have accentuated the inequalities in this area, where the population density is high and residents are of the low socioeconomic bracket. This makes the area's residents more exposed to the effects of air pollution.

Based on the above, the District Environment Secretariat and other district entities have been building an operational action project. Its aim is to solve the air quality and public health problems in the most affected and vulnerable area of the city. This requires the different actors to implement management, control and monitoring measures for mobile and stationary sources of pollution and resuspended particulate matter in order to reduce air pollution. The operational action project—called Project No 19: Intervention Plan for the Southwest Zone—is within the Air Plan. This project seeks to be the instrument with which to tackle the city's air pollution problem in a differentiated manner. It will focus on implementation of concrete actions to reduce emissions of particulate matter in localities that have been subject to the greatest air quality problems. This effort will be based on governance that harmonizes institutions, the public and private sectors, academic and citizen agendas, focusing discussions on environmental, sociocultural and economic dimensions.

4.3 Sources of information for residents

The main source of information on Bogotá's freight sector is the characterization carried out approximately every five years. The results are published on the Mobility Secretariat website: www.movilidadbogota.gov.co.

There are different channels of communication between members of the public and officials of the Mobility Secretariat. These channels are as follows:

- A Mobility Centre staffed by a manager and counsellor is located at each district. The counsellor is available to receive individual residents at these centres and over the telephone. Additionally, there are meetings, and programmed or requested tours.
- Problems related to freight projects and requests by the freight transport population are channelled through the Social Management Office of the Secretariat of Mobility, whose technical team will provide prompt solutions. Requests to the office can also be addressed to the email Cargabogota@movilidadbogota.gov.co, and directly to some leaders of associations.
- The Mobility Secretariat also has direct contact with some leaders of associations and cargo companies, according to the database of the urban logistics network -RLU (more information in section 7).

The Secretariat of Environment for the construction of the Air Plan, has acted to improve air quality governance. Among the actions taken, it has created 12 public-private-academic collaboration groups. So far, these groups, collectively made up of 350 participants, have held 35 meetings during which 45 upcoming projects have been discussed.

In addition, the United For a New Air Pact was created by the Secretariat of Environment. This is an instrument that consolidates the commitments of different actors through dialogue. Currently, 100 actors from academia, trade unions, businesses, and other organisations have signed on, as have 1,556 individual residents.

5.

Costs and planned investments

5.1 Investment plans and financial resources related to the freight sector

The Bogotá Development Plan 2020-2024 sets out the Mayor's objectives, policies and proposals for protecting the environment and improving the Bogotá quality of life. For this regard it provides a vision for Bogotá through 2 purposes: No 2: Bogotá Reverdece and No 4 Region of a model of multimodal, inclusive and sustainable mobility.

The Secretariat of Mobility is working to strengthen the role of urban logistics in public policy documents. The structuring of the Land Management Plan, the Mobility Master Plan, the Low Carbon Action Plan for Urban Freight, and the Logistics Vision 2050 set out objectives, actions, and indicators and present the conditions necessary to implement these actions in the short, medium, and long term. To achieve this, collaboration with all stakeholders and the generation of regular and reliable data are the success factors for structuring programs, projects, and policies in this area. From there, it is possible to plan efficient and low-carbon urban logistics, involving stakeholders and contributing to national GHG emission reduction goals.

Freight transport is a new topic in policy documents, and its vision is being drawn up. As a result, there is an opportunity to make logistics visible and generate periodic, reliable information and data to straighten planning processes and instruments, and seek specific resources for investment plans in logistics competitiveness.
In terms of air quality, the Secretariat of Environment has submitted the Bogotá Air Quality Plan 2030, whose 2020–2030 budget is $COP 147.519 million (US$ 38.8 million approximately) for 45 projects. This includes the Sustainable Freight Transport Programme to reduce emissions from this sector. This Air Plan is the management tool for the actions that the city must take to reduce air pollutant emissions to comply with World Health Organization (WHO) goals. These actions are intended to improve Bogotá's quality of life and competitiveness and integrate fundamental goals: governance, relationship with climate change, green growth, and energy efficiency.

Furthermore, the Land Use Plan of Bogota and the region presents several infrastructure projects that contribute to

Table 2: Land Use Plan - POT

Projects	Estimated Budget (Million COP)
AIM Modal Exchange Area	$COP 200,000
Vital Neighbourhoods	$COP 250,000
CIM Modal Integration Complex	$COP 752,314
High-capacity corridor	$COP 28,822,770
Corridor green	$COP 1,881,588
Arterial Road Grid	$COP 18,232,267
Regional Integration Road Network	$COP 5,385,072
Intermediate Road Grid	$COP 1,316,766
Cycle Infrastructure Network (Micromobility)	$COP 3,917,316
Pedestrian Infrastructure Network	$COP 232,600
Maintenance of the Arterial Road Network to be implemented by 2021	$COP 219,456
Maintenance of the Intermediate Road Network to be implemented in 2021.	$COP 14,989
Maintenance of vehicular bridges to be implemented by 2021	$COP 14,814
Strengthen regional coordination bodies for the planning, management and operation of the urban-regional mobility system.	$COP 5,164
Overall total	**$COP 61,245,116 (US$ 16,000 million)**

Source: Urban Development Institute-IDU and Budget execution programme of the Land-Use Plan-POT

5.2 Costs associated with inefficient freight

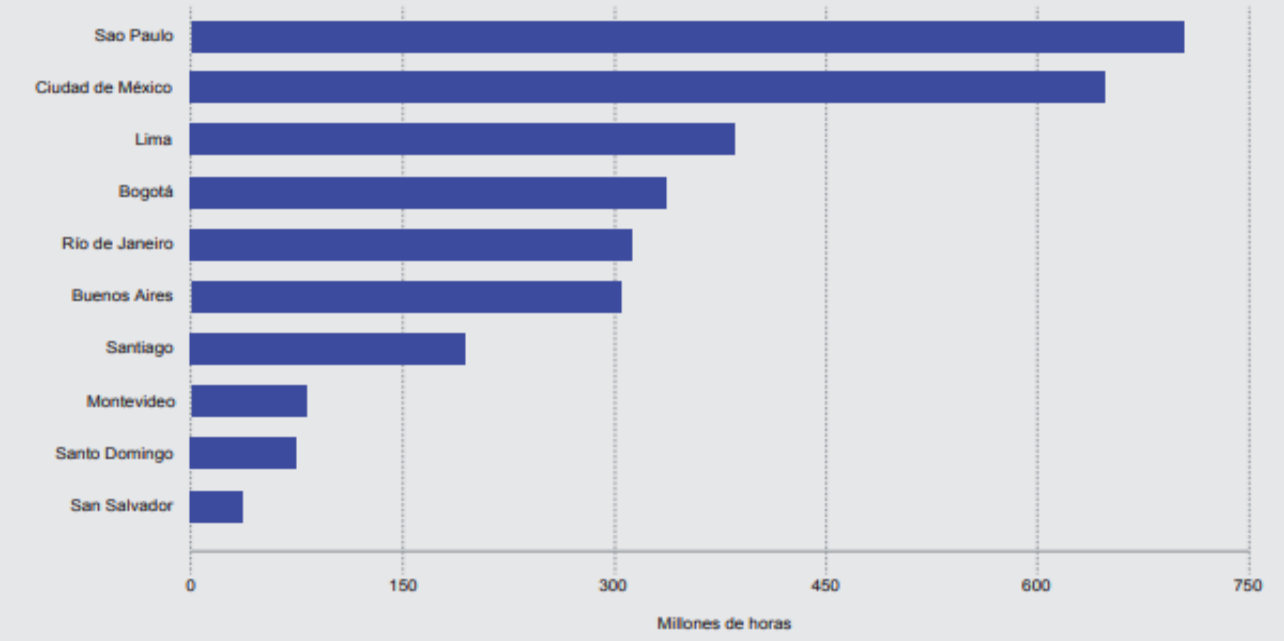
Storage and transport represent 81.7 per cent of logistics costs, according to the National Planning Department. Of this, storage accounts for 46.5 per cent, followed by transport (35.2 per cent), and administrative and customer service (11.1 per cent).

A company in Colombia allocates, on average, 13.5 per cent of its income to logistics costs and domestic or foreign trade operations. This cost is high when compared with those of the Organization for Economic Cooperation and Development countries, where the average lies between 8 per cent and 10 per cent. Colombia's national government's goal for 2022 is to reduce the national average of logistics costs to 12.9 per cent of sales.

In Bogotá, last mile freight delivery from the warehouse to the customer's door represents nearly 85 per cent of the cargo transport vehicles mobilized. According to global figures indicated by Business Insider in its 2018 report, the costs generated in the last mile can represent 53 per cent of the total cost of freight transport.

Furthermore, in terms of traffic congestion, according to a comparative study conducted by BID (Calatayud et.al, 2021) in 2019, Bogotá recorded an aggregate delay of 335 million hours, ranking it fourth of the ten Latin American and Caribbean cities analysed for most delays. Furthermore, each inhabitant of Bogotá loses 31 hours in traffic. However, when considering the delay per private vehicle user it amounted to 186 hours (see figure 9).

Figure 9: Total delay (million hours, 2019)



Source: Traffic congestion comparative study conducted by BID for the year 2019 (Calatayud et.al, 2021)

The same study highlights that in 2019 the total cost of congestion in Bogotá exceeded US$600 million, which translates into almost US$2 million per day. This figure is significant as it represents close to 1 per cent of the city's gross domestic product, and is similar to what the local government spends on health. Relative to the number of commuters, each driver in Bogota loses no more than US$340 per year to congestion (9 per cent of median annual labour income), making it the third most congestion-costly city in the world.

6.

The challenge: Reducing the climate impact of freight transport

The aim is to design an interdisciplinary, innovative and comprehensive solution that allows for intelligent management of freight transport to reduce bottlenecks and streamline vehicle traffic in the city.

Overcoming this challenge requires finding a way to integrate all available data sources, from the public and private sectors, into a system that enables managers to take decisions and direct freight movements in real time. In this way, freight activity can be optimized while reducing the city's congestion, GHG emissions, atmospheric pollution, and transport costs.

To achieve this, the problem was divided into several difficulties that needed to be solved:

1. Primary:

a. Difficulty to collect, process and manage information related to the impact of the freight sector in terms of vehicle congestion and emissions (GHG and particulate matter).
b. Constraints to develop and offer a tool to improve decision-making processes of freight sector stakeholders (shippers, receivers, carriers) in real time.
c. Limited incentives or ways to empower all actors in the search for collective solutions to congestion caused by freight activities.
d. Engage small and informal carriers to be part of the ecosystem, since they represent a great percentage of freight vehicular traffic.

2. Secondary, complementary:

a. Difficulty in establishing assertive communication with all the stakeholders involved in the sector, both to and from the public and private sectors.
b. Limited capacity to evaluate the costs and benefits, in economic and environmental terms, of vehicle congestion and the use of obsolete technologies.
c. Need to analyse and understand the impact of regulations on freight sector activities, traffic flow, and routing competitiveness.
d. Need to integrate and understand freight stakeholders who work permanently within the city and the ones who only cross Bogotá on their way from their place of origin to their destination.

6.1 Towards an optimized urban freight system

The city would gain several benefits by solving the problem of procuring and integrating information for the smart management of freight transport actors in the city, as well as raising their awareness and empowering them to tackle competitiveness and emissions issues. The first would be to optimize the system's capacity for self-regulation, develop a favourable ecosystem for trade, and reduce negative impacts on residents and the environment.

The main improvement objectives are:

1. Mobility:
- Improve cargo flows to reduce the general congestion of the urban road network
  - ➲ Identify nodes, bottlenecks and other factors affecting the system in real time to facilitate the intervention of the authorities if needed
  - ➲ Plan alternatives for freight movements due to construction works (e.g. undergoing metro system, and public service maintenance works)
- Measure impacts of implemented administrative decisions in order to improve public policies in city planning
- Benefit from a continual monitoring system that can propose solutions for a more balanced use of infrastructure and vehicle capacities
  - ➲ Build capacity to identify and measure information related to real-time freight movement in the city

2. Competitiveness:
- Measure cargo movement efficiencies to make decisions that improve the system's competitiveness
- Identify freight supply and distribution maps in terms of capital flow for infrastructure needs
- Identify opportunities to reduce operating costs in:
  - ➲ transport movements
  - ➲ logistics
  - ➲ energy efficiency
- Assess and measure the correlation between number of vehicles circulating and corresponding freight flows

3. Environmental impact:
- Improve understanding of the relationship between vehicle congestion and greenhouse gas and particulate matter emissions
- Improve traffic flow and reduce emissions of pollutants and greenhouse gases produced by freight, private and public service vehicles
- Improve the capacity of the public sector to intervene to reduce and mitigate emissions
- Favour the valuation of investment in technology by the actors, championing the renovation towards technologies that reduce fuel consumption and emissions
- To identify, more precisely, the impact of certain technologies on emissions, in order to better manage roads in environmental matters

4. Health impact:
- Measure and evaluate the impact on the health of the city's population
- Measure and evaluate the impact on health-related costs for the Capital District
- Cross-reference information between freight traffic concentration and health impact zones related to environmental pollution

6.2 The challenge that needs to be solved

The specific problems that should be taken into account and solved are:

1. Technological tools:

- Define the tool that is best suited to the need to capture and transmit information from transport vehicles, shippers and receivers of cargo
- Implement machine learning and artificial intelligence tools that have the capacity to capture and process the information generating analysis and reports to different offices and entities of the local and regional public administration
- Implement an artificial intelligence tool that can redirect traffic or send alerts to the different actors involved, so that they can automatically adapt their schedules and routes to the reported difficulties
- Define the elements of data collection and deployment plan in cargo vehicles
- Scalability of the technology within other cities and countries, in order to benefit from worldwide developments

2. Communication:

- Inform all cargo vehicle owners that circulate, operate or provide cargo transport services in Bogota and the region
- Deliver a "guerrilla campaign" to socialize the project's objective and answer questions
- Response to misinformation campaigns and mistrust directed at the public sector
- Create channels for information, interaction and follow-up processes of transporters in the implementation process

3. Financing:

- Define resources needed for each stage of the process
- Define sources of financing for the construction and maintenance of the solution
- Define who assumes each cost in the process
- Build a project whose cost-benefit ratio is favourable to all stakeholders, particularly for small and medium-sized entrepreneurs

4. Implementation:

- Develop a resilient, market-sound solution that can be sustained through time, specially without the participation of the public sector
- Define timelines of activities and partners required at each stage of the implementation process
- Build a legal framework that follows up and promotes the implementation of tools for data collection and efficient use of information
- Develop the capacity to implement, maintain and update the solution

7.

Creating a conducive environment for innovation

7.1 Regulations related to the challenge

1. Resolution 3002 of 1991 - District Environment Secretary. Permissible levels of pollutants produced by gasoline-powered mobile sources are regulated.
2. Resolution 1969 of 1992 - District Environment Secretary. Permissible emission levels of pollutants produced by mobile sources with diesel engines are regulated.
3. Decree 948 of 1995 amended by decree 1552 of 2000 - National Level. Law 23 of 1973, National Decree 2811 of 1974, Law 9 of 1979, and Law 99 of 1993 are regulated in relation to the pressure and control of atmospheric pollution and the protection of air quality.
4. Agreement 23 of 1999 - Council of Bogotá D.C. The evaluation of cost emissions and other pollutants emitted by motor vehicles is ordered to protect air quality in the Capital District.
5. Decree 173 of 2001 - Ministry of Transport, by which the public service of Cargo Transportation Service is regulated.
6. Decree 1530 of 2002 - National Level. Lead content and other contaminants in fuels. Lead content and other environmental and technical quality specifications for fuels that are imported, produced, distributed and consumed throughout the national territory.
7. Decree 98 of 2011 - Mayor's Office, Bogotá, D.C. Whereby the Ten-Year Air Pollution Decontamination Plan for Bogotá is adopted.
8. Resolution 2254 of 2017 - Environment Ministry. Adopts the ambient air quality standard which incorporates a progressive adjustment of the maximum permissible levels of pollutants, including new pollutants, and defining comprehensive technical elements to improve air quality management.
9. Law 1972 of 2019 - Ministry of Transport. By means of which the protection of the rights to health and a healthy environment is established, setting up measures to reduce polluting emissions from mobile sources and other dispositions are dictated.

7.2 Laws, plans and policies

It is essential to take into account the legal framework at the local and national levels as well as at all local and national authorities, so that the proposed solutions integrate the actors and conditions that may affect their implementation.

1. Authorities:

- Environment Ministry. National Level
- Ministry of Transport. National level
- Environment Secretary. District Level
- Secretary of Mobility. District Level

2. Strategic Plan of Air Management of Bogota 2030, also called the Air Plan, is the critical instrument that needs to be implemented in ten years to meet international air quality standards and thus offer better health to all residents. Organizations, companies and the public are invited to commit to improve air quality.

3. Bogotá's Climate Action Plan, which aims to attain carbon neutrality by 2050, as detailed in section 4.

4. Decree 174 of 2006 and Resolution 1869 of 2006 regulates the new environmental self-regulation programme for passenger and freight fleets.

5. CONPES 3547 (National Council for Economic and Social Policy, Republic of Colombia), National Logistics Policy, National Planning Department.

6. **CONPES 4034 (National Council for Economic and Social Policy, Republic of Colombia).** Support from the national government for the update of the Integral Mobility Programme of the Bogotá-Cundinamarca Region (PIMRC), National Planning Department

7. **The Mobility Master Plan:** This is an urban planning instrument that develops and complements the Land-Use Plan.

7.3 Bogota Climate Action Plan

The recently adopted Climate Action Plan for Bogotá aims to reduce GHG emissions by 15 per cent in 2024, 50 per cent in 2030, and achieve carbon neutrality by 2050. As the transport sector is responsible for around 48 per cent of GHG emissions in the city, being the largest greenhouse gas emitter, the inclusion of ambitious actions to mitigate emission within this sector is crucial within this Action Plan. Therefore, four strategic groups of transport-related actions were included. They are as follows:

1. Transport-oriented development.
2. Sustainable mobility promotion: walking, cycling and public transport.
3. Fossil fuel substitution for less carbon-intensive fuels or even carbon-intensive neutral for public and private transport in the city.
4. Technological renewal and logistics improvement for freight transport to improve energy efficiency.

Improving the efficiency of freight logistics is one of the four transport-related pillars within the Action Plan, demanding specific resources, innovations and actions. These actions aim for GHG emission reduction by increasing efficiency in freight transport, implementing a multimodal transport scheme, increasing delivery efficiency by issuing logistics updates, and replacing technology and fuel in vehicles.

7.4 Monitoring frameworks

The Greenhouse Gas Inventory is the general measurement tool for monitoring and evaluating the progress of initiatives related to the reduction of GHG emissions. On the other hand, the city of Bogotá is in the process of structuring the Monitoring, Evaluation and Reporting System of the Climate Action Plan, for which impact indicators related to the implementation of mitigation actions are defined. This includes the action "Freight Transportation Management: technological upgrading and logistical improvements to increase energy efficiency in the city's supply chain". In this sense, the Climate Action Plan's Monitoring, Evaluation and Reporting System will be the main tool for checking the initiative's progress in terms of greenhouse gas mitigation.

7.5 Communication

Bogotá city uses social media and institutional websites as the main communication channels with residents. In these cases, the Environment and Mobility Secretariats accounts are:

- Facebook: https://www.facebook.com/secretariamovilidadbogota/, https://m.facebook.com/AmbienteBogota/
- Twitter: @SectorMovilidad, @Ambientebogota
- Instagram: @ambiente_bogota @sectormovilidad
- YouTube: https://youtube.com/user/secretariamovilidad, https://m.youtube.com/user/AmbienteBogota,
- App aire Bogotá

In addition, the Urban Logistics Network - RLU is a communications channel between the Mobility Secretariat and the private sector that seeks to develop a comprehensive urban logistics ecosystem in the Bogotá Region through the dissemination of knowledge, the promotion of participation, and the recognition of best practices throughout the supply chain to meet the city's current needs.

The RLU seeks the coordination of all actors in the supply chain in order to:

- promote the development of best logistics practices in a sustainable manner, ensuring a balance between responsibility towards society, economic competitiveness and environmental preservation
- contribute to the sustainable growth of companies operating in Bogotá by supporting the optimization of their logistics processes
- implement projects aimed at reducing emissions of polluting gases, greenhouse gases and noise
- encourage the exchange of good logistics practices among the different companies in the Logistics Network
- achieve a private business commitment in the implementation of plans and competitive practices of socio-environmentally responsible logistics management

Communication and sharing in the Network are entirely voluntary.

The Secretariat of Environment for the construction of the Air Plan will also continue with processes aimed at strengthening air governance links that have been created since 2020 among public-private-academic collaboration groups.

7.6 Experimentation environments and test beds

The city commits to:

- Facilitate access to data sets with which developers can experiment:
- In terms of mobility data, the city can share data gathered through different sources and used for monitoring traffic conditions in Bogotá. This data includes the four-stage transport model, vehicle volumes, speed per corridor, car crashes and the Origin-Destination freight survey.
- Regarding environmental data sets, the city could provide data and forecasts from the Integrated Air Quality Modelling System, GHG and local pollutant source inventories, and real-time and historical data on the concentration of criteria pollutants in the city measured by the Bogota's Air Quality Monitoring Network (La Red de Monitoreo de Calidad de del Aire de Bogotá).

- Link the participants with freight sector stakeholders through the Urban Logistics Network.

- Provide the following through the MoviLab Bogotá:

a. Access to city assets or infrastructure, regulatory permissions to test out an innovation, through the lab in its lines of action:

i. Open data exchange. Within this line, the DataJam MoviLab calls to design and test startup solutions to generate new data sources; currently five startups are in methodological support.

ii. Scouting and testing of solutions. MoviLab launched the Mobility Demo Day call through which five technologies of startups were identified and three chosen to measure the performance of electric cargo bicycles for a food company.

b. Connect contestants with potential allies and investors.

8.

Studies, research and data

- Resumen ejecutivo REGULACIÓN DE LA CIRCULACIÓN DE VEHÍCULOS DE TRANSPORTE DE CARGA EN BOGOTÁ D.C. https://simur.gov.co/biblioteca-digital/documents/644.pdf
- Información sobre transporte de carga en bogotá https://www.simur.gov.co/transporte-de-carga
- Indicadores del transporte de carga https://observatorio.movilidadbogota.gov.co/carga
- Productos caracterización del transporte de carga, Secretaría Distrital de Movilidad. 2019 https://drive.google.com/drive/folders/1dsf7eetMdqCAOxWX4LiWhkccFpSxHL5P
- Inventario de emisiones, Secretaría Distrital de Ambiente, 2018. http://www.ambientebogota.gov.co/c/document_library/get_file?uuid=1417a184-2e1c-412b-9872-31ad4dd3bb3e&groupId=10157

A better quality of life for all in an urbanizing world

UN HABITAT
FOR A BETTER URBAN FUTURE

UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME
P.O. Box 30030, Nairobi 00100, Kenya
www.unhabitat.org