

# Medellin

## Climate Investment Opportunities Diagnostic




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## About this Report

This report presents a summary of the Climate Investment Opportunities Diagnostic, focusing on prioritized climate investments and potential financing mechanisms. Technical information is available separately in a supplementary technical appendix. The Climate Investment Opportunities Diagnostic was developed using APEX (Advanced Practices for Environmental Excellence in Cities), an innovation of the International Finance Corporation (IFC), with the support of the Swiss Economic Cooperation and Development (SECO).

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# Foreword

The Special District for Science, Technology, and Innovation of Medellín has been an example for Colombia and the world in terms of urban development and public policies that have aimed at improving the quality of life of its inhabitants. Several policies have focused on environmental management, providing guidelines on biodiversity, landscape protection, preservation of strategic ecosystems, water resources management, solid waste recovery, and circular economy, among other priorities.

The district is facing several challenges, including accelerated growth of its urban footprint, the migration of new population to the city, the need to provide new infrastructure and services, and episodes of natural disasters. Medellín's Climate Action Plan (CAP) 2020-2050 was developed to design the way forward through actions and appropriate practices to mitigate climate risks and achieve carbon neutrality no later than 2050.

Meeting the important objectives and goals established by the CAP 2020-2050 will require strong planning and financial management. The Climate Investment Opportunities Diagnostic serves to guide the district team's decision making and is key to ensuring the successful implementation of the various greenhouse gas reduction measures.

The Climate Investment Opportunities Diagnostic was developed in partnership with IFC and supported by Swiss Economic Cooperation and Development (SECO), to support the implementation of the district's CAP 2020-2050. It uses IFC's new APEX Green Cities platform to identify climate-smart municipal and private investments across the built environment and energy, transportation, waste, and water sectors to help Medellín reach its carbon reduction targets. Furthermore, it identifies potential policies, financing mechanisms, and business models that could help support implementation, including those encouraging the private sector to invest in green measures. Medellín is honored to be the first city in Latin America to use APEX to help move their CAP toward reality.

I want to thank IFC and SECO for supporting our ongoing efforts towards building a climate-smart, inclusive, and resilient Medellín.

**Vanesa Álvarez Restrepo**

*Secretary of Environment Medellín*

*Medellín City Administration*

# Acknowledgements

The Climate Investment Opportunities Diagnostic is the result of a collaboration between Medellín district administration officials, representatives of the Aburrá Valley Metropolitan Area (AMVA), and IFC. The diagnostic leverages a new IFC initiative, APEX, which is supported by the APEX Online App, a tool that helps quantify and prioritize policy and investment solutions across four key sectors: built environment and energy, transportation, waste, and water. The diagnostic was supported by the Swiss Economic Cooperation and Development (SECO).

IFC's team was led by Prashant Kapoor, working closely with Camila Rodriguez, Anaïs Christine Julienne, Ursula Blotte, Lorraine Sugar, Nancy Moreno Mora, Diego Duarte Guerrero, Sahlla Abbasi, and Lisa De Vellis.

The diagnostic was coordinated by Medellín's Secretariat of Environment. Juan Esteban Monsalve (Secretariat of Environment) led its preparation with technical input from the following district officials: Vanesa Álvarez Restrepo (Secretary of Environment), Luis Eduardo Cuervo Tafur (Deputy Secretary of Environmental Management), Óscar Hurtado Pérez (Secretary of Finance), Luisa Fernanda Gómez (Secretary of Physical Infrastructure), Elizabeth Granada (Secretary of Mobility), María Isabel Vélez (Secretariat of Mobility - Support in Financial Issues), Enith Sánchez (Secretariat of Mobility – Transport Sector Leader), Sara Restrepo Aristizabal (Secretariat of Environment - Waste Sector Leader), Jasballeidy Pirazán García (Director of the Administrative Department of Planning of the District of Medellín), and Carlos Bohorquez (Administrative Department of Planning Medellín – Build Environment and Energy Leader).

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The teams wish to thank workshop participants from Medellín district administration, AMVA, and the C40 Cities Climate Leadership Group for their valuable feedback.



# Acronyms and Abbreviations

<b>AFD</b>	Agence Française de Développement ( <i>French Development Agency</i> )	<b>IFC</b>	International Finance Corporation
<b>AMVA</b>	Área Metropolitana del Valle de Aburrá ( <i>Aburrá Valley Metropolitan Area</i> )	<b>IPPU</b>	Industrial Processes and Product Use
<b>AFOLU</b>	Agriculture, Forestry, and Other Land Uses	<b>kg</b>	Kilograms
<b>APEX</b>	Advanced Practices for Environmental Excellence in Cities	<b>km<sup>2</sup></b>	Square kilometers
<b>BAU</b>	Business-as-usual	<b>KPI</b>	Key Performance Indicator
<b>BOOT</b>	Build-Own-Operate-Transfer	<b>kWh</b>	Kilowatt-hour
<b>BOT</b>	Build-Operate-Transfer	<b>kWp</b>	Kilowatts peak
<b>BRT</b>	Bus Rapid Transit	<b>LFI</b>	Local Financial Institutions
<b>CAMACOL</b>	La Cámara Colombiana de la Construcción ( <i>The Colombian Chamber of Construction</i> )	<b>LILP</b>	Lincoln Institute of Land Policy
<b>CAP</b>	Climate Action Plan	<b>LRT</b>	Light Rail Transit
<b>CIOD</b>	Climate Investment Opportunities Diagnostic	<b>m<sup>2</sup></b>	Square meters
<b>COP</b>	Colombian Peso	<b>m<sup>3</sup></b>	Cubic meters
<b>CPF</b>	Climate Performance-Based Finance	<b>MLD</b>	Million Liters per Day
<b>CPOT</b>	Construction-Ownership-Operation-Transfer	<b>MSW</b>	Municipal Solid Waste
<b>DANE</b>	Departamento Administrativo Nacional de Estadística ( <i>National Administrative Department of Statistics</i> )	<b>MWp</b>	Mega Watt peak
<b>DFI</b>	Development Financial Institutions	<b>OECD</b>	Organization for Economic Co-operation and Development
<b>DHA</b>	Habitual Activity Development	<b>PACE</b>	Property Assessed Clean Energy
<b>EaaS</b>	Energy-as-a-Service	<b>NAMA</b>	Nationally Appropriate Mitigation Action
<b>E-buses</b>	Electric Buses	<b>PLF</b>	Property-Linked Financing
<b>ECA</b>	Sorting and Utilization Station	<b>PPP</b>	Public-Private Partnerships
<b>EDGE</b>	Green Building Certification	<b>PV</b>	Photovoltaics
<b>EPM</b>	Empresas Publicas de Medellín ( <i>Public Companies of Medellín</i> )	<b>SECO</b>	Swiss Economic Cooperation and Development
<b>ESA</b>	Energy Service Agreement	<b>SGP</b>	Sistema General de Participaciones ( <i>General Participation System</i> )
<b>EV</b>	Electric Vehicles	<b>SITVA</b>	Sistema Integrado de Transporte del Valle de Aburrá ( <i>Aburrá Valley Integrated Transport System</i> )
<b>FIDE</b>	Fideicomiso para el Ahorro de Energía Eléctrica ( <i>Electric Energy Saving Trust</i> )	<b>SMMLV</b>	Salario Mínimo Mensual Legal Vigente ( <i>Current Legal Monthly Minimum Wage</i> )
<b>FY</b>	Fiscal Year	<b>t/day</b>	Tonnes per day
<b>GHG</b>	Greenhouse Gas	<b>TOC</b>	Construction, Operation and Transfer
<b>ICONTEC</b>	Instituto Colombiano de Normas Técnicas y Certificación ( <i>Colombian Institute of Technical Standards and Certification</i> )	<b>tCO<sub>2</sub>e</b>	Tonnes of carbon dioxide equivalent
		<b>TFL</b>	Light Rail Transportation
		<b>UCLG</b>	United Cities and Local Governments
		<b>USD</b>	U.S. Dollar

# Executive Summary

The Medellín Climate Investment Opportunities Diagnostic (CIOD) aims to support the implementation of Medellín's Climate Action Plan (CAP) 2020-2050 by assessing several of its selected actions in terms of potential investments, indicative costing, and suitable financing options. The CIOD leverages the Advanced Practices for Environmental Excellence in Cities (APEX) platform, a new initiative by

the International Finance Corporation (IFC). An online software tool, APEX helps quantify and prioritize city-based policy and investment solutions in the built environment, energy, transportation, solid waste, and water supply and wastewater treatment sectors.

The CIOD prioritizes a total of twenty investment opportunities aligned with the Ambitious Action Scenario of

Medellín's CAP 2020-2050. The overall investment cost of approximately USD 2,805 million comprises both direct investments by the public sector (32.5%) and indirect investments by the private sector (67.5%). The project pipeline is anticipated to deliver a 20% reduction in greenhouse gas (GHG) emissions across all the sectors under analysis.

**Prioritized climate investments were categorized according to shared characteristics and potential financing opportunities. This report presents five sets of measures, which are listed below:**

- 1. Investing in Green Municipal Buildings.** Reducing energy consumption in new and existing public buildings through energy efficiency improvements and renewable energy (*Table 1*).
- 2. Improving Provision of Infrastructure and Public Services.** Enhancing the availability and quality of public amenities and providing basic services (*Table 2*).
- 3. Leveraging Utilities and Tax Collection to Upgrade Private Buildings.** Using public resources, such as taxes and public utilities, to incentivize or support the improvement of privately owned buildings (*Table 3*).
- 4. Enabling Green Privately Owned Electric Public Transportation.** Promoting the acquisition and operation of privately owned electric buses, minibuses, and taxis through enabling actions (*Table 4*).
- 5. Leveraging Green Private Financing Through Local Intermediaries.** Enabling local financial institutions to serve as a link between private investors and green projects, optimizing the use of private financing to support sustainable development and promoting the involvement of local communities and businesses (*Table 5*).

Financing mechanisms were identified and analyzed within the city's specific regulatory and financial context. Low-carbon projects identified in the CIOD were then categorized into five groups to reflect the wide range of funding options available to support their implementation. Next, the financing options were aligned with each of the five groups, as indicated above. Details of investments, scopes, and suggested financing delivery models are described further in later sections of the report.

*This report is accompanied by a supplementary technical appendix, available upon request.*



## Executive Summary

Table 1: Investing in Green Municipal<sup>1</sup> Buildings.

Measures	Cost (USD million)	GHG Savings (% from BAU)	Financing Options	
			1 <sup>st</sup>	2 <sup>nd</sup>
1. New green municipal buildings	47	0.6%	Municipal Debt	Grants/Own Revenue Sources
2. Energy efficiency retrofit of municipal buildings	445	2.3%	Public-Private Partnerships - PPP (Energy as-a-Service)	Municipal Debt
3. Rooftop solar on municipal buildings	67	3.6%		
<b>Total</b>	<b>560</b>	<b>6.4%</b>		

Table 2: Improving Provision of Infrastructure and Public Services.

Measures	Cost (USD million)	GHG Savings (% from BAU)	Financing Options	
			1 <sup>st</sup>	2 <sup>nd</sup>
1. Build bicycle lanes and infrastructure	2	2.4%	Municipal Debt	
2. Provide EV charging infrastructure	8	1.1%	Public-Private Partnerships - PPP (Energy as-a-Service)	Municipal Debt
3. Electric BRT buses	23	<0.1%	Private Asset Co.	Public-Private Partnerships - PPP (Traditional Contracts)
4. Decentralized composting facilities	79	0.3%	Public-Private Partnerships - PPP (Traditional Contracts)	Municipal Debt
5. Material recovery facilities to enhance recycling	113	0.2%		
6. Landfill gas capture	3	0.1%		
7. Wastewater reuse	63	<0.1%		
8. Energy from wastewater biogas	3	0.1%		
9. New centralized wastewater treatment plant	58	0.1%		
<b>Total</b>	<b>351</b>	<b>4.4%</b>		

<sup>1</sup>The municipal buildings or the reference to the municipal, concerns the affairs of the territorial entity.

## Executive Summary

**Table 3: Leveraging Utilities and Tax Collection to Upgrade Private Buildings.**

Measures	Cost (USD million)	GHG Savings (% from BAU)	Financing Options	
			1 <sup>st</sup>	2 <sup>nd</sup>
1. Energy and water efficiency refurbishment & rooftop solar program - residential buildings	648	5.3%	On-Bill Financing	Property-Linked Financing
2. Efficient water fittings in existing commercial buildings	7	<0.1%		
3. Energy efficiency refurbishment and rooftop solar program - commercial buildings	162	1.4%	Property-Linked Financing	Lending through Local Financial Intermediaries
<b>Total</b>	<b>818</b>	<b>6.6%</b>		

**Table 4: Enabling Green Privately Owned Electric Public Transportation.**

Measures	Cost (USD million)	GHG Savings (% from BAU)	Financing Options	
			1 <sup>st</sup>	2 <sup>nd</sup>
1. Electric buses - private buses and minibuses	219	0.3%	Leasing	Lending through Local Financial Intermediaries
2. Electric vehicles - e-taxis	130	0.5%	Loans via a Dedicated Debt Lending Facility	
<b>Total</b>	<b>349</b>	<b>0.9%</b>		

**Table 5: Leveraging Green Private Financing Through Local Intermediaries.**

Measures	Cost (USD million)	GHG Savings (% from BAU)	Financing Options	
			1 <sup>st</sup>	2 <sup>nd</sup>
1. Incentivize green certification and water efficiency in new buildings	84	0.8%	Lending through Local Financial Intermediaries	-
2. Energy efficiency in industry and manufacturing sector	16	n/a		
3. Electric vehicles for private consumers	628	0.8%		
<b>Total</b>	<b>728</b>	<b>1.6%</b>		

# Introduction

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# City Context



Medellin is located in the Aburrá Valley, a central region of the Andes Mountains. The city sits at an altitude of 1,479 meters above sea level and is framed by mountainous topography. The total land area of the city spans 376.4 km<sup>2</sup>, 29.5% of which is urbanized, 70% is classified as rural, and 0.5% is available for urban expansion.

Medellin is divided at the political and administrative level into 16

communes with a total of 249 neighborhoods, and 5 townships representing its rural area. The varying topography has led to structural differences between city neighborhoods, particularly in terms of housing, facilities, and service provision. In 2018, the official population count was 2,376,337 inhabitants (DANE, 2019).

*Panoramic view of Medellin - Communa 10 - La Candelaria*



Image: Medellin.gov.co

## Built Environment & Energy

Medellin's buildings have a total constructed area of approximately 95 million m<sup>2</sup> (gross floor area). Based on land-use zoning, we estimate 80% of building area is residential, 12% is commercial, 5% is government / institutional,

and 3% is transportation / warehouse space (Figure 1). Energy consumption in buildings is primarily sourced from the national electricity grid, with some local combustion of natural gas and liquified petroleum gas.

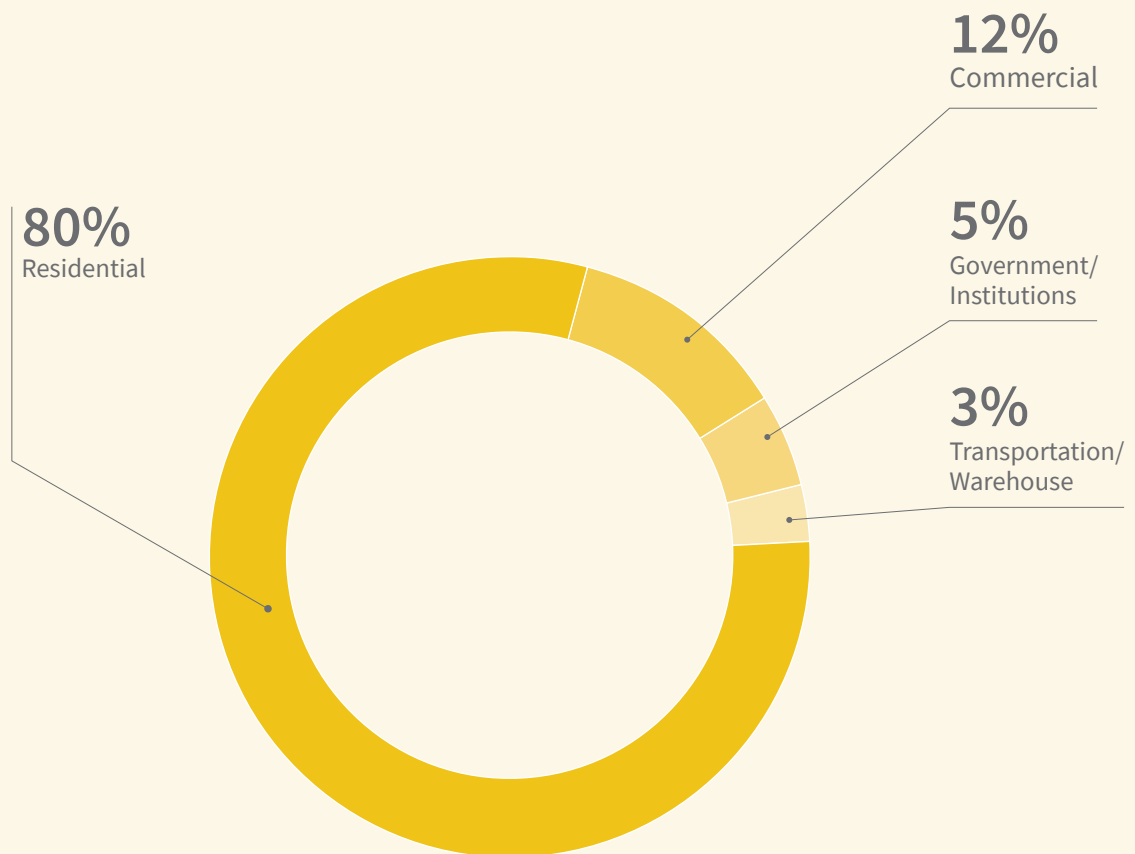


Figure 1: Building area percentage by type. Source: Calculated with data provided by Municipality of Medellin.

## Transportation

Medellin is the largest of ten municipalities in the Metropolitan Area of the Aburrá Valley (AMVA). The municipalities are highly interconnected, and the region is served by the Aburrá Valley Integrated Transport System (SITVA). SITVA includes Medellin Metro, Metrocable (aerial cable car), Metroplus (bus rapid transit, BRT), Ayacucho Tram (light rail transit, LRT), a minibus network, and EnCicla (bike sharing).

While the majority of the trips in the AMVA region are walking trips (28%), public transportation is popular (Figure 2). Sixteen percent of trips are taken by mass transit modes (i.e. metro, BRT, etc.) and 18% by collective public transport (i.e. minibuses). Private automobiles make up 13% of trips, followed by motorcycles (12%), taxis (7%), and other modes (5%). Cycling is less common, comprising 1% of trips in the AMVA region.

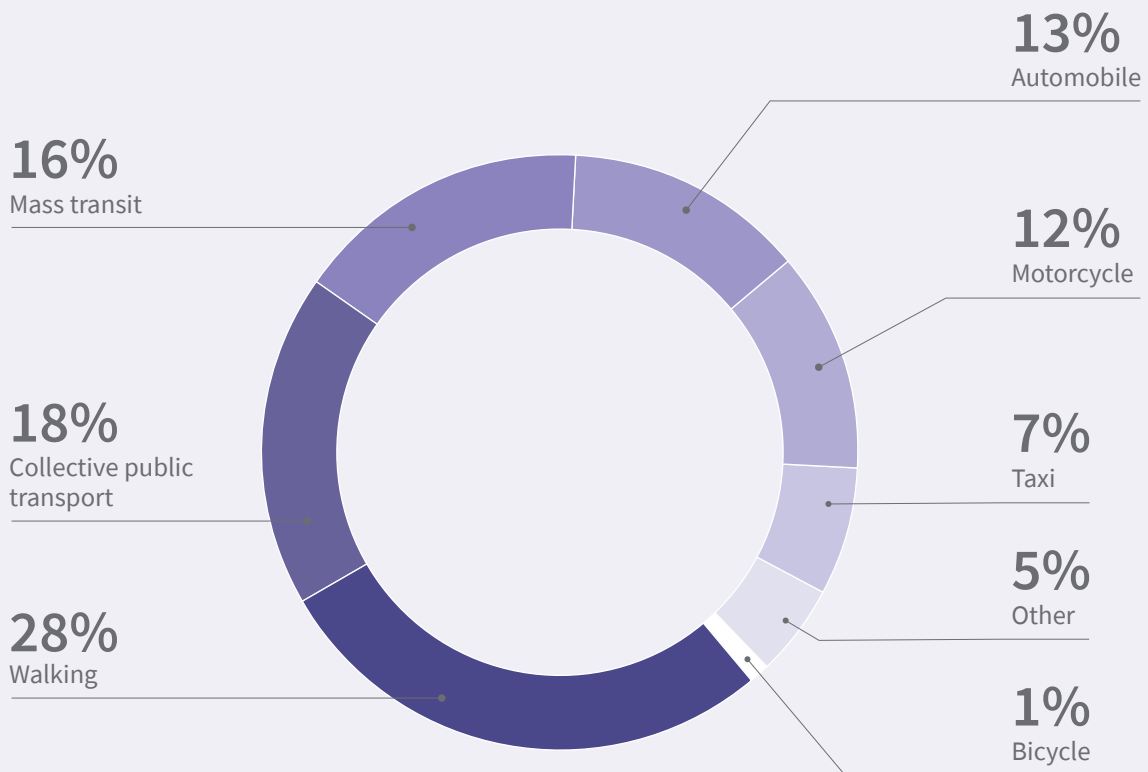


Figure 2: Modal split in the AMVA region. Source: AMVA, 2020.

## Waste

Municipal solid waste (MSW) in Medellín is generated at a rate of 0.54 kg/person/day. Most of the waste is organic (40%), 13% is plastic, 6% paper and cardboard, 4% glass, 3% textiles, 1.4% metal, 0.4% wood, and 0.2% rubber and leather (Figure 3). The remaining 32% is classified as ‘other’, including non-recyclables, hazardous waste, and other debris. There is also approximately 3,000 t/day of construction waste generated in the city, which is not included in MSW baseline totals.

Three-quarters of the municipal solid waste is disposed at the *La Pradera* landfill, which has been operating since 2003. The remaining 25% of waste is recycled, and a small percentage (0.22%), mainly hazardous and hospital waste, is incinerated. Recycling is collected by the main sanitation service provider, EMVARIAS together with 27 waste picker organizations is responsible for managing recycling within the framework of the recycling component of the household public sanitation service. Upon collection, recyclables are taken to collection

centers called Sorting and Utilization Stations (*Estaciones de Clasificación y Aprovechamiento, ECAs*), where the recovered material is sorted and sold. The city, together with EMVARIAS, is planning the construction of a waste transfer station, to be called “*El Caracol*”, in order to develop a more efficient process of collection, transportation, and final disposal of non-usable waste.

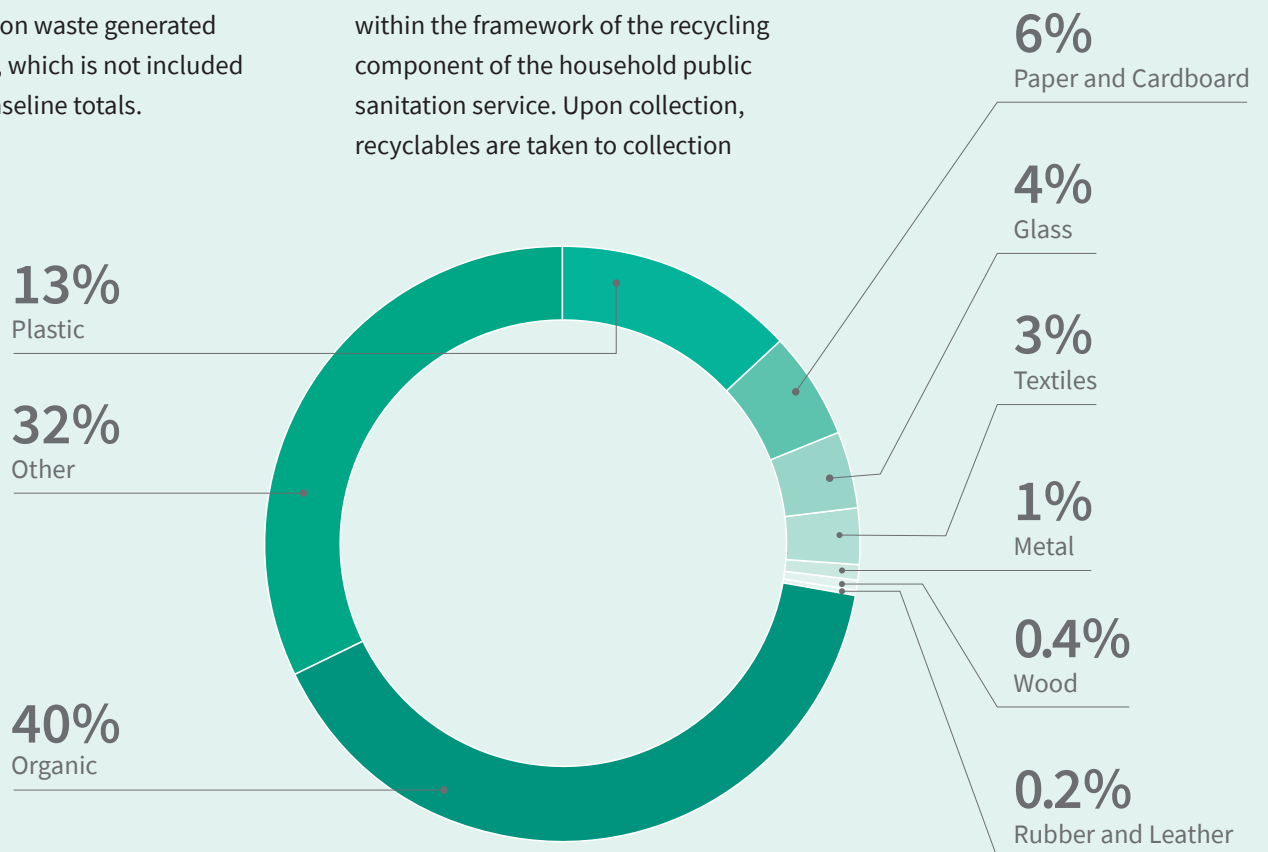


Figure 3: Waste composition by type. Source: Solid Waste Consortium Medellín, 2018.

## Water

Drinking water supply in Medellín comes largely from surface water sources (88%) originating from watersheds within the Department of Antioquia. The remaining 12% is from groundwater abstraction (Figure 4). This dependence on the surrounding environment for drinking water implies a need to control urban growth to ensure adequate water supply in the years to come. Centrally treated water reaches 84% of the city's population.

The most important wastewater treatment plant in Medellín is *Aguas Claras*, located in the municipality of Bello, which treats 5 m<sup>3</sup> per second of residential, commercial, and industrial wastewater. The sewage collection network covers 95% of the city's population. Wastewater treatment is the first major step towards cleanup of the Medellín River.

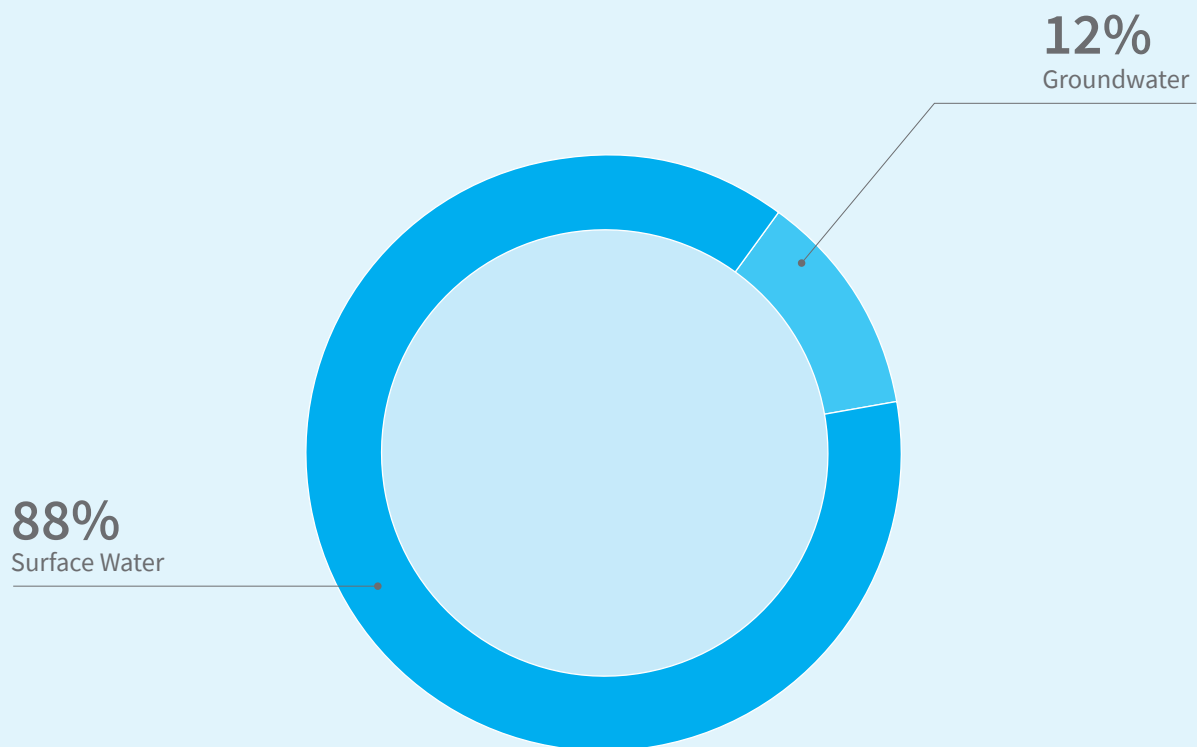


Figure 4: Water supply sources. Source: Mayor of Medellín, 2021.



## Greenhouse Gas Emissions

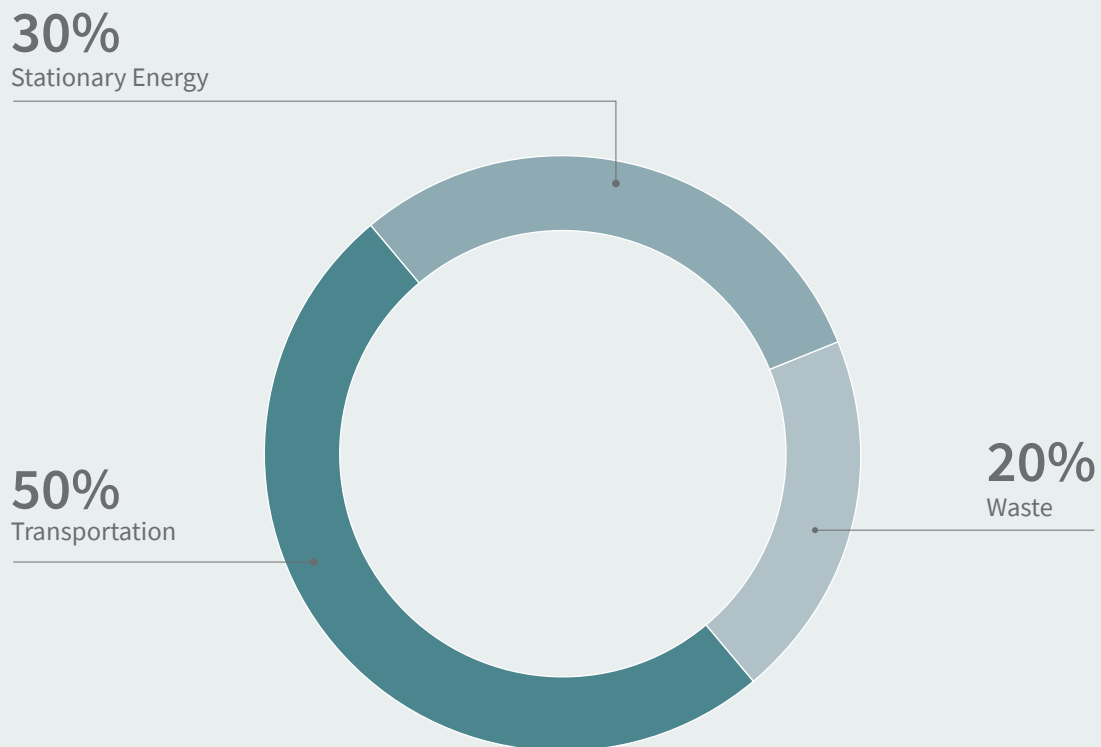
Medellin’s 2015 GHG inventory serves as the baseline for the development of the CAP 2020-2050 (Mayor of Medellin & Secretary of Environment, 2021). The 2015 inventory and its annual updates from 2016 to 2019 had a methodological adjustment to ensure consistency in the sources of information following the internationally recognized parameters in the Global Protocol for Community Scale Greenhouse Gas

Emission Inventories (WRI, 2014), known as the GHG Protocol for Cities. The GHG Protocol for Cities covers five sectors: stationary energy, transportation, waste (including wastewater), industrial processes and product use (IPPU), and agriculture, forestry and other land use (AFOLU)<sup>2</sup>.

In 2019, the city-wide GHG emissions were 3.35 million tCO<sub>2</sub>e, about 1.4 tCO<sub>2</sub>e/capita. The highest-emitting sector was transportation (50%),

followed by stationary energy (30%), waste and wastewater (20%), as shown in *Figure 5*. The Medellin inventory does not include the AFOLU and IPPU sectors in its inventory due to methodological difficulties and the unavailability of consistent data.

<sup>2</sup>APEX GHG calculations include stationary energy (residential, commercial, and institutional), transport, and waste sectors. IPPU and AFOLU sectors are not included in APEX.



**Figure 5:** GHG emissions by sector in 2019. City-wide GHG emissions were 3.35 million tCO<sub>2</sub>e, following GHG Protocol for Cities BASIC+ reporting. Source: Mayor of Medellin & Secretary of Environment, 2021.



# The Medellin Climate Action Plan 2020-2050

The Medellin CAP 2020-2050 was developed in collaboration with the C40 Cities Climate Leadership Group in 2021. C40 member cities in Colombia and around the world are exploring pathways to achieve carbon neutrality by the year 2050, which is necessary to meet the commitments established in international agreements such as the 2015 Paris Agreement. In Colombia, climate change objectives are set by specific policies at the national, regional, and local levels, such as Colombia’s nationally appropriate mitigation actions (NAMAs), the Comprehensive Plan for Climate Change for Antioquia 2018, and Medellin’s Municipal Agreement 46 of 2015, Comprehensive Strategy for the Management of Climate Change and Climate Variability in the Municipality of Medellin.

The Medellin CAP is a guide for the city to reduce GHG emissions according to its mitigation goals in both the short term (20% reduction by 2030) and long term (carbon neutrality by 2050). The C40 Pathways tool was used to develop GHG reduction scenarios and identify actions. Within the CAP 2020-2050 there are three GHG reduction scenarios:

1. The Business-as-usual (BAU) Scenario where the city of Medellin continues the same trends of development without considering climate change, which is to be avoided;
2. The Existing and Planned Actions Scenario, which is a projection that considers the city’s current plans across all sectors; and

3. The Ambitious Actions Scenario, which pursues the goal to achieve carbon neutrality by 2050.

The Medellin CIOD aims to support the implementation of the Medellin CAP by identifying investments that correspond to actions described in the **Ambitious Actions Scenario**. Table 6 shows the CAP’s prioritized mitigation actions for the transportation, waste, and energy sectors. The CAP 2020-2050 has a total of seven study sectors, but only the actions related to the key sectors analyzed in the APEX application are shown here. The selected actions were analyzed by the municipal team according to their feasibility in the short, medium, and long term, some of which have already demonstrated progress in their implementation due to the successful public policies in Medellin.

Workshop 2 Presentation - November 1st, 2022. / Municipal Administrative Center (CAM) - La Alpujarra (previous page)



Image: Diego Duarte Guerrero/JFC

Table 6: Medellín CAP 2020-2050 Mitigation Actions.

Sector	Medellin Climate Action Plan 2020-2050 – Mitigation Actions
Transport	#M1: Develop safe, comfortable, and inclusive physical infrastructure enabling the growth of trips made by men and women through walking and biking.
	#M2: Develop resilient infrastructure to reduce the impacts of extreme precipitation events and mitigate the urban heat island effect.
	#M3: Reduce the number of trips and distances that fossil fuel vehicles travel due to business and corporate processes.
	#M4: Generate transition and renewal of public service vehicles that consume fossil fuel to electric energy-powered vehicles.
	#M5: Generate transition and renewal of private vehicles with fossil fuel towards electric energy-powered vehicles and low, ultra-low and zero emission technologies.
	#M6: Implement demand management mechanisms consistent with academic and technical evidence.
	#M7: Optimize the logistics processes of the freight transport sector and encourage the technological renovation of the vehicle fleet.
	#M8: Optimize and improve the coverage of the city’s public mass and collective transportation system.
Waste	#M9: Promote the transition towards a regional economy model through the development of sustainable production and consumption processes enabling the revaluation of solid waste, its commercialization, and the reduction of final disposal rates in landfills.
	#M10: Develop strategies for the treatment and use of organic solid waste and wastewater management.
	#M11: Optimize the system of collection and final disposal of ordinary solid waste in the city, maintaining a regional perspective for the administration of the integrated waste management system.
	#M12: Implement an inclusive scheme for the use of waste enabling the application of affirmative actions to improve the vulnerable population’s socio-economic conditions.
Energy	#M13: Improve the energy performance of industrial processes and production chains in the city.
	#M14: Reduce energy consumption in the construction, operation, and maintenance of the new and existing public, commercial and residential buildings.
	#M15: Increase the participation of renewable energy sources in the portfolio of utility companies.

# City Budget and Financial Context

According to the Colombian National Constitution of 1991 (Presidency of the Republic of Colombia, 1991), there are two levels of autonomous subnational government entities:

1. 32 departments (regional level); and
2. 1,103 municipalities and districts (local level).

Among the 1,103 municipalities, ten are categorized as special districts due to their political, commercial, historical, industrial, cultural, or environmental characteristics, among other factors, which allows them to enjoy certain prerogatives (Law 1617/2013; OECD/UCLG, 2022). In 2021, Medellín was categorized as a Special District of Science, Technology, and Innovation.

Colombia is one of the most decentralized unitary countries in Latin America. Generally, subnational governments have significant resources, spending responsibilities, and broad competencies. Nonetheless, some still heavily rely on intergovernmental transfers (approximately 60% of subnational governments total revenues) coming from the General Participation System (SGP), which is the primary central government transfers fund system earmarked to current expenditures on social investments (i.e. education, health, water supply, and basic sanitation). Other common sources of revenue are taxes (approximately 30% of subnational governments total revenues), as well as income from assets, tariffs, and

fees (approximately 10% of subnational governments total revenues) (OECD/UCLG, 2022).

Most representative expenses at subnational level are current expenditures and those earmarked to education, health, water, sanitation, and pensions. Direct investments in local infrastructure projects were around 48% of general government direct investment in 2020 (OECD/UCLG, 2022).

From the analysis of secondary financial data and reports from 2017 to 2020 for the Medellín Special District, the city shows a relatively independent position in terms of own revenues collection (approximately 50% of current revenues), mainly originating from direct taxes such as property tax, industry and commerce tax, and gasoline surtax. Medellín records a high tax collection capacity. Other relevant sources of revenue are transfers from the national government (approximately 27% of current revenues) and other revenues associated with thematic funds (i.e. health, disasters, etc.), representing approximately 22% of current revenues. One important aspect is that most of municipality's capital revenues are financial returns from its municipal enterprises, particularly Empresas Públicas de Medellín (EPM), which constitutes over 70% of total capital revenues.

During the same period, the city primarily spent its budget on capital investments, with such investments accounting for more than 80% of

total expenses. These investments went towards infrastructure projects and developing its human resources. In terms of operating expenses, labor-related payments and transfers to other municipal entities were their most significant, making up 7% and 3% of the total expenditures, respectively. Medellín's expenses associated with debt service and loan repayments, on average, accounted for 6% of its total disbursements.

During the 1990s, several factors impacted the fiscal health of subnational governments requiring national government action through legislation. Regulation involving limits to borrowing, operating expenses, and deficits, as well as enhancing transparency and responsibility capabilities at the subnational level was part of the national rules enacted to improve the local government's financial performance. Stricter regulations apply to special districts like Medellín (OECD/UCLG, 2022).

Although Medellín's autonomy can still be rated as medium, given the participation of central government transfers into its current revenues, it is worth highlighting the local efforts towards more independent sources of revenues to finance the city's growth. Municipal tax revenues have risen steadily and growth has even accelerated in recent times.

Regarding debt, the issuance of the domestic, subnational public debt will require authorization, provided by a resolution of the Ministry of Finance and Public Credit. The authorization may be granted once the favorable concept of the department or district planning agency is in place (Law 80/1993). Generally, subnational governments are allowed to take on debt to finance capital investments. Medellín's solvency and sustainability limits increased from 40% and 80%, respectively, to 60% and 100% (Law 2155/2021), which allowed Medellín to increase its indebtedness capacity. Even with this additional debt capacity, according to local officials, Medellín has already committed future budget allocations (until FY 2029) to fund projects with upcoming start dates, leaving the municipality with little room for additional debt as a funding source for future investment projects. Therefore, any new local debt will need to be carefully considered in light of the municipality's available fiscal space.

With a BB+ credit rating in 2022 (Fitch Ratings, 2022), the city registered an outstanding long-term debt balance of COP 2.1 trillion. Around 31% of



Plaza Mayor

Medellin's long-term debt was denominated in foreign currency (loan from the French Development Agency, AFD). Bonds accounted for 11.8% of long-term (local) debt. According to the Fitch report, approximately 85% of the debt will mature by 2031.

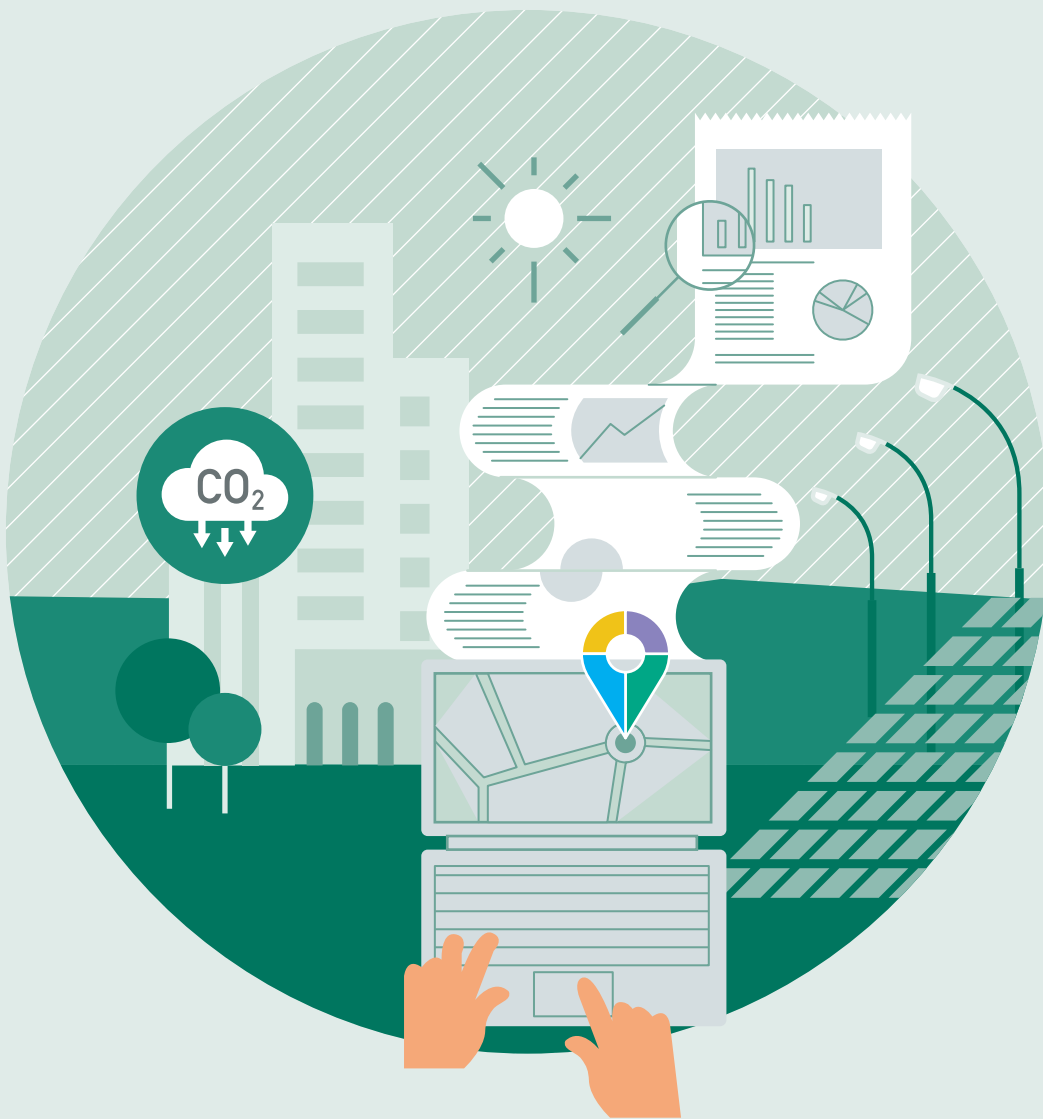
Colombia and its cities are known around the world for successfully implementing land value capture instruments. Infrastructure levies are among the most frequently used mechanisms, which are utilized to finance all kinds of public infrastructure investments (i.e. roads, transport, utilities, public spaces, etc.). Other typical instruments in Colombia include the obligation of developers to obtain approvals for new development or densification, which is retributed in the form of land (for public uses) or cash payments. Additional land value capture instruments are allowed by law (i.e. charges for development rights).

However, they have not been implemented due to their complexities (OECD/LILP, 2022).

Lastly, with respect to the establishment of a framework for Public-Private Partnerships (PPP), the country has been ranked second in the region for its capacity to develop PPPs since the enactment of Law 1508/2012 (Infrascope, 2019). The country has utilized this model to implement extensive infrastructure programs. The aforementioned law extended the applicability of PPPs to other productive and social sectors beyond road concessions, incorporating the concept of performance-based payments and re-balancing the distribution of risk between public and private actors. Subsequently, Law 1882/2018 adjusted aspects related to transparency, property management, and the rights of joint ventures, public services companies, and regional entities (IDB Invest, 2019).

# Climate Investment Opportunities Diagnostic

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## Climate Investment Opportunities Diagnostic

The Medellín CIOD identifies 20 investment opportunities aligned with Medellín’s climate ambitions, which can be converted into a green investment pipeline (Table 7). The green investment pipeline includes a mix of both direct-cost (i.e. public sector) and indirect-cost (i.e. private sector) actions, for which potential financing options are provided.

The project pipeline is anticipated to reduce 20% of the city’s GHG emissions across all sectors under analysis.

The total investment cost for all measures totals approximately USD 2,805 million, USD 910 million of which is for direct-cost measures. Direct-cost measures includes actions where the city can nudge

(i.e. implement policies, such as water efficiency requirements for new buildings, or pilot projects, such as electric vehicle, EV, charging stations) or leverage (i.e. through loans, PPP, etc.) the private sector to invest in green measures. The potential for alternative sources of financing is visualized in the investment flow diagram in Figure 6.

**Table 7: Summary of the 20 investments in the green investment pipeline. Total cost includes direct and indirect investments to be made by the public and the private sector, respectively. In some cases, direct costs include actions where the City can nudge (i.e. implement policy) or leverage (i.e. through PPP, etc.) the private sector to invest in green measures. Costs are indicative only; all would need further feasibility work.**

Measures	Direct Cost Municipality (USD Million)	Indirect Cost Private (USD Million)	GHG Savings (%)	Potential Financing Options								
				Municipal Revenue / Govt. Grants	Municipal Loans / Bonds (Incl. CPF)*	PPPs (Multiple Contract Modalities)	Product-as-a-Service or Leasing of Assets	Carbon Credits and Pricing	Property Linked Financing	On-bill Financing	Private Financing through Local Intermediaries	
<b>Built Environment</b>	1. New green municipal buildings	47	0.6%	✓	✓							
	2. Energy efficiency in existing municipal buildings	445	2.3%		✓		✓					
	3. Rooftop solar PV program on municipal buildings	67	3.6%		✓		✓					
	4. Energy efficiency in existing residential buildings <sup>1</sup>		416	2.3%						✓	✓	
	5. Rooftop solar PV program on residential buildings <sup>1</sup>		186	2.9%						✓	✓	
	6. Energy efficiency in existing commercial buildings <sup>2</sup>		115	0.6%						✓		✓
	7. Rooftop solar PV program on commercial buildings <sup>2</sup>		47	0.7%						✓		✓
	8. Incentivize green certification in new buildings (e.g. EDGE) <sup>3</sup>		80	0.7%								✓
	9. Energy efficiency in industrial and manufacturing sector		16	n/a								✓
<b>Transportation</b>	1. Build bicycle lanes and infrastructure	2	2.4%		✓							
	2. Provide EV charging infrastructure	8	1.1%		✓		✓					
	3. Electric BRT buses	23	<0.1%			✓	✓					
	4. Electric Buses - Private buses and minibuses		219	0.3%				✓				✓
	5. Electric Vehicles - E-Taxis		130	0.5%								✓
	6. Electric Vehicles for private consumers		628	0.8%								✓



# Climate Investment Opportunities Diagnostic

Measures	Direct Cost Municipality (USD Million)	Indirect Cost Private (USD Million)	GHG Savings (%)	Potential Financing Options									
				Municipal Revenue / Govt. Grants	Municipal Loans/ Bonds (Incl. CPF)*	PPPs (Multiple Contract Modalities)	Product -as-a-Service or Leasing of Assets	Carbon Credits and Pricing	Property Linked Financing	On-bill Financing	Private Financing through Local Intermediaries		
<b>Waste</b>	1. Decentralized composting facilities	79		0.3%		✓	✓						
	2. Materials recovery facilities to enhance recycling	113		0.2%		✓	✓						
	3. Landfill gas capture	3		<0.1%		✓	✓						
<b>Water</b>	1. Wastewater reuse	63		<0.1%		✓	✓						
	2. Energy from wastewater biogas	3		0.1%		✓	✓						
	3. New centralized wastewater treatment plant	58		0.1%		✓	✓						
	4. Efficient water fittings in existing residential buildings <sup>1</sup>		46	<0.1%						✓	✓		
	5. Efficient water fittings in existing commercial buildings <sup>2</sup>		7	<0.1%						✓	✓		
	6. Efficient water fittings in new buildings <sup>3</sup>		4	<0.1%									✓
<b>TOTAL</b>	<b>910</b>	<b>1,895</b>	<b>20%</b>										

\*CPF: Climate Performance-Based Finance (Loans or Bonds)

✓ Primary  
✓ Secondary

Measures noted above are grouped into the following measures in the CIOD:

<sup>1</sup>Energy and water efficiency refurbishment & rooftop solar program - residential buildings

<sup>2</sup>Energy efficiency refurbishment and rooftop solar program - commercial buildings

<sup>3</sup>Incentivize green certification and water efficiency in new buildings

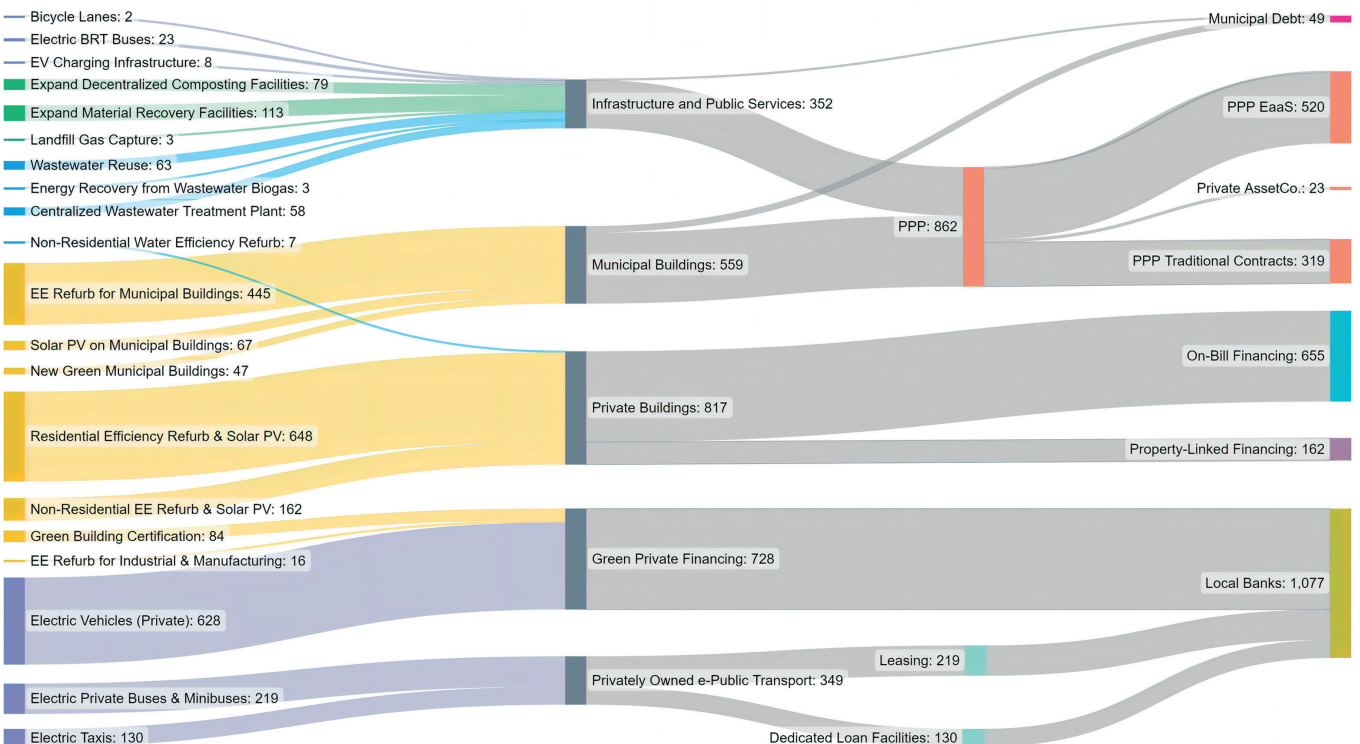


Figure 6: Investment flow diagram showing the measures in the green investment pipeline and potential financing volumes (shown in USD million).

## Investing in Green Municipal Buildings

The Medellín CAP aims to reduce energy consumption in new and existing public buildings through energy efficiency improvements, including lighting upgrades and efficient air conditioning systems and appliances, as well as renewable energy generation such as solar

photovoltaics (PV) on municipal rooftops. Public buildings in Medellín, such as City Hall, hospitals, schools, and others, have the option to pursue carbon neutral certification by the Colombian Institute of Technical Standards and Certification (ICONTEC). Several of Medellín's

municipal buildings are located within the *La Alpujarra Thermal District*, a district cooling system operating on natural gas, and the first of its kind in the region.

In the CIOD, we consider three measures for investing in green municipal buildings:

- 1. New Green Municipal Buildings.** All new municipal buildings meet green building certification standards, such as IFC's EDGE green building certification. This will represent 20% savings in energy and water consumption compared to typical construction.
- 2. Energy Efficiency Retrofit of Municipal Buildings.** All existing municipal buildings undergo energy efficiency improvements.
- 3. Rooftop Solar PV on Municipal Buildings.** 20% of municipal buildings have solar PV systems, representing 85 MWp of additional renewable electricity generation capacity.

In total, these measures will cost **USD 560 million**. Investments in green municipal buildings could be financed with municipal debt, grants, or own-source revenue sources, as well as implemented through a PPP structure, such as energy-as-a-service (EaaS). Two financing mechanisms are described in further detail: **Energy Efficiency Revolving Funds** and **Energy-as-a-Service**.

La Alpujarra Administrative Center



Image: Medellín.gov.co

# Energy Efficiency Revolving Funds

Funds designed to provide loans for energy efficiency retrofits or energy investment projects, and then recover investment costs and associated fees through energy cost savings. These funds are considered “revolving” because they are returned or recycled for the next round of subprojects. There are two implementation models: Debt and Energy Service Agreement (ESA).

In the debt model (Figure 7), beneficiaries (i.e. building/facility owners) are responsible to contract service providers to implement the

energy efficiency project, including the initial building energy audit, project design, construction, installation, and maintenance. The beneficiaries can then use the energy cost savings from the project to repay the principal, interest, and fees, allowing the fund’s capital to revolve.

In the ESA model (Figure 8), beneficiaries make fixed payments based on the baseline energy bill to the fund, including energy bill payments and repayments for cost recovery. The fund contracts service providers to implement projects

using performance-based contracts. The fund then pays the reduced energy bill directly, keeping the energy cost savings to recover its own costs. A case study for this model from Mexico is shown in Box 1.

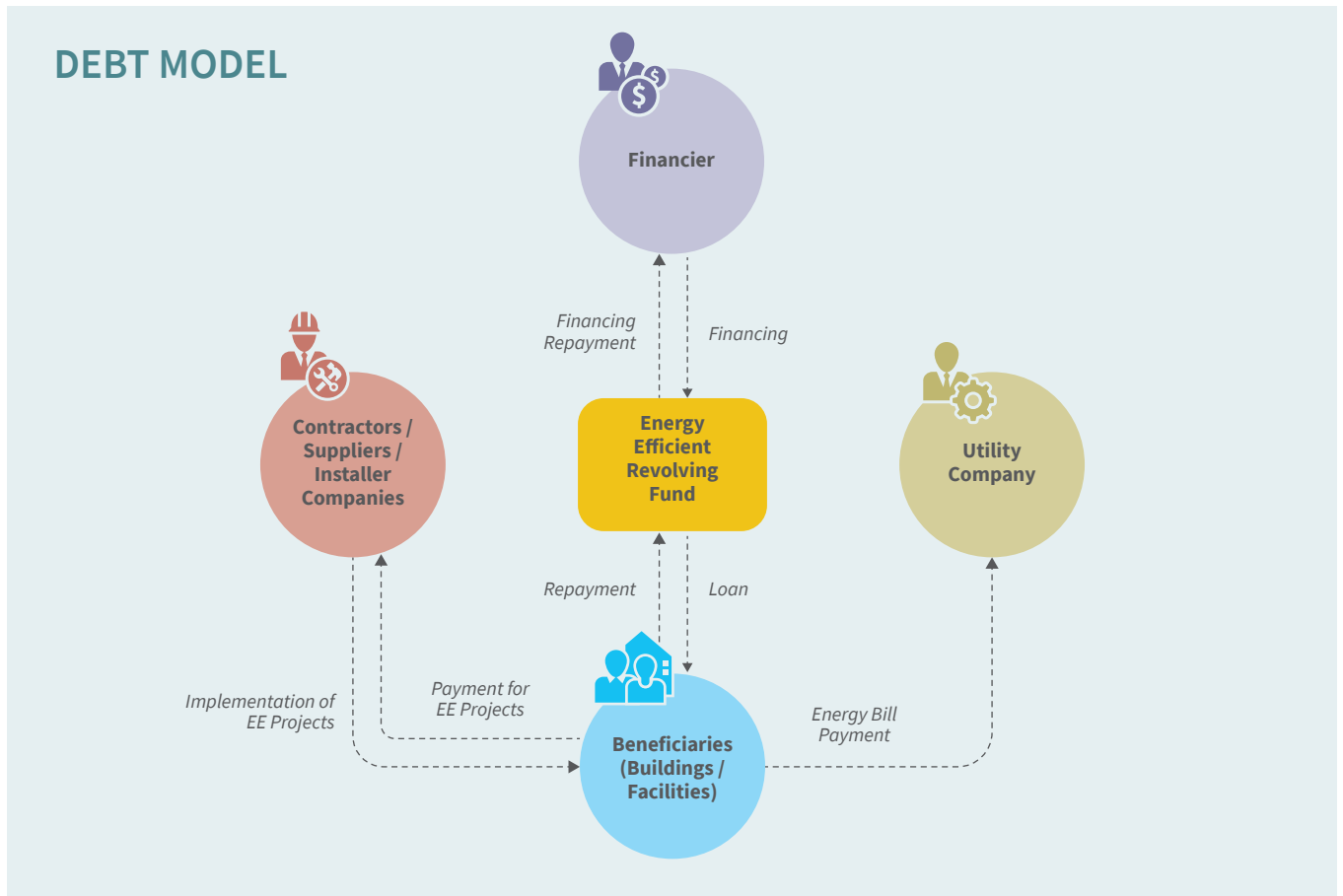


Figure 7: Energy Efficiency Revolving Funds - Debt Model.

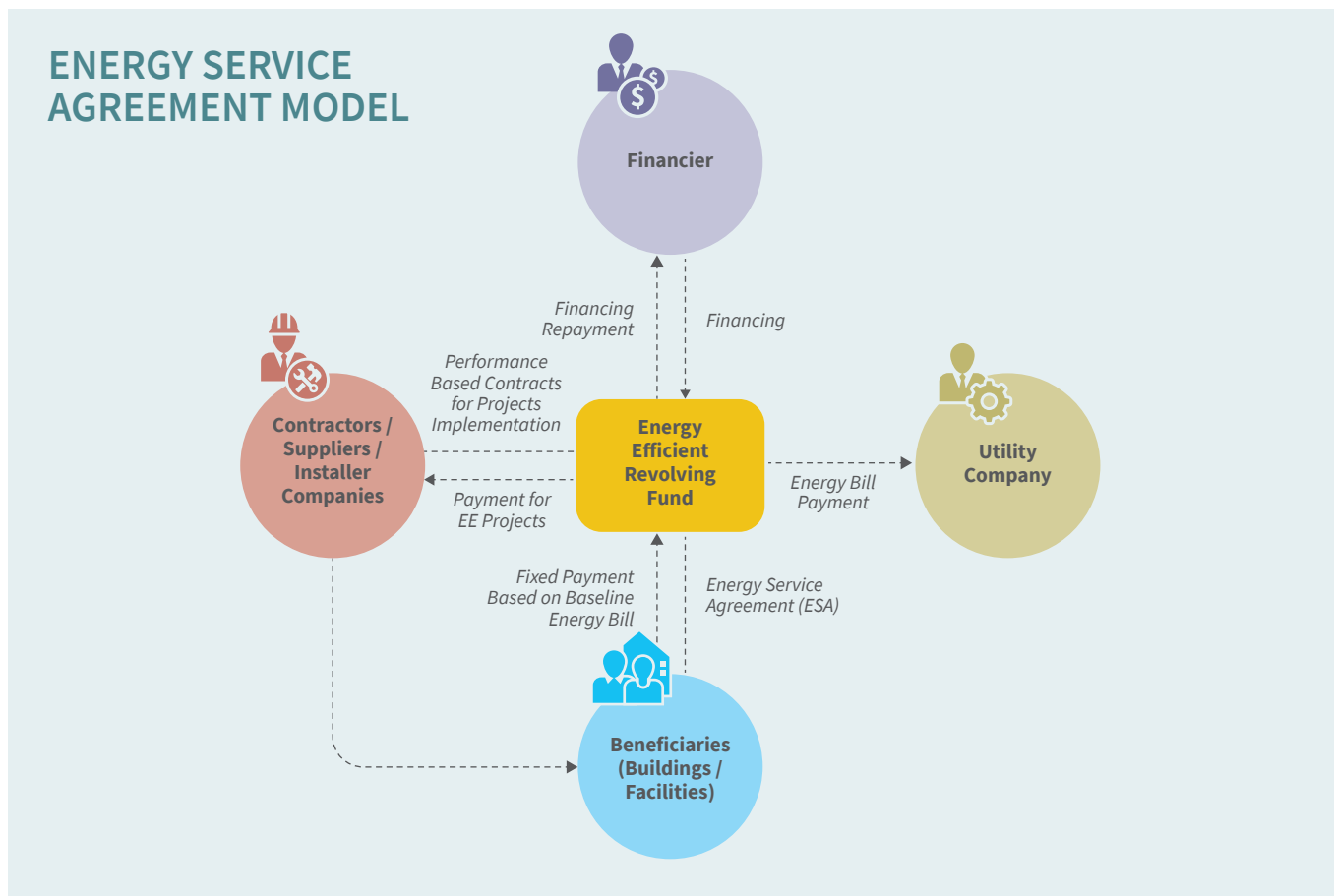


Figure 8: Energy Efficiency Revolving Funds - Energy Service Agreement Model.

The following aspects have been identified as relevant for the proper functioning of this financing mechanism in the local context of Medellín, as well as for achieving the intended goals of this set of measures:

- **Private Sector Role.** Private companies and contractors deliver energy efficiency projects in municipal facilities according to the contractual agreements put in place. They collect payments for the services provided and, in some cases, might need financing to implement projects.
- **Public Sector Role.** The city government gathers energy consumption statistics for its facilities. Energy audits in specific facilities can help identify upgrade opportunities and priorities. It also identifies the implementation model, financier, facilities, types of investments, and implementation arrangement suitable to the local context, and then negotiates, signs, and administers the contract according to the implementation model selected. One important factor to consider pertains to baseline data. To guarantee success, it is crucial for beneficiaries to possess adequate baseline data and exhibit a track record of discipline when it comes to paying energy bills.
- **Additional Considerations.** Energy service agreements are generally not registered as debt (i.e. long-term contractual commitments) and pose little risk to the city. They can be made with flexible contract durations in the event the energy savings are a bit higher or lower than expected. An energy efficiency upgrading program can be carried out in phases, initially focusing on large or visible facilities with high energy demand. The program can also include incentives or subsidies from other levels of government.

## Energy Efficiency in Public Facilities, Mexico



Image: Roman Lopez on Unsplash

*Fideicomiso para el Ahorro de Energía Eléctrica (FIDE)* operates a fund that uses energy service agreements to finance energy efficiency measures in municipal street lighting, buildings (e.g. schools and hospitals), and wastewater utilities in Mexico. It has been funded by the World Bank since 2016. During the initial phase, the government of Mexico provided subsidies to support investments. Implementation arrangements include a contingency facility for municipalities or water operators to partially cover non-payment risks. FIDE offers a package of services to identify, finance, implement, and monitor energy efficiency projects for public clients. Since the implementation model is an energy service agreement, it is viewed as a long-term contract obligation, similar to utility payments. Thus, the beneficiary would not incur debt nor need to increase public budget allocations.

**Box 1:** Case study for energy efficiency revolving funds - energy service agreement model in Mexico.  
Sources: World Bank, 2018a; World Bank 2018b; FIDE, 2023.

# Energy-as-a-Service Model

EaaS is a business model whereby customers pay for an energy service without having to make any upfront capital investment. Cities can take advantage of this business model to reduce their carbon footprint without having to incur upfront costs or utilize public funds. It is an off-balance sheet financing option. The potential areas of application of as-a-service models include energy and water efficiency technology upgrading, low carbon heating and cooling, as well as higher efficiency chillers. It can also be used for renewable energy supply such as that from a rooftop solar and electric mobility.

The EaaS model is shown in *Figure 9*. From the city government's perspective, the operation of the model can involve the following actions:

- The city gathers annual energy consumption statistics for its facilities. Having energy audits in specific facilities can help identify upgrade opportunities. Utility companies might already have this information.
- The city government invites EaaS companies to put forward proposals (with a performance guarantee) for the identification, technical evaluation, and development of potential sites for the execution of projects. Then, the city signs a contract (5-20 years) with an EaaS company to lower its own buildings' carbon footprints.
- EaaS company carries out the energy services without the city investing its own capital into the projects. The city pays a recurring fee to the EaaS.

The EaaS company responsibilities include installing energy efficiency solutions on public buildings selected by the city, retaining ownership of the equipment, and receiving service fees. To cover upfront and ongoing expenses and to satisfy any city requirements, the EaaS company may require financing and guarantees. Additionally, the company must carry out maintenance and operational tasks to guarantee proper equipment performance and service quality.

A case study of EaaS applied in Medellin is shown in *Box 2*. To expand this approach, the city could initially focus on large buildings with high energy demand and conduct a city-wide pilot involving one or more visible buildings, and then implement the remaining program in phases.

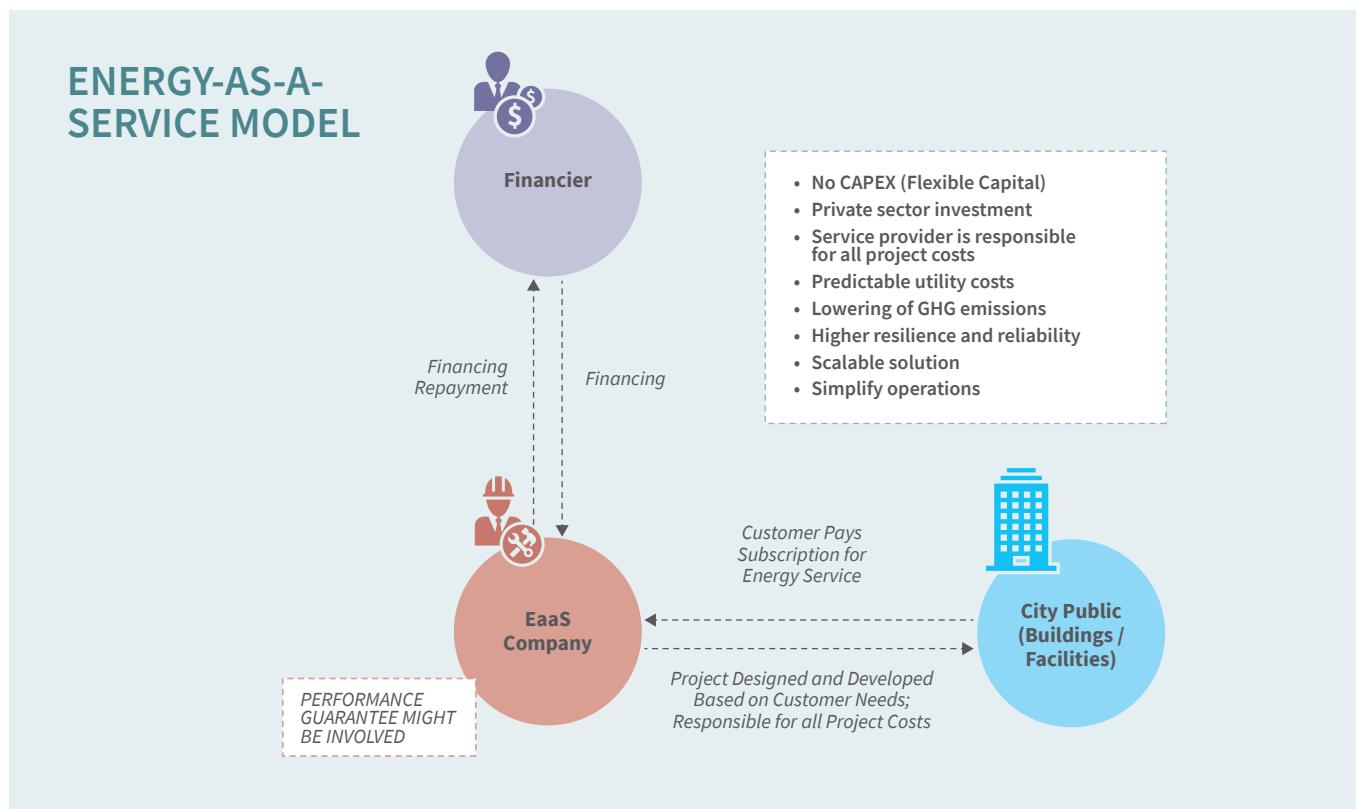


Figure 9: Energy-as-a-Service Model.

## Parque Comercial El Tesoro, Medellin



Image: Parque Comercial El Tesoro

*Empresas Publicas de Medellin (EPM) has a portfolio of renewable energy projects, including hydroelectric power plants, wind farms, and solar PV systems. In 2018, Parque Comercial El Tesoro, a shopping mall in the El Poblado neighborhood, became the first client to use EPM's solar energy solution. EPM will sell solar power to the facility for 15 years.*

The system consists of 1,568 solar panels on the roof of the mall, covering an area of 2,570 m<sup>2</sup>. It generates approximately 590,000 kilowatt-hours (kWh) annually, which is equivalent to the average consumption of 341 homes. The solar energy provides close to 24% of the energy consumption in *Parque Comercial El Tesoro*, mainly in common areas, resulting in economic and environmental benefits. The company ERCO Energia played an important role in the project by performing the solar system's installation, assembly, operation, and integral maintenance.

Box 2: Case study of energy as a service applied in Medellin. Source: EPM, 2018.

# Improving Provision of Infrastructure and Public Services

The availability and quality of public amenities and facilities, as well as delivery of basic services are essential to creating a successful, livable city. Measures under this group typically involve planning, financing, constructing, and maintaining public systems and

services to meet the needs of the city's population, while also considering sustainability factors.

The CIOD includes nine measures for improving infrastructure and public services in the key areas of transport, solid waste, and wastewater:

## Transport

- 1. Build Bicycle Lanes and Infrastructure.** An additional 36 km of bike lanes are constructed to help achieve the 5% cycling mode share target. The ambitious target would also require incentives to encourage cycling, such as improved safety and security of infrastructure, parking and shower facilities for commuters, and easy interconnections with other modes, such as BRT and metro.
- 2. Provide EV Charging Infrastructure.** 500 public EV chargers are distributed around the city, enough to support 5,000 new, privately owned EVs.
- 3. Electric BRT Buses.** 75 new electric BRT buses are added to the BRT fleet, replacing gas powered buses currently in operation.

## Solid Waste

- 1. Decentralized Composting Facilities.** 9 additional 20 t/day community composting facilities are introduced throughout the city, so that 35% of food waste is composted.
- 2. Materials Recovery Facilities.** A new 50 t/day Sorting and Utilization Station for recyclables is constructed to help achieve a 95% recycling rate, plus a 1,000 t/day facility is implemented to process 30% of the city's construction waste.
- 3. Landfill Gas Capture.** 80% of landfill gas captured at *La Pradera* landfill is converted into renewable electricity. In 2019, there was capture and flaring of almost 7 million normal m<sup>3</sup> of landfill gas with a 44% methane content.

## Wastewater

- 1. Wastewater Reuse.** 20% of wastewater effluent is reused by industries and businesses for secondary use, displacing the need for fresh, potable water in such applications.
- 2. Energy Reuse of Wastewater Biogas.** Biogas collected at the *Aguas Claras* wastewater treatment center is converted into electricity that is used to operate the treatment plant with an output of 5 MW of electrical energy and thermal energy of 6.7 MW for heating biodigesters and air conditioning equipment<sup>3</sup>.
- 3. New Centralized Wastewater Treatment Plant.** A new centralized wastewater treatment plant is constructed to add 38 million liters per day (MLD) of treatment capacity.

The overall cost of these initiatives across the three sectors amounts to **USD 351 million**. Funding could come from municipal debt or PPP structures, including traditional contracts or EaaS models. Private Asset Corporation schemes could be utilized to structure the electrification of BRT buses. Three financing options are outlined in detail:

**Climate Performance-Based Loans or Bonds, Private Asset Corporation, and Traditional PPP Contracts.**

<sup>3</sup><https://www.grupo-epm.com/site/home/sala-de-prensa/aguas-claras-alcanzo-pleno-autoabastecimiento-de-energia>



## Climate Performance-Based Loans or Bonds

Performance-based financing can help the city access lower-cost debt to finance municipal investment projects and receive financial benefits from meeting targets. These instruments focus on key performance indicators (KPIs) and targets, and they do not necessarily establish the use of proceeds in detail.

Climate performance-based loans or bonds may help Medellín achieve its sustainability targets by tying interest rates to the delivery of sustainability results. These instruments focus on

impact indicators, such as reductions in GHG emissions, and rely on robust datasets that APEX can provide to measure progress. Unlike other types of sustainable finance instruments, these performance-based instruments do not impose restrictions on how the funds are to be used. Blended finance may also be used to support the development of performance-based financing in emerging markets.

To successfully implement these instruments, a sustainability

coordinator with expertise in performance metrics, reporting, and incentives can be appointed by the city, with the support of development finance institutions (DFIs) to ensure the technical viability of new decarbonization technologies. *Box 3* shows a city-based sustainable-linked financing example from Helsingborg City, Sweden.

### CASE STUDY

#### Helsingborg City, Sweden



In January 2022, Helsingborg, Sweden, became the first city to issue a sustainability-linked bond. The framework underpinning the bond is the emission reduction target to be achieved by 2035. The performance indicator will be the trajectory of the municipal emission reduction rate in the coming years. The goal of the bond is to attract capital for carrying out and expanding green initiatives. Technical specialists will use the Swedish national emissions database to track the emission reduction performance.

Source: <https://www.themayor.eu/en/a/view/helsingborg-is-the-first-municipality-to-issue-sustainability-linked-bonds-9810>

*Box 3: City case study for climate performance-based financing. Source: Iolov, 2022.*

# Private Asset Corporation

A private asset corporation is an alternative financing model for electric buses (e-buses). As shown in *Figure 10*, there are multiple private companies with specific responsibilities, including purchasing electric buses, installing the infrastructure, and providing transport services, typically under concession and/or leasing agreements. An entity administers the whole transport system (i.e. system manager/operator). Private sector operator(s) provides transport services through a ‘gross cost contract’, typically signing a concession agreement.

The following are important considerations for implementing the Private Asset Corporation financing model:

- **Ownership and Management.** The Private Asset Corporation acquires electric buses, batteries, and charging infrastructure and enters a concession or leasing agreement with the system manager for asset provision and preventive maintenance of the e-bus fleet. The Private Asset Corporation typically receives one or two service fees, including a periodic fixed fee per e-bus and a fee for infrastructure usage, if applicable. Independent private sector operators provide transport services through concession agreements, and e-bus operators generally receive two or three fees, including a fixed periodic fee, a fee per kilometer, and/or a fee per passenger.
- **Funding Sources.** All revenues from ticket sales and other sources (e.g. advertisements) can flow directly to a trust fund, which is then used to make all payments to the agents participating in the system. The primary funding source comes from private equity and/or debt with international financial intermediaries.
- **Potential Guarantees Involved.** The system manager guarantees payments to the Private Asset Corporation and fleet operators. The e-bus manufacturer guarantees maintenance to the Private Asset Corporation.

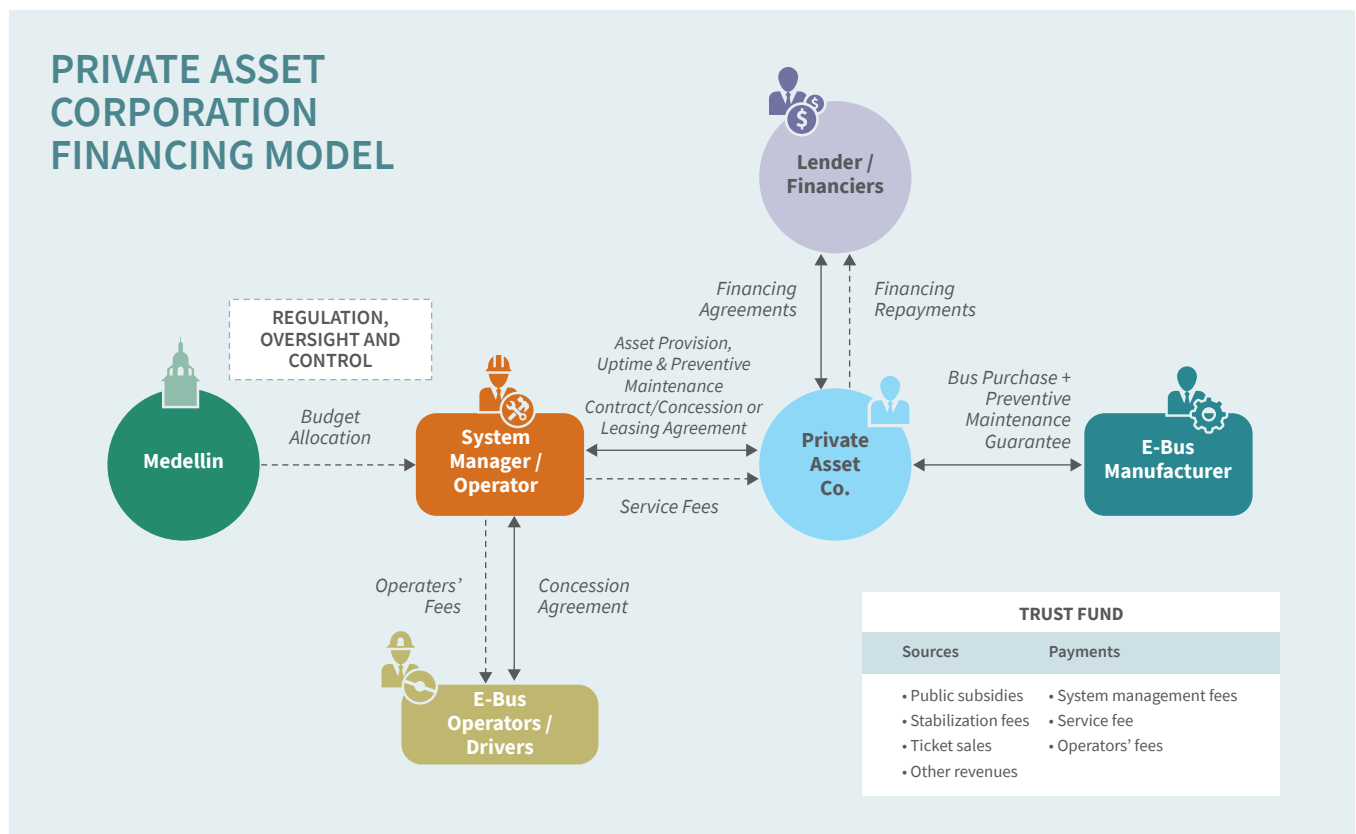


Figure 10: Private Asset Corporation Financing Model.

## Traditional PPP Contracts

Traditional PPP contracts for managing new infrastructure projects are either Build-Operate-Transfer (BOT), Concession, or Build-Own-Operate-Transfer (BOOT). PPP contracts can implement user or government payments. Transfer of assets is subject to the type of contract (e.g. after an agreed period of operation in the case of BOT). In Colombia, PPP contracts must be for less than 30 years and above 6,000 times the current legal monthly minimum wage (*Salario Mínimo Mensual Legal Vigente, SMMLV*).

As shown in *Figure 11*, role and operational considerations for PPP contracts are as follows:

- Private Sector Role.** Service providers/operators may require financial resources to deliver services, in which case a lender/financier could provide financing in multiple forms (debt, equity, etc.). The private company delivers services according to the PPP contract signed with the government, while managing risks and subcontracting some activities if necessary. The private company collects government payments based on the availability of the infrastructure to contractually set levels. If under an Availability Payments arrangement, outputs or results must be measured or verified to trigger payments. There may be a fiduciary agent responsible for managing project funds and payments.
- Public Sector Role.** The city government is responsible for conducting eligibility and value-for-money analyses, as well as project structuring, identifying the most competitive service provider, and effectively managing the PPP contract. The government is also responsible for public service provision, regulating PPP activities, and making timely and reliable payments based on the achievement of results. An external auditor may be hired to supervise the technical and financial execution of the project.

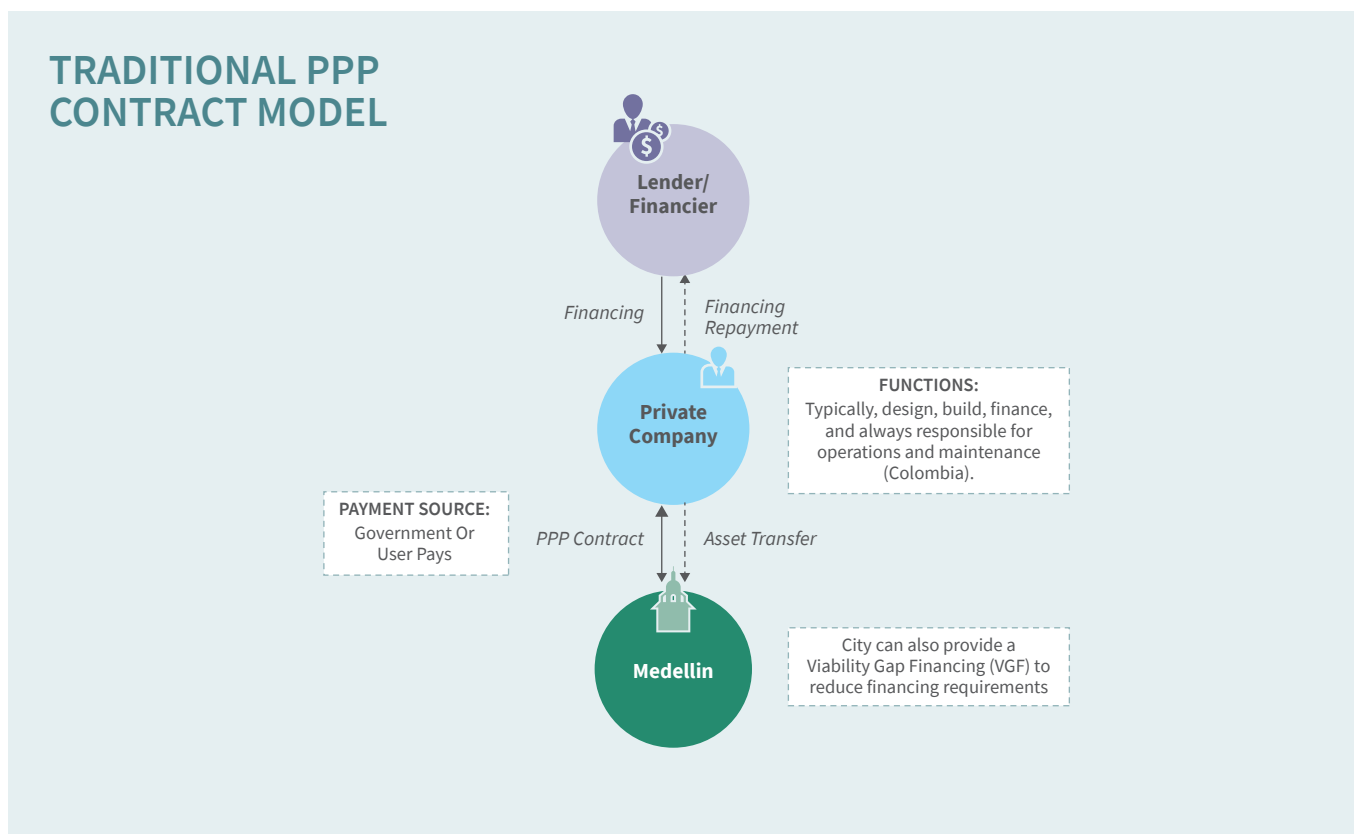


Figure 11: Traditional PPP Contract Model.

## Leveraging Utilities and Tax Collection to Upgrade Private Buildings

This group of measures focus on using public resources, such as taxes and public utilities, to incentivize or support sustainability improvements for privately owned buildings. These investments include efficient water fittings, energy efficiency refurbishment, and renewable energy technologies to upgrade both residential and commercial buildings.

The CIOD identifies three measures that may be undertaken by leveraging local tax and utility systems to facilitate investments, as follows:

- 1. Energy and Water Efficiency Refurbishment & Rooftop Solar PV Program for Residential Buildings.** 50% of existing residential buildings are upgraded with energy efficient appliances and lighting. 55% of existing residential buildings are upgraded with water efficient fixtures. 20% of new and existing residential buildings are outfitted with solar PV systems, equivalent to a capacity of 236 MWp.
- 2. Efficient Water Fittings in Commercial Buildings.** 55% of existing commercial buildings are upgraded with water efficient fixtures.
- 3. Energy Efficiency Refurbishment & Rooftop Solar PV Program for Commercial Buildings.** 50% of existing commercial buildings are upgraded with energy efficient appliances and heating, ventilation, and cooling systems. 20% of new and existing commercial buildings have solar PV systems installed, equivalent to a capacity of 59 MWp.

The total cost of these initiatives amounts to **USD 818 million**. Funding could come from private sector schemes with utility companies that can help overcome the upfront costs associated with energy efficiency upgrades or renewable energy installations, making it easier for customers to invest in clean energy technologies. Two options are outlined below: **On-bill Financing** and **Property-Linked Financing**, also known as **Property Assessed Clean Energy (PACE) financing**.

Rooftop solar panels



Image: Jeroen van de Water on Unsplash

# On-Bill Financing

Utility on-bill financing programs provide an easy option for consumers to invest in clean energy upgrades that may be expensive. The utility company covers the cost of a clean energy upgrade at its customer’s premises (financed as a loan to the consumer), which is collected periodically through the utility bills. Consumer benefits from monthly energy savings. The structure for on-bill financing is shown in *Figure 12*.

There are several potential areas of application for on-bill financing, including energy and water efficiency through technology upgrades, renewable energy supply with rooftop solar, and electric mobility options such as bicycles, motorcycles, and scooters. A case study from Mexico is shown in *Box 4*. Since 2008, Medellin’s utility company, EPM, has been offering a credit line called *Somos* to finance these solutions for residential and commercial buildings. Eligible clients can subscribe to a credit card with non-revolving conditions, allowing them to borrow up to 50 SMMLV for residential or 270 SMMLV for commercial purposes, with repayment terms of up to 120 months at market rates. EPM works with technical partners to offer solutions to *Somos* program beneficiaries. Loans can be provided by EPM or a third party, and a fiduciary trust fund manages the financial resources of the *Somos* program with assistance from DFIs.

The following describe roles and operational characteristics of the on-bill financing mechanism:

- Private Sector Role.** Utility companies may require financial resources from a financier to implement the program, and loans to consumers can also be provided by local financial intermediaries. Contractors and equipment providers are also key participants, as they offer affordable technology and services. Beneficiaries are responsible for timely payments. The payment mode, loan amount, and repayment tenor make this financing scheme a popular choice among households.
- Public Sector Role.** The city can use this model to advance private sector energy transformation, including by offering additional incentives or subsidies to encourage households and businesses to participate. The city can set up partnerships with equipment retailers, such as warehouses, supermarket chains, and construction stores, as well as with financial institutions to help facilitate the financing scheme. The public sector also has the responsibility to regulate and monitor the implementation of the program.

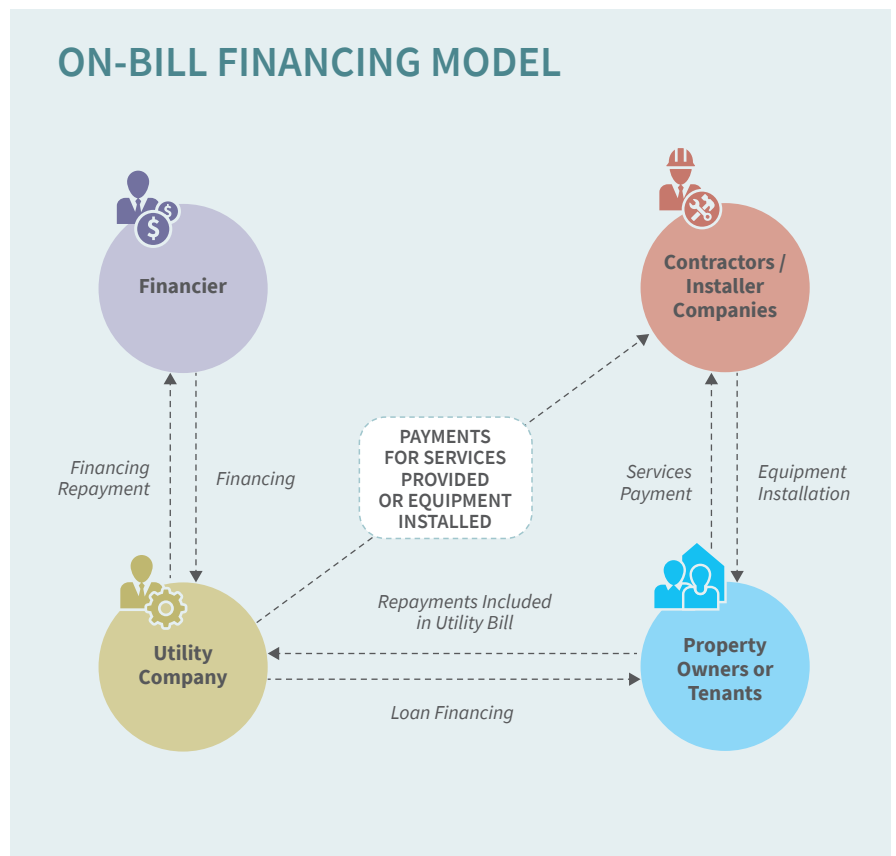


Figure 12: On-Bill Financing Model.

## Efficient Lighting and Appliances Project, Mexico



The Mexican government initiated several energy efficiency programs to replace inefficient lighting and appliances in homes. The programs provided financial incentives to consumers. The Sustainable Light Program replaced incandescent light bulbs with more efficient compact fluorescent lamps in 8 million homes. The *Cambia tu Viejo por uno Nuevo* Program replaced 1,884,129 old and inefficient appliances (approximately 90 percent refrigerators and 10 percent air conditioners) in low-income households. Together, the initiatives avoided 5,074,000 tCO<sub>2</sub>e.



An aggressive media campaign was essential to the project's success. The campaign involved using television, radio, newspapers, and the Internet to raise awareness, as well as targeted promotions during soccer matches. At the peak of appliance replacement, approximately 100 scrapping facilities were in operation, contributing to job creation throughout the country.

Box 4: Case study for on-bill financing from Mexico. Source: World Bank, 2017.

# Property-Linked Financing

Property-linked financing (PLF), also known as PACE in some countries, is a financing mechanism that can support long-term funding for energy efficiency improvements, renewable energy, and water savings in buildings. The loan is attached to the property, not the individual or company that owns the building. PLF is provided to building owners to help pay for the upfront costs, and then loans are paid back by increasing property taxes by a set rate for an agreed-upon term. PLF is processed in a similar way to other local public benefit assessments in cities, such as sewers and sidewalks, and depending on the local legislation, it may be used for both commercial and residential

properties (PACENation, 2016). Property owners begin saving on energy and water costs while paying for improvements, often resulting in net gains even with increased property tax.

The operation of the PLF mechanism involves the building owner and an accredited contractor working together to define specific upgrades, assess investment costs, and estimate energy savings resulting from the improvements. Once these details are established, the building owner submits an application to the PLF administrator for approval. If approved, the lender will disburse funds to the contractor, with complete payment to be received upon completion. After the project

is finished, the owner's property tax increases to reflect the investment made. The PLF process is summarized in *Figure 13*.

Initial recommendations to ensure successful implementation include focusing on non-residential buildings, conducting city-wide pilots involving visible buildings, ensuring independent verification and technical audits, and ensuring that repayments do not exceed the typical annual utility bill savings.

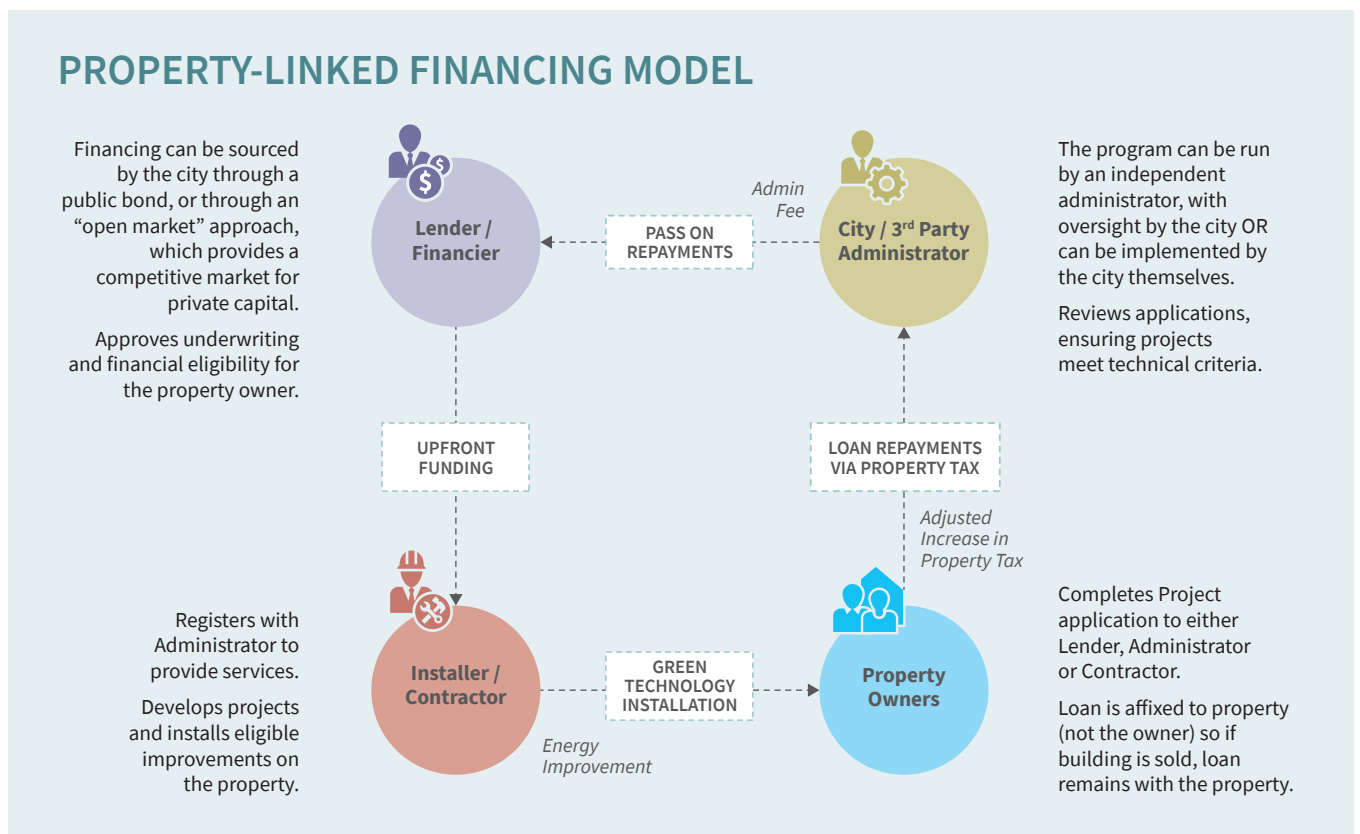


Figure 13: Property-linked Financing Model, also known as Property Assessed Clean Energy.

## Enabling Green Privately Owned Electric Public Transportation

These measures aim to encourage and promote the use of EVs in the public transportation sector by supporting the acquisition and operation of privately owned electric buses, minibuses, and taxi vehicles. The city can play an enabling role

focused on policies, regulations, or incentives that facilitate the transition to electric public transportation, such as providing infrastructure for charging and offering tax incentives for vehicle purchases, among others.

In the CIOD, we analyze two priority measures for privately owned electric public transportation:

- 1. Electric Private Buses and Minibuses.** 877 new electric buses are put into operation, representing 24% of the current private bus fleet, including buses, minibuses, and minibuses.
- 2. Electric Taxis.** 5,650 new electric taxis are added to the fleet, representing 26% of registered taxi vehicles.

The overall cost for the measures is **USD 349 million**, which could be funded through leasing schemes or dedicated lending facilities offered by financial intermediaries. Three financing options being considered are explored in detail: **Leasing Schemes, Unbundling Vehicles and Batteries**, and **Loans Obtained from a Specialized Lending Facility**.

*Electric buses on city streets*



Image: Medellin.gov.co



## Leasing for Private EV Buses and Minibuses

Leasing is the first of two potential financing options for private EV buses and minibuses. Under this option, instead of paying the total cost upfront, the bus operator agrees to pay the leasing entity a specific monthly amount for an agreed period for use of an e-bus. At the end of the lease agreement, the operator could have the option to either return or buy the e-bus. The leasing service covers the full EV package, including the vehicle, battery, and/or charging infrastructure.

The following are considerations for the e-bus leasing model:

- Roles and Operation.** Leasing service providers could be local financial institutions (LFIs), microcredit institutions, utility companies, or EV manufacturers. If potential leasing service providers need capital to acquire the buses and minibuses, financiers will also be part of the model. Under the lease agreements, bus operators and/or associations will take responsibility for the vehicles and batteries, and then pay the agreed fees in exchange. If EV charging is provided separately, third-party entities can be part of the model to supply the necessary infrastructure and charging services. The roles and operations for the e-bus leasing model are shown in *Figure 14*.
- Additional Considerations.** The city can offer various incentives to stimulate e-bus uptake, including tax reductions, parking fee waivers, streamlined license processes, and dedicated e-bus lanes. Leasing payments can include an option to purchase the e-bus at the end of the term, allowing drivers to become owners over time. It is critical to design a collection system for leasing fees based on the local context and e-bus driver profiles.

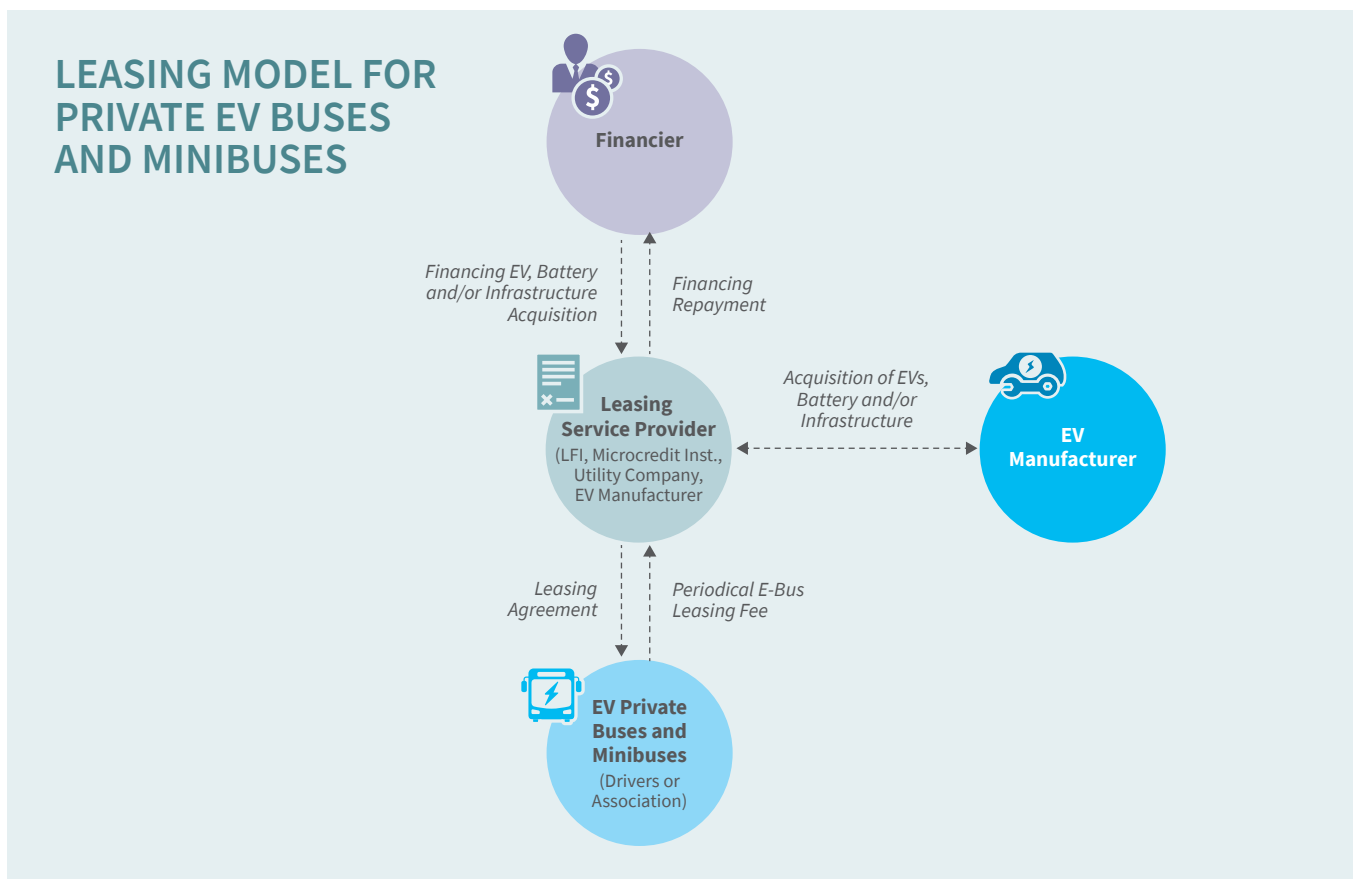


Figure 14: Leasing Model for Private EV Buses and Minibuses.

## Unbundling Vehicles and Batteries

The second financing option for private EV buses and minibuses involves the separation of the asset ownership, including the bus/chassis, battery, and/or charging. This approach facilitates cost and risk sharing. The bus owner/operators acquire the e-bus/chassis through debt financing, and then lease batteries and/or charging infrastructure through third-party asset owners (e.g. LFIs, microcredit institutions, utility companies, or EV manufacturers).

For the unbundling approach, the following are important considerations:

- **Roles and Operation.** DFIs can provide financing to local players, who in turn lend to both drivers to purchase e-buses, as well as third-party asset owners to acquire batteries and charging infrastructure. LFIs, microcredit institutions, and/or EV manufacturers may serve as both debt and leasing providers. Drivers and/or associations purchase the buses, and then lease the batteries under lease agreements, paying fees in exchange. The model is shown in *Figure 15*.
- **Additional Considerations.** Similar to the previous leasing scheme, cities can offer incentives to encourage e-bus uptake, leasing agreements can be structured to include an option to buy the battery over time, and a well-designed fee collection system is critical. By separating asset ownership, upfront costs can be reduced and risks for drivers can be mitigated. The scheme may also require guarantees, such as battery and revenue.

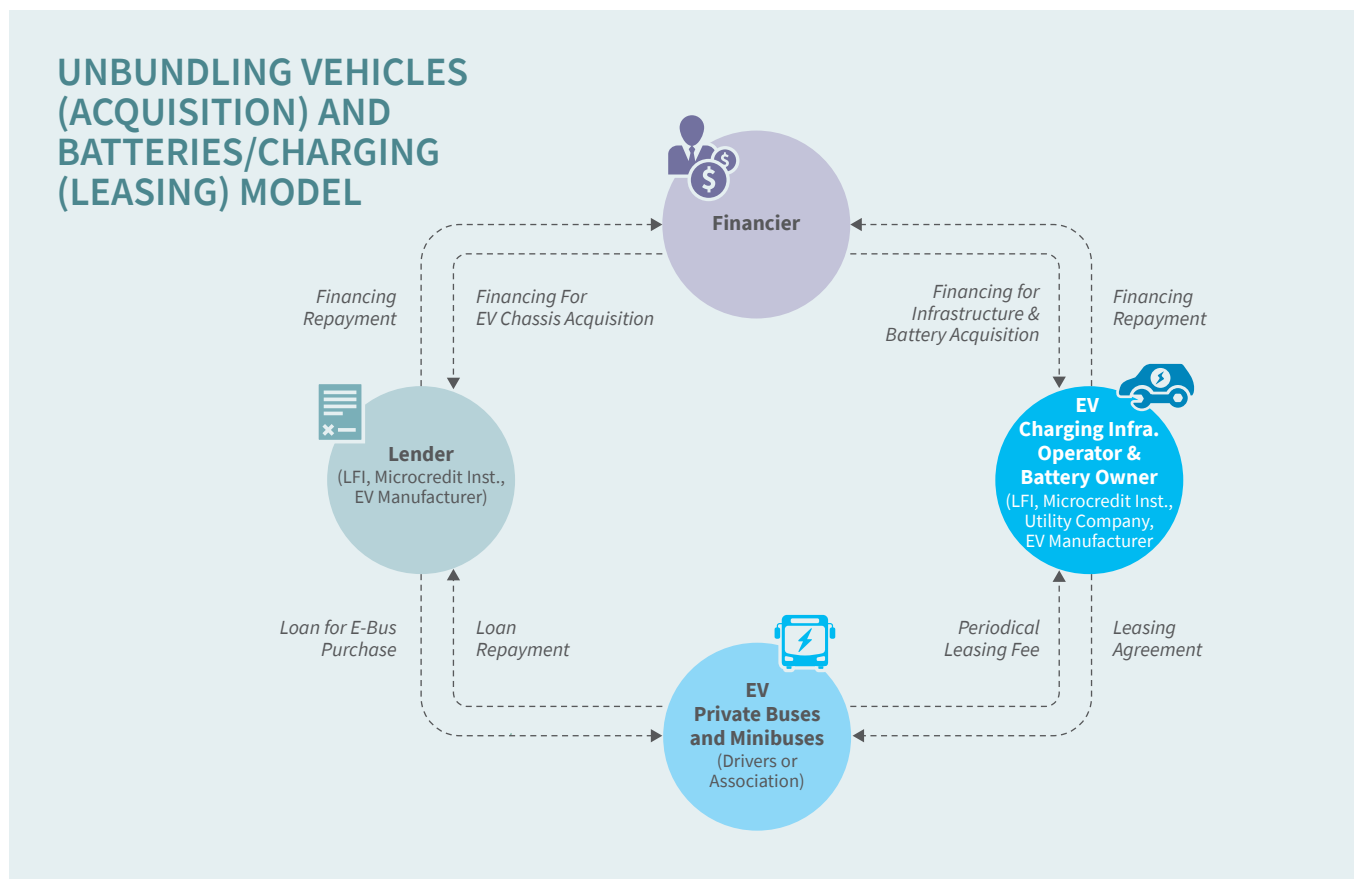


Figure 15: Unbundling Vehicles (Acquisition) and Batteries/Charging (Leasing) Model.

## Loans via a Dedicated Debt Lending Facility

This model involves a dedicated loan product to enable taxi drivers to shift from conventional to electric vehicles. A dedicated lending facility could offer debt financing for the full cost of purchasing an electric taxi, be collateral-free, and have lower interest rates than traditional vehicle loans.

The roles and operation of the model are shown in *Figure 16*. The dedicated lending agency, whether public, private, or combined, may raise funds of different characteristics (e.g. debt, equity, concessional, and others) to lower the cost of loans, and then transfer the benefits to taxi drivers. In partnership with LFIs, DFIs could

help with de-risking through first loss guarantees. The lending agency is responsible for conducting due diligence, disbursing loans, and collecting repayments. A non-profit, third-party organization can play an operational role in running community programs/campaigns to raise awareness about the instrument, identify potential borrowers, and structure and manage lending pipelines. Payback periods should match drivers' earning profiles, and low-interest rates are essential for successful implementation.

Public financial support in the form of concessional finance is

recommended during the initial stages to establish a track record of operations. The city can convene foreign institutions, encourage private participation, facilitate the institutional setup, and provide data for monitoring and assessment. The city can also provide incentives, such as waiving taxicab license fees and offering EV tax abatements.

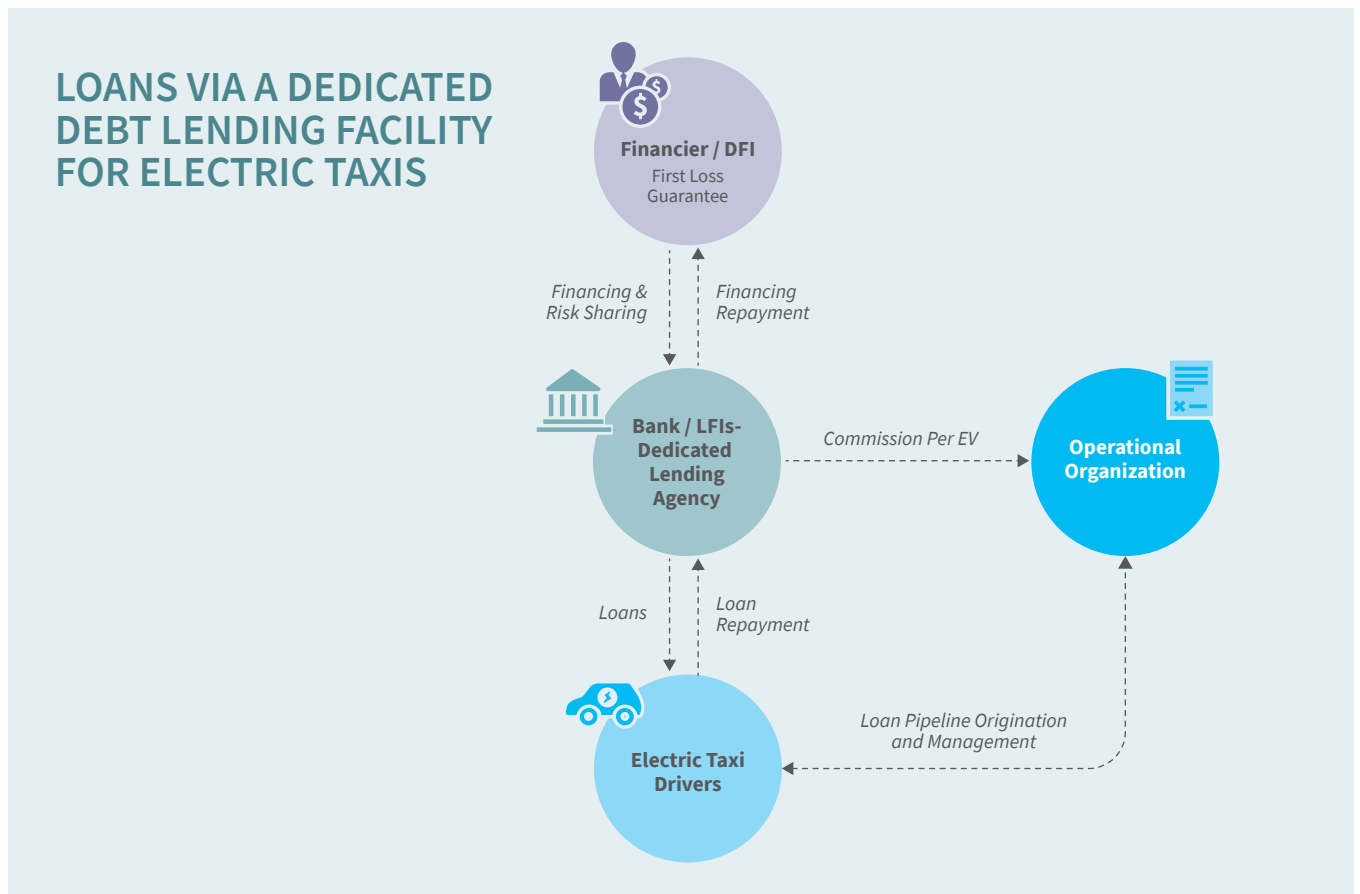


Figure 16: Loans via a Dedicated Debt Lending Facility for Electric Taxis.

## Leveraging Green Private Financing Through Local Intermediaries

Local financial institutions are crucial to low-carbon city development. They serve as a link between private investors and green projects, optimizing the use of private financing to support sustainable development, while promoting the involvement of local communities and businesses in the process. Mobilizing private funding to support climate-smart investments through local intermediaries, such as banks, microcredit entities, cooperatives, leasing operators, or other financial institutions, can finance sustainability initiatives across sectors and in areas such as renewable energy, energy efficiency, electric mobility, and others.

In the CIOD, we consider three measures for leveraging green private financing through local intermediaries:

- 1. Incentivize Green Certification and Water Efficiency in New Buildings.** 50% of new buildings meet green building certification standards, such as IFC's EDGE, defined as 20% energy and water savings compared to typical construction. 25% of new buildings that do not already meet green building standards are constructed with water efficient fixtures.
- 2. Energy Efficiency in Industry and Manufacturing Sector.** Industries implement energy efficiency investments to reduce their energy consumption by 50%<sup>4</sup>.
- 3. Electric Vehicles for Private Consumers.** 27,325 privately owned EVs come into operation, equivalent to approximately 10% of existing private automobiles.

The overall cost of these measures totals **USD 728 million**, all of which would be paid by developers, industries, local businesses, and private consumers. As such, they may be enabled with **Lending Through Local Financial Intermediaries**.

A pedestrian area on Avenida Oriental



Image: Medellín.gov.co

<sup>4</sup>Industrial/manufacturing sectors are not included in APEX. Energy savings from this sector are quantified independently; therefore, they are not included in the overall GHG savings total. Energy efficiency upgrades are costed at USD 0.025/kWh of energy saved.

# Lending Through Local Financial Intermediaries

Banks can offer financing options to buyers looking to purchase electric vehicles, rooftop solar panels, and green homes (mortgages), as well as green building construction finance for developers. These financing options can be paired with other incentives offered by the city.

Box 5 shows the case of rapid scaling of green buildings in Colombia, in which IFC worked with the Colombian Chamber of Construction (CAMACOL) and Bancolombia to support green building construction and mortgage finance. Lessons from this case inform initial recommendations for how the public sector could work with local financial intermediaries to scale up green actions:

- The city can offer green building incentives to encourage voluntary certification that the banks can use to offer green financing.
- The city can endorse a green building certification with third-party verification, such as EDGE, and embed it in the building permitting process as an alternative compliance method to meet and exceed energy and water efficiency codes.
- The city can adopt a variety of incentives to stimulate green building growth in local communities such as regulatory flexibility or benefits for green buildings (i.e. extra floor allowance), expedited or reduced permits, net metering, and lowering parking costs for EVs.
- The city can partner with local banks to help them launch a green buildings and EV financing investment programs via public advocacy campaigns, technical assistance for developers, and capability-building programs.
- DFIs could offer financing for banks, along with risk sharing facilities with potential blended finance, to scaling up low-carbon public and private investments.

## CASE STUDY

### Rapid Scaling of Green Buildings in Colombia



In Colombia, IFC worked with policymakers and the leading industry association, CAMACOL, to create the right context for IFC client Bancolombia to launch green finance in 2017. Bancolombia held 17 events with 500 developers, supported by a major marketing push and training for loan officers. IFC invested USD 115 million in the first green bond in Colombia. Proceeds supported green building construction and mortgage finance. Within four years, certified green buildings reached 20% of annual new building construction.

As of June 2022, 5 local banks were offering green building finance products. Approximately USD 9 billion worth of floor space has been green certified. Of the 114,000 homes certified, 60% is affordable housing. Homeowners save up to USD 20 per month in utility bills. In August 2022, IFC provided a USD 200 million loan to one of the largest banks in the country, BBVA Colombia, to support net zero carbon ready homes.



**Box 5:** Case study showing how local financial institutions enabled the rapid scaling of green buildings in Colombia. Source: Andrade, 2021; IFC's EDGE data.

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## APEX

An innovation of IFC, APEX supports cities in emerging economies to accelerate the implementation of ambitious and transformative policy actions and investments that significantly contribute to transitioning to low-carbon and resource-efficient growth pathways. The platform leverages the APEX Online App, which helps cities to quickly assess the most cost-effective ways to incorporate measures into their investment and policy pipelines.

[www.apexcities.com](http://www.apexcities.com)

## IFC

IFC is a member of the World Bank Group that focuses on private sector development. Working with partners in more than 100 emerging markets, IFC invests, advises, and mobilizes resources from others, creating opportunity for clients in a broad range of industries. Standing between the public and private sectors, IFC brings market-based solutions to respond to the challenge of creating low-carbon economic growth.

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