

Accelerating a market transition in Latin America: New business models for electric bus deployment

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INTRODUCTION

CONTEXT

This report was commissioned by Partnering for Green Growth and the Global Goals 2030 (P4G) to support the Zero Emission Bus Rapid-Deployment Accelerator (ZEBRA) with its goal of accelerating the transition to zero emission buses across Latin American cities. Today, there are many doubts and questions about how to finance this transition, given the high upfront cost of electric buses (“e-buses”). Therefore, this report aimed to develop concrete financing and commercial models that investors, bus operators, manufacturers, and governments can implement together. The report draws from consultations with 50+ stakeholders, in-depth financial modelling, and extensive desk research. As part of the report, we also developed a dynamic tool that cities can use to estimate the financials of transitioning to e-buses under various scenarios. C40 Cities and the International Council on Clean Transportation (ICCT) oversaw the development of this report.

ACKNOWLEDGEMENTS

We would like to thank the many bus operators, government officials, investors, e-bus manufacturers, and other experts who helped create this report. We would also like to recognize the contributions from:

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ABOUT THE AUTHORS



P4G—Partnering for Green Growth and the Global Goals 2030—is an initiative launched in 2018, with the ambition of becoming the world’s leading forum for developing concrete public-private partnerships at scale to deliver on the UN Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change. We bring together business, government, and civil society organizations in innovative partnerships to advance solutions to help meet humanity’s greatest needs in five key areas: food and agriculture (SDG2); clean water and sanitation (SDG6); affordable clean energy (SDG7); sustainable cities (SDG11); and circular economy (SDG12). www.P4Gpartnerships.org



The Zero Emission Bus Rapid-deployment Accelerator (ZEBRA) is a partnership funded by P4G that aims to accelerate the deployment of zero emission buses in major Latin American cities by overcoming political, technical, market and financial barriers. The ZEBRA partnership is co-led by C40 Cities and the ICCT with additional support from the Centro Mario Molina-Chile and the World Resources Institute.

Dalberg

Dalberg is a global group working to build a more inclusive and sustainable world where all people everywhere can reach their fullest potential. Dalberg partners with and serves communities, governments, philanthropic institutions, and companies throughout the world, providing an innovative mix of advisory, investment, research, analytics, and design services. A Dalberg team from the Mexico City office supported the development of this report.



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EXECUTIVE SUMMARY (1/4)

E-bus context: What is the opportunity for e-buses in Latin American cities?

Electric buses (“e-buses”) are gaining traction in public transportation systems across Latin America. For example, Santiago will have over 400 operational e-buses by the end of 2019 and Medellín is integrating 64 units into its Metroplus Bus Rapid Transit (BRT) system. This nascent transition away from diesel fleets can—and is starting to—deliver positive social, economic, and environmental impact.

There is not only an impact case to transition to e-buses, but also a business case. While e-buses have higher upfront costs (~2-3 times a comparable diesel bus, depending on model), they deliver savings via lower maintenance and fuel costs. As a result, e-buses can potentially have a lower total cost of ownership (TCO) than diesel buses. Yet commercial and financing models that exist today for diesel buses are not well-suited for e-buses, as they favor low upfront costs and disregard operational cost savings. Therefore, commercial models need to be adapted to accelerate e-bus scale-up.

Bus operator landscape: What are current bus operator business models?

Today, five “archetypal” bus operator business models are most common in Latin America. These business models vary by which assets are in the system (e.g., buses, terminals, stops), who is responsible for various aspects of ownership/ operations/maintenance/scrapping, and how these assets and activities are financed and funded. These business models include (A) vertically-integrated private operators in BRT/integrated system; (B) divided responsibilities in BRT/integrated system; (C) large, more formal, private operators in traditional service; (D), small, informal, private operators in traditional service; and (E) government-run systems. Across these models, it is common for the same actor (e.g., government, private operator) to own and operate bus assets.



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EXECUTIVE SUMMARY (2/4)

In general, private and public operators within more formalized and integrated bus systems are most “ready” to transition to e-buses—as strong planning, governance, financial contracts and guarantees, and infrastructure underpin viable commercial arrangements. These operators include private and public operators within models A, B, E—who often have access to city-level guarantees and sometimes subsidies—as well as more established private operators in model C. Yet to transition to e-buses, these operators must overcome key financial challenges of accessing upfront capital, mitigating the operational risk of switching to a new technology, and guaranteeing repayment to investors, amongst others.

Solutions & investment opportunities: What are options to transition to e-buses & investments to support this?

There are two promising commercial arrangements that can increase viability of e-buses by better tailoring financing and shifting asset ownership responsibilities. First, engaging different capital providers (e.g., multilateral development banks) provides an opportunity to tailor financing to better match the expected cash flows of an e-bus. Second, changing who owns the e-bus components (e.g., bus, battery, charging station) not only provides an opportunity to mobilize capital, but also to better distribute risks between asset owners and operators. At a high-level, these two arrangements include:

- **Concessional finance for asset owners.** This solution focuses on adapting standard fleet renewal financing to enable operators to purchase e-bus components. Specifically, concessional financing provided by MDBs or other development finance institutions (DFIs) via financial intermediaries (e.g., local banks) would have longer duration (e.g., >10 years), grace periods—and initially—lower interest rates (several percentage points lower than commercial rates, depending on the market). After proof-of-concept, first-loss concessional financing could de-risk commercial investment, enabling further replication and scale-up of this solution via blended finance.



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EXECUTIVE SUMMARY (3/4)

- **Separation of asset ownership.** This solution focuses on transferring ownership of e-bus assets—charging infrastructure, batteries, and/or buses—to new players who have capital available to make upfront investments. Operators would then lease e-bus components from these asset owners. This mitigates upfront costs for operators and distributes risk across actors, as demonstrated by current model in Santiago with Engie, Enel, and private operators.

Success of both arrangements hinges on mitigating financial risk (e.g., operator repayment)—amongst other types—via revenue guarantees, credit guarantees, first-loss capital, or other mechanisms discussed further in the report.

Modelling potential solutions: How could potential solutions be applied in CDMX and Medellín?

The most appropriate commercial arrangement will vary based on the city and the operator business model.

Operators want to have options and to understand the pros, cons, and financials of each. Therefore, we have modelled three scenarios—(1) concessional finance for asset owners, (2a) separation of asset ownership (bus, battery, charging), (2b) separation of asset ownership (battery and charging only)—for operators in two cities: Mexico City and Medellín.

- **Mexico City: The Metrobus BRT system presents the most near-term opportunity to accelerate the scale-up of e-buses.** While Metrobus is a small portion of CDMX's total bus fleet (~700/22,300), its operators are most “ready” to transition and provide an important demonstration effect. For Metrobus, early analysis suggests the most promising commercial arrangement is dividing responsibilities between asset ownership and operations. Specifically, the Metrobus fideicomiso (city-level trust) would lease all e-bus components from a third party asset owner, rather than paying for operator credits to purchase new buses. Metrobus would also continue to pay operators (e.g., by kilometer) to operate these assets. Success of this solution hinges on extending Metrobus contracts beyond 10 years (ideally to 15 years) and leveraging the fideicomiso to execute operating leases.



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EXECUTIVE SUMMARY (4/4)

- **Medellín:** The ~60 private operators within the Sistema de Transporte Público Colectivo (TPC) present a **large—but difficult—untapped opportunity to accelerate e-bus transition.** While Metroplus (the government-run city BRT) has already begun to transition its fleet, the TPC operators represent 92% of the market (~6,000 total in the metropolitan area, ~3,800 in the city) and face considerable challenges to access e-buses (e.g., most notably, lack of government guarantees). Given the large variability of TPC operators’ “readiness,” it is important to identify and engage the more formal, creditworthy companies and help transition a part of their fleets. This could involve battery leasing from a manufacturer to reduce upfront costs and concessional financing to operators to purchase the e-bus chassis (e.g., via a line of credit a national development bank, Findeter, is developing). A key enabler of this solution will be increasing government financial support and developing a mechanism to ensure operator repayment (e.g., creating a guarantee fund or insurance product). After proof-of-concept, this solution could be scaled to other TPC operators as they formalize their businesses; it could also support the two Sistema Integrado de Transporte del Valle de Aburrá (SITVA) concessionaires, one of which has already purchased four e-buses.

The path forward

Next steps to move these commercial arrangements forward include securing buy-in from key partners and investors, further developing each arrangement, and strengthening the enabling environment. For Mexico City, this will require testing commercial arrangements with Metrobus, selecting one, and completing additional technical and design work to launch. Key enablers to explore include longer concessions (15 years) and tax exemptions for e-buses. In Medellín, it will be critical to identify and engage ~4-5 operators and work with financial institutions to create lines of credit and an associated guarantee fund. In both cities, efforts to engage/educate operators and correct key “e-bus myths” will remain critical. Lessons based on initial rollout can then shape efforts with other operators in each city—and beyond.



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What are options to transition to e-buses & investments needed to support this?

MODELLING COMMERCIAL ARRANGEMENTS

How could potential commercial arrangements be applied in CDMX and Medellín?

PATH FORWARD

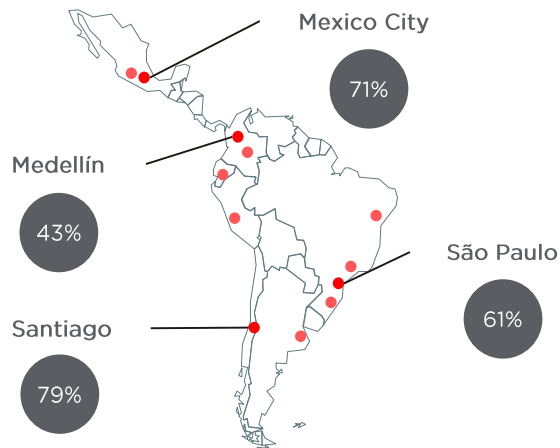
What are key next steps?



Transportation is a major source of global and local air pollution in Latin American cities

Emissions from transportation¹

% of greenhouse gas (GHG) emissions, estimated 2017



- In addition to GHG, urban buses are estimated to produce **one-quarter of all black carbon emissions**²
- Transport also increases concentration of other particulate matter (e.g., PM_{2.5}), which has health effects

Estimated impact of local & global pollution:

- Health impact: Local outdoor air pollution (e.g., particulate matter) causes cardiovascular disease, asthma, other respiratory diseases, and cancer, amongst other health problems. Pollution kills 7 million people annually,³ and Mexico City is the urban center with the fourth highest number of transportation-attributable air pollution deaths in the world⁴
- Economic impact: Health impacts of air pollution are estimated to cost more than 4% of GDP in 15 countries with largest GHG emissions³
- Environmental impact: GHGs have warming impact; black carbon has warming impact 900 to 3,200 times that of carbon dioxide²

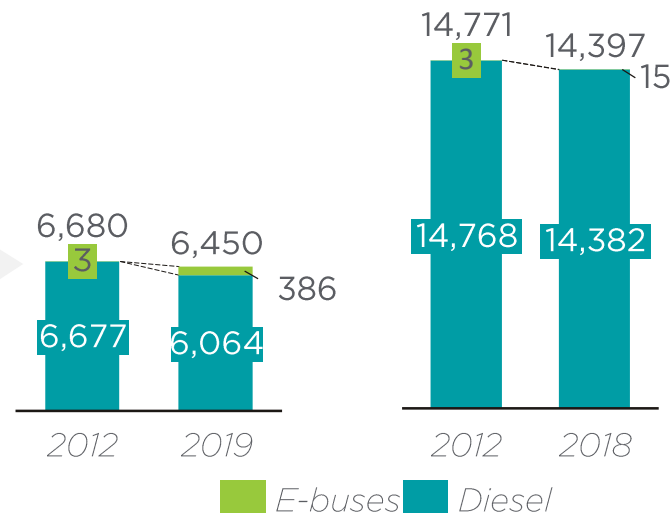
Public transport improves urban sustainability and efficiency, which electric mobility can further increase

- Buses have lower carbon dioxide emissions per passenger than private cars, on average¹
 - However, most bus fleets in Latin America today are older and use diesel fuel—driving global and local pollution
 - Cities therefore have opportunity to further “green” their public transport systems via transition to e-buses
- Santiago has made the most progress when it comes to e-buses in Latin America, relative to its total bus fleet size, but e-buses still only represent less than 5% of its bus fleet (see detailed case study in annex)
 - São Paulo, like other cities in Latin America, has integrated e-buses as part of a pilot program, but is yet to scale
 - In both cities, the total number of buses has decreased over time, as cities address surplus of buses and enforce regulations for integration, formality, and scrapping

Case studies: Santiago and São Paulo

Santiago bus fleet³
of buses

São Paulo bus fleet⁴
of buses



Cities have made commitments and/or started to integrate e-buses (1/2)

Signed C40 Green and Healthy Streets Declaration



Commitment only

Pilot or testing

Scaling post-pilot

Summary of advances in adopting e-buses¹ – *not comprehensive*

ZEBRA focus cities

Medellín

The municipality has committed to electrifying 100% of the city's bus fleet by 2030. A national law passed in 2019 (Ley 1964) promotes vehicle electrification (e.g., through tax breaks). Metroplus, the Bus Rapid Transit (BRT) public body, recently ordered 64 e-buses from BYD, following successful pilot since 2017. Masivo de Occidente, a private operator and concessionaire of SITVA feeder lines, has ordered four e-buses and plans to order eight more next year²



Mexico City

Plans to procure only no-emission buses starting in 2025, in line with the C40 declaration. Servicio de Transportes Eléctricos (STE), a public entity, operates 290 trolleybuses and developed a plan to make a zero-emission corridor in 2016 (Eje 8), but the plan has stalled³



Santiago

Began transitioning Transantiago's (BRT) bus fleet to electric in 2016. Today, it has the largest fleet of e-buses in Latin America (and outside China) with almost 400 buses. Enel and Engie own and lease the e-buses and infrastructure to private operators⁴



São Paulo

Passed law mandating progressive reduction in bus emissions over next 20 years;⁵ BYD delivered 15 e-buses at the end of 2018 for a pilot; buses and solar panels were produced in BYD's Brazil factory in Campinas⁶



Bogota

Released tender in July 2019 to acquire 594 e-buses for the Sistema Integrado de Transporte Público (SITP), which was later voided.⁷ Another tender is ongoing, but not exclusive to e-buses



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Notes: 1. For this, and future pages, "e-bus" only refers to battery electric buses. 2. BYD, "BYD to Provide Colombia's Largest Pure-Electric Bus Fleet," 2019. 3. C40, "Mexico City," 2019. 4. Red Metropolitana de Movilidad, "100 nuevos buses eléctricos se sumarán a Red Metropolitana de Movilidad," 2019. 5. Tim Dallman, "Climate and Air Pollutant Emissions Benefits Of Bus Technology Options In São Paulo," 2019. 6. Metro Report, "BYD electric buses delivered to São Paulo," 2018. 7. Electrek, "Bogotá, Colombia to add nearly 600 electric buses in 2020, makes claim for largest fleet in Latin America," 2019.

Cities have made commitments and/or started to integrate e-buses (2/2)

Signed C40 Green and Healthy Streets Declaration



Commitment only

Pilot or testing

Scaling post-pilot

Summary of advances in adopting e-buses – *not comprehensive*

Buenos Aires	Currently piloting Yutong e-buses for one year; two are in operation. ¹ Depending on the results, plans to procure 350 e-buses at the end of the eight-bus pilot ²	●
Curitiba	Through a partnership with Portugal, accessed three electric mini-buses in 2014 and has operated them since then ³	●
Guadalajara	Metropolitan area government wants to electrify Peribus (BRT system), which connects Guadalajara to wider metropolitan area ⁴	●
Lima	Running a pilot with one 12-meter e-bus to obtain real data related to costs and operations in an attempt to eventually fully electrify its bus fleet, with the support of Enel ⁵	●
Quito	Is currently testing one articulated 18-meter e-bus and one 12-meter e-bus—and is planning for the electrification of the entire bus fleet operating in Ecovia (BRT corridor) ⁶	● ★
Rio de Janeiro	Took part in the Hybrid and Electric Bus Test Program to make the case that clean buses can perform as well as diesel buses, within a reasonable payback period. ³ The city is also studying health benefits of electrifying its BRT and entire bus system, with support from C40	● ★
Salvador	Currently testing a BYD bus to measure its performance in the city ⁷	●



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Notes: 1. Argentina.gob.ar, "Ya circulan los primeros buses eléctricos en la Ciudad de Buenos Aires," 2019. 2. China Daily, "Chinese electric buses begin trial operations in Buenos Aires," 2019. 3. WRI, "Brazilian cities search business models to make clean buses viable," 2017. 4. Stakeholder interview, 2019. 5. Enel, "The electric bus arrives in Lima to revolutionize public transport," 2018. 6. C40, "Quito Electric Bus Corridor," 2017. 7. Diario do Transporte, "BYD 100% electric bus begins to be tested in Salvador, says city hall," 2019.

However, a range of policy, technology, and financial barriers are impeding scale-up

Policy



- **Variable support from city and national governments to deploy e-buses.** For example governments that are not flexible to update bus procurement mechanisms that benefit diesel buses (e.g., only take into account upfront costs)
- **Varying knowledge of potential purchasing models to access e-buses.** This includes unclear or non-existent roadmaps of how to access e-buses, besides purchasing upfront

Technology



- **Perception of lack of readiness of e-buses to replace conventional buses.** While e-bus technology has been tested, some cities and operators remain uncertain about its capabilities under certain conditions (e.g., weather, traffic, topography); careful planning of routes and charging stations is also needed
- **Misinformation about technology.** There are knowledge gaps and inaccurate expectations (e.g., that battery prices are guaranteed to decline), creating aversion to adopt e-buses as a “first mover”

Finance



- **High upfront asset costs** (e.g., 2-3x a diesel bus)
- **Access to and cost of financing**, given some operators have limited credit history, and some (but not all) consider current financing options for fleet renovation expensive—compounded by high upfront costs
- **Few financial guarantees outside of govt-backed systems**, creating challenges for operators in traditional service to de-risk operations & access financing
- **Infrastructure, including charging, requires considerable investment** from gov or other players

Focus of this report

Despite financial barriers, the potential lower total cost of ownership (TCO) of e-buses presents a business case

Upfront costs and financial risks



- **Fleet renovation costs** – e-buses can cost 2X to 3X more than a diesel bus, depending on their size;¹ for example, a ~8m diesel bus costs ~USD 80,000, while an e-bus costs closer to ~USD 150,000²
- **Charging infrastructure** – use of e-buses requires infrastructure, which can cost ~USD 20,000 - 25,000 per bus²
- **Risk of losses in transitioning phase** – during the initial integration of e-buses, operators could suffer losses as they learn to operate and maintain the new technology

Total cost of ownership



- **Maintenance costs** – estimated to be around 50% to 70% higher for diesel buses than e-buses, annually¹
- **Energy costs** – on average, the cost of the electricity required to cover a distance is significantly lower than the cost of the diesel or CNG required to cover the same distance. For instance, a bus manufacturer estimates that the annual electricity expenses for a 12-meter bus are a fourth of the required diesel costs⁴
- **Bus replacement** – because of emissions, many cities recommend replacing diesel buses every 10 years – though this is not always enforced. E-buses do not produce tailpipe emissions and can operate for 15 years for chassis/body and eight years for batteries⁵

This highlights the need to explore, identify, and develop commercial and financing models to support e-bus transition



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Notes: 1. ICCT, "Financing the Transition to Soot-Free Urban Bus Fleets in 20 Megacities," 2017. 2. Data points from Medellín. 3. BNEF "Electric Buses in Cities," 2018. 4. Proterra, "Financing your electric bus," accessed September 2019. 5. Stakeholder interviews, 2019.
Sources: Stakeholder interviews, 2019; ICCT, 2017; BNEF, 2018

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- What are current bus operator business models?
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MODELLING COMMERCIAL ARRANGEMENTS

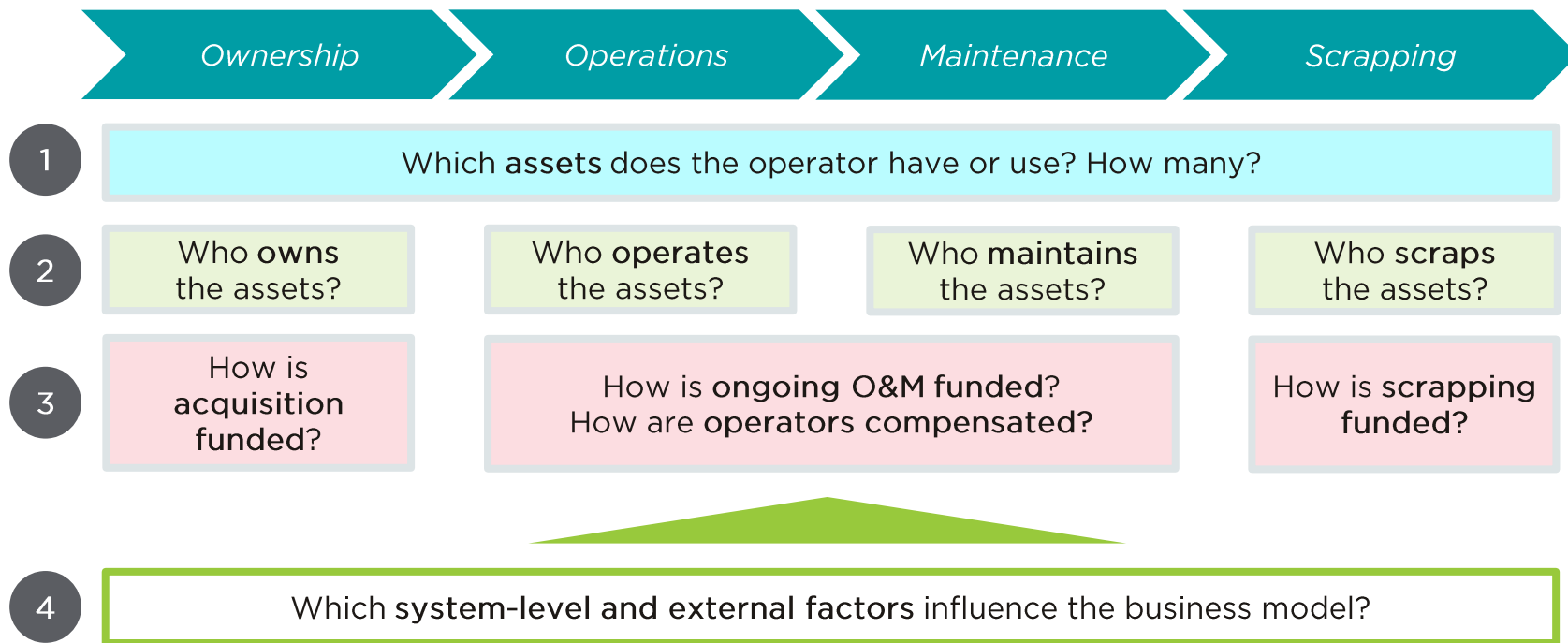
How could potential commercial arrangements be applied in CDMX and Medellín?

PATH FORWARD

What are key next steps?



We explored several questions to characterize bus operator business models



We identified five types of bus operator business models¹...

Examples

A	Vertically-integrated, private operator in BRT/integrated system		Private actor owns, operates, and maintains buses via public concession; public transport authority oversees shared infrastructure
B	Divided responsibilities in BRT/integrated system		Public sector or private actor (via public concession) owns buses; another private actor operates and maintains buses via other public concession
C	Large, more formal, private operator in traditional service		More formal company owns, operates, and maintains buses in traditional transport service via permit or shorter-term public concession, with less oversight from government
D	Small, informal, private operator in traditional service		Individual owns, operates, and maintains small bus fleet in traditional transport service via permit or shorter-term public concession, with less oversight from government
E	Government-run system		The government owns, operates, and maintains buses and associated assets; there is little participation by the private sector



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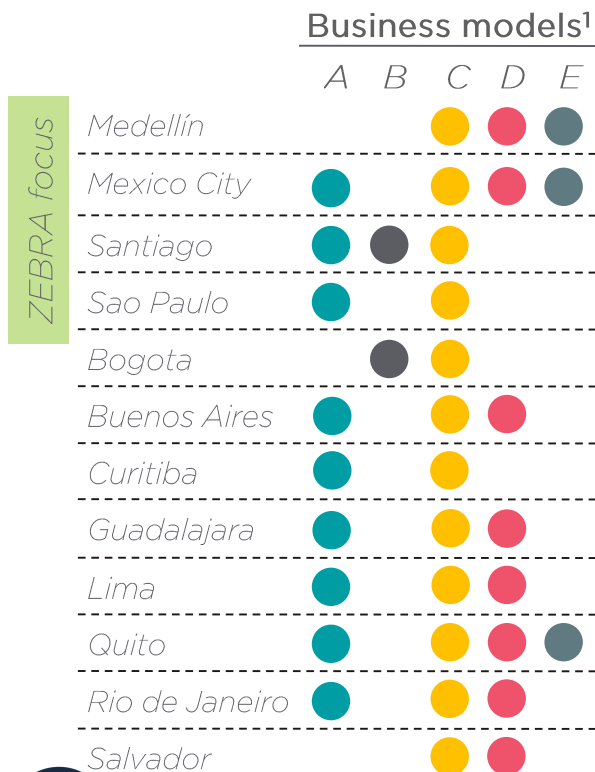
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Notes: 1. These are higher-level business models. Many differences exist within each business model across cities and operators.

...which vary in terms of assets, responsibilities, and funding

Model	1 What are the assets?	2 Who is responsible?				3 How are activities funded?	
	Fleet size ¹	Ownership	O&M	Scrapping ²	Oversight and control	Financial risk mitigation	O&M – remuneration scheme
A	Large	Private operator	Private operator	Private operator per BRT entity regulation	Govt sets routes, fares, schedules, and fleet specifications via concessions	BRT trust	By kilometer; sometimes by passenger (e.g., Rio de Janeiro)
B	Large	Govt or private third party	Private operator	Govt or private third party	Govt sets routes, fares, schedules, fleet specifications via concessions; sometimes owns buses	BRT trust	By kilometer; sometimes by passenger
C	Medium – large	Private operator	Private operator	Private operator but not always enforced	Govt assigns routes and sets fares via concessions or permits	Sometimes city-level trust or other guarantees	By passenger
D	Small	Private operator	Private operator	Private operator but low enforcement	Govt assigns routes and sets fares via permits	None	By passenger
E	Medium – large	Govt	Govt	Govt	Govt controls and owns entire system	Govt budget	By kilometer or by passenger ³

Vertically-integrated BRT systems and traditional service operators are most common across Latin American cities



- Across cities, transportation agencies assign the majority of ownership/operations/maintenance responsibilities to the private sector
- All cities besides Salvador (which is developing one corridor) have developed Bus Rapid Transit (BRT) systems
- Apart from Brazil, informal traditional service operators are common across cities; these smaller operators compete in the same routes without defined schedules (often leading to over-supply)
- In recent years, cities have worked to formalize their bus systems by incentivizing small operators to unite and form consortiums, like in Sao Paulo, Bogota, and CDMX Metrobus
- Vertical BRT (A) and divided BRT (B) are most relevant for transition to e-buses
 - Government (E) is also relevant, but fewer models exist
 - Readiness of large traditional (C) varies by city
 - Small, traditional players (D) are least ready

Operators within each business model face distinct barriers to e-bus adoption

BUSINESS MODELS




Degree of barrier

● High ● Moderate ● Low

MAIN BARRIERS

A. Vertically-integrated BRT
B. Divided responsibilities BRT
C. Formal operator in traditional service
D. Informal operator in traditional service
E. Gov-run system

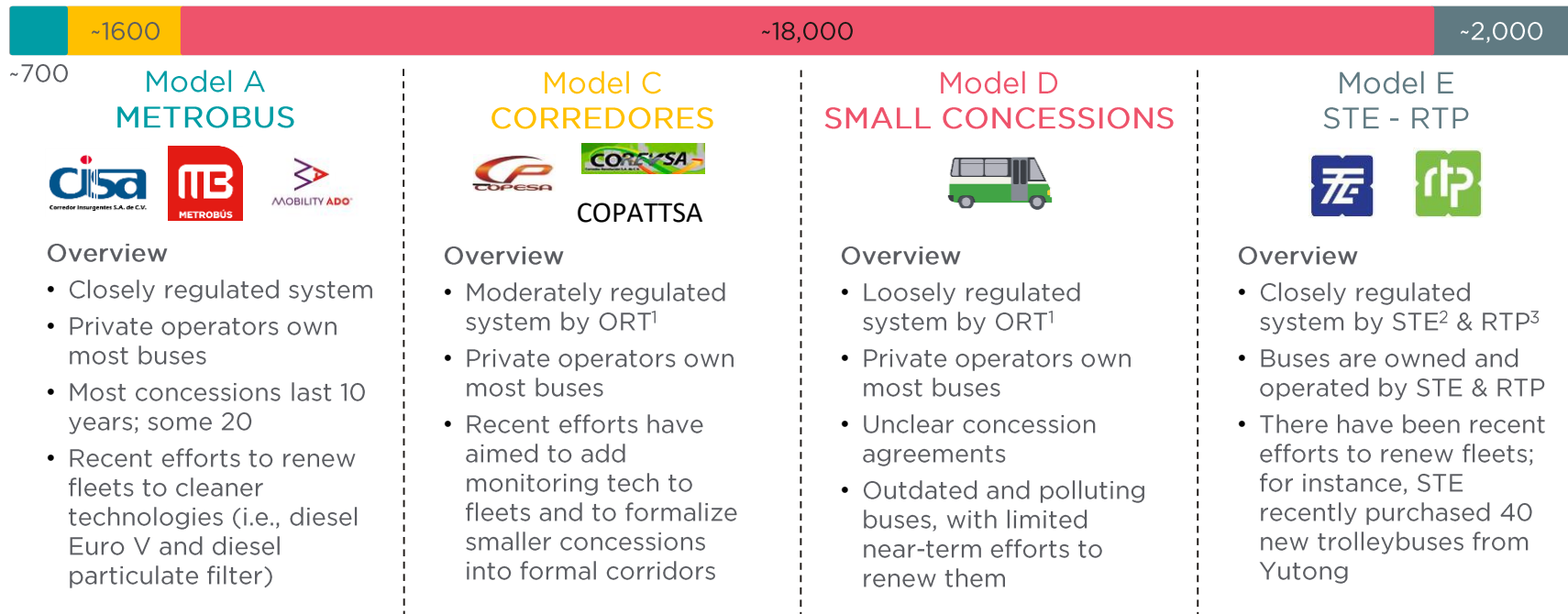
Focus for study

 Finance ¹	High upfront asset costs	●	●	●	●	●
	Access and cost of financing	●	●	●	●	●
	Limited access to financial guarantees to de-risk operations	●	●	●	●	●
	Limited investment in infrastructure	●	●	●	●	●
 Policy/ gov	Limited support from govt to deploy e-buses	●	●	●	●	●
	Limited knowledge of potential purchasing models for e-buses	●	●	●	●	●
 Technology	Perception of lack of readiness of e-buses to replace conventional buses	●	●	●	●	●
	Misinformation about technology	●	●	●	●	●

Mexico City has four bus models, with varying levels of formalization and government oversight

Market share of business models

of units, out of ~22,300 total



Spotlight: CDMX Metrobus operator

POTENTIAL OPPORTUNITIES FOR E-BUSES

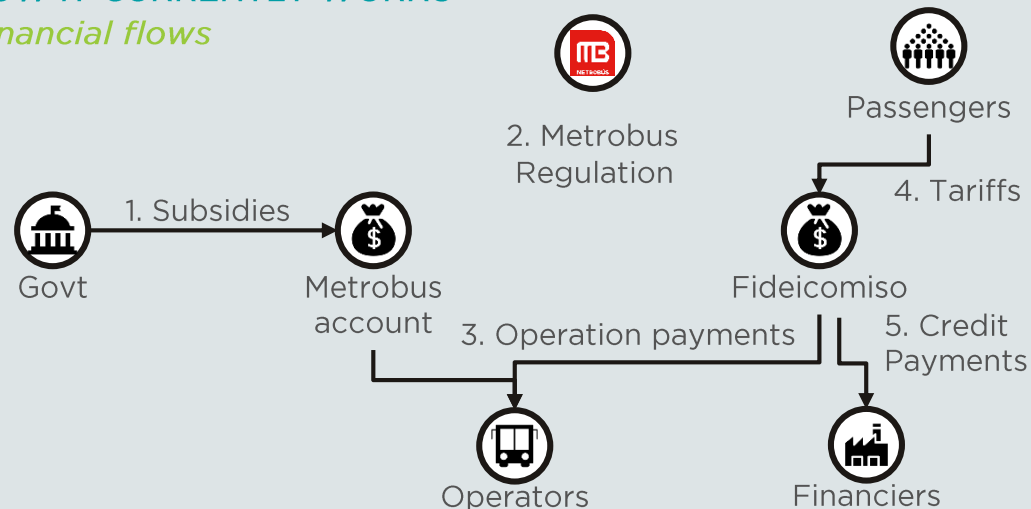
- Currently undergoing the process of updating the first fleet of buses to cleaner technologies
- Interest from the city govt and operators in e-buses, including visits to Santiago to learn about their work with Engie
- E-buses pilots are taking place already

MAIN BARRIERS FOR E-BUS ADOPTION

- Uncertainty around the technology and impact of operators, particularly the battery's performance, lifetime, & disposal
- Operators do not want to buy buses from manufacturers that do not have a strong local presence (i.e., Chinese brands), as they will not be able to provide quality after-sale support
- Metrobus procurement and operating terms do not benefit e-buses; e.g., procurement is done based on upfront costs

HOW IT CURRENTLY WORKS

Financial flows



Description of financial flows

1. Subsidies provided by the govt to Metrobus go into a Metrobus account
2. Metrobus manages and regulates all of the system and its payments
3. Payments from the Metrobus account only pay operators for kms. operated
4. Passenger tariffs go into the fideicomiso. Disbursements from the fideicomiso are paid in the following order: payments per kms. operated, credits for fleet renewal, and other administrative costs
5. Operators, Metrobus, and manufacturers negotiate purchase and payments of buses. After negotiations, bus credits are paid directly from the fideicomiso. Operators usually pay 20% of buses upfront, and the fideicomiso pays a credit of 80% of the bus for six years, discounted from operators' operations – which means last four years are more profitable

Medellín has gov-run BRT and range of private operators that vary by scale and level of formalization

Market share of business models

of units, out of ~6,440 total

~5,930

~370

~140

Model C / Model D 60 PRIVATE OPERATORS



Overview

- Regulated by the Secretary of Mobility & AMVA;¹ operators have permits with no end date
- Many buses are Euro V, some VI²
- Range from larger companies (e.g., ~70 buses) to small owners in cooperatives/associations
- Some are integrated into common payment system

Model C 2 CONCESSIONAIRES



Overview

- Two private operators have concessions as Metroplus feeder lines
- They have access to the Fondo de Estabilidad de la Tarifa (FET), which guarantees their revenues
- They have CNG buses, and Masivo de Occidente is procuring ~12 electric buses

Model E METROPLUS



Overview

- Closely regulated and operated by government institutions (i.e., Metro de Medellín)
- All assets are owned by public institutions: Metroplus, Metro de Medellín, and the city
- Fleet consists of 74 CNG buses and 64 e-buses (starting Oct. 2019); e-buses purchased from BYD via an open tender, financed upfront by city funds



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Notes: 1. Área Metropolitana del Valle de Aburrá. 2. We do not have detail on exact breakdown.
Sources: Stakeholder interviews, 2019

Spotlight: Medellín TPC operator

POTENTIAL OPPORTUNITIES FOR E-BUSES

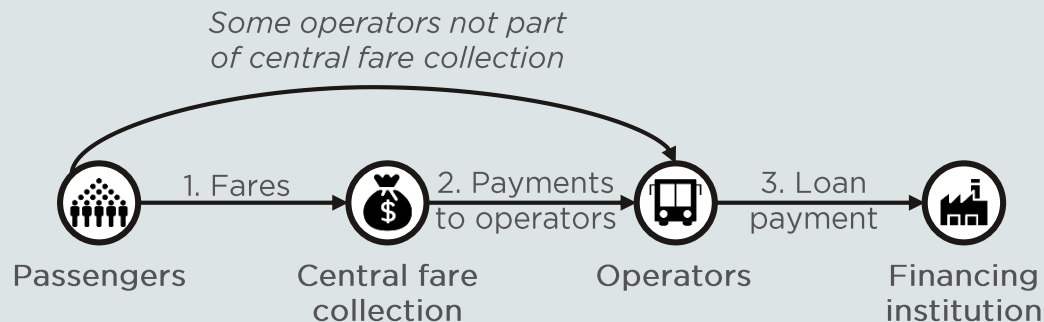
- The city government is leading efforts to make Medellín the capital of electromobility in Latin America by 2030 and have launched efforts to help private sector achieve this
- Local players are working to create solutions to access financing for e-buses; for example, AMVA, EPM, Findeter, and others are leading a program to facilitate financing for electric vehicles

MAIN BARRIERS FOR E-BUS ADOPTION

- Most TPC operators are small and may have difficulty accessing/unlocking the required amount of capital to acquire e-buses
- TPC operators have limited guarantees, besides their current assets as collateral, hampering ability to access e-bus financing

HOW IT CURRENTLY WORKS

Financial flows



Description of financial flows

1. Passengers pay a fare of ~USD 0.66 to ride TPC buses. Some TPC buses are linked to a central payment system, which also provides users access to other public transport systems, such as Metro and BRT
2. Payments are collected in a central farebox and disbursed to operators. The farebox divides collected fares among groups of operators (e.g., different areas in AMVA), and they determine how these incomes are distributed
3. Operators receive payments and manage them individually. With these revenues, some TPC operators are able to save and buy new buses with a minimum amount of debt. For instance, some operators only require <25% of financing when buying a new bus

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● **What are options to transition to e-buses & investments needed to support this?**

MODELLING COMMERCIAL ARRANGEMENTS

How could potential commercial arrangements be applied in CDMX and Medellín?

PATH FORWARD

What are key next steps?



Transition to e-buses requires strong organization and viable commercial arrangements



SYSTEM ORGANIZATION (not the focus of this report)

What are key characteristics that must be in place for a bus system to adopt e-buses?

VIABLE COMMERCIAL ARRANGMENT/SOLUTION

OPERATORS



What commercial options can maintain similar income and operational conditions?



MANUFACTURERS



What conditions enable the purchasing of e-buses in cities?



INVESTORS



What investment structures can provide attractive return on investment?



CITIES



What conditions should the city guarantee to enable e-bus commercial arrangements?

Viable commercial solutions must address needs of all key stakeholders

Strong transport systems can help accelerate e-bus scale-up

While not formal pre-requisites, system-level considerations impact the level of feasibility and the level of risk in transitioning to e-buses, as well as how risks are allocated across actors

PLANNING

- Strong **technical knowledge** is used for decision-making (e.g., transport demand for different routes, technology specifications required)
- **Clear and actionable transport plans** exist, such as master plans, mobility plans, fleet update guidelines, etc.

RESPONSIBILITIES

- Clear **roles and responsibilities** exist about what each stakeholder should do, and which **risks they take on**
- This includes clear roles for who owns, operates, and maintains different **system assets**

FINANCIAL CONTRACTS & GUARANTEES

- Clear **contract rules** are in place, including terms of how concessionaries and other players will be remunerated in the system
- **Clear guarantees are in place** to ensure proper compensation for unexpected changes (e.g., fare changes, new technology requirements, operator going out of business)

GOVERNANCE

- A clear **governing authority** has the agency, power, and tools to oversee the system
- **Clear regulations** exist for bus system functioning
- **Close implementation** of policies & plans by all stakeholders

SYSTEM ORGANIZATION



We found different levels of readiness to deploy e-buses across each business model archetype

- Businesses with a **high** level of readiness to deploy e-buses are:
 - Vertically-integrated, private operator in BRT/consolidated system (**model A**)
 - Divided responsibilities private operator in BRT/consolidated system (**model B**)
 - Government-run system (**model E**)
- Large, more formal, private operators in traditional services are **moderately** ready to deploy e-buses (**model C**)
- Small, informal, private operators in traditional services (**model D**) have a **low** level of readiness and will require organizational strengthening before or while deploying e-buses

City-specific conditions influence level of readiness

BASIC FOUNDATIONS	BUSINESS MODELS				
	A	B	C	D	E
Overall level of readiness	HIGH	HIGH	MEDIUM	LOW	HIGH
Planning	●	●	●	●	●
Responsibilities	●	●	●	●	●
Governance	●	●	●	●	●
Financial contracts & guarantees	●	●	●	●	●

We identified two promising commercial arrangements for e-bus deployment

Key
levers:

Change
sources
and terms
of
financing

Change
asset
ownership

Promising commercial arrangements:

1

CONCESSIONAL FINANCE FOR ASSET OWNERS

- Provides **attractive financing terms** to asset owners to enable purchase of e-buses:
 - Lower interest rates (e.g., several percentage points below commercial rates)
 - Extended payment periods (e.g., 10+ years instead of ~6 years)
 - Grace periods (e.g., two years of no payments)
- Shows **proof-of-concept for models that can be replicated and scaled**

2

SEPARATION OF ASSET OWNERSHIP

- **New players come into the bus sector** to buy e-bus assets and lease them to traditional operators to use
- Allows for **sharing of costs** (i.e., the operator not cover all upfront costs) and the **sharing of risk** (e.g., traditional asset owners take on less technology and financial risk)

RISK
MITIGATION

Required for
both
commercial
arrangements

The following pages present additional detail on each solution



Prepared by

Overview

Concessional finance for asset owners

1. CONCESSIONAL FINANCE FOR ASSET OWNERS

Overview of proposed solution

Public and private financial institutions provide **concessional/blended financing**¹ to **bus system asset owners** (operators, cities, or third party asset owners) to access e-buses

Roles & responsibilities of key actors

Finance provider(s)

Who? DFIs, MDBs, DBs, donors, and private sector provide capital at varying tranches—for instance, private sector and MDBs provide capital at more commercial rates while governments, certain DFIs, and donors provide “first-loss” capital (e.g., grants)²

Role: Provides financing to buy e-bus components, with focus on creating proof-of-concept that could be further scaled



Guarantor

Who? City-level trusts, PTAs for revenues; MDBs for credit

Role: Provides guarantees to reduce risk/help access financing



Asset owners

Who? Operators, cities, or third party asset owners who lease

Role: Accesses e-bus components through concessional/blended financing



SPOTLIGHT EXAMPLE

Renewing buses to clean technologies in Bogotá through blended finance

In 2014, the bus system in Bogotá, SITP, received USD 40 million concessional financing from the Clean Technology Fund (CTF) to finance the purchase of hybrid and electric buses. This loan was given to the national development bank Bancóldex, who extended the financing to local banks, who then provided credit to transport service providers (SITP concessionaires). Bancóldex co-financed each vehicle at a 1:1 ratio, resulting in a total investment of USD 80 million. This arrangement led to **additional financing focused specifically on hybrid buses, allowing SITP operators to purchase 282 clean technology buses**



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Implementing Partners



Supporting Partners



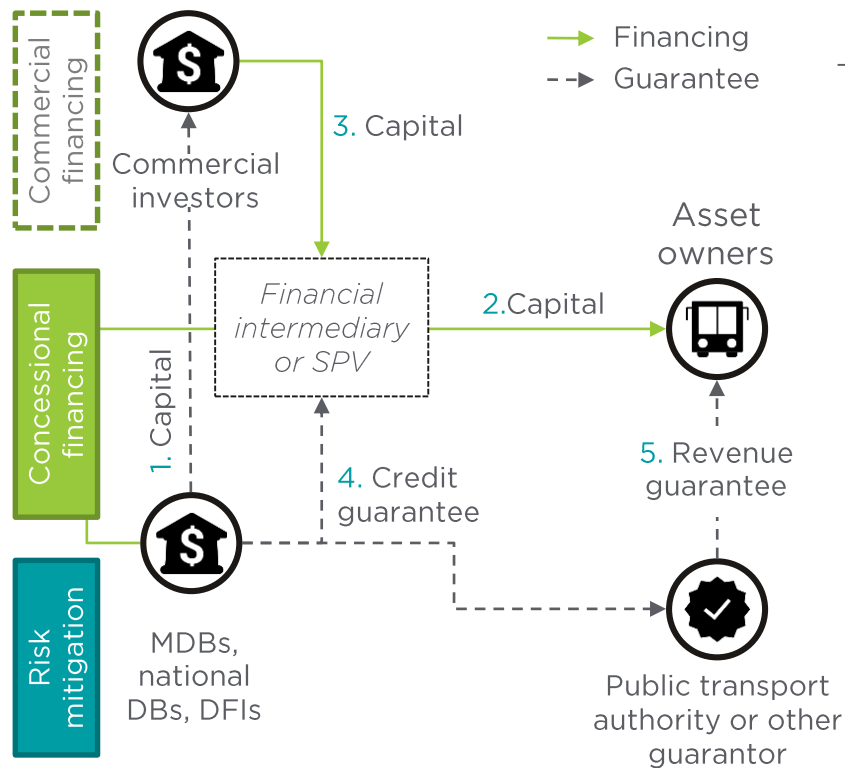
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Notes: 1. Concessional financing is defined as loans extended on terms substantially more generous than market loans - either through interest rates below those available on the market or by grace periods, or a combination of these. 2. Some actors (e.g., MDBs) could play role of providing finance or credit guarantee.

Sources: Stakeholder interviews, 2019; ICCT, 2017

How it works

Concessional finance for asset owners



KEY COMPONENTS

Financing

- 1. MDB, DFI, and/or national DB** provides financing to financial intermediaries via tiered/blended structure
- 2. Operators access concessional financing, typically from a financial intermediary, to purchase e-buses:**
 - Lower interest rate (e.g., 2-3 percentage points below commercial rates)
 - Longer duration (e.g., ~10 years)
 - Grace periods
- 3. Longer term:** After proof-of-concept, first-loss concessional financing can de-risk **commercial investment**, enabling further scale-up of this solution via blended finance




Risk mitigation

- 4. MDB, DFI, and/or national DB** provides partial credit guarantee to financial intermediary and/or to PTA
- 5. Government or other structure** (e.g., operator federation) provides minimum revenue guarantee to asset owner

Concessional/blended finance can reduce upfront costs, but does not always mitigate risks for operators

MAIN BARRIERS ADRESSED

1.CONCESSIONAL FINANCE FOR ASSET OWNERS

FOCUS BARRIERS	 Finance	High upfront asset costs	✓ Increases access to capital, helping access e-buses
		Access and cost of financing	✓ Reduces financing costs, by providing beneficial terms
		Limited access to financial guarantees to de-risk operations	? Guarantees to operators can be part of the solution, but are not a given
		Limited investment in infrastructure	✓ Provides means to invest in required infrastructure
NON-FOCUS BARRIERS	 Policy	Limited support from govt to deploy e-buses	<i>May increase interest or viability for govt support</i>
		Limited knowledge of potential purchasing models for e-buses	<i>Provides concrete options and models for accessing e-buses</i>
	 Technology	Perception of lack of readiness of e-buses to replace conventional buses	<i>No expected impact</i>
		Misinformation about technology	<i>May increase knowledge about e-bus technology</i>

Overview

Separation of asset ownership

2. SEPARATION OF ASSET OWNERSHIP

Overview of proposed solution

Third party asset owners purchase some or all e-bus components (chassis/body, battery, and charging station) to reduce upfront costs and risks for operators

Roles & responsibilities of key actors



Third party asset owner

Who? Utility companies, banks, bus manufacturers, asset-owner equity funds

Role: Owns and leases e-bus components for operation

Financiers – *can provide financing to asset owners*



Operators

Who? Companies in charge of operating buses

Role: Leases and operates buses



Public transport authority

Who? Bus system regulating entity, govt

Role: Supports leasing contracts, can provide revenue guarantees, and regulates e-bus components to ensure interoperability and quality

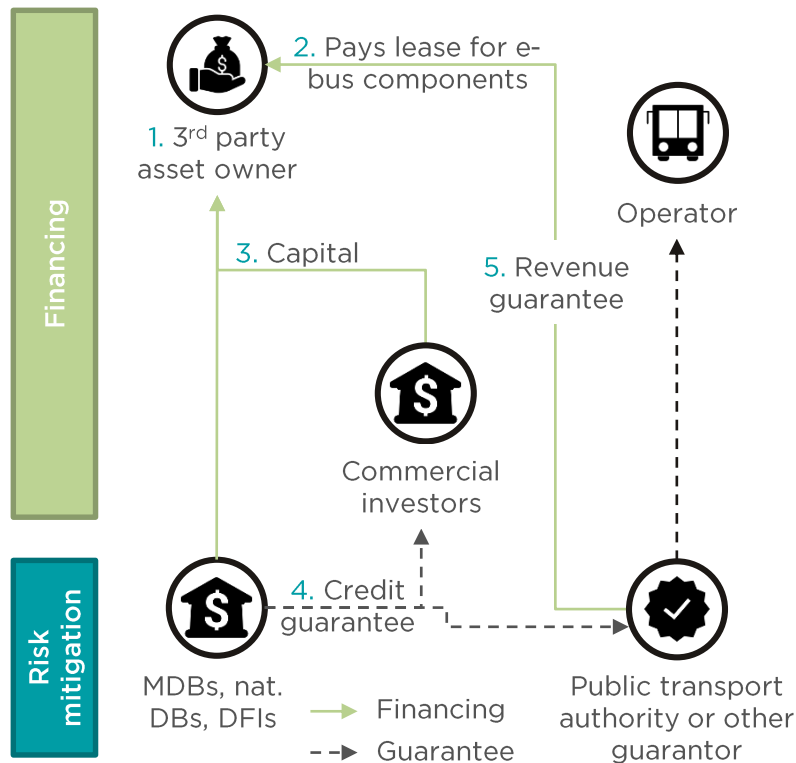
SPOTLIGHT EXAMPLE

Creating a fund with investors to scale-up a battery leasing program

Mitsui & Co., a Japanese investment and trading company, will provide a USD 200 million credit facility to e-bus manufacturer Proterra to **accelerate its battery leasing program**. This program is expected to save buyers up to USD 75,000 per bus through combination of leasing, lower maintenance costs, and fuel costs. Moreover, Proterra will provide maintenance and warranty to leased batteries, including a guarantee that their batteries will retain their energy capacity throughout the 12-year life of an e-bus. This credit facility will be available for all buyers of e-buses from Proterra. However, today, most Proterra buses are for the US market.

How it works

Separation of asset ownership



KEY COMPONENTS

Financing

1. Third party asset owner purchases e-bus components
2. Operators lease some or all e-bus components from third party asset owner, based on agreed terms for ownership and use of bus, battery, and charging station
3. **Optional: Concessional and/or commercial investors finance purchase of e-bus components¹** (by third party asset owner or operators); this may need to be guaranteed, depending on the purchaser. Please see concessional financing solution for further details




Risk mitigation

4. **MDB, DFI, and/or national DB** provides partial credit guarantee to investors financing purchase of e-bus components and/or PTA guaranteeing payment
5. **Government or other structure** (e.g., operator federation) pays lease for e-bus components directly and/or provides minimum revenue guarantee to asset owner

Separation of asset ownership can help alleviate upfront costs and reduce risks for operators

MAIN BARRIERS ADRESSED

2. SEPARATION OF ASSET OWNERSHIP

FOCUS BARRIES	 Finance	High upfront asset costs	✓ Reduces upfront costs for operators due to third party asset owner purchasing bus, battery, and/or charging
		Access and cost of financing	✓ Large players have access to better financing options, compared to operators
		Limited access to financial guarantees to de-risk operations	✓ Risk of asset ownership (e.g., batteries) is shifted to third party asset owner
		Limited investment in infrastructure	? Large players may attract more capital for infrastructure
NON-FOCUS BARRIERS	 Policy	Limited support from govt to e-buses	<i>May increase interest or e-bus viability for govt support</i>
		Limited knowledge of potential purchasing models for e-buses	<i>Presence of third party asset owners can increase the knowledge of actors around different models</i>
	 Technology	Perception of lack of readiness of e-buses to replace conventional buses	<i>No expected impact on perception of readiness, but eliminates availability/technology risk for operator</i>
		Misinformation about technology	<i>Third party asset owners may be experts in the technology (e.g., Enel) and help resolve issues</i>

Both commercial arrangements require active mitigation of several types of risks

Type of risk:

Political

- Change in bus system contracts (e.g., between PTA and operator)
- Change in government (e.g., city mayor)

Tech & operational

- Availability risk (i.e., buses do not function reliably)
- Battery lifetime (i.e., # years)
- Falling prices of batteries

Financial

- Demand risk (i.e., fewer passengers)
- Counterparty risk (e.g., operator defaults on loan)
- Currency risk

Mitigation approaches:

- Detailed contract clauses between PTA, operators, and any other asset owners
- Public political commitments to e-buses, to use to hold government accountable
- Battery warranties from manufacturers
- Battery leasing programs
- Purchasing terms with post-sale support from manufacturers
- Revenue guarantees
- Credit guarantees
- First-loss capital
- Insurance, mezzanine financing

Additional detail on following pages. See annex for more detail on policy and tech & operational risks.

Credit guarantees and revenue guarantees can help mitigate counterparty and demand risk

TYPE	OPTIONS	HOW WOULD THIS WORK?	WHEN IS THIS MOST RELEVANT?
Credit guarantee	Partial credit guarantee	<ul style="list-style-type: none"> MDB, DFI, or national development bank agrees to pay certain portion of principal and/or interest in the case of default; would likely be structured at portfolio level (e.g., across many operators) 	<ul style="list-style-type: none"> For operators with credit history, but without access to city-level trusts
Revenue guarantee	Creation of new city-level government trusts	<ul style="list-style-type: none"> Dedicate government resources to set up city-level trusts that can guarantee certain types of payment, where they do not already exist 	<ul style="list-style-type: none"> For operators in more formalized, integrated bus systems (e.g., with central fare collection and set remuneration scheme) backed by govt
	Expansion of existing city-level government trusts	<ul style="list-style-type: none"> Invest additional gov resources to expand city-level trusts to cover more operators (e.g., two operators in Medellín now have access to the FET), as an incentive to switch to e-buses 	<ul style="list-style-type: none"> For operators in more formalized, integrated bus systems (e.g., central fare collection and set remuneration scheme) backed by government
	Structuring of other guarantee pools	<ul style="list-style-type: none"> Organize operators to use and structure their shared revenue pool as guarantee mechanism (e.g., actors agree that part of revenue pool can cover repayment under certain conditions) Structure e-bus guarantee pools with MDBs/DFIs 	<ul style="list-style-type: none"> For private operators with central farebox (e.g., for TPC in Medellín or private operators in Rio), but without access to city-level trusts

First-loss capital can also mitigate financial risk for more senior investors

TYPE	OPTIONS	HOW WOULD THIS WORK?	WHEN IS THIS MOST RELEVANT?
Revenue guarantee	Direct minimum revenue guarantee	<ul style="list-style-type: none"> Analyze operators' past cash flows and demand (e.g., number of passengers) Government grants to operator a minimum level of revenues for a concession period This can be structured as a put option, put and call option, or put and call option with limitations¹ 	<ul style="list-style-type: none"> Operators with strong operational history and profitability, but without access to city-level trusts – to help secure lease/purchase payments
Others	Insurance	<ul style="list-style-type: none"> Insurance company insures the savings promised to operators by guaranteeing a payment if promised savings are not met 	<ul style="list-style-type: none"> Operators with credit history that lack access to other guarantee mechanisms; enough operators must be interested for insurers to offer these products
	Mezzanine finance	<ul style="list-style-type: none"> Change repayment terms so that the investor receives a certain percent of operator revenues for a certain period of time – until the debt is repaid (revenue sharing models) 	<ul style="list-style-type: none"> Operators with strong operational history and profitability, but without access to city-level trusts
	First loss capital	<ul style="list-style-type: none"> Donors or govt absorb losses in the case that e-bus investment is not profitable/counterparty cannot repay obligations 	<ul style="list-style-type: none"> Operators that purchase e-bus assets and require financing



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Implementing Partners



Supporting Partners



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Notes: For put option, government pays private partner for any gap in revenues below agreed threshold. For put and call option, government receives all revenues above agreed threshold. The put and call option with limitations sets a limit on the income shortcoming or income surplus the private partner and government, respectively, receive.

Sources: Real Options Ltd, "Minimum Revenue Guarantees," accessed 2019

Overall, allocating risks across actors can make commercial arrangements viable

		<div> <div>1 Actor takes on risk in concessional finance commercial arrangement¹</div> <div>2 Actor takes on risk in separation of assets commercial arrangement¹</div> </div>						
Type of risk:		PTA	Asset owner	Manuf.	Financier	Credit. guar.	Intermediary	Operator
Political	Change in contracts ²		2					1 2
	Change in govt ²		2					1 2
Tech & operational	Availability risk ³	1 2		1 2				1 2
	Battery lifetime ⁴			1 2				
	Falling prices		2					1
Financial	Demand risk ⁵	1 2						
	Counterparty risk ⁶				1 2	1 2	1	
	Currency risk ⁶		2		2	1 2	1	

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What are options to transition to e-buses & investments needed to support this?

MODELLING COMMERCIAL ARRANGEMENTS

● **How could potential commercial arrangements be applied in CDMX and Medellín?**

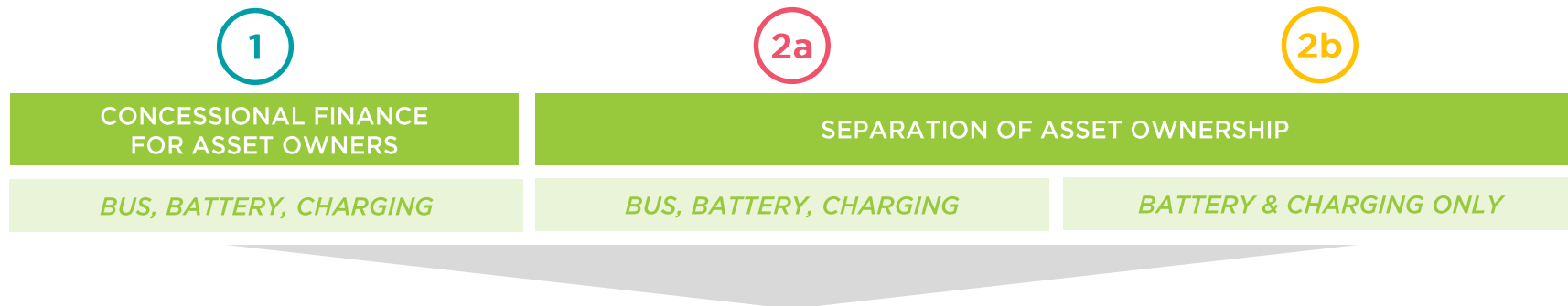
PATH FORWARD

What are key next steps?



We modelled three scenarios to transition to e-buses for CDMX Metrobus and Medellín TPC

MODELLING SCENARIOS:



- **CDMX:** We modelled for Metrobus operators given they are the most “ready,” have government support, and are considered an example for others to follow (*for additional detail, please see the annex*)
- **Medellín:** We modelled for Transporte Público Colectivo operators given they are 92% of the city’s public transport bus fleet (*for additional detail, please see the annex*)

The following slides summarize findings for each city

CDMX: We modelled transition to 20 articulated e-buses with 350 kWh batteries

1

CONCESSIONAL FINANCE FOR ASSET OWNERS

BUS, BATTERY, CHARGING



Operator buys 20 articulated e-buses¹



Operator buys 20 350 kWh batteries²



Operator buys 10 depot chargers

- 80% of all asset costs financed via concessional loan to operators³

2a

SEPARATION OF ASSET OWNERSHIP

BUS, BATTERY, CHARGING



Third party buys 20 articulated e-buses & leases (capital) to operators¹



Third party buys 20 350 kWh batteries & leases (operating) to operators



Third party buys 10 depot chargers & leases (operating) to operators

2b

BATTERY & CHARGING ONLY



Operator buys 20 articulated e-buses¹



Third party buys 20 350 kWh batteries & leases (operating) to operators



Third party buys 10 depot chargers & leases (operating) to operators

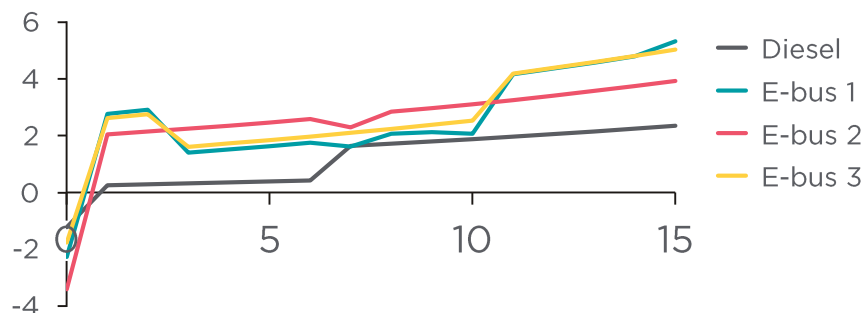
- 80% of bus costs financed via concessional loan to operators³

CDMX: For Metrobus, all three e-bus scenarios are competitive with diesel

- Financial estimates vary considerably based on inputs and assumptions, which differ by operator
- Estimates are **highly sensitive to leasing cost assumptions**—where limited data available varies considerably
- The financials below are triangulated based on **two Metrobus operators**; they will NOT be the same for all operators
- We therefore recommend using the dynamic modelling tool to **adjust assumptions, as needed, before presenting results to other operators**
- We also expect these estimates to **change considerably in the coming years** as the e-bus market develops

Commercial arrangements ¹	IRR, operator
1. Concessional finance for asset owners	>30%
2a. Separation of asset ownership – bus, battery, charging ²	>30%
2b. Separation of asset ownership – battery & charging only	>30%
Diesel buses ³	~30%

Operator cash flows
USD millions, Years 0-15



CDMX: Separation of asset ownership is promising model given risk allocation

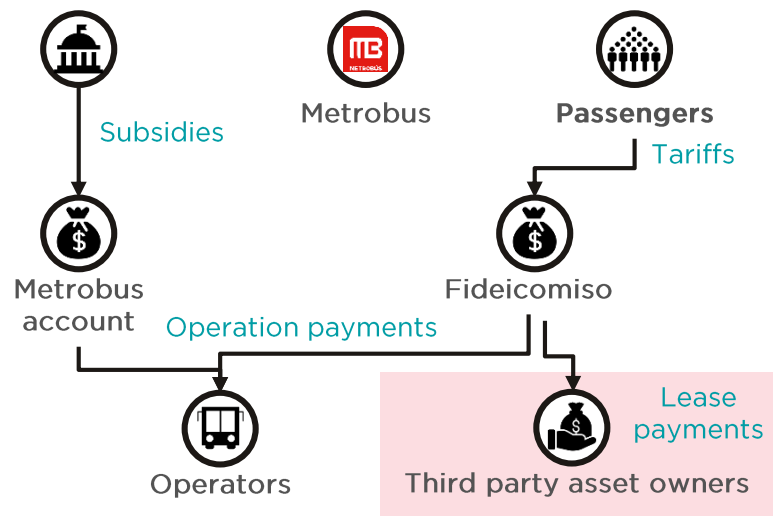
Scenario	When would commercial arrangement be most appropriate?
1. Concessional finance for asset owners	<ul style="list-style-type: none"> • Focused on Metrobus operators that are most creditworthy • Operators want to own assets—as is the current Metrobus model—and take on associated risk • Operators have upfront capital to make larger down payment • Investors interested in providing concessional finance
2a. Separation of asset ownership – bus, battery, charging	<ul style="list-style-type: none"> • Third party is interested in entering bus system to own assets • Metrobus can oversee leasing arrangements and guarantee payments • Operators do not want to take on risk of asset ownership • Larger operator(s) with 100+ units want to transition
2b. Separation of asset ownership – battery & charging only	<ul style="list-style-type: none"> • Manufacturer or other third party is interested in entering bus system to lease batteries and charging stations • Metrobus can oversee leasing arrangements and guarantee payments • Operators want to own non-electric assets—as is the current Metrobus model—and take on associated risk

See additional detail on following slide

RATIONALE:

- Separation of assets reduces risk for Metrobus operators—not all of whom could take on risk of asset ownership
- Metrobus has capacity and scale to negotiate leasing arrangements with third party—and guarantee payment via its fideicomiso
- Interested third parties exist (e.g., Engie)

CDMX: Metrobus fideicomiso could pay lease payments to third party asset owner



KEY ENABLERS & RISK MITIGATION

- Work with Metrobus to update contracts to ~15 years (currently, the 10-year contracts frequently last ~13 years due to process delays)
- Ensure as close to 1-to-1 replacement of diesel buses with e-buses as possible:
 - Secure performance guarantees from manufacturers to ensure that operators have a minimum number of buses available that meet key performance metrics (e.g., # of km per charge of battery)
 - Prioritize fast-charging systems, where possible
 - Prioritize routes where e-buses are most feasible

POTENTIAL PARTNERS

- Coordinator – Metrobus
- Third party asset owners – Engie
- Investors/financiers – BANOBRAS, NAFIN, IDB, IFC

KEY CHARACTERISTICS

- The fideicomiso would cover lease payments to third party asset owners—instead of credit payments to financiers for fleet renovation
- *Other aspects of Metrobus model would remain similar*

CDMX: We modelled transition to 20 micro e-buses with 200 kWh batteries

1

CONCESSIONAL FINANCE FOR ASSET OWNERS

BUS, BATTERY, CHARGING



Operator buys 20 micro (<12m) e-buses¹



Operator buys 20 250 kWh batteries²



Operator buys 10 depot chargers

- 80% of all asset costs financed via concessional loan to operators³

2a

SEPARATION OF ASSET OWNERSHIP

BUS, BATTERY, CHARGING



Third party buys 20 micro (<12m) e-buses & leases to operators¹



Third party buys 20 250 kWh batteries & leases to operators



Third party buys 10 depot chargers & leases to operators

2b

BATTERY & CHARGING ONLY



Operator buys 20 micro (<12m) e-buses¹



Third party buys 20 250 kWh batteries & leases to operators



Third party buys 10 depot chargers & leases to operators

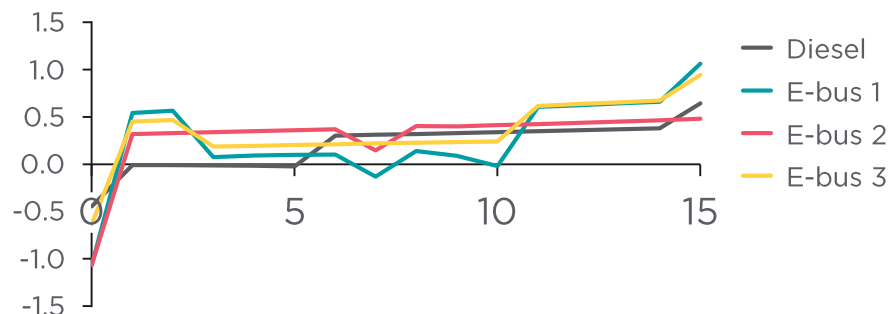
- 80% of all asset costs financed via concessional loan to operators³

Medellín: For TPC, leasing can offer competitive returns

- Financial estimates vary considerably based on inputs and assumptions, which differ by operator
- Estimates are highly sensitive to leasing cost assumptions—where limited data available varies considerably
- The financials below are triangulated based on two operators; they will NOT be the same for all operators
- We therefore recommend using the dynamic modelling tool to adjust assumptions, as needed, before presenting results to other operators
- We also expect these estimates to change considerably in the coming years as the e-bus market develops

Commercial arrangements ¹	IRR
1. Concessional finance for asset owners	25-30%
2a. Separation of asset ownership – bus, battery, charging ²	~30%
2b. Separation of asset ownership – battery & charging only	>30%
Diesel buses ³	~20%

Operator cash flows
USD millions, Years 0-15



Leasing is promising model to help more mature TPC operators transition

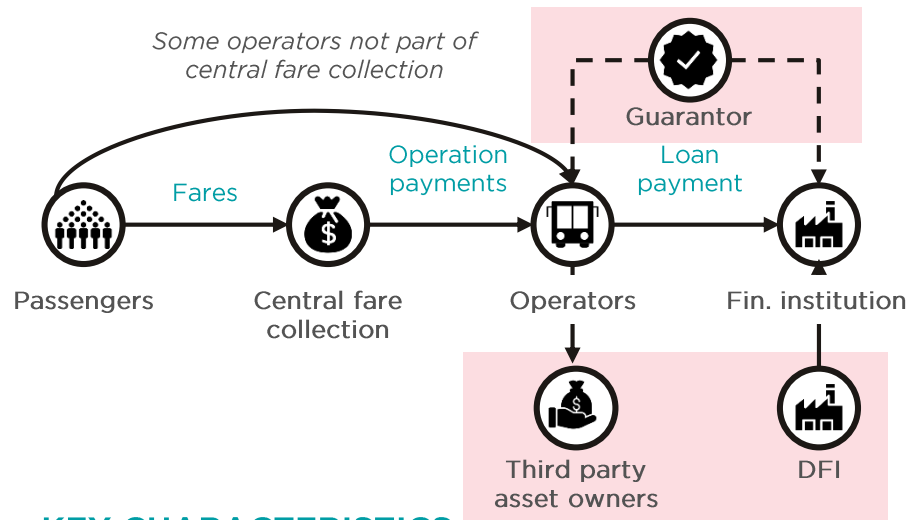
Scenario	When would commercial arrangement be most appropriate?
1. Concessional finance for asset owners	<ul style="list-style-type: none"> • Focused on ~4-5 TPC operators that are more formal, creditworthy, and integrated into central payment system • Operators want to own assets and take on associated risk • Operators have upfront capital to make larger down payment • Investors interested in providing concessional finance
2a. Separation of asset ownership – bus, battery, charging	<ul style="list-style-type: none"> • EPM or other third party is interested in entering bus system to own assets • AMVA or other government entity steps in to oversee leasing arrangements and guarantee payments • Operators do not want to take on risk of asset ownership
2b. Separation of asset ownership – battery & charging only	<ul style="list-style-type: none"> • Manufacturer, EPM, or other third party is interested in entering bus system to lease batteries and charging stations • AMVA steps in to oversee leasing and guarantee payments • Operators want to own non-electric assets • Investors interested in providing concessional finance to support purchase of chassis

See additional detail on following slide

RATIONALE:

- Only ~4-5 TPC operators are “ready” to transition
- Battery & charging leasing can reduce cost for operators
- Findeter is designing line of credit for vehicle renovation—which could support purchase of chassis
- Currently, there is no clear third party to own all assets—but this could change

TPC operators could lease batteries and receive finance to purchase e-bus chassis



KEY CHARACTERISTICS

- DFI provides financing to financial intermediary, who lends to operators to purchase chassis
- Third party purchases and leases batteries and charging stations to operators
- TPC and government work together to develop mechanism to ensure operator payment of lease and loan

ENABLERS & RISK MITIGATION

- Identify and engage more formal, creditworthy TPC operators, integrated into central fare collection
- Provide insurance or guarantees to operators based on operator data collected by the central farebox (such as revenue history, hours of operation, etc.)
- Assess which lines have the highest potential to be covered by e-buses, to prioritize
- Continue to support the formalization of traditional TPC operators into bus companies—and evaluate possibility of leapfrogging to e-buses in the process

POTENTIAL PARTNERS

- DFIs – Findeter, Bancoldex
- Financial intermediaries – Bancolombia, Davivienda, Banco de Occidente
- Third party asset owners – EPM, battery manufacturers

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MODELLING COMMERCIAL ARRANGEMENTS

How could potential commercial arrangements be applied in CDMX and Medellín?

● PATH FORWARD

What are key next steps?



Moving these ideas forward requires securing buy-in and completing additional design work

1. SECURE BUY-IN

- Set up meetings with key stakeholders—public transport authorities, operators, potential investors, manufacturers, asset owners—to share back findings from study
- Solicit input on which commercial arrangements--concessional finance, separation of assets—have the most potential in each city

2. REFINE COMMERCIAL ARRANGEMENTS

- Based on conversations with stakeholders, select various commercial arrangements to move forward with operators in each city
- Complete additional design work to develop a detailed “roadmap” to move the selected commercial arrangements forward

3. EXECUTE AND LEARN

- Help stakeholders launch selected commercial arrangement in each city
- Capture and disseminate learnings
- Identify opportunities to scale to other operators—and to bring in more commercial/sustainable sources of financing over time



Key next step in CDMX is to work with Metrobus to refine and implement commercial arrangements

1. Secure buy-in

2. Refine comm. arrangements

3. Execute and learn

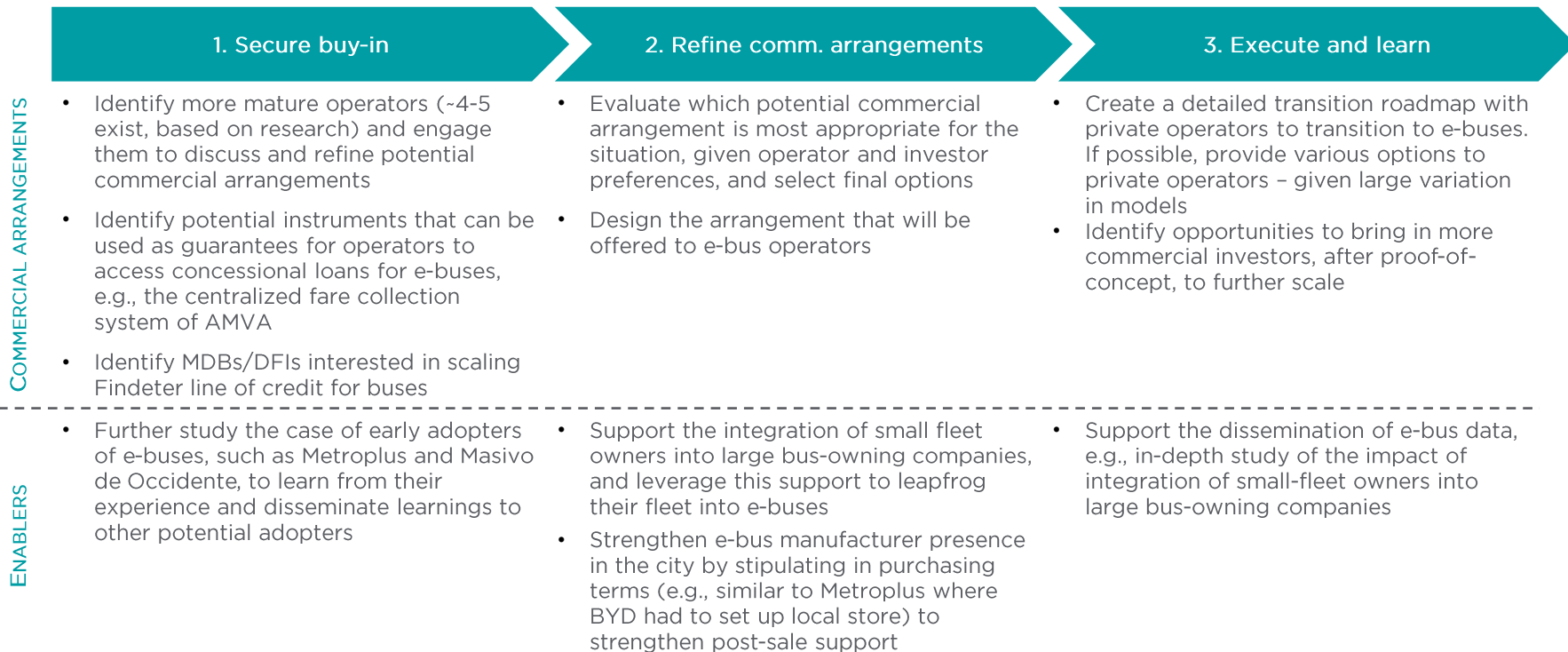
COMMERCIAL ARRANGEMENTS

- Present findings to Metrobus and solicit their input
- Identify potential operators (e.g., RTP, MIVSA, CISA) and identify which commercial arrangement is most attractive
- Engage potential investors (see Section 4) and test interest in commercial arrangements; refine concepts
- Based on arrangement, identify third party asset owners (e.g., Engie, ADO, manufacturer)

ENABLERS

- Advocate for tax exemptions (e.g., IVA) for e-buses, similar to Colombia
- Work with gov to update concession agreements (e.g., more than 10 years, separating asset ownership)
- Advocate for tax exemptions for e-buses, similar to Colombia
- Strengthen e-bus manufacturer presence in the city by stipulating in purchasing terms (e.g., similar to Metroplus where BYD had to set up local store) to strengthen post-sale support
- Support the dissemination of e-bus pilot data, e.g., in-depth study of the performance of e-buses working in CE4s' fleet to increase uptake

Key next step in Medellín is to work with “first wave” of identified TPC operators to design and execute procurement



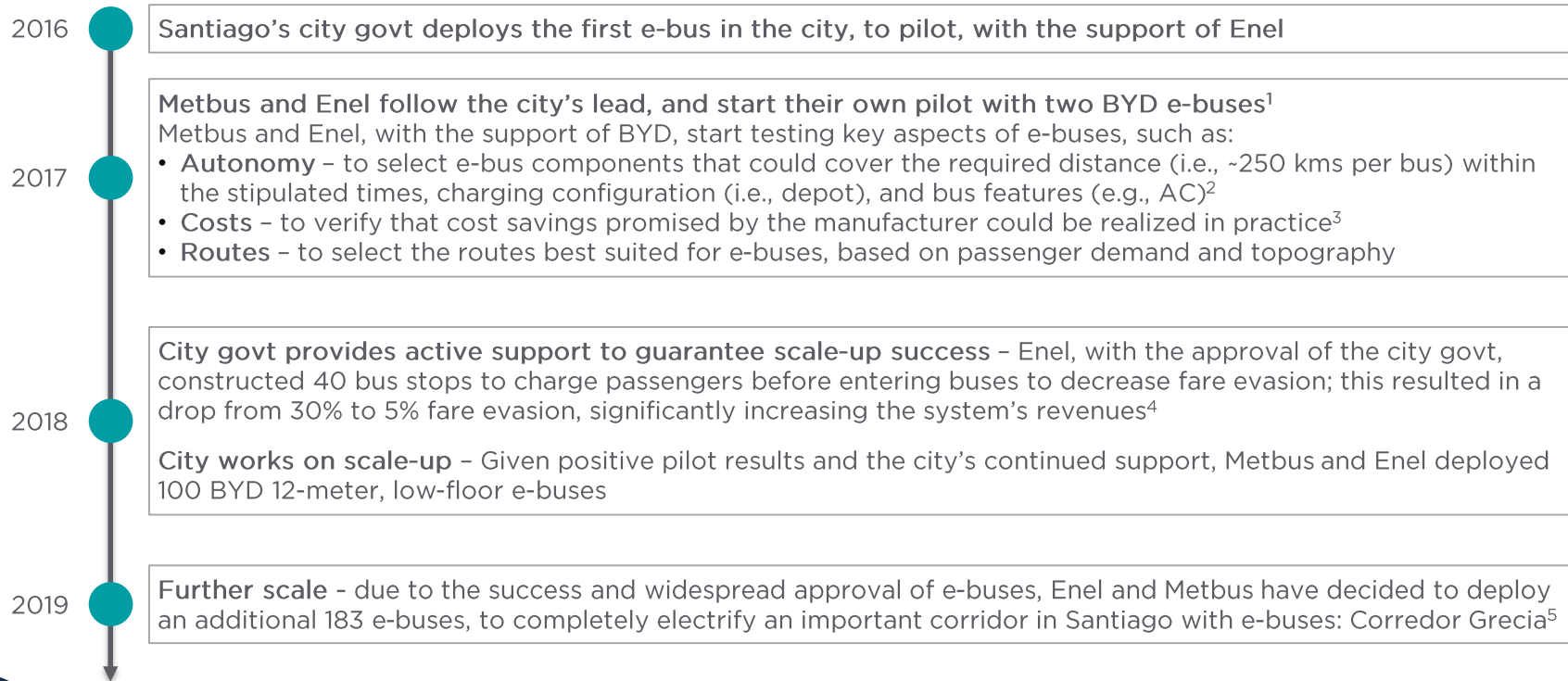
ANNEX

ANNEX

- E-bus context: What is the opportunity for e-buses in Latin American cities?
- Bus operator landscape: What are current bus operator business models?
- Commercial arrangements: What are options to transition to e-buses & investments needed to support this?
- Modelling potential solutions: How could potential solutions be applied in CDMX and Medellín?
- Sources and references



In 2016, Santiago's govt took concrete action to deploy e-buses; today, its system has the largest e-bus fleet in Latam



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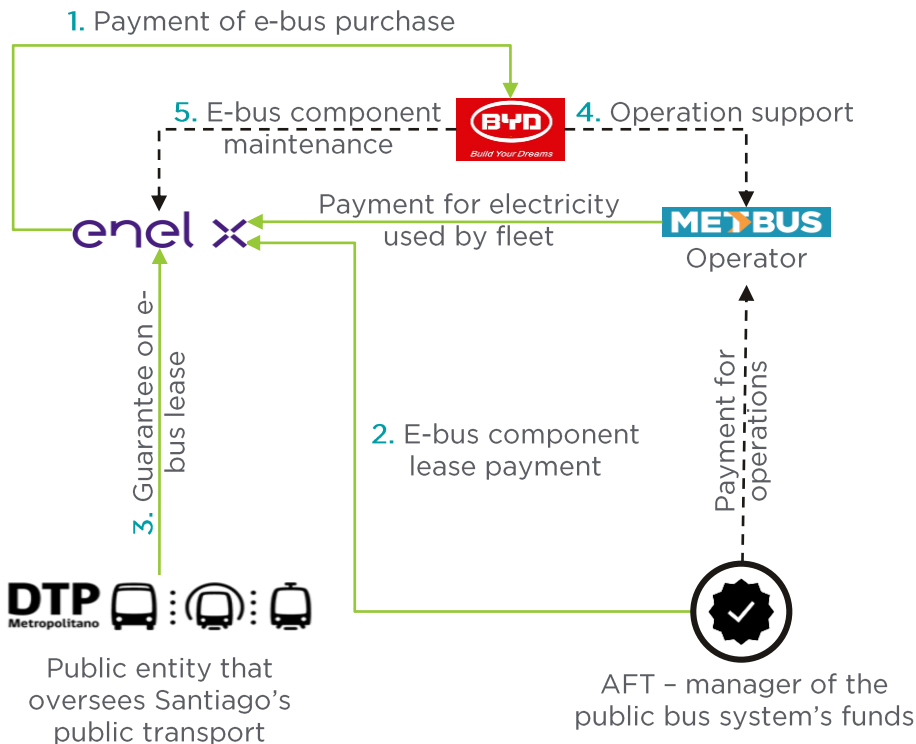
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Notes: 1. Red Metropolitana de Movilidad, "Contraloría aprobó las bases de licitación para el Sistema de Transporte Público de Santiago," 2017. 2. METBUS, "Experiencias de un operador de transporte público en la introducción de buses eléctricos en Santiago, Chile," 2019. 3. Enel X, "Electric buses imported by Enel X and MetBus are awarded by the International Association of Public Transport," 2019. 4. METBUS, "Experiencias de un operador de transporte público en la introducción de buses eléctricos en Santiago, Chile," 2019. 5. Reuters, "Enel-BYD say Chile electric bus roll-out heralds more for region," 2018.

The clear definition of roles and responsibilities between players has been critical to e-bus deployment



Key characteristics

1. Enel invested ~USD 30 million for the purchase of 100 BYD buses; the cost was USD 330k per e-bus, compared to USD 222k for a Euro VI diesel bus^{1,2}
2. Administrador Financiero de Transantiago (AFT) directly pays Enel a monthly lease of USD 1,574 for the Metbus operator's use of the e-buses, under a 10-year concession contract²
3. Directorio de Transporte Público (DTP) provided a guarantee for the lease payment provided by AFT
4. BYD provides a service package—in collaboration with Enel—on best practices for e-bus use and maintenance
5. BYD provides warranties on all components

Various strategies have helped mitigate risks and drive strong operational and financial results

RISK	MITIGATION STRATEGY
Political	Active government support – Santiago's government led e-bus deployment through different policies and motivated operators to use e-buses (e.g., provided a financial incentive)
Tech & operational	<p>Battery warranty – BYD offered a 10-year warranty on batteries and will replace them in case of malfunction</p> <p>Operation guarantee – BYD signed a clause where it is obliged to pay Metbus a fine if buses are not available to operate during required times, due to technology malfunctions</p> <p>Maintenance support – BYD supports Metbus with day-to-day maintenance, staff training, problem diagnosis and resolution, and work orders for bus repairs</p>
Financial	Revenue guarantee – DTP guarantees payments between Metbus and Enel, as stipulated by the contract for the provision of services

WHAT ARE RESULTS TO DATE?

- Buses have covered **1.8 million km**
- Realized autonomy is **241 km per day, on average**
- Buses serve an average of **700,000 passengers per day**
- **Air conditioning and heating** are in use
- **Operational costs are <1/3 of diesel:**
 - Electric: USD 0.12/km
 - Diesel: USD 0.42/km
- This leads to **USD 226 in net savings per month**, after accounting for leasing cost¹



Notes: 1. An e-bus running 6,000 km per month saves USD 1,800 per month in energy costs, compared to diesel. This is compared to the monthly lease of USD 1,574.

Sources: METBUS, "Experiencias de un operador de transporte público en la introducción de buses eléctricos en Santiago, Chile," 2019; BYD, "Flota de buses eléctricos BYD Chile," 2019; ZEBRA round table discussions in Medellín and São Paulo, 2019

Bus operator landscape – by city (1/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
CDMX	Metrobus	Around 670 buses.	Metrobus owns the terminals and outsources the off-board fare collection system. Private operators own the buses, with purchase made/guaranteed by Metrobus trust. Operators have to meet fleet specifications.	Metrobus allocates each operator to a corridor and sets the schedule. It is also in charge of managing the terminals while operators maintain their fleet.	Fares are collected and put into the Metrobus fideicomiso trust, which then pays operators (by km) and other service providers. Government subsidies do not enter into the fideicomiso. Most concessions last 10 years.
	Individual concessions	Almost a total of 30,000 buses.	Private operators own every aspect except the bus stops.	Private operators have to pay for maintenance and are responsible for operations.	Operators get remunerated directly from fares collected; there is no trust. Concessions are assigned based on demand; larger concessions are corridors.
	SM1/RTP	Around 1,400 buses.	Government owns every aspect of the system.	Government in charge of operations.	System is heavily subsidized by government. Buses in Metrobus and corridors follow those terms.



Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

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Bus operator landscape – by city (2/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
CDMX	STE	300+ trolleybuses, but only ~100 in operation; 42 new buses purchased in 2019 from Yutong	STE owns the trolleybuses as well as the charging sub-stations.	STE is responsible for all operations and maintenance.	STE operates using dedicated budget from the government.
Sao Paulo	BRT	Combined, around 15,000 buses.	Operators own their buses and garages while the city owns all terminals and stops.	SPTrans allocates each operator to one of the eight zones, where they operate alone or as part of a consortium.	A trust fund was created for the BRT system to collect user fees through the Bilhete Único. The trust pays operators by km and covers some other costs (e.g., fleet renewal, infrastructure). ² Operators have a concession or a permit, with the difference being the type of lines where they operate.
	Private (28)				



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Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive. 2. C40 Cities and Clinton Climate Initiative, "BUILDING SUCCESSFUL PUBLIC PRIVATE PARTNERSHIPS IN SÃO PAULO'S TRANSPORTATION SECTOR," 2013.

Bus operator landscape – by city (3/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Medellín	Metroplus (BRT)	74 CNG buses and 64 e-buses (starting Oct. 2019)	Metroplus owns all assets. Metro (also a public company) operates them.	Metroplus in charge of setting routes, fares, and maintaining terminals. Metro manages the buses and their maintenance.	Citizens pay their fare through the Tarjeta Cívica. Government budget supports fleet purchase, operations, and maintenance.
	SITVA concessionaries (2)	~370 buses, mostly CNG with ~12 electric	Private operators own their buses.	Private operators operate and maintain their buses.	Citizens pay their fare through the Tarjeta Cívica. Operators have access to the Fondo de Estabilidad de la Tarifa (FET), which guarantees their revenues
	Private (60)	Around 6,000 buses.	Private operators own their buses while the city owns the stops.	AMVA has divided the metro area into 10 “cuencas” and operators have permits to run defined routes within/across.	The city demands that operators own a certain quantity of buses that meet specific requirements and operate given routes.



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Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

Bus operator landscape – by city (4/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Santiago	Red Metropolitana de Movilidad (BRT)	6,681 buses.	Operators own the buses while the city owns the stops and terminals. Private utility companies own emerging e-bus fleet.	The city develops the routes and then assigns them to the six operators who have to cover the distance given. Operators also maintain their fleet.	Contracts last five years and have the option to be extended for up to another five years. Payment done through the Tarjeta bip! for all buses. Administrador Financiero de Transantiago (AFT) functions like city-level trust and makes payments to operators.
	Private (6)				

Bus operator landscape – by city (5/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Quito	Metrobus-Q (BRT)	310 buses	The Empresa Pública Metropolitana de Transporte de Pasajeros de Quito (EPMTPQ), a public company, owns buses.	Similar to ownership, the EPMTPQ operates the buses in all five corridors.	Government funds the system.
	Private	N/A	Private operators own the buses while the city owns the terminals and the stops.	The city determines the number of routes and buses needed as well as the frequency of trips. Private operators manage day-to-day operations.	Operators get remunerated if they met the operational requirements and the fleet standards.

Bus operator landscape – by city (6/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Lima	Metropolitano (BRT)	Around 720 articulated and 200 feeder buses.	Private operators own the buses while the government owns the terminals.	Operators in charge of following the routes set by Protransporte (transport agency).	Users pay with an electronic prepaid card and operators get remunerated.
	Private (303)	Small buses that serve to transport people on short rides.	Private operators own the buses while the governments owns the stops or paraderos.	Private operators operate and maintain buses. There are no defined routes; a designated person in each bus announces the next stop.	The user pays directly to the driver in cash.

Bus operator landscape – by city (7/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Guadalajara	Macrobus (BRT)	~45 articulated buses.	Private operators own the buses while Macrobus provides the stations.	Sistema de Tren Eléctrico Urbano (SITEUR) manages the 27 stations and dictates schedules. Private operators manage the buses.	Concessions last for up to 12 years. Fares are collected in a trust that then remunerates operators and service providers.
	Private	5,200 buses.	Government owns the infrastructure, while operators own the buses.	The government assigns the contracts, designs the lines, and sets the fare. Private operators operate and maintain the buses.	Passengers pay directly in cash.



Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

Bus operator landscape – by city (8/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Bogota	TransMilenio (BRT) - 10 operators	2,027 articulated or bi-articulated and 947 feeders. 10 operators.	TransMilenio owns the buses and hires drivers and maintenance personnel. TransMilenio also owns the stations.	The city is responsible for the maintenance of all infrastructure related to daily operations. Private operators operate and maintain buses.	Users pay via a prepaid card. Operators are remunerated based on the number of route kilometers (for trunk line buses) or the number of passengers carried (for feeder buses).
	Sistema Integrado de Transporte Público (SITP) - 7 operators	9,339 buses.	Private operators own their buses and garages while the government provides the infrastructure.	The government plans the routes and operates the stops and terminals. Private operators are in charge of all bus expenses and operations.	Users pay with a prepaid card (the same as for TransMilenio).



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Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

Bus operator landscape – by city (9/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Salvador	Private operators (16)	2,445	Private operators own the buses that have to meet the requirements set by the Public Transport Service Collective for Bus Passengers in the city of Salvador (STCO).	STCO maintains the infrastructure. Private operators operate and maintain buses.	25-year concessions divide operations in three different areas. <i>Detailed information on payment not available.</i>



Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

Bus operator landscape – by city (10/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Rio de Janeiro	BRT (Transoeste, Transcarioca and Transolimpica)	383 buses	Private operators own the buses and the city owns the infrastructure.	The local government assigns the operations and maintenance of buses to private operators. The government oversees stations and terminals.	Through an integrated payment system, where revenues are collected and then distributed to operators.
	Private (47)	8,700 buses	Operators own the buses and the city provides minimal infrastructure.	Operators have to maintain their buses while the city defines the routes.	Through an integrated payment system, where revenues are collected and then distributed to operators.



Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

Bus operator landscape – by city (11/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Buenos Aires	Metrobus (BRT)	Some articulated and some conventional buses	Private operators own the buses. The local government owns the infrastructure.	Private operators in charge of buses, the Comisión Nacional de Regulación y Transporte (CNRT) and the Subsecretaría de Transporte in charge of planning routes and expanding the system.	Each line is given to a different operator. Users pay through the SUBE system.
	Private (199)	18,413 buses.	Each operator owns the buses needed to meet the demand of its assigned line.	The CNRT divides routes and operators manage the operation of the buses in each route.	Passengers pay directly in cash.

Bus operator landscape – by city (12/12)¹

City	Operator model	What are assets?	Who owns assets?	Who operates and maintains assets?	How are assets/activities funded?
Curitiba	Rede Integrada de Transporte (BRT and other buses integrated)	1,930 buses in total (from biarticulated to micro)	Private operators own the buses and the Urbanização de Curitiba S.A. (URBS) owns the infrastructure.	The URBS is in charge of assigning contracts and schedules, setting and collecting fares, and setting standards. Private operators have to meet the schedules and standards through the operation of the buses.	The city pays operators a set amount each month.



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Notes: 1. This high-level landscaping was completed rapidly and is not comprehensive.

ANNEX

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- Bus operator landscape: What are current bus operator business models?
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- Sources and references



We explored several questions to break down bus operator business models

Key question	Key considerations/variants
Which assets does the operator have/use? How many?	<ul style="list-style-type: none"> Number, type, and quality of buses, stations, terminals, garages (and batteries and charging infrastructure, after transition to e-buses)
Who owns/operates/maintains/scraps the assets? ¹	<ul style="list-style-type: none"> Public, private, or a mix Degree of vertical integration across own/operate/maintain Degree of public authority oversight
How is acquisition funded ?*	<ul style="list-style-type: none"> Leasing, renting, debt, grants/subsidies, guarantees, a mix, etc. Public, private, or mix of financing Role of city-level trusts/guarantees
How is ongoing O&M funded ? How are operators compensated ?*	<ul style="list-style-type: none"> Tariff collection, government subsidies Role of city-level trusts/guarantees Set remuneration scheme (by km, passengers, both)
How is scrapping funded ? ¹	<ul style="list-style-type: none"> Various financing schemes; buses sometimes re-sold
Which system-level and external factors influence the business model?	<ul style="list-style-type: none"> Policy and regulations – Less to more supportive (e.g., government commitments, fuel and vehicle taxes/subsidies) Transport governance – Who oversees system & how Local utility landscape – Readiness for/interest in e-bus transition City features – Route distance, weather, topography, etc.

Model A: Vertically-integrated private operator in BRT/integrated system

Private actor owns, operates, and maintains buses via public concession; public transport authority oversees shared infrastructure

Examples



- Metrobus, CDMX

Key question	Description
Which assets does the operator have/use? How many?	<ul style="list-style-type: none"> • Quality: newer buses overall, given BRTs began ~15 years ago, but many buses are reaching the end of their productive life • Size: fleet ranges from small to large, depending on city size and coverage • Type: Special bus technology (i.e., articulated) and station infrastructure
Who owns/operates/maintains/scraps the assets?	<ul style="list-style-type: none"> • A single consolidated, mature private sector transport company owns, operates, and maintains buses, garages, and repair shops end-to-end; with terms set by ~10 year concessions • Public sector owns all other infrastructure • Stronger government requirements and oversight, relative to traditional service
How is acquisition funded?	<ul style="list-style-type: none"> • Sometimes debt and grants • Sometimes down payment from scrapping • Sometimes supported by city-level trust/guarantee (e.g., CDMX Metrobus fideicomiso)
How is ongoing O&M funded? How are operators compensated?	<ul style="list-style-type: none"> • Tariff collection • Commonly, government subsidies (often city-level) • Sometimes coordinated via city-level trust/guarantee • Other revenue sources (e.g., advertising) are often limited
How is scrapping funded?	<ul style="list-style-type: none"> • More formal, regulated process



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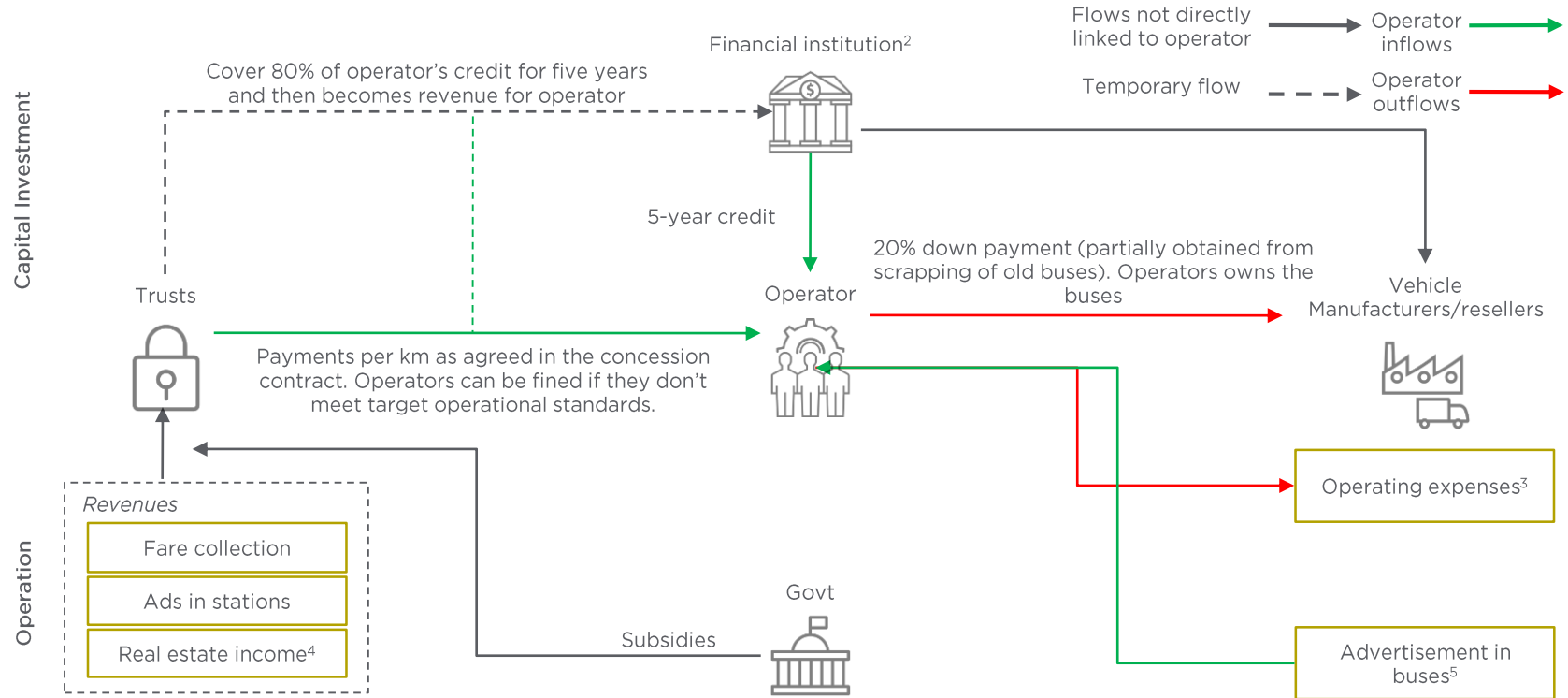
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Financial flows of model A¹

Private actor owns, operates, and maintains buses via public concession;
public transport authority oversees shared infrastructure



Model B: Divided responsibilities in BRT/integrated system

Public sector or private actor (via public concession) owns buses; another private actor operates and maintains buses via other public concession

Examples



- Transmilenio, Bogotá

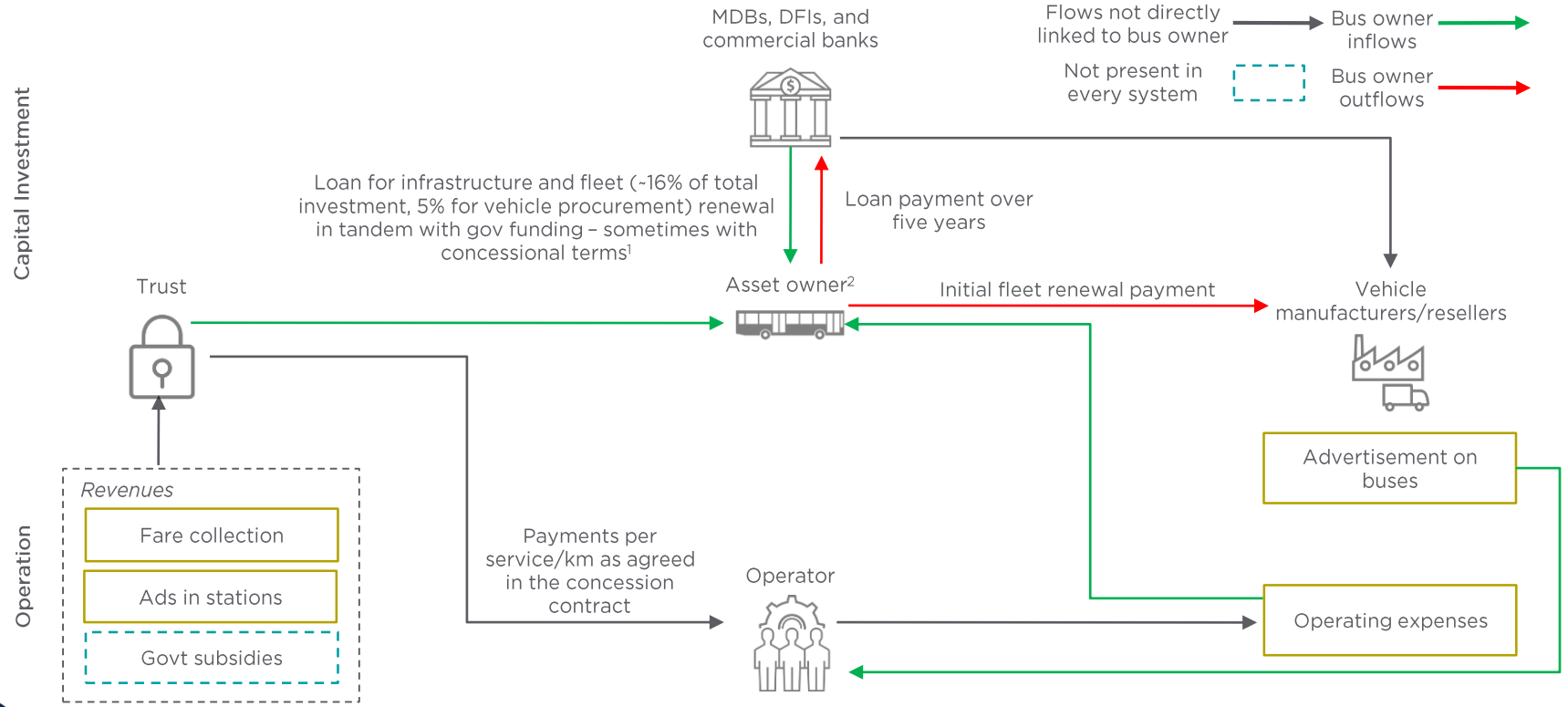
Key question	Description
Which assets does the operator have/use? How many?	<ul style="list-style-type: none"> • Quality: newer buses overall, given BRTs began ~15 years ago • Size: fleet ranges from small to large, depending on city size and coverage • Type: Special bus technology (i.e., articulated) and station infrastructure
Who owns/operates/maintains/scraps the assets?	<ul style="list-style-type: none"> • Unlike vertically-integrated BRT, responsibilities are split between asset ownership and O&M: <ul style="list-style-type: none"> ➢ Public sector owns all/most assets, including buses, OR a private sector actor owns buses (without any role in O&M) via public concession ➢ Different private sector actor (not owners) operate and maintain buses via public concession • Stronger government requirements and oversight, relative to traditional service
How is acquisition funded?	<ul style="list-style-type: none"> • Government-financed via budget, debt, etc. OR debt/grants from private operator
How is ongoing O&M funded? How are operators compensated?	<ul style="list-style-type: none"> • Tariff collection • Sometimes government subsidies (often city-level) • Other revenue sources (e.g., advertising) are often limited
How is scrapping funded?	<ul style="list-style-type: none"> • More formal, regulated process



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Financial flows of model B

Public sector or private actor (via public concession) owns buses; another private actor operates and maintains buses via other public concession



Model C: Large, more formal, private operator in traditional service

More formal company owns, operates, and maintains buses in traditional transport service via permit or shorter-term public concession, with less oversight from government

Examples



- COPESA, CDMX
- SITP, Bogotá
- Some TPC operators, Medellín

Key question	Description
Which assets does the operator have/use? How many?	<ul style="list-style-type: none"> • Quality: relatively modern, as formalization of traditional bus operators is relatively new in LATAM • Size: larger fleets, usually with several hundred buses • Type: traditional bus sizes (e.g., <12m)
Who owns/operates/maintains/scraps the assets?	<ul style="list-style-type: none"> • Private sector owns all/most assets, including buses, and operates and maintains most assets of the system (vertically-integrated) • Loose government requirements and oversight (often via concession)
How is acquisition funded?	<ul style="list-style-type: none"> • Sometimes debt (e.g., five-year credit)
How is ongoing O&M funded? How are operators compensated?	<ul style="list-style-type: none"> • Tariff collection • Other revenue sources (e.g., advertising) are often limited
How is scrapping funded?	<ul style="list-style-type: none"> • Less regulated process; some sell buses to other operators



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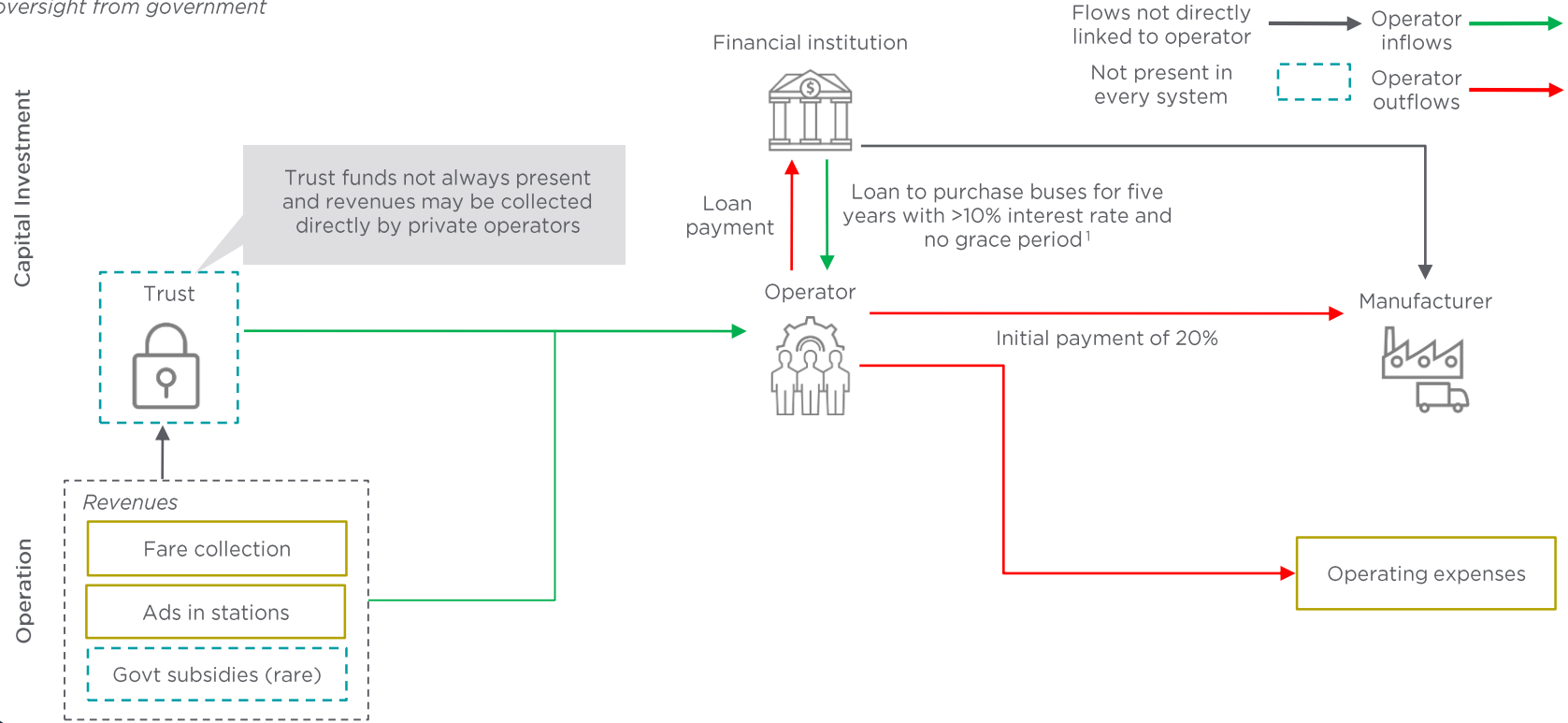
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Financial flow of model C

More formal company owns, operates, and maintains buses in traditional transport service via permit or shorter-term public concession, with less oversight from government



Model D: Small, informal, private operator in traditional service

Individual owns, operates, and maintains small bus fleet in traditional transport service via permit or shorter-term public concession, with less oversight from government

Examples



Key question	Description
Which assets does the operator have/use? How many?	<ul style="list-style-type: none"> • Quality: generally older buses that are not well-maintained • Size: generally small fleets owned by a single person/family • Type: standard fossil fuel buses and minibuses
Who owns/operates/maintains/scraps the assets?	<ul style="list-style-type: none"> • Private sector owns all/most assets, including buses, and operates and maintains most assets of the system (vertically-integrated) <ul style="list-style-type: none"> ➢ Stops are sometimes not clearly defined; garages and stations are owned by private actors, but these are usually players outside the bus system ➢ Sometimes operations rely on “hombre-camion” model • Loose government requirements and oversight (often via “permission” contracts)
How is acquisition funded?	<ul style="list-style-type: none"> • Sometimes debt
How is ongoing O&M funded? How are operators compensated?	<ul style="list-style-type: none"> • Tariff collection • Other revenue sources (e.g., advertising) are often limited
How is scrapping funded?	<ul style="list-style-type: none"> • Less regulated process; some sell buses to other operators

Model E: Government-run system

The government owns, operates, and maintains buses and associated assets; there is little participation by the private sector

Examples



- SM1/RTP, CDMX
- Metroplus, Medellín

Key question	Description
Which assets does the operator have/use? How many?	<ul style="list-style-type: none"> • Quality: broad range • Size: commonly large as it is monopolized and protected by the govt • Type: broad range, depending on the coverage – SM1 has smaller buses and articulated buses in the BRT
Who owns/operates/maintains/scraps the assets?	<ul style="list-style-type: none"> • Public sector owns all assets, including buses, and oversees operations and maintenance
How is acquisition funded?	<ul style="list-style-type: none"> • Government-financed via budget, debt, etc.
How is ongoing O&M funded? How are operators compensated?	<ul style="list-style-type: none"> • Tariff collection • Commonly, government budget and subsidies (often city-level) • Other revenue sources (e.g., advertising) are often limited
How is scrapping funded?	<ul style="list-style-type: none"> • <i>Additional details to be added following city visits</i>



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ANNEX

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Risks and mitigation – additional detail (1/2)

RISK TYPE	POTENTIAL RISKS	MITIGATING MEASURE
Political & regulatory	<ul style="list-style-type: none"> • Unfavorable changes in govt – changes in government priorities can impede or reverse progress to deploy e-buses • Unforeseen contract changes – unexpected changes in the contracts can create instability for stakeholders 	<ul style="list-style-type: none"> • Detailed contract clauses – can assure stability and ensure compensation in case of unforeseen changes • Public commitments – can help mobilize and align different parts of government
Technological & operational	<ul style="list-style-type: none"> • Falling technology prices – increases the risk perceived of investing now, given assets costs are quickly coming down (e.g., from 2010-2017 battery prices fell by 79%)¹ • Battery lifetime – uncertainty about how long battery will last and when it will need to be replaced (for a cost) • Limited local post-sale support – spare parts and mechanical experts less readily available for e-buses, causing delays and increased costs • Availability risk -- vehicles may be unable to operate at the capacity promised; for instance, they may cover lower ranges than expected or buses may not be as reliable as promised 	<ul style="list-style-type: none"> • Battery leasing – allows operators to capture the value of lower battery prices in the future • Manufacturer warranties – reduces risk of technology failure/poor performance for buyers • Purchasing terms – ensure post-sale support from manufacturers with local presence and/or compensation for delays



Notes: 1. BNEF "Electric Buses in Cities," 2018
Sources: Stakeholder interviews, 2019; BNEF, 2018

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In general, testing new financial models can provide valuable proof-of-concept to increase stakeholders' (e.g., investors) understanding of and confidence in e-bus investment over the longer term

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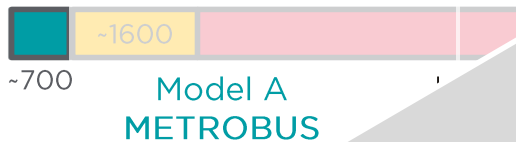
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CDMX: We modelled solutions for Metrobus, as it is the most ready and considered an example for others to follow

Market share of business model Readiness

of units, out of ~22,300 total



Overview

- Closely regulated system by Metrobus
- Private operators own most buses
- Most concessions last 10 years, with a few exceptions that last 20
- Recent efforts to renew fleets to clean technology

- **Planning** – Metrobus creates clear central plans for routes, operations, and expansion, which are accessible by all system stakeholders
- **Responsibilities** – Responsibilities are clearly defined in the system; for instance, operators are responsible for supplying the buses, Metrobus is in charge of stations, roads, and parking lots
- **Financial contracts & guarantees** – A central trust (fideicomiso) guarantees payments to operators (based on kms. in service), fleet renewal credits, admin costs of the system's ticket charging system, and others; concession agreements have comprehensive terms that clearly define the relationship between Metrobus and operators
- **Governance** – Metrobus has strong governance over operators. It constantly monitors that operating routes are met, bus maintenance is up to date, and operators are on schedule

Impact

- Metrobus is seen as a “first mover,” that can motivate other bus systems to follow suit and adopt e-buses

CDMX: Concession contracts and operational feasibility affect all commercial arrangements

Key barrier	Potential mitigating strategies
<ul style="list-style-type: none"> Current concession contracts make e-buses less attractive and are difficult to change – contracts mostly last 10 years and allow for Euro V buses 	<ul style="list-style-type: none"> Work with Metrobus to update contracts to last >10 years; currently, 10-year concession contracts frequently get extended (up to 13 years) due to process delays
<ul style="list-style-type: none"> Replacement of diesel buses at a 1:1 ratio not feasible for some operators, for example charging time required for e-buses to cover similar distances as diesel/CNG, is four hours. Requiring more e-buses decreases financial viability of all commercial arrangements 	<ul style="list-style-type: none"> Identify lines and operators where close to 1:1 replacement is possible, based on routes and charging needs, and focus initial procurement on these lines Prioritize fast-charging systems, where possible Secure performance guarantees from manufacturers, to ensure that operators have a minimum number of buses available that meet key performance metrics (e.g., # of km per charge of battery)
<ul style="list-style-type: none"> Unclear roles and responsibilities between third party capital providers and operators may jeopardize the operation of the public transport system, given this would be a new setup 	<ul style="list-style-type: none"> Establish new terms in the concessional clauses that clearly establish who will be responsible for owning, maintaining, and operating all new assets in the system

CDMX: Guarantees are critical for all solutions

Commercial arrangements	Key barrier	Potential mitigating strategies
1. Concessional finance for asset owners	<ul style="list-style-type: none"> • Large exposure to asset risks as operators will bear all the risks related to e-buses assets, which may lead to serious financial strains for operators • Operators may not have access to favorable credit terms to allow for financial viability, given many are newly-formalized companies with limited credit history 	<ul style="list-style-type: none"> • Provide credit and/or revenue guarantees to ensure repayment of debt to investors • Given high upfront e-bus costs, additional guarantors beyond Metrobus may be required to de-risk the operation
2a. Separation of asset ownership – bus, battery, charging	<ul style="list-style-type: none"> • Significant change from traditional business model for all stakeholders, as most operators currently own all their bus assets • Lack of attractive financial returns might reduce the capital available for investment 	<ul style="list-style-type: none"> • Revenue guarantees – Metrobus could restructure operating concession agreements to pay third party capital providers directly (e.g., pay them directly via the fideicomiso/Metrobus accounts) to mitigate their risks • Risk-mitigating contracts – Metrobus can motivate good use of batteries (e.g., monitoring program that ensures batteries are used as intended to optimize their lifetime) and guarantee functional batteries are always available
2b. Separation of asset ownership – battery & charging only		

CDMX: Local banks and DFIs could help finance transition

Note: Not exhaustive

Type	Potential partners	Illustrative examples	Potential role
Financiers/ financial intermediaries	Commercial banks	<ul style="list-style-type: none"> Banca Mifel has supported bus financing projects alongside Banobras' PROTRAM; for example, in Queretaro they established a line of credit to purchase 222 new BRT buses, that were backed by the trust of the BRT¹ Banco Multiva and Banamex have also supported bus financing projects alongside Banobras' PROTRAM 	<ul style="list-style-type: none"> Provide financing to operators for the purchase of e-buses Act as financial intermediary to bridge concessional financing from multilaterals to operators
	Local development institutions	<ul style="list-style-type: none"> Nacional Financiera (NAFIN) commonly provides guarantees and loans; for example, in 2017 it issued a credit line for USD ~25 million for fleet renewal at a federal level² Banobras, has a fund focused on infrastructure projects for BRTs named PROTRAM, which has invested over USD 1.2 billion to date³ Banobras has also financed various technical studies for BRTs, their infrastructure, and their fare collection systems through grants; for example, it financed feasibility studies for Ecovia in Monterrey and Mexibús in Estado de Mexico 	<ul style="list-style-type: none"> Provide credit guarantees to operators to access financing for e-buses Provide financing to operators for the purchase of e-buses Develop technical studies for operators to understand the minimum requirements for new e-bus fleets Procure charging infrastructure for stations and depots
Financiers/ guarantors	Metrobus	<ul style="list-style-type: none"> The Metrobus Fideicomiso is the current guarantor for operators to buy buses Has expressed interest in electric mobility 	<ul style="list-style-type: none"> Provide revenue guarantee for operators to access financing to buy e-buses Organize operators for joint e-bus procurement Provide revenue guarantees to third party capital providers who lease components by paying them directly



Notes: 1. Revista Transportes, "GroBus logra credito por 500 mdp para 222 buses," 2017. 2. Revista Transportes, "Invierte Gobierno Federal en renovacion de transporte publico," 2017. 3. Animal Politico, "La Movilidad de los mas privilegiados," 2018.

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Medellín: The largest opportunity to electrify buses is with private operators

Market share of business models
of units, out of ~6,440 total

Model C 60 PRIVATE OPERATORS



Overview

- Regulated by the Secretary of Mobility & AMVA;¹ operators have permits with no end date
- Many buses are Euro V
- Range from larger companies (e.g., ~70 buses) to small owners in cooperatives/associations
- Some are integrated into common payment system

Readiness

- **Planning** – Operators develop activities based on central planning carried out by AMVA and the Secretary of Mobility, including recent efforts to consolidate and integrate the system
- **Responsibilities** – Responsibilities are clearly stipulated: operators own, operate, and maintain buses; the city handles road infrastructure, permits, and fare collection
- **Financial contracts & guarantees** – Operators have contracts with AMVA government to operate; however, there is not currently a city-level trust to back operations
- **Governance** – AMVA and the Secretary of Mobility closely regulate the system

Impact

- TPC has the highest potential impact as it represents ~92% of total buses in AMVA; Metroplus has already committed to only renew fleet with e-buses

Medellín: In TPC most operators must be formalized into companies before transitioning to e-buses

Key barrier	Potential mitigating strategies
<ul style="list-style-type: none">• Many TPC operators are still less-sophisticated small fleet owners of a few buses. Transitioning to e-buses for these small owners is harder due to resistance to change, limited access to credit to purchase e-buses, etc.	<ul style="list-style-type: none">• Continue to support the formalization of traditional TPC operators into bus companies and evaluate the possibility of leapfrogging them into adopting e-buses in the process
<ul style="list-style-type: none">• Formal TPC operators have limited access to guarantees, as they do not have access to city-level trust and the central farebox does not provide guarantees for operators	<ul style="list-style-type: none">• Provide insurance or credit guarantees to operators based on the operator data collected by the central farebox such as revenue history, hours of operation, etc.
<ul style="list-style-type: none">• Not all routes in AMVA can be covered by e-buses due to long distances, topographic difficulties, etc.	<ul style="list-style-type: none">• Assess which lines have the highest potential to be covered by e-buses, to prioritize



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Medellín: TPC operators need access to revenue and income guarantees to participate in e-bus arrangements

Commercial arrangements	Key barrier	Potential mitigating strategies
1. Concessional finance for asset owners	<ul style="list-style-type: none"> Operators might not have access to loans that make e-buses viable, as they don't have the credit history or transparency required by financing institutions Operators bear all e-bus technology and financial risks (e.g., drops in battery prices) Loan providers risk non-repayment due to transportation market risks, as TPC operators' income depends on passenger fares 	<ul style="list-style-type: none"> Manufacturers provide warranties to operators to ensure assets function Expand access to income stabilization guarantees (e.g., FET), provide guarantee mechanisms via the central farebox for TPC operators, or consider other mechanisms (e.g., insurance)
2a. Separation of asset ownership – bus, battery, charging	<ul style="list-style-type: none"> Required change in culture, as financials of operators will significantly change compared to status quo Third party capital providers will need a guarantee that leases will be paid 	<ul style="list-style-type: none"> Provide technical support to operators to understand their new business model Expand access to income stabilization guarantees (e.g., FET), provide guarantee mechanisms via the central farebox for TPC operators, or consider other mechanisms (e.g., insurance)
2b. Separation of asset ownership – battery & charging only		

Medellín: Many partners have already started working to support electric vehicles, led by the govt

Note: Not exhaustive

Type	Potential partners	Illustrative examples	Potential role
Financiers/ financial intermediaries	Local development institutions	<ul style="list-style-type: none"> Findeter is currently working with EPM in Medellín to provide credits for private actors to purchase electric vehicles for buses; the credits can cover up to 70% of the bus price, last up to 10 years, and have interest rates ranging from 0-12% Bancoldex has provided financing to operators to update their fleets; for example, Bancoldex matched a CTF loan for clean technology buses at a 1:1 ratio 	<ul style="list-style-type: none"> Provide concessional financing to operators, through commercial banks, to purchase e-buses
	City and regional govts	<ul style="list-style-type: none"> The city government is actively supporting the electrification of transportation and has provided funds to electrify fleets For example, in 2019, the city government purchased 64 electric buses, with batteries, and 16 charging stations for the city's BRT system 	<ul style="list-style-type: none"> Purchase buses directly Subsidize cost of financing for operators who want to update their buses to electric Continue to create and enforce laws that motivate the electrification of transportation in the city
	Commercial banks	<ul style="list-style-type: none"> Local banks such as Davivienda, Bancolombia, and Banco de Occidente are supporting Findeter's initiative in Medellín to finance fleet renewal 	<ul style="list-style-type: none"> Provide concessional financing to operators to purchase e-buses
Financiers/ Guarantors	Agencia Nacional de Infraestructura (ANI)	<ul style="list-style-type: none"> Worked on Colombia's fourth generation (4G) of toll road concessions by providing (i) grants to finance part of the projects, and (ii) revenue guarantees to potential investors based on toll revenues 	<ul style="list-style-type: none"> Provide guarantees for financing to operators
	Fondo Nacional de Garantías (FNG)	<ul style="list-style-type: none"> Is providing guarantees in the EPM program to electrify Medellín's mobility 	<ul style="list-style-type: none"> Provide guarantees for financing to operators



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International partners can support commercial arrangements in both cities

Note: Not exhaustive

Type	Potential partners	Illustrative examples
Financiers/ financial intermediaries	Commercial investors	<ul style="list-style-type: none"> HSBC has a group specialized in electric mobility investment; for instance, in Colombia HSBC and IFC supported a recent fleet renewal Macquarie has a group that works on electromobility and has created financing solutions to scale the deployment of electric vehicles in different countries (e.g., a leasing program of e-trucks in Australia) Mitsui recently supported USD 200 million battery leasing facility with Proterra
	DFIs, MDBs	<ul style="list-style-type: none"> IDB has provided financing for bus renewals in the region; for example, it provided bonds for USD ~58 million for the purchase of hybrid buses for Bogota's BRT KfW has concessional credit lines for electric mobility, including specific concessional credits for e-buses; for example, it provided loans to Indian operators with 2% annual interest rates to finance fleet procurement
	Other funders	<ul style="list-style-type: none"> Green Climate Fund, Clean Technology Fund have provided concessional financing for e-bus projects; for example, GCF financed Mythra Mobility, an Indian operator, to purchase e-buses and build infrastructure
Third party capital providers	Utility companies	<ul style="list-style-type: none"> Engie and Enel are participating in the deployment of ~400 e-buses in Santiago de Chile by purchasing e-buses and their components and leasing them to operators
	Bus manufacturers	<ul style="list-style-type: none"> Proterra sells e-bus chassis/body and provides battery leasing for 12 years, with full warranty BYD partnered with Generate Capital Inc. (a clean-energy financing company) to allocate USD 200 million for its first-ever leasing program in the United States



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ANNEX

- E-bus context: What is the opportunity for e-buses in Latin American cities?
 - Bus operator landscape: What are current bus operator business models?
 - Commercial arrangements: What are options to transition to e-buses & investments needed to support this?
 - Modelling potential solutions: How could potential solutions be applied in CDMX and Medellín?
- Sources and references



List of stakeholders interviewed (1/4)

Name	Organization	Location
Carlos Alberto Orlando Guillen	ADO/MIVSA	CDMX
Jose Miguel Diaz Hernandez	ADO/MIVSA	CDMX
Gabriel Guggisberg	Agencia Chilena de Eficiencia Energética	Global
Adam Sherman	ARC	Global
Bryan Wisk	ARC	Global
Juan Guillermo Zapata	ASOTRANSVA	Medellín
Francisco Quiñones	BANOBRAS	CDMX
Carlos Valdes Mariscal	BANOBRAS	CDMX
Julián Villarroel	BYD	CDMX
Nicolas Rosales	CISA	CDMX
Jorge Suarez	Engie	CDMX
Flavio Raposo de Almeida	EPE	Rio de Janeiro
Gustavo Naciff de Andrade	EPE	Rio de Janeiro

List of stakeholders interviewed (2/4)

Name	Organization	Location
Natalia Goncaves	EPE	Rio de Janeiro
Sandra Milena Puertas Arango	EPM	Medellín
Jose Fernando Trujillo	Findeter	Medellín
Juan Gonzalo	Flota Nueva Villa	Medellín
Joscha Rosenbusch	GIZ	CDMX
Jone Orbea Artuza	GiZ/C40 Cities Finance Facility	CDMX
Nicole Taumeuel	GiZ/C40 Cities Finance Facility	CDMX
Stephanie Hartman	GiZ/C40 Cities Finance Facility	CDMX
Graham Smith	HSBC	Global
Daniel Perez	IDB	Global
Juan David	IDB	Global
Juan Pablo Brichetti	IDB	Global

List of stakeholders interviewed (3/4)

Name	Organization	Location
Yuichiro Inoue	IFC	CDMX
Andres Garcia-Novel	IFC	CDMX
John Graham	IFC	Global
Emmanuel Pouliquen	IFC	Global
Gonzalo Peon	ITDP	CDMX
Baruch Sangines	Jetty	CDMX
Fabiola Gómez	KfW	CDMX
Leticia Ferreras	Macquarie	Global
Skye d'Almeida	Macquarie	Global
Fernando Montoya	Masivo de Occidente	Medellín
Leonardo Campino	Masivo de Occidente	Medellín
Joni Fontoura	Meridiam	Global

List of stakeholders interviewed (4/4)

Name	Organization	Location
Fredy Velázquez	Metrobus	CDMX
Quetzalli Castillo Ramirez	Metrobus	CDMX
Gustavo Jiménez	Órgano Regulador de Transporte (ORT)	CDMX
Diego Silva	Rio Onibus	Rio de Janeiro
Irina Rodríguez	Secretaria de Movilidad Medellín	Medellín
Donald Calle	Secretaria de Movilidad Área Metropolitana	Medellín
Juan Manuel Gómez	Servicio de Transporte Eléctrico (STE)	CDMX
Ramón Morales Zepeda	SM1/RTP	CDMX
Vladimir Sosa	WRI	CDMX
Dhyana Quintanar Solares	WSP	Global
Julio Cesar Pérez	Yutong	CDMX



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