Identification of Business Models to Accelerate E-Bus Introduction in Uruguay

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MOLO eMobility

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This analysis was carried out by a team led by **Liljana Sekerinska** (Senior Transport Specialist), that included **Leonardo Samuel Leyton Abalos** (Electric Mobility Consultant), **Lucia Spinelli** (Senior Energy Specialist), **Juan Carlos Cardenas Valero** (Energy Consultant), **Javier Morales Sarriera** (Transport Economist), **Rebekka Bellmann** (Transport Economist) and **Ignacio Sánchez D'Ocon** (Transport Consultant). The team would like to thank peer-reviewers **Pierre Graftieaux** (Senior Operations Officer), **Gregoire F. Gauthier** (Senior Transport Specialist) and **Alicia Hernández Muñoz** (Consultant). The team would also like to thank Practice Manager **Nicolas Peltier-Thiberge** for his overall guidance and support.

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Acronyms

BEB	Battery Electric Bus
BSP	Bus service provider
CAPEX	Capital expenditure
CIF	Cost, insurance, and freight
COMAP	Commission for Application of Investment Promotion Law (Comisión de Aplicación de la Ley de Inversiones)
TC	Consular Tax (Tasa Consular)
EFAMSA	EF Asset Management (Administradora de Fondos de Inversión S.A.)
EV	Electric vehicle
FleetCo	Third-party investor under leasing agreements
GoU	Government of Uruguay
IM	Municipality of Montevideo (Intendencia Municipal de Montevideo)
IRAE	Corporate Tax (Impuesto a la Renta de las Actividades Económicas)
IRR	internal rate of return
MEF	Ministry of Economy and Finance (Ministerio de Economía y Finanzas)
MIEM	Ministry of Industry, Energy and Mining (Ministerio de Industria, Energía y Minería)
MTOP	Ministry of Transport and Public Works (Ministerio de Transporte y Obras Públicas)
NDC	Nationally Determined Contributions
NPV	Net present value
OPEX	Operational expenditure
TCO	Total Cost of Ownership
TGA	Global Duty Tax (Tasa Global Arancelaria)
UREE	Unidad Reguladora de la Energía Eléctrica
URSEA	Unidad Reguladora de Servicios de Energía y Agua
UTE	Uruguayan electric utility (Administración Nacional de Usinas y Trasmisiones Eléctricas)
US$	United States dollar
UY$	Uruguayan peso
WACC	Weighted Average Cost of Capital

Executive Summary

Introduction

Scaling-up e-mobility in Uruguay is considered an important step forward towards achieving the country's decarbonization goals. Through its Nationally Determined Contribution (NDC) to the Paris Agreement , Uruguay has committed to several mitigation measures in the transport sector, including the promotion of e-mobility, especially for intensive-use vehicles, such as cargo vehicles and buses, but also offering incentives for private cars. While e-buses have started to enter the public transportation system, they still represent a very small percentage of the total fleet in Uruguay. There is, however, a strong commitment to change the situation and make all the fleet electric by 2030.

The MOVÉS project1 promotes the use of electric vehicles (EVs), helps banks develop green credits for the purchase of EVs, and gives specific credits for medium-sized enterprises. Tax benefits to import or buy EVs have been introduced to encourage private car users, taxi service providers, and public utilities to replace their fleets with electric cars. Moreover, Uruguay has a mid-term plan to replace all buses in cities with electric buses (e-buses) while improving services and has established subsidies for the purchase of e-buses. These ambitions require high investments and also impact tax revenues, thus, requiring the country to take a closer look at the financial mechanisms it can consider for moving to electric mobility at the lowest public cost and to ensure its sustainability.

[1] MOVÉS is a Project funded by the Global Environment Facility (GEF) which seeks to promote the use of public passenger transport and active mobility (walking and cycling), as well as the replacement of passenger and cargo and last mile vehicles to electric and sustainable ones. (https://moves.gub.uy/)

This report is the product of the technical assistance to develop a business model to finance and scale up e-mobility in Uruguay provided by the World Bank and funded by the Mobility and Logistics (MOLO) Trust Fund. The report systematically analyzes international experiences and synthesizes them as stylized business models. Combining key learnings from other countries and an in-depth assessment of the regulatory and fiscal framework in Uruguay, the report formulates five alternative business models. In a next step, it evaluates these models under different scenarios regarding their expected financial and fiscal impacts.

Combining key learnings from other countries and an in-depth assessment of the regulatory and fiscal framework in Uruguay, the report formulates five alternative business models. In a next step, it evaluates these models under different scenarios regarding their expected financial and fiscal impacts.

The Uruguayan experience in terms of e-bus deployment since 2019 has shown to be effective based on an integrated assets model (Bus service providers (BSPs) own chassis, batteries, and charging stations), financed through a combination of a fleet renewal trust fund from the Municipality of Montevideo and an investment subsidy from the Government of Uruguay. Beyond the public investment subsidy, the Municipality of Montevideo trust fund for fleet renewal has managed to get financing and guarantees at a moderate interest rate, helping to mitigate the high investment cost of e-buses.

Through the financial and fiscal analysis of the alternative models, the report simulates and compares two models of total asset separation and leasing (named Model 3A and 3B), taken from successful Latin American experiences, with the current business models in place in Uruguay: (i) the COMAP model (Investment Promotion Regime providing tax incentives) – Model 1 and (ii) the Investment Subsidy model (launched in September 2019 and covering the price difference between an electric bus and a diesel bus) – Model 2. The results of the simulation give guidance regarding the feasibility of the new business models, from the point of view of BSPs and of society as a whole. As described in detail below, new asset separation and leasing models achieve economic results comparable to the current models (total costs for society and internal rates of return of BSPs), but present clear advantages in terms of lower public subsidies and stronger business sustainability.

Under the technical and financial assumptions applied, total asset separation and leasing models (Models 3A and 3B) achieve results comparable to the current models. The leasing model shows better results for the whole system when UTE participates as the third-party investor developing collective parking bays for the use of all BSPs (either by the utility itself or by outsourcing those services to private companies).

The analysis suggests that total asset separation and leasing models may open a wider range of opportunities for e-bus deployment in terms of regulatory improvements in the transport sector. Asset separation has the benefit of isolating assets from BSP risk.

The implementation of a total asset separation and leasing model would require changes in the current regulatory and institutional status. In particular, there would be a need to i) explore and address legal conditions to guarantee leasing contracts between BSPs and third-party investors (manufacturers, energy subsidiaries, investment funds) through the trust funds already in place (for fleet renewal) or others; and ii) allow current operational subsidies to be oriented towards the new operational leasing expenditures.

Assets are available for the system irrespective of the operator and remain as such even after changes of BSP because of regulatory or financial reasons. These models also represent an opportunity to attract fresh funding for renewal of the diesel fleet, which will demand increasing amounts of CAPEX. This advantage would be even more relevant considering that public direct subsidies (as considered in Model 2) may not be sustainable in the medium and long term. At the same time, leasing models may provide operational solutions that may be more efficient from the point of view of the Total Cost for the Society.

The total asset separation and leasing model may also allow additional steps to improve the efficiency of the bus and battery acquisition process through i) the implementation of centralized and competitive purchasing mechanisms for e-bus fleet expansion in future stages; ii) the adoption of price-revealing tender mechanisms through two-step tendering processes; and iii) the planning and implementation of sequenced investment processes to benefit from technology developments in the e-bus field that are constant and the time of acquisition significantly impacts the required amount of support in the form of subsidies/grants.

The e-bus transition imposes challenges on the power system and UTE activity, but equally so opportunities to include UTE as the developer and operator for large common charging stations for all e-buses.

When it comes to private EV charging and given the reduced number of e-bus operators, a mechanism can be implemented by means of which UTE owns and operates (by itself or outsourced) charging stations that are open to all e-buses. Concentration of power needs and rationalization of flows would be achieved, easing the distribution network planning and allowing the exploitation of the bidirectional flow potential of such a considerable battery within the system. Moreover, increased infrastructure utilization factors open the door to higher-cost investments (faster chargers, more complex infrastructure) and relieve BSPs from a significant source of expenditure. On the other hand, UTE can design a new tariff to recover investment costs while benefitting from better distribution network management capabilities.

Beyond the scope of the study, there are additional environmental and economic benefits that can be internalized by new e-bus models, in particular in Uruguay, due to the availability of renewable energy, less noise pollution and quality improvement of public transport service.

Technical issues/restrictions that must be addressed to ensure a successful transition to an asset separation and leasing model:

- It is important to clearly establish the role of manufacturer, BSP, and leaser with respect to operations and maintenance (O&M).
- Given range restrictions for batteries, it is important to select those routes whose length and altimetry best fit the range of each unit.
- The current technical specifications for e-bus subsidies limit the options to consider regarding charging technologies since only two types are accepted. To benefit from future developments, this limitation should be removed for future tendering rounds.
- When batteries reach 65 percent of their capacity, they will be replaced by a new unit according to the technical requirements of the call for subsidies. They may be used as backup for charging infrastructure or connected to low-voltage grids (operated by UTE) to increase their flexibility. Uruguay is currently working at the second life cycle regulation for batteries.
- E-buses are a new technology to all BSPs in Uruguay: New O&M routines, new activities (charging), and a different type of driving must be introduced in the system.

International Experience and Stylized Business Models

Cities around the world have deployed different business models to introduce e-buses in order to overcome obstacles, such as high up-front costs, insufficient access to financing, and/or difficulty to change concession contracts, thus easing the transition to electric public transportation. The implementation of those business models illustrates how certain issues can be mitigated in a variety of local contexts.

These alternative business models for e-buses can be characterized along three axes:

- The degree of asset separation between BSPs and third parties (such as municipalities or third-party investors).
- The means of financing and guaranteeing the investment in e-buses.

- The participation of power utilities and other stakeholders in the power industry in the e-bus business

Usually, BSPs enter concession contracts with municipalities requiring them to operate public transportation services, subject to specified levels of quality of service, and, in return, they are granted a certain level of profitability. Bus fares are typically subsidized so that end users only pay a portion of the actual cost of the service while the rest is provided by the municipality or the government.

To mitigate potential liquidity problems for BSPs (given the small size of many companies and the required investment in assets), in some cases buses belong to the municipality itself and BSPs only operate them. For the industry, this was the initial step toward the separation of operation and ownership and has shown to be a way to allow the introduction of additional parties in the business. Such asset separation models apply equally to diesel and e-buses, although for e-buses three different assets can be characterized—chassis, batteries, and chargers—and utilities/power companies can also be involved.

In parallel to the three conceptual axes, there is a set of technical restrictions and uncertainties that affect the feasibility of all business models as techno-economic parameters: lifetime of chassis and batteries, bus range, local road and infrastructure conditions, charging time, and other policy and social issues, such as political will to mitigate pollution/noise, the need to keep bus fares low, and the subsidization of some groups of customers over others (urban versus rural dwellers).

As a way to promote and expand their own businesses, stakeholders not traditionally involved in transport, such as manufacturers and utility companies, have also recently been entering the market to purchase vehicles or batteries and lease them to the operators of the public fleets.

The case for power agents' investment (utilities or other subsidiaries) is supported by three identified benefits:

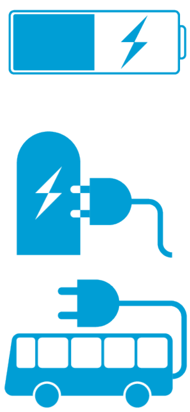
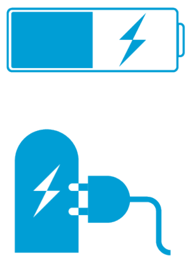
- It helps to scale up e-bus deployment and the expansion of electricity transportation.
- It may mitigate the challenge as distribution companies face the increased installation of self-generation/distributed generation, which decreases the volume of energy distributed through the grid, making consumption from the grid more expensive (less energy must support increased fixed costs) and reinforcing the position of self-consumption, and aggravating the problem described. The expansion of EVs implies higher power consumption and higher power flows through the grid, which may help mitigate the problem.
- It creates an opportunity to develop smart solutions for battery charging and vehicle-to-grid advantages for distribution operators.

The previous conceptual considerations allow to initially identify a set of typical business models based on the degree of asset separation:

- **No asset separation**. This is an integrated assets model, meaning that the chassis, batteries, and charging stations are the property of BSPs. Typical cases: Shenzhen and Beijing. Both cases are characterized by high public participation and public funding of the e-bus activity (even being different public institutions), with the main purpose being its effective deployment and expansion. BSPs' investment is directly funded, subsidized, or guaranteed by the public budget.
- **Total asset separation**, mostly developed in Latin America. Typical cases: Santiago de Chile and Bogotá.
- **Partial asset separation 1**, with batteries and charging infrastructure owned or leased by a third-party investor and chassis being the property of BSPs. Typical cases: London and São Paulo.
- **Partial asset separation 2**, with charging infrastructure owned by a third-party investor and chassis and batteries being the property of BSPs. Typical

The following figure represents the four stylized business models identified from international experience.

Figure ES.2 - Business Models from International Experience

	Total Separation	Partial separation 1	Partial separation 2	No separation
Assets separated from BSP				No separated assets
Third-party investor	Electricity/ energy subsidiary	Manufacturer (or subsidiary)	Electric utility	No third-party investor
Investment funding and guarantee	Asset leasing Public trust funds/Ticket fare funds	Asset leasing BSP Guarantee	Electricity tariff revenue Investment guarantees in utility regulation	Public Funds/subsidies
	Santiago de Chile Bogotá	London São Paulo	California Kolkata	China(Shenzen, Bejing) Uruguay(pilot case)

Source: MRC Group

China and the Organisation for Economic Co-operation and Development (OECD) countries have provided substantial public funding and subsidies to their local governments for the adoption of e-bus mobility, which is not a possibility in emerging markets. This state-funded model, based on public subsidies and strong fiscal systems to back them up, is not easily implementable in developing countries.

In the midterm, in the municipalities of emerging markets, EVs must stand on their own from an economic perspective. Cities are adapting to how buses and bus services are procured, allowing third parties to assume an important share of the risk. More flexible procurement enables third-party agents to offer BSPs the option to lease both buses and batteries, reducing technological and financial risks. Complementarily, a key factor that attracts third-party investors in the e-bus business is the financial guarantee to back the recovery of their investment.

The lessons learned from asset separation from BSPs in Latin America (mainly in Chile and Colombia) have been quite effective in terms of alleviating the significant up-front cost and financial challenges that investment in e-bus transition impose on BSPs and city transport authorities. Asset separation has been combined with leasing arrangements between authorities or BSPs and third-party investors that allow the mitigation of the significant initial CAPEX barriers (usually supported by public subsidies), transforming them into periodic leasing (OPEX) payments along the lifetime of the assets (chassis and batteries).

Asset separation/leasing strategies have managed to attract international energy corporations, electric utilities (when allowed by regulation), and manufacturers as third-party investors as a way of promoting the development of an increasing demand for electricity and e-buses from BSPs and cities that clearly favors their own business sustainability.

Regulatory and Fiscal Framework in Uruguay

Uruguay's current framework is characterized by support schemes for e-buses, regulation of the public transport system, and the role of the power supplier (Administración Nacional de Usinas y Trasmisiones Eléctricas; UTE) in deploying e-buses. The main characteristics are:

- Operator revenues are set based on a Technical Tariff (defined under efficiency criteria) and the actual number of passengers (tickets). As the actual average tariff is lower than the Technical Tariff because of final subsidies to different user groups, a tariff subsidy payment by the Municipality of Montevideo is required.
- Currently, all BSPs receive a diesel subsidy for fuel consumption (through the so-called Diesel Trust Fund[2]), paid by all end-user diesel consumers. Part of this subsidy could be used to subsidize e-buses.
- The creation of financial liabilities trust funds in Montevideo and sub-urban areas has allowed BSPs to obtain low financing costs and reinforce guarantees for lenders.
- UTE is the sole power supplier in the country, while chargers are owned by BSPs.
- There are different tax treatments for e-buses and diesel buses, and BSPs can choose between two support schemes for e-buses: (i) COMAP - (Investment Promotion Regime) and (ii) e-bus purchase subsidy

General Subsidy Regime for Public Transport

The public transport system in Uruguay is based on concessions to BSPs who operate certain routes and receive end fares fixed by the state, plus some subsidies to complement their revenues.

- Around 66 percent of the volume of public transport is generated in Montevideo, and the service is provided by a fleet of 1,514 buses.
- Other than compensation for discounts to students, retirees, and frequent travelers, there are two main operational subsidies:
    - The diesel subsidy (through the so-called Diesel Trust Fund): All BSPs are granted a subsidy payment on the amount of diesel they consume (up to a regulated level per liter) directly lowering their operational costs. This subsidy is directed toward lowering end-user fares

[2] Decree 347/2006.

  - Tariff subsidy: This is directly provided by the state and covers the difference between the average fare and the so-called technical fare (cost of service tariff).
- The system is financed by means of revenues collected from tariffs (around 66 percent) while the rest of revenues for BSPs (34 percent) come in the form of previous subsidies (diesel subsidy, tariff subsidy, and periodic compensation for discounts to students, retirees, and frequent travelers).
- Trust funds for financial liabilities (facilitating fleet renewal) were developed as a mechanism to grant low-cost financing to BSPs, who can leverage on the system to obtain financing.
- Regarding tickets, most trips are sold as pre-paid tickets (using an electronic card) and revenues go to a central fund, which allocates the money to BSPs every 48 hours (to avoid cash restriction problems for BSPs).

Investment Promotion Regime (COMAP)

The general Investment Promotion Regime in Uruguay is a well-established regime by which investments that result in job creation and are innovative receive specific tax exemptions. Approved by Law 16.906 in 1998, it isimplemented through the Commission for Application of Investment Promotion Law (Comisión de Aplicación de la Ley de Inversiones, COMAP) and includes exemptions from the payment of import duties (Global Duty Tax and Consular Tax), and reductions of up to 50 percent in the Corporate Tax (Impuesto a la Renta de las Actividades Económicas; IRAE) are enjoyed. It has been recently used for e-bus investment in a few cases

E-Bus Investment Subsidy

In September 2019, the first call for subsidies for the purchase of e-buses was launched in Uruguay under a specific e-bus subsidy regulation with the objective of replacing 4 percent of the total bus fleet. The subsidy covers the difference in the price of a diesel bus and an e-bus with similar characteristics to assist any operator to buy an e-bus at the same price as a conventional one. Using this mechanism, BSPs are granted a monthly payment (for seven years) that covers the difference in investment costs between a diesel bus (as computed by the government) and the actual e-bus purchase costs (as declared by each of the BSPs on a CIF[3] basis). According to the Government of Uruguay estimates, investment subsidies for e-buses are equivalent to subsidizing the consumption of a diesel bus throughout the useful life of the bus, so the system will not experience an increase in total costs.

[3] Cost, insurance, and freight.

Under this framework, Montevideo companies received 30 units: 20 for CUTCSA (BYD), 4 for COETC, 3 for COMESA, and 3 for UCOT (all of them from YUTONG). The remaining 3 units, awarded to companies in the metropolitan area (CodelEste), are from ANKAI.[4]

The Electricity Sector and UTE

There are three main aspects related to e-bus prospects:

- Electricity tariffs applied to e-mobility consumers
- Connection regime for e-bus charging depots
- Regulatory regime for electricity supply to EVs by private charging service providers.

The Uruguayan power sector is concentrated around UTE, a vertically integrated state-owned company.

Even though the regulatory framework allows competition in the generation market and third-party access to transmission and distribution networks, in practice, generation competition has been very limited. The transmission and distribution sectors remain as regulated sectors, under the ownership of UTE, and the principle of free access to networks is stated though not totally effective.

Currently, BSPs managing e-bus fleets have their charging depots connected as GC1 clients (large customers, at low voltage, with contracted demand above 200 kilowatts). Extraordinary connection costs and grid/substation reinforcement are charged to BSPs as a non-reimbursable capital contribution to UTE.

There is no specific tariff category for e-bus charging similar to the ones that exist for taxis and private EVs. Currently, a rebate applies to regular tariffs (50 percent during valley and 20 percent during the rest of the periods), but it is only applicable to e-buses until December 2023. Tariff design optimization may improve the operational costs of BSPs.

EV charging services are currently fully provided by UTE. There is no explicit regulation allowing third party competitive providers to supply energy procured in the wholesale market to final EV customers. commercialization of electricity to third parties as a public service that can be provided only by UTE or under a public concession regime (needs to be clarified in the medium term to scale up the provision of competitive EV charging services and, consequently, the availability of a reliable EV charging system for e-buses.

[4] CUTCSA, COETC and UCOT are bus service providers in Uruguay. YUTONG and ANKAI are bus manufacturers

Alternative Business Models and Financing Schemes in Uruguay

There exist three different models that support diesel buses and the e-bus introduction in Uruguay:

- **Diesel Model**: Includes the purchase of diesel buses by means of the Investment Trust Fund (low-cost financing, including guarantees for lenders) and later receive a subsidy for diesel consumption. No fiscal incentives apply, but BSPs receive an operational subsidy (the diesel subsidy) for the quantities of diesel they consume.
- **Model 1** (E-bus purchase under the Investment Promotion Regime (COMAP) Model): Allows the purchase of e-buses under the investment promotion scheme (COMAP), with reduced tax obligations. If investments result in job creation and are innovative, they can be exempted from the payment of import duties (Global Duty Tax and Consular Tax) and reductions of up to 50 percent are enjoyed regarding the Corporate Tax. No bus asset separation is implied in this model.
- **Model 2** (E-bus purchase under the Investment Subsidy Model): Allows the purchase of e-buses under the subsidy regime. BSPs that participated in the subsidy tender are given a monthly payment for 84 instalments that covers the difference in the investment cost between the e-bus and a diesel bus. In this case, imports are additionally exempted from the Global Duty Tax (but not from the Consular Tax). No asset separation is implied in this model.

Besides the three existing models, an alternative model, based on asset ownership separation, is analyzed:

- Model 3 (asset ownership separation): this model foresees that a third party (a power subsidiary or any other asset manager) creates a company that buys large fleets of e-buses (FleetCo) and then offers the e-buses to the BSP under a financial leasing agreement. Fiscal conditions are the same as in Model 1 (COMAP) but now the buyer is a third party instead of the BSP. If a subsidy is still necessary, it must be noted that leasing payments are operating expenses, not an investment. Therefore, this creates the possibility to use the Diesel Trust Fund to partially subsidize leasing payments by the BSP to the leaser.

An analysis of international experience shows that the timely development of charging infrastructure, the access to non-congested power distribution networks, and the cost of installing chargers can be relevant factors for success. As a result, the analysis considers the benefits of involving the power incumbent (UTE) in the development of charging infrastructure and therefore Model 3 has two variants:

- **Model 3A:** Includes the leasing of all assets (chassis + battery + charging infrastructure). E-buses are purchased under an asset separation model. A third party purchases all assets and leases them to the BSP. The third party is entitled to receive COMAP benefits..
- **Model 3B:** Includes the leasing of (chassis + battery), while UTE develops the charging infrastructure. E-buses are purchased under an asset separation model, together with UTE involvement. A third party purchases all chassis and batteries and leases them to the BSP (the third party is entitled to receive COMAP benefits).e UTE invests in and manages chargers with the goal of establishing common charging stations for BSPs.

In terms of new business models for the sector, we include Model 3A of total asset separation through lease financing as the most differentiated model with respect to the current situation, that international experience shows facilitates third-party investment and e-bus deployment. Model 3B is a variant of Model 3A, in which the utility invests in charging infrastructure, but does not change the degree of asset separation (total asset separation). It must be borne in mind that in both models (3A and 3B), the third-party investor has been assumed to operate under the COMAP scheme, i.e., benefit from fiscal incentives.

Figure ES.3 - Diagram of Proposed Business Models in Uruguay

Technology	Diesel	E-BUSES			
Support Scheme	Current subsidized model	Investment subsidy	COMAP		
Business model name	Diesel Model	Current model (Model 2)	Current Model (Model 1)	FleetCo (leasing) Model 3A	FleetCo (Leasing) +UTE (Model 3B)

Source: MRC Group

Financial Assessment of Business Models

The financial assessment compared the Total Cost for Society for the five selected business models in three different investment scenarios. All e-bus models were compared to the current Diesel Model, and savings computed against total cost of the model. The Total Cost for Society of each business model was calculated as the sum of:

- **Total payments by public sector**: The GoU/IM
- **Costs borne by consumers** (ticket fares, power charges, and diesel subsidy):
  - Power charges represent the extra payments made by power consumers in case UTE develops the charging infrastructure required for common charging bays.
  - Ticket fares represent total payments by end users of the transportation system. This item is equal for all cases since the financial tool assumes no changes to final transport fares.
  - Diesel subsidy is paid by all diesel consumers to subsidize diesel for BSPs. The financial tool considers that if one diesel bus is replaced by an e-bus, the amount of diesel subsidy corresponding to that unit is saved.
- **Total avoided cost (pollution):** This represents the reduction in polluting emissions achieved by e-buses (this measure does not apply to diesel buses but is equal among all e-bus business models)..
- **Total tax revenues**: These are revenues collected yearly in terms of Corporate Tax and Road Tax, and at the time of investment (Consular Tax, Global Duty Tax, and VAT + IMESI).

The financial assessment also compared internal rates of return (IRRs) for operators and third parties (leasing entities) when applicable.

In FleetCo business models (Models 3A and 3B), a subsidy to leasing payments is included that may be funded by the current Diesel Trust Fund with the purpose of financing the deployment of e-buses and allowing a minimum acceptable IRR to BPSs. As of today, the Diesel Trust fund lowers the cost of diesel for BSPs with the aim of achieving lower end-user fares for public transportation. The same goal can be achieved if the subsidy is applied to the leasing payments for e-buses. It would mean applying an operational subsidy (the diesel subsidy) to a leasing payment that can also be considered as an operational cost. Compared to the current e-bus subsidy (Model 2), this proposal implies changing a subsidy to investment (to be repaid in seven years) for an operational subsidy to be paid during the whole life of the bus (16 years). As such, the burden for the state/consumers is reduced over time.

The financial tool was constructed to deliver the exact amount of subsidy required to grant both BSP and third parties their required levels of profitability (different subsidies are granted in the two FleetCo models).

Main model assumptions:

- Demand for the bus transport system (December 2019)
- Technical tariff as computed by IM for defining BSP revenue
- Unit costs aligned with values used by IM for technical tariff computation
- Cost of capital comparison:
  - BSPs (6.0 percent)
  - FleetCo cost of capital (leasing conditions) (5.52 percent)
  - UTE (6.88 percent)
- Social discount rate (3.09 percent)
- Period of assessment (16, 17, and 26 years, depending on the investment scenario)
- International technical performance standards

Three investment scenarios were considered to present different degrees of fleet renewal (affecting different time horizons). They are subject to different investment prices given the scale of investment.

- **Investment Scenario 1:** 100 e-buses purchased in year zero, considering a 10 percent discount on investment price. This scenario covers 16 years.
- **Investment Scenario 2:** 200 e-buses purchased, 100 in year one and another 100 in year two, considering a 15 percent discount on investment price. This scenario covers 17 years.
- **Investment Scenario 3:** 100 e-buses a year for 10 years, purchased between years zero and nine, considering a 20 percent discount on investment price. This scenario covers 26 years.

All buses have a 16-year useful life (following the estimations made by the GoU). All scenarios consider that buses operate for their full useful life and are then retired from the market. In order to allow for their full depreciation, different time horizons are required for each investment scenario.

The following tables present Total Cost for Society [net present value (NPV) along assessment period] disaggregated by component for each of the business models under consideration, together with the IRR obtained by operators. Figures are expressed in million US$ for 2019.

Table ES.3 - Investment Scenario 1 (100 e-buses): Total Cost for Society (US$, millions 2019)

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
Total Payment by Public Sector	-43.9	-57.3	-76.5	-57.3	-57.3
Cost Borne by Consumers	-183.3	-157.2	-157.2	-170.3	-165.7
Total Avoided Cost (Pollution)	-	8.4	8.4	8.4	8.4
Total Tax Revenues	7.1	0.6	5.9	2.4	2.3
TOTAL	**-220.1**	**-205.5**	**-219.4**	**-216.8**	**-212.4**
IRR BSPs	7.1%	1.8%	7.9%	6.0%	6.0%

Source: MRC Group

It is relevant to highlight that the goal of the financial simulation is to obtain high-level findings about the feasibility of the business model from the point of view of the society and the involved parties. Under this approach, the previous results allow for the extraction of the following initial findings:

Under the assumptions considered for the financial simulation, the Diesel Model seems to have the highest total cost (for society), which is consistent with the goal of transitioning toward an e-buses fleet.

Total leasing models based on third-party investors (3A and 3B) show a total cost comparable to the current models in place (Models 1 and 2), considering the reasonable uncertainty over technical and financial assumptions, while keeping acceptable IRR levels for BSPs.

As FleetCo has lower cost of capital than BSPs, both Models 3A and 3B have lower total cost than Model 2.

Even though the cost of capital for UTE is higher than for FleetCo, the total cost of Model 3B is lower than that of Model 3A because UTE being the developer of charging infrastructure, common depots for BSPs are installed, taking advantage of substantive economies of scale and higher productivity of those bigger charging depots.

Due to the low subsidization in Model 1, it has the lowest Total Cost for Society, but shows a very low IRR for BSPs. The COMAP model appears to be a nonviable solution for e-bus deployment in terms of profitability for BSPs. For it to be effective, additional measures (such as further tax incentives) need to be in place; this will alter the final cost of the model.

With respect to incentives for the transition, in the absence of mandatory administrative targets (that could be derived from NDCs), the main incentive is BSPs' profitability. It is relevant to highlight that BSPs' profitability in leasing models reach acceptable levels with respect to their weighted average cost of capital (WACC), making them feasible from the point of view of BSPs. Analysis of Investment Scenarios 2 and 3 shows that when considering the 10-year investment plan, the size of the fleet and the cost evolution of the e-bus technology play a greater role.

The analysis of Investment Scenarios 2 and 3 shows that when considering the 10-year investment plan, the size of the fleet and the cost evolution of the e-bus technology play a greater role.

Table ES.4 - Investment Scenario 2 (200 e-buses): Total Cost for Society (US$, millions, 2019)

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
Total Payments by Public Sector	-88.6	-115.7	-149.6	-115.7	-115.7
Cost Borne by Consumers	-369.8	-317.1	-317.1	-338.1	-329.3
Total Avoided Cost (Pollution)	-	17.0	17.0	17.0	17.0
Total Tax Revenues	14.9	2.0	16.4	6.4	6.0
TOTAL	**-443.5**	**-413.9**	**-433.4**	**-430.4**	**-422.1**
IRR BSPs	7.2%	3.1%	7.8%	6.0%	6.0%

Source: MRC Group

Table ES.5 - Investment Scenario 3 (1,000 e-buses): Total Cost for Society (US$, millions, 2019)

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
Total Payments by Public Sector	-384.4	-502.0	-621.2	-502.0	-502.0
Cost Borne by Consumers	-1,604.5	-1,375.9	-1,375.9	-1,456.7	-1,415.7
Total Avoided Cost (Pollution)	-	73.6	73.6	73.6	73.6
Total Tax Revenues	67.0	12.0	71.3	27.8	26.2
TOTAL	**-1,921.9**	**-1,792.4**	**-1,852.3**	**-1,857.3**	**-1,817.9**
IRR BSPs	7.1%	4.4%	8.0%	6.0%	6.0%

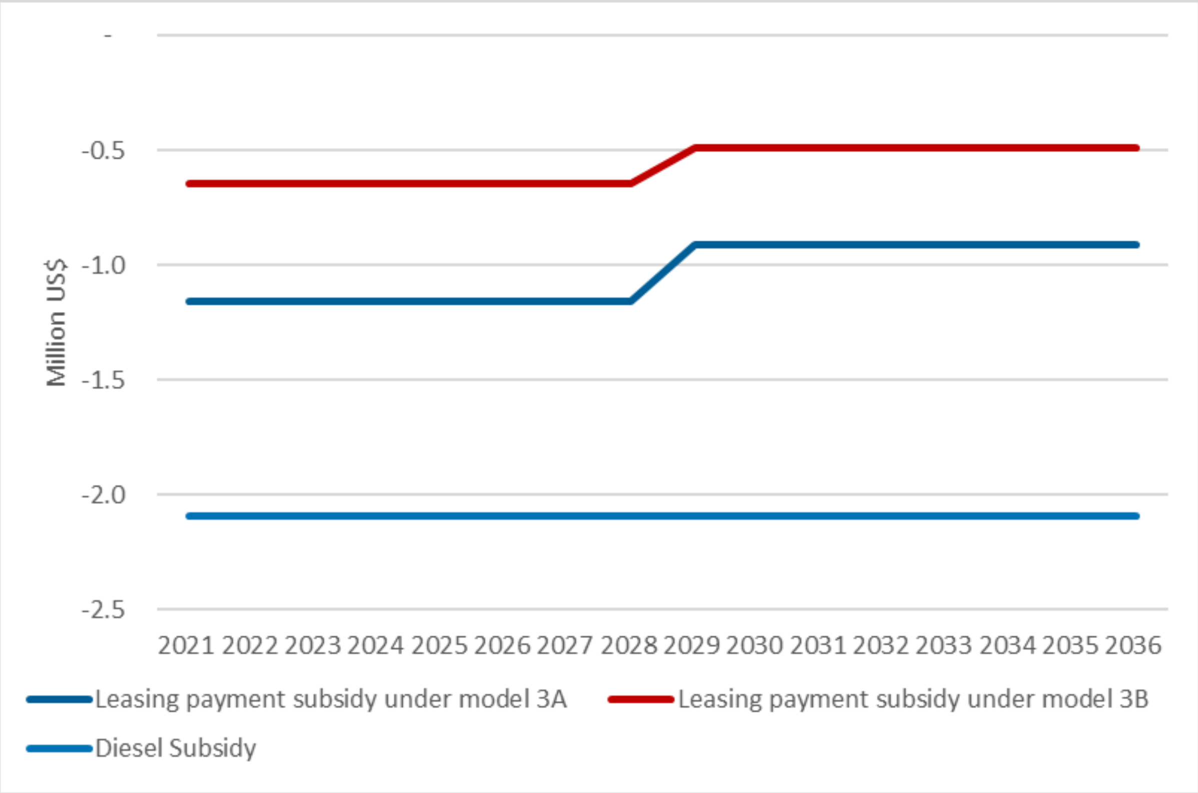
Source: MRC Group

In any case, the comparative analysis between alternative business models does not change with respect to Investment Scenario 1. The size of the fleet renewal, and the associated decrease in unit cost, favors all e-bus business models:

- The model under the investment subsidy (Model 2) is the most expensive if small fleets are considered but becomes less so as the fleet size increases (and the bulk purchase discounts increase). It is also the one that presents the highest profitability for operators.
- Leasing models present significant savings compared with the rest of the models, but the effect is a bit diluted if fleet renewal is large (and, hence, BSPs can benefit from future price decreases). If chargers are transferred to UTE, and common charging stations are developed, the savings implied by higher infrastructure usage factors result in significant cost reductions for the whole system.

A final relevant finding is that models in which leasing payments are present (Models 3A and 3B) require operational subsidies, but these are much lower than current diesel subsidies. The following figure presents the evolution of the subsidies paid year by year for the three models (in Investment Scenario 1). In Models 3A and 3B there is a reduction when batteries are replaced (since leasing payments are computed according to the battery acquisition price, which is forecasted to decrease).

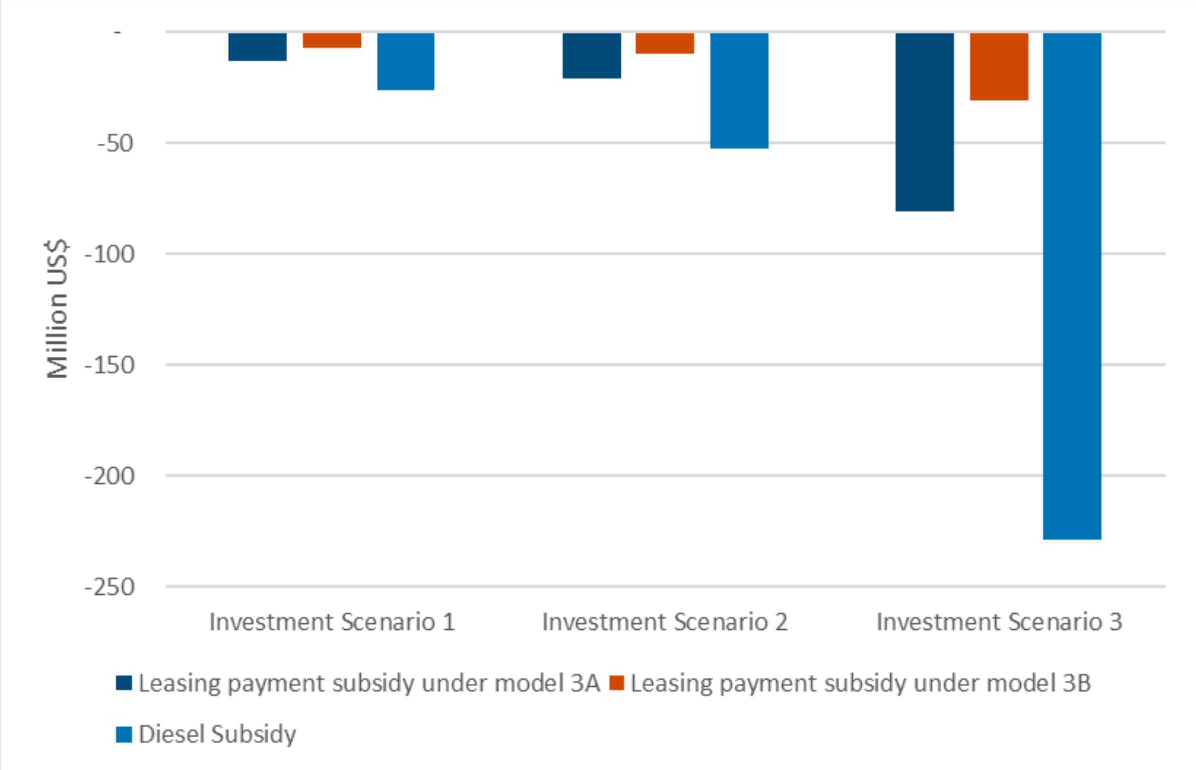
Figure ES.4 - Diesel Subsidy vs. Leasing Subsidies for Investment Scenario 1



Source: MRC Group

The following figure presents NPV of operating subsidies under the three investment scenarios considered. Results show that significant savings can be obtained if leasing models are applied. The higher the degree of fleet renewal, the larger the savings to be obtained.

Figure ES.5 - Comparison of Operational Subsidies



Source: MRC Group

In summary, the lowest Total Cost for Society is obtained with the leasing models, and particularly with the Model 3B which considers the participation of UTE. Significant savings can be obtained with respect to the Diesel Model, but support schemes are required, especially during the initial phases of development.

The **Diesel Model** is the most expensive option in two out of three scenarios (those with the largest fleets).

The **COMAP model (Model 1)** represents the largest savings in all investment scenarios, but BCP profitability is low. It starts as a nonviable solution due to the low profitability, but its position is improved as the size of the fleet is enlarged and as unit costs decrease, becoming more attractive to operators. For it to be effective, additional measures (such as further tax incentives) need to be in place—this will alter the final cost of the model.

The **Subsidy model (Model 2)** is the most expensive if small fleets are considered but improves as the fleet size increases (and the bulk purchase discounts increase). It is also the one that presents the highest profitability for operators.

The **Leasing models (Models 3A and 3B)** present significant savings when compared with the rest of models, but the effect is diluted if fleet renewal is large (and, hence, BSPs cannot benefit from future price decreases). Model 3B is the least-cost option among the scenarios that offer profitability for BSPs. If chargers are transferred to UTE and common charging stations are developed, the savings implied by higher infrastructure use factors result in significant reductions for the system as a whole.

There is a trade-off between BSPs profitability and the total cost of the system but, as economies of scale weigh in (large effect of fleet renewal), BSPs profitability increases in all models and the least expensive model (Model 1, COMAP) becomes a viable option for BSPs to operate.

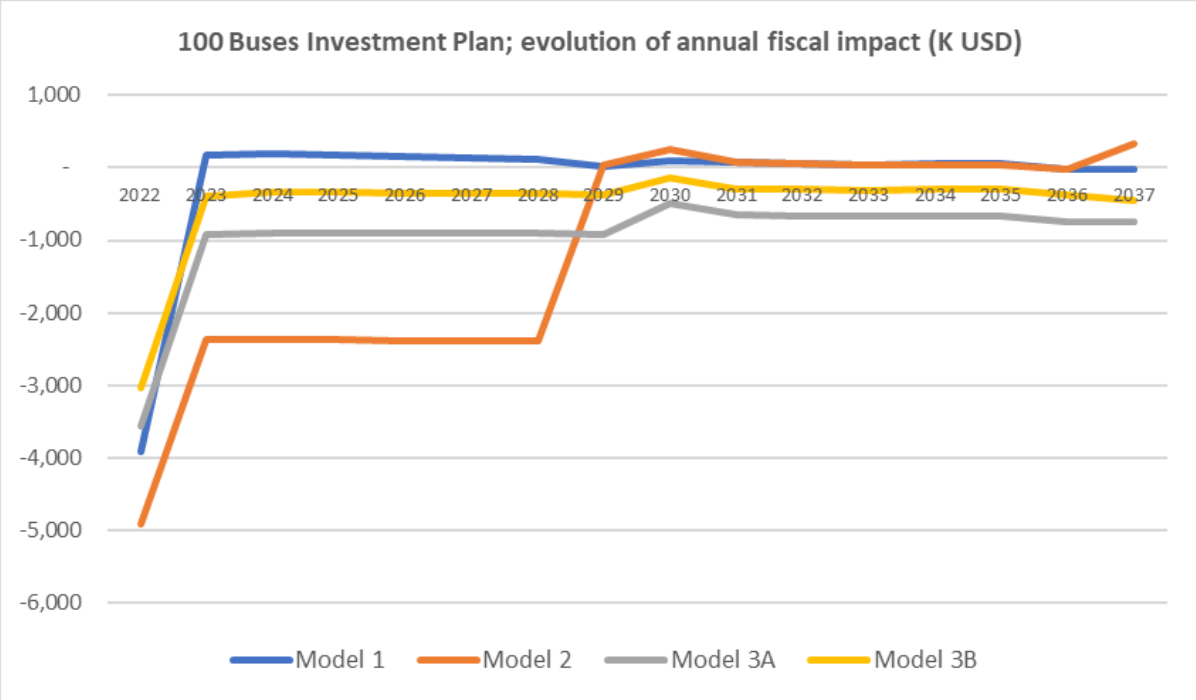
Fiscal Impact Assessment of Business Models

The fiscal impact of the four e-bus business models was calculated for the three investment scenarios. To allow the assessment of the results, the following aggregates have been calculated:

- **Fiscal impact**, distinguishing between investment and operation phases, for the first year and average per year.
- **Ratio of fiscal impact/current subsidies to diesel**, for the first year and average per year; it allows an appreciation of how much the state must increase its financial engagement in the bus transport sector.
- **NPV of the total fiscal impact**, calculated on the entire period of analysis (duration differs among the three investment scenarios).

The graph below (Figure ES.6) depicts the evolution of annual fiscal impact for investment scenario 1 (100 Buses-10% discount). Model 1 performs better than the other models, with the second most negative fiscal balance of the first year (-US$3.5 million), just after Model 2 (US$4.7 million), and a positive fiscal balance in the following years of the analysis period. The first-year imbalance of all the options is due to public subsidies and lower taxation for Models 2 and 3A/B, compared to the absence of taxation for Model 1.

Figure ES.6 - Investment Scenario 1 (100 buses); Evolution of Annual Fiscal Impact



Source: MRC Group

Such scenarios are compared with the traditional diesel bus, characterized by the absence of subsidies for asset purchase and higher taxation. Therefore, the investment phase is generating a huge fiscal imbalance which could be mitigated if the strong bargaining power deriving from the creation of a single purchasing center will allow to reach lower prices, as is the case with large fleet purchases in Chile..

The operational phase is more favorable to e-buses because of the subsidies to diesel purchase, only partially compensated by a different taxation of the two different sources of energy: 37 percent of VAT and other taxes for diesel, against 22 percent for electricity, applied to a much lower level of expenditure (power versus diesel)..

The main conclusions of the fiscal impact results are summarized by the NPV of total fiscal impact of each business model under the different scenarios. Model 1 (COMAP, with tax exemption) shows the smallest impact in all investment scenarios, but the differences are diluted if fleets become bigger and the investment period longer. Indeed, in Investment Scenario 1 (100 buses), Model 3B (the second best performing, with leasing and UTE involvement), has an almost three times larger fiscal impact than Model 1; in Investment Scenario 2 (200 vehicles) this is less than double; and in Investment Scenario 3 (1,000 buses) is less than 50 percent larger.

Table ES.6 - NPV of the Total Fiscal Impact: Four Business Models vs. Three Investment Plan Scenarios (values in US$, 2019)

Business Model	Investment Scenario		
	Sc. 1	Sc. 2	Sc. 3
Model 1 (COMAP)	- 2,828,790	- 5,334,223	- 21,889,807
Model 2 (Subsidy)	- 18,368,192	- 27,877,326	- 93,948,486
Model 3A (Leasing)	- 13,463,792	- 20,409,039	- 80,255,217
Model 3B (Leasing/UTE)	- 7,530,236	- 9,204,145	- 30,771,025

Source: MRC Group

In the following table, total fiscal impact for the first year and average per year, as well as the ratio of fiscal impact/current subsidies (also for first year and average per year) are shown for the four business models and the three investment scenarios. The above-described conclusions on NPV are confirmed (Model 1 first, Model 3B second, Model 3A third, and Model 2 fourth) and it is interesting to appreciate the fiscal impact in relative terms, through comparison with the current level of subsidies for the traditional diesel bus transport system. Indeed, in investment scenario 1, Model 1 shows an average increasing of the current financial support of only 3.1 percent. The first-year imbalance, at 62 percent, seems to be much less affordable. So, as previously noted, the possibility of reaching lower prices, similar to what has been achieved in Chile, through the creation of a single purchasing center, becomes a decisive factor in reducing both the huge first year fiscal imbalance as well as the average annual level of the imbalance. As regards the other two investment scenarios (200 and 1,000 buses), the average per year ratio of fiscal impact/ current subsidies is improving: Model 1 passes from 3.1 percent on the investment scenario 1 (100 buses) to 2.8 percent and 2.5 percent, respectively, for the investment scenario 2 (200) and investment scenario 3 (1,000 buses).

As regards to the other three models (2, 3A, 3B) the two indexes (average fiscal impact/current subsidy and first year imbalance) improve with the size of the investment, thereby suggesting investment scenario 3 as the optimal approach for Uruguay in terms of relative fiscal impact.

Concerning the temporal evolution of the impact, all four models present a relevant imbalance during the first year when the investment is carried out. Indeed, for Model 1, no taxes are accounted, while Models 2, 3A, and 3B receive subsidies and take advantage of reduced tax levels. In the following years, Model 1's balance becomes immediately positive (because of no subsidies on buses' purchase), Model 2 takes seven years, while for Models 3A and 3B the payoff stays negative to the end, depending on the different timing of subsidies disbursement.

Table ES.7 - Fiscal Impact of the Four Considered Business Models: First Year and Average per Year; Three Investment Scenarios (values in US$, 2019)

		Investment Scenario 1		Investment Scenario 2		Investment Scenario 3	
		Total Fiscal Impact	Fiscal impact/ current subsidies	Total Fiscal Impact	Fiscal impact/ current subsidies	Total Fiscal Impact	Fiscal impact/ current subsidies
M1	Year 1	-3,470,041	61.8%	-3.470.041	61.8%	-3,470,041	61.8%
	AVG/ year	- 92,174	3.1%	-170.016	2.8%	- 748,618	2.5%
M2	Year 1	-4,688,058	83.5%	-4.526.522	80.7%	-4,362,919	77.8%
	AVG/ year	-658,752	22.0%	-966.157	15.7%	3,577,902	12.0%
M3/A	Year 1	-3,175,885	56.6%	-3.006.738	53.6%	-2,971,792	53.0%
	AVG/ year	- 531,198	17.7%	- 806.683	13.1%	-3,550,351	11.9%
M3/B	Year 1	- 611,325	46.5%	-2.458.568	43.8%	-2,392,623	42.6%
	AVG/ year	- 293,162	9.8%	- 348.913	11.9%	-1,272,466	4.3%

KEY FINDINGS OF THE FISCAL IMPACT ASSESSMENT

The initial costs of e-buses are clearly the most relevant variable. Bulk purchasing of units and technology evolution could have a significant impact on the need for subsidies and tax reduction; initial hard subsidies will likely be progressively reduced.

Leasing schemes reduce total costs of the support scheme and would allow to replace the current investment subsidy (to be paid in seven years) with an operational subsidy (to be paid during the whole lifetime of the e-bus), alleviating the burden on the GoU. In a future scenario of bulk purchasing of units, and technology evolution, the leasing scheme could become even more efficient.

The inclusion of UTE as a relevant agent in Model 3B presents significant operational and investment savings and, consequently, less need for subsidies and lower fiscal impact, making the model more convenient from the fiscal point of view.

There is a convergence of fiscal impact for all models as the size of the fleet increases and technology costs decrease (battery evolution), and a lower fiscal impact in relative terms (as percentage increase of the current financial engagement of the GoU for the bus transport sector).

M - Model **AVG/Year** - average per year

Additional Considerations for the Introduction of Asset Separation and Leasing Models

The Uruguayan experience in terms of e-bus deployment since 2019 has shown to be effective based on an integrated assets model (BSPs own chassis, batteries, and charging stations), financed through a combination of a fleet renewal trust fund from IM and an investment subsidy from the GoU. Beyond the public investment subsidy, the IM trust fund for fleet renewal has managed to get financing and guarantees at a moderate interest rate, helping to mitigate the high investment cost of e-buses.

Through the financial and fiscal analysis of the alternative models, this report has simulated and compared two models of total asset separation and leasing, i.e., Models 3A and 3B (adopted from successful Latin American experiences) with the current business models in place in Uruguay, i.e., Model 1 (COMAP model) and Model 2 (Investment Subsidy model). The results of the simulation give guidance regarding the feasibility of the new business models, from the point of view of BSPs and of society as a whole.

Under the technical and financial assumptions applied, total asset separation and leasing models (Models 3A and 3B) achieve results comparable to the current models. The leasing model shows better results for the whole system when UTE participates as the third-party investor developing collective parking bays for the use of all BSPs (either by the utility itself or by outsourcing those services to private companies).

The analysis suggests that total asset separation and leasing models may open a wider range of opportunities for e-bus deployment in terms of regulatory improvements in the transport sector. Asset separation has the benefit of isolating assets from BSP risk. Assets are available for the system irrespective of the operator and remain as such even after changes of BSP because of regulatory or financial reasons. These models also represent an opportunity to attract fresh funding for renewal of the diesel fleet, which will demand increasing amounts of CAPEX. This advantage would be even more relevant considering that public direct subsidies (as considered in Model 2) may not be sustainable in the medium and long term. At the same time, leasing models may provide operational solutions that may be more efficient from the point of view of the Total Cost for the Society.

The implementation of a total asset separation and leasing model would require changes in the current regulatory and institutional status. In particular, there would be a need to i) explore and address legal conditions to guarantee leasing contracts between BSPs and third-party investors (manufacturers, energy subsidiaries, investment funds) through the trust funds already in place (for fleet renewal) or others; and ii) allow current operational subsidies to be oriented towards the new operational leasing expenditures.

The total asset separation and leasing model may also allow additional steps to improve the efficiency of the bus and battery acquisition process through i) the implementation of centralized and competitive purchasing mechanisms for e-bus fleet expansion in the next stages; ii) the adoption of price-revealing tender mechanisms through two-step tendering processes as suggested in Section 4.2.7; and iii) the planning and implementation of sequenced investment processes to benefit from technology developments in the e-bus field that are constant and the time of acquisition significantly impacts the required amount of support in the form of subsidies/grants.

At the same time, the e-bus transition imposes challenges on the power system and UTE activity. It is possible to include UTE as the developer and operator for large common charging stations for all e-buses. When it comes to private EV charging and given the reduced number of e-bus operators, a mechanism can be implemented by means of which UTE owns and operates (by itself or outsourced) charging stations that are open to all e-buses. Concentration of power needs and rationalization of flows would be achieved, easing the distribution network planning and allowing the exploitation of the bidirectional flow potential of such a considerable battery within the system. Moreover, increased infrastructure utilization factors open the door to higher-cost investments (faster chargers, more complex infrastructure) and relieve BSPs from a significant source of expenditure. On the other hand, UTE can design a new tariff to recover investment costs while benefitting from better distribution network management capabilities.

Finally, irrespective of the business model adopted for e-bus deployment, there are technical issues/restrictions that must be addressed to ensure a successful transition to an asset separation and leasing model:

- It is important to clearly establish the role of manufacturer, BSP, and leaser with respect to operations and maintenance (O&M).
- Given range restrictions for batteries, it is important to select those routes whose length and altimetry best fit the range of each unit.
- The current technical specifications for e-bus subsidies limit the options to consider regarding charging technologies since only two types are accepted (see Section 2.9.2 for a more detailed description). To benefit from future developments, this limitation should be removed for future tendering rounds.
- When batteries reach 65 percent of their capacity, they will be replaced by a new unit according to the technical requirements of the call for subsidies. They may be used as backup for charging infrastructure or connected to low-voltage grids (operated by UTE) to increase their flexibility. Uruguay is currently working at the second life cycle regulation for batteries.
- E-buses are a new technology to all BSPs in Uruguay: New O&M routines, new activities (charging), and a different type of driving must be introduced in the system.

This Report is organized in eight chapters:

1. **Chapter 1** presents and analyzes business models and suitable financing schemes to deploy e-buses extracted from international experience.
2. **Chapter 2** describes the current regulatory and fiscal framework for e-bus activity in Uruguay.
3. **Chapter 3** analyzes the regulatory framework and role of the state-owned electricity company UTE in EV activities.
4. **Chapter 4** proposes specific business models and financing schemes for the Uruguayan case.
5. **Chapter 5** presents the basics of the financial tool developed to assess e-bus business models and alternative financing schemes proposed.
6. **Chapter 6** presents the results of the financial simulation applied to the business models and financing schemes considered for Uruguay.
7. **Chapter 7** presents the fiscal impact analysis in the Uruguayan framework of the business models previously assessed.
8. **Chapter 8** summarizes the main conclusions raised in the study, characterizing what we consider the most promising regulatory, institutional, and financial proposals for the acceleration of e-bus deployment in Uruguay.

1. Business Models and Financing Schemes for E-Buses

Worldwide, experience with transition to EV transportation shows that public policies at the national and local level are relevant and complementary drivers to reduce fossil fuel-based transportation and improve the air quality of cities.

These drivers are backed by global mobility trends associated with three elements:

- Assuming climate change mitigation as a global priority in terms of pollution reduction and energy efficiency improvement
- A spiking evolution of connected devices technology and its influence on public mobility
- A surge of new consumption patterns based on new cooperative business models for individual transport and positive consumer attitude toward cleaner mobility technologies

In recent years, policies to support the introduction of EVs have been based on the definition of long-term targets, primarily with the aim of phasing out traditional vehicle (internal combustion engine; ICE) sales, reaching 100 percent of zero emission vehicle (ZEV) sales or fleet within the country. For instance, China and the United States started setting targets for EVs in 2011 and 2015, respectively. China now has a goal of reaching five million EVs by 2021. Norway is currently the most representative example with the ambitious target of having ZEVs as the only sale option for the country by 2025.

In the context of zero emission transport and public transport electrification, the introduction of e-buses often complements national targets for improving air quality in cities. As in the case of light-duty vehicles, cities around the world are also introducing e-buses for public transport supported by a combination of national and local policies. The following table reports the transport regulatory and policy arrangements that support heavy-duty EV in a selection of countries.

Figure 3 - Transport Regulatory and Policy Arrangements Supporting Heavy-Duty EV Around the World

Region / Country	EV 30@30 Sign	2011	2015	2016	2017	2018	2019	2020	2021	2023	2025	2027-28	2029	2030	2035	2038	2040	2045	2050
Asia																			
China	X		Target of 5 million EVs by 2020 (including 0.4 mill. buses and 0.2 mill. trucks)																
India	X				Target of 100% BEV share of purchases in urban buses by 2030														
							FAME Phase II includes a purchase incentive scheme for electric buses												
Japan	X						Fuel economy to be improved 13.4% by 2025 for heavy trucks and of 14.3% for buses relative to 2015 levels												
Korea							Target of: (i) 40 000 FCEV buses by 2040; (ii) 30 000 FCEV trucks by 2040.												
Malaysia						2 000 EVs in bus stock by 2030													
Pakistan							Buses: 50% of new sales to be EV by 2030 and 90% by 2040 Heavy-duty trucks: 30% of new sales to be EV by 2030 and 90% by 2040												
Europe																			
European Union							Revision of the Clean Vehicles Directive including minimum requirem. for urban buses (24-45% in 2025 and from 33% to 65% in 2030), and for trucks (6-10% in 2025 and 7% to 15% in												
France	X							By 2023 target of 200 hydrogen heavyduty vehicles (buses											
								By 2028, target of 800 to 2 200 hydrogen heavy-duty vehicles (buses, MFT and											
Germany							Incentives for buses to switch to electric, hydrogen and biogas technologies												
Hungary							All public transport to be electric by 2029												
Ireland						Ban on sales of diesel-only buses in 2019 - Target of 70% electric bus stock by 2035													
Netherlan	X						30% reduction of CO2 emissions across the transport sector by 2030												
				Target of 100% EV bus share of purchases by 2025 and 100% EV public bus stock by 2030															
							2025 target of 3 000 FCEV heavy-duty vehicles on the road												
Norway	X			Target of 100% EV share of purchases of urban buses by 2025															
				Target of 75% EV share of purchases of long distance buses and 50% in trucks by 2030															
Spain								Targets of 5 mill. EV in LDV, buses and 2/3-wheelers in 2030											
Sweden	X				Targets of reduction of CO2 emissions from transport by 70% in 2030 relative to 2010														
					Target of net zero GHG emissions by 2045														
North America																			
Canada	X					Tighter GHG emissions standards for heavy-duty trucks from 2021 and increasing stringency up to 25% relative to 2017 in														
United States		Fuel economy of heavy-duty trucks should be reduced by 30% by 2027 relative to 2010 levels																	
Central and South America																			
Brazil (Sao Paulo)						Reduce emissions of PM and Nox by 95% from 2016 levels by January 2038													
Costa Rica							Targets of 70% of buses to be ZE by 2035												
							Target of 100% of buses to be zero emissions by 2050												
Chile						100% electric public transport sector by 2040													
Colombia							100% new public transport to be ZEV by 2035												
Other Regions																			
Cabo Verde							50% of EVs (new acquisitions) for urban transportation by 2025												
							25% of heavy-duty trucks sales to be electric in 2030, 100% in 2035												

Source: MRC Group[5]

[5] EV30@30 is a global campaign launched in 2017 (part of the Clean Energy Ministerial Campaign), which sets a collective aspirational goal of reaching a 30 percent sales share for EVs by 2030 among the participating countries. The campaign supports the market for electric passenger cars, light commercial vans, buses, and trucks (including battery-electric, plug-in hybrid, and fuel cell vehicle types). It also works toward the deployment of charging infrastructure to supply sufficient power to the deployed vehicles.

As will be presented in the next section, in Uruguay, e-mobility is also considered a fundamental step toward achieving the country's decarbonization goals. Hence, the main national institutions have adopted measures to push ZEV adoption. In particular:

- Through its Nationally Determined Contribution (NDC) to the Paris Agreement,[6] Uruguay has committed to several mitigation measures in the transport sector, including:
  - Promotion of collective transportation means over individual vehicles
  - Promotion of e-mobility, especially for intensive-use vehicles, such as cargo vehicles and buses, but also offering incentives for private cars
  - Promotion of "active transport" means, such as walking or riding bikes
- The MOVÉS project promotes the use of EVs, helps banks develop green credits for the purchase of EVs, and gives specific credits for medium-sized enterprises.
- Uruguay has a mid-term plan to replace all buses in cities with e-buses while improving the service:
  - Implementation of Decree 165/019, establishing subsidies for the purchase of e-buses
  - Introduction of 110 buses by 2025
- Tax benefits to import or buy EVs have been introduced to encourage private car users, taxi service providers, and public utilities to replace their fleets with electric cars. These benefits include:
  - Exemption from the Global Duty Tax
  - Exemption from the Consular Tax[7]
  - Reductions in the Road Tax
  - Reduction on VAT and IMESI taxes

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[6] "Nationally Determined Contributions (NDCs)," United Nations Climate Change, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs.

[7] Only under the COMAP schedule. See Section Suggested Business Models and Road Map for E-Bus Transition in Uruguay

1.1. E-bus Transition Benefits and Barriers

E-bus deployment may result in benefits for cities around the world, such as helping to lower emissions that contribute to poor air quality and global climate change, as well as economic benefits, such as potential cost savings. These benefits are listed in detail in the figure below.

Figure 4 - E-Bus Transition Benefits

LIST OF BENEFITS
The total cost of ownership (TCO) is lower if compared with a diesel or CNG bus. E-buses have lower maintenance costs because they have fewer moving parts and thus fewer potential points of failure. Fleets can save on fuel costs by switching to electricity over other fuels, although charging and infrastructure have to be closely managed to achieve these savings.
E-buses have lower maintenance requirements and generate less noise pollution than diesel buses.
E-buses represent a valuable opportunity to build a domestic industry (chassis, batteries) around national transport electrification.

Source: MRC Group

However, it is internationally recognized that several factors may prevent a municipality from taking steps toward e-bus transition. Internationally recognized barriers are described in the following figure.

Figure 5 - Barriers to E-Bus Transition

LIST OF BARRIERS
E-bus technology has a high upfront cost and municipalities often do not have enough funds to finance the initiative.
Related to the high upfront cost is the scalability of e-bus introduction project. Loans and grants from the central or local government do not make the e-bus project scalable.
E-buses are usually characterized by different dynamics if compared with traditional buses: their operation and routes are less flexible, and at commercial scale they may cause important challenges for the transport operator and the local municipality.
There exists a trade-off between between early deployment of a full e-bus fleet and a wait for a cost reduction due to a decline in the cost of batteries technology.
Electricity network suitability and resilience can be challenged due to new electricity demand, periods of extreme weather conditions, and the need for the public municipality to allow all the installations needed across public property.
Standardization of charging infrastructure equipment is key to ensure e-bus interoperability.
All the above create risks that require financial guarantees. Government policy support may not be strong enough.

Source: MRC Group

In their current state of technology maturity, e-buses may offer a lower Total Cost of Ownership (TCO) over their useful lifetime. Nonetheless, they do have higher up-front costs—due to expensive batteries and the need for additional charging facilities—as well as costs related to disposal and recycling of the assets. However, these expenses vary according to the local electricity, fuel, and labor costs as well as the local bus market.

The cost of technology, especially in relation to batteries that usually represent 50 percent of chassis cost,8 is declining and, depending on the scenario considered, e-buses are more convenient in some cases than ICE buses if the TCO (investment and operation costs through the useful life of the asset) are considered. However, in the last few years, only a few countries have been able to scale up e-bus deployment, while other countries are introducing only small pilot projects. Transition to e-buses still encounters context conditions that are the expression of the local background related to the transportation network, the buses' operation flexibility, the feasibility of public-private partnership or to the accessibility of funds and available guarantees for the project..

1.2. Reference Cases of E-Bus Transition from the International Experience

Cities around the world have deployed different business models for e-bus introduction as a way to overcome obstacles and ease the transition to electric public transportation.

Through the implementation of various business models, it has been proved that certain issues mainly related to the high up-front costs, scalability, operational flexibility, and electricity supply infrastructure can be mitigated. Implemented business models have helped cities around the world effectively manage such obstacles and make the e-bus transition successful.

Below are presented the main organizational characteristics and involved stakeholders in a selection of cities and business models worldwide.[9] Stakeholder profiles and asset ownership and operation are associated with three types of involved assets:

- Chassis of the buses
- Electric batteries
- Charging infrastructure

Figure 3 and Annex 1A summarize reference cases from international experience after the review of most recent surveys, developed along a variety of organizational and operational arrangements. We have considered the following ones:

[8] Johnson, Caley, Erin Nobler, Leslie Eudy, and Matthew Jeffers. 2019. Financial Analysis of Battery Electric Transit Buses. National Renewable Energy Laboratory, U.S. Department of Energy.

[9] A comprehensive review of international experience in the deployment of e-buses is presented in Moon-Miklaucic, Christopher, Anne Maassen, Xiangyi Li, and Sebastian Castellanos. 2019. "Financing Electric and Hybrid-Electric Buses: 10 Questions City Decision-Makers Should Ask." Working Paper, World Resources Institute, Washington, DC. www.wri.org/publication/financing-electric-buses.

- Asia: Shenzhen and Beijing in China, and Kolkata in India.
- Europe: London in the United Kingdom, and Helsinki in Finland.
- North America: Los Angeles and Aspen in the United States.
- South America: Santiago de Chile in Chile, Bogotá in Colombia, and the pilot project of São Paulo in Brazil.

From these examples, we have selected four cities/states to bring real-world experiences and details on how they have deployed different business models for e-bus introduction to successfully overcome city background challenges. These examples are:

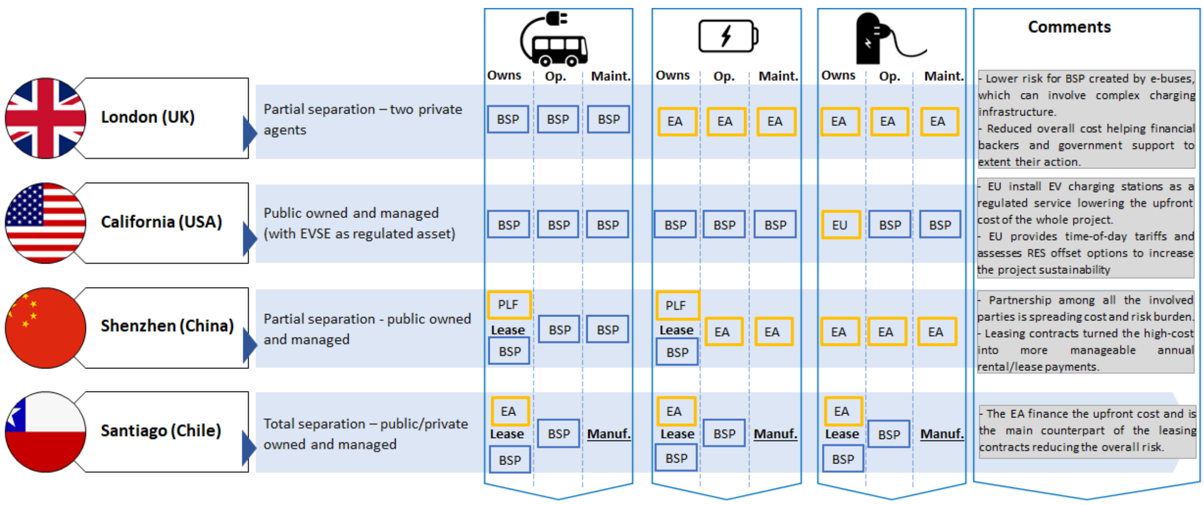
- London (United Kingdom): A case of partial separation of assets between two private agents. BSP (owner of the chassis fleet) and an electricity storage service provider which owns, maintains, and operates batteries and charging infrastructure.
- California (United States): Cases of public-owned and managed systems, with the participation of the electric utilities allowed by the electricity regulatory authority.
- Shenzhen (China): A case of partial separation of assets between public agents, the BSP, and a subsidiary of the state power company.
- Santiago de Chile (Chile): A case of total separation of assets between private agents and investors.

The following figure summarizes the main characteristics of the selected cities' models.

* Key: BSP: bus service provider; EA: Electricity Agent (SPV, subsidiary); Manuf.: assets manufacturer. Leasing arrangements are represented through third-party investors (i.e., PLF) and BSPs.

Annex 1B presents detailed diagrams of each of the cases summarized in Figure 6.

Figure 6 - Selected Cities' Business Models



Source: MRC Group

1.3. Conceptual Framework and Stylized Business Models

The international experience and selected cases presented in the previous chapters allow us to go a step forward toward a conceptual identification of stylized business models than can be transferred and assessed in other jurisdictions around the world.

For this purpose, a basic conceptual framework to guide the model definition and assessment is developed.

Usually, BSPs enter concession contracts with municipalities by means of which they are required to operate public transportation services, subject to specified levels of quality of service. In return, BSPs are granted a certain level of profitability. Typically, bus fares are subsidized so that end users only pay a portion of the actual cost of the service while the rest is provided by the municipality/the government.

To mitigate potential liquidity problems for BSPs (given the small size of many companies and the required investments in assets), in some cases buses belong to the municipality itself (or to a city trust fund) and BSPs only operate the buses. This was the initial step taken toward the separation of operation and ownership in the industry and has proven to be a way to include additional parties in the business. These asset separation models apply equally to diesel and e-buses, although for e-buses three different assets can be characterized (chassis, batteries, and chargers) and utilities/ power companies can also be involved.

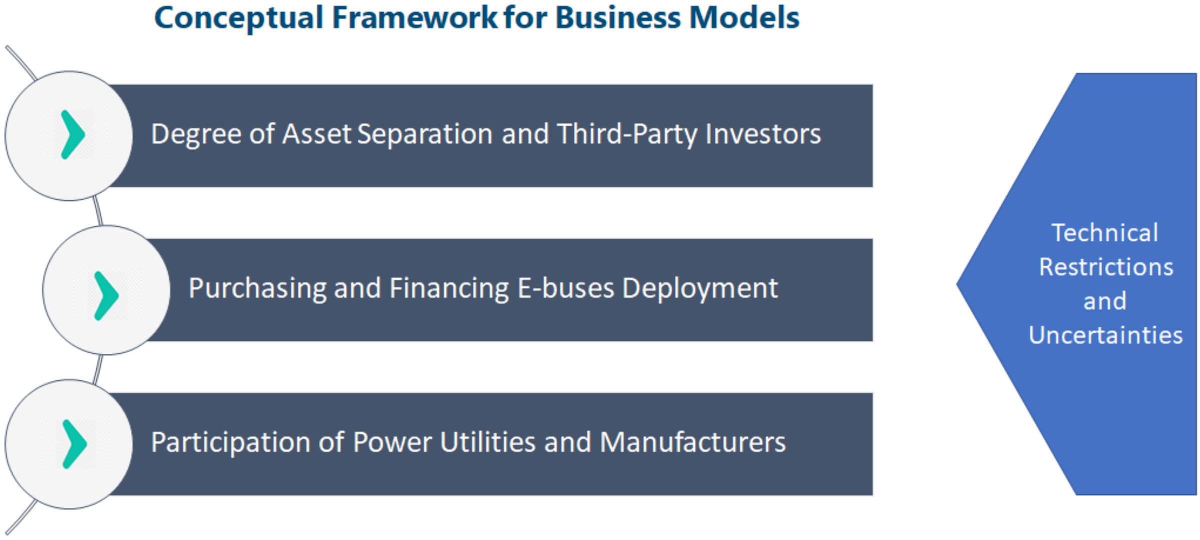
Based on international experience and the focus of this study, we will characterize the alternative business models for transition to e-buses along three axes:

- The degree of asset separation with respect to the BSP. In other words, the BSP has the ownership of transport or electric assets.
- The way of purchasing and financing e-bus deployment.
- The participation of power utilities and other stakeholders of the power industry in the e-bus business.

In parallel to these three conceptual axes, there is a set of technical restrictions and uncertainties that affect the feasibility of all business models as techno-economic parameters: lifetime of chassis and batteries, range, local road and infrastructure conditions, charging time, and other policy and social issues, such as political will to mitigate pollution/noise, the need to keep bus fares low, or the subsidization of some groups of customers over others (urban versus rural dwellers).

The following figure represents the said conceptual framework.

Figure 7 – Conceptual Framework for Business Models' Identification and Assessment



Source: MRC Group

1.3.1. Degrees of Asset Separation and Third-Party Investors

There are two main reasons to separate asset ownership from BSPs (operators):

- Initially, to enhance competition of BSPs, originated from the United Kingdom's experience in the early 1990s, but this is not still applied for e-buses.
- More recently, to attract third-party investors in jurisdictions that need to address big investment needs. This is the most typical situation in Latin America and other developing countries.

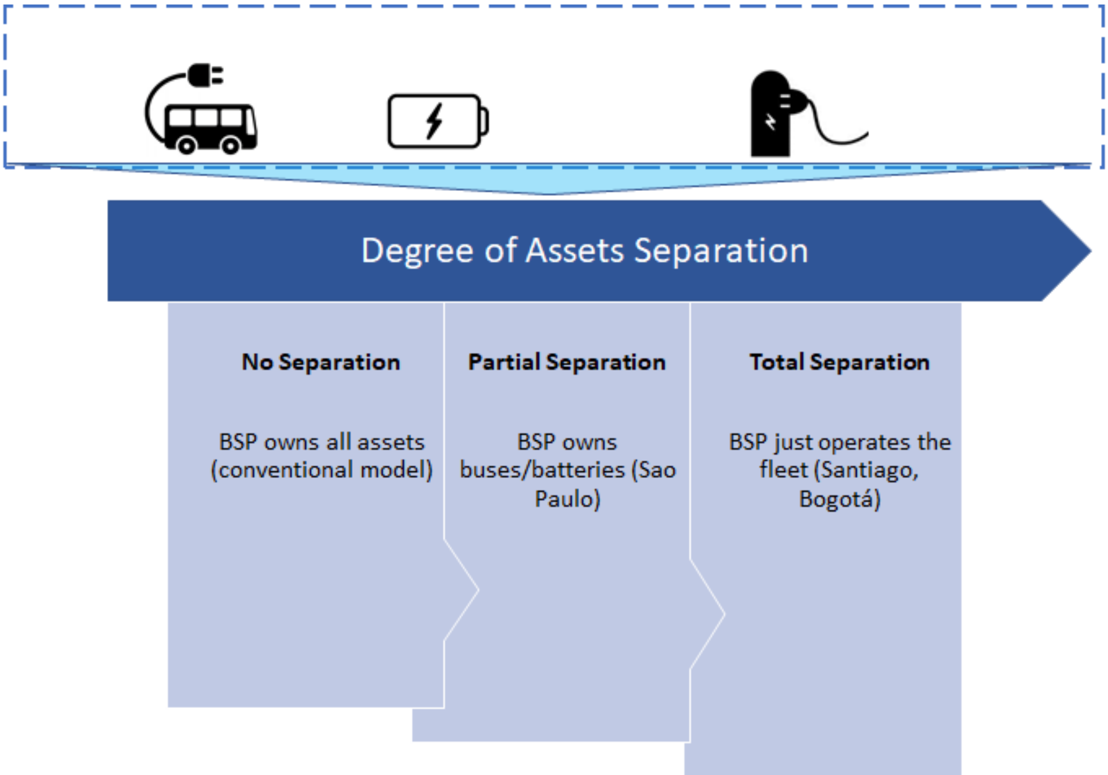
Based on the previous classification of business models, it is possible to identify three levels of asset separation:

- **No separation:** BSP owns buses, batteries, and charging infrastructure. Bus depots are a key asset for the deployment of e-buses and are usually under BSP ownership, even though in some jurisdictions this can constrain competition.[10]
- **Partial separation:** BSP owns buses, or buses and batteries.
- **Total separation:** BSP does not own any asset, and just operates the fleet.

[10] F., Sergio Sáez. 2021. "Estado expropiará terminales de buses del ex Transantiago." Litoralpress, March 12, https://www.litoralpress.cl/sitio/Prensa_Texto?LPKey=7f.S77g3.Cr.Y45/.Ma6.B8nws.V.Ip5.Kj.Fjoom.Yec.N.K.Am48.K.M.%C3%96.

The following figure represents the three degrees of asset separation in the international experience.

Figure 8 – Degrees of Asset Separation



Source: MRC Group

In parallel to the degree of asset separation, urban bus services face public and private sectors bearing variable costs with different contracts or structures. A new model of delivery is emerging as third-party actors (mainly manufacturers and leasing companies) take on greater roles. In general, the leasing figure is an extended arrangement to allow third parties to recover their investment.

1.3.2. Purchasing and Financing E-Bus Deployment

China and several OECD countries (the United States, France, the United Kingdom, and Italy) have provided substantial public funding and subsidies to municipalities for the adoption of e-bus mobility[11] though this is not a possibility in emerging markets. The state-funded model based on public subsidies is hardly sustainable in the long term in developing countries.

In emerging markets and municipalities, EVs must stand on their own from an economic perspective. Cities are adapting to how buses and bus services are procured, allowing third parties to assume an important share of the risk. More flexible procurement

[11] Illustrative examples of public participation in e-bus funding are described in Moon-Miklaucic, Maassen, Li, and Castellanos. "Financing Electric and Hybrid-Electric Buses."

enables bus manufacturers to offer operators the option to lease both buses and batteries, reducing technological and financial risks.

Consequently, many city transport authorities in Latin America are experimenting with business models and the allocation of risk between operators, asset owners, and even electric utilities in a way that attracts debt and equity. Separation of asset ownership and operator roles, segregation of the charging infrastructure, and leasing models are innovative ideas that are being implemented, particularly in Latin America.

Innovative financing arrangements have also been successfully implemented mainly in Latin America to support and promote more accelerated deployment and expansion of e-buses in populated municipalities such as Santiago de Chile and Bogotá.

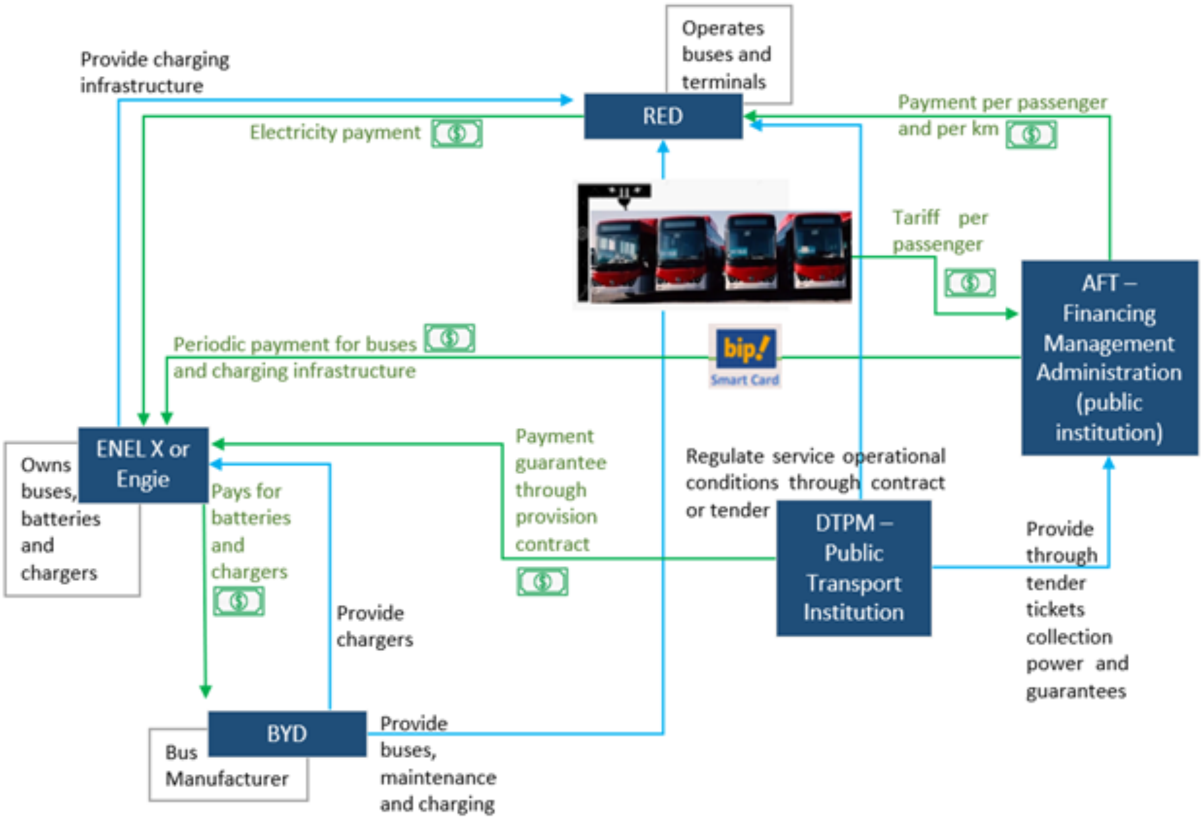
In general terms, the purchase of e-buses is mainly achieved in three ways:

- City or transit authority purchases buses and operates service. Public provision is a model in which the infrastructure is publicly owned, and the bus service is provided by a public entity, such as a public transit agency or a subsidiary of the public administration. This is the major public transit provision mechanism in countries like the United States and China.
- Private operators purchase buses and operate service on behalf of the city. A public entity, such as a local government or transit agency, owns and manages the bus system, but bus services are contracted out to private operators who are responsible for investing in the vehicles. This kind of private sector provision predominates in Europe, Latin America, and Oceania. The transport authority can contract private entities to service specific areas of the system, including operating bus routes and installing and maintaining charging stations.
- A third party owns (manufactures or purchases) buses and leases them to operators (public or private). Manufacturers and other asset owners provide options for operators (public and private) to lease buses rather than buying them. The leasing of assets is based on the third party's ability and willingness to take on some of the risks related to new technologies.

For instance, operators may purchase buses and lease batteries. Although most public e-buses are still paid for through public budgets (including public transport system revenues), there is a growing need for affordable finance to help tackle the up-front investment gap and achieve scale, what amounts to a diverse variety of leasing models, mostly for buses and batteries.

As an example of innovative arrangements for e-bus deployment, the following figure represents the total leasing financing model adopted in Santiago de Chile for the recent e-bus concessions.

Figure 9 - Total Leasing Model in Santiago de Chile



Source: MRC based on Ministerio de Transporte (MTT) and Directorio Metropolitano de Transportes (DTPM)

In parallel to the three purchasing ways, typical funding funds come from three sources:

- Up-front purchases from public budgets. In many cities in Europe and the United States, e-buses are paid for up front from existing public budgets. A common source is the public transportation budget, which covers the capital or operational costs of the transit system, including bus services. It is made up of operating revenues—including farebox revenues and potential revenues from other operations, such as advertising and taxes, which are sometimes transferred from the central government and other levels of administration.
- Commercial debt financing is not commonly used for e-buses, but concessional loans and green bonds do exist. These instruments, as well as commercial loans (loans to BSPs), may become more common as confidence in the technology and viability of the investment grow.

- Leasing of buses, batteries, and charging infrastructure. When leasing, a third party (who is not the operator) legally owns some or all the assets and assumes some of the risks associated with the investment. This third party could be a technology manufacturer, an authorized subsidiary of energy utilities, or even a specialized financial company.[12]

As previously noted, in recent years, leasing has emerged as an important model for managing the investment costs and risks associated with e-bus investments. Leasing reduces the financial burden for the operator and transfers technology and/or credit risk onto the third party, although it works best where the risk of contract curtailment is low. There are several types of leasing options that have been used, with different levels of risk transfer.

The main types of leasing from international experience are the following:

- **Component lease (commonly battery leases)**. The manufacturer (or third party) owns the battery during the lease term and replaces it as required.
- **Operating lease**. Contract that allows for the use of the asset but does not transfer ownership. Leasers retain legal ownership of the asset while the operator pays for its use on a timely basis and takes responsibility for taxes and insurance. Maintenance is often covered separately in a different service contract with the manufacturer or another provider.[13]
- **Financial (capital) lease**. Operates like loans and typically requires the lessee (bus service operators) to have a strong balance sheet. The duration of the lease is close to the useful life of the asset, and it includes a residual value and repurchase agreement that applies at the end of the lease term.

Complementarily, a key factor that attracts third-party investors in the e-bus business is the financial guarantees to back the recovery of their investment. The assessed international experience shows different types of guarantees:

- In cases in which the bus operator is the owner of assets, it is the proper operator who guarantees the investment of, for example, the buses/batteries/charger manufacturer. This is the case of Transwolff guaranteeing BYD's investments in São Paulo, or Abellio guaranteeing CaetanoBus' investments in London (commercial credits).
- Usually, when third-party investors play a role as a leaser, their contractual counterpart is the municipality or transport authority, and the reimbursement of their investment is guaranteed by city trust funds with public subsidies support.

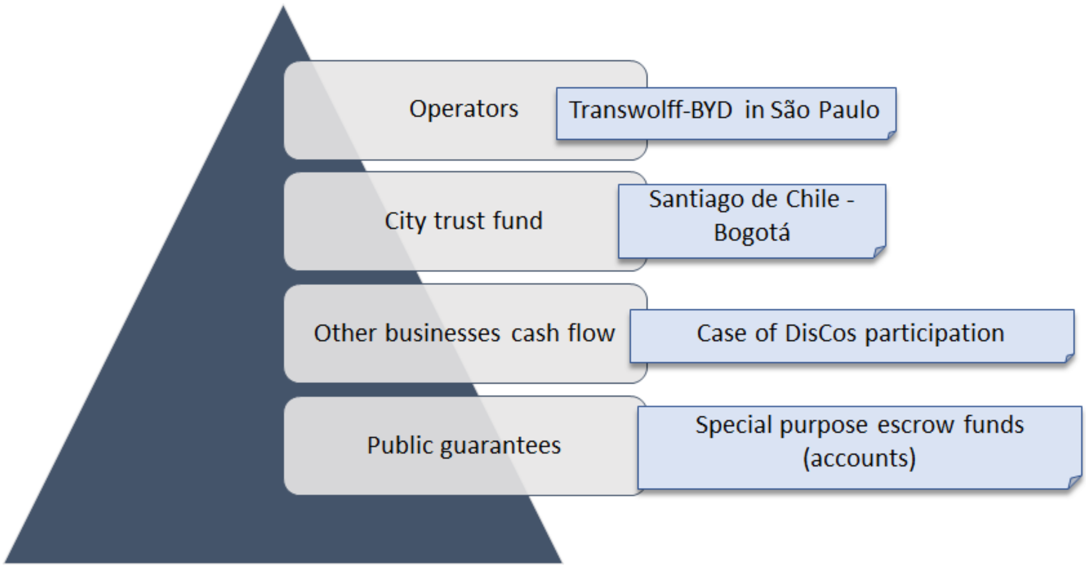
[12] For illustrative cases, see Moon-Miklaucic, Maassen, Li, and Castellanos. "Financing Electric and Hybrid-Electric Buses."

[13] Recent changes in widely accepted accounting practices for operating leases make this model difficult to execute because assets are no longer allowed off the balance sheet for the operator.

- The possibility of direct investment from distribution utilities would be backed by the electricity business cash flow,[14] which is sometimes banned by electricity regulators.
- Special purpose trust funds (accounts) may play a substantial role in terms of guaranteeing commercial loans or leasing contracts between operators and third-party investors.[15]

The following figure summarizes the previous considerations.

Figure 10 – Financial Guarantees for Third-Party Investors



Source: MRC Group

1.3.3. Participation of Power Utilities and Manufacturers

To promote and expand their own businesses, stakeholders not traditionally involved in transport, such as power utility companies and manufacturers, have also recently been entering the market to purchase vehicles or batteries and lease them to the operators of the public fleets.

In general terms, the participation of power industry agents as investors in the e-bus business is channelized through special purpose vehicles or subsidiary companies of power corporations. Power distribution utilities are usually banned from investing in businesses other than distribution network maintenance and operation to avoid cross-subsidies from electricity customers to transport service users. However, some jurisdictions have opened the possibility of power utilities participating as third-

[14] Assets would be included in the regulatory asset base and, therefore, adequately remunerated.

[15] The legal trust fund (Fideicomiso de Inversiones de Transporte) established in Uruguay will be considered as a potential source for this type of guarantee in further sections.

party investors (California, Kolkata).

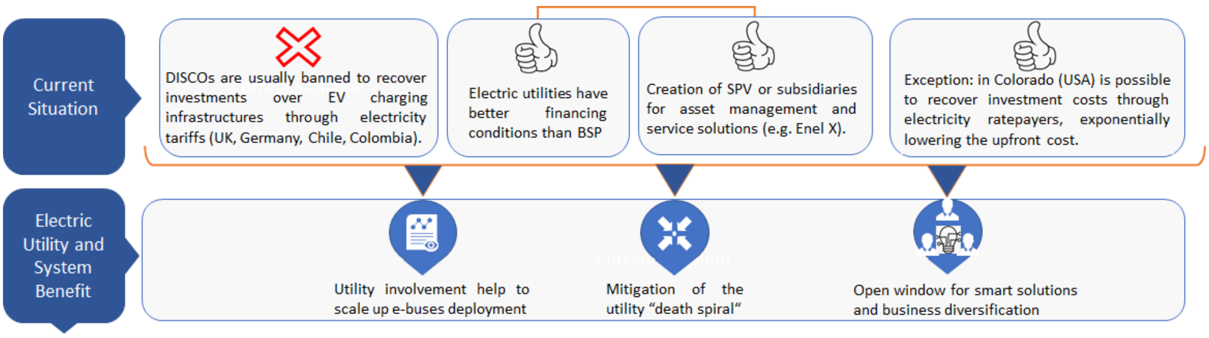
Whichever the case, the participation of power corporations in the e-bus business may attract capital with lower cost and better financing conditions.

The case for power agents' investment (special purpose vehicles or utilities) is supported by three identified benefits:

- It helps to scale up e-bus deployment and the expansion of electric transportation.
- It may mitigate the challenge as distribution companies face the increased installation of self-generation/distributed generation, which decreases the volume of energy distributed through the grid, making consumption from the grid more expensive (less energy must support increased fixed costs) and reinforcing the position of self-consumption, and aggravating the problem described. The expansion of EVs implies higher power consumption and higher power flows through the grid, which may help mitigate the problem
- It creates the opportunity as well to develop smart solutions for battery charging and vehicle-to-grid advantages for distribution operators.

The following figure summarizes the previous considerations.

Figure 11 – Participation of Power Sector Stakeholders



Source: MRC Group

A possible variation on the participation of power company subsidiaries is the participation of other institutional investors as investment and pension funds. This possibility may release power companies from the burden of managing assets that are not familiar to them (such as bus chassis or batteries), and the "flooding" of their balance sheets with assets out of the traditional power industry. This is an alternative that is currently being assessed and experienced by international donors and multilateral financial institutions.

In parallel, bus manufacturers may take several measures to promote the substitution of conventional buses with their own produced e-buses. These measures include the provision of training schemes, bus and battery leasing options, and packages that include charging infrastructure and demonstration pilots. The pilot case of e-buses in São Paulo (Brazil) shows an active participation of the manufacturer, BYD, in this direction.

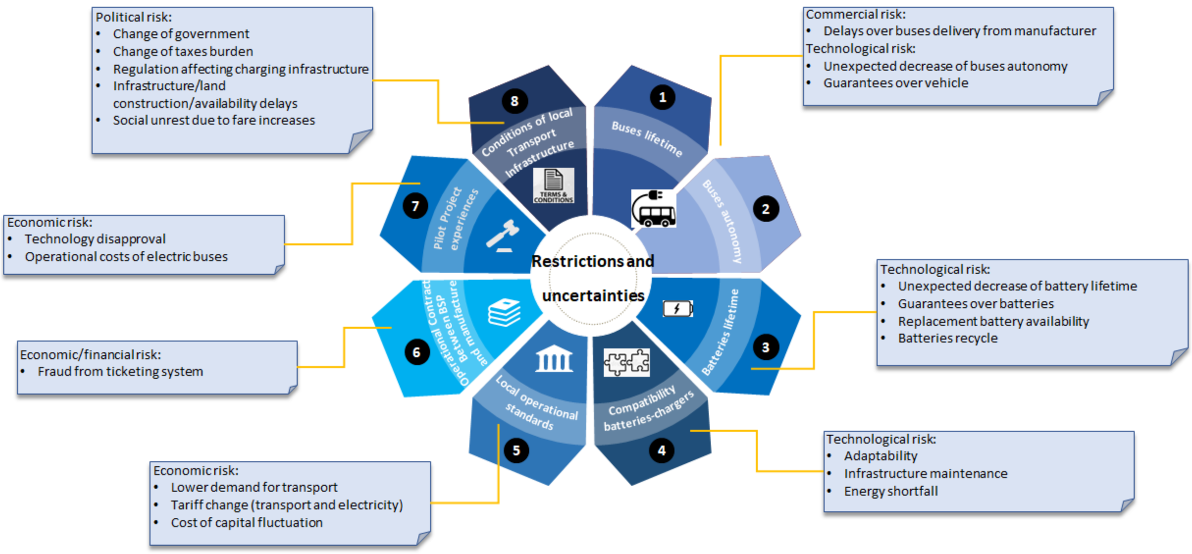
1.3.4. Technical Risks and Uncertainties

As previously noted, there is a set of technical restrictions and uncertainties that affect the feasibility of all business models as techno-economic parameters. These are of different nature:

- Access to land in different locations to allow the installation of charging infrastructure and depot connections in private and public garages
- Conditions and cost of local transport and electricity infrastructure
- Buses and batteries' lifetime, affected by operative practices and routines
- Buses' range and compatibility between batteries and chargers
- Pilot experiences and conditions of contracts between BSPs and manufacturers
- Economic and financial risks such as, for example, operational costs of e-buses, drops in transport demand, fluctuations in cost of capital
- Other policy and social risks due to the influence and sensitivity on transport costs and fares of civil society and public authorities

The following figure summarizes the different nature of those model parameters, and typical examples.

Figure 12 - Technical Risks and Uncertainties



Source: MRC Group

1.4. Stylized Business Models from the International Experience

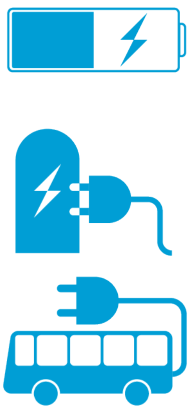
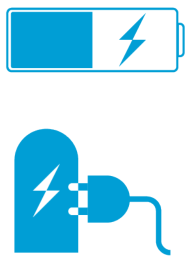
The previous conceptual considerations allow us to identify, initially, a set of typical business models based on the degree of asset separation.

- **Total asset separation**, mostly developed in Latin America, with the cases of Santiago de Chile and Bogotá as the most typical ones.
  - Power subsidiaries as third-party investors (utilities are not allowed because of distribution business regulation)
  - City trust fund guaranteeing third-party investment
- **Partial asset separation 1**, with batteries and charging infrastructure owned or leased by a third-party investor and **chassis being the property of BSPs**. Typical cases: London and São Paulo.
  - In both cases no distribution utility participation is allowed.
  - In the case of São Paulo, the municipality farebox guarantees the revenues for investment recovery by a third party. BSP guarantees its own chassis procurement.
- **Partial asset separation 2**, with charging infrastructure owned by a third-party investor and **chassis and batteries being the property of BSPs**. Typical cases: California and Kolkata.
  - Both cases allow utility investment (flexibility in power distribution regulation).
  - Government and local authorities have an active role in backing or subsidizing third party's investment.
  - Utility investment is guaranteed by electricity revenue cash flow.
- **No asset separation**. All assets are the property of the BSP. Typical cases: the Chinese cities of Shenzhen and Beijing. Both cases are characterized by high public participation and public funding of the e-bus activity (possibly involving several different public institutions), with the main purpose being its effective deployment and expansion. The BSP's investment is directly funded, subsidized, or guaranteed through the public budget.[16]

[16] The pilot case of 30 e-buses in Uruguay is an example of no asset separation, funded through a special purpose trust fund and complemented by public subsidies.

The following figure represents the four business models identified from international experience.

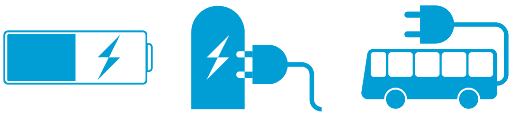
Figure 13 - Business Models from International Experience

	Total Separation	**Partial separation 1**	**Partial separation 2**	**No separation**
Assets separated from BSP				No separated assets
Third-party investor	Electricity/ energy subsidiary	Manufacturer (or subsidiary)	Electric utility	No third-party investor
Investment funding and guarantee	Asset leasing Public trust funds/Ticket fare funds	Asset leasing BSP Guarantee	Electricity tariff revenue Investment guarantees in utility regulation	Public Funds/subsidies
	Santiago de Chile Bogotá	London São Paulo	California Kolkata	China(Shenzen, Bejing) Uruguay(pilot case)

Source: MRC Group

1.5. Comparison Matrix for Different Business Models

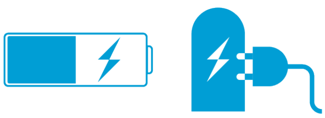
TOTAL ASSET SEPARATION



ADVANTAGES

- Creates space for third-party investors since it allows non-BSPs to invest, attracting fresh capital with lower cost to address the high up-front cost of e-buses.
- Isolates third-party investors from operator's risk.

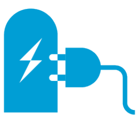
PARTIAL ASSET SEPARATION / 1



ADVANTAGES

- Creates financial space for third-party investors, attracting fresh capital with lower cost, to address the high up-front costs of e-buses.
- Isolates third-party investors from operator's risk.
- Chassis being owned by BSPs, the under-performance risk is allocated and managed by BSPs, eventually through technical guarantees with manufacturers.
- In regimes that remunerate assets, it may keep operator's remuneration at a certain level. Even though the total amount of assets owned by operators is reduced with respect to integrated concession contracts, chassis still generate returns to BSPs.
- In the case of participation of the distribution utility, a substantial part of the investment (batteries + chargers) is guaranteed by the more solid electricity sales cash flow.
- Allows batteries to be used at secondhand market by the distribution utility for grid operation flexibility and improvement.

PARTIAL ASSET SEPARATION / 2



ADVANTAGES

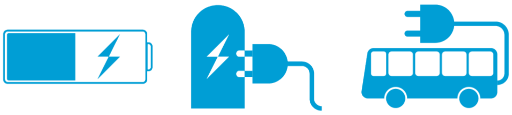
- The charger separation model keeps similar benefits and drawbacks to the batteries and chargers separation model (PAS1), with the difference that:
- It reduces the technical risk (compatibility) in the interface between buses and batteries at the expense of higher monopoly power of bus operators and, in the end, the manufacturer of buses and batteries.
- It charges the operator with the responsibility of managing second life batteries, something that is not familiar to its usual business, and can be more efficiently

NO ASSET SEPARATION

ADVANTAGES

- High public participation and public funding of the e-bus activity (even being different public institutions), promotes an effective deployment and expansion of e-bus service.

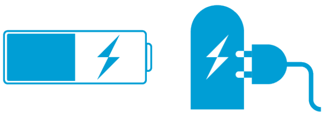
TOTAL ASSET SEPARATION



DRAWBACKS

- In cases in which BSPs are remunerated based on their asset base, it would highly reduce the operator's remuneration with respect to the current transport concessions. The reduction in their own asset base would directly affect operator's cash flow. It would require the definition of remunerated operational margins.
- The financial guarantee for the third-party investor is the City Farebox Trust, which is highly dependent on public subsidies.
- Operation and management of the buses by the BSP must be subject to a management contract with the buses' owner. In general, asset leasers (buses and batteries) are subject to underperforming penalties, and this requires a specific contractual arrangement with operators.

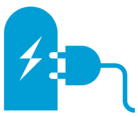
PARTIAL ASSET SEPARATION / 1



DRAWBACKS

- BSP debt holders take the bus operators' default risk. Bus operators' credit rating may compromise the operation, especially after the impact of the COVID-19 pandemic.
- The financial guarantee for the third-party investor shall be a City Farebox Trust, which is highly dependent on public subsidies.
- The separation of buses and batteries' ownership between two different agents (BSP and third-party investor) has a certain level of technical risk (compatibility) in their interface.
- The case of partial separation with the participation of the distribution utility is usually banned by electricity regulatory authorities to avoid cross-subsidies and the consequent increase in electricity tariffs. However, this short-term increase in electricity tariffs could be offset by the growth of electricity sales in the midterm.

PARTIAL ASSET SEPARATION / 2



DRAWBACKS

- Similar to PAS1

NO ASSET SEPARATION

DRAWBACKS

- Concentrates asset ownership.
- Assets face operator's business risk.
- Financial sustainability on a standalone basis is a challenge for the future.

2. Regulatory and Fiscal Framework for E-Buses in Uruguay

2.1. General Subsidy Regime for Public Transport

The public transport system in Uruguay is based on concessions to BSPs who operate certain routes and receive end fares fixed by the state, plus some subsidies to complement their revenues.

- Around 66 percent of the volume of public transport is generated in Montevideo, and the service is provided by a fleet of 1,514 buses.
- Other than compensation for fare discounts to students, retirees, and frequent travelers, there are two main operational subsidies:
  - The **diesel subsidy (through the so-called Diesel Trust Fund[17])**: All BSPs are granted a subsidy payment on the amount of diesel they consume (up to a regulated level per liter, see Section 2.8) directly lowering their operational costs. The amount for the subsidy is collected from all diesel consumers and is directed toward lowering end-user fares.
  - **Tariff subsidy** directly provided by the state and covering the difference between the average fare and the so-called technical fare (cost of service tariff).
- The system is financed by means of revenues collected from final tariffs (around 66 percent), while the rest of revenues for BSPs (34 percent) come in the form of previous subsidies (diesel subsidy, tariff subsidy, and periodic compensation for discounts to students, retirees, and frequent travelers).
- Trust funds for financial liabilities (facilitating fleet renewal) were developed as a mechanism to grant low-cost financing to BSPs, who can leverage on the system to obtain financing.
- Regarding tickets, most travels are sold as pre-paid tickets (using an electronic card), and revenues go to a central fund, which allocates it to BSPs every 48 hours (to avoid cash restriction problems for BSPs).

[17] Decree 347/006.

2.2. Investment Promotion Regime (COMAP)

The general Investment Promotion Regime in Uruguay, approved by Law 16.906 in 1998 and implemented through the Commission for Application of Investment Promotion Law (Comisión de Aplicación de la Ley de Inversiones; COMAP), is a well-established regime by which investments that result in job creation and are innovative (according to specific criteria established by the regulation) can be exempted from the payment of import duties (Global Duty Tax and Consular Tax) and reductions of up to 50 percent are enjoyed regarding the Corporate Tax (Impuesto a la Renta de las Actividades Económicas; IRAE). It has been recently used for e-bus investment in a few cases.

2.3. E-Bus Investment Subsidy

E-buses are in utilization, but they still represent a very small percentage of the total fleet in Uruguay. However, there is a strong commitment to change the situation and make all the fleet electric by 2030.

In September 2019, under the ruling of a specific e-bus subsidy regulation,[18] the first call for subsidies for the purchase of e-buses was launched in Uruguay, with the total objective of replacing 4 percent of the total number of units.

The subsidy covers the price difference between a diesel bus and an e-bus of similar characteristics so that any operator can buy an e-bus at the same price as a conventional one. Using this mechanism, BSPs are granted a monthly payment (for seven years) that covers the difference in investment costs between a diesel bus (as computed by the government) and their actual purchase costs (as declared by each of the BSPs on a CIF basis). According to Government of Uruguay (GoU) estimations, investment subsidies for e-buses are equivalent to subsidizing the consumption of a diesel bus throughout the useful life of the bus, so no increase in total costs for the system is experienced.

2.4. The Uruguayan Public Transport System and E-Bus Fleet

The concentration of population around the metropolitan area of Montevideo, which accounts for roughly 54 percent of Uruguay's total population, and the limited size of other cities (Salto, Paysandú, Maldonado, and Rivera), all of them with less than 100,000 inhabitants, results in a high level of concentration of the public

[18] Decree 165/019.

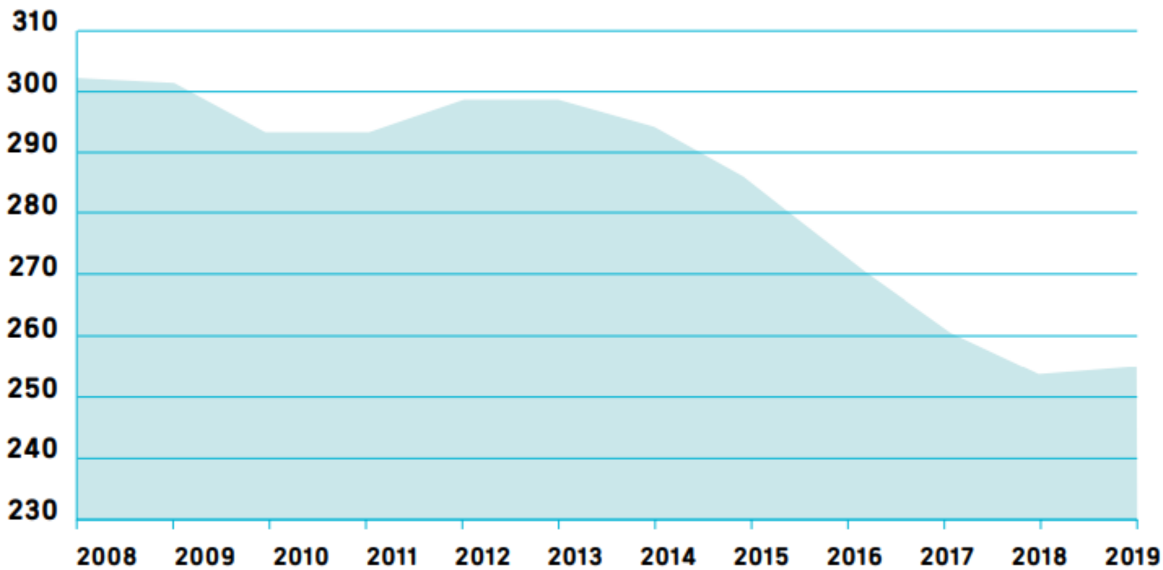
transport system in Montevideo (Intendencia de Montevideo; IM).

The public transportation system in the metropolitan area of Montevideo is served by several companies (CUTCSA, COETC, UCOT, COPSA, COMESA, Tala Pando Montevideo, Casanova, Compañía del Este) under concession agreements. These companies cover the urban and suburban areas of the metropolitan region, including several districts from other departments.

The public transportation system is composed of 1,514 buses (no trolleys or metro system) of different lengths, with 11 meters to 12 meters being the most common units.

The system has experienced a decrease in the volume of tickets sold since 2008, decreasing from 300 million tickets to roughly 255 million in 2019 (18%).

Figure 14 - Tickets Sold in the Public Transportation System of Montevideo (millions)



Source: Intendencia de Montevideo

The annual number of tickets sold in 2019 was little bit above 255 million—23 million tickets sold a month on average.

Several years ago, the system (called the Metropolitan Transport System or SMT) introduced pre-payment cards, which currently represent 80 percent of the tickets sold (pre-paid tickets versus post-paid or cash tickets). Using this card, all the payments made by final users accrue into a single account managed by the municipality, which then allocates cash flows to each BSP (every 48 hours).

The following table presents the evolution of the financing sources for the system, measured in constant US$ (2019). Total revenues from tickets, together with proceeds from the Diesel Trust Fund,[19] have decreased as the number of travels declined. In parallel, financing from the municipality has increased to cover the gap.

[19] The Diesel Trust Fund collects all payments by diesel consumers (UY$3.848/L) and then allocates them to BSPs by means of the diesel subsidy. See Section 2.8 for a more detailed explanation.

Table 1 - Funding Sources for the Public Transportation System of Montevideo

	US$ Millions					**Relative Weight**				
Type	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Municipality	904	793	750	1,152	1,387	8%	7%	7%	11%	13%
National Government	1,151	1,204	1,279	1,253	1,190	10%	11%	11%	12%	11%
Diesel Trust Fund	1,560	1,396	1,382	1,263	1,184	14%	13%	12%	12%	11%
Ticket Collection	7,860	7,749	7,763	7,076	6,857	68%	70%	69%	66%	65%
Total	11,475	11,142	11,174	10,744	10,618	100 %	100%	100%	100%	100%

Source: Intendencia de Montevideo

The diesel subsidy coming from the Diesel Trust Fund, explained in Section 2.8, is neutral for the state, but the share of its contribution to the system has decreased from 14% to 11% in the last five years.

Regarding the age of the fleet, some efforts have been implemented in recent years to improve the quality of existing units and promote renewal of the fleet. In 2018,[20] a new standard was introduced for vehicles joining the system that requires them to present improvements in terms of accessibility (low platform, wheelchair access, no steps), comfort, and polluting emissions. All new units need to include air-conditioning systems, and only Euro V or higher versions are allowed for diesel buses.

Still, 53 percent of the units are 10 years old or older, which is an indicator of the renewal needs of the fleet (useful life of buses is estimated at 16 years)

Table 2 - Fleet Composition by Age

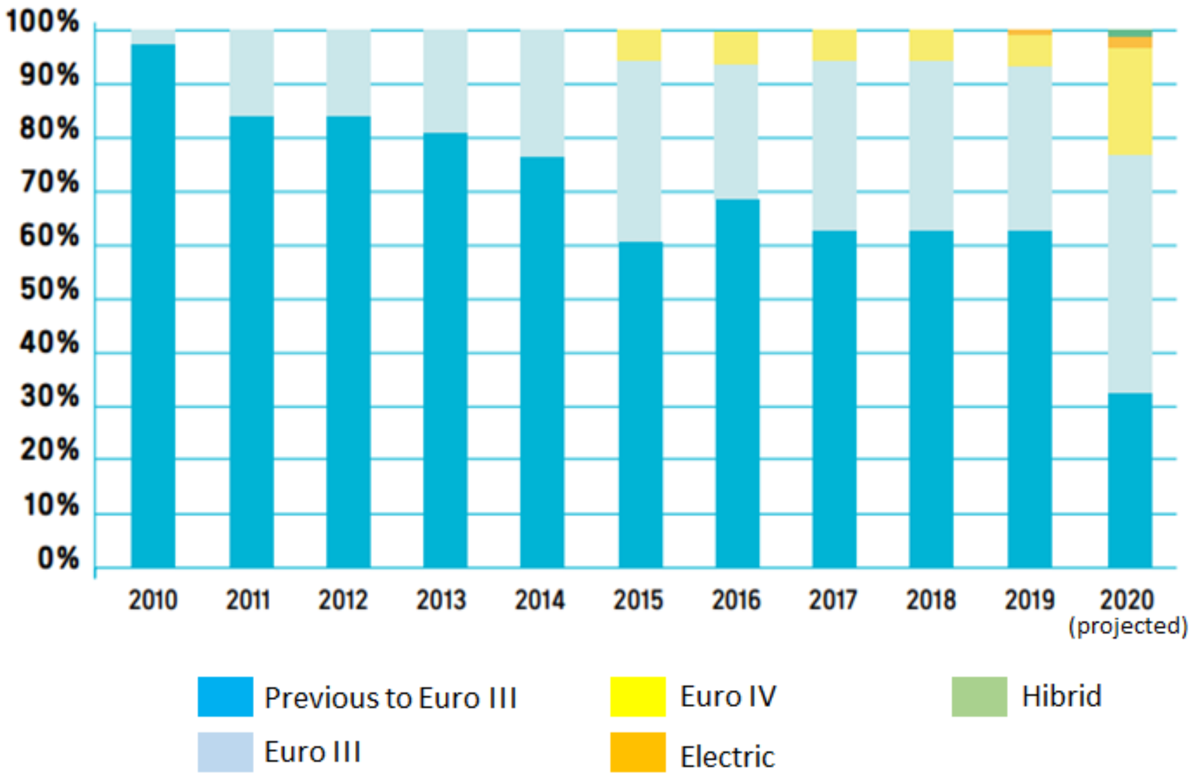
Age	Number of Buses	Percentage	Age	Number of Buses	Percentage
0	76	5.0%	8	191	12.6%
1	20	1.3%	9	40	2.6%
2	6	0.4%	10	200	13.2%
3	28	1.8%	11	197	13.0%
4	246	16.2%	12		0.0%
5	75	5.0%	13	3	0.2%
6	23	1.5%	14	16	1.1%
7	14	0.9%	15	5	0.3%

Source: Intendencia de Montevideo21

[20] Resolución 4787/19.

21 Marquez. Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo. [Report on Fares and Subsidies for Users of the Montevideo Public Passenger Transport System.] Annex 1. Intendencia de Montevideo (2020)

Figure 15 - Composition of Montevideo's Bus Fleet by Technology



Source: Intendencia de Montevideo22

It is impossible to know the exact composition of the fleet, but around one-third of buses do not fulfil Euro III standard, 43 percent to 45 percent are Euro III, and only those included in the last years fulfil Euro V (around 20 percent). No figures are available for Euro VI standards. The following table presents the emission standards for each of them

Table 3 - European Emission Standards

Standard	Date	CO	HC	NO_x	PM	PN	Smoke
		g/kWh				1/kWh	1/m
Euro III	10/2000	2.1	0.66	5.0	0.10		0.8
Euro IV	10/2005	1.5	0.46	3.5	0.02		0.5
Euro V	10/2008	1.5	0.46	2.0	0.02		0.5
Euro VI	01/2013	1.5	0.13	0.4	0.01	8.0*10^11	

Source: EC

22 Marquez. Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo. [Report on Fares and Subsidies for Users of the Montevideo Public Passenger Transport System.] page 94.

2.5. Cost of Service (Technical Tariff)

IM monthly computes the cost of service for BSPs, which constitutes the technical tariff. This tariff includes all the variable and fixed costs required for a BSP to efficiently carry out its public services.

Table 4 - Structure of the Technical Tariff (Dec-19), expressed in UY$

December 2019			
	Cost ($/km)	Cost ($/passenger)	Percentage
FIXED COST	$ 74.69	$ 32.09	93%
Administrative costs	$ 6.59	$ 2.83	8%
Salaries	$ 58	$ 24.92	73%
Expenditure on spare parts and repairs	$ 4.16	$ 1.79	5%
Bus depreciation expense	$ 2.80	$ 1.20	4%
Business benefit	$ 1.63	$ 0.70	2%
Cost of funding	$ 1.00	$ 0.43	1%
Cost of restructuring staff	$ 0.51	$ 0.22	1%
VARIABLE COST	$ 5.21	$ 2.24	7%
Fuel expenditure	$ 3.69	$ 1.59	5%
Lubricant expenditure	$ 0.51	$ 0.22	1%
Bearing expenditure	$ 1.01	$ 0.43	1%
TOTAL COST	**$79.90**	**$ 34.33**	**100 %**

Source: Intendencia de Montevideo23

Conceptually, the technical tariff arises from the ratio of computed total cost per kilometer (which includes labor costs, administrative costs, fuel and input costs, depreciation, etc.) and the passenger per kilometer index (PPI), which in turn results from the ratio of total number of tickets sold and the kilometers travelled:

technical tariff = total cost per kilometer / passenger per kilometer index

[23] Marquez. *Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo.* *[Report on Rates and Subsidies for Users of the Montevideo Public Passenger Transport System.]*

Hence, the technical tariff represents the actual cost of carrying a passenger for the system. The difference between this value and the average cost of a ticket is then covered by the tariff subsidy.

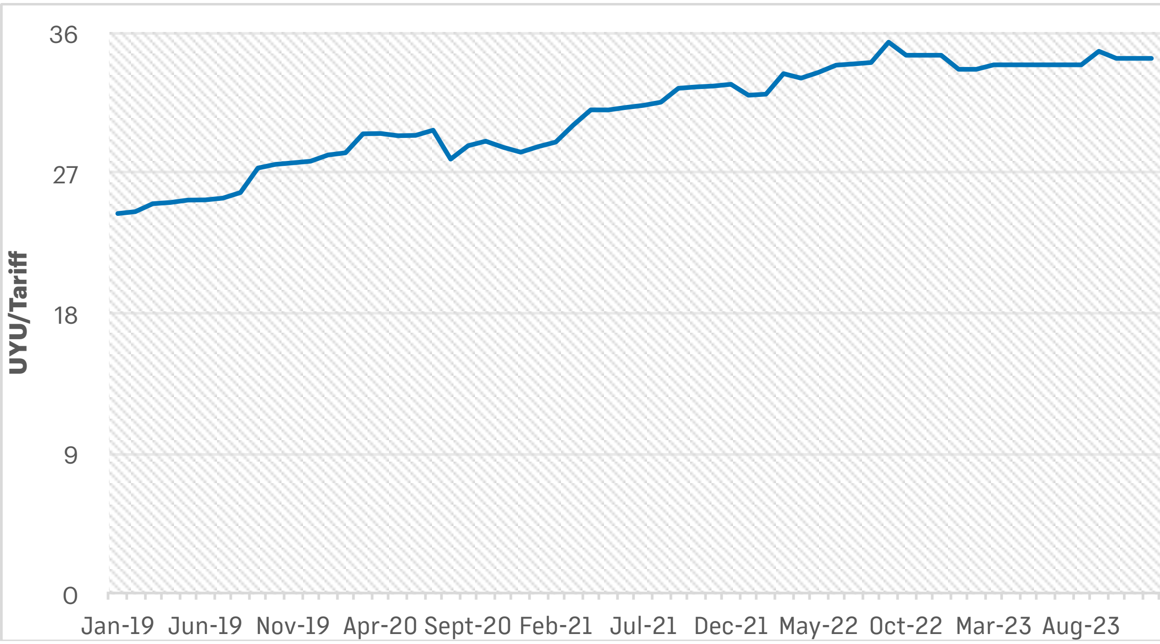
This element is crucial to our simulation exercise: the technical tariff, both considering the effect of the diesel subsidy and without considering it, are the basis of the subsidy payments to diesel and e-bus operators.

Among others, the technical tariff computation includes reference values for the following variables, which have been included in our assumptions (see the assumptions section 5.1 for a more detailed description):

- Return on capital: 6 percent
- Total fleet: 1,514 units
- Kilometers/month/vehicle: 6,550 kilometers
- Useful life: 16 years, same as in the case of e-buses
- Reposition value for diesel buses (US$142,305) and historical costs (US$87,662)
- Price of ticket machines (and useful life)
- Residual value of buses and ticket machines
- Reference salary costs, spare parts, and consumption

The following table presents the evolution of the technical tariff, between January 2015 and December 2019 in current UY$, as published by IM. This technical tariff experienced a continuous increase until mid-2018 and had reached a value of UY$35/ticket in 2019.

Figure 16 - Evolution of the Technical Tariff (UY$/ticket)



Source: Intendencia de Montevideo

2.6. Subsidies to Final Users

End-user tariffs are a policy decision not directly related to the actual cost of use of the service. These tariffs are subsidized for certain groups to facilitate access to the service and to promote rent redistribution.

Currently, the system provides discounted tariffs to students, retirees, and frequent travelers. The following subsidy percentages apply to each user type:

Table 5 - Share of End-User Subsidies

	User Payment	Subsidy Payment
Students A	50%	50%
Students B	70%	30%
Retirees A	30%	70%
Retirees B	50%	50%

Source: Intendencia de Montevideo

For students, Type A tickets apply to students (secondary and tertiary education) under 30 years. Type B applies to students 30 years and older. For retirees, the type of tariff depends on the pension amount received by users: Type A receive less than UY$17,947/month while Type B receive less than UY$26,836/month.[24]

Subsidies for reduced tariffs are computed as the difference between the common ticket (see table below) and the technical tariffs (explained in Section 2.5), which already considers an average between cash and electronic payments. Subsidies are paid by travel, and there is a clearing system between BSPs, for those travels including travel with different transport companies.

Besides, a discount is offered on all electronic payments to promote the use of such payments.

Total subsidy payments to each BSP are computed in terms of the technical tariff and the number of homogeneous tickets that represent tickets of all kinds weighted to the value of the common ticket.

Their total costs are then divided by the total number of tickets. Common tickets (which do not benefit from a discount) are paid in cash.

[24] Sistema Metropolitano de Transportes.

Table 6 - End-User Tariffs

Tariff Group	Price if paid in cash (UY$)	Price if purchased online (UY$)
Common	44	n.a.
1 hour	44	36 (-18%)
Local	25	18 (-28%)
Centre	32	24 (-25%)
2 hours	66	55 (-17%)
Differential	66	55 (-17%)
Students A	n.a.	20
Students B	n.a.	28
Retirees A	14	11
Retirees B	21	18
Metropolitan Combination	60	60

Source: Intendencia de Montevideo

Resulting trip payments from all groups, divided by the total number of travels, results in an average tariff of UY$24.76/ticket (as of December 2019),[25] which will later be compared with the technical tariff. It is significant to compare this UY$24.76 against a single one-hour ticket paid in cash, which cost UY$40 in March 2020.

The following table presents the evolution of total subsidy amounts between 2015 and 2019, measured in millions of constant US$ (as of 2019). It can be observed that the amounts devoted to end users (retirees and students) have remained stable, although an increase has been experienced with the introduction of the frequent traveler discount.

Table 7 - Funding Sources for the Public Transportation System of Montevideo

Type	2015	2016	2017	2018	2019
Retirees	261	247	267	249	244
Students	1,274	1,332	1,423	1,400	1,382
Tariff Subsidy	520	419	339	750	856
Diesel Subsidy	1,560	1,396	1,382	1,263	1,184
Frequent Traveler				6	96
Total	3,615	3,394	3,411	3,668	3,762

Source: Intendencia de Montevideo

At the same time, the amounts received in the form of tariff subsidies have increased as new discounts entered the system and the number of travels declined.

[25] Total collected revenues from tickets (UY$ 6.857 million) were divided by the monthly average homogeneous tickets sold for each bus (15.244,2) times the bus fleet (1.514 buses)

2.7. Trust Fund for Financial Liabilities in Montevideo

Traditionally, transport companies obtained financing from private banks, in the form of commercial loans nominated in foreign currency, which implied high risks, given the frequent devaluation movements of the Uruguayan peso, causing problems for the BSPs that had to devote increasing resources for the re-payment of financial liabilities.

A Trust Fund for Urban Collective Transport of Montevideo was created by means of the Decree by the Departmental Board of Montevideo Nº30.598. This fund is intended to be a tool that enables transport companies to obtain more accessible funding. The fund issues debt that is then repaid with a percentage of the collection (which cannot exceed 5 percent) and is guaranteed by the subsidies that the IM pays to transport companies, which allows them to access cheaper and more flexible credit to pay.

Considering the five percent limit, several instances of the fund have been created (fund I and II have already been extinguished) and funds III, IV and V remain in force. For all instances of the Fund, Trusts were created for the management of the funds generated and the payments of the contributions that the companies must make (percentage of their collection).

The funds initially raised go to an account with the IM, which is the fund manager, and as the transport companies submit financial liabilities to be cancelled (with the corresponding documentation) the IM pays those suppliers. In this Investment Trust Fund, the Municipality of Montevideo acts as trustor while EF Asset Management Administradora de Fondos de Inversión S.A. (EFAMSA) acts as the fund manager.

Through this system, the trustor entity (IM) transfers assets or securities to another entity (the fund manager, EFAMSA), which in turn invests them for the benefit of a third party (the trustee, BSP).

It is a tool that allows BSPs to collectivize investments. The Investment Trust Fund issues bond emissions by means of which it obtains capital. Investors make an initial disbursement equivalent to the NPV of the future payments by the fund (annuity-like). BSPs receive the amount they require to finance their purchases and to cancel financial liabilities and commit to monthly repay the amount received by reserving a given percentage of their monthly sales.

Re-payment is guaranteed by the whole system instead of by each BSP individually, securitizing the flow of ticket revenues and reducing cost of capital. If a given BSP ceases to pay, the system maintains payments to the financiers, and the system is backed up by the IM (diversifying and lowering risks for the investor).

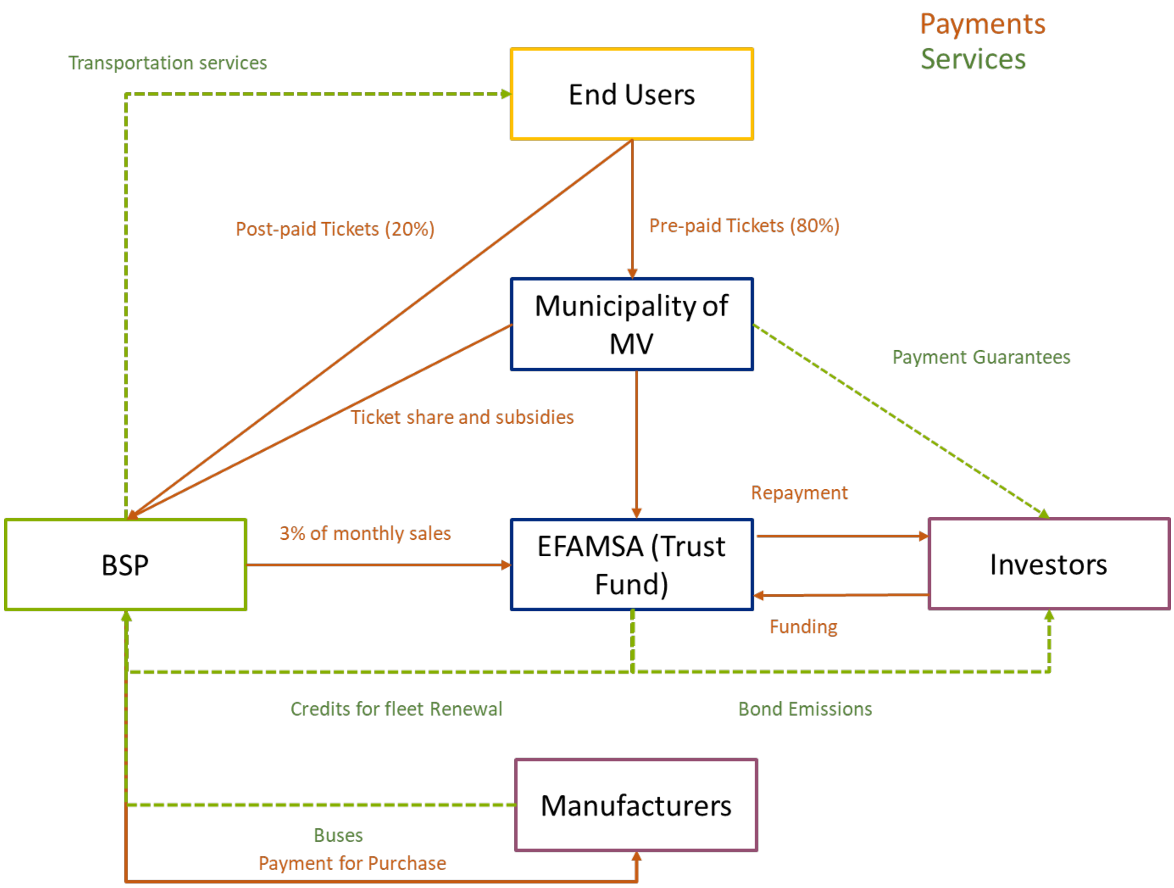
The system works in such a way that, if a given BSP fails to pay its dues, the IM exits the guarantee and gives the corresponding subsidies from that BSP to the trust. If the BSP ceases to exist its sales are absorbed by the other BSPs and by that mechanism the other BSP pay what the BSP that left would have paid.

When issuing the bond emission, the percentage of monthly repayment is determined (according to the degree of competition between investors). These percentages have ranged between 1.5 percent and 5 percent, and payback periods are around seven years, but depend on each case. There is also a similar trust fund for sub-urban public transport (using a 5 percent monthly contribution by BSPs).

Therefore, transport companies invest a certain amount of capital in the fund, and the IM cancels their debt with creditors and transfers the remaining securities to the company acting as the fund manager (EFAMSA). Finally, EFAMSA re-invests the securities in the transport companies in the form of credits destined to the renewal, maintenance, and improvement of the fleet.

The assets that constitute the trust are composed of 3 percent of the monthly income of the companies, including state subsidies. To avoid confusion, pre-paid tickets refer to pre-paid cards, as presented in Section 2.1.

Figure 17 - Structure of the Investment Trust Fund



Source: MRC Group

The series are administered by the IM which has, as a guarantee, the right to retain the subsidies for student and pensioner tickets, as well as the tariff subsidy. To date, five different emissions were held, with the following results:

Table 8 - Emission Characteristics of the Investment Trust Fund

Name	Date	Quantity (UI)	Quantity (USD M)	Interest Rate (annual)	Maturity	% of Monthly Sales	Beneficiaries
Fideicomiso I	28/01/2005	351,239,000	21.7	8%	Max. 10 years	5%	CUTCSA, RAINCOOP
Fideicomiso II	13/10/2010	400,000,000	35	5.50% (1st serie) 5.80% (2nd serie)	Variable, depending on the amount allocated	3%	CUTCSA, RAINCOOP, COETC, UCOT, COME
Fideicomiso III	01/10/2018	225,000,000	29	4.0%	8 years 2 month (variable)	2.0%	CUTCSA, COETC, UCOT, COME
Fideicomiso IV	01/09/2019	170,000,000	19	3.39%	7 years, 10 months	1.5%	CUTCSA, COETC, UCOT, COME
Fideicomiso V	01/12/2020	170,000,000	19	3.39%	7 years, 10 months	1.5%	CUTCSA, COETC, UCOT, COME

Source: EFAMSA

The funds are deposited directly into the trust account and as departmental revenues, which, by decree, are not subject to seizure.

If the companies do not contribute the agreed amount to the fund, the municipality may withhold the subsidies for student and pensioner tickets. If any of the BSPs involved reduce their participation, the concessionaire who took their concession permit is obliged to contribute to the trust. Finally, in case of bankruptcy of the trustee, the trust is not affected since the assets of the trustee form a separate estate from those of the fund manager.

In conclusion, the adoption of this system supports companies, as it offers them a form of financing that is not subject to currency devaluations since it is nominated in UY$ (previously loans were usually nominated in US$). Thus, the companies can allocate a fixed budget to the payment of their liabilities and can be sure that this budget will not increase in times of crisis. In terms of the benefits obtained by the municipal authorities, not only do they ensure the payment of compulsory contributions from the BSPs, but they also favor the modernization and efficient operation of public transport services.

This system was extended to suburban transport: Law 18.878 (December 29, 2011) created an Investment Trust for all sub-urban BSP, with the objectives of canceling the financial liabilities of these companies and facilitating the investments necessary for the provision of the service.

2.8. Diesel Subsidy to Diesel Buses

All diesel consumers are required to pay a tax on diesel consumption devoted to keeping public transport fares low. This rule has been in place since 2006 and has been renewed for periods of seven to eight years, contributing to the stability of the system, since it can be used as payment guarantee in front of financial institutions. All diesel consumers (subject to some exceptions) pay a fixed amount of tax per liter of diesel consumed, which has been periodically adjusted.

- Decree 347/006 created the Diesel Trust Fund with an initial contribution of UY$ 1.053/liter of diesel or its financing.
- Decree 406/07 determined that the initial contribution would be adjusted by an amount equivalent to 14 percent of the variations in the absolute value of the price of diesel up to a ceiling of 2.5 times the initial value.
- Decree 314/08 modified that ceiling to 3.5 times the initial value, so that the maximum contribution can be up to UY$ 3.686/liter of diesel.
- Currently, the value of the contribution is UY$ 3.488/liter, and according to the decree it could increase up to the aforementioned ceiling based on the following calculation formula: UY$ increase in the price of gasoil x 14 percent.

The collection is kept by the National Administration for Fuel, Alcohol and Concrete (Administración Nacional de Combustibles Alcohol y Pórtland; ANCAP),[26] which then allocates a fixed amount to all BSPs by liter of diesel consumed. BSPs are required to monthly submit their information of fuel consumption to the Corporación Nacional para el Desarrollo (CND)[27], to which they pay their contribution as any other customer, and from which they receive the diesel subsidy. Diesel subsidy payments vary according to the type of vehicle (there is a 20 percent to 25 percent difference among different types of buses) but diesel subsidy payments do not differentiate by BSP.

The total amount transferred to BSPs is finally considered in the calculation of the ticket price, to keep transport fares low and stable. Total figures are presented in Table 7.

According to IM estimates, in case the diesel subsidy was not in place, a 9 percent increase of the public fare would be required. As of today, the diesel subsidy already implies a cost for society, which may be redirected toward e-buses, as long as the final fare is kept low (the goal of the diesel subsidy is not to promote diesel consumption, but to decrease transport tariffs for end-users, which can also be achieved if subsidies apply to e-buses).

In 2018, around UY$3.1 billion[28] was collected in Uruguay with the purpose

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[26] "Administración Nacional de Combustibles Alcohol y Pórtland", https://www.ancap.com.uy/

[27] "Corporación Nacional para el Desarrollo" https://www.cnd.org.uy/es/inicio

[28] Marquez. *Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo*. [*Report on Rates and Subsidies for Users of the Montevideo Public Passenger Transport System.*]

of subsidizing the cost of fuel for passenger transport throughout the country. Of the total collected, 39 percent went to subsidize passenger transport in Montevideo, and the rest went to subsidize urban, departmental, or road passenger transport in the rest of the country (medium and long distance, suburban, etc.).

This subsidy is included in the methodology for calculating the technical fare for the Montevideo public transport system, accounting for a UY$5 reduction in its value.

2.9. Special Scheme for E-Buses

The following sections present the evolution of existing e-bus projects in Uruguay (since 2015) and the development of the subsidy scheme (from 2018 onwards), including the results obtained so far under this scheme.

2.9.1.Pilot Project

In line with the Uruguay 2030 energy policy, in November 2015, the Ministry of Industry, Energy and Mining (Ministerio de Industria, Energía y Minería; MIEM) invited CUTCSA (Montevideo's main BSP) to form a working team to test the operation of an e-bus in the public passenger transport system. The target of the pilot project was to conduct a field test with e-buses in real working conditions and to make a full evaluation of the following variables: routes, load capacity, stops, performance, and consumption of the unit.

With the participation of the Ministry of Transport and Public Works (Ministerio de Transporte y Obras Públicas; MTOP), MIEM, ANCAP, IM, and UTE, work began on the materialization of this project.

CUTCSA acquired the e-bus by means of a commercial agreement with representatives of BYD in Uruguay (it began circulating on May 9, 2016, identified with the number 2016). According to CUTCSA representatives,[29] the unit was a BYD K9 unit, including chargers and batteries, for a closed price of US$450,000, financed by the manufacturer under a ten-year repayment period, without interest and with the option of giving the unit back to the manufacturer (and ceasing payments) at the end of year five after the acquisition. Conditions are currently being re-negotiated since CUTCSA understands that they no longer favor the company.

To achieve reliable results, it was necessary to define a protocol for monitoring indicators, ensuring the traceability and relevance of the data. In this sense, together with technicians from the MIEM and UTE, the procedures for data collection were established, installing a consumption monitoring system (SIS.CON.VE)[30] and a system for monitoring the state of charge on the bus.

[29] Meetings held with CUTCSA representatives under current assignment.

[30] Vehicle Consumption Control System (Sistema de Control de combustible del Vehículo).

The training of personnel designated to drive and carry out the maintenance of this unit was carried out by BYD as the manufacturer and supplier of the bus. With its diesel buses (usually Mercedes-Benz engines mounted on Marco Polo chassis) CUTCSA implements the O&M itself (it is an official spare part provider for both brands), it has its own repair shop and trained personnel. According to CUTCSA, it intends to do the same with e-buses.

The rationale for this approach to O&M is that e-buses require less O&M in terms of repairs and spare parts. However, CUTCSA lacks the information required on O&M costs. Changing some parts of the engine may be substantially expensive (although, given the youth of their units, CUTCSA has not needed to change them to date).

As for the operational data gathered by means of the pilot projects, initial results were good and seemed to back up the operational data offered by the manufacturer, but the initial unit was subject to a special working regime (which does not necessarily represent actual working conditions for its diesel equivalents). Besides, because of COVID-19 pandemic restrictions, buses are no longer using air-conditioners. As a result, data on consumption does not reflect full long-term operating conditions.

According to the manufacturer, the e-bus has a 250-kilometer range (i.e., its battery can cover up to 250 kilometers with a single charge). According to CUTCSA, the unit was employed on 150 kilometers to 170 kilometers ranges (it was an operational decision until the actual range of the vehicle was proven). Apart from its actual range, such units could only serve around 20 percent of actual routes, given the length of the routes, which would require the buses to re-load in the middle of their journey

2.9.2.First Round of Subsidized Acquisitions

(1) Rationale

In September 2019, the first call for subsidies for the purchase of e-buses was launched in Uruguay, with the objective of replacing 4 percent of the total number of units throughout the country.

This subsidy is promoted by the Ministry of Economy and Finance (Ministerio de Economía y Finanzas; MEF), MIEM, MTOP, and the Ministry of Environment (Ministerio de Ambiente; MA). It is implemented through a Technical Commission composed of members of the four ministries. This Technical Commission created by Executive Decree No. 165/019 of June 17, 2019, and composed of representatives of the MEF, MIEM, MTOP, and of Housing, Land Planning and Environment, issued a call to public transport operators to access a subsidy for the replacement of buses with diesel engines by new e-buses.

The technical conditions included in the call imply improvements in the quality of service currently provided by BSPs since all units are required to have air-conditioning, wheelchair access, USB connection, and information panels.

The subsidy covers the price difference between a diesel bus and an e-bus of similar characteristics so that any operator can buy an e-bus at the same price as a conventional one. According to the technical characteristics specified, the price of the charger is included in the price of the bus.

According to the MTOP's initial estimates, the price of an electric unit and its charger is between US$350,000 and US$400,000, depending on its performance, while that of a diesel unit is about US$140,000.

According to the GoU's interpretation, from a financial point of view, the total diesel subsidy that a conventional bus receives in its lifetime is equivalent to the subsidy for the purchase of an e-bus (received for only seven years).

The following table shows the baseline figures calculated by the Technical Commission for this call.

Table 9 - Reference Value for Diesel and Maximum Subsidy for the First Tender

	Reference Cost (CIF import cost for diesel buses for the last 3 years)			Max. Cost for the E-Bus (batteries included)*
Unit	UI	UY$	US$	US$
Urban, < 11 m	770,692	3,265,499	90,824	429,048
Urban, ≥ 11m	1,070,667	4,536,523	126,176	464,399
Suburban, ≥ 11m	1,078,793	4,570,954	127,133	465,357
Inter cities	1,578,689	6,689,063	186,045	524,268

* Cost if the max. subsidy is applied

Source: Annex 2, Circular 1/019

The subsidy consists of a monthly payment to be paid for seven years (84 instalments).

Table 10 - Maximum Subsidy Values

	Cost (in UI)	Cost (in US$)
Maximum Annual Subsidy	410,000	48,318
Monthly Payment	34,167	4,026
Maximum Subsidy	2,870,000	338,223

Source: Article 13, Decree 165/019

(2) Comments on the call[31]

- Technology restrictions

According to the technical specifications, only two types of chargers were allowed, both with Type 2 connection. Depending on the charging system (alternating current or direct current), the connectors must be:

- for AC charging: IEC 62196-2 (UNIT 1234:2016) with plug and socket Type 2 (Mennekes)
- for DC load: CCS Type 2 (acc. to IEC 62196)

Including limitations to charging systems within the tender documents may result in technological discrimination and can potentially lead to higher costs. It is preferable to look for technologically agnostic tenders. In the case of Santiago de Chile, there are already three different types of chargers.

- Eligibility

The call refers to a transport concessionaire, not to consortia or joint ventures. It is advisable to clarify the wording in case it could be considered a limiting principle for potential entrants.

The call states that BSPs shall obtain the regulator's approval for the incorporation of new units before requesting the subsidy. This step, prior to the auction, may be a disincentive given that it is necessary to obtain authorization for a project that may not be developed.

To attract other entrants or third parties not directly related to the BSP (to allow for leasing agreements with a potential FleetCo), this requirement can be erased.

- Scale of the subsidy

The subsidy is limited to 4 percent of the bus fleet (Article 8, Decree 165/019). We see no clear rationale for this limitation. It seems to be below the official e-bus target for 2021 (150 e-buses, around 10 percent of the total fleet).

- Cost of capital

According to Article 12 of Decree 165/019, the maximum cost of financing will be determined as the seven-year rate of the Curva Uruguay de Unidades Indexadas (CUI) published on the Bolsa Electrónica de Valores (BEVSA) plus a risk premium of 100 basis points, assuming a financial flow of constant payments and a constant interest rate. In the September 2019 call, this rate took the value of 3.08785 percent and, with the 100 basis points, it is 4.08785 percent. This methodology does not necessarily represent a company's cost of capital and replacing it with the WACC can help attract new investors to the business (resulting cost of capital from this methodology may be too low for potential entrants).

[31] Ministerio de Industria, Energía y Minería. 2020. "Primera Convocatoria - Subsidio para sustitución de ómnibus con motor diésel por ómnibus con motorización eléctrica." July 14. https://www.gub.uy/ministerio-industria-energia-mineria/comunicacion/convocatorias/primera-convocatoria-subsidio-para-sustitucion-omnibus-motor-diesel.

- Participation of third-party financiers

Payments will be made by the GoU directly to the operator or to the financial institutions to which the operator has assigned its collection, i.e., to its financiers (Article 14 of Decree 165/019).

This direct payment by the GoU to the financiers removes one of the main obstacles to third-party participation in the model since financing from commercial banks to BSPs receives the guarantee of subsidy payments.

- Additional equipment (embarked equipment)

Within the technical specifications included in the auction, certain elements that the buses must have (displays, USB ports) are included, while others that are usually included (ticket validators) are not mentioned. This variable is important given the difference in useful lives of the assets: Chassis have a useful life of 16 years, but a ticket validator/screen may only last five years, forcing new investments for the BSP (both for diesel and e-bus).

The analysis assumes that the bid price includes all elements (meaning no additional investments by the BSP), but it may be good to make explicit their inclusion in the technical specifications and require their revealed prices. Otherwise, potential bidders do not know exactly what they need to include in the offers, which may lead to over/underbidding.

(3) Results of the First Round of Subsidized Acquisitions

Under this framework, Montevideo companies received 30 units: 20 for CUTCSA (BYD), 4 for COETC, 3 for COMESA, and 3 for UCOT (all of them from YUTONG). The remaining 3 units, awarded to companies in the metropolitan area (CodelEste), are from ANKAI.[32]

Afterwards, in the framework of the same subsidy, the company CodelEste purchased two more Ankai units (January 2021).[33] The following table shows the results of the auction in which 33 units were awarded the subsidy. All but one of the units are 10.5-meter buses (the other is an 8.5-meter bus).

[32] CUTCSA, COETC and UCOT are bus service providers in Uruguay. YUTONG and ANKAI are bus manufacturers

[33] Ministerio de Industria, Energía y Minería. 2021. "Se amplía la flota de ómnibus eléctricos en Uruguay." January 15. https://www.gub.uy/ministerio-industria-energia-mineria/comunicacion/noticias/se-amplia-flota-omnibus-electricos-uruguay.

Table 11 - Results Obtained in the Tender (i)

BSP	Type	Units	Entitled to Subsidy?	Annual Subsidy per Unit in UI	Total Subsidy per Unit (7 years) in UI
Cerro del Mar S.A.	10.5-m unit	1	No	N/A	N/A
Sucesores de Arturo Caraballo	8.5-m unit	1	Yes	141,138	987,967
S. en C. por A. al P. (CodelEste)	10.5-m unit	1	Yes	228,662	1,600,634
COETC	10.5-m unit	4	Yes	306,799	8,590,366
COMESA	10.5-m unit	3	Yes	306,799	6,442,774
Cumbres Blancas 1 SRL	10.5-m unit	1	Yes	305,425	2,137,973
CUTCSA	10.5-m unit	20	Yes	346,974	48,576,314
UCOT	10.5-m unit	3	Yes	306,799	6,442,774
Total		34	33		74,778,802

Source: Resolution 120/020

The table above presents the amounts of subsidies awarded, expressed on an annual basis and as a total amount, in indexed units (IU).

For the comparison, we have converted the prices to US$ (using the exchange rate set by the call). In addition, the price of the reference diesel unit has been considered according to the values in Table 39 - Investment Costs for E- to obtain the total acquisition cost. This information is useful for the study since it provides the average cost considered for a new e-bus as well as the amount of subsidy required. See Section 5.2 for a more detailed explanation. The total cost for each bus includes financing costs for that asset.

Table 12 - Results Obtained in the Tender (ii)

BSP	Annual Amount in US$	Total Subsidy (7 years) US$/Bus	Total Costs	Implied Cost for Each E-Bus	Total Cost for All Buses
Sucesores de Arturo Caraballo	16,633	116,430	116,430	242,605	242,605
S. en C. por A. al P. (CodelEste)	26,947	188,631	188,631	314,807	314,807
COETC	36,156	253,089	1,012,356	379,265	1,517,059
COMESA	36,156	253,089	759,267	379,265	1,137,794
Cumbres Blancas 1 S.R.L.	35,994	251,955	251,955	378,131	378,131
CUTCSA	40,890	286,231	5,724,612	412,406	8,248,127
UCOT	36,156	253,089	759,267	379,265	1,137,794
Total	-		**8,812,518**		

Source: Resolution 120/020

The weighted average value of the subsidy received was US$267,046, resulting in an average selling cost of US$393,222 for each e-bus. It should be noted that there are significant price differences between units of the same size (up to US$97,599). Given that all of them passed the technical requirements of the Technical Commission, it will be necessary to wait for the operational data resulting from their first year of operation to determine whether units offered by some manufacturers are better than others, and whether this price difference is justified or results from higher commercial margins.

3. The Role of UTE

The Uruguayan power sector is concentrated around UTE, a vertically integrated state-owned company. The total installed generation capacity of the system in 2019 was 2,228 megawatts (effective), of which 51 percent is thermal, 27 percent hydro, and 22 percent wind [in the Power Purchase Agreement (PPA) regime]. In addition to this internal generation capacity, there is a binational hydro-power plant shared with Argentina (Salto Grande), with 1,890 megawatts (50 percent available to Uruguay), and an almost 200-megawatt biomass cogeneration from industrial clients. Additional interconnections with Brazil and Argentina totalize 570 megawatts with Brazil and 1,486 megawatts with Argentina.

To complete the system, UTE owns and manages 5,800 kilometers of transmission lines and 86,200 kilometers of distribution lines.

Total internal demand of the Uruguayan power system in 2019 was 2,121 megawatts, and an 11,000 gigawatt-hours internal consumption, with around 1.5 million customers.

3.1. Regulatory Overview for UTE

From the regulatory point of view, the Uruguayan power market is ruled by the Electricity Regulation Law 16,832 of 1997 and its Regulatory Decree 276/002. Beyond that, specific decrees regulate each of the industry segments (wholesale market, transmission, distribution, and supply).

The law and its regulations determine the separation of the generation, transmission, and distribution sectors; the creation of the market operator as an independent entity (ADME) on which the National Dispatch Center also depends; and the creation of the regulatory unit, first UREE comprising only the electricity sector and then URSEA, with the incorporation of powers in energy and water.

Even though the regulatory framework allows competition in the generation market and third-party access to transmission and distribution networks, in practice, generation competition has been very restricted. It is considered "competition for the market" (through open bids for renewable PPAs with UTE), and not so much "in the market" (generation dispatch is based on a merit order managed by the System Operator with PPAs dispatched as "must run" plants).

3.2. Key Aspects Affecting E-Bus Deployment

The following are the main aspects of the electricity system related to e-bus prospects, which are analyzed in the next three sections:

- Electricity tariffs applied to e-mobility consumers
- Connection regime for e-bus charging depots
- Regulatory regime for electricity supply to EVs by private charging service providers

3.3. Electricity Tariffs

Final electricity tariffs are proposed by UTE and approved by the regulator URSEA. They depend on the voltage level and power demand, with energy charges (UY$/kilowatt-hour), demand charges (UY$/kilowatt/month) and fixed charges (UY$/month). The following table summarizes the tariff charge structure applicable to final clients.

Table 13 - Low-Voltage Power Tariff Schedule

Tariff Category	Characteristic	Energy Charge (UY$/kWh)	Demand Charge (UY$/kW/month)	Fixed Charge (UY$/month)
Residential (basic)	contracted demand <3.7kW	• fixed (UY$/month) for consumption < 100 kWh • increasing blocks for consumption < 100kWh	N/A	N/A
Residential (simple)	contracted demand <40kW	increasing blocks	on contracted demand	constant
Residential ToU	3.3kW<contracted demand<40kW	• 2 periods • working/non-working days	on contracted demand	constant
Residential ToU	3.7kW<contracted demand<40kW	• 3 periods • working/non-working days	on contracted demand	constant
General Simple	contracted demand <40kW	increasing blocks	on contracted demand	constant
General Seasonal	3.7kW<contracted demand<40kW	• 3 periods • season	on contracted demand	constant
MC1	10kW<contracted demand	• 3 periods	on maximum metered demand (2 periods)	constant
GC1	200kW<contracted demand	3 periods	on maximum metered demand	constant
EV chargers	Public chargers	3 periods	N/A	N/A

*Low Voltage – 230V, 400V

Source: UTE

Table 14 - Medium Voltage Power Tariff Schedule

Medium Voltage – 6.4kV, 15kV, 22kV, 31.5kV, 63kV

Tariff Category	Characteristic	Energy Charge (UY$/kWh)	Demand Charge (UY$/kW/month)	Fixed Charge (UY$/month)
MC2	• 6.4kV, 15kV, 22 kV • 10kW<contracted demand<250kW	3 periods	on maximum metered demand	constant
MC3	• 31.5 kV • 10kW<contracted demand<250kW	3 periods	on maximum metered demand	constant
GC2	• 6.4kV, 15kV, 22 kV • 200kW<contracted demand	3 periods	on maximum metered demand (2 periods)	constant
GC3	• 31.5 kV • 200kW<contracted demand	3 periods	on maximum metered demand (3 periods)	constant
GC4	• 63 kV • 200kW<contracted demand	3 periods	on maximum metered demand (3 periods)	constant

Source: UTE

EV public chargers are an individual tariff category, with monomic energy charges (UY$/kilowatt-hour).

As detailed in the next section, bus depots do not represent an individual tariff category. Current e-bus operators are connected under the GC1 category, with a special and transitory discount on energy charges until 2023.

3.4. Depot Connection

Currently, BSPs managing e-bus fleets have their charging depots connected as GC1 clients (large customers, at low voltage, with contracted demand above 200 kilowatts). Extraordinary connection costs and grid/substation reinforcement are charged to BSPs as a non-reimbursable capital contribution to UTE.

There is no specific tariff category for e-bus charging as exist for taxis and private EVs. Currently, a rebate applies (50 percent during valley and 20 percent in the rest of periods), but it is only applicable until December 2023.[34] This is an area in which tariff design optimization may provide further improvements to the operational costs of BSPs (adapting hourly block tariff charges to the typical load profile of e-bus

[34] Considering that the financial tool foresees investment in the current year and start of operation the year after, this rebate only affects the first two years of operation of the buses.

chargers).

UTE's role becomes important for the Uruguayan case. UTE could be the tendering body for new collective charging stations. Currently, BSPs are the owners of the parking bays. The potential use of common charging stations may imply slight increases in distances for some operators, but the adoption of such an approach would result in higher intensity use of assets, improving the efficiency of the system. New collective charging stations could be developed by UTE and then operated by a third party; this would imply lower total costs for the whole system.

UTE could have a lead role in planning the expansion of new stations: coordinating distribution network expansion, offering special Time of Use (ToU) tariffs, signing supply contracts, or facilitating the signature between electricity suppliers and BSPs. Currently, BSPs own their own parking depots; it may be easier for UTE to develop new common parking depots than to convert existing ones. This will, in turn, depend on the availability of land: Can UTE purchase/lease the land required? IM/the GoU can play a relevant part in this if low-cost leases or land concession contracts are awarded to UTE for the development of common charging stations.

3.5. Regulatory Regime for EV Charging Services

EV charging services are currently fully provided by UTE. There is no explicit regulation allowing third-party competitive providers to supply energy procured in the wholesale market to final EV customers. In fact, there may be an ambiguous interpretation of Decree 276/002 (Art. 2) that defines commercialization of electricity to third parties as a public service that can be provided only by UTE or under a public concession regime (what would potentially hinder the entrance of competitive providers).

This issue might be addressed in the medium term to scale up the provision of competitive EV charging services and, consequently, the availability of a reliable EV charging network.

4. Business Models and Alternative Financing Schemes Proposed

4.1. Suggested Business Models and Road Map for E-Bus Transition in Uruguay

As of today, BSPs can use at least two different support mechanisms for the adoption of e-buses in Uruguay: the e-bus Investment Subsidy and the Promoted Investment Projects scheme (COMAP).

The e-bus investment subsidy was previously described (see Section 2.9). Apart from the subsidy itself, e-buses and related charging infrastructure can enjoy a full exoneration on the Global Duty Tax (Tasa Global Arancelaria; TGA), from 23 percent to 0 percent. The Consular Tax (Tasa Consular; TC) of 5 percent still applies. Import duties are applied directly to CIF prices of the buses, on a cumulative structure [i.e., CIF*(1 + TGA + TC)]. The Corporate Tax applies to declared profits of each BSP, and VAT applies to diesel and electricity purchases by each BSP.

Table 15 - Fiscal Regime Applicable to Existing Business Models for Buses (Diesel and E-Buses)

	Diesel Buses	E-Buses under COMAP	E-Buses under the Subsidy
Global Duty Tax	23%	0%	0%
Consular Tax	5%	0%	5%
Corporate Tax	25%	12.5%	25%
VAT to energy/fuel	37%	22%	22%
Subsidy	Monthly subsidy for diesel consumption (16 years)	No subsidy	Monthly subsidy on investment (7 years)

Source: Author's Consultant's elaboration

Those e-buses which have not been granted a subsidy can be financed by means of the Investment Promotion Regime (COMAP). In this case, investments are exonerated from TGA and TC, and are granted a reduction on the Corporate Tax rate (Impuesto a las Rentas de las Actividades Económicas; IRAE), covering up to 90 percent of the tax. Buses, irrespective of their technology, need to pay a road tax (Patente de Rodados), paid annually based on their remaining useful life.

E-bus chargers are installed by each BSP and the electricity is supplied by UTE under the category for Large Customers Type 1. UTE has been in charge of installing chargers for private cars in public roads, servicing them under a special tariff, but this approach has not been adopted for public transport chargers.

In conclusion, there exist three different models that support diesel buses and the e-bus introduction in Uruguay:

- **Diesel Model**: Purchase diesel buses by means of the Investment Trust Fund (low-cost financing, including guarantees for lenders) and receive a subsidy for diesel consumption. No fiscal incentives apply, but BSPs receive an operational subsidy (the diesel subsidy) for the quantities of diesel they consume.
- **Model 1 (E-bus under Investment Promotion Regime (COMAP) Model):** Purchase e-buses under the investment promotion scheme (COMAP), with reduced tax obligations. No asset separation is implied in this model. If investments result in job creation and are innovative, they can be exempted from the payment of import duties (Global Duty Tax and Consular Tax) and reductions of up to 50 percent are enjoyed regarding the Corporate Tax.
- **Model 2 (E-bus under Investment Subsidy Model):** Purchase e-buses under the Subsidy Regime. BSPs that took part in the subsidy tender are given a monthly payment for 84 instalments that covers the difference between the investment cost of a diesel and e-bus. No asset separation is implied in this model. In this case, imports are also exempted from the Global Duty Tax (but not from the Consular Tax).

Besides the three existing models, an alternative model, based on asset ownership separation, has been analyzed:

- **Model 3 (asset ownership separation):** a third party (a power subsidiary or any other asset manager) creates a company that buys large fleets of e-buses (FleetCo) and then offers them to the BSP under a financial leasing agreement. Fiscal conditions are the same as in Model 1 (COMAP) but now the buyer is a third party instead of the BSP. If a subsidy is still necessary, it must be noted that leasing payments are operating expenses, not an investment. Therefore, this opens the window to using the Diesel Trust Fund to partially subsidize leasing payments by the BSP to the leaser.
- An analysis of international experience shows that the timely development of charging infrastructure, the access to non-congested power distribution networks, and the cost of installing chargers can be relevant factors for success. As a result, we recommend analyzing the involvement of the power incumbent (UTE) in the development of charging infrastructure. Consequently, Model 3 has two variants:
- Model 3A: Leasing of all assets (bus + battery + charging infrastructure). E-buses are purchased under an asset separation model. A third party purchases all assets and leases them to the BSP. The third party is entitled to receive COMAP conditions.

- Model 3B: Leasing of (bus + battery) while UTE develops charging infrastructure. E-buses purchased under an asset separation model, together with UTE involvement. A third party purchases all chassis and batteries and leases them to the BSP (the third party is entitled to receive COMAP conditions), while UTE invests in and manages chargers with the goal of establishing common charging stations for BSPs.

We have considered total asset separation options (3A and 3B) as they are the most innovative references for the Uruguay context, but there are other alternatives which may also be formulated:

- **Partial asset separation**, in which a third party - FleetCo leases batteries and chargers ("charging service"), while the chassis remains under ownership of BSPs. This partial asset separation model involves technical and performance control complexities between chassis and batteries, as the performance of the batteries depends on the characteristics of the chassis and how they are driven (by the operator's staff) and not the supplier itself. The closest case in the region is that of São Paulo (15 Transwolff e-buses), in which even though the chassis is owned by Transwolff and the battery owned by BYD, the supplier of both assets is BYD. BYD assumes responsibility for performance within the framework of an aggressive penetration strategy in Brazil, but this scheme is more complex to implement when chassis and battery suppliers are different, and markets are small and less commercially attractive. A second case of reference for this model is the 34 e-buses operated by Abellio in London, in which the chassis supplier is Caetano Bus, and the company Zenobe (an energy firm) provides battery service (provided by Visedo) and charging infrastructure. For this model, we do not have access to contractual information, but a possible initial interpretation is that the attractiveness and size of the potential market warrant the costs of developing and monitoring complex chassis-battery performance contracts, a condition that may not apply to Uruguay.
- **Partial assets separation**, with UTE as the sole third-party investor regarding charging infrastructure, while the rest of assets are purchased by the BSP under the COMAP schedule. Financial results and performance would be intermediate to Model 1 and 3B and would eventually be an easily implementable model, because it requires just extending the current investing role of UTE from private vehicles to public buses.

The following figure presents the structure of the business models used in the assessment.

The following sections specify the business models in Figure 18.

Figure 18 - Diagram of Proposed Business Models in Uruguay

Technology	Diesel	E-BUSES			
Support Scheme	Current subsidized model	Investment subsidy	COMAP		
Business model name	Diesel Model	Current model (Model 2)	Current Model (Model 1)	FleetCo (leasing) Model 3A	FleetCo (Leasing) +UTE (Model 3B)

Source: MRC Group

4.1.1.The e-bus subsidy model

The e-bus subsidy model was introduced in 2019 and resulted in the first round of subsidized acquisitions of e-buses. BSPs request a subsidy amounting to the CAPEX difference between diesel and e-buses and obtain a lump sum for each new unit. This subsidy is paid in 84 monthly instalments over seven years. Conditions are specified by means of tenders, using as the reference the cost for a diesel unit as computed by the Technical Commission. Chargers and batteries are included in the price. Chargers are installed by the BSP who acts as a large customer for UTE.

The e-buses, besides the subsidy, are exempt from paying the TGA (0 percent), and so are the chargers. The Consular Tax (5 percent) still applies to CIF prices.

It must be noted that payments of the subsidy can be made directly by the state to the financing parties of the e-bus in case it is not the BSP itself (there are strong payment guarantees).

4.1.2.The COMAP model

E-buses that did not take part in the subsidy scheme are eligible for the COMAP scheme (promoted investment projects). Investors are exempt from TGA and Consular Tax and are entitled to a reduction on the Corporate Tax rate up to 90 percent (IRAE, standard rate of 25 percent).

4.1.3.FleetCo models

These models introduce a unique fleet company (FleetCo) to purchase all the assets and to lease them to the BSP. FleetCo will be subject to lower capital costs and economies of scale/bargaining power. Since leasing payments are considered operative costs, it opens the door to using diesel subsidy collection to subsidize leasing payments.

A variation involves the same FleetCo model but requiring UTE to install the chargers (reduced costs for the BSP) while the rest of the conditions hold. UTE, as it does with regular EVs, invests in the charger and defines a specific tariff for e-buses, which currently does not exist. UTE will also be the supplier of power and would oversee operating and maintaining chargers.

4.1.4.Current Diesel Model

Consumption of diesel by BSPs is currently subsidized. This mechanism is financed by a tax (UY$3.484/liter) imposed on all diesel consumers and it is paid monthly to the BSPs.

Besides the diesel subsidy, the BSPs currently receive four additional types of subsidies: retirees, students, frequent travelers, and tariff subsidy.

The tariff subsidy covers the gap between existing average prices and the technical tariff, so it must vary across models, but the three end-user subsidies (to students, retirees, and frequent travelers) apply in the same way irrespective of the bus model chosen, so their current level is considered constant.

The technical tariff represents the real cost of service for buses, as monthly computed by the municipality. It provides the level of profit any BSP is entitled to receive for one passenger. The difference between this value and the average tariff, after accounting for the other subsidies mentioned, is covered by the tariff subsidy.

The financial tool considers “the State” as a term that encompasses all public bodies, such as IM, the national government, and other tax gathering bodies, if any.

The other source of financing for the system is the collection from consumers, either in the form of tickets for transportation or the diesel subsidy (which is paid entirely by diesel consumers).

4.1.5. Summary of proposed business models

- Diesel
  - Current model, where the BSP purchases the diesel bus by means of the Investment Trust Fund (low-cost financing including guarantees for lenders)
  - BSP receives the diesel subsidy
  - Higher O&M than e-buses
  - Costs for society measured as cost of pollution, cost of the diesel subsidy
  - BSPs are subject to different tax payments
- Model 1: E-buses Investment Promotion Regime (COMAP)
  - One of the two existing models for e-buses.
  - No import duties, reduced Corporate Taxes, and access to green certificates.
  - BSPs purchase the e-bus (chassis, batteries, and chargers).
  - BSPs can use the Investment Trust Fund for the remaining required investment or resort to local commercial financing.
  - Costs for society measured as a decrease in fiscal revenues (less TC, TGA, and IRAE collection).
- Model 2: E-buses subsidy regime
  - The other existing model for e-buses.
  - BSPs purchase the e-bus (chassis, batteries, and chargers).
  - BSPs can use the Investment Trust Fund for the remaining required investment or resort to local commercial financing (as was the case with CUTCSA).
  - The GoU pays a subsidy according to the technical data published after the first round of concessions.
  - Costs for society measured as cost of the subsidy.
- Model 3: E-buses leasing
  - A third party enters the model, buys part of the rolling stock, and leases it to the BSP.
  - This third party uses local commercial financing.
  - The third party uses the COMAP schedule (no TC, TGA, reduced IRAE).
  - A lease contract, backed up by the Investment Trust Fund, is established between the BSP and the third party.

- Leasing payments are designed to yield the required IRR for the third party.
- The Investment Trust Fund would not be able to finance the investment using the normal schedule for repayment (2 percent to 5 percent monthly sales go to the financier) given the size of the investment.
- This system can reduce the burden on the GoU since it no longer needs to subsidize the purchase of assets.
- If subsidy is still desirable, it must be noted that leasing payments are operative expenses, not an investment: This opens the door to using the Diesel Trust Fund to partially subsidize leasing payments.
- Costs for society measured as reduced fiscal revenues and cost of subsidy, if any.
- Two alternative options are foreseen for this model:
    - 3A: Leasing (bus + battery + charging infrastructure)
    - 3B: Leasing (bus + battery)/UTE charging infrastructure
- The case in which UTE develops the charging infrastructure reduces the required initial investment but may result in higher power prices.

The financial tool considers the total social cost of each business model as the sum of:

- Total payments by the GoU/IM
- **Costs borne by consumers** (fares, power charges, and diesel subsidy):
    - Power charges represent the extra payments made by power consumers in case UTE develops the charging infrastructure required for common charging bays.
    - Fare charges represents total payments by end users for the transportation system. This item is equal for all cases since the financial tool assumes no changes to final transport fares.
    - Diesel tax is paid by all diesel consumers to subsidize diesel for BSPs. The financial tool considers that if one diesel bus is replaced by an e-bus, the amount of diesel subsidy corresponding to that unit is saved. Under Models 3A and 3B, diesel consumers are required to pay a lower subsidy (the leasing subsidy) in order to lower leasing costs for BSPs and to maintain low bus fares (same target as the diesel subsidy, different mechanism).
- **Total avoided cost (Pollution)**: Reduction in polluting emissions obtained by e-buses (this measure does not apply to diesel buses but is equal among all e-bus business models).

- **Total tax revenues**: Revenues collected yearly in terms of Corporate Tax and Road Tax, and at the time of investment (Consular Tax, Global Duty Tax, VAT and IMESI - Impuesto Específico Interno).

The financial tool also compares IRRs for operators and third parties (leasing entities) when applicable.

In FleetCo business models (3A and 3B), a subsidy to leasing payments is included that may be funded by the current Diesel Trust Fund[35] to finance the acquisition of new e-buses. As of today, the fund lowers the cost of diesel for BSPs with the aim of achieving lower end-user rates for public transportation. The same goal can be achieved if we apply the subsidy to leasing payments of e-buses. It would mean applying an operational subsidy (the diesel subsidy) to a leasing payment that can also be considered as an operational cost. Compared to the current e-bus subsidy (Model 2), this proposal implies changing a subsidy to investment (to be repaid in seven years) for an operational subsidy to be paid during the whole life of the bus (16 years). As such, the burden for the state/consumers is reduced over time.

The financial tool has been constructed to deliver the exact amount of subsidy required to grant both BSP and third parties their required levels of profitability (different subsidies are granted in the two FleetCo models).

4.2. Additional Considerations for E-Bus Business Models

The experience with e-bus introduction in Uruguay, even though relatively recent, allows for the elaboration of some additional considerations in terms of risks and uncertainties[36] in the implementation of the models suggested in the previous section. These considerations could inform the structuring of the future e-bus schemes regardless of the model pursued by Uruguay..

4.2.1.Operations and maintenance (O&M)

It is important to clearly establish the role of manufacturer, BSP, and leaser with respect to O&M. The usual approach is for the BSP to enter an O&M contract with the manufacturer. In some cases, BSPs try to obtain further benefits by providing the O&M themselves, since they already have the expertise for internal combustion engine buses.

[35] The Diesel Trust Fund collects payments from all diesel consumers to subsidize diesel consumption by BSPs.

[36] See Section 2.3.4.

However, this model has proven risky since, given the lack of lengthy experience with e-buses, there is a large degree of uncertainty about the spare parts that will be required in the future. E-buses do not generate heat and produce no vibrations given that there are fewer moving parts within the engine. As such, their initial O&M is cheaper than that of a diesel bus, but BSPs are uncertain about what potential costs may appear in the future.

In Chile and Ecuador, BSPs have started to sign O&M contracts with manufacturers on a cost/kilometer basis to hedge against this possibility of high costs in the future.[37]

In Chile, we find two main approaches to O&M:

- Metbus (BSP) has signed a contract with BYD (manufacturer) by means of which BYD carries out O&M for buses (preventive, corrective, and predictive maintenance) and provides the spare parts required. It also manages charging of units. If buses are not properly charged/maintained, the monthly leasing payments BYD is entitled to receive are reduced.
- Two BSPs (Buses Vule and STP) have taken on the responsibility of total O&M for the buses (including charging) so that the manufacturer (Yutong) is only required to provide the spare parts that are needed.

It seems that different schemes depend on the commitment and capabilities of both manufacturers and BSPs to correctly implement O&M routines (CUTCSA seems inclined toward this approach).

Another possibility is to split O&M in two: BSPs can implement O&M for non-electrical components of the bus (such as tires, external elements, lights, etc.) while the rest is contracted to the manufacturer on a cost/kilometer basis. This method allows BSPs to maintain their ability to benefit from proper O&M routines while de-risking future maintenance.

Box 1. O&M Routines in Santiago de Chile (RED Santiago)

For O&M routines, the manufacturer is required to define exact O&M practices and conditions and to certify that BSPs using its units are fulfilling these conditions. Such descriptions include lists of prices for spare parts. This opens the door to several different O&M structures: the BSP, the manufacturer, or a third party may provide the required O&M, as long as it fulfils the conditions established by the manufacturer. The manufacturer then needs to monitor if maintenance levels are acceptable. This monitoring activity is covered by the monthly payments received by the manufacturer from the municipal trust fund.

[37] US$0.09/kilometer for the agreement with BYD and Metbus in Chile; US$0.147/kilometer for BYD in Ecuador.

A different approach can be found in the case of Bogotá, where Volvo (manufacturer) chose a two-axis approach to maintenance: On one side, Volvo signed a five-year O&M contract with the BSP (all-inclusive contract), and on the other, it established a training program for the BSP's technicians. The rationale was that after five years of training, O&M from the manufacturer would no longer be required, and the BSP could undertake the task itself.[38]

Another way to approach O&M is for the manufacturer to provide lifetime warranties for all assets (batteries, motors, electronic control systems) so that service-related risks become minimized. That is the case in Shenzhen.[39]

4.2.2.Route length and bus range

Given range restrictions for batteries, it is important to select routes whose length and altimetry best fit the range of each unit, since some routes will result in excessive consumption or will force operators to include further units (since some will be unavailable due to charging).

4.2.3.Guarantees

In successful systems, such as in Chile, Colombia, or the United States, the contracts held between BSPs and the contracting authority allow the allocation of part or all direct payments they receive to either manufacturers or financing parties (or power utilities) involved in the purchase, greatly reducing risks for investors.

Besides, the transport system guarantees that a given e-bus unit will be kept in the system irrespective of the BSP exploiting it, i.e., if a BSP goes bankrupt, the state guarantees that the unit will remain in operation in the system until full repayment of the initial debt. As a result, irrespective of the BSP that operates the bus, the third party has certainty that the bus purchased will be in operation for its complete useful life, allowing the investor to recover its initial costs.

In this regard, the system in Montevideo is currently able to provide guarantees for the purchase of new buses by means of the Investment Trust Fund, managed by EFAMSA. In cases in which leasing payments are present, some minor changes would need to be introduced to include leasing agreements under the umbrella of guarantees of the Investment Trust Fund. Basically, there are two ways to implement this change: either let financiers directly apply to the Investment Trust Fund themselves (as if they were the BSPs) or allow them to use the ability of IM to retain payments (those granted for end-user subsidies) to guarantee the payment of the leasing agreement (no end-user subsidy refund if the BSP ceases to pay the leasing).

[38] Moon-Miklaucic, Maassen, Li, and Castellanos. "Financing Electric and Hybrid-Electric Buses."

[39] Lu, Lu, Lulu Xue, and Weimin Zhou. 2018. "How Did Shenzhen, China Build World's Largest Electric Bus Fleet?" Insights (blog), April 4. https://www.wri.org/insights/how-did-shenzhen-china-build-worlds-largest-electric-bus-fleet.

It could also be done by means of the cash collected by pre-paid cards, where the ticket trust fund receives all payments from pre-paid tickets (80 percent of total tickets) and then allocates it to BSPs.

4.2.4.Chargers

Chargers present different characteristics and can use different technologies, but some features can be highlighted:

- 80 kilowatt chargers for BYD are in Mode 3 (AC) and the bus itself includes an internal converter. Chargers using this technology are much cheaper than DC ones, and present two different charging hoses providing 40 kilowatts each.
- The rest of the producers usually provide DC chargers (Mode 4) and present higher capacities (≈150 kilowatts).
- There could be a possibility of bidirectional exchanges, even though UTE does not foresee this possibility in the medium term.

Chargers for private cars were initially installed by UTE to avoid entry barriers: large investment costs together with low utilization factors and idle infrastructure. Chargers are located on public spaces, with unlimited access for all EV customers owning an identification card.

The charger and the required equipment are owned by UTE, which is also the supplier of power. All users are required to sign a contract with UTE for the supply, while UTE oversees the O&M of the facility. The tariff designed by UTE includes marginal generation costs (long-run) and network expansion costs. It also includes commercial costs, installation of the charger, and measure system costs.

As mentioned in Section 2.9.2, current technical specification for the subsidy constrain charging technologies since only two types of chargers are allowed [for AC charging: IEC 62196-2 (UNIT 1234:2016) with plug and socket Type 2 (Mennekes), and for DC load: CCS Type 2 (acc. to IEC 62196)]. To benefit from future technology advancements, which may result in cost decreases for existing connectors or in the appearance of new, lower-cost charging technologies, this limitation could be removed for future tendering rounds.

4.2.5.Collective parking bays

It is possible to include UTE as the developer and operator for large common charging stations for all e-buses. Following the role undertaken by UTE when it comes to private EV charging and given the small number of e-bus operators, a mechanism can be implemented by means of which UTE owns and operates charging stations that are open to all e-buses.

A third party may as well be able to develop these common charging stations but given the role of UTE as unique power supplier and its position as distribution system operator, we understand that there is more space for UTE to undertake the task and then, if deemed appropriate, tender out a concession for the operation of the facility.

Concentration of power needs and rationalization of flows would be achieved, easing distribution network planning, and allowing the exploitation of the bidirectional flow potential of such a considerable battery within the system. Bus charging stations can be a significant size, depending on the number of chargers installed: For 100 buses, considering 150-kilowatt fast DC chargers, and if each charger can fully charge four buses a night, connection capacity of 4 megawatts would be required. This is a significant load for the power distribution grid and will increase the inflows and outflows in the network, which can result in technical constraints during charging hours. If a single charging station is created in parts of the network that present no constraints, planning of power flows (and network expansion) can be coordinated in an easier way than if several uncoordinated charging stations are connected to the grid.

Moreover, increased infrastructure utilization factors open the door to higher-cost investments (faster chargers, more complex infrastructure) and relieve BSPs from a significant source of expenditure.

On the other hand, UTE can design a new tariff to recover investment costs while benefitting from better distribution network management capabilities.

For this system to work, it is crucial to select the right location of the collective parking bays, to minimize additional mileage for buses, and to ensure grid capacity. Existing parking lots can be converted into common charging areas, although that would involve alienating existing assets and may imply significant costs and be a lengthy process.

To minimize transaction costs, the best option seems to be to build a new charging area from scratch that can be located on public land and be granted to UTE under a long-term lease/concession agreement.

An example of this practice can be found in Los Angeles, where Foothill Transit (BSP) was entitled to a no-cost 40-year land lease from the city of Pomona to build and install its opportunity charging station. This station was located close to an existing transformer.[40] Similar experiences are found in China, where local authorities granted low rentals on land for the deployment of charging stations (such as the case of Shenzhen)[41] and in Stockholm (Sweden), where the transit authority (Stockholm Public Transport) provided the bus depot to the BSP (Keolis) within the pilot project undertaken in 2013.[42]

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[40] Eudy, Leslie, Robert Prohaska, Kenneth Kelly, and Matthew Post. 2016. *Foothill Transit Battery Electric Bus Demonstration Results*. Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy16osti/65274.pdf.

[41] Lin, Yuping, Kai Zhang, Zuo-Jun Max Shen and Lixin Miao "Charging Network Planning for Electric Bus Cities: A Case Study of Shenzhen, China." *Sustainability* 11 (17): 4713. https://doi.org/10.3390/su11174713.

[42] Volvo Buses. 2014. "Electric Hybrid Buses with Quick-Charge Facility Demonstrated in Stockholm." Press Release, June 25. https://www.volvobuses.com/en-en/news/2014/jun/news-147639.html.

The operational procedure can be depicted as follows: BSPs drive the bus at the end of their working day to the charging area and deliver the bus to UTE; UTE, using their specific workers (*electrobomberos*) moves the units, places them in the right charging locations, connects the chargers, monitors the process, and parks the units again out of the charging area. This type of routine allows for many buses to be charged during the night shift. The following day, BSP drivers start their daily shifts from the charging area.

Given that UTE is not used to this type of work, it may be recommended to initially relocate workers from the BSPs that can implement the parking activities, while workers from UTE implement the charging and monitoring process.

UTE can be the actor in charge or can subcontract its activities. This feature applies to all the following areas or to each of them separately:

- UTE may tender the purchase of assets to a third party
- UTE may subcontract the O&M of chargers to a third party
- UTE may tender the actual operation of the charging station
- Installation of photovoltaic (PV) panels and construction of the charging area can be done by a separate party (for PV, it may even be an independent power producer selling to UTE instead of UTE generation).

By concentrating several charging stations into one centralized facility, dimensioning and planning of the distribution grid becomes easier, and the upgrades required are immediately identified.

Large-scale charging stations can put a significant burden on the power grid (given their size and consumption pattern), so it becomes beneficial to consider both the transportation network and the power grid (and their foreseen expansion) when planning the charging infrastructure.[43]

The inclusion of UTE guarantees that no mismatch appears between the plans of private BSP and the future development of a medium-voltage network, since UTE will also participate in deciding where best to locate the charging station according to its knowledge of power flows.

Including UTE has an additional benefit: part of the investment is shifted to the power segment. Instead of BSPs (or its financiers), UTE, as the unique operator of the distribution network, undertakes the required investment and then recovers it by means of special tariffs applied to BSPs. UTE is a well-established company operating under a regulated regime, whose customer base is not forecasted to change significantly and faces low risk to the recovery of its investment (since it is the only power supplier in the country).

The idea is to use UTE's preeminent role as incumbent to benefit from the lower risk implied (as opposed to a private third party developing all the infrastructure and depending only on its contract with a private BSP, who may go bankrupt and cease payments).

[43] See Lin, Zhang, Shen, and Miao. "Charging Network Planning for Electric Bus Cities" for a detailed description of the need to coordinate EV charging infrastructure and power grid planning.

Management by UTE of the charging stations opens the door to some interesting opportunities, but also implies operative challenges.

The main opportunities from having common charging facilities managed by UTE are the following:

- Having the bus fully charged at the right time becomes crucial for BSPs. It is necessary to devote personnel to charge the buses. The inclusion of third parties who only operate the charging station can result in operational savings.
- In-house production can be used if PV panels are included in the charging area. This can expand the charging hours, and not limit all the charging to night hours.
- Space has been cited as a significant problem by some operators: Charging facilities and the space required to maneuver buses and correctly place them into the charging area imply larger space needs than that needed for diesel buses, restricting existing space for the rest of the units.
- Creating the charging area from scratch, instead of adapting already existing parking lots from BSPs, will allow UTE to implement an efficient design and maximize available space. To this end, the possibility of installing elevated charging infrastructure, as was the case in El Conquistador charging station (see page 88), should be considered.
- Fast DC chargers, with high capacity, that can generate stronger currents and charge vehicles much faster, present higher up-front costs than normal AC chargers (a 40-kilowatt AC charger can be obtained for US$10,000 as compared to a 150-kilowatt DC charger which costs US$50,000, plus installation costs). UTE would then be acting as the FleetCo for charging infrastructure: Purchasing assets in bulk, it will be able to increase bargaining power and lower investment costs, and the high level of utilization of the infrastructure (servicing large e-bus fleets instead of powering 20 or 30 units) enables the possibility of investing in fast chargers, an option discarded for small BSPs since initial costs would not be recovered with a low use factor of the asset.

On the other hand, the main challenges of having common charging facilities managed by UTE are:

- If all buses need to be parked in a common facility, either they stay overnight, or drivers need to wait two to three hours to get the unit back and return it to its own parking facility.
- Staying overnight implies that bus drivers need to start and finish their shifts at the central charging station, instead of the BSP's premises.

- Depending on the location of the charging station, some additional mileage for buses will need to be considered since their routes will be altered. Those units servicing lines whose route is distant from the facility may be at a disadvantage.
- Waiting for the bus to be charged implies increased labor requirements, which will increase OPEX for BSPs.
- All BSPs start and end their shifts at similar times, creating rush hours for the common charging station at the end/beginning of their activity. Clear parking procedures and locations need to be in place, otherwise space limitations and jams within the facility may appear, significantly increasing time needs and decreasing efficiency.
- Usually, buses start and return to station bays in which repair shops are present and where the usual external maintenance (such as cleaning) is performed. This way small repairs can be made to units between working shifts. With a common charging facility, this feature is no longer available, unless BSPs decide to relocate some of their O&M personnel into the common charging facility.
- The new area needs to include locker/changing rooms for drivers, together with some minor additional services (canteen, communications, etc.).
- Clear charging routines need to be established to prevent potential mistrust between BSPs (who goes first, who parks where, who receives the unit, and at which point) who may perceive the service as biased (no arm's-length principle). These problems can be mitigated if more than one common charging station is established (with a size that enables economies of scale).
- The area required can be significant (El Conquistador, the largest charging station in South America, covers a 15,000-square-meter area).

The city of Shenzhen used common charging stations to tackle land scarcity and the need to implement systematic planning in the power distribution network. The city plans to build 26 large-scale e-bus charging stations to charge its fleet (16,359 e-buses). All facilities are scheduled to have charging services together with parking and maintenance services. One of the examples, currently under construction, is the Yueliangwan charging station, which will have 11 floors (10 above ground and one underground), covering a 19,465-square-meter area (the total building is 98,478 square meters).[44] The station will include 237 chargers which will serve 660 buses. According to the developers, this type of station will result in a better use of the city's scarce land resources, as opposed to charging stations located at the BSPs' bus depots that only have one floor.

Other large-scale examples can also be found in Shenzhen, but these service other vehicles. The local distribution company China Southern Power Grid (SPG), for example, together with the state-owned IT company Potevio and EV manufacturer

[44] Lin, Zhang, Shen, and Miao. "Charging Network Planning for Electric Bus Cities."

BYD built the Shenzhen Minle charging station to power the city's taxi fleet. The station is composed of 637 fast chargers,[45] resulting in a total combined charging capacity of 16.8 megawatts, able to supply 5,000 cars a day. This station includes different types of chargers to supply all types of plugging systems.

SPG is also currently developing a charging facility for dump trucks and other heavy-duty vehicles. The Shenzhen Guangming Gongchang road charging station will be completed in 2021. This project includes 84 floor-mounted DC chargers (240 kilowatts) and represents the twenty-second large-scale charging station developed by the distribution company.[46]

4.2.6.Timing of new acquisitions

As previously mentioned, technology developments in the e-bus field are constant and the time of acquisition significantly impacts the required amount of support in the form of subsidies/grants. Technology improvements can take the form of less heavy units (reduced consumption, reduced tire stress), increased battery capacity, increased range, less noise, improved regenerative brake systems, faster chargers, etc.

The success of the initial tender may tempt regulators to believe that the moment is ripe, and the more units included in the system, the better for society as a whole. Total policy costs can be optimized if the pace is correctly designed.

Regulators may choose to establish annual quantities to be auctioned, year after year, and assign quantities in an increasing order (e.g., 50/50/100/100/200 instead of 100 units a year) to benefit from future cost decreases. Pauses in between new acquisitions can also be included.

This policy can be designed to match the eventual deployment of common charging areas: A batch of new e-buses can be tendered out when plans for new charging stations have been designed.

This approach was taken in Bogotá, where Enel X signed a supply contract for 379 new buses together with three new charging stations.[47] These charging stations, to be managed by Enel X, include repair shops and service several BSPs selected by Transmilenio (the public transport authority in Bogotá).

With our successive investment scenarios (see Chapter 6) we have tried to simulate this optimal pace for acquisition.

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[45] *Shenzhen Daily*. 2019. "Largest EV station in use." Shenzhen Government Online. May 23, http://www.sz.gov.cn/en_szgov/business/news/content/post_1346655.html.

[46] Seetao. 2013. "Shenzhen Guangming Gongchang Road Charging Station starts construction." May 13. https://www.seetao.com/details/24977.html.

[47] https://www.enelx.com/es/noticias-medios/press/2019/11/enel-x-entregera-puntos-de-recarga-nuevos-buses-sitp-in-bogota.

4.2.7.Alternative tendering approach

The information provided in the first round of subsidy acquisitions in Uruguay is insufficiently disaggregated: there is no price disaggregation by component (chassis, batteries, and chargers), which impedes comparing different technologies, and the way to allocate the subsidies may not have been the most efficient since BSPs did not have incentives to reveal and minimize their actual costs.

A two-step process may be considered for the allocation of the subsidy:

- As a first step, the MTOP (or another public body) tenders out large packages of units (e.g., three lots of 50 buses each). Manufacturers present their offers (subject to the minimum technical requirements established by the Technical Commission) and several (up to four) models are selected as winners.
- Then BSPs can choose between the models presented to renew their fleets. The subsidy assigned to each unit may be computed with reference to the average price of all bids to foster efficiency. With this two-step mechanism, the ministry guarantees economies of scale due to large shipments while increasing economic efficiency.
- Another possibility is to tender out the subsidy as a premium to the price of a diesel bus: The ministry can establish the number of buses to be purchased (150) and fix the reference price for the diesel bus. All participants can bid and offers will be listed in ascending value. A limit (much lower than the current limit) needs to be included to guarantee that no outliers are included in the tender.

This system guarantees price efficiency if enough manufacturers respond to the tender.

For Chile, there are Freight on Board (FOB) price quotations for 2020, for large fleets (around 200 units), that reflect total costs of buses of US$240,000 (Foton) and US$260,000 (BYD). These values represent conditions for Chile, on a FOB basis, without chargers and considering that it is already an established market. Conditions can be different for the Uruguayan case but should converge with similar figures. Besides, it must be reiterated that a range of US$97,000 price difference between units was already present in this first subsidy round (which means that the GoU may have saved up to US$2.6 million in subsidies if the lowest price model was selected for all bidders).

4.2.8.Second life cycle for batteries

Regarding the role of UTE, there is another interesting field of activity: according to current technical specifications and guarantees, batteries need to be guaranteed to work up to 65 percent of their efficiency until at least the eighth year of service. If correctly maintained, their useful life can be extended by a couple of years. Even so, when the battery reaches 65 percent of its capacity, it will be replaced by a new unit.

What is to be done? Batteries are subject to strict transport conditions (given their contents) so there is a significant constraint on their future mobility. However, they may be used as backup for charging infrastructure or connected to low-voltage grids (operated by UTE) to increase flexibility. They may not be enough to power a bus for 250 kilometers, but they are still capable of providing storage capacity to the distribution system operator.

Uruguay is currently working at the second life cycle regulation for batteries since current conditions for this second use remain uncertain. The second cycle can provide further revenues to battery owners, as second-life batteries can provide value opportunities for a range of stakeholders across the automotive and energy storage sectors, since batteries are not necessarily to be retired after they are no longer suitable for e-buses (as their range is reduced, their ability to serve buses is limited, but they still have a significant value as batteries for other uses). Besides second uses of batteries, there is new regulation to be developed regarding the treatment of its residues, a task that, given the specificities of the product, can create a significant value chain in the country. However, this issue is out of the scope of the present assignment a different report would need to be devoted to this task.

4.2.9.Capacity building

E-buses are a new technology for all BSPs in Uruguay: new O&M routines, new activities (charging), and a different type of driving are introduced to the system.

Drivers need to learn the proper use of regenerative braking systems to optimize power consumption and expand range. This improved driving will also positively affect customer experience (less burst of acceleration/slamming on the brakes).

Repair workers need to learn the new routines and new electrical technicians need to be trained in case the BSP undertakes O&M for electronics as well.

Charging routines can significantly impact loading periods for each unit. A new type of job is created (*electrobomberos*) which entails surveillance tasks as well as purely operational tasks, so new personnel need to be trained. To this end, the application of optimization software to control loading of units also becomes a relevant matter. Usually, manufacturers provide capacitation services to the BSP, as was the case between CUTCSA and BYD and CodelEste and Ankai in Uruguay, where the manufacturers implemented training sessions for drivers and where technicians from the manufacturer were present during the initial months of operation to facilitate adaptation to the new technology. BYD has implemented these types of arrangements in other cases (Chile, Brazil), and under some contracts it has committed to provide O&M for the first year while instructing BSPs' technicians how to implement it (such as under the BYD-Transwolff agreement for São Paulo).

5. The Financial Tool

The cost benefit assessment tool for e-buses was developed based on the concept of total economic costs entailed by each of the business model options, comparing e-buses and conventional diesel buses. This way, total costs for Uruguay's transportation system, including environmental costs and subsidies impact, are computed.

Additionally, the model distinguishes between BSP and third parties and delivers a full set of simplified financial statements for both agents and for each of the business models considered, assessing the attractiveness of the business for them.

The financial tool currently considers five different business models for the development of e-buses in Uruguay (see Chapter 4).

- **Diesel Model:** This is the current model for Uruguay, where BSPs purchase the diesel bus by means of the Investment Trust Fund (low-cost financing, including guarantees for lenders).
- **Model 1:** purchases benefit from the E-bus investment promotion (COMAP) and reduced Corporate Taxes and access to green certificates (no import duties are applied).
- **Model 2:** is the e-bus subsidy regime, where BSPs purchase the e-bus (chassis, batteries, and chargers) and the GoU pays a subsidy according to the technical data published after the first round of concessions. **Models 3A and 3B** introduce the e-bus leasing, where a third party enters the model, buys part of the rolling stock, and leases it to the BSP. The third party uses the COMAP schedule (no TC, TGA, reduced IRAE) and a lease contract, backed up by the Investment Trust Fund, is established between the BSP and the third party. **Models 3A and 3B** represent variations of the same business model (a third party leases the assets to the BSP). Models have been classified according to the type of support scheme (subsidy or COMAP) and by ownership of assets. They are all compared against the diesel alternative..

It must be reminded that total cost of bus fares does not change between models (i.e., ticket prices are kept constant). Hence, costs borne by consumers appear in the form of the cost of subsidies (diesel subsidy and subsidies to leasing payments). Since the cost of maintaining the subsidy to diesel consumption is higher than a potential subsidy supporting leasing payments, the costs borne by consumers are lower. In the case of Model 1 and Model 2, where consumers do not have to pay for any subsidy, their cost is the lowest.

The following table presents a summary of the business models considered.

Table 16 - Summary of Business Model Specifications

		Diesel Model	Model 1	Model 2	Model 3A	Model 3B
Asset Ownership	Chassis	BSP	BSP	BSP	3rd Party	3rd Party
	Battery	N/A	BSP	BSP	3rd Party	3rd Party
	Charger	N/A	BSP	BSP	3rd Party	UTE
Applicable Taxes Asset Owner	Global Duty Tax	23%	0%	0%	0%	0%
	Consular Tax	5%	0%	5%	0%	0%
	Corporate Tax	25%	12.5%	25%	12.5%	12.5%
	VAT to energy/fuel	37%	22%	22%	22%	22%
Subsidy to BSP		Diesel subsidy	No subsidy	E-bus investment subsidy	Leasing subsidy	Leasing subsidy

Source: MRC Group

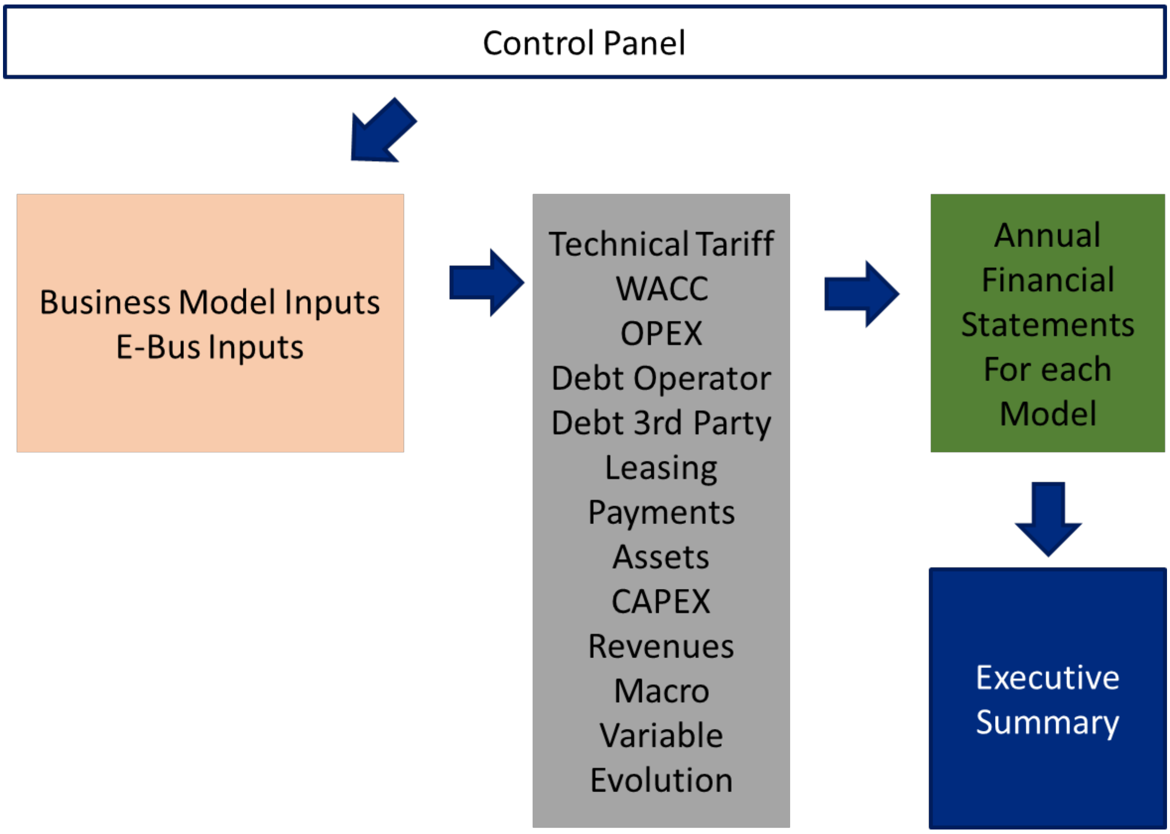
5.1. Structure of the Financial Tool

The financial tool is composed of:

- **Two input spreadsheets** (colored in light orange) which include all the assumptions and data that create the rest of the model.
- **Nine computation spreadsheets** (colored in gray), which present all the calculus required to determine profitability of each business model.
- **Five Annual Financial Statement (AFS) spreadsheets** (colored in green) that contain the results for each business model, differentiating by agent (BSP and third party, when it applies), and include profitability indicators for each case.
- **One executive summary spreadsheet** (colored in blue) that contains the most relevant information of the AFS and compares the cases under study.
- **One control panel spreadsheet** that presents the model and includes the switches required to choose between different scenarios.

The following figure offers a graphic representation of the relationship between elements.

Figure 19 - Relation between Financial Tool Spreadsheets



Source: MRC Group

A brief description of each spreadsheet is offered in the following paragraphs.

- **Input spreadsheet**
  - **Business Model Inputs:** It includes the formal definition of each of the business models included (i.e., asset ownership structure, financing, applicable taxes) and the composition of the investment plan, the financing conditions for all agents, and the data regarding macro variables (taxes, inflation, exchange rate).
  - **E-Bus Inputs:** It includes the assumptions required for O&M of diesel and e-buses (kilometers of operation, days of operation, consumption/kilometer, spare parts, garage costs, etc.), costs of energy, CAPEX figures (including useful lives of assets and embarked equipment), and scrap value of assets.
- **Computation spreadsheet**
  - **WACC:** It presents required profitability levels for BSP and third parties for each of the business models envisaged. Figures are computed in nominal terms and are used to compute NPVs for all agents in the AFS spreadsheets.

- **OPEX:** Operating expenses are computed based on the number of operating buses (not so relevant for investment scenarios with no rolling investment plans). It presents a common part for all business models (salaries, administrative expenses, and garage costs) and specific computations for each case, covering the leasing payments, power purchase costs, and O&M costs.
- **Leasing payments:** It computes monthly and annual payments to asset owners for each of the asset categories included (chassis, batteries, slow chargers, and fast chargers). Payments are computed to yield the required level of profitability to agents (their WACC). In the case of batteries, since replacement costs are different from initial investment costs, two different payments have been computed. Leasing payments cover the whole useful life of each asset and consider the remaining scrap value.
- **CAPEX:** Using the investment plan figures and cost figures for each asset, this spreadsheet derives a yearly investment figure for each agent and type of asset. It also includes additional equipment required for the correct functioning of buses (validation equipment).
- **Debt-Operator and Debt-Third Party:** Using the investment figures computed in the CAPEX spreadsheet and the financing conditions included within the Business Model Inputs spreadsheet, they provide the evolution of outstanding debt, debt repayment schedule, and interest payments derived for each business model and agent. This also includes the evolution of equity disbursement.
- **Assets:** Using the investment figures derived within the CAPEX spreadsheet, and the useful lives contained in the E-Bus Inputs spreadsheet, it computes depreciation and net book value of asset for each agent and business model.
- **Revenues:** This spreadsheet derives total revenues for BSPs in terms of the total number of operating buses, current technical tariffs granted by IM, existing subsidies, and scrapping revenues (for those cases in which the BSP owns part or all of the assets).
- **Macro Variables Evolution:** On the basis on the macro variables included within the Business Model Inputs spreadsheet, it computes the evolution of exchange rate, inflation (US$ and UY$), internal inflation, and power prices. These variables are used to compute actual CAPEX and OPEX values for the rest of the tool.

- **Annual Financial Statements spreadsheet:** It gathers and sorts the information computed in the rest of spreadsheets from the tool to offer results. For each of the business models under study, they provide simplified annual financial statements (Profit and Loss, Balance Sheet, and Cash Flow Statements) for the BSP and the third party, when applicable. They also provide profitability measures (Free Cash Flot to Equity - FCFE and Free Cash Flot to Firm - FCFF) and compute Total Cost for Society (total payments by the state, by consumer, taxes collected, and pollution avoided). The structure is the same for all five Annual Financial Statements spreadsheets.

Box 2. El Conquistador Charging Station

In December 2020, a new charging station was commissioned in Santiago de Chile (Electroterminal El Conquistador), including elevated charging infrastructure: chargers are located on the second floor and are connected to the buses parked on the ground floor by means of a retractable hose. This way, the ground floor contains no electrical equipment, increasing available space and facilitating operations within the premises.

The charging station includes 55 high-capacity chargers (150 kilowatt) that can simultaneously charge 110 buses and, according to the managing company, serve 215 e-buses daily. This charging station has been developed by three companies: STP, the bus operator who also operates the charging station; Copec-Voltex charging infrastructure provider, constructor of the facility and power supplier; Foton, the bus manufacturer.

The cost of the whole operation (215 buses and the charging infrastructure, together with land and installation) has been estimated at US$80 million.

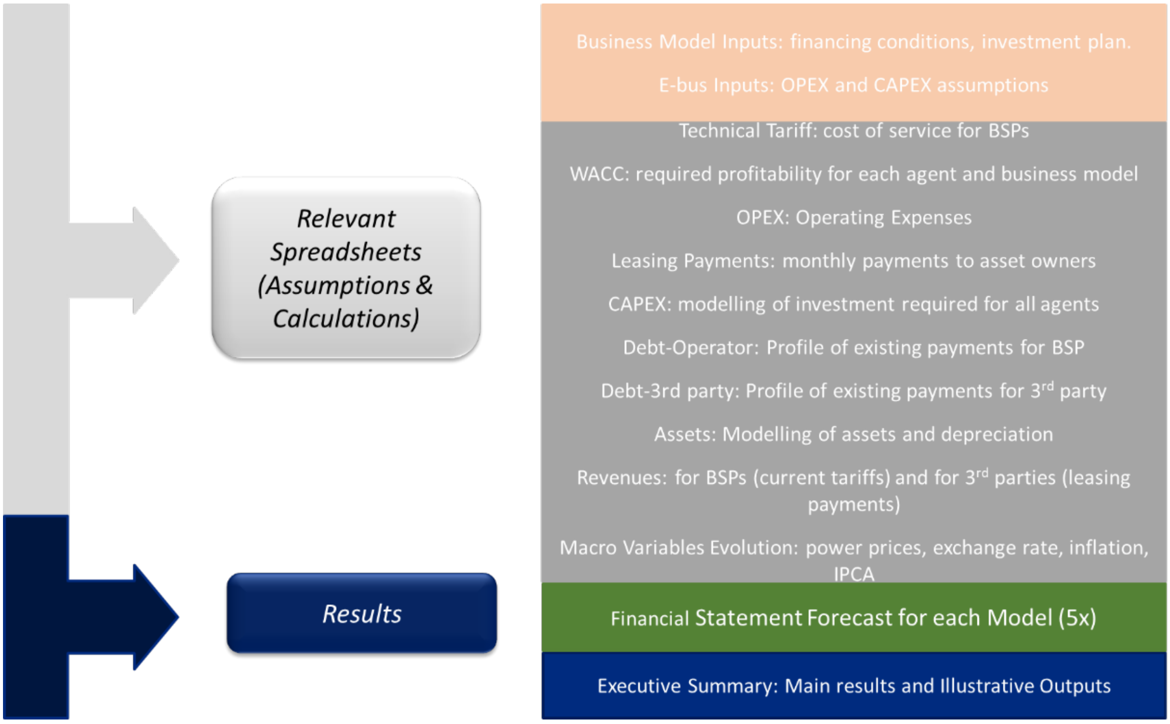
The charging station includes PV panels to power the chargers, owned and operated by a subsidiary of Copec-Voltex. This example illustrates the benefits of including several agents and not leaving all the cost in the hands of BSPs.

- **Executive summary spreadsheet:** It presents a summary of the results presented in the AFS and allows a comparison between business models. It includes no computations (only gathers information from other spreadsheets). It has been structured as:
    - Total Cost for Society
    - Total OPEX for BSP
    - IRR
    - NPV

    - Cash flows
    - Total Cost of Ownership (TCO)

- **Control panel spreadsheet:** This spreadsheet allows the user to control the assumptions included in the tool by changing the switches included in column C. Presently, the tool allows a choice between several scenarios for:
- WACC scenario
- Investment plan scenario
- Inflation scenario
- It also contains the structure, the color code, and some security checks to the tool.

Figure 20 - General Overview of Spreadsheets



Source: MRC Group

5.2. Main Assumptions

The main operative assumptions are summarized in the table below. A complete description of each item can be found within Annex 2.

Table 17 - Main Operative Assumptions

Input	Value	Source
Total Battery Electric Bus (BEB) investment cost (US$)	392,150	Obtained from the first round of subsidized acquisitions in Uruguay (Resolution 120/020)
Investment costs for chassis (US$)	248,350	Derived from the Total Investment Costs, after subtracting battery and charger costs
Avg. consumption of electricity (kWh/km)	1	BYD
Avg. cost of maintenance (US$/km)	0.09	Metbus-BYD agreement
Charging worker/bus	0.1	Own estimation. We have considered that one worker is able to correctly operate the loading of 10 buses during the night shift.
Distance	252 km/day	IM
O&M for batteries	1,250 US$/year	Based on previous projects
O&M for charging stations	0.5% of CAPEX as O&M (annual)	C40 Cities Finance Facility. 2018. Análisis de buses eléctricos para el corredor cero emisiones Eje 8 Sur. Ciudad de México, México. Mayo. https://cff-prod.s3.amazonaws.com/storage/files/2CVq9El0ehKvFJbJWd14QHZghxABGbYPCyaYS16s.pdf.
Power costs (3 periods) UY$/kWh	2.078/3.753/11.29	UTE, tariff for large consumers (GC1) connected in medium voltage. A rebate of 50%/20%/20% applies until December 2023
Diesel price (UY$/L)	28.7	URSEA, price for Gasoil 50 s (ex-plant price without taxes). Price as of Dec-2020.
Parts and accessories	2,897	IM
Diesel bus investment cost (US$)	142,305	IM
Operational costs (UY$/km)	0.529539	Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo, Anexo 1. Intendencia de Montevideo (2020).

Driver (UY$/ month)	85,848	IM
Driver-cashier (UY$/ month)	112,633	IM
Guard (UY$/ month)	80,443	IM
Inspector (UY$/month)	96,850	IM
Mechanic (UY$/month)	96,850	IM
Administrati on (UY$/ month)	96,850	IM
	350 kWh	and Peter Faguy. 2016. "Overview of the DOE VTO Advanced Battery R&D Program." U.S. Department of Energy, June 6.
Cost of batteries	268 USD/kWh	and Peter Faguy. 2016. "Overview of the DOE VTO Advanced Battery R&D Program." U.S. Department of Energy, June 6.
Investment cost for batteries (US$)	93,800.00	Derived from the previous two features
Type of Charger	AC 80 kW	Characteristics of BYD chargers, obtained from the largest BSP in UY (CUTCSA)
Cost of charger (incl uding installation costs)	US$40,000	Johnson, Caley, Erin Nobler, Leslie Eudy, and Matthew Jeffers. 2019. *Financial Analysis of Battery Electric Transit Buses*. National Renewable Energy Laboratory, U.S. Department of Energy.
Number of chargers required for each bus	0.5	Characteristics of BYD Chargers, obtained from the largest BSP in UY (CUTCSA)
Type of charger	DC 150 kW	Own estimation based on COPEC Voltex 150 kW DC chargers
Cost of charger (including installation costs)	US$67,000	Own estimation (US$50,000 for the charger and US$17,000 for the installation)
Number of chargers required for each bus	0.25	Own estimation based on loading times of batteries
Debt to equity	70/30	Own estimation

Monthly payment (as percentage of sales)	8%	Own estimation based on Fideicomiso Emission
Interest rate (annual, expressed in UI)	1.50%	Fideicomiso V and Fideicomiso VI. It is also the interest rate used by IM to compute the technical tariff.
Maturity	Variable, depending on purchase size	8% of total monthly sales of the company devoted to payment, as done in the Fideicomiso emissions
Required subsidy	267,046	Obtained from the first round of subsidized acquisitions in Uruguay (Resolution 120/020)
Scrapping values, expressed as a percentage over total investment costs, for all assets	10%	IM
CO_2 (MT/year)	105.447	Euro V diesel bus emissions considering 78,600 km a year
NO_x (MT/year)	0.284	Euro V diesel bus emissions considering 78,600 km a year
MP (MT/year)	0.003	Euro V diesel bus emissions considering 78,600 km a year

6. Financial Assessment of Business Models

This section presents the results of the simulations implemented for the five models considered under three investment scenarios.

The investment scenarios present different degrees of fleet renewal (affecting different time horizons) and are subject to different investment prices given the scale of investment.

- **Investment Scenario 1:** 100 e-buses purchased in year zero, considering a 10 percent discount on investment price.[48] This scenario covers 16 years.
- **Investment Scenario 2:** 200 e-buses purchased, 100 in year one and another 100 in year two, considering a 15 percent discount on investment price. This scenario covers 17 years.
- **Investment Scenario 3:** 100 e-buses a year for 10 years, purchased between years zero and nine, considering a 20 percent discount on investment price. This scenario covers 26 years.

All buses have a 16-year useful life (following the estimations made by the GoU). All the scenarios consider that buses operate for their full useful life and then are retired from the market. To allow for their full depreciation, different time horizons are required for each investment scenario. If we consider Investment Scenario 2, investments take place in years zero and one, so we need to extend the horizon to 17 to allow buses purchased in year one to complete their useful life. Those purchased in year zero do not operate in year 17. The same reasoning applies to Investment Scenario 3.

Total costs of each scenario are computed as the addition of four components:

- Total payments by public sector (subsidies to final users)
- Costs borne by consumers
- Total avoided cost (pollution costs)
- Total tax revenues

Costs borne by consumers includes:

- Diesel model:
  - Payment for tickets (equal for all models)
  - Gas Oil subsidy
- Model 1 (COMAP) and Model 2 (Subsidy):

[48] The investment price considered is the average of the first round of subsidized acquisitions when the largest buyer purchased 20 units and where the allocation method employed did not foster economic efficiency.

    - Payment for tickets (equal for all models)
- Model 3A:
    - Payment for tickets (equal for all models)
    - Leasing subsidy
- Model 3B:
    - Payment for tickets (equal for all models)
    - Leasing subsidy (lower than 3A)
    - Incremental payment to UTE

6.1. Results under Investment Scenario 1 (100 buses in one year)

Regarding Model 1 (COMAP), it must be considered that exoneration of taxes only applies if the company is able to generate benefits, which is not the case during the initial years under Investment Scenario 1 (100 buses in one year). Besides, it can be argued that e-buses may be subject to higher exoneration degrees. We have considered a 50 percent reduction, but if a project is able to obtain a reduction of 90 percent, the profitability obtained by investors will be increased. This will not affect the total cost of the project for society since tax money will just change hands from the government to the BSP.

The following table and figure present Total Cost for Society disaggregated by component, for each of the business models under consideration, together with the IRR obtained by operators.

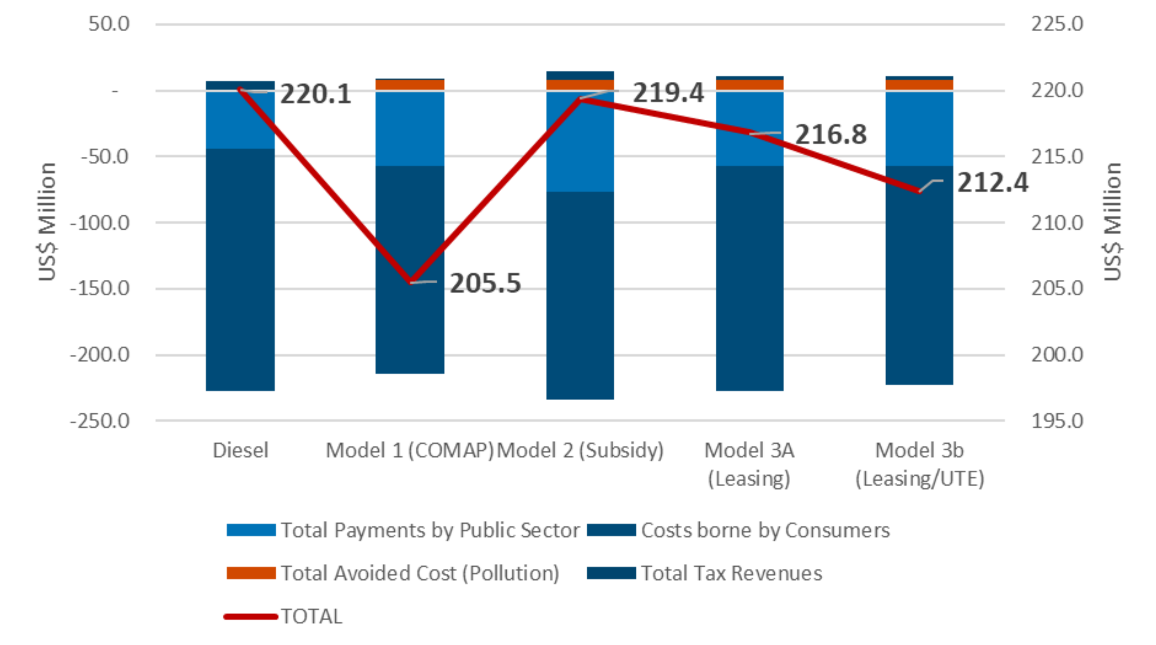
Table 18 - Investment Scenario 1: Total Cost for Society (US$, millions)

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/UTE)
Total payments by public sector	-43.9	-57.3	-76.5	-57.3	-57.3
Costs borne by consumers	-183.3	-157.2	-157.2	-170.3	-165.7
Total avoided cost (pollution)	-	8.4	8.4	8.4	8.4
Total tax revenues	7.1	0.6	5.9	2.4	2.3
TOTAL	-220.1	-205.5	-219.4	-216.8	-212.4
IRR operators	7.0%	1.8%	7.9%	6.0%	6.0%

Source: MRC Group

The following figure presents the graphical representation of the table above, adding all the costs implied by each model. The secondary axis presents total costs without disaggregation and has been included for clarity.

Figure 21 - Investment Scenario 1: Total Cost for Society (US$, millions)



Source: MRC Group

Social costs are lower under the leasing agreements (Models 3A and 3B). The entry of UTE into the equation, with the implementation of common charging stations, increases social benefits. Results show that all four different business models proposed for e-buses result in savings for society.

The following table presents those savings (computed against the diesel alternative), both in US$ and in relative terms. It must be considered that investment prices have been derived from the results obtained in the first round of subsidy allocations, whose figures seem to be above other regional references.

Table 19 - Investment Scenario 1: Savings for Society with Respect to Diesel (US$, millions)

Savings	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/UTE)
In US$, millions	14.55	0.71	3.28	7.70
% with respect to diesel	7%	0%	1%	4%

Source: MRC Group

Regarding profitability levels (Table 20), BSPs are better off under the subsidy scheme (Model 2), considering that current prices and subsidies apply. The worst option for them is to invest in e-buses without any subsidy (case in which their required level of return is below their capital cost of 6 percent). In such a situation, BSPs would not implement any fleet renewal.

As for individual decisions, BSPs would prefer to operate under the subsidy scheme or continue operating diesel buses (models with the highest IRR). Regarding leasing payments, the financial tool currently considers that part of the diesel subsidy is diverted to subsidize leasing payments by BSPs. The amount that is diverted is computed to allow the BSP to recover their cost of capital (6 percent). To this regard, BSPs would be indifferent between Models 3A and 3B. It must also be noted that Models 3A and 3B require low investment by the BSPs, as opposed to the other three—Diesel Model and Models 1 and 2.

The model with no subsidies (Model 1), considering the price assumptions made, would not be able to attract new e-buses.

Third parties are only present in Models 3A and 3B. In both cases, the interest payment included in the leasing agreements has been computed to offer third parties profitability levels above their weighted average cost of capital (WACC). The financial tool currently does not allow the application of different interest rates depending on the type of asset leased (batteries, chassis, and chargers), and results in higher returns if chargers are removed. This result can be refined to adjust profitability (what will result in increased savings for the system).

Table 20 - Investment Scenario 1: IRR for the Parties Involved

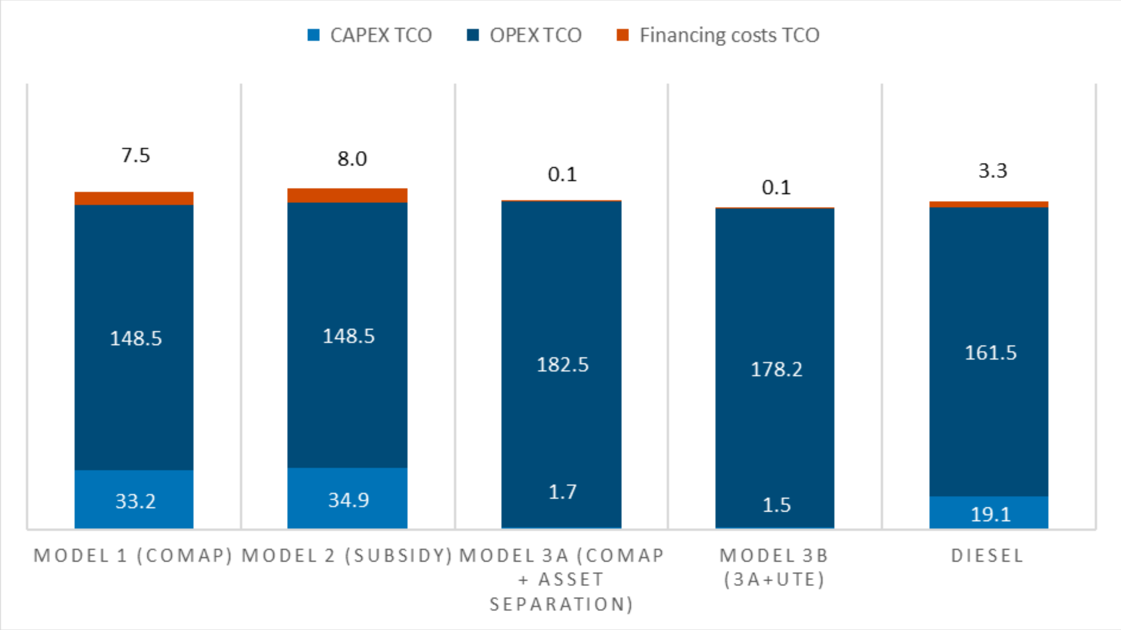
Real Values	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
IRR-Operators (FCFF)	7.0%	1.8%	7.9%	6.0%	6.0%
Operators WACC	6.0%	6.0%	6.0%	6.0%	6.0%
IRR-Third Party (FCFF)	N/A	N/A	N/A	6.7%	8.4%
Third Party WACC	N/A	N/A	N/A	5.2%	5.2%

Source: MRC Group

If we have a look at the TCO by business model, we can see that for BSPs, the models that offer the cheapest solution are those that include third parties (3A and 3B). In these two models, the transfer from CAPEX to OPEX can be observed (as investment is replaced by leasing payments). Hence, the BSPs are no longer required to make the initial investment, which allows them to save on financing costs, but trade that initial expenditure for a recurrent payment (the leasing payment). This way, the investment to be done in year zero is traded for a periodical expense to be incurred throughout the whole useful life of the asset (16 years).

The Diesel Model and Model 2 (subsidy) present almost the same values, while Model 1 (COMAP) is slightly lower.

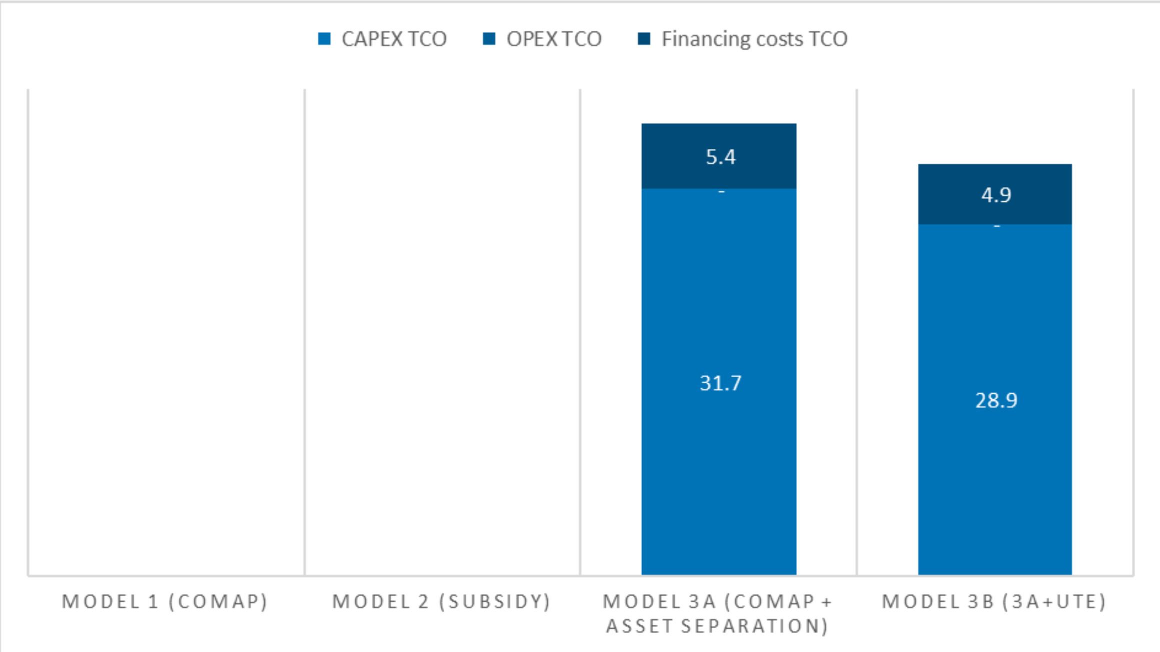
Figure 22 -Investment Scenario 1: TCO for Operators (US$, millions)



Source: MRC Group

If we implement the same analysis for third parties, the only visible effect is the transfer from CAPEX and OPEX expenditure to UTE.

Figure 23 -Investment Scenario 1: TCO for Third Parties (US$, millions)



Source: MRC Group

6.2. Results under Investment Scenario 2 (200 buses for two years)

Under Investment Scenario 2 (100 buses each year for two years, with a time horizon of 17 years, to allow for the complete life cycle of all buses), the effects of larger fleets become more important as purchasing prices converge with past regional experiences (it must be reminded that the prices obtained in the first round of subsidized acquisitions in Uruguay were higher than the prices observed in other South American countries, such as Chile, Colombia, and Brazil).

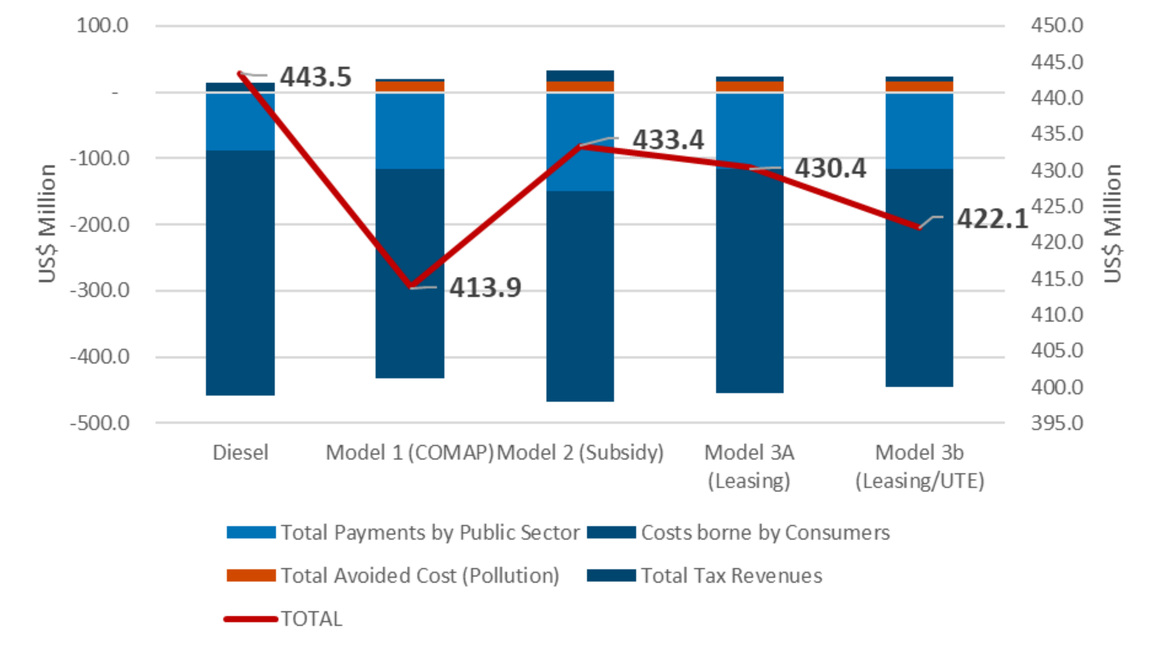
Table 21 - Investment Scenario 2: Total Cost for Society (US$, millions)

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
Total payments by public sector	-88.6	-115.7	-149.6	-115.7	-115.7
Costs borne by consumers	-369.8	-317.1	-317.1	-338.1	-329.3
Total avoided cost (pollution)	-	17.0	17.0	17.0	17.0
Total tax revenues	14.9	2.0	16.4	6.4	6.0
TOTAL	-443.5	-413.9	-433.4	-430.4	-422.1
IRR operators	7.2%	3.1%	7.8%	6.0%	6.0%

Source: MRC Group

The Diesel Model represents the highest cost for society, followed by the subsidy alternative (Model 2). The other three models present better results: models implying leasing agreements present similar numbers (3B lower than 3A), while Model 1 offers much lower costs but not high enough profitability levels for BSPs. Of the potentially feasible options, Model 3B is again the preferred one.

Figure 24 - Investment Scenario 2: Total Cost for Society (USD, millions)



Source: MRC Group

As in the case of Investment Scenario 1, savings can be obtained in all scenarios with respect to the diesel alternative. Again, among the alternatives offered, the subsidy scheme (Model 2), given the assumptions on prices, presents the lowest saving level.

Table 22 - Investment Scenario 2: Savings for Society with Respect to Diesel (USD, millions)

Savings	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/UTE)
In USD millions	29.60	10.10	13.05	21.40
% with respect to diesel	7%	2%	3%	5%

Source: MRC Group

Results regarding profitability for private operators do not change significantly with respect to Investment Scenario 1 (fleets are not so different and proximity in time of purchase – two consequitive years- precludes higher effects from cost decreases). Figures improve under the COMAP model (Model 1) but profitability still lies below the WACC (6 percent).

Table 23 - Investment Scenario 2: IRR for the Parties Involved

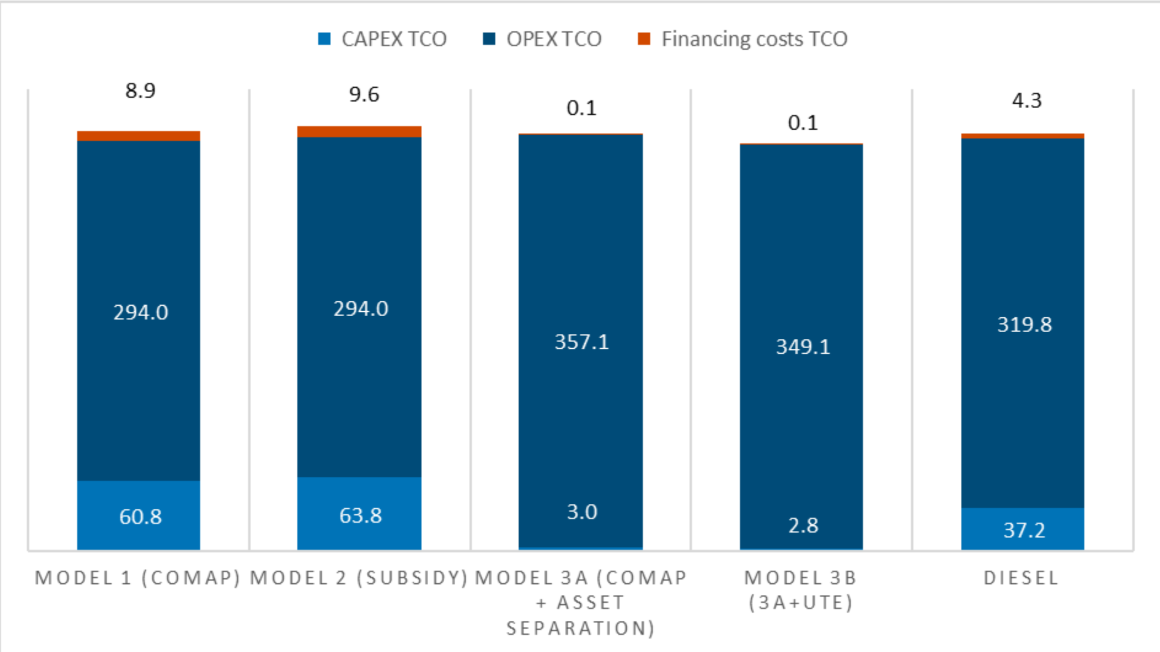
Real Values	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/UTE)
IRR-Operators (FCFF)	7.2%	3.1%	7.8%	6.0%	6.0%
Operators WACC	6.0%	6.0%	6.0%	6.0%	6.0%
IRR-Third Party (FCFF)	N/A	N/A	N/A	6.6%	8.5%
Third-Party WACC	N/A	N/A	N/A	5.2%	5.2%

Source: MRC Group

Although the decrease in cost is not so relevant, bulk purchasing benefits e-buses both in terms of reducing CAPEX and OPEX. Now diesel already becomes the most expensive model for BSPs, followed by Model 2 (subsidy), Model 1 (COMAP), and the models including leasing payments (3A and 3B). It must be noted that BSPs would still prefer to choose diesel or subsidy over COMAP, given their higher level of profitability.

Regarding leasing models, if UTE is present, TCO is further reduced.

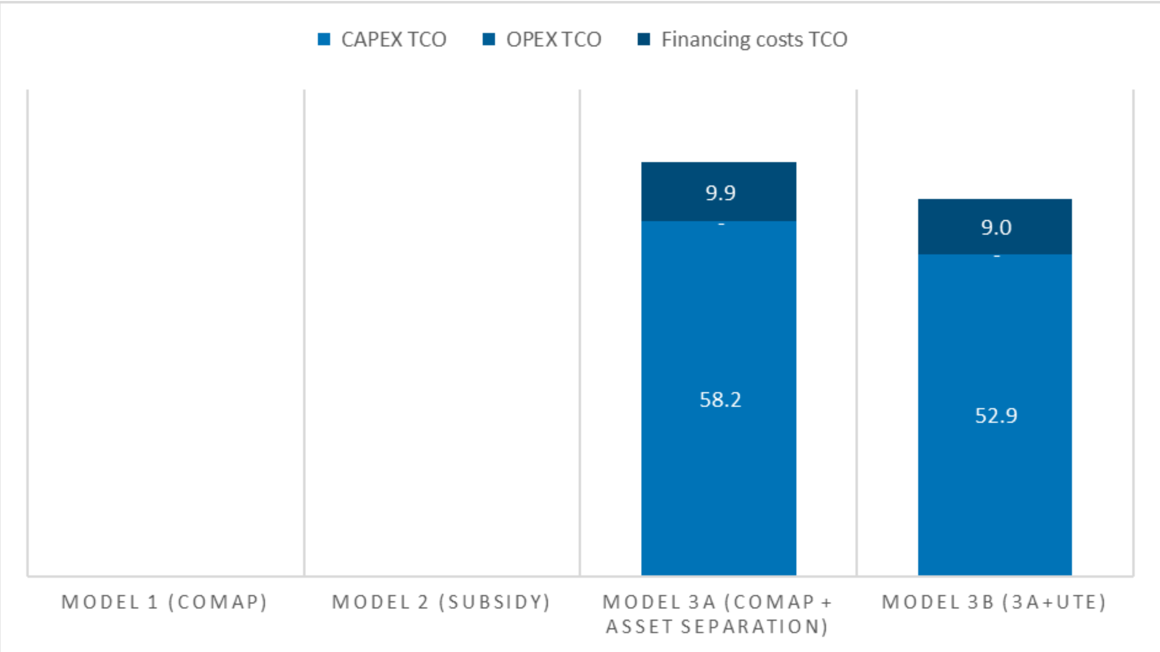
Figure 25 - Investment Scenario 2: TCO for Operators (USD, millions)



Source: MRC Group

Regarding TCO for third parties, there is no significant change, only a reduction of unit TCO.

Figure 26 - Investment Scenario 2: TCO for Third Parties (USD, millions)



Source: MRC Group

6.3. Results under Investment Scenario 3 (1,000 buses for 10 years)

When the 10-year investment plan is considered, the size of the fleet and cost evolution of the e-bus technology play a much more relevant role. Diesel remains the most expensive option for society. Model 3B is still the preferred option. Model 1 presents the lowest cost for society, but profitability levels are still very low (although, thanks to reduced investment costs, they are better than in the rest of the scenarios).

However, relative positions between the rest of the models are altered: As investment costs of both technologies converge, the need for large amounts of subsidy is reduced, allowing Model 2 to present a similar cost as Model 3A. This illustrates one relevant fact: the potential benefits of centralizing purchase of buses to lower total investment costs and the impact on the type of support scheme selected. If the price of e-buses in Uruguay converges with those in the region, they could be introduced without a subsidy (only with fiscal incentives).

This situation also opens the door to a potential modulation of the fiscal incentives: 50 percent for an initial period, 30 percent after, etc., and highlights the importance of having an escalated approach toward e-buses (applying the same policy to all units during a long-time horizon can result in significant missed benefits from lower costs on future purchases).

Table 24 - Investment Scenario 3: Total Cost for Society (USD, millions)

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
Total payments by public sector	-384.4	-502.0	-621.2	-502.0	-502.0
Costs borne by consumers	-1,604.5	-1,375.9	-1,375.9	-1,456.7	-1,415.7
Total avoided cost (pollution)	-	73.6	73.6	73.6	73.6
Total tax revenues	67.0	12.0	71.3	27.8	26.2
TOTAL	-1,921.9	-1,792.4	-1,852.3	-1,857.3	-1,817.9
IRR operators	7.1%	4.4%	8.0%	6.0%	6.0%

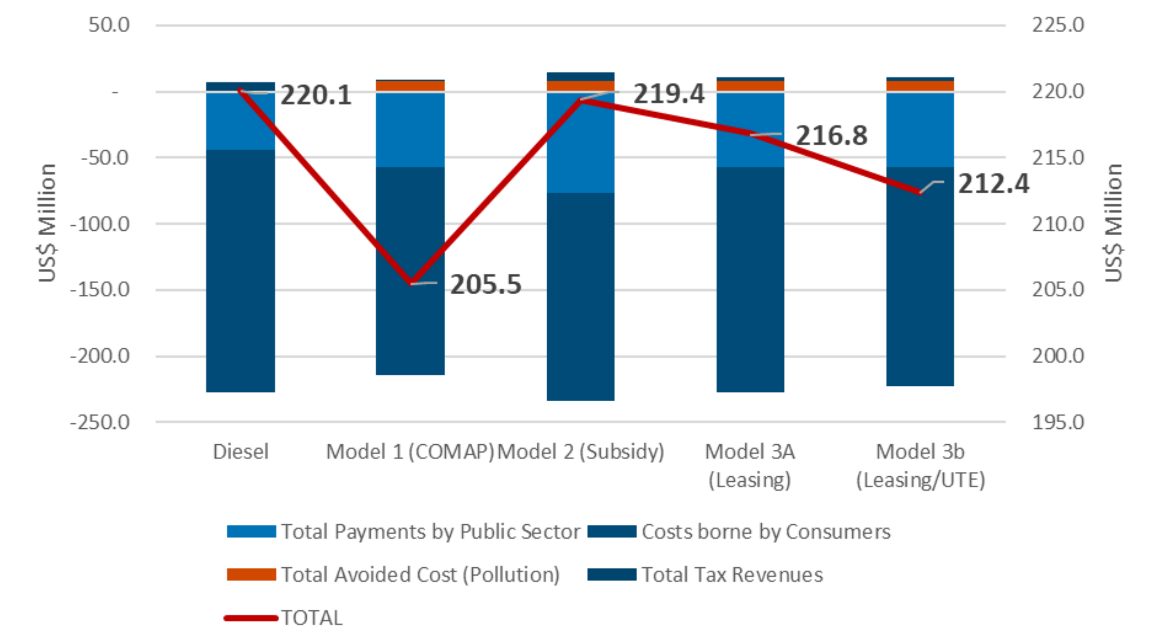
Source: MRC Group

All alternatives to the Diesel Model present significant savings, especially in the case of Models 1 and 3B. Models that imply leasing are well positioned but the subsidy model (Model 2) can become better than Model 3A if bulk purchase is effective and initial investment costs are reduced. The potential rebates on investment prices seem more difficult to obtain though, since under Model 2 each BSP would be negotiating their own prices with the manufacturer. If a FleetCo or a centralized purchasing mechanism is in place, that reduction seems more likely.

Model 1 presents the lowest cost in all investment scenarios, but additional incentives need to be proposed to BSPs since profitability levels are too low (increase tax rebates).

Model 3B seems the best option, highlighting the relevance of high use factors for infrastructure and the potential savings achieved if fast DC chargers are installed instead of conventional, slow AC chargers. Again, this supports the development of common charging stations and highlights the potential role of UTE in the deployment of e-buses in Uruguay.

Figure 27 - Investment Scenario 3: Total Cost for Society (USD, millions)



Source: MRC Group

Table 25 - Investment Scenario 3: Savings for Society with Respect to Diesel (USD, millions)

Savings	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/UTE)
In M USD	129.53	69.57	64.56	103.96
% with respect to diesel	7%	4%	3%	5%

Source: MRC Group

It must be noted that IRR for the diesel and subsidy alternatives are higher than for the rest since bulk purchase also affects diesel units (and the subsidy), while payments (the technical tariff) are not altered. In all other business models but COMAP (Model 1), profitability for BSPs reaches or exceeds the WACC (6 percent).

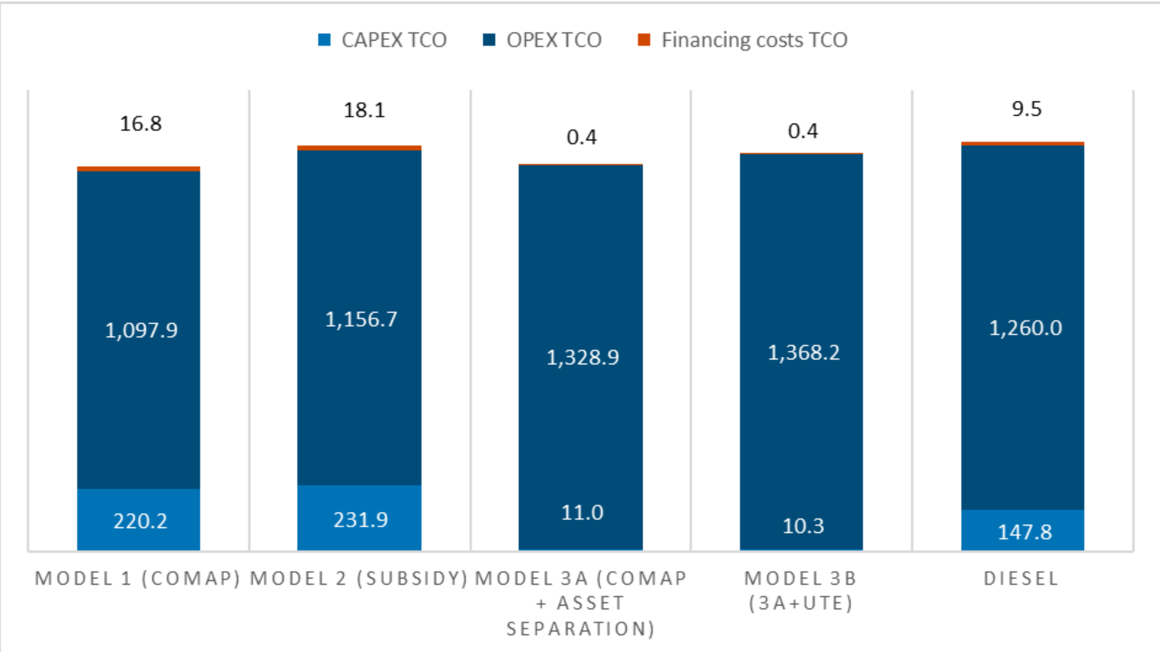
Table 26 - Investment Scenario 3: IRR for the Parties Involved

Real Values	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Leasing)	Model 3B (Leasing/ UTE)
IRR-Operators (FCFF)	7.1%	4.4%	8.0%	6.0%	6.0%
Operators' WACC	6.0%	6.0%	6.0%	6.0%	6.0%
IRR-Third Party (FCFF)	N/A	N/A	N/A	7.5%	9.6%
Third-Party WACC	N/A	N/A	N/A	5.2%	5.2%

Source: MRC Group

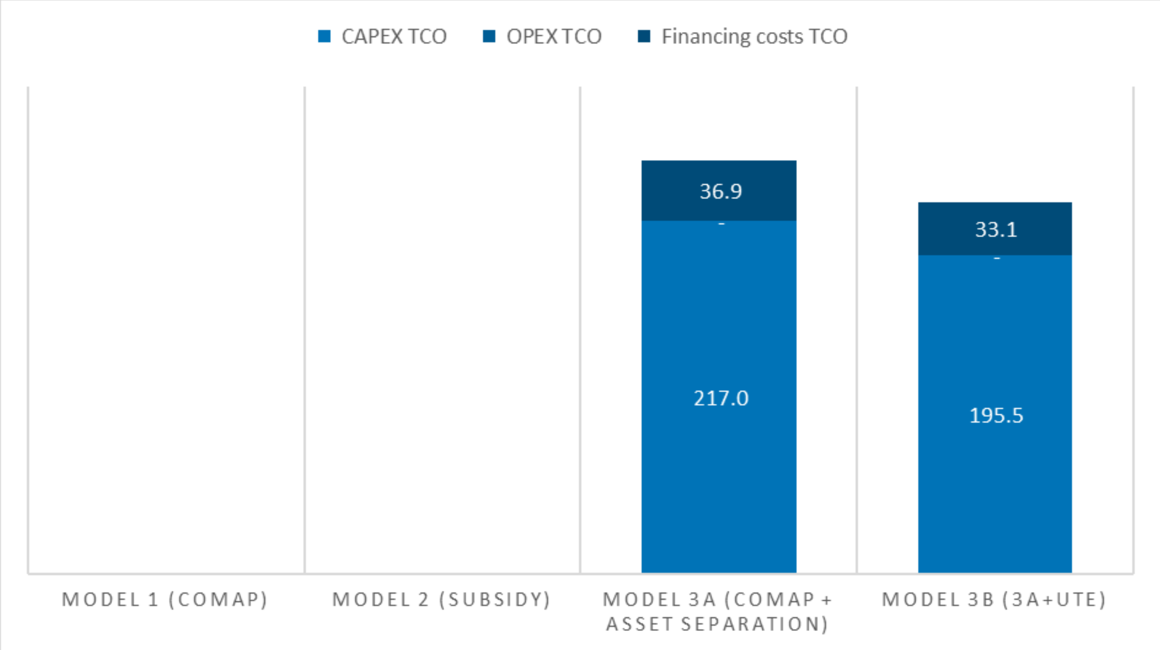
Regarding TCO for BSPs, diesel is the most expensive alternative, and there is a significant convergence between all e-bus alternatives (5.4 percent between the least and highest-cost options). This points to the fact that, as investment costs converge with those of diesel, the design of support schemes does not have such a strong relevance for BSPs since operational savings allow for faster recovery of the initial expenditure.

Figure 28 - Investment Scenario 3: TCO for Operators (USD, millions)



Source: MRC Group

Figure 29 - Investment Scenario 3: TCO for Third Parties (US$, millions)



Source: MRC Group

6.4. Conclusions of Financial Results

The main conclusions of the financial results are related to Total Cost for Society of each business model under the different scenarios. The lowest Total Cost for Society is obtained with the leasing models, in particular, with the one considering the participation of UTE (Model 3B). Significant savings can be obtained with respect to the Diesel Model, but support schemes are required, especially during the initial phases of development.

Model 1 represents the largest savings in all investment scenarios, but profitability is low, while the Diesel Model is the most expensive option in all scenarios. Model 3B is the least-cost option among the scenarios that offer profitability for BSPs. The size of the fleet renewal, and the unit cost decrease associated, favors all e-bus models.

The COMAP model (Model 1) starts as a nonviable solution as profitability is very low, but its position is improved as the size of the fleet is enlarged and as unit costs decrease (as unit price decreases, this model becomes more attractive to operators). For it to be effective, additional measures (such as further tax incentives) need to be in place—this will alter the final cost of the model.

The model under the subsidy (Model 2) is the most expensive if small fleets are considered but improves as the fleet size increases (and the bulk purchase discounts increase). It is also the one that presents the highest profitability for operators.

Leasing models (Models 3A and 3B) present significant savings when compared with the rest of models, but the effect is diluted if fleet renewal is large (and, hence, BSPs can benefit from future price decreases). If chargers are transferred to UTE and common charging stations are developed, the savings implied by higher infrastructure use factors result in significant reductions for the system as a whole.

Table 27 - Summary of Savings by Business Model and Investment Scenario

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Total Leasing)	Model 3B (Leasing/UTE)
Total Cost for Society					
Investment Sc1	220.1	205.5	219.4	216.8	212.4
Investment Sc2	443.5	413.9	433.4	430.4	422.1
Investment Sc3	1,921.9	1,792.4	1,852.3	1,857.3	1,817.9
Savings					
Investment Sc1	N/A	14.55	0.71	3.28	7.70
Investment Sc2	N/A	29.60	10.10	13.05	21.40
Investment Sc3	N/A	129.53	69.57	64.56	103.96

Source: MRC Group

With respect to incentives for the transition, it's relevant to highlight that BSPs' profitability reaches acceptable levels with respect to their WACC. The Diesel Model and Model 2 incentives are higher, but not sustainable. In the absence of mandatory administrative targets (that could be derived from NDCs), the main incentive is BSPs' profitability.

IRR for third parties is slightly higher in Model 3B, so leasing payments can be further adapted to achieve increasing savings.

Table 28 - Summary of IRR by Business Model and Investment Scenario

	Diesel	Model 1 (COMAP)	Model 2 (Subsidy)	Model 3A (Total Leasing)	Model 3B (Leasing/ UTE)
BSP IRR					
Investment Sc1	7.0%	1.8%	7.9%	6.0%	6.0%
Investment Sc2	7.2%	3.1%	7.8%	6.0%	6.0%
Investment Sc3	7.1%	4.4%	8.0%	6.0%	6.0%
Third-Party IRR					
Investment Sc1	N/A	N/A	N/A	6.7%	8.4%
Investment Sc2	N/A	N/A	N/A	6.6%	8.5%
Investment Sc3	N/A	N/A	N/A	7.5%	9.6%

Source: MRC Group

The following are some specific findings of the financial results:

- Initial costs of e-buses are clearly the most relevant variable. Bulk purchasing of units, and technology evolution, have a very significant impact on the ranking of the business models.
- Relative positions of alternative business models change as costs decrease, highlighting the need to progressively adapt regulation to technology evolution (favoring some models for initial stages and others for large-scale deployment).
- The current investment framework in place (mainly the trust funds and the e-bus investment subsidy) may be adjusted to allow leasing schemes, with the benefit of reducing total costs of the support mechanism and would allow to replace the current investment subsidy (to be paid in seven years) with an operational subsidy (to be paid during the whole lifetime of the e-bus), alleviating the burden on the GoU. In a future scenario of bulk purchasing of units, and technology evolution, the leasing scheme could become even more efficient.
- The creation of common charging stations and the inclusion of UTE as a relevant agent present significant savings due to the inclusion of better technology solutions (large-scale DC chargers). The relevance of UTE in the process allows for better planning for operational and investment savings (by means of common charging stations) and special tariffs (in high voltage).

- Model 3B comes out to be the optimal, highlighting the relevance of high use factors for infrastructure and the potential savings achieved if fast chargers are installed, allowing for increased use of chargers. Again, this supports the development of common charging stations and highlights the potential role of UTE in the deployment of e-buses in Uruguay.
- There is a convergence in TCO for all models as the size of the fleet increases and technology costs decrease (battery evolution). This points to the fact that, as investment costs converge with those of diesel, the design of support schemes does not have such a strong relevance for BSPs since operational savings allow for faster recovery of the initial expenditure.
- Leasing structures represent a significant saving at the beginning, where BSPs face potentially excessive up-front costs, but may no longer be required in the future as technology costs decrease.

Those previous findings are heavily conditioned by:

- The assumption that there are no technology advances in chassis and chargers which result in price decreases in future years. This is a very conservative approach, which we consider adequate for this level of analysis. However, we recognize that increases in battery capacity will allow lighter and smaller chassis and chargers.
- The initial prices assumed for all assets seem to be a bit higher if compared with other local references (Chile and Colombia). Initial investment costs are the most relevant factor in the analysis, so a rationalization of the purchasing method should be introduced.
- We are considering that O&M is not affected by scale; it should be noted that if the same company is performing O&M for many units, the normal trend will be for unit costs to decrease.
- Investment takes place at a constant pace (same number of new units every year). An increasing investment path, resulting in the same amount of total buses, would allow the system to benefit from foreseen savings.
- Pollution costs for CO_2, NO_x, and particulates are the only environmental gain considered in this study, but e-buses present further positive externalities (other pollutants not considered, noise reduction, improved quality of service, reduced health spending, etc.).
- Currently, the analysis assumes that charging stations are limited to 100 buses and are connected at low voltage levels. If common charging stations are implemented (for a larger number of buses), capacity requirements for each station would range between 6 megawatts and 8 megawatts, which would imply connection to the grid at higher voltages. If instead of Large Customer Type 1, as currently applied, BSP would be classified as Type 4, a 9.6 percent discount would be achieved, increasing operational savings.

- Changes in relative positions of the business models highlight three issues:
  - The need to adapt incentives to the evolution of technology costs
  - The importance of centralizing the purchase of buses to lower total investment costs and the impact on the type of the selected support scheme. If the prices for e-buses in Uruguay converge with those in Chile, e-buses could be introduced without a subsidy (only with fiscal incentives).
  - There is space for a potential modulation of fiscal incentives. This conclusion highlights the importance of having an escalated approach toward e-buses (applying the same policy to all units during a long-time horizon can result in significant missed benefits from lower costs on future purchases).

A good analogy for the e-bus transition is the historical evolution of renewable energy support schemes, progressively adapted (until disappearing) as technology costs converged with that of conventional power sources. In this case, a non-polluting technology needs to be fostered against a conventional, polluting one. Social benefits are higher than private benefits, so incentives need to be in place if society is to have an interest in its development. Besides, there is a significant level of uncertainty regarding the evolution of costs and performance of e-buses in the future, and the market must readapt to them. In the case of renewable energy sources, initial hard subsidies (FIT schemes) were prevalent at the beginning but were progressively substituted by operational subsidies (contracts for differences with respect to market prices) and by centralized purchasing schemes (tenders) as the evolution of investment costs allowed them to directly compete with (and beat) conventional technologies.

7. Fiscal Impact Analysis

The scaling up of e-buses will have fiscal impact that has been estimated in accordance with different scenarios of e-bus expansion. In addition to the direct taxes impact, it is important to assess the impact on the central government and municipality's budget due to increases in subsidies for the remuneration of bus operators. While in previous sections the proposed business models/financing schemes for e-buses have been identified and successively evaluated from a financial point of view, considering the regulatory and fiscal framework of reference, this section is devoted to the fiscal impact of the proposed business models under different investment scenarios.

In particular, the fiscal impact on the state and municipalities' budget can be exacerbated by the increase in the number of e-buses in the fleet, which have, in principle, higher initial costs than diesel buses. In summary, the assessment of fiscal impact and ways to ensure efficiency and sustainability of financing schemes for e-buses will require the implementation of the following activities:

- Identify and quantify fiscal revenues and costs derived from taxes and subsidies currently in application to the Diesel Model, both on investment and operational costs.
- Specify and quantify fiscal revenues and costs of the four business models that have been proposed for e-buses and evaluated through the financial model of BSPs.
- Determine the fiscal equation of the proposed business models by a differential analysis between diesel and e-buses, and make recommendations for improving its sustainability in the long term.

The fiscal analysis will be dependent on the scale-up plan that will be proposed for e-buses.

7.1. Methodology of the Fiscal Impact Assessment

The fiscal impact assessment has been deployed for each of the four proposed business models (Model 1: COMAP; Model 2: Subsidy; Model 3A: Leasing; Model 3B: Leasing and UTE participation), considering the three investment scenarios envisaged (100 buses, 10 percent discount; 100 buses per year for two years, totaling 200 buses, 15 percent discount; 100 buses per year for 10 years, totaling 1,000 buses, 20 percent discount).

Subsidies and taxes have been analyzed separately for investment and operational phases. For the investment phase, in particular, the following items have been considered:

- Subsidies to assets:
  - Diesel and Model 1: no subsidies are foreseen
  - Model 2: calculated as CAPEX difference between diesel and e-buses
  - Model 3A: subsidy is decreasing for Investment Scenarios 2 and 3 because of a growing discount on purchase price and a reduction of the purchase price due to technological disruption (11 percent year-on-year learning rate for batteries) is considered
  - Model 3B: the same as 3A, with an initial reduced cost because UTE develops charging infrastructure

Table 29 - Investment Phase: Subsidies and Taxes

	Subsidies to Assets			Taxes	
	Investment Sc. 1	Investment Sc. 2	Investment Sc. 3	Global Duty Tax	Consular Tax
Diesel	-	-	-	23%	5%
Model 1	-	-	-	-	-
Model 2	CAPEX difference between diesel and e-buses			-	5%
Model 3A	33.29%	28.08%	25.11%	-	5%
Model 3B**	21.54%	15.41%	11.61%	-	5%

Source: MRC Group

Concerning the operational phase:

- Ticket subsidies:
  - Diesel: on both transport fares and diesel consumption
  - E-buses: only on transport fares
- Tax on vehicles and revenues:
  - Tax on vehicles: the same for diesel and e-buses
  - IRAE: 25 percent for all the business models except for Model 1 (12.5 percent)49
- VAT + other taxes: 37 percent for diesel and 22 percent for electricity

[49] This exercise assumes a uniform IRAE applied to business models 2 and 3. This is a referential theoretical assumption (not related to the current actual ones that apply differentiated tax exemptions depending on the BSP corporate nature), that can be adjusted according to the specific cases under further assessment.

Table 30 - Operational Phase: Subsidies and Taxes

	Ticket Subsidies		Tax on Vehicles and Revenues			
	on transport fares	to diesel	Tax on vehicles UY$		IRAE	VAT + others
			First year	others		
Diesel	Retirees, students, frequent travelers, and tariff subsidy	12.78 URU/L	12,058	8,623	25.0%	37%
Model 1		0	12,058	8,623	12.5%	22%
Model 2		0	12,058	8,623	25.0%	22%
Model 3A		0	12,058	8,623	25.0%	22%
Model 3B		0	12,058	8,623	25.0%	22%

Source: MRC Group

Considering the above illustrated parameters, subsidies and taxes have been estimated for all the business models and subsequently the fiscal impact has been determined as the difference between each of the four e-bus business models and the one with traditional diesel buses. The exercise has been carried out for each of the envisaged investment plans, as described above.

7.2. Results of the Analysis

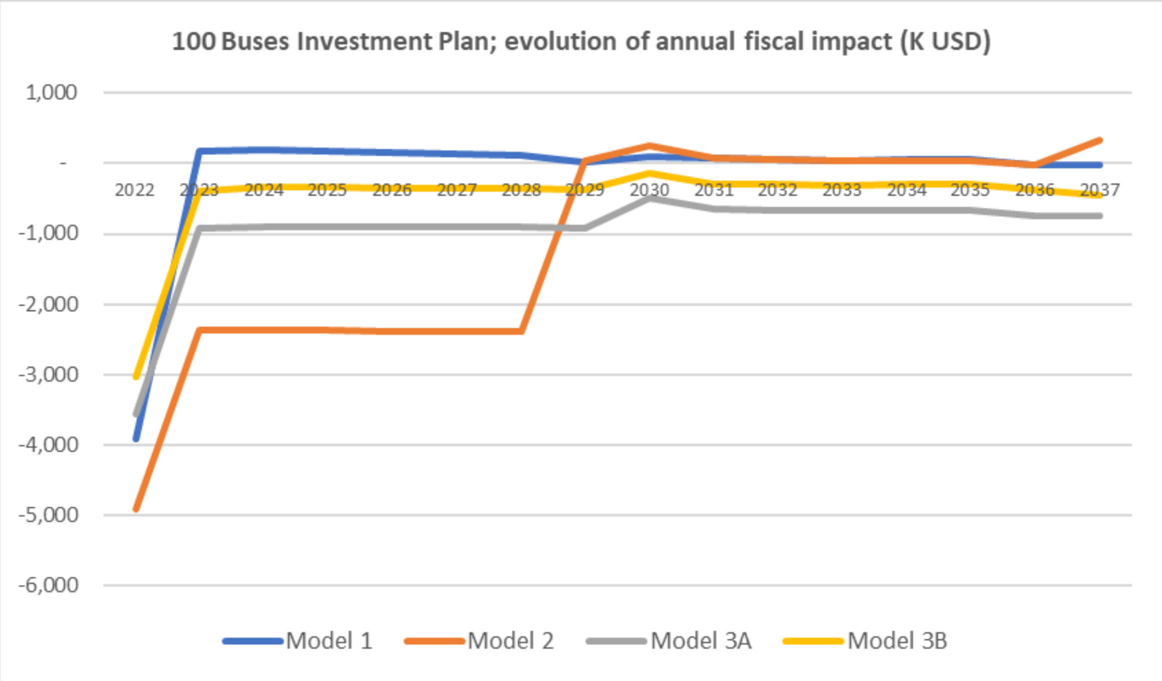
Based on the differential analysis illustrated in the previous section, it has been possible to estimate the fiscal impact of the four e-bus business models, combined with the three investment scenarios envisaged.

The following aggregates have been calculated to allow for the assessment of the results:

- Fiscal impact, distinguishing between investment and operation phases, for the first year and average per year
- Ratio fiscal impact/current subsidies to diesel, for the first year and average per year; it allows an appreciation of how much the state must increase its financial engagement in the bus transport sector
- NPV of the total fiscal impact, calculated on the entire period of analysis (duration differs among the three investment plan options)

As can be also appreciated in the following figure where the evolution of annual fiscal impact is presented for the Investment Scenario 1 (100 buses, 10 percent discount), Model 1 performs better than the others, with the second negative fiscal balance of the first year (-USD3.5 million), just after Model 2 (USD4.7 million), and an always positive fiscal balance in the following years of the analysis period. The first-year imbalance of all the options is due to public subsidies and lower taxation for Models 2 and 3A/B, in relation to Model 1.

Figure 30 - Investment Scenario 1 (100 buses); Evolution of Annual Fiscal Impact



Source: MRC Group

Such scenarios are compared with the traditional diesel bus, characterized by the absence of subsidies to asset purchase and higher taxation. Therefore, the investment phase is generating a huge fiscal imbalance, which could be mitigated if the strong bargaining power deriving from the creation of a single purchasing center will allow Uruguay to reach lower bus purchase prices, similar to the case of Chile.

The operational phase is much more favorable to e-buses because of the subsidies to diesel purchase, only partially compensated by a different taxation of the two different sources of energy: 37 percent of VAT and other small taxes for diesel against 22 percent for electricity, applied to a much lower level of expenditure (power versus diesel).

In the following table, the NPV of the total fiscal impact is presented for the four business models, combined with the three investment scenarios. Through this indicator, it is possible to define ranking between the considered business options. As anticipated above, Model 1 (COMAP) shows the lowest fiscal impact (-USD2.8 million) and Model 2 the highest one (USD18.4 million). In between them are the two business models using leasing for asset purchase (3A/B), which allow to spread the expenditure over time. Model 3B shows better results because the charging infrastructure is financed by UTE.

Table 31 - NPV of the Total Fiscal Impact: Four Business Models vs. Three Investment Scenarios (USD, 2019)

Business Model	Investment Scenario		
	Sc. 1	Sc. 2	Sc. 3
Model 1 (COMAP)	- 2,828,790	- 5,334,223	- 21,889,807
Model 2 (Subsidy)	- 18,368,192	- 27,877,326	- 93,948,486
Model 3A (Leasing)	- 13,463,792	- 20,409,039	- 80,255,217
Model 3B (Leasing/UTE)	- 7,530,236	- 9,204,145	- 30,771,025

Source: MRC Group

7.3. Conclusions of Fiscal Impact Results

The main conclusions of the fiscal impact results are summarized by NPV of total fiscal impact of each business model under the different scenarios. Model 1 (COMAP, with tax exemption) shows the smallest impact in all investment scenarios, but the differences are a bit diluted if fleets become bigger and the investment period longer. Indeed, in Investment Scenario 1 (100 buses), Model 3B (the second best performing, with leasing and UTE involvement) has an almost three times larger fiscal impact than Model 1. In Investment Scenario 2 (200 vehicles) the fiscal impact is less than double, and in Investment Scenario 3 (1,000 buses) the fiscal impact is less than 50 percent bigger.

In the following table, total fiscal impact for the first year and average per year, as well as the ratio of fiscal impact/current subsidies (also for first year and average per year) are shown for the four business models and the three investment scenarios. The above-described conclusions on NPV are confirmed (Model 1 first, Model 3B second, Model 3A third, and Model 2 fourth) and it is interesting to appreciate the fiscal impact in relative terms, through comparison with the current level of subsidies for the traditional diesel bus transport system. Indeed, in investment scenario 1, Model 1 shows an average increasing of the current financial support of only 3.1 percent. The first-year imbalance, at 62 percent, seems to be much less affordable. So, as previously noted, the possibility of reaching lower prices, similar to what has been achieved in Chile, through the creation of a single purchasing center, becomes a decisive factor in reducing both the huge first year fiscal imbalance as well as the average annual level of the imbalance. As regards the other two investment scenarios (200 and 1,000 buses), the average per year ratio of fiscal impact over current subsidies is improving: Model 1 passes from 3.1 percent on the investment scenario 1 (100 buses) to 2.8 percent and 2.5 percent, respectively, for the investment scenario 2 (200) and investment scenario 3 (1,000 buses).

As regards to the other three models (2, 3A, 3B), the two indexes (average fiscal impact/current subsidy and first year imbalance) improve with the size of the investment, thereby suggesting investment scenario 3 as the optimal approach for Uruguay in terms of relative fiscal impact.

Concerning the temporal evolution of the impact, all four models present a relevant imbalance during the first year when the investment is carried out. Indeed, for Model 1, no taxes are accounted, while Models 2, 3A, and 3B receive subsidies and take advantage of reduced tax levels. In the following years, Model 1's balance becomes immediately positive (because of no subsidies on buses' purchase), Model 2 takes seven years, while for Models 3A and 3B the payoff stays negative to the end, depending on the different timing of subsidies disbursement.

Table 33 - Fiscal Impact of the Four Considered Business Models: First Year and Average per Year; Three Investment Scenarios (USD)

		Investment Scenario 1		Investment Scenario 2		Investment Scenario 3	
		Total Fiscal Impact	Fiscal impact/ current subsidies	Total Fiscal Impact	Fiscal impact/ current subsidies	Total Fiscal Impact	Fiscal impact/ current subsidies
M1	Year 1	-3,470,041	61.8%	-3.470.041	61.8%	-3,470,041	61.8%
	AVG/ year	- 92,174	3.1%	-170.016	2.8%	- 748,618	2.5%
M2	Year 1	-4,688,058	83.5%	-4.526.522	80.7%	-4,362,919	77.8%
	AVG/ year	-658,752	22.0%	-966.157	15.7%	3,577,902	12.0%
M3/A	Year 1	-3,175,885	56.6%	-3.006.738	53.6%	-2,971,792	53.0%
	AVG/ year	- 531,198	17.7%	- 806.683	13.1%	-3,550,351	11.9%
M3/B	Year 1	- 611,325	46.5%	-2.458.568	43.8%	-2,392,623	42.6%
	AVG/ year	- 293,162	9.8%	- 348.913	11.9%	-1,272,466	4.3%

M - Model **AVG/Year** - average per year

The following are some specific findings of the fiscal impact results:

- Initial costs of e-buses are clearly the most relevant variable. Bulk purchasing of units, and technology evolution, could have a significant impact on the need for subsidies and tax reduction; initial hard subsidies will likely be progressively reduced.
- Leasing schemes reduce total costs of the support scheme and would allow to replace the current investment subsidy (to be paid in seven years) with an operational subsidy (to be paid during the whole lifetime of the e-bus), alleviating the burden on the GoU. In a future scenario of bulk purchasing of units, and technology evolution, the leasing scheme could become even more efficient.
- The inclusion of UTE as a relevant agent in Model 3B presents significant operational and investment savings and, consequently, less need for subsidies and lower fiscal impact, making the model more convenient from the fiscal point of view.
- There is a convergence of fiscal impact for all models as the size of the fleet increases and technology costs decrease (battery evolution), and a lower fiscal impact in relative terms (as percentage increase of the current financial engagement of GoU for the bus transport sector).

Table 34 - Fiscal Impact of the Four Considered Business Models: First Year and Average per Year; 100 Buses Investment Plan (USD)

	Model 1		Model 2		Model 3A		Model 3B	
	first year	average per year	first year	average per year	first year	average per year	first year	average per year
INVESTMENT	-3,628,780	-127,350	-5,407,148	-843,446	-3,384,301	- 649,457	-2,866,052	-399,190
Subsidies to assets	-	-	-3,317,483	-774,079	-1,221,345	-577,329	703,096	327,063
Taxes	3,628,780	-127,350	-2,089,665	- 69,366	-2,162,956	-72,127	-2,162,956	- 72,127
OPERATION	158,739	35,176	719,090	184,693	208,415	118,259	254,726	106,028
Ticket subsidies	1,015,328	541,508	1,015,328	541,508	1,015,328	541,508	1,015,328	541,508
Road tax + IRAE	- 141,328	- 124,860	419,023	24,658	- 91,652	- 41,777	- 45,341	- 54,008
VAT	- 715,261	- 381,472	-715,261	- 381,472	- 715,261	- 381,472	- 715,261	- 381,472
ANNUAL FISCAL IMPACT	- 3.470.041	- 92.174	- 4.688.058	- 658.752	- 3.175.885	- 531.198	- 2.611.325	- 293.162
Fiscal impact/ current subsidies	61.8%	3.1%	83.5%	22.0%	56.6%	17.7%	46.5%	9.8%

Source: MRC Group

Table 35 - Fiscal Impact of the Four Considered Business Models: First Year and Average per Year (USD)

	Model 1		Model 2		Model 3A		Model 3B	
	first year	average per year	first year	average per year	first year	average per year	first year	average per year
Investment	- 3,628,780	- 254,700	- 5,226,991	- 1,546,119	- 3,211,847	- 1,093,009	- 2,711,312	- 603,020
Subsidies to assets			- 3,063,396	- 1,400,351	- 978,481	- 942,054	- 477,946	- 452,065
Taxes	- 3,628,780	- 254,700	- 2,163,595	- 145,768	- 2,233,366	- 150,955	- 2,233,366	- 150,955
OPERATION	158,739	84,684	700,469	579,962	205,109	286,326	252,745	254,107
Ticket subsidies	1,015,328	1,116,861	1,015,328	1,116,861	1,015,328	1,116,861	1,015,328	1,116,861
Road tax + IRAE	- 141,328	- 245,351	400,402	249,927	- 94,958	- 43,708	- 47,322	- 75,927
VAT	- 715,261	- 786,826	- 715,261	- 786,826	- 715,261	- 786,826	- 715,261	- 786,826
ANNUAL FISCAL IMPACT	- 3,470,041	- 170,016	- 4,526,522	- 966,157	- 3,006,738	- 806,683	- 2,458,568	- 348,913
Fiscal impact/ current subsidies	61.8%	2.8%	80.7%	15.7%	53.6%	13.1%	43.8%	5.7%

Source: MRC Group

Table 36 - Fiscal Impact of the Four Considered Business Models: First Year and Average per Year; 1,000 Buses Investment Plan (USD)

	Model 1		Model 2		Model 3A		Model 3B	
	first year	average per year	first year	average per year	first year	average per year	first year	average per year
ASSETS	- 3,628,780	- 1,241,546	- 5,044,513	- 6,359,213	- 3,213,933	- 4,839,393	- 2,678,724	- 2,414,525
Subsidies to assets	-	-	- 2,805,738	- 5,610,274	- 908,967	- 4,069,089	- 373,758	- 1,644,221
Taxes	- 3,628,780	- 1,241,546	- 2,238,776	- 748,939	- 2,304,966	- 770,304	- 2,304,966	- 770,304
OPERATION	158,739	492,929	681,595	2,781,311	242,141	1,289,041	286,102	1,142,059
Ticket subsidies	1,015,328	5,415,082	1,015,328	5,415,082	1,015,328	5,415,082	1,015,328	5,415,082
Road tax + IRAE	- 141,328	- 1,085,971	381,528	1,202,411	- 57,926	- 289,859	- 13,965	- 436,841
VAT	- 715,261	- 3,836,182	- 715,261	- 3,836,182	- 715,261	- 3,836,182	- 715,261	- 3,836,182
ANNUAL FISCAL IMPACT	- 3,470,041	- 748,618	- 4,362,919	- 3,577,902	- 2,971,792	- 3,550,351	- 2,392,623	- 1,272,466
Fiscal impact/ current subsidies	61.8%	2.5%	77.8%	12.0%	53.0%	11.9%	42.6%	4.3%

Source: MRC Group

8. New Business Models and Steps Forward

In chapter 1 of this study, we analyzed the most recent international experience related to business models and financial schemes to accelerate e-bus deployment.

As one of the most relevant findings, the lessons learned from **asset separation** from BSPs in Latin America (mainly in Chile and Colombia) show that it has been quite effective in terms of alleviating the huge up-front cost and financial challenges that investment in e-bus transition impose on BSPs and city transport authorities. Asset separation has been combined with **leasing arrangements** between authorities or BSPs and third-party investors that allow the mitigation of the huge initial CAPEX barriers (usually supported by public subsidies), transforming them into periodic leasing (OPEX) payments along the lifetime of the assets (chassis and batteries).

It is worth highlighting that the asset separation/leasing strategies have managed to attract international energy corporations, electric utilities (when allowed by regulation), and manufacturers as **third-party investors** as a way of promoting the development of an increasing demand for electricity and e-buses from BSPs and cities that clearly favors their own business sustainability.

The **Uruguayan experience in terms of e-bus deployment since 2019 has proven to be effective** based on an integrated assets model (BSPs own chassis, batteries, and charging stations), financed through a combination of a fleet renewal trust fund from IM and an investment subsidy from the GoU. Beyond the public investment subsidy, the IM trust fund has managed to get financing and guarantees at a moderate interest rate, helping to mitigate the high investment cost of e-buses.

Through the financial and fiscal analysis of the alternative models, we have simulated and compared two models of **total asset separation and leasing** (taken from successful Latin American experiences) with **the current business models in place in Uruguay**: the COMAP model and Investment Subsidy model (on top of the Investment Trust Fund credit). The objective of the simulation is to obtain **guidance results** about the feasibility of the new business models analyzed from the point of view of BSPs and the society as a whole. In that sense, under the technical and financial assumptions applied, **new asset separation and leasing models achieve results comparable to the current models**.

The total asset separation model shows better results for the whole system when **UTE participates as a third-party investor** developing parking bays for use by all BSPs (either by the utility itself or by outsourcing those services to private companies).

However, there is a need to highlight that the financial analysis assumes that current arrangements for the Investment Trust Fund apply to a notional BSP: It can finance its new capital expenditures for fleet renewal using the securitization method, and paying a given percentage of its monthly sales in exchange, irrespective of the size of the BSP. Hence, the scale effect is not reflected in the analysis, specifically how an investment in such a high number of new units would burden the different BSPs financial situation.

This consideration highlights **the problems of small companies to access financing: even when the Investment Trust Fund helps to de-risk the operation, their ability to repay is limited**.

The analysis of alternative business models considers **total asset separation options that are relevant innovative references** to be considered for the Uruguayan case. There are other alternatives which may also be formulated, including:

- **Partial asset separation**, in which a third-party leases batteries and chargers as a "charging service" while chassis remain under the ownership of BSPs. This model implies technical and performance complexities due to different ownership (and responsibilities) of chassis and batteries. International experience (the London case is an example) shows that complex performance contract agreements are required for this model, which suggests that this model should not be considered as one of the main options in a small market like the Uruguayan one.
- **Partial asset separation**, with UTE as the sole third-party investor regarding charging infrastructure while the rest of the assets are purchased by the BSP under the current investment schemes. This seems to be a very short-term alternative, with a quite straightforward implementation, because it requires simply extending UTE's current investing role from private vehicles to public buses.

Under the previous reasoning, it can be said that from the point of view of potential business models to scale up e-buses in Uruguay, it seems that leasing models that allow the participation of third-party investors may open a wider range of opportunities for e-bus deployment:

- In terms of regulatory improvements in the transport sector: asset separation has the benefit of isolating assets from BSP risk. Assets are available for the system irrespective of the operator and remain as such even after changes of BSP because of regulatory or financial reasons.
- Representing an opportunity to attract fresh funding for the renewal of the diesel fleet that will demand increasing amounts of CAPEX. This advantage would be even more relevant considering that public direct subsidies (as considered in Model 2) may not be sustainable in the medium or long term.
- Leasing models may provide operational solutions that may be more efficient from the point of view of the Total Cost for the Society.

The implementation of business models that create an opportunity for third-party investment through leasing arrangements will require following some steps beyond the current regulatory and institutional status, including:

- Exploring and addressing legal conditions to guarantee leasing contracts between BSPs and third-party investors (manufacturers, energy subsidiaries, investment funds) through the trust funds already in place (for fleet renewal) or others.

- Allowing current operational subsidies (gas oil trust fund) to be oriented toward the new operational leasing expenditures.

At the same time, the e-bus transition imposes challenges on the power system and UTE activity:

- There is a possibility to include UTE as the developer and operator for large common charging stations for all e-buses. Following the role undertaken by UTE when it comes to private EV charging, and given the reduced number of e-bus operators, a mechanism can be implemented by means of which UTE owns and operates charging stations that are open to all e-buses.
- Concentration of power needs and rationalization of flows would be achieved, easing distribution network planning and allowing the exploitation of the bidirectional flow potential of such a considerable battery within the system. Moreover, increased infrastructure utilization factors open the door to higher-cost investments (faster chargers, more complex infrastructure) and relieve BSPs from a significant source of expenditure.
- On the other hand, UTE can design a new tariff to recover investment costs while benefitting from better distribution network management capabilities.

The asset separation and leasing model may also allow additional steps to improve the efficiency of the bus and battery acquisition process through:

- Implementation of centralized and competitive purchasing mechanisms for e-bus fleet expansion in the next stages
- Adopting price-revealing tender mechanisms through a two-step tendering processes, as suggested in Section 4.2.7
- Planning and implementing sequenced investment processes, to benefit from technology developments in the e-bus field, that are constant, and the time of acquisition significantly impact the required amount of support in the form of subsidies/grants

Finally, irrespective of the business model adopted for e-bus deployment, the following technical issues/restrictions must be addressed in order to achieve a successful transition:

- It becomes important to clearly establish the role of manufacturer, BSP, and leaser with respect to O&M.
- Given range restrictions for batteries, it is important to select those routes whose length and altimetry best fits the range of each unit.
- Current technical specifications for subsidies award constrain charging technologies since only two types are accepted (see Section 2.9.2 for a more detailed description). To benefit from future developments, this limitation should be removed from future tendering rounds.

- When batteries reach 65 percent of their capacity, they will be replaced by a new unit according to the technical requirements of the call for subsidies. They may be used as backup for charging infrastructure or connected to low-voltage grids (operated by UTE) to increase their flexibility. Uruguay is currently working at the second life cycle regulation for batteries since conditions for this second use remain uncertain.
- E-buses are a new technology for all BSPs in Uruguay: new O&M routines, new activities (charging), and a different type of driving must be introduced in the system.

Annexes

Annex 1A. Technical Characteristics of Representative E-Bus Cases Worldwide

Region	Asia		
Cities	Shenzhen	Beijing	Kolkata
Total bus fleet	~17,000 (all electrified)	~25,000	• 9,700 (including private minibuses) • 1,550 conventional diesel powered
Number of e-buses	~17,000 (100% of total fleet)	7,882	80 + 50 + 100
Manufacturer	BYD (79.1%), NJL (17%), WZL (3.9%)	Zhuhai Yinglong, Beiqi Foton Motor (state-owned)	Foton PMI Tata Motors
Bus service provider	Shenzhen Bus Group Co. Ltd. (SZBG) — 6,053 e-buses	Beijing Public Transport Group (BPTG – state-owned)	West Bengal Transport Corporation (WBTC)
Chassis			
Provider	• SZBG through a separate financial lease company • Financial lease company leases to SZBG for 8 years	BPTG	WBTC
Operator	SZBG	Beijing Public Transport Group	WBTC
Financier/backer	Government (to SZBG)	Government backs BPTG	1. Gov. of India: 60% 2. Municipal Gov. of Kolkata: 40%
Batteries			Octillion Power (United States) (manufacturer)
Provider	Financial lease company (BYD 8-year warranty)	Beijing Public Transport Group	WBTC
Operator	SZBG (BYD performance guarantee)	Beijing Public Transport Group	WBTC

Financier/backer	Government (to SZBG)	Government backs BPTG	• Gov. of India: 60% • Municipal Gov. of Kolkata: 40%
Chargers	1,707		Tellus Power (China) (manufacturer)
Owner	Operator (see below)	Beijing Electric Power Company	• CESC: private DisCo • WBSEDCL: state-owned DisCo
Operator	Potevio 35% (state-owned) and Winline 33% + other 7 operators	Beijing Electric Power Company	CESC/WBSEDCL
Financier/backer	Charging subsidy from national and local govts.	China State Grid Corporation	Government of India: 15% cost of buses

Region	USA	
Cities	Los Angeles	Aspen (Colorado)
Total bus fleet	373	~100
Number of e-buses	32	8
Manufacturer	Proterra-Alexander Dennis	New Flyer (buses)/ABB (batteries)
Bus service provider	Foothill Transit	Roaring Fork Transportation Authority (RFTA)
Chassis		
Owner	Foothill Transit	RFTA
Operator	Foothill Transit	RFTA
Financier/backer	Bank of the West	Federal Transit Administration, City of Aspen
Batteries		
Owner	Foothill Transit	RFTA
Operator	Foothill Transit	RFTA
Financier/backer	Bank of the West	Federal Transit Administration, City of Aspen
Chargers		
Owner	• Foothill Transit • Southern California Edison (SCE—private electric utility) issues up to 50% rebate on charger costs)	Holy Cross Electric (electric utility)
Operator	Foothill Transit or other operators	Holy Cross Electric
Financier/backer	Southern California Edison (SCE—private electric utility)	Holy Cross Electric

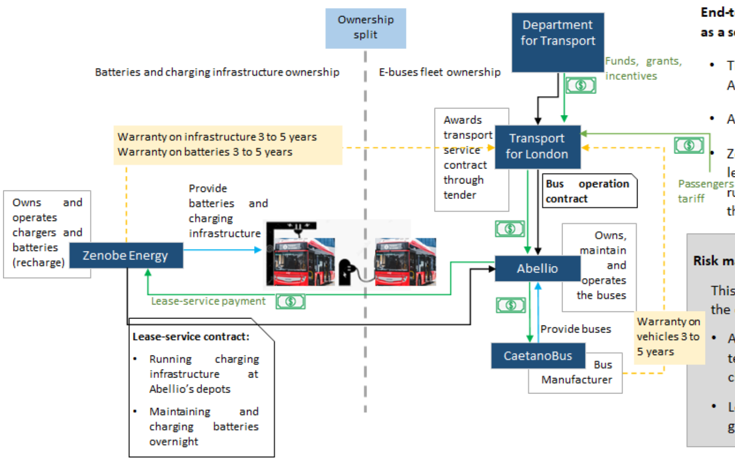
Region	South America		
Cities	Santiago	Bogotá	São Paulo
Total bus fleet	6,756	12,484	14,039
Number of e-buses	776	483	15
Manufacturer	1. BYD 2. Foton 3. Yutong 4. King Long	1. BYD 2. Yutong	BYD
Bus service provider	1. Metbus 2. STP 3. STP/Buses Vule 4. Redbus Urbano	1. Argos Group 2. SOMOS	Transwolff
Chassis			
Owner	1. Enel X 2. Kaufmann/COPEC 3. Engie 4. NEoT	1. Celsia (126) 2. Ashmore (253)	Transwolff
Operator	1. Metbus 2. STP 3. STP/Buses Vule 4. Redbus Urbano	1. Argos Group 2. SOMOS	Transwolff
Financier/backer	DTPM/AFT (City Trust Fund)	City Trust Fund	SPTrans/Farebox
Batteries			
Owner	1. Enel X 2. Kaufmann/COPEC 3. ENGIE 4. NEoT	1. Celsia 2. Ashmore	BYD
Operator	1. Metbus 2. STP 3. STP/Buses Vule 4. Redbus Urbano	1. Argos Group 2. SOMOS	Transwolff
Financier/backer	DTPM/AFT (City Trust Fund)	City Trust Fund	SPTrans/Farebox
Chargers			
Owner	1. Enel X 2. COPEC 3. ENGIE	1. Enel-Codensa (electric utility) 2. Independent operators in the future	BYD
Operator	1. Metbus 2. STP 3. STP/Buses Vule 4. Redbus Urbano	3. Enel-Codensa (electric utility) 4. Independent operators in the future	Transwolff
Financier/backer	DTPM/AFT (Trust Fund)	City Trust Fund	SPTrans/Farebox

Source: MRC elaboration on international literature review

Annex 1B. Reference Business Models in International Experience

London (UK)

Partial separation – two private agents



Business model brief description:

End-to-end fully funded and managed service with private capital. Electric bus as a service.

- The business model splits the ownership of the e-bus project between Abellio and Zenobe.
- Abellio, the bus service provider, owns the vehicle body and runs the buses.
- Zenobe Energy, the energy storage company, owns the bus batteries and leases them to Abellio as part of a service contract. The contract includes running the electric charging infrastructure at their bus depots and charging the batteries overnight.

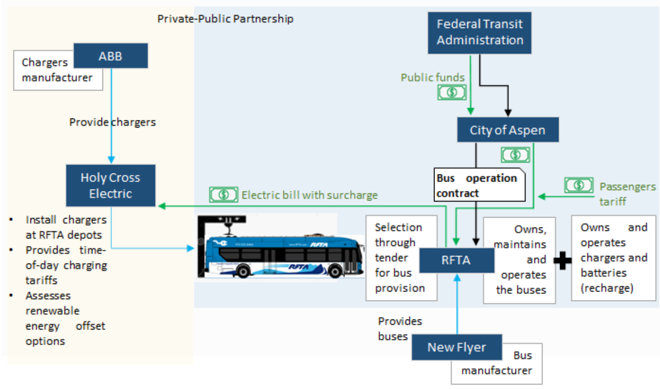
Risk management:

This model separates between the ownership of the battery system from the e-bus itself to:

- Allow transport companies to reduce concerns about covering the technical gap and risk created by e-buses, which can involve complex charging infrastructure.
- Lower the overall cost of e-buses and help financial backers and government support to extend their action.

Aspen (CO)

Public owned and managed (with EVSE as regulated asset)



Business model brief description:

Public-private partnership model.

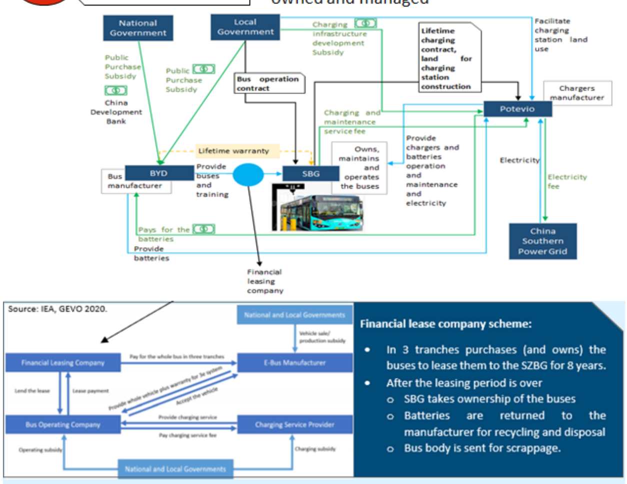
- Project developed under public-private partnership involving the transport authority and bus service provider (RFTA), the City of Aspen with help in funding from the Federal Transit Administration and Holy Cross Electric.
- Half of the total project cost was roughly funded with federal and state grants and the remaining funds were provided by RFTA and the City of Aspen.
- New Flyer, the bus manufacturer, was chosen via competitive process.

Risk management:

- The possibility for the electric utility to install EV charging stations as a regulated service with the possibility for cost recovery from ratepayers for the investment, exponentially lowers the up-front cost of the whole project.
- The electric utility Holy Cross Electric provides charging ports as regulated service, provides strategic time-of-day tariffs and assesses renewable energy offset options to increase the project sustainability.

Shenzhen (China)

Partial separation - public owned and managed



Business model brief description:

Public-owned and managed model

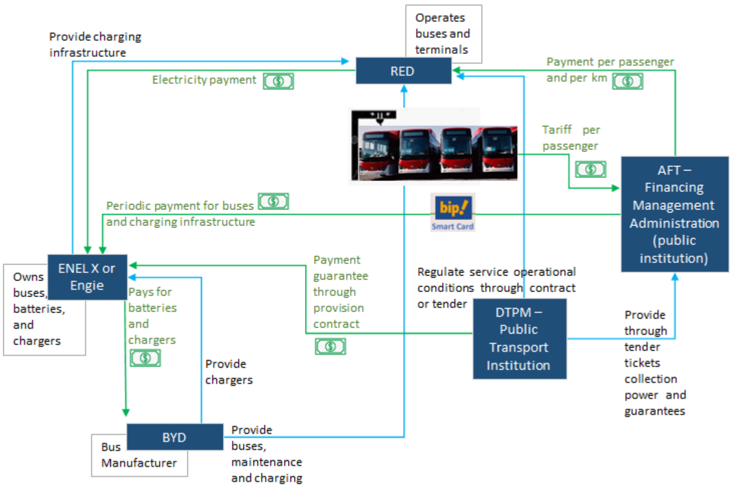
- Shared responsibilities, risks, and costs among 4 main entities, the public stakeholders, the e-bus manufacturer, the BSP and the charging infrastructure providers.
- Government mandate and supporting subsidies lowered the up-front cost by 36% if compared with a diesel bus (IEA, GEVO 2020).
- Local municipality offices simplify and speed up processes for land disposal and charging stations connection to the grid.

Risk management:

- Partnership among all the involved parties is spreading cost and risk burden, i.e. technology leasing contracts and warranties issued by technology providers as well as maintenance provision (i.e., for buses, batteries and chargers)
- Contracts structure is key: leasing period equalling the total life of the buses turned the high-cost procurement into more manageable annual rental/lease payments.

Santiago (Chile)

Total separation – public/private owned and managed



Business model brief description:

Mix-owned and managed: "total leasing"

- Enel X financed the buses and leased them to Metbus/RED for 10 years, after which ownership will be transferred to Metbus/RED.
- Metbus/RED operates the buses and provides basic maintenance. BYD handles major maintenance operations, including battery packs and electric drivetrains, for a fixed rate of $0.09/km.

Risk management:

- Private energy companies provide financing (leasing) and reduce risks.
- For future tenders, there will be a fully separation between fleet ownership and fleet operation.

Annex 2. Main Assumptions Considered in the Financial Tool

Operative Assumptions

We considered route length and mileage as provided by the Municipality of Montevideo (Intendencia Municipal de Montevideo; IM), which amounts to 78,600 kilometers/year/bus (252 kilometers/day, 26 days a month).

Consumption per kilometer was obtained from BYD.

Average cost of maintenance was obtained from the BYD-Metbus operation and maintenance (O&M) agreement (USD0.09/kilometer). We understand this is a conservative assumption. The study *Financial Analysis of Battery Electric Transit Buses* can be used as a reference, in which a cost of USD0.4/kilometer (USD0.64/mile) is employed.[50]

For the additional amount of work required, we considered that one worker is able to correctly operate the loading of 10 buses during the night shift. Since every bus charges in less than three hours, two shifts can be done, according to CUTCSA's current practices. Each parking/unparking operation and connection to the SAVE charger has been estimated to take 20 minutes. The remaining time is spent on surveillance activities (checking if the hoses are correctly connected, checking load levels, attending to potential infrastructure malfunctions, etc.).

Table 37 - Main Operating Assumptions for E-Buses

	Standard buses (12m)
Avg. consumption of electricity (kWh/km)	1
Avg. cost of maintenance (USD/km)	0.09
Ratio charging worker/ bus	0.1

Source: MRC Group

- **Diesel price**: UY$28.7/liter.[51]
- **O&M for batteries:** 3 percent of CAPEX (annual).[52]
- **O&M for charging stations**: 0.5 percent of CAPEX as O&M (annual).[53]

[50] Vehicle maintenance costs were gathered from Transit Cooperative Research Program. 2018. *TCRP Synthesis 130: Battery Electric Buses—State of the Practice*. http://www.trb.org/Main/Blurbs/177400.aspx. An average was taken of the scheduled and unscheduled maintenance costs. It includes spare parts, too. It does not include related labor costs.

[51] URSEA, price for Gasoil 50 s (explant price without tax). Price as of December 2020.

[52] Based on previous projects.

[53] C40 Cities Finance Facility. 2018. *Análisis de buses eléctricos para el corredor cero emisiones Eje 8 Sur*. Ciudad de México, México. Mayo. https://cff-prod.s3.amazonaws.com/storage/files/2CVq9ElOehKvFJbJWd14QHZghxABGbYPCyaYS16s.pdf.

Salaries

All figures expressed in Uruguayan pesos/month, as obtained from Annex 1 of Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo.54

Table 38 - Salaries and Other Operating Assumptions

Variable	Monthly Cost (UY$/month)
Driver	85,848
Driver-cashier	112,633
Guard	80,443
Inspector	96,850
Mechanic	96,850
Administration	96,850
Parts and accessories	2,897

Source: Intendencia de MontevideoSubsidy and Investment Costs

Subsidy and Investment Costs

The subsidy for e-bus purchases is conceived to cover the difference in investment costs between a diesel bus and a new e-bus unit. As such, its initial amount (derived from the first round of subsidized acquisition by the Government of Uruguay[55]) will necessarily evolve due to the expected decrease in e-bus costs.

We considered the average subsidy price obtained (USD267,045) in the first round of subsidized acquisitions, together with the diesel price established by Annex 2, Circular 1/019 (USD126,176) for an 11-meter bus. It must be noted that prices declared in that round of acquisitions present a high degree of variability (+USD97,599), so using lower range values can significantly change the results.

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[54] Marquez, Gonzalo. 2020. *Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo, Anexo 1.* Intendencia de Montevideo. Departmento de Movilidad. Division Transporte. https://pmb.parlamento.gub.uy/pmb/opac_css/index.php?lvl=publisher_see&id=20606.

[55] Resolución 120/020.

Since the figures obtained in this auction comprise all components:

- We estimated the cost of batteries as a function of their capacity (350 kilowatt-hours) and a unit cost per kilowatt-hour of USD268.[56]
- The cost of an AC 80 kilowatt charger was obtained from a recent study by the National Renewable Energy Laboratory (NREL) (USD50,000, including installation costs).[57]

Based on this, the following prices (expressed in USD) by component were obtained and are utilized in the financial tool:

Table 39 - Investment Costs for E-Buses

BEB Investment Cost (USD)	392,150
Battery	93,800
Chassis	248,350
Charger	50,000
Diesel bus investment cost	126,176
Required subsidy	267,046

Source: Resolution 120/020

Table 40 - Proposed Investment Scenarios

Price Expressed as a Percentage of the Average Price Obtained in the First Round of Subsidized Acquisition	Investment Scenario	Description of the Scenario
90.00%	1	100 buses, 10% discount on purchase price
85.00%	2	100 buses per year for 2 years (totaling 200 buses), 15% discount on purchase price
80.00%	3	100 buses per year for 10 years (totaling 1,000 buses), 20% discount on purchase price

Source: MRC Group

[56] Howell, David, Brian Cunningham, Tien Duong, and Peter Faguy. 2016. "Overview of the DOE VTO Advanced Battery R&D Program." U.S. Department of Energy, June 6. https://www.energy.gov/sites/prod/files/2016/06/f32/es000_howell_2016_o_web.pdf.

[57] Johnson, Nobler, Eudy, and Jeffers. Financial Analysis of Battery Electric Transit Buses.

These figures represent average values obtained in the first round of allocations. However, we expect different key drivers to push prices down in the future.

- We are currently simulating larger fleets: The largest single acquisitor included in the first round (CUTCSA) bought 20 units. Discounts are expected if larger fleets are included.
- The cost of batteries is expected to dramatically decrease in the coming years. The rest of the components can be considered as constant (although there is room for a decrease in costs of both chargers and chassis for Battery-Electric Buses), but year-on-year price decreases need to be assumed for batteries.
- We have considered an 11 percent year-on-year reduction on the basis of BloombergNEF's *Electric Vehicle Outlook 2020*. Alternatively, an 8 percent reduction year on year may be used.[58]

Our computation of the subsidy considers these price trends and differentiates subsidies according to purchasing year (these only affect Investment Scenarios 2 and 3, when investment takes place in successive rounds).

Scrapping Values

Ten percent of the investment cost for all assets has been considered (batteries, chassis, and chargers, and also for diesel buses). The same residual value considered by IM for diesel buses has been used.[59] This practice has been employed in previous BEB studies (see *Financial Analysis of Battery Electric Transit Buses*).[60]

Fiscal Assumptions

The following table presents a summary of the main fiscal assumptions affecting each scenario. As for the COMAP scheme, exonerations from the IRAE differ for each project, but can reach up to 90 percent of the tax due. We have considered that e-buses are able to obtain a 50 percent reduction, resulting in an effective tax rate of 12.5 percent.

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[58] As suggested by Nykvist, Björn, and Måns Nilsson. 2015. "Rapidly Falling Costs of Battery Packs for Electric Vehicles." *Nature Climate Change* 5 (March 23): 329-332. https://www.nature.com/articles/nclimate2564.

[59] Marquez. Informe Sobre Tarifas y Subsidios a Usuarios del Sistema De Transporte Público de Pasajeros de Montevideo, Anexo 1.

60 Johnson, Nobler, Eudy, and Jeffers. Financial Analysis of Battery Electric Transit Buses.

Table 41 - Fiscal Assumptions under Different Business Models

	Diesel	E-Bus-Subsidy	E-Bus-COMAP
Global Duty Rate	23.00%	0.00%	0.00%
Consular Tax	5.00%	5.00%	0.00%
Road Tax	8,623.47	8,623.47	8,623.47
Corporate Tax	25.00%	25.00%	12.50%

Source: DNE

Charging Assumptions

Power tariffs correspond to Large Customers Type 1:

Region	Europe	
Cities	Helsinki	London
Total bus fleet	~1,400	~9,000
Number of e-buses	48	200 (34 operated by Abellio)
Manufacturer	Linkker, Yutong Bus, and VDL Bus & Coach	Caetano Bus
Bus service provider	Helsingin Bussiliikenne Oy (HKL) (owned by City of Helsinki)	Abellio
Chassis		Maintenance: Caetano Bus
Owner	Helsingin Bussiliikenne Oy (HKL)	Abellio
Operator	Helsingin Bussiliikenne Oy (HKL)	Abellio
Financier/backer	City of Helsinki	Abellio
Batteries		1. Manufacturer: Visedo 2. Maintenance: Zenobe
Owner	Helsingin Bussiliikenne Oy (HKL)	Zenobe Energy (energy storage company)
Operator	Helsingin Bussiliikenne Oy (HKL)	Zenobe Energy
Financier/backer	City of Helsinki	Zenobe Energy/NatWest
Chargers	Manufacturers: Heliox, Ekoenergetyka	Leasing contract Abelio - Zenobe
Owner	Helsingin Bussiliikenne Oy (HKL)	Zenobe Energy
Operator	• Opportunity charging: separate operators (BSP is not responsible for operating the chargers)	Zenobe Energy
Financier/backer	City of Helsinki	Zenobe Energy

Table 42 - Power Tariffs for Large Customers

Tariff	Voltage Level (kV)	Energy charge (UY$/kWh)			Capacity Charge (UY$/kW)	Fixed Monthly Payment (UY$)
		Valley	Plateau	Peak		
GC1	0.230-0.400	2.078	3.753	11.29	429.9	14,636

Source: UTE, Pliego Tarifario

After conversations with CUTCSA, we learned that in the 80 kilowatt modus, chargers need between two and three hours to fully charge a bus. Using the valley period (from midnight to 7 a.m.), two buses can be charged using only one charger.

Table 43 - Charging Infrastructure Features

Variable	Unit
Capacity of each charger (kW)	80.0
Coefficient charger/bus	0.5
Required capacity per bus (kW)	40

Source: MRC Group

Financing Assumptions

All investments from BSP are assumed to be financed on a 70/30 debt/equity proportion. The debt part, however, is covered by the Investment Trust Fund explained below. The financial tool considers 1.5 percent of interest rate (since that is the amount considered by IM when computing the technical tariff) and considers that the company is required to devote 8 percent of its sales to principal repayment. This scenario applies to diesel as well as e-buses.

Financing the Purchase of Buses: Investment Trust Fund

The financial tool assumes that current arrangements for the Investment Trust Fund apply to the notional company: It can finance its new capital expenditures for fleet renewal using the securitization method, and paying a given percentage of its monthly sales in exchange. In the five bond emissions carried out by the Investment Trust Fund, this percentage has ranged between 1.5 percent and 5 percent, depending on the concurrence of companies. However, there is a relevant difference: this method applies to companies that already have a running fleet and are renewing a fraction of it, not to companies that have recently started the business and need to create a new fleet. For example:

- Company A holds a fleet of 200 buses and wants to renew 10 of them. It resorts to the Investment Trust Fund to obtain financing and commits to repay using 2 percent of its monthly revenue. That is, the monthly revenue generated by 200 buses will be used to repay the cost of renewing 10 buses.
- Company B, on the contrary, is a new entrant to the market and wants to buy 20 e-buses to start running its business. It can also use the Investment Trust Fund, but it will be required to either commit larger percentages of monthly revenues or the lenders will face a much longer payback period.

Hence, we have not reflected the previous scale effect in our analysis, and the way the number of renewed units may represent a burden on BSPs' financial situation and future revenues. Percentages for monthly repayment should be "scaled" to reflect the actual ability of the company to repay the lenders. This also highlights the problems small companies face when trying to access financing: even when the Investment Trust Fund helps to de-risk the operation, their ability to repay is limited.

This problem could be overcome if a single purchaser (FleetCo) buys large fleets of e-buses and then leases them to a BSP (similar to the business models in effect in other large cities, such as Santiago de Chile, London, Shenzhen, Bogotá, and Medellín).

Polluting Figures for Diesel Buses

We could not find estimates for the pilot project (BYD K9 vehicle) in Montevideo, so polluting figures are based on data for 12 BYD chassis D9W – 12 Caio Millennium IV and 03 chassis Marcopolo Torino-E.[61] The vehicle is also a 11-meter e-bus from the same manufacturer, implying similar battery size and weight of the vehicle.

Table 44 - Polluting Figures for EURO V Diesel Buses

Pollutant	Yearly amount (MT/year)
CO_2	105.447
NO_x	0.284
MP	0.003

Source: SPTrans on the basis of BYD K9 vehicle

Since no references for pollution can be obtained in Uruguay, we considered the costs for pollution computed by SPTrans[62] (the transport authority in the state of São

[61] Aditamento Ao Contrato 048/19 Grupo Local de Distribuição Lote D10 SEI Nº 6020.2019/0002199-0.

[62] SPT, Planilha de Custos 2019, Q8-Ganhos Sociais.

Paulo in Brazil) and converted them to pesos. They have been converted to pesos using the non-weighted average value for 2019 (8.33) and actualized for Uruguayan inflation (both series published by the National Institute for Statistics).

Table 45 - Polluting Prices

Pollutant	Price (UY$/MT)
CO_2	105.447
NO_x	0.284
MP	0.003

Source: SPTrans based on BYD K9 vehicle

These estimates represent pollution savings against Euro V diesel units. Given that not all diesel buses in Uruguay present that standard, pollution savings are expected to be actually higher (see Figure 15 for a more detailed description of fleet composition in Montevideo).