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FINANCIAL HUB EXECUTIVE SUMMARY

PROPOSAL FOR A FINANCIAL HUB FOR ELECTROMOBILITY PROJECTS IN BRAZIL

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FEDERATIVE REPUBLIC OF BRAZIL

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Proposal For a Financial Hub for Electromobility Projects In Brazil. Ministry of Regional Development - MDR and World Bank (authors). Clean Technology Fund - CTF (funder) - Brasília, 2022.

ISBN: 978-65-87999-56-2

32p.

1. Financial Hub 2. Electromobility Projects 3. Brazil I. Ministry of Regional Development - MDR II. World Bank III. Clean Technology Fund - CTF

CDU: 629.3

TABLE OF CONTENTS

The **Brazilian Institute of Development and Sustainability (IABS)** has contractedspecialized consulting services for the development of guidelines, technical and legal mechanisms, and financing models for the introduction of electric buses in Brazilian cities.

The services are intended to meet the objectives of the project "**Transition to Electromobility in Brazilian Cities**", a result of the Grant Agreement (TF0A9560).

This agreement was concluded between **IABS** and the **World Bank**, with funding from the Climate Technology Fund (CTF) and the **Ministry of Regional Development** as the main beneficiary of the project.

INTRODUCTION

This document is the Executive Summary of the Financial Hub, developed under the Transition to Electromobility in Brazilian Cities Project TEP – TF0A9650. This technical cooperation project between the Ministry of Regional Development (MDR) and the World Bank, is financially supported by the Clean Technology Fund (CTF) and implemented by the Brazilian Institute of Development and Sustainability (IABS).

The Financial Hub is a platform administered by the Ministry of Regional Development – MDR. It will gather stakeholders interested in the transition to electromobility in Brazilian cities; that is, municipalities with public transport electromobility projects requiring funding and project funders.

The following chapters will further analyze the Financial Hub platform's objectives, functionalities, and content.

1.

THE FINANCIAL HUB

The Financial Hub aims to **provide the Federal Government with a platform to stimulate the electrification of public transport fleets in Brazilian cities** via the Ministry of Regional Development. This platform is a virtual meeting space between those who need to finance electromobility projects and financiers from national and international public and private markets. It aims to materialize projects under the management of subnational entities, expanding their possibilities of social and environmental returns. Thus, the platform also facilitates the **improvement of urban mobility managers and technicians from the public and private spheres and civil society** in financing electromobility.

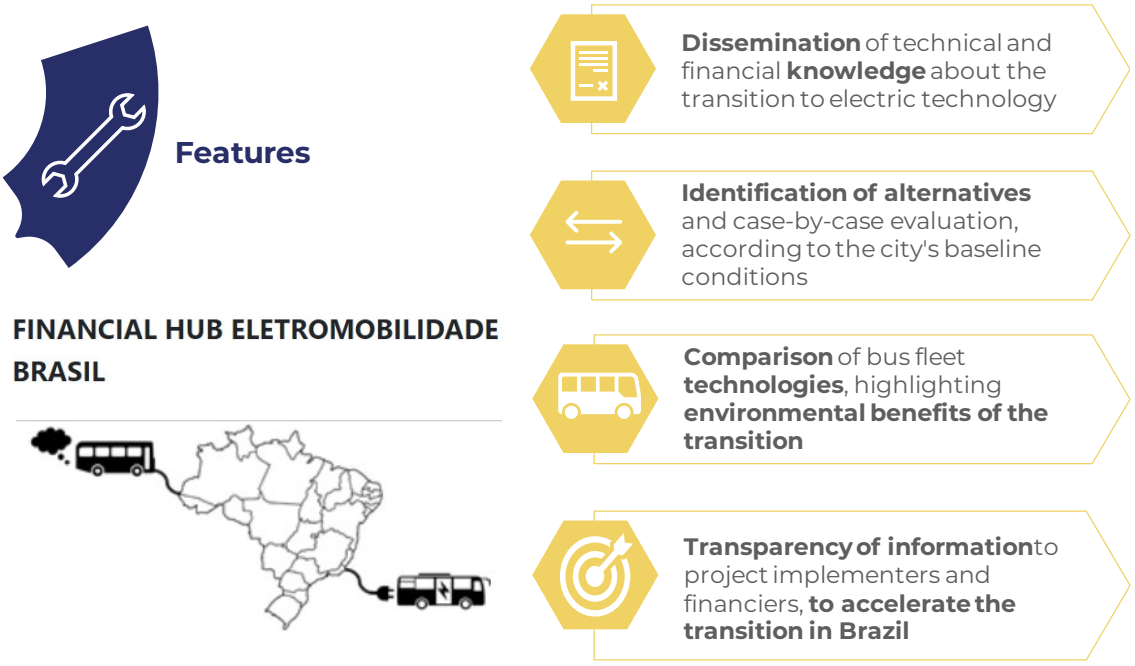
At least ten cities in Brazil have already become familiar with the new technology, conducting pilot projects, and other cities are currently learning about the technical and financial aspects to access funding that will allow the implementation of electric buses and the support infrastructure required for operation (charging infrastructure, chargers, and monitoring systems).

Brazilian cities have a growing interest in introducing electric buses to reduce emissions from the transport sector and improve air quality and the quality of public transport [1]. The Financial Hub tool was developed to foster and **scale up the transition to electromobility**, providing a way for cities to seek funders and expand the possibilities of including electric buses in public transport systems.

1.1 FINANCIAL HUB FEATURES

The tool has technical parameters and methods to calculate investments and business models **to respond to funding needs in the initial phase of project structuring**. This allows cities to define technical and financial parameters per the local context and financial institutions to get informed and adhere to cities' needs. Figure 1 summarizes the most innovative features of the Financial Hub.

Figure 1 – Financial Hub features



Source: Own elaboration.

The platform gathers two types of users: City and Funder, allowing the sharing of technical, financial, and regulatory information between the two stakeholders, including references to socio-environmental benefits. The Financial Hub receives input from the City user and the Funder user.

City

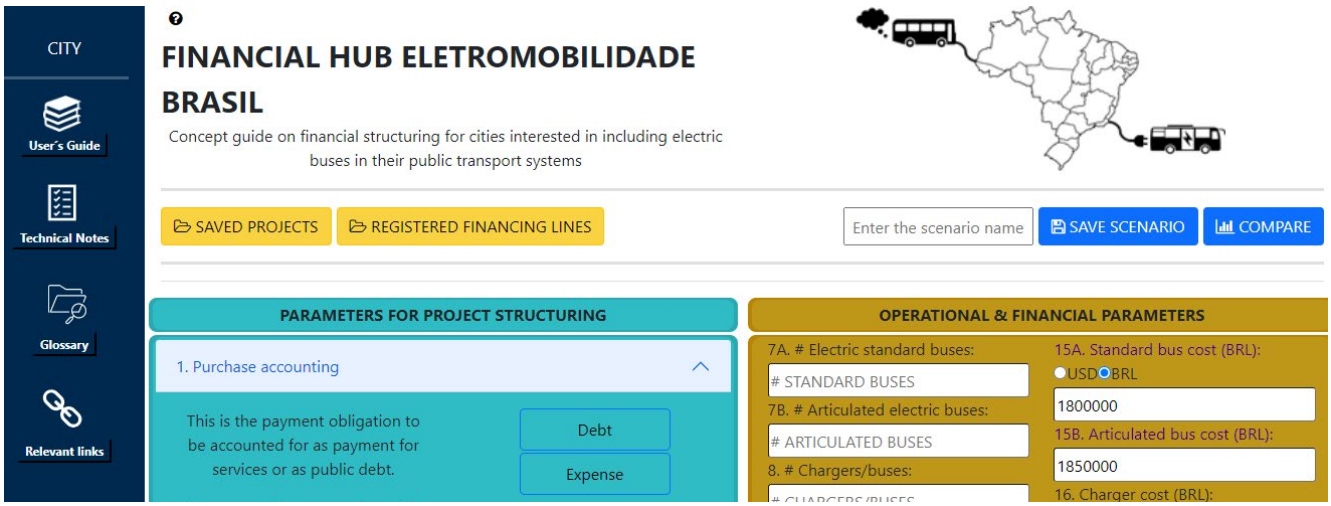
- For the *City* user, the inputs are information from the initial structure of the transition project to electromobility. Examples: financing, beneficiary, bussiness model, regulatory feasibility, and project guarantees.
- The tool also **guides the City user** to enter operational and financial inputs. Examples: number of electric buses, project timeframe, useful life of assets (buses and batteries), cost of vehicles and infrastructure, net profit margin and % equity etc.

Funder

- The Funder **is advised to provide information** about the financing lines for electromobility, such as the financing term, % of financed amount, an interest rate range, guarantee conditions, grace period, among other inputs.

The platform provides cities with technical and training information on project structuring, a recommendation for the best financing model based on the project's initial parameters, and international best practices. The City also receives financial institutions' contacts if they respond to the funding need. Thus, the City can continue the structuring process with a financial feasibility study to access funding. On the other hand, funders receive information from the Financial Hub on the nature of the projects to identify and adjust their offer to the projects' demands.

City and Funder users have a **User Guide** that provides guidance on how to use the tool and what decisions to make within the tool, a glossary with definitions of essential concepts, and a **Benchmarking** of international success cases applied to Financial Hub [2, 3, 4].



Cities need references and information on the theme of the transition to electromobility, and funders need to know the financial, environmental, and social benefits to support customers better. Thus, the tool comprehensively analyzes the business and financing models based on international benchmarking but adapted to the country's reality to answer these questions.

Additionally, the platform offers a group of five (5) Technical Notes that provide the user with a detailed explanation of (1) electromobility business models, (2) financing models, (3) financing mechanisms for the transition, (4) electromobility regulatory framework and (5) the most critical criteria of banking capacity in the project structuring process, as shown in Figure 2.

Figure 2 – Financial Hub Technical Notes

NT 1: Business Models

- Role of the municipality
- Responsibilities
  - Buses, chargers, charging and garages infrastructure

NT 2: Financing Models

- Financial Hub Model Details
- Financial barriers of the models

NT 3: Financing mechanisms in Brazil

- Financing lines for electromobility
- Conditions and limits for credit operations

NT 4: Regulatory framework for electromobility

- Regulation for electromobility projects
- Obstacles for the implementation of financing mechanisms

NT 5: Banking criteria

- Subsidy and financing rate
- Project IRR & *Equity*
- Debt Coverage Ratio

Source: Own elaboration.

2.

FINANCIAL HUB STRUCTURE

The main element of the Financial Hub corresponds to a **multi-criteria reference tool that serves as a conceptual guide in the financial structuring** for cities or municipalities interested in planning the introduction of electric buses in their urban public transport systems. The tool assesses the feasibility of financing alternatives/models identified as the most common for projects of this type under the specific characteristics of the project entered by the City user. These models are specified in Figure 3:

Figure 3 – Financing models considered in the Financial Hub

	1. Direct loan	2. Concessional funding	3. Financing Leasing	4. Asset investor	5. Investment trust, SPE, crowd-funding
Buses characteristics	Operator or public entity	Operator or public entity	Operator (Partial Leasing) or public entity	Energy company Fleet provider company	Supplier (SPE) or other Battery investor
Battery investor characteristics					
Maintenance			Manufacturer (OEM)		
Operation			Operator	Operator	Operator
Charging infrastructure			Manufacturer (OEM)	Energy company Fleet company	Supplier (SPE) or other Support investor
Support investor infrastructure					
User fees		Centralized collection system			
Financing	Commercial banks	Development, commercial and multilateral banks	Development, commercial and multilateral banks	Development, commercial and multilateral banks	Development and multilateral banks
Fuel/energy	Energy free market				

Source: Own elaboration.

The assignment of responsibilities for each model may vary depending on the business model. Ownership of buses, batteries, and infrastructure may differ according to the current situation and the capacity of these stakeholders in each city. The description of these financing and respective business models are available in the technical notes **NT 1: Feasible business models** and **NT 2: Financing models**, respectively.

The tool provides the City user with technical and training information on project structuring, a recommendation of the suggested funding model based on the initial parameters of the project, and international best practices. The City also has access to the contact information of the financial institutions responding to the funding need. Thus, the structuring process may continue with a financial feasibility study to access financing.

We should stress, however, that the tool was designed to guide the financial structuring of an electromobility project and not as a substitute for a detailed structuring process or risk analysis to be implemented by stakeholders (City and Funder). This process should occur in a subsequent stage, following the financing model recommendations from the **Financial Hub**. Then, it will define the interest rates, guarantee conditions, and other necessary parameters in detail. Thus, the structuring itself must be customized for each project. Therefore, the feasibility study of the financing and the definition of conditions depend on the City's context and specific needs, the funding beneficiary, and the macroeconomic context.

The tool was developed based on Latin American market rules and adjusted to the Brazilian reality. Recommendation weights for the best financing model and interest rates assigned stem from the experience of other electromobility projects and information received by funders increasingly interested in this type of project.Thus, the project financial indicators estimated by the tool may differ considerably from those calculated at the time of a much more detailed structuring for project appraisal by a funder. For example, the Internal Rate of Return (IRR), net profit margin, and the percentage of net profit over income will vary depending on the interest rate, grace period, and financing term the funder offers. We should also mention that the financial feasibility of an electromobility project involves much more than just choosing an adequate financing alternative. Therefore, **Technical Notes** and **Technical, Operational, and Financial Recommendations** are available on the platform to evaluate the project comprehensively.

2.1 USER TYPES

The Financial Hub allows the interactions of two user types:

1. **City**: This type of user corresponds to any municipality that provides a base or minimum advance of an electromobility project and that seeks funding for the project in the initial stage. The City user has the following interactive elements:

    a. **User City registers a project by entering:**

        I. **General parameters of the project:**

            - Purchase accounting
            - Funding beneficiary
            - Business model
            - Regulatory feasibility
            - Project guarantees
            - Credit rating

        II. **Operational and financial parameters:**

            - Number of buses (Padron/articulated)
            - Number of chargers/buses
            - Project deadline
            - Fleet lifetime
            - Bus battery life
            - Average monthly trip
            - Equivalent passengers/bus/day
            - Expansion factor (which transforms passenger/day into passenger/year)
            - Bus cost
            - Charger cost
            - Infrastructure cost
            - USD/BRL exchange rate *
            - Full fare per passenger
            - Net profit margin (% of gross revenue)
            - Equity %

    b. **The parameters requested from the City user** aim to characterize the electromobility project that requires funding. This characterization allows estimating the most critical flows and financial indicators to deliver the results or outputs to the user.

c. **The City user receives several outputs** (based on the inputs filled in), such as evaluation and selection of the best financing model, cash flow for each option, and the possibility to view financing lines published by the Funder user. This type of user must register contact information, the name of the city, and the public institution responsible for the project to be structured. The tool evaluates the feasibility of each financing alternative under the specific characteristics of the project provided by the City user, which the Funder will evaluate.

2. **Funder**: This type of user can register contact information and the financial institution's name. The Funder user has two complementary interactive options with the platform, and it is not mandatory to choose both:

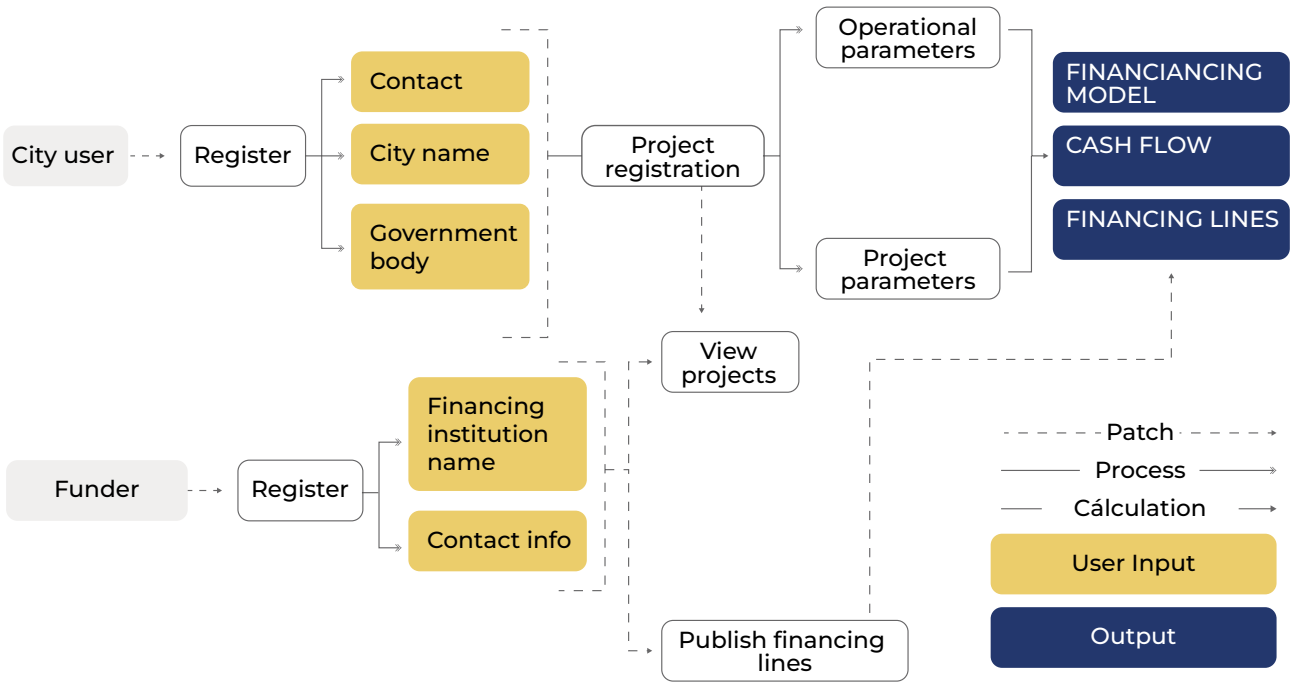
   a. **View the projects**: The Funder can access projects registered by cities interested in structuring electromobility projects in the public transport system.

   b. **Publish financing lines**: The second interactive option of the Funder is publishing financing lines. To register a line, the Funder user must complete the following information:

      - Financing institution name
      - Financing line name
      - Financing term (years)
      - Guarantee conditions (actual , third-party, or both)
      - Type of company to be financed (public or private)
      - Grace period
      - Financing object (vehicle, battery, charging infrastructure, and civil works combinations)
      - Interest rate range (p.a.)
      - % of the asset's financed value

The **platform administrator** is not considered a user. He/she will be responsible for coding the tool, computer security, domain, updates, permanent monitoring, maintenance, and active management of users interacting with the platform and for managing their credentials. Figure 4 shows the general structure of the Financial Hub.

Figure 4 – The general architecture of the Financial Hub



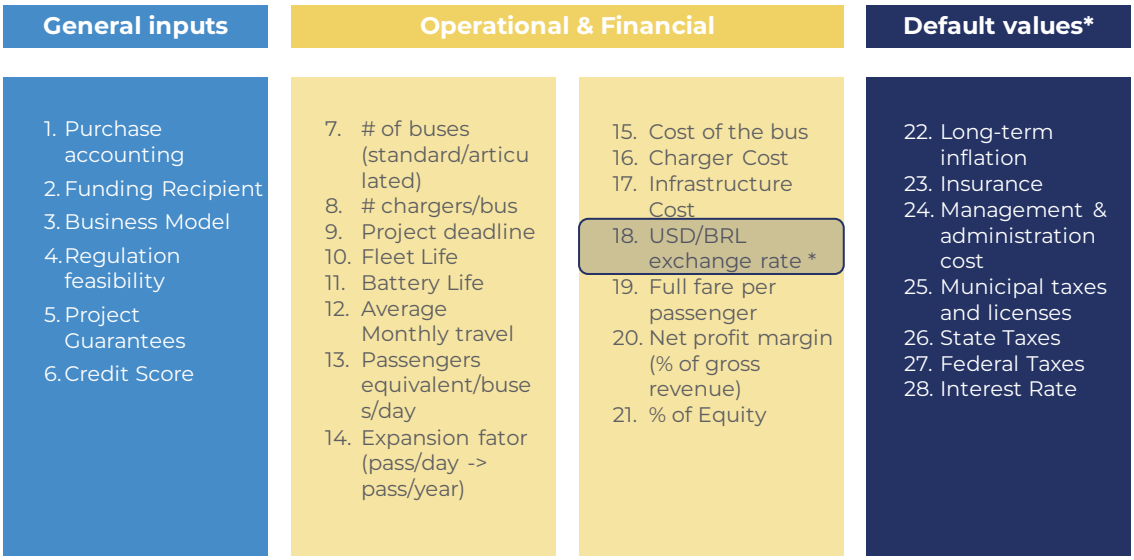
Source: Own elaboration.

2.2 INPUT PARAMETERS

2.2.1 City

The tool operates based on a set of inputs that characterize an electro-mobility project in Brazil, consisting of 27 variables, as shown in Figure 5.

Figure 5 – Summary of Financial Hub Tool Input Parameters

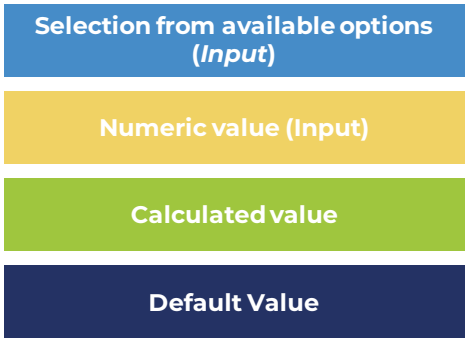


* Values preset by the Platform administrator, but can bemodified by the user if not correct, except for federal taxes and interest rate.

Source: Own elaboration.

The user must enter this set of inputs for the characteristics of the electromobility project, whose financing must be evaluated. Given the types of variables and how the Financial Hub processes the evaluation of alternatives, each parameter is classified into a typology (unique classification of inputs) which describes whether the value is delivered solely by the user, the type of value (numerical or categorical) and whether it has suggested default values, as shown in Figure 6.

Figure 6 – Types of parameters by origin



Source: Own elaboration.

INPUT

Selection from available options: User input parameter chosen from a closed list of options.

Numerical value:
Free user input, the value range varies by parameter and the indicated units.

INTERNAL CALCULATIONS AND DEFAULT VALUES

Calculated value:
Tool parameter calculated from **numerical values**.

Standard value:
Standard value defined by the platform's administrator.

Table 1 shows the values calculated from the inputs entered by the user in the tool. The calculated values are used directly in calculating the best financing model. The impact of these values on the final recommendation is explained in item 2.3 Assumptions and processes.

Table 1 – Calculated values used in the tool

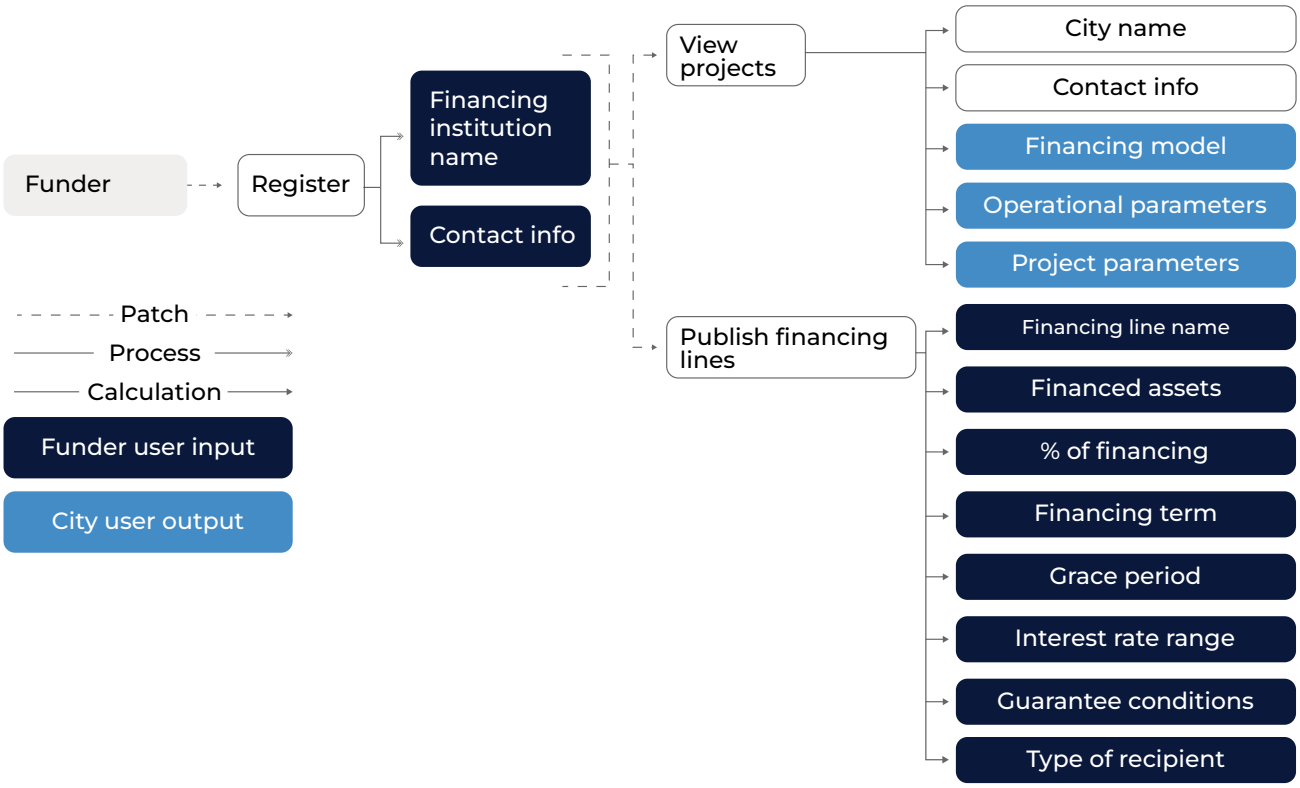
Parameter	Description
Calculated values	
Bus service life/concession term	It is the relationship between the useful life of the electric bus and the concession term. If the concession term is 20 years and the useful life of the electric bus is 15 years, the value will be 0.75. The concession term and the useful life of the buses should be the same. (See: Technical Note 1)
Battery useful life/concession term	It is the relationship between battery life and concession term. If the concession term is 20 years and the battery life is eight years, the value will be 0.40. The term of the concession and the useful life of the buses should be the same, but current battery technology allows a duration of up to 8 or a maximum of 10 years.
Project size	The project size corresponds to one of the following categories, defined by the number of electric buses purchased. (See: Technical Note 1, in the item "Projects' Size") • **Pilot project**: <= 19 electric buses • **Small project**: 20-49 electric buses • **Medium-sized project**: 50-99 electric buses • **Large project**: >= 100 electric buses

Parameter	Description
Calculated values	
Total CAPEX	Fleet + Infrastructure: Investment volume in BRL, the sum of buses, infrastructure, and chargers. (See: Technical Note 1) • **Small investment**: up to 75 million reais • **Medium investment**: 75-125 million reais • **Large investment**: 125 million reais and over
Equivalent passengers per year	N° of buses [7] x n° of equivalent passengers/bus/day [13] x expansion factor day per year [14]

2.2.2 Funder

The Funder user will have a different interaction than the City user. The Funder will be able to access projects registered by cities and publish financing lines that respond to the needs of electromobility projects. Figure 7 shows the Funder user's working architecture.

Figure 7 – Funder user's work architecture in the Financial Hub



Source: Own elaboration.

2.3 ASSUMPTIONS AND PROCESSES

The final score of the financing alternatives considered in the Financial Hub follows two main aspects:

1. A score from 1 to 10 is assigned to each financing alternative per the value of each parameter;

2. The weight (%) of each parameter in the final evaluation of the best financing model (see Figure 8).

A ranking is generated based on the total score obtained from the project characteristics, sorting the possibilities of the financial models per the one that got the best result and guiding the user to the most feasible alternative to structure their project. The best option identified is the alternative with the best score.The definition of scores assigned to each combination of variables and financial model is based on **experiences** in structuring processes for electromobility projects. Thus, the weights identified can be modified to better correspond to the reality and sensitivity of these types of projects in Brazil [5, 6]. We shouldhighlight that the score aims to guide the user in a final ranking of financing options that best fit the essential characteristics of the project in question and not to indicate that it is **necessarily** the best financing model. The weights employed on the platform are listed in Figure 8..

Figure 8 – Weights of the parameters of the Financial Hub

Types of inputs	Parameters	Pond.
General	Purchase Accounting (Debt/Current Expenses)	5%
	Funding beneficiary: public or private	10%
	Business model: operator is the supplier or with a separate supply	9%
	Normative feasibility: established, defined, or initial	15%
	Project guarantees (% Budget, % Revenue, % from other sources)	18%
	Credit rating	6%
Operacionais e financeiros	Total Capex: Fleet + Infrastructure	7%
	Project size (# of Buses)	3%
	Fleet Useful Life/Project deadline	2%
	Battery Useful Life / Project deadline	2%
	Interest rates (depends on the financing model)	23%

Source: Own elaboration.

As mentioned before, the interest rate under each alternative follows the assessment of the situation of electromobility projects in the Brazilian financial market. Thus, the score assigned to each alternative is based on the competitiveness of these interest rates. A score of 10 is assigned to the best option (corresponding to the lowest rate), and a weighted score is proportional to the relationship between the other alternatives' interest rates and the best alternative's rate. Table 2 shows the allocation of these scores.

Table 2 – Values and scores of the parameter: Interest rates

Variable: Interest rates		
	Interest rate	**Score**
1. Direct loan	9.80%	7.0
2. Concessional funding	8.50%	8.1
3. Leasing or finance lease model	8.10%	8.5
4. *Asset Investor* model	7.32%	9.4
5. Investment fund/SPE/*Crowdfunding*	6.90%	10.0

Source: Own elaboration.

However,these score assignments and the weights of the variables on the total score and overall feasibility of each financing alternative are only representative and may vary significantly with the type of project evaluated and the funder evaluating the project. The tool is **not designed to replace a detailed financial risk analysis by a bank or other funder** that may finance the project but to give an initial approximation of what cities can expect from the project's funding needs and the main alternatives to be considered.

Likewise, the model **provides the user with other general financial and economic indicators**, including an estimate of **subsidy need**, debt coverage, and overall financing flow [7]. The information contained in the tool is related to the cost of providing the assets, not incorporating operational costs throughout the project's useful life. (See: Technical Note 1)

In public transport projects of this type, **subsidies are often essential for the project's financial feasibility**. The tool calculates the project's subsidy requirement considering a standard net margin of 5%[1]. This value was defined based on the experience of consultants in structuring **urban public transport and bus operation projects**, where **profit margins for operators** and other stakeholders are generally **low**, which is one of the project's apects that shows the need for subsidies and funding.

1 This value can be changed if necessary.

The financing and subsidy rates over the project's life are estimated, guaranteeing this minimum net margin of 5% (value suggested by the platform, which the user can modify). This value serves as a reference for the city or other entity that **offers guarantees to the project** by obtaining funding from subsidies from stakeholders such as the Federal Government or multilateral agencies whose agendas prioritize this type of project.

2.4 INTERFACE

The interface is intended to be as friendly as possible to both user types. Figure 9 shows what the City interface looks like. On the left are the hyperlinks of interest for downloading supporting documents, and on the right, the user is asked to **complete the project structuring information and the operational and financial parameters**. Besides the **User's Guide**, the **Technical Notes**, and the **Glossary**, the user will be able to access a list of **links of interest** with reference materials and information related to the structuring of electromobility projects in Brazil (i.e., WRI Brasil, BNDES, EPE, MDR, ITDP Brasil, *Diário do Transporte* , and the like).

The platform guides the user to understand the meaning of each parameter and, if necessary, delivers a detailed explanation of the available options. The City user can **compare results and financial indicators** between different financing models and settings created by the same user before the definitive registration of the electromobility project.

Figure 9 – Interface aspect for the City user in the Financial Hub

Source: Financial Hub of Electromobility in Brazilian Cities.

A score table of the financing models is displayed once all the fields requested from the user are complete, as shown in Figure 10.

Figure 10 – Default values and model score results for the City user in the Financial Hub

DEFAULT VALUES (TAXES, INSURANCE AND FINANCIAL MODEL ASSUMPTIONS)

INSURANCE AND MANAGEMENT		
Insurance (% de CAPEX):	2	%
Management and administration (% Revenues):	2	%
MUNICIPAL TAXES		
Taxes and Licenses (% Revenues):	2,5	%
STATE TAXES		
Tax on Circulation of Goods and Services (ICMS):	14	%
Motor Vehicles Ownership Tax (IPVA):	2	%
FEDERAL TAXES		
Corporate Income Tax (IRPJ):	25	% (Pre-tax profit)
PIS/COFINS:	9,25	% Revenues
LONG-TERM INFLATION		

MODELS SCORES

CALCULATE RESULTS

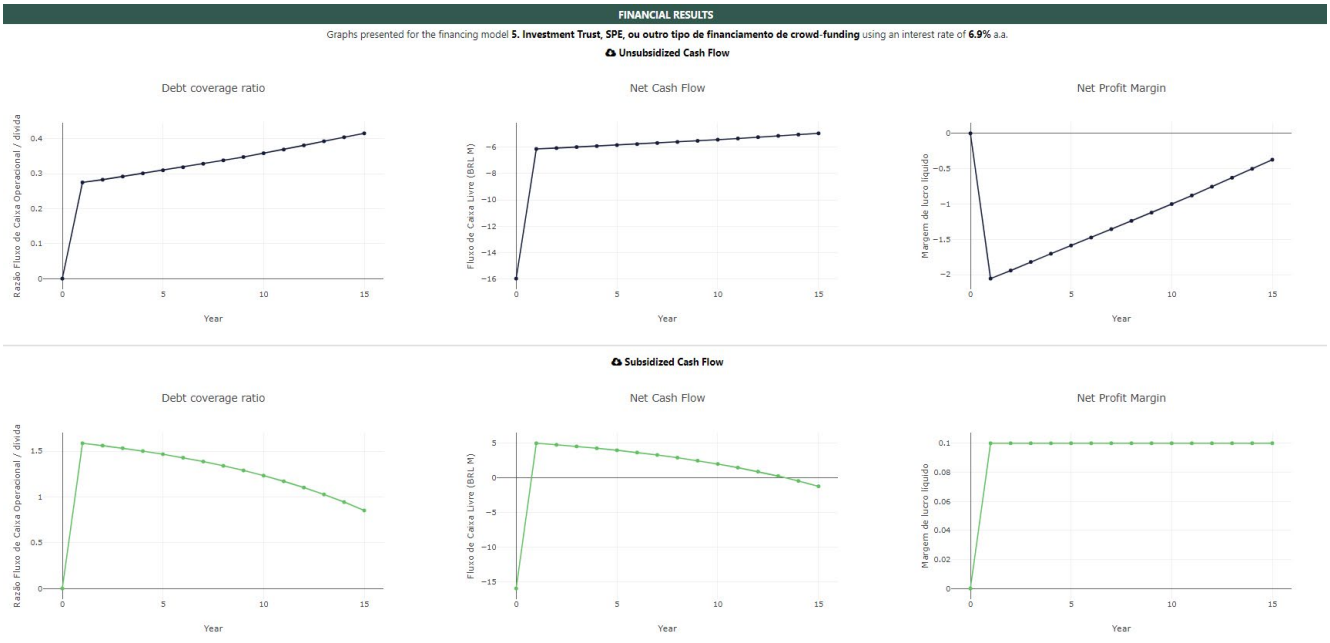
Export

Position	Model	Score
1	5. Investment Trust, SPE, ou outro tipo de financiamento de crowd-funding	6.464
2	4. Modelo de Participação Asset Investor	6.336
3	3. Modelo de Leasing	6.235
4	2. Financiamento concessional	6.143
5	1. Instrumento de Empréstimo Direto	5.794

Source: Financial Hub of Electromobility in Brazilian Cities.

The results and financial indicators for a project with and without subsidy based on the parameters entered by the user also appear and are available for download, as shown in Figure 11.

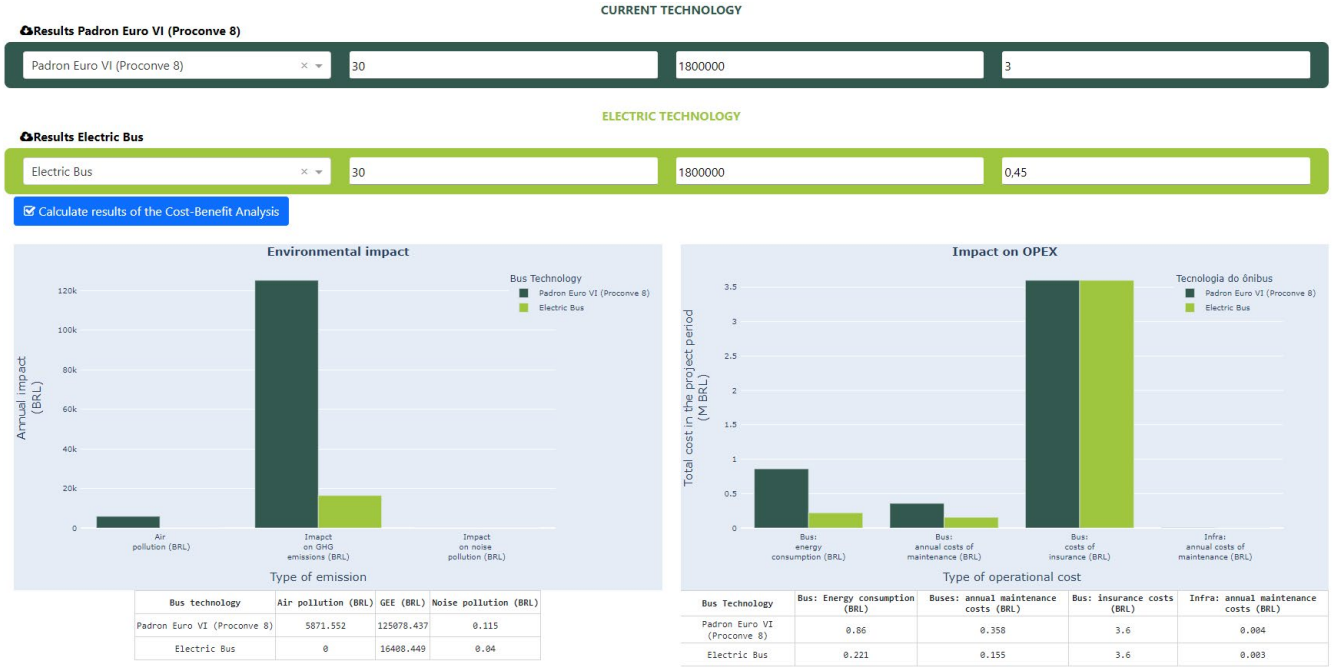
Figure 11 – Financial results for the model with and without subsidy for the City user in the Financial Hub



Source: Financial Hub of Electromobility in Brazilian Cities.

Besides the possibility of reviewing the leading financial indicators during the project's useful life and downloading a spreadsheet with the results, the user can compare diesel and electric technology through a cost-benefit analysis. The user must confirm the technologies to be compared, the number of buses for each technology (anticipating that the size of the fleet may vary in the transition), the unit cost of the bus, and the fuel or energy cost. The results of the cost-benefit analysis are shown in Figure 12.

Figure 12 – Results of the Cost-Benefit Analysis for the City user in the Financial Hub



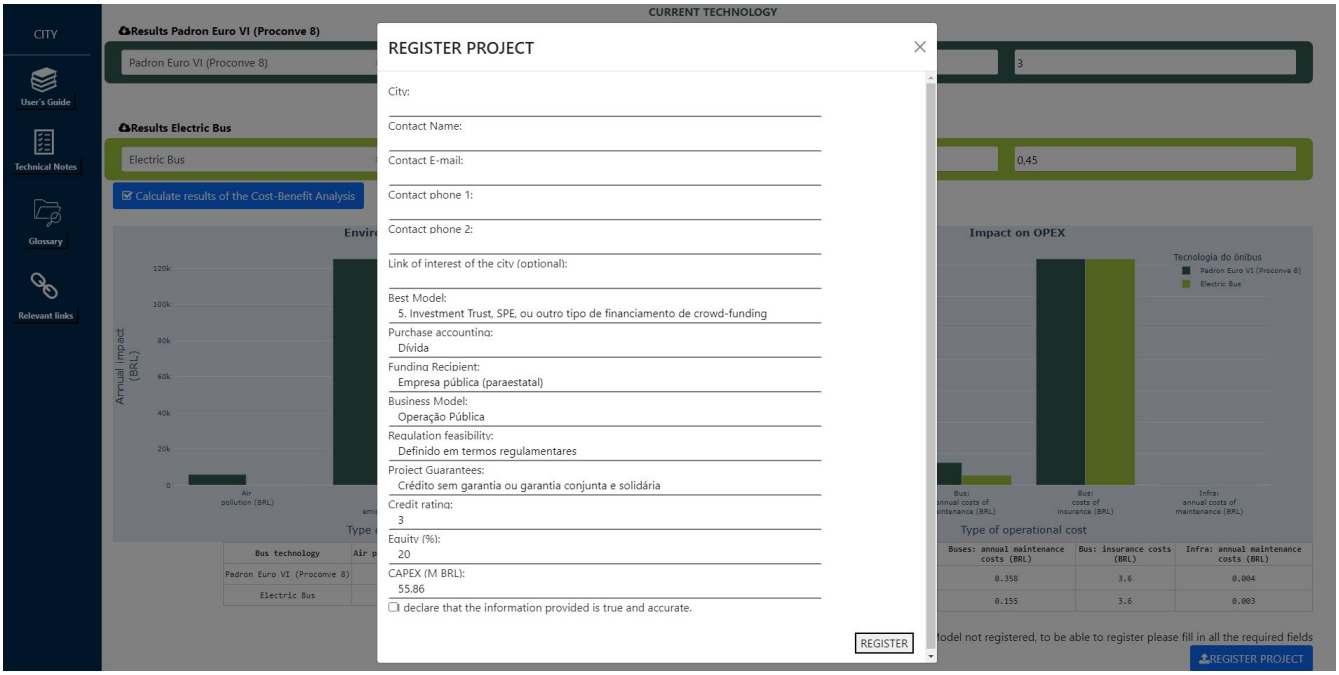
Bus technology	Air pollution (BRL)	GEE (BRL)	Noise pollution (BRL)
Padron Euro VI (Proconve 8)	5871.552	125078.437	0.115
Electric Bus	0	16408.449	0.04

Bus Technology	Bus: Energy consumption (BRL)	Buses: annual maintenance costs (BRL)	Bus: insurance costs (BRL)	Infra: annual maintenance costs (BRL)
Padron Euro VI (Proconve 8)	0.86	0.358	3.6	0.004
Electric Bus	0.221	0.155	3.6	0.003

Source: Financial Hub of Electromobility in Brazilian Cities.

Finally, users can register the project after duly entering the parameters. Users must confirm that all the parameters entered are correct and certify their validity for publication on the platform, as shown in Figure 13.

Figure 13 – Final form with contact information and project summary for the City user in the Financial Hub



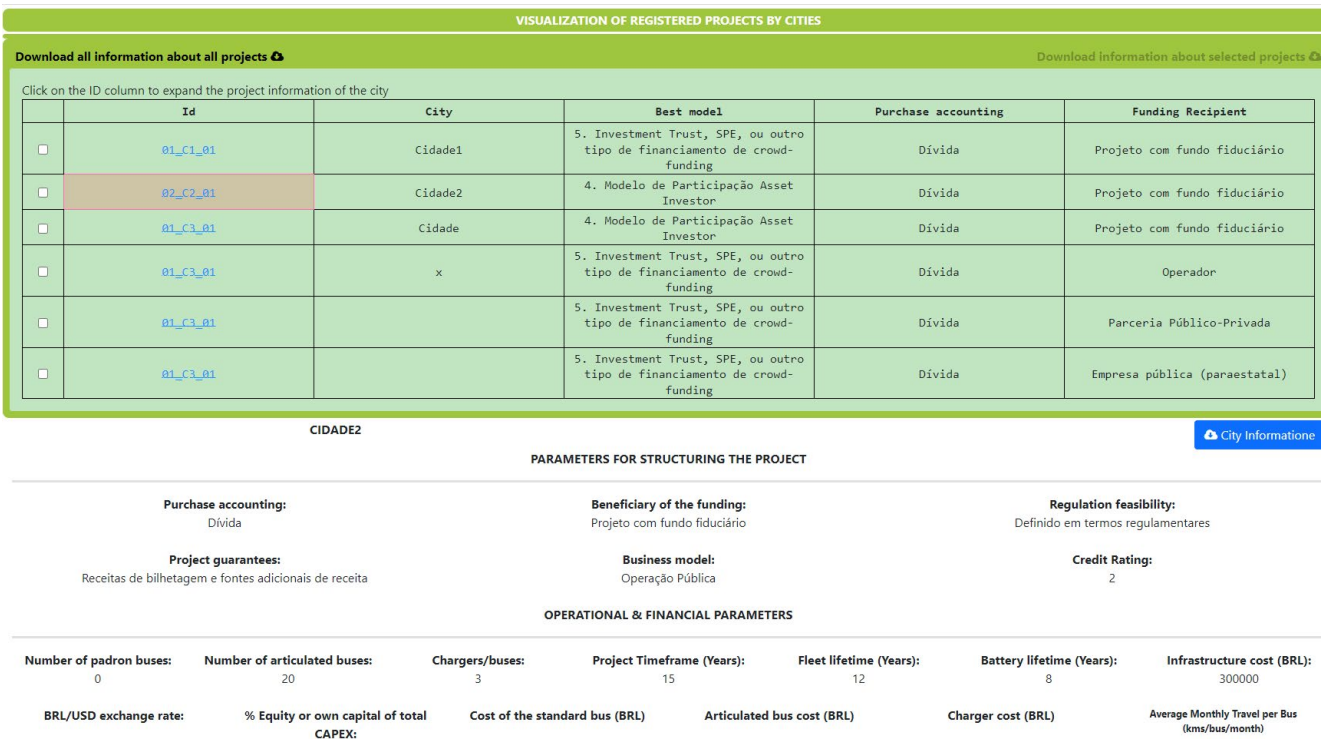
Source: Financial Hub of Electromobility in Brazilian Cities.

Figure 14 shows the general Funder user interface. This type of user has two interactions with the Financial Hub: (1) registering the financing line with essential information related to financing conditions and (2) viewing information about projects registered by cities and their contact details (see Figure 15).

Figure 14 – Interface aspect for the Funder user in the Financial Hub

Source: Financial Hub of Electromobility in Brazilian Cities.

Figure 15 – Viewing cities' records for the Funder user in the Financial Hub



VISUALIZATION OF REGISTERED PROJECTS BY CITIES

Download all information about all projects

Download information about selected projects

Click on the ID column to expand the project information of the city

	Id	City	Best model	Purchase accounting	Funding Recipient
☐	01_C1_01	Cidade1	5. Investment Trust, SPE, ou outro tipo de financiamento de crowd-funding	Dívida	Projeto com fundo fiduciário
☐	02_C2_01	Cidade2	4. Modelo de Participação Asset Investor	Dívida	Projeto com fundo fiduciário
☐	01_C3_01	Cidade	4. Modelo de Participação Asset Investor	Dívida	Projeto com fundo fiduciário
☐	01_C3_01	x	5. Investment Trust, SPE, ou outro tipo de financiamento de crowd-funding	Dívida	Operador
☐	01_C3_01		5. Investment Trust, SPE, ou outro tipo de financiamento de crowd-funding	Dívida	Parceria Público-Privada
☐	01_C3_01		5. Investment Trust, SPE, ou outro tipo de financiamento de crowd-funding	Dívida	Empresa pública (paraestatal)

CIDADE2

City Informatione

PARAMETERS FOR STRUCTURING THE PROJECT

Purchase accounting: Dívida

Beneficiary of the funding: Projeto com fundo fiduciário

Regulation feasibility: Definido em termos regulamentares

Project guarantees: Receitas de bilhetagem e fontes adicionais de receita

Business model: Operação Pública

Credit Rating: 2

OPERATIONAL & FINANCIAL PARAMETERS

Number of padron buses:	Number of articulated buses:	Chargers/buses:	Project Timeframe (Years):	Fleet lifetime (Years):	Battery lifetime (Years):	Infrastructure cost (BRL):
0	20	3	15	12	8	300000

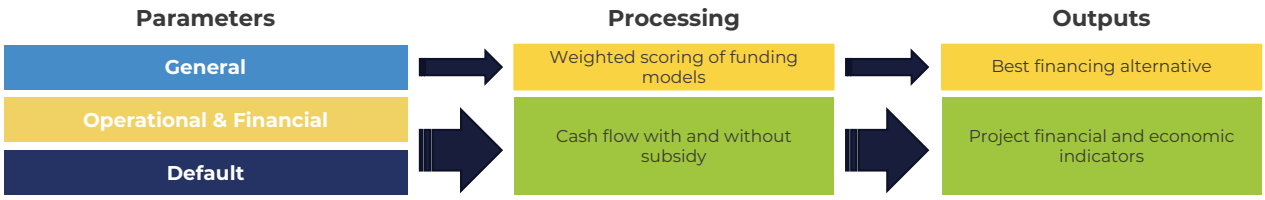
BRL/USD exchange rate:	% Equity or own capital of total CAPEX:	Cost of the standard bus (BRL)	Articulated bus cost (BRL)	Charger cost (BRL)	Average Monthly Travel per Bus (kms/bus/month)

Source: Financial Hub of Electromobility in Brazilian Cities.

2.5 OUTPUTS

The tool assesses the feasibility of several financing models for electric bus projects in Brazil. The way to evaluate the different financing alternatives is to assign weighted scores to each of the financing alternatives according to the project described by the tool user, as detailed in the previous section. The tool's results are shown in Figure 16:

Figure 16 – Outputs of the Financial Hub



Source: Own elaboration.

2.5.1 Best financing option

For the **feasibility of each financing alternative**, the tool ranks them by order of preference per weighted score from 1 to 10. Figure 17 shows an example of the ratings given to each funding alternative for a **medium-sized project (60 buses)** that requires an initial investment of **R$93 million** and whose primary beneficiary is **a trust fund project.**

Figure 17 – Examples of results and feasibility of financing alternatives

Parameter	User input	Weighting	Final weight	1. Direct loan	2. Concession financing	3. Leasing model	4. Asset Investor Model	5. Investment Trust, SPV, or crowd-funding
FUNDING RECIPIENT	Project with Trust Fund	10,0%	10,0%	6	7	7	7	7
BUSINESS MODEL	Shared responsibility	9,0%	9,0%	9	9	9	10	10
REGULATORY FEASIBILITY	Defined in regulatory terms	15,0%	15,0%	6	6	6	7	N/A
PROJECT GUARANTEES	ısecured credit or joint and several guarant	18,0%	18,0%	4	4	4	4	N/A
CREDIT SCORE	2	6,0%	6,0%	7	7	7	7	7
PURCHASE ACCOUNTING	Debt	5,0%	5,0%	3	3	3	3	3
NUMBER OF BUSES	Average project	3,0%	3,0%	6	6	6	6	6
TOTAL CAPEX	Average investment	7,0%	7,0%	7	7	7	6	4
INTEREST RATE	Depends on the alternative	23,0%	23,0%	7,04	8,12	8,52	9,43	10,00
FLEET USEFUL LIFE / TERM	1	2,0%	2,0%	0,00	0,00	0,00	0,00	0,00
BATTERY USEFUL LIFE / TERM	0,53	2,0%	2,0%	1,25	1,25	1,25	1,25	1,25
		SCORE	SCORE	5,91	6,26	6,35	6,73	N/A
		100,0%	100,0%					
		Best option		4. Asset Investor Model				
Excluded scenarios	*Selecting the Operator as the Financing Recipient and the Public Operation as the Business Model* *Selecting Public Company or Public Entity as the Financing Recipient and Traditional Model as the Business Model* *Selecting variables that from experience in other Latin American cities*							

Source: Own elaboration.

In this case, the most feasible alternative, as recommended by the multi-criteria tool, is an **Asset Investor participation model** in which an asset investor has interests and participates in the business through the transfer of resources in exchange for a future return without the need to operate or provide assets within the model. For example, this investor can be a subsidiary company of an **energy company** (e.g., ENEL X, Engie, or the like) or a **fleet company** that supplies electric buses.

The expected annual interest rate following **this financing alternative is 7.32%**. The least recommended option is a direct business model, while a model that seeks funding through an Investment Trust is not considered feasible.

2.5.2 Financial indicators

On the other hand, regarding the **financial indicators** calculated for the values of capital investment, interest rate, and additional costs associated with the project entered by the user in the tool, the following information is presented:

- **Financial statements** for the project term in years, including annual cash flows, for the overall project and the equity interest in the project.

- **Profitability indicators**, which include the project's Internal Rate of Return (IRR) (ratio between initial investment and expected cash flows), again, for both the overall project and the equity percentage, and the net margin for the project term (net profit to revenue percentage ratio) [8].

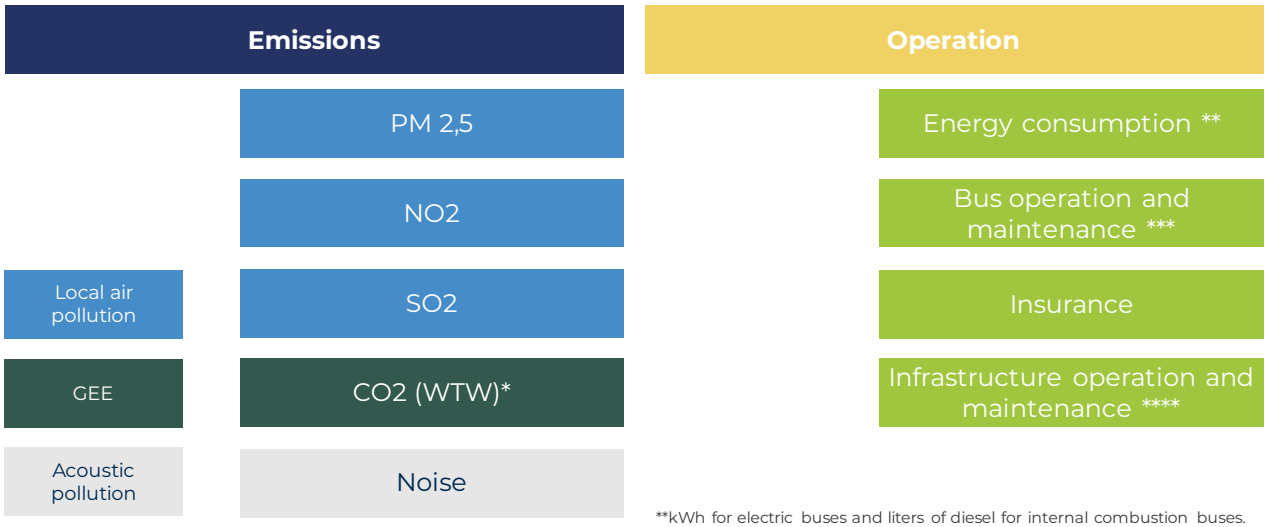
- **The debt coverage ratio**, which corresponds to the fraction of annual debt obligations that can be covered by net operating income.

- **An estimate of the need for subsidy and the associated funding rate**. This calculation is made annually for the project term considering an annual net margin of 5% and responds to the need for subsidies for electromobility projects for public transport.

2.5.3 Operational and economic indicators

The Financial Hub considers a series of economic indicators that aim to give the user the benefits of reducing emissions and operating costs of electric technology compared to diesel. The emissions and operating costs are considered in the platform, as shown in Figure 18.

Figure 18 – Emissions considered in the Financial Hub



*Well-to-Wheel: analysis that evaluates the total energy consumed by the vehicle for each kWh of energy or liters of diesel supplied to the vehicle's wheels, including all the steps covered by the well-to-wheel conversion, and, later, by the tank-to-wheel conversion.

**kWh for electric buses and liters of diesel for internal combustion buses.
***Operation and maintenance of buses which include tire replacement costs, lubricants, ARLA, parts and accessories.
****Operation and maintenance of charging infrastructure for electric buses and fuel stations.

Source: Own elaboration.

Considering the technologies provided for purchase under the legislation [9], the technologies available for comparison for Padron or Articulated buses are:

- EURO V (Proconve 7) Diesel
- EURO VI (Proconve 8) Diesel
- Electric

The emissions included are:

- Particulate matter (PM)
- Carbon dioxide (CO2)
- Nitrogen oxide (NOx)
- Sulfur dioxide (SO2)

The comparison of the two technologies includes a Padron low-floor diesel bus with EURO V technology, the technology required by law for passenger transport vehicles in Brazil, and a Padron low-floor electric bus. The calculation is based on emission factors from the European Monitoring and Evaluation Programme (EMEP) and the European Environment

Agency (EEA) [10]. CAPEX and OPEX data provided by SPTrans and BYD Brasil were used to calculate the two technologies' reduced emissions and operating costs. Other values such as insurance and infrastructure costs are indicative values based on the operational experience in Latin American cities.

As an example, the impacts on emissions and operating costs are shown for the case of a city with inputs as shown in Table 3.

Table 3 – Examples of inputs for reducing emissions and operational costs

Input	Diesel EURO V bus	Electric bus
Concession period	15	15
N° of buses	60	60
Kilometers/bus/month	6,000	6,000
Kilometers/bus/year	72,000	72,000
Expansion factor of pass-day to pass-year	312	312

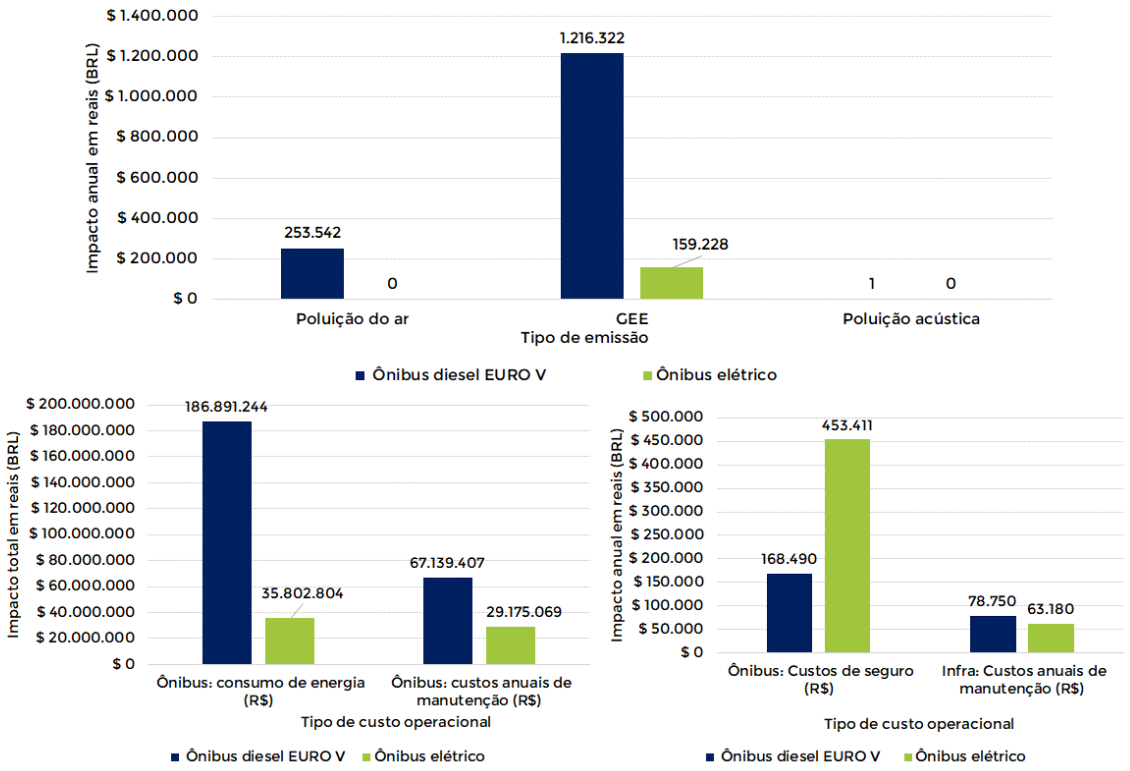
Source: Own elaboration.

During the project of a city with these characteristics and a 15-year concession period, emissions are reduced by 90% and 74.2% for operating costs. Although electric buses have higher start-up and insurance costs due to investment in electric buses and charging systems, the total operating cost is almost three times lower than diesel. The main results appear next in Figure 19.

Input	Padron electric bus	Diesel Padron EURO V bus	% of variation vs. Euro V
ANNUAL IMPACT (BRL)			
Air pollution	$-	$253,541.87	-100.0%
GHG	$79,613.80	$1,216,321.92	-93.5%
Noise pollution	$0.20	$1.12	-82.5%
Annual impact	$79,613.99	$1,469,864.91	-94.6%
TOTAL IMPACT IN THE CONCESSION PERIOD			
TOTAL impact	$1,194,209.92	$22,047,973.67	-94.6%

Input	Padron electric bus	Diesel Padron EURO V bus	% of variation vs. Euro V
OPEX REDUCTION			
Bus: energy consumption (R$)	$17.90	$186.89	-90.4%
Bus: maintenance costs (R$)	$14.59	$67.14	-78.3%
Bus: insurance costs (R$)	$0.45	$0.17	169.1%
Infra: annual maintenance costs (R$)	$0.06	$0.08	-19.8%
TOTAL OPEX in the concession period (M BRL)	$33.01	$254.28	-$0.87

Figure 19 – Reduced emissions and operational costs between Padron EURO V and electric buses



Source: Own elaboration.

3.

REFERENCES

[1] ANTP. **Construindo hoje o amanhã:** propostas para o transporte público e a mobilidade urbana sustentável no Brasil. Brasília, 2019.

[2] CAF. **La electromovilidad en el transporte público de América Latina**. CAF, Buenos Aires, 2019.

[3] THE WORLD BANK. **Latin America Clean Bus in LAC:** lessons from Chile's experience with E-mobility, 2020.

[4] ZEMO PARTNERSHIP. **Accelerating transport to Zero Emissions**, 05 2021. [Online]. Available at: https://www.zemo.org.uk/.

[5] WRI BRASIL. **Guia de Eletromobilidade:** orientações para a estruturação de projetos no transporte coletivo por ônibus. Mobilidade Urbana de Baixo Carbono, 2022.

[6] WRI BRASIL. **Eletromobilidade no transporte coletivo**, 2019.

[7] TESOURO NACIONAL. **Sistema de Análise da Dívida Pública, Operações de Crédito e Garantias da União, Estados e Municípios**, 24 01 2022. [Online]. Available at: https://sadipem.tesouro.gov.br.

[8] GIZ. **Financial mechanisms for e-bus adoption**, 2019.

[9] CONAMA. **Resoluções do Conama**, 2012. [Online]. Available at: https://www.iwa-network.org/filemanager-uploads/WQ_Compendium/Database/Selected_guidelines/007-11.pdf.

[10] EMEP; EEA. **Air pollutant emission inventory guidebook 2016**, 2016.

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