

# EcoMaglev

## Abstract

It will be an Internet platform, under the domain [www.ecomaglev.com.br](http://www.ecomaglev.com.br) which aims to stimulate the infrastructure sector in urban mobility, initially taking advantage of existing or planning BRT (Bus Rapid Transit) corridors, generating increased capacity, regularity and comfort for users.

By the implementation of a high road on the bus corridor, covered with solar panels, it will be possible to reduce by 75% the average journey time, replace the fleet of diesel buses with electric vehicles and deploy stations shopping malls, constituting an integrated system with the following revenue distribution: 40% urban transport; 40% rental of commercial space and parking in stations and 20% commercialization of electricity. The average kilometric cost of implementing EcoMaglev on a BRT track is estimated between US\$ 10 and 15 million, equivalent to 10% of a subway system of the same capacity (45 thousand passengers / hour / direction).

The web platform will offer a wide database and simulators with use of Artificial Intelligence (multiagent system) allowing hundreds of urban planners, graduate students and all interested community to propose solutions for urban mobility, social and environmentally correct solutions. It constitutes an open and cooperative system for information transmission and knowledge creation at international level, capable of attracting private investments in the BOT (Building Operation Transfer) regime. The initial market is cities in 40 countries, which operate BRT, daily moving approximately 34 million passengers on more than 5,000 kilometres of track.

The platform connects the technical and academic community with investors, implementing practical and viable solutions, dispensing the need for public financial resources for investments. The government that manages the BRT corridor, to be used by EcoMaglev, will only be responsible for stimulating private investment, bidding concessions, overseeing the works and operation and, when the concession term expires, receive the entire system in operation free of charge.

## The Problem

Due to the ease of implementation and low cost, by taking advantage of existing public roads; a strong lobby formed by the automotive industry, fuel, tires and spare parts suppliers, in addition to preserving the bus operators market, the BRT which has expanded worldwide.

For a system analysis this text uses BRTData information ([www.brtdata.org](http://www.brtdata.org)). It is a platform created in collaboration with ITDP - Transport and Development Policies Institute ([www.itdp.org](http://www.itdp.org)), with data on the BRT implementation and operation existing on all continents and updated monthly. In February 2020, the website reported BRT 172 cities operating, with 5.163 km, carrying daily 33,86 millions of daily passengers.

BRT is a good solution to democratize public transport. However, there is a technical limit when demand is too high. Its continental use is as follows:

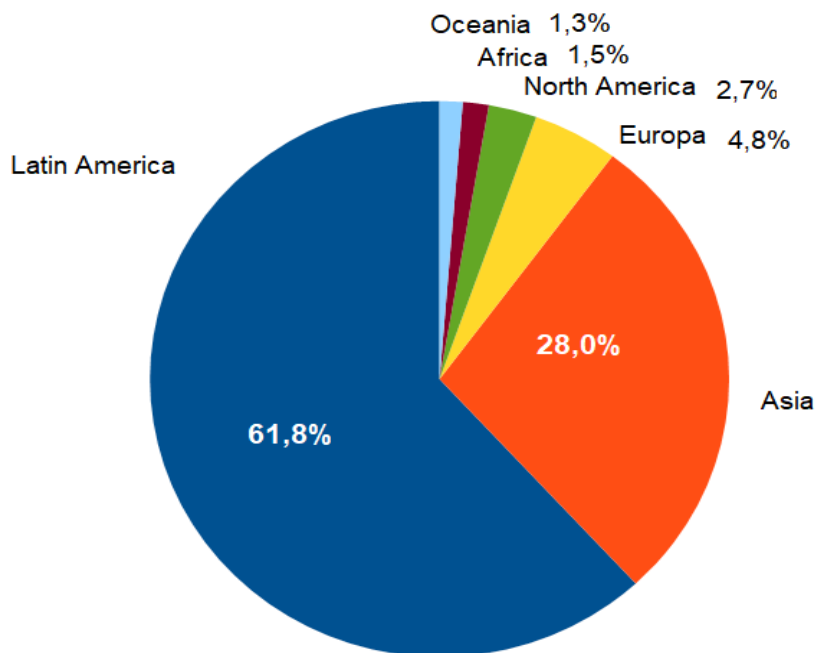


Fig. 1 – BRT transport of 33,9 million passengers/day per Continent

According to the BRTData, with 3.18 million daily passengers, the city of Rio de Janeiro is the second largest passenger traffic through this system worldwide, after the city of São Paulo, also in Brazil, with daily service of 3.3 million passengers.

As a legacy for the urban mobility of the Olympic Games 2018 in Rio de Janeiro, four major BRT runners were planned, with three in operation and one under construction. However, used as a technical option for mass transport, BRT gives signs of exhaustion. Newspapers frequently reports discomfort problems, excessive travel time and irregularities in the interval between buses.

Aiming to prove this information, with support from NECI –Intelligent Cities Studies Center, a group that works at the Senac School of Technology, in Rio de Janeiro, an Opinion Survey is carried out on the quality of service provided by BRT TransOeste.

For a preliminary analysis, part of the sampling of the interviews took place on weekdays and Saturdays, in the period between 10 January and 18 February 2020. The interviews are being carried out with users at stations and buses, being presented in this text a quantitative summary, with a sample of 177 passengers interviewed, which 54% declared being male and 46% female.

The sample was divided into four groups according to age group: young people (15 to 29 years old), adults (30 to 44 years old), mature (45 to 65 years old), elderly individuals aged over 65. Elderly people in Rio de Janeiro do not pay tickets, and their transport is subsidized indirectly by the paying public. For this reason, in the sampling, the preference was given to the payers, the sample not representing their actual participation. In December 2018, gratuity was equivalent to 25% of payers.

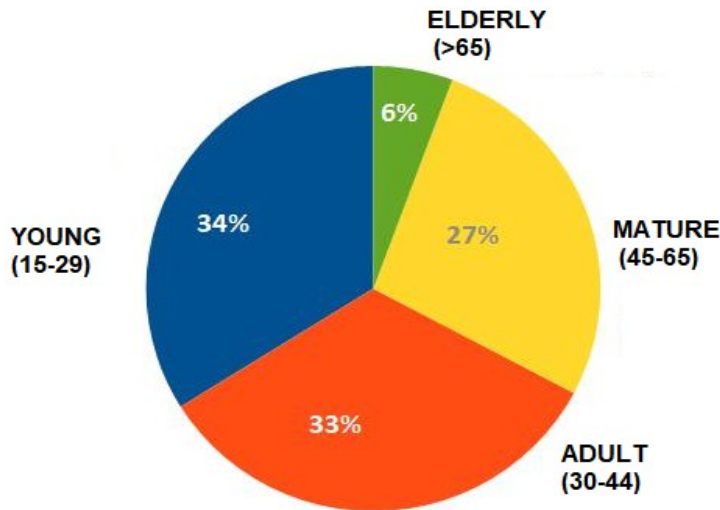


Fig. 2 – Sample Distribution by Age Range

The important thing in the research is to detect the user’s perception in three factors, starting with comfort, in other words, if the bus is **full**, making the journey unfit sitting, and crowded to the point of causing discomfort. To allow comparison, the sample was divided into two parts, with working-days and Saturdays information. There is a big difference in perception: 2/3 (64%) of the interviewees consider the bus always crowded and very crowded **on weekdays and Saturdays**, inverted, 63% consider the buses to be little full and empty.

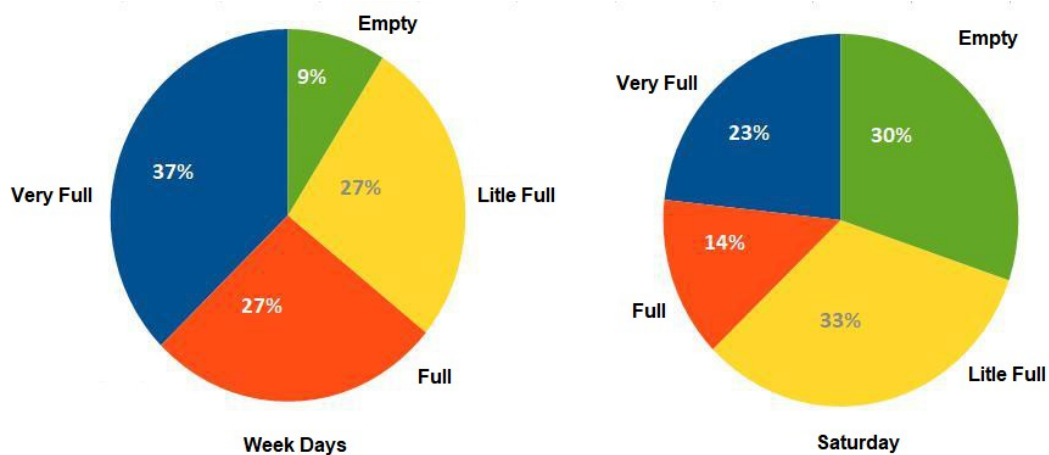


Fig. 3 – Level of comfort during travel

The second quality indicator refers to the **speed** item, whose result was surprising, since generally BRTs can only improve 20% in the average speed of buses, always below 20 km/h in urban areas at large cities in Brazil. Four classifications were created based on the passenger's perception. In the sample, even on weekdays, the perception that the bus was too slow or slow was only 53%. On Saturdays, on the other hand, 83% of users considered the trip a bit slow and fast.

Probably, the driver faced by the company's requirement to make seven complete trips per day, in 20 hours of work, from 4 am until midnight, a very difficult goal to be fulfilled, they drive at the limit of the maximum speed allowed.

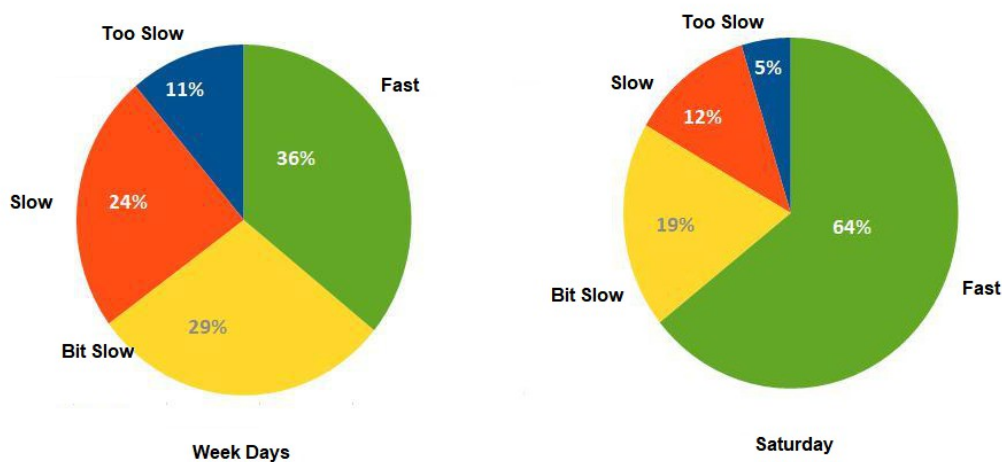


Fig. 4 – Perception of bus speed during travel

The third item researched can be considered the most important, it is the frequency, which is, the time interval between buses. The waiting time the passenger waits for the bus ("which never arrives") at the station; it is the main distress factor, being, therefore, an information not detected by the system's operational control center, based on GPS on buses, explaining why the stations are always full. In the qualitative part of the survey, many users reported having to wait for more than an hour standing for their bus to arrive.

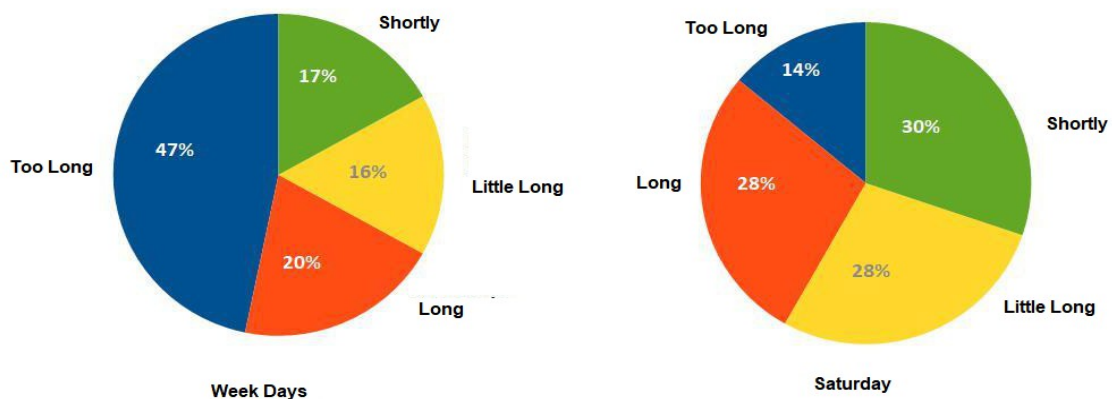


Fig. 5 – Interval between buses excessive: 67% week days and on Saturdays 42%

Aiming to assess whether the negative perception about the bus interval would not be associated with the passenger's age group, the working day sample was divided into four parts, corresponding to the age group of the Youth, Adults, Mature and Elderly people. It is observed that the pattern is practically the same, i.e., the frequency of BRT TransOeste is considered irregular by 65% of the Young, 63% of the Adults, 61% of the Mature and 66% of the Elderly people.

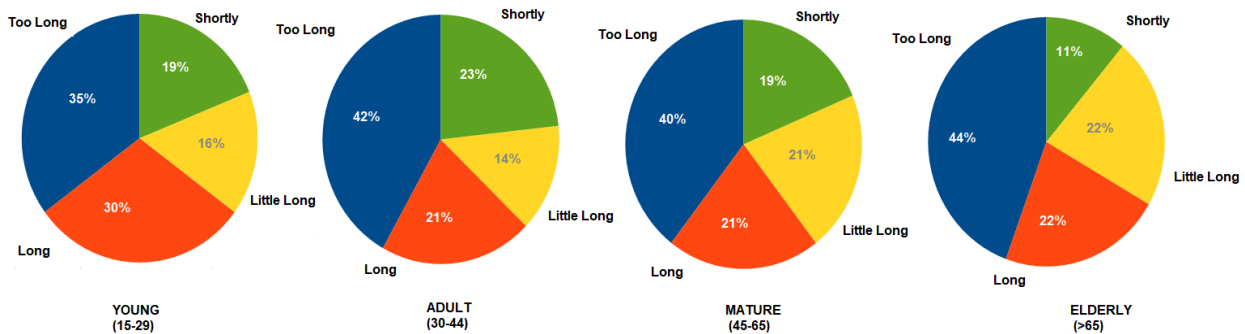


Fig. 6 – Perception of the interval between buses by age group is excessive

The survey confirmed the reports published in Rio de Janeiro on the quality of the BRT TransOeste service. It also confirms data from other regions, as in São Paulo, where irregular frequency is the most common users complaint.

The conclusion is technical: the BRT system shows signs of exhaustion when demand is high. Being a surface transport, subject to the uncertainties of traffic, there is no way to guarantee a consistent interval between regular buses.

The finding is serious because so many Latin American and Asian cities have bet on this faster and cheaper solution than mass transport on rails. However, at a cost of US\$ 150 million/kilometer, as in the recent bid won by a Chinese consortium in December 2019, for the construction of 24 km of high road in Bogota, Colombia, few developing economy countries are able to afford investment in subway transport.

To assess the consequences, the 172 cities listed by the site BRTData were ordered by transport density; i.e., the result of the division of the number of daily passengers by the corridor's mileage. It resulted that 42 cities, 24% of the total, account for 77% of the daily traffic, but only 32% of the mileage reported by BRTData.

Table 1 – 42 Cities with density > 7,000 passengers/km

Region	km	Pass/day	% km	% Pass
Latin America	1.218	18.619.201	73%	71%
Asia	194	3.748.082	12%	14%
Middle Orient	130	2.000.000	8%	8%
Europa	57	795.000	3%	3%
Africa	43	380.000	3%	1%
Oceania	28	356.800	2%	1%
North America	4	166.000	0%	1%
<b>TOTAL</b>	<b>1.674</b>	<b>26.065.083</b>		
TOTAL	32%	77%		

Source: BRTData

## The Solution

It is not always where the problems are located exactly where the solutions are generated; the opposite usually happens. In these places, people are suffering in such a way from problems that they do not have time and conditions to propose solutions. On the other hand, where there is an excellent educational level, efficient transportation systems and articulation capacity, ideas can arise to help, as people have not suffered from the problems of public transport capacity and irregularities in meeting schedules. With the current ease of communications and knowledge dissemination through the Internet, innovative solutions can emerge from anywhere in the world to help BRT users, as long as people, even at a distance, are motivated.

The UNO's 2030 Sustainable Development Agenda prioritizes the following objectives:

1. human dignity
2. regional and global stability
3. the health of the planet
4. a just and fair society and
5. economic prosperity.

Theoretically perfect, there's nothing more to discuss. It is time for concrete, practical and effective measures.

According to the BRTData website, in one of the 172 world cities operating the system; If, a single of these cities decide to test the proposal on canvas, we will have started the long journey. Quickly, concrete results can be obtained in these large population clusters, increasingly problematic, if the populations of public transport users from all over the world, who are somehow affected by the inaccuracies willing to collaborate.

The increase in urbanization is inexorable. In the South, Southeast and Midwest regions of Brazil, for example, which concentrates 2/3 of the population of 210 million inhabitants and 80% of the Gross Domestic Product, in 37% of the entire territorial area of 8.5 million square kilometers, the motorization rate (vehicles per 1000 inhabitants) reaches 545, which is very close to the average rate for the 36 OECD forming countries. In these three regions the urbanization rate is more than 90%, as in the 15 world cities where more passengers are transported by BRT:

Table 2 – Passengers/day through BRT in populous cities

City	Population	Country	Region	Km	Pass/dia	Pass/km
São Paulo	11.967.825	Brazil	Latin America	135	3.300.034	24.445
Rio de Janeiro	6.476.631	Brazil	Latin America	168	3.178.600	18.920
Bogotá	8.181.047	Colombia	Latin America	113	2.192.009	19.398
Tehran	8.244.535	Iran	Middle Orient	130	2.000.000	15.385
Buenos Aires	2.891.082	Argentina	Latin America	55	1.419.000	25.800
Taipei	2.683.257	Taiwan	Asia	60	1.302.832	21.714
Mexico City	8.851.080	México	Latin America	140	1.240.000	8.857
Belo Horizonte	2.502.557	Brazil	Latin America	39	1.047.374	26.856
Guangzhou	6.780.000	China	Asia	23	850.000	36.957
Istanbul	14.160.467	Turkey	Europa	52	750.000	14.423
Quito	1.619.791	Ecuador	Latin America	71	745.000	10.493
Lima	7.605.742	Peru	Latin America	26	704.803	27.108
Zhengzhou	5.872.000	China	Asia	31	650.000	20.968
Curitiba	1.879.355	Brazil	Latin America	74	566.500	7.655
Porto Alegre	1.476.867	Brazil	Latin America	55	540.000	9.818

Source: BRTData

Probably all cities worldwide with high transport density, measured in passenger/kilometer, suffers the same problems raised in the research carried out in Rio de Janeiro. Therefore, everyone is being affected in terms of **human dignity**.

The technical solution from the operational point of view is to implant in the most busy corridors, a parallel track, high or underground, of high capacity. Our proposal is for a magnetic levitation train, silent, powered by electric energy from photovoltaic origin.

Aiming at regional and global stability, one must expand globalization, of ideas and products. Currently, China is the world's large manufacturing industrial park, estimated to be responsible for 25% of all production, with a tendency to increase, always winning competition bids, due to cost reduction of an industrial scale. No way out of the current globalized model and no protectionism. But would the situation be in a globalized approach, but of Industry 4.0?

For this, our EcoMaglev project recommends that the magnetic levitation vehicle be able to travel disassembled inside an ISO HC (High Cubic) 40-foot container. In this way, at each location where it is deployed, the train will be assembled in the Maintenance Center itself, by workers who will later work on this service. Instead of large factories in a few countries, the approach is to have

hundreds of suppliers in dozens of countries. That the purchase of components can be done by websites from [www.amazon.com](http://www.amazon.com) or [www.alibaba.com](http://www.alibaba.com), following assembly instructions as simple and didactic as those of [www.ikea.com](http://www.ikea.com). That the solutions are elaborated by designers from all over the world. That engineers shares experience and information in an open system, decentralized. Why does a Swedish designer can't propose a levitation train to Bogotá or Rio de Janeiro? An architect from Holland cannot suggest the design of a shopping station in Colombia - why? Can't a Chinese physicist support a teacher interested in creating Fuzzy Logic-based levitation software at a Brazilian University? Can an Australian financier not indicate banks to fund projects in Africa? The full use of the Internet allows us to break geographical and cultural limitations, if we want to.

There is a perception that the health of the planet **is threatened by** global warming. Although there is controversy about whether or not it is a natural phenomenon, that is, independent of human action, surely urbanization is due exclusively to human action.

Moving people and goods requires energy consumption. The problem will be reduced if this energy is renewable. For this reason, the EcoMaglev project foresees the installation of solar panels along the entire high road. Fortunately, the cities where most passengers move around the system have a high rate of sunshine. As the levitation train has low energy consumption, simulations indicate that 80% of the electric energy generated by the solar panels can be marketed. At a rate of 7.7 m<sup>2</sup> of photovoltaic cells per meter of track, real solar farms are created in the cities centers. In Rio de Janeiro, for example, covering from solar panel the main BRT corridors, the resulting area would be 1.15 million square meters, with the potential to generate 1.5 GW (GigaWatt) per day, a capacity 28% higher than the world's largest solar farm, Noor Abu Dahabi, located in the city of Sweihan, in the United Arab Emirates, which has a capacity of 1.17 GW.

Implementing solar panels on trains that circulate over congested BRT corridors, able to reduce travel time by 75%, as is the proposal of EcoMaglev, is a practical, effective and not a theoretical discussion, because photovoltaic energy generation is encouraged worldwide, including in Brazil. The proposal has a positive environmental impact capable of directly benefits millions of people and indirectly billions.

A **just and fair** society has less inequality, a complex concept, the subject of endless philosophical discussions. But there is an unquestionable equality: anyone has 24 hours a day. In fact, what differentiates people from each other is what they do or can do in those 24 hours. Those who spend, as in the case of Rio de Janeiro, in BRT TransOeste 2 hours to travel 38 kilometers and who can consume only 30 minutes on a magnetic levitation train, earn 3 extra hours per day.



Hours you can invest in studying, shopping, enjoy with friends, spend more time with family or simply live without being confined in a crowded bus. What would be the impact on the quality of life of the 33.8 million BRT users worldwide?

EcoMaglev makes a very small contribution to the reduction of social, economic and cultural inequality in order to achieve a more just society as the UN wants, but by providing more time, it gives the opportunity for each person to invest, themselves, in the reduction of this inequality that has only increased.

The prefix Eco in the EcoMaglev project is not only derived from Ecological neologism, its root is also Economic. Currently, with the fall in interest rates, often generating negative income for savers, there is a lot of available capital in search of opportunities. The great difficulty is to overcome the barriers of prejudice and lack of technical knowledge about the technology of magnetic levitation, in order to draw the attention of these capitalists and thus be able to meet the economic prosperity objective of Agenda 2030, with regard to urban mobility.

When China bought Transrapid from Germany to open the high-speed line in Shanghai in 2004 and adapted electromagnetic technology for urban transport (operating trains in Changsha and Beijing), it enhanced the German project in its virtues and defects, being the main defect the cost of the permanent way. Something unjustifiable through the lens of the Resistance of Materials, for an urban vehicle, with tare equivalent to 1/3 of the common train and distributed load instead of concentrated on the wheels, as in the traditional rail.

Due to lack of technological knowledge and the convergent regulation for traditional solutions, it is considered impossible for a high-speed metro line to cost between US \$ 10 and US \$ 15 million / km. However, with magnetic levitation, there is a great cost reduction in civil engineering (responsible for 2/3 of the investment). Having no friction, the maintenance cost is 50% lower than that of the train and even more in relation to the monorail on tires. After all, Maglev has no wheels. The consumption of 1.6 kW to levitate a ton is largely offset by the very low rolling resistance (1% of tire resistance and 10% of rail).

In innovative marketing, all EcoMaglev stations on the BRT will be shopping stations. The line covered with directable solar panels, installed at marginal cost over the emergency exit between the two lines of the train, generates energy for the entire system, feeding even a fleet of electric buses and making it possible to install air conditioning at the bus stop stations, where the train will pass over without stopping. In the simulations carried out, the revenue of the EcoMaglev system consists of 40% for the transportation tariff, 40% for the rental of commercial areas (shops and parking) and 20% for the sale of the surplus electricity, since the maglev train itself only

consumes between 15 and 20% of the photovoltaic energy generated.

EcoMaglev is an excellent system. Very useful for the urban environment, it contributes to minimize the environmental impact by not producing noise (trains and electric buses), dispensing with expropriations for its implementation, very advantageous for its users due to their comfort, by regularity and the average speed of operation above 60 km / h which is very profitable for investors, counting on a safe return in a long term application.

When Jaime Lerner, urban planner and ex-mayor, implanted the first BRT in his city of Curitiba, he created a concept that traveled the world. Overcame many challenges. Today times are different, in Brazil for example, in this period the population doubled. However, the need to persist in ideas has not changed. Nobody welcomes news in the conservative infrastructure sector. There is a priori skepticism, justified by the history of the metro-rail sector in recent decades. In order to change, it is essential that the planner who proposes and the politician who authorizes the innovation have an open mind, require technical justifications and above all have a willingness to test, in an operational segment, not studies, because one only learns to do, by applying.

Given the philosophical foundations of EcoMaglev, we go to the steps of solving the problem, namely the creation of a platform on the Internet to accelerate the infrastructure sector with digital ideas.

## **Planning**

In the case of technological innovation, it is challenging to establish rigid planning. How to walk on slippery ice? Each step has to be well thought out because the fall is always imminent; even more in the case of a humanitarian project, indirectly related to opposing interests, fearful of losing the market they dominate. As with true innovations, possibly future business leaders don't even know that it can exist today. So the first goal of planning is to establish a good, broad and unrestricted disclosure plan.

Probably the first target for the dissemination of technological advantages is NGOs supported, openly or not, by those interested in transport. The immediate options are ITDP - Institute for Transportation & Development Policy ([www.itdp.org](http://www.itdp.org)) and EWB International - Engineers Without Borders International ([www.ewb-international.com](http://www.ewb-international.com)), both with a presence in several developed and developing countries. Many other entities of the kind can and should be part of this first focus, something that will be the subject of future research. It will soon be possible to understand where support, resistance and, above all, indifference will come from.

The second key step in planning will be to create a quality database on the technology. The proponent is the author of a book and technical articles on magnetic levitation that will be immediately available on the website [www.ecomaglev.com.br](http://www.ecomaglev.com.br). Several teachers and former teachers are in the same situation and can also contribute.

Fortunately, since 1977 there has been an international magnetic levitation congress. This year 2020, the 25th international conference will be held in Changsha, China, where the first low-speed maglev, the Maglev Express, started operating in 2016. The author has participated in previous events and will present works for the next one. This organization has a huge collection of technical material that our platform aims to serve as a channel for dissemination and interaction with stakeholders. Those articles that have an immediate relation to the project's objectives will be translated into Portuguese, Spanish and Mandarin, as they are regions where more BRT is in operation with great movement.

The third planning step will be to conduct an expeditious and remote analysis of the application of the EcoMaglev alternative on BRT corridors with high passenger density per kilometer. Initially, up to 7,000 passengers / km, existing in 42 cities. Subsequently, increasing the limit to 5,000 passengers / kilometer, covering 58 cities, whose sum of users in relation to the total number of passengers transported by the BRT represents 84% of the total. However, how does the summation occur; having been performed in 42 cities, the increase will be just 16 more.

It is clear that the margin of imprecision will be relatively large, as each municipality in the world has its work code, public transport regulations and a series of legal requirements and cultural restrictions. However, the laws of classical physics are universal and superior to the imperfections of human laws. It is feasible to have an initial mathematical model, subsidized by Artificial Intelligence (AI) resources and to adopt the technique of successive approximations. This participatory methodology is always successful, when local technical support is obtained, from people who know the problem well and are able to propose solutions.

## **Financing**

There are things that money doesn't buy. For example, the attention of a political or business leader, an internationally recognized NGO and even large and innovative companies. Gaining those few minutes of attention is invaluable. Several examples can be cited:

Entrepreneur George Soros, who proposes to invest US \$ 1 billion to create a global network of universities and prepare people to fight the advances and skeptics of global warming. How much is Soros' support for EcoMaglev worth?

Businessman Bill Gates and his wife, creators of the Bill and Melinda Gates Foundation, whose central objective is to improve living conditions and fight poverty. How much is a possible support from the Gates couple worth to researchers all over the world of solar powered magnetic levitation?

Another billionaire businessman, Elon Musk, wants to develop a revolutionary high-speed electrodynamic magnetic levitation project with trains running on depressurized tubes. How much is Mr. Musk's support worth for a much simpler, more mature and well-tested electromagnetic levitation project for low speed systems (120 km / h), but of immediate application?

How much is the support of Mark Zuckerber, from [www.facebook.com](http://www.facebook.com) to the EcoMaglev project, publicizing the need for a worldwide integration of researchers, technicians or simply people committed to the 2030 Agenda?

To start the development of pilot projects in selected cities around the world, the ideal would be to rely on the formidable Google database. Its Google Earth, Google Studio and Google Maps products provide valuable, public domain information. How much specific information would the company have useful for the project? How to attract the interest of Google's management for the EcoMaglev project, ecological, capable of bringing great social benefit, besides being profitable for investors?

Various architecture and vehicular design proposals were made with free software until the 2016 version, SketchUp is easy to apply. Would it be possible for the company to create a special tool for EcoMaglev, available and free of charge to researchers?

Gaining a few minutes of attention from these successful entrepreneurs is worth more than effective resources. To attract investors, there are several collective financing entities for innovative projects on the Internet, such as Kickstarter ([www.kickstarter.com](http://www.kickstarter.com)) that can contribute directly or indirectly to researchers who register patents applied to technology in various markets. For this, the platform to be created should provide technical support so that inventors and researchers from all over the world have the capacity to register their ideas, so that there is a return in the future for those who bet on the projects and subprojects of the EcoMaglev system.

Without a doubt, money is important. However, it is a necessary but not sufficient condition. Very important will be voluntary adherence and the participation of people who are truly committed to the purposes of the UN Agenda 2030 and concerned with the environment, sustainability and climate change. Each of them contributing according to their individual abilities and skills.

## Construction

Starting the creation of the Internet platform, provided that it has a minimum cooperative effort from some people, is not the most difficult task and absorbs few resources.

As interest grows there, costs increase so that there is no degradation in the time taken to respond to requests. In the beginning, probably the biggest cost will be in the dissemination of the proposal, in the realization of lectures and paper publications.

It is feasible to create a collaborators network spread around the world and share links on several other sites of equal interest. The Senac Faculty of Technology, in Rio de Janeiro, which worked on the Opinion Survey on the quality of the BRT TransOeste service, has a Web Development center that can cooperate. SENAC - National Service for Commercial Learning is a professional education institution created in 1946 and open to all society. It is a private entity, for public purposes, which receives a compulsory contribution from commercial companies. As an important part of the EcoMaglev project are shopping stations, there is an unmistakable interaction between commercial activities and Senac's objectives.

Brazil leads the use of BRTs worldwide with participation in the movement of passengers. Considering those with a density greater than 1,000 passengers per kilometer, it is possible to organize the following list:

Table 3 – Largest Brazilian Cities in which BRT operation

City	Population	Km	Pass/day	Pass/km
Belo Horizonte	2.502.557	39	1.047.374	26.856
São Paulo	11.967.825	135	3.300.034	24.445
Niteroi	496.696	15	328.000	21.867
Rio de Janeiro	6.476.631	168	3.178.600	18.920
Fortaleza	2.643.247	10	186.777	18.678
Campinas	1.164.098	13	200.000	15.385
Goiania	328.300	24	328.300	13.679
Porto Alegre	1.476.867	55	540.000	9.818
Recife	1.633.697	50	409.620	8.192
Curitiba	1.879.355	74	566.500	7.655
São Paulo Metropolitan	14.360.674	45	325.000	7.222
Londrina	548.249	7	37.000	5.286
Sumaré	265.955	33	75.000	2.273
Guarulhos	1.324.781	16	30.000	1.875
Brasília	2.914.830	49	51.000	1.041
<b>TOTAL</b>	<b>49.983.762</b>	<b>733</b>	<b>10.603.205</b>	

Source: BRTData

In October 2020 there will be municipal elections in all these cities. The ideal would be that in these cities the EcoMaglev proposal would arouse the candidates interest, but without party affiliation. As Brazilian law allows reelection, those who are running for the first time would have 8 years (two terms) to implement the project, at no cost to the municipality and with great social appeal.

The author managed to get the municipality of Petrópolis, in the state of Rio de Janeiro, to publish a Notice of PMI (Expression of Interest Procedure), a legal instrument where the government invites businessmen to invest in mobility projects. Two other cities in the state of Rio de Janeiro are also evaluating a similar publication.

In this PMI, the first phase consists of a feasibility study being carried out by any interested group. Approved by the public authorities, a competition is held and the authors of each project can participate. If you lose and your ideas are used by the competitor, the cost of the defeated project will be used and reimbursed. In other words, the investor in the feasibility study never loses money; at least it is compensated.

This model, approved by Decree No. 8428 of April 2, 2015 of the Brazilian Federal Government, when published by a city hall, creates a paradigm that can be copied by all others. In the case of Petrópolis, where there is no BRT in operation, the magnetic levitation train will use the aerial part of the Piabanha River, which rises on the outskirts of the city, in more than 70% of the route. The model was inspired by the monorail operated in Wuppertal, Germany, with more than a century of operation.

## **Operation**

Once a good disclosure has been made and the necessary political and financial support has been obtained, maintaining the platform in operation becomes a routine job, facilitating the expansion of the system. It will, of course, be necessary to create a self-sustaining process, through the charging of a “success fee” fee, voluntary contribution from interested companies participating in the database of recommendations or even technical consultancy services and approval of new vehicles.

There are still no technical standards for magnetic levitation. It does not make sense to adopt railway requirements in this technology, which has its own safety requirements, some less rigid than railway, others even more rigid. There is a great deal of standardization work to be done, an important mission for technicians associated with the [www.ecomaglev.com.br](http://www.ecomaglev.com.br) platform.

A “green seal” for suppliers, consultants and operators who want to advertise their products and services on the website is another alternative for generating revenue for self-support. The important thing is to start safely, without abandoning or making concessions to the guidelines of the UN Agenda 2030, supported by the G20 member countries.

Due to the fact that it does not consider the physical existence of a factory (assembler) of magnetic levitation trains, the project can be classified as a model of Industria 4.0.

The “factory” that will coordinate the various suppliers is in the clouds and the parts for the vehicle, stations, Operational Control Center (CCO) and Operational Maintenance Center (CMO), must be packed in containers and sent to the CMO of the future line of EcoMaglev. All technical assistance and monitoring of the assembly can be done remotely, from anywhere in the world.

All operational information from EcoMaglev will be sent to the [www.ecomaglev.com.br](http://www.ecomaglev.com.br) platform, taking advantage of the potential of the 5G Internet, in the concept of Internet Things with the purpose of following the development and enabling its improvement, on line.

Global, participatory and with Artificial Intelligence resources, Industry 4.0 concepts and Internet Things, the EcoMaglev project is effectively a modern and innovative virtual solution, capable of accelerating the infrastructure sector, with great environmental, social and economic benefits .

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