STATUS OF ELECTRIC MOBILITY

IN LATIN AMERICA AND THE CARIBBEAN

2019

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ELECTRIC MOBILITY: STATUS IN LATIN AMERICA AND THE CARIBBEAN AND OPPORTUNITIES FOR REGIONAL COLLABORATION 2019.

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Glossary

This glossary has been compiled by the lead authors of this report and is based on glossaries and other resources available on the websites of the following organizations: International Energy Agency [1], Intergovernmental Panel on Climate Change [2], United Nations Environment Programme [3], United Nations Framework Convention on Climate Change [4].

Paris Agreement: on December 12, 2015, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached a historic agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low-carbon future. The Paris Agreement builds on the Convention and, for the first time, brings all nations together in common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with increased support to help developing countries do so.

Climate change: the United Nations Framework Convention on Climate Change (UNFCCC), in Article 1, defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". The UNFCCC therefore differentiates between climate change attributable to human activities that alter the composition of the atmosphere and climate variability attributable to natural causes.

Charging station: infrastructure for the supply or trading of electrical energy for the charge of batteries for electric vehicles or hybrid plug-in vehicles.

Connector: The terminal to which the electric vehicle is connected to receive electrical energy. There are several types of terminals with different levels of charge and most are not compatible with each other.

Flexible fuel: a vehicle that has a fuel system, but can mix different types of fuel in the same tank; for example, gasoline and ethanol. Supports a wide range of blends. Also known as flex fuel.

Short-Lived Climate Pollutants: (SLCPs), compounds in the atmosphere that cause warming and have a shelf life of less than about 20 years. These include black carbon, ozone, methane, and many hydrofluorocarbons.

Nationally Determined Contribution (NDC): Actions submitted by countries, ratified by the Paris Agreement, that present their national efforts to achieve the long-term temperature goal stipulated in the Paris Agreement: to limit global warming to below 2°C. New or updated NDCs will be submitted in 2020 and every five years thereafter. Therefore, NDCs represent a country's current target for reducing its emissions nationally.

Electric vehicle corridor: (also known as "electro corridor"), a succession of charging stations that allows different points in a territory to be connected so that electric vehicles can be charged along the route in which those stations are located.

Decarbonization: process by which countries or other entities seek to achieve a low carbon economy, or by which individuals seek to reduce their carbon consumption.

Carbon dioxide equivalent (CO_2e): a way of placing the emissions of various radiative forcing agents (difference between the insolation absorbed by the Earth and the energy radiated back into space) on a common basis when considering their effect on climate. It describes, for a given mixture and amount of greenhouse gases, the amount of CO_2 that would have the same global warming capacity, when measured over a specific period.

Electrification: for the purposes of this report, is understood as the process of conversion or replacement of other energy vectors by electricity for a given application. For example, replacing a fossil fuel vehicle with an electric vehicle.

Greenhouse gases: the atmospheric gases responsible for causing global warming and climate change. The main greenhouse gases are Carbon

Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O). Less frequent, but also very potent, greenhouse gases are Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF_6).

Interoperability: in the context of charging electric vehicles, seeks to ensure reliable communication and functionality of any plug-in electric vehicle with the charging infrastructure in order to enhance integration with smart electrical grids (Smart Grids) [5].

Roaming: Or "e-roaming", a service that allows electric vehicle users the option to charge at all charging stations and not just with the charging operator with whom they signed a charging contract.

Mitigation: in the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Shared mobility: shared use of a mode of transport (e.g. vehicles, motorcycles, bicycles, scooters or others), which gives users access to its use for a short period of time based on demand [6].

Electric mobility: For the purposes of this report, it is understood as means of movement of people or goods that result in a vehicle powered by electricity, lacking a combustion engine and that does not circulate on rails.

Sector coupling: electrification of a sector coupled with increasing amounts of renewable energy to meet demand, so that sectors can provide balance or flexibility to the electricity system.

Private transport services: unlike public transport, this refers to vehicles that perform transport services, but do not belong to a country's public fleet.

Electric vehicle: a vehicle with an electric motor that is powered by batteries (charged through connection to the electrical grid), directly from hydrogen or by direct current.

Hybrid vehicle: contains an internal combustion engine and an electric motor with a battery bank. In contrast to a plug-in hybrid vehicle, it does not provide the ability to connect to an external source to charge the batteries. However, the batteries are charged by the internal combustion engine or a regenerative braking system.

Plug-in hybrid vehicle: contains an internal combustion engine and an electric motor with a battery bank. Provides the ability to connect to an external source to charge the batteries.

Plug-in vehicles: usually refers to electric and hybrid plug-in vehicles.

Acronyms

AAVEA	Argentine Association of Electric and Alternative Vehicles
ABRAVEi	Association of Innovative Electric Vehicle Owners of Brazil
ABVE	Brazilian Association of Electric Vehicles
ADAP	Association of Automobile Dealers of Panama
AEA	Argentine Electricity Association
AEADE	Association of Automotive Companies of Ecuador
AECID	Spanish Agency for International Development Cooperation
AEDiVE	Spanish Business Association for the Development and Promotion of Electric Vehicles
ALAMOS	Latin American Association for Sustainable Mobility
AMEGUA	Association of Electric Mobility of Guatemala
AMIA	Mexican Association of the Automotive Industry
ANDEMOS	Colombian Association of Motor Vehicles
ANETA	Automobile Club of Ecuador
APVE	Paraguayan Association of Electric Vehicles
ASOMOEDO	Dominican Electric Mobility Association
ASOMOVE	Costa Rican Association of Electric Mobility
AUDER	Uruguayan Association of Renewable Energies
AVEC	Association of Electric Vehicles of Chile
BNEF	Brazilian National Development Bank
BRT	Bus Rapid Transit
CA	Alternating Current
CAF	Latin American Development Bank
CB	Black carbon
CD	Direct Current (DC)
CDMX	Mexico City
CH_4	Methane
CMNUCC	United Nations Framework Convention on Climate Change
CO_2	Carbon Dioxide
FIA	International Automobile Federation
GEI	Greenhouse gases
$GtCO_2e$	Giga metric tons of Carbon Dioxide Equivalent
Hz	Hertz
ICCT	International Clean Transportation Council
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
km	Kilometer
KWh	Kilowatt-hour
LAC	Latin America and the Caribbean
NDC	Nationally Determined Contribution
ODS	Sustainable Development Goals
WHO	World Health Organization
UN	United Nations
UN Habitat	United Nations Human Settlements Programme
PM	Particulate Material
UE	European Union

Prologue

UNITED NATIONS ENVIRONMENT PROGRAMME.

Latin America and the Caribbean is one of the most urbanized regions on the planet. The fast growth of the urban population that began in the 1950s has posed a series of environmental challenges, among them rising temperatures and air pollution, which affect human health and upset the balance of the most fragile ecosystems.

In the region, about 100 million people reside in areas with poor air quality. Most live in cities, where ground transportation is a major source of pollution. If we do not take action to change the current course, this problem could worsen in the coming decades, especially considering that in the next 25 years the region's car fleet could triple to over 200 million units by 2050, according to the International Energy Agency.

The decarbonization of transport through the deployment of electric mobility emerges as an effective solution to transform the sector, improve the quality of life in the region, protect human health and contribute to the fulfillment of the climate commitments made by the countries under the Paris Agreement. In 2020, the population confinement measures dictated to confront the COVID-19 pandemic triggered visible improvements in air quality in the region. These effects are by no means promising, as they are only due to a temporary slowdown in the economy and daily activities.

In the long term and on a lasting basis, Latin America and the Caribbean has the opportunity to drastically reduce transport emissions and improve urban air quality through the transition to electric mobility, a transformation that is largely made possible by the region's high renewable energy generation matrix. In recent years, Latin America and the Caribbean has stood out for its interest in the deployment of electric mobility and for the progress made by several countries in developing regulations and implementing pilot projects.

This report, the third in this series, compiles regional progress on urban transport electrification in 2019 and gathers relevant information and progress from different nations. Beyond what can be expressed with figures, important qualitative advances stand out: innovation processes in both technological elements and business models, financial structures and contracts that promote transport electrification. Given the great challenge posed by this transition, the countries of Latin America and the Caribbean are looking for ways to move forward at a steady pace. We hope that this report will serve as a source of inspiration for decision-makers, who today have the opportunity to " rebuild better" after the COVID-19 pandemic and to invest in their citizens' health and clean development in their countries' economic recovery plans.

Leo Heileman
REGIONAL DIRECTOR FOR THE UN ENVIRONMENT PROGRAMME
IN LATIN AMERICA AND THE CARIBBEAN

Prologue

MINISTRY OF THE ENVIRONMENT OF CHILE AND PRESIDENCY OF THE COP 25

The increase in the world's population and its concentration in cities has had various impacts on the environment. One of the most relevant is the emission of greenhouse gases and its consequent impact on the climate system due to transport.

With 80% of its population living in urban areas and 15% of Greenhouse Gas emissions coming from that sector, Latin America and the Caribbean needs to move towards more efficient, but also clean, transportation. This will also allow it to respond to the health problems associated with air pollution, which today claims the lives of 300,000 people a year in the region.

There is progress, but it is imperative to accelerate the "green" transformation of cities and transport systems in Latin America and the Caribbean. This transition will bring several benefits, such as reducing pollution and vehicular congestion in cities, encouraging the development of renewable energies, exploiting and generating competitive advantages and finally, increasing the well-being of the entire population.

As the COP 25 Presidency, we believe that in order to achieve what science asks of us and to have greater ambition, it is necessary to bring new issues, new actors and more sectors to climate action and transport, and particularly electromobility, can play a leading role. An example: each electric bus can avoid up to 60 tons of carbon emissions per year.

In Chile we are opting heavily on electric mobility. Since 2019, we are implementing the National Electromobility Strategy. In the same way as countries such as Colombia, Costa Rica and Panama, this long-term public policy aims to promote efficient energy use in the transport sector to reduce its effects on the environment and to reduce dependence on fossil and imported fuels and the implicit vulnerability of this situation.

Our goal is 100% electric urban public transport by 2040 and by 2022 to have 10 times more electric cars than today, milestones that will be key to being able to contribute to achieving the commitment of reaching carbon-neutrality by 2050, in line with what science has required to achieve the objectives of the Paris Agreement. But we know that it is not only Chile that is transforming towards electromobility and that Latin America and the Caribbean have taken substantive steps in that direction.

This report from the United Nations Environment Programme, the third in this series, demonstrates this, compiling the region's progress in the electrification of urban transport in 2019, a decisive year in the positioning of Latin America and the Caribbean as a pioneering region in the deployment of electric mobility, especially in the development of regulation and the implementation of pilot projects. Our region already has 6000 light-duty electric vehicles; 11 countries have established some kind of electric corridor; and 13 countries are preparing electric bus public transport systems, among other remarkable figures.

There are undoubtedly challenges in terms of infrastructure, charging network or electro-corridors and the standardization of the technologies used, but today the region shows innovation processes in technologies, business models, financing mechanisms and contracts that allow us to say that electromobility is here to stay.

These efforts are not limited to action in the national territories. We recall that a group of countries in our region has expressed interest in and commitment to making progress in this matter at the multilateral level. In 2019, we achieved the approval of a resolution on sustainable mobility at the Fourth Session of the United Nations Environment Assembly, which we promoted thanks to the joint work with Argentina, Costa Rica and Peru. This is a first step to highlight the region as a leader in international electric mobility.

We are at a transcendental moment to consolidate that path. The COVID-19 pandemic has shown that confinement throughout the region has exponentially improved the air we breathe, however, this is only a momentary effect and when the crisis is overcome, countries will be faced with the harsh economic impacts already predicted and will have to decide whether to return to the old productive systems or opt for a clean, green and sustainable recovery.

In Chile, we believe this is the path and the decarbonization of transport can play a fundamental role. The United Nations Environment Programme's report "Zero Carbon Latin America and the Caribbean 2019" anticipates this. By decarbonizing the energy matrix and electrifying the entire transportation system by 2050, the region could avoid 1.1 billion tons of CO2 and save 621 billion dollars per year, savings that would include reductions in expenses related to ground transportation, electricity and health by reducing air pollution in cities.

Today we have the opportunity to choose a clean transport, which allows us to achieve the goals of reducing emissions and carbon-neutrality that contributes to a pollution-free environment and substantially improve the quality of life of our citizens in Latin America and the Caribbean.

Carolina Schmidt Zaldívar
MINISTER OF THE ENVIRONMENT OF CHILE AND PRESIDENT COP 25

Prologue

EUROPEAN COMMISSION

Climate change is one of the greatest challenges we must face in our time, and there is no doubt that transport is a critical sector for addressing this challenge. In the European Union alone, road transport contributes around 20% of greenhouse gas emissions. These emissions must be reduced by more than two thirds if we want to achieve the agreements registered in the European Union's Climate and Energy Framework 2030.

However, beyond the regional goal, the need for a global approach that, through collaboration and support among nations, leads to joint comprehensive solutions is becoming increasingly clear. In this year 2020, we are facing a triple crisis, health, economic and climate, which gives us the opportunity to tackle them simultaneously in order to accelerate systemic change towards a green economy, anchored in nature-based, zero-emissions, resilient and oriented towards public good and job creation. Decision-makers' responses must be guided by science, include a long-term vision and leave no one behind. Otherwise, the conditions that created the pandemic, economic recession and climate change may be accentuated and perpetuated.

At a time when the world is at a critical point, moving into uncharted territory, Europe has pledged to lead global efforts to intensify climate action. To this end, the European Union is already taking steps to make Europe carbon neutral by 2050, following the path set out by the European Green Deal.

The European Green Deal is the EU's strategy for green growth, whereby the continent will achieve zero net GHG emissions by 2050, decouple economic growth from resource use, and leave no person or region behind. The EU is also increasing its climate ambition through policy reforms and by setting a target of 50% GHG emission reductions by 2030. The European Green Pact focuses on (i) the decarbonization of the energy system, with an emphasis on energy efficiency and an energy sector based on renewables energies; ii) the establishment of an action plan based on a circular economy for industries to reduce waste and promote sustainable products; iii) renovation of public and private buildings to increase energy efficiency; (iv) reorientation of transport towards intelligent and sustainable mobility; (v) development of the farm-to-fork strategy to create a more sustainable food system; (vi) development of a biodiversity strategy to protect and restore ecosystems. In addition, it will carry out green funding and investment initiatives and develop mechanisms to ensure a just transition to carbon neutrality.

Europe's commitment and the strength of the European Green Pact goes beyond our borders and includes our international partners, with whom we will strengthen our climate diplomacy efforts and build regional and global alliances to accelerate the transition to decarbonization.

Launched in 2010, EUROCLIMA is the EU's main regional climate change programme in Latin America. It provides financial and technical cooperation in the region. EUROCLIMA+ focuses mainly on supporting countries to renew and achieve their Nationally Determined Contributions, that is, their emission reduction commitments under the COP21 Paris Agreement.

The transport sector represents 15% of total GHG emissions in Latin America, although under current policies it is estimated that emissions would increase by 50% by 2050. Additionally, transport is responsible for approximately half of the local pollution in the region's cities. Ensuring better air quality by switching to electric mobility can significantly improve human health and prevent deaths. For these reasons, the transport sector is a key sector to be decarbonized if the region wants to comply with its collective NDCs.

Through EUROCLIMA+, the European Union has, for example, contributed to the development of national electric mobility strategies and is helping countries to access climate financing for electric mobility. Among other initiatives, EUROCLIMA+ will keep opting on joint work and multilateralism to accelerate sustainable urban mobility solutions that encourage innovation and promote new business and job creation, while improving public health. Focusing on promoting policy dialogue and high-level regional inter-ministerial cooperation, energy, transport and environment, in order to promote the legal, regulatory and public policy frameworks necessary for the deployment of electric mobility in the region.

In order to promote this transversality, bi-regional strategic cooperation between Latin America and the European Union has been strengthened in the area of, for example, standardization and interoperability of electricity and charging infrastructure for electric vehicles. All this, with the aim of generating and exchanging knowledge and building capacities that help consolidate regional, inter-institutional and inter-sectoral decisions across the different territories.

As part of the European Union's efforts to support climate action in the region, and on behalf of the European Commission, I am pleased that the EUROCLIMA+ programme is able to present this important publication, which takes stock of electrical mobility in the Latin American region, as well as providing recommendations that contribute to the electrification of the transport sector, in a manner consistent with the decarbonization goals in Latin America. Likewise, the document presents business models currently operating in the region; summarizes the public policy instruments and laws put in place by the different countries, and shows us the different educational and training alternatives that are emerging, as well as the involvement of citizen associations, key actors in the collection of information for this report. Therefore, the report is presented as a very useful tool to know the range of possible policies to carry out the electrification of transport, especially road transport, as well as to find success stories in this regard and learn from the experiences of other countries.

Jolita Butkeviciene
DIRECTOR OF DEVELOPMENT AND COOPERATION
IN LATIN AMERICA AND THE CARIBBEAN

Content

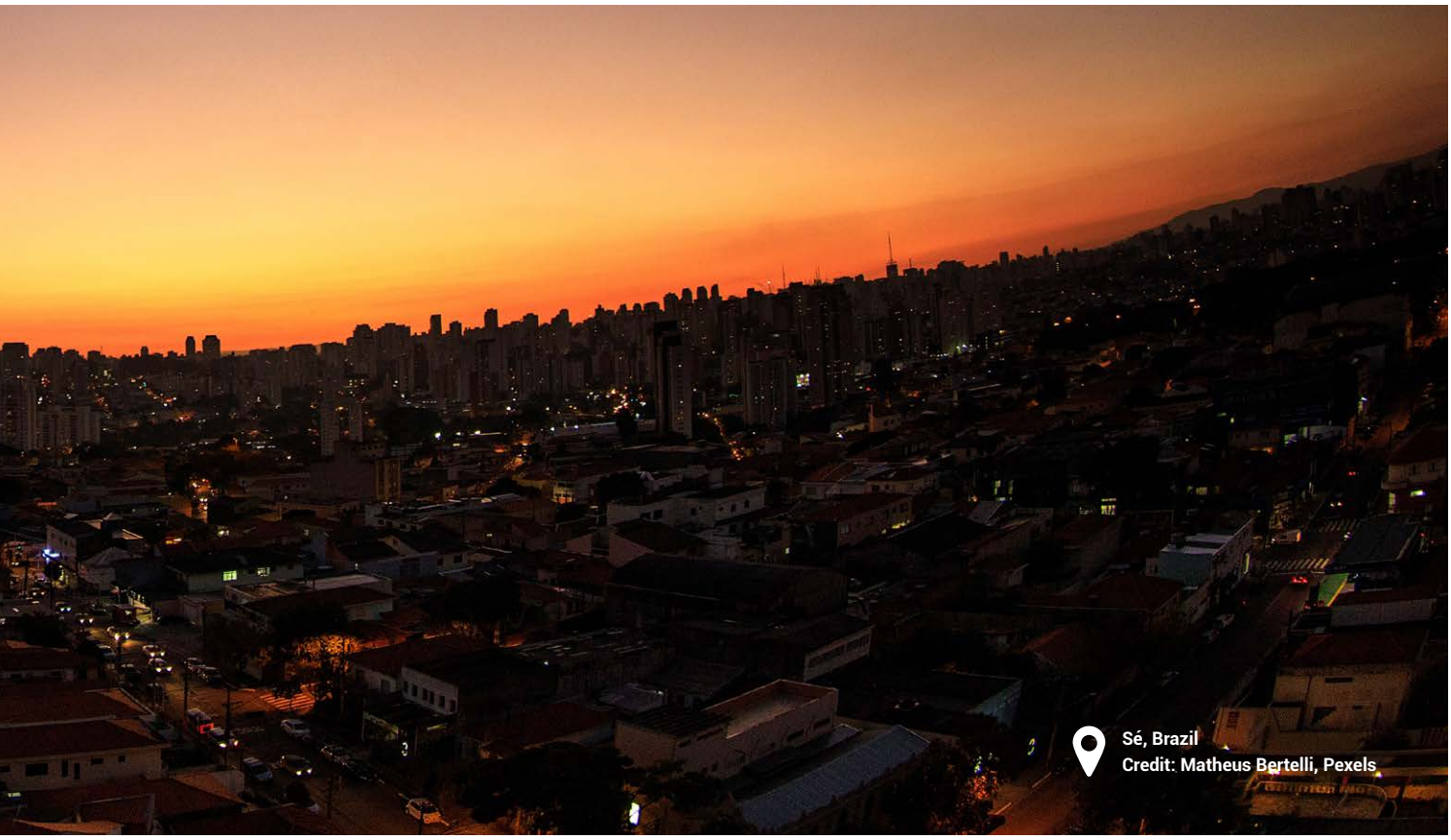
Click on the map to see the data for each country

EXECUTIVE SUMMARY

This is the third edition of the regional report on electric mobility in Latin America and the Caribbean, for the year 2019, developed by the MOVE platform of the United Nations Environment Programme (UNEP) Office for Latin America and the Caribbean, with financial support from the European Union (EU), through the EUROCLIMA+ Programme, the Spanish Agency for International Development Cooperation (AECID, by its Spanish acronym) and the multinational company Acciona Energía. This report seeks to provide an assessment of the status of electric mobility in the region. And at the same time, based on the findings, offer recommendations to tune the development of this technology with the context and opportunities that arise in the region, so that it can generate the greatest amount of integrated benefits.

One of the main findings of this report is the growing interest of citizens in the adoption of clean technologies. Given the high percentages of renewable energy, rapid urbanization, heavy use of public transport and high levels of pollution in the region, the transition to electric mobility powered by clean energy is beginning to generate growing interest among governments, but also among citizens. Beyond the electric rail transport systems (metro, trains and trams), which this study does not focus on, the emergence of various associations coming from civil society dedicated to this sector and formed by enthusiasts, early adopters and entrepreneurs is noted. So much so that this year the report is largely based on data on the progress of mobility in several countries of the region provided by these associations.

On the legislative and legal framework side, it can be seen that the different countries of the region follow different strategies to integrate electric mobility into public policy. In some cases, progress has been made in a complete legal framework, with comprehensive laws that are in development phase or already in force. In other cases, there is a national mobility strategy that will govern legislative developments and short-, medium- and long-term goals, and serve as a basis for the future formalization of a comprehensive legal framework.



Sé, Brazil
Credit: Matheus Bertelli, Pexels

All the countries analyzed have, to a greater or lesser extent, economic and non-economic instruments to encourage the import, purchase, use, etc., of electric vehicles, some in the design phase and others already in operation.

It is important to highlight the leadership of the cities in the development and implementation of this technology. It is a fact that several of the region's large cities set the pace for their respective countries, moving from pilot projects to the introduction of large numbers of buses and other means of public transport in their fleets. Likewise, it is in the cities where the dissemination of alternative transport such as scooters, bicycles or electric motorcycles is most intense. In addition, there is a clear proliferation of charging points in many countries of the region, as well as the emergence or expansion of charging corridors that allow covering long distances and that encourage the acquisition and/or use of electric vehicles by their citizens. There is also a strong potential for replication between certain countries, as well as the possibility of development of markets based on elements linked to electric mobility, such as primary components, batteries or vehicle manufacturing. On the other hand, there is evidence of the emergence of new ventures and business models. In some cases, these new entrepreneurs serve as a spearhead for accelerating the adoption of this technology and for the creation of legislation that is well adapted to it. It is also important to highlight the emergence of educational and training programs that will make possible the systemic implementation of electric mobility.

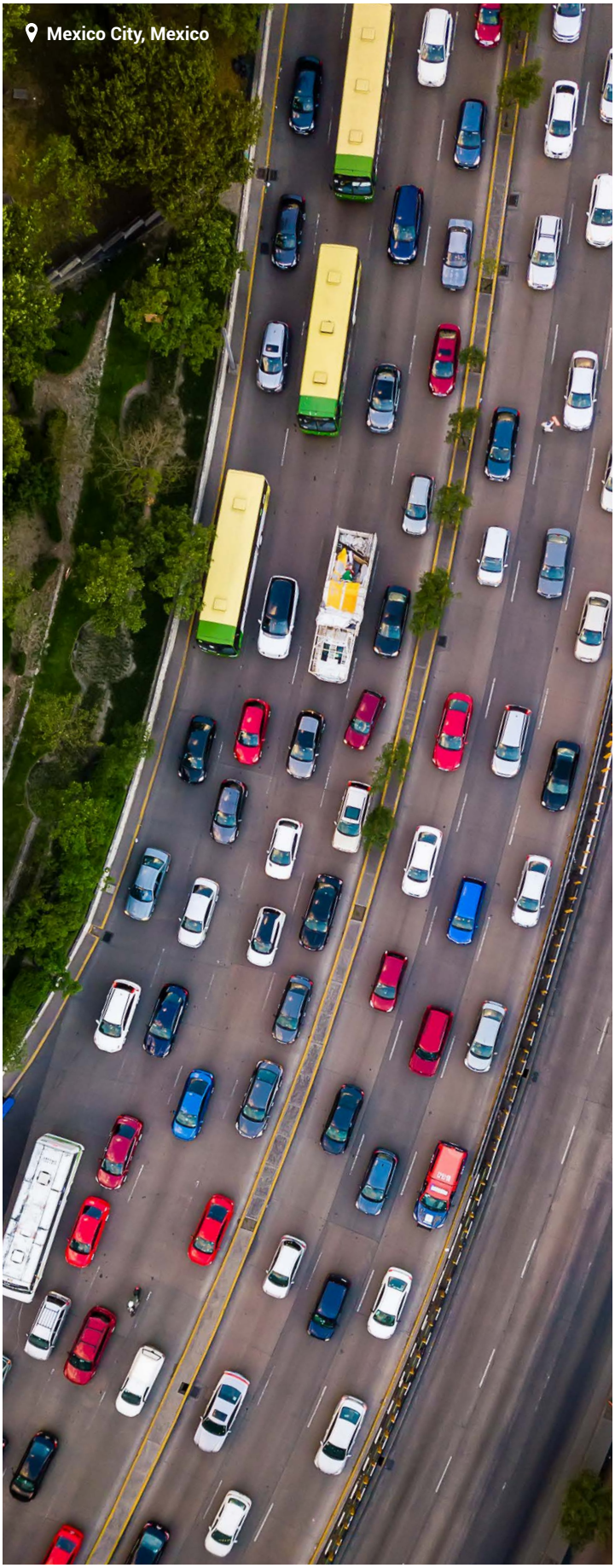
This report presents these findings and statistical data in more detail for the 20 countries studied. Based on all this data, it provides a series of recommendations for accelerating this transition, taking advantage of the opportunities it presents, and doing so in an environmentally friendly manner and in line with the region's greenhouse gas and pollution reduction needs.

Introduction

Electric mobility is beginning to spread as an alternative to internal combustion vehicles due to the pollution levels they generate in cities and the fact that they are one of the main emitters of greenhouse gases into the atmosphere. The Latin American and Caribbean region is making progress in including this type of vehicle in transport fleets, since it has developed policies to promote and facilitate their penetration, and has expanded the charging infrastructure that allows the implementation of this type of technologies on a massive scale.

The transport of both passengers and goods is basic to the development of the region. However, it is necessary to develop sustainable transport respectful with the environment and with the health of the citizens. To achieve this, it is necessary to couple the decarbonization of the transport sector and the electricity generation sector, in order to promote greater integrated benefits. Hence the importance of setting and monitoring ambitious short, medium and long-term goals that include electric mobility as a key sector for decarbonization.

This report shows the current situation of 20 countries in Latin America and the Caribbean, from a quantitative point of view, showing the levels of penetration of different modes of transport, public and private, and the associated charging infrastructure; as well as from a qualitative point of view, explaining the policies and programs that are being applied or developed in the region, including the goals set and the trends coming from civil society.


Mexico City, Mexico

Background

Latin America and the Caribbean have one of the highest urbanization rates in the world [7]. This, combined with its high rate of motorization, growing population and increasing mobility rates and transport of goods, makes transport responsible for 22% of emissions of short-lived climate pollutants in the region. According to the Zero Carbon 2019 study, it is estimated that transport accounted for 15% of greenhouse gas emissions in 2018. Therefore, it is shown that transport electrification would bring important benefits in terms of health and climate change mitigation. The region has enormous potential for the development of electric mobility due to the high penetration of renewable energies in the electricity matrix and the interest in reducing dependence on hydrocarbons for the operation of the transport sector.

In this way, the electrification of mobility would contribute to the achievement of a good number of Sustainable Development Goals, directly or indirectly, including: Health and Wellness, Sustainable Cities and Communities, and Climate Action, among others. Below, several areas are listed where transport electrification would bring major benefits both in terms of health, environment, as well as new development and market opportunities.

Improving air quality

Electric mobility technologies involve a powerful tool to fight against the negative impacts on public health generated by air pollution. As already reported in the 2018 Report on Electric Mobility [8], much of this pollution comes from emissions generated by transport, which entails high public health costs for States. According to the WHO, 9 out of every 10 people in the world breathe highly polluted air [9], which increases the incidence of cerebrovascular and respiratory diseases, causing more than 300,000 deaths in the American continent [10].

Table 1 shows the estimated integrated benefits that would result from the gradual electrification of transport in 5 cities in the region until it reaches 100% by 2050.

Table 1.

Estimation of benefits

of the electrification of 100% of the transportation of selected cities, 2019-2050

	Cumulative values from 2019 to 2050				
	PM thousand tons	CO_2 million tons	BC thousand tons	CH_4 thousand tons	Avoided deaths
Cali	29,0	214,3	15,5	577,8	24.664
CDMX	142,6	818,8	78,0	650,3	180.117
Buenos Aires	82,8	343,1	43,3	342,7	207.672
Santiago	27,7	99,9	13,9	262,9	13.003
San Jose	23,5	101,8	12,4	77,0	9.923
Total	**305,6**	**1.577,8**	**163,1**	**1.910,8**	**435.378**

* Estimates made by UN Environment through the Methodology through the evaluation of integrated benefits of electric mobility policies, carried out by the Clean Air Institute (2019). The estimates assume a gradual electrification of 50% of transport in these cities for the year 2030, reaching 100% by 2050.

Santiago, Chile
Credit: MTT Chile (2019)

Modernize public transport

A good number of cities in Latin America and the Caribbean have public transport fleets of a certain age with internal combustion engines, which causes high levels of pollution and high levels of greenhouse gas emissions. In addition, the region has high rates of urbanization and intensive use of public transport, making this sector a perfect candidate for electrification.

However, it is important to highlight the region's efforts, especially at the city level, to carry out a multitude of pilot projects spread throughout the continent, in order to gain experience and prepare to integrate electric means of transport into public transport fleets. For this reason, many cities are starting to include large numbers of electric buses in their fleets. This process should be accompanied by friendlier urban models focused on pedestrians and bicycles.

Despite these efforts, it is worth noting the need for increased ambitions to reduce CO2, as well as to accelerate the transition to electric mobility in public transport. It is key to avoid the technological blockage resulting from the inclusion of internal combustion vehicles that will remain in circulation for an average of between 7 and 15 years, with the consequent consequences for greenhouse gas emissions and public health.

Promoting innovation ecosystems

The electrification of transport involves an opportunity for the creation of new business models in many areas, from digitalization to vehicle production, through maintenance, optimization and many others. This technological revolution entails the creation of jobs linked to the automotive, energy and information technology sectors, which, together, can generate synergies that accelerate the decarbonization of the economy.

There is a growth in the number of training and education programs associated with electric mobility technologies, which shows that both industry and society are beginning to show interest in these technologies. The demand for labor trained in these matters, the innovation, as well as the extraction and manufacture of raw materials to implement this transition, are growing and will continue to grow in the coming years. Some countries in the region have a high degree

of experience and the necessary infrastructure for vehicle manufacturing which, if well exploited, could give them an advantage in the Latin American market. On the other hand, it is worth noting the abundance of mineral and other resources present in the region, required in the production of batteries and other elements linked to electric mobility. The sustainable exploitation of these resources could place the region in a competitive position in international markets for this type of raw material.

Contribute to climate action

The 2019 Emissions Gap Report points out that there is still a considerable difference of about 32Gt CO2e between the current level of ambition and the scenarios that science indicates that they could avoid the catastrophic effects of climate change reported by the Intergovernmental Panel on Climate Change [11]. Transport electrification can play a major role in closing this gap. To this end, it will be necessary to increase the ambitions and targets in the NDCs to be presented in 2020.

For this reason, it is crucial to take the "A-C-I" approach, avoid, change and improve, emphasized by the NDC Partnership. Thus, the "avoid" strategy describes measures to reduce motorized travel and its duration; the "shift" one transfers travel activity to less polluting modes of transport; and the "improve" one focuses on increasing vehicle energy efficiency and decarbonizing energy sources.

Electric mobility can be part of the three strategies through the improvement of service quality [12], the transfer of users from private to public transport (modal shift) and shared transport, and the use of more energy efficient and less polluting vehicles.

Casco Antiguo, Panamá
Credit: MiBus

Methodology

For this edition of the electric mobility report, the methodology has been modified by integrating electric and sustainable mobility partnerships in the region, from an early stage, in the process of collecting and processing information. This has allowed to feed the report with a "bottom-up" approach. Given that electric mobility is still an incipient technology and the associated sources of information are dispersed and dissimilar, the incorporation of allies with experience in the field has been especially helpful in the construction of this report. For this reason, various associations from civil society made up of enthusiasts, early adopters and entrepreneurs in the different countries included in the report were contacted.

All these associations are included in the Latin American Association for Sustainable Mobility (ALAMOS), which developed a very relevant data collection and validation work. So much so that this year the report is largely based on data provided by these associations. Next, the Center for Urban Sustainability in Costa Rica helped in processing and supplementing the information. Subsequently, electric mobility references from the private sector, governments and civil society were contacted to review the final text. Following this methodology, a representative sample of influencing actors who influence and work on policy development, technology adoption and the promotion of electric mobility in the region have been integrated.

Figure 1.

Participants

in the development of this report 2019.

ALAMOS
Asociacion Latinoamericana de Movilidad Sostenible

AAVEA · ANDEMOS · ASOMOEDO · abravei

AVEC · asomove · AEDIVE PERU · APVE · auder tomemos conciencia · e-mobility GUATEMALA

UN environment programme · move · CENTRO PARA LA SOSTENIBILIDAD URBANA · External reviewers from governments and the power sector

Co-financiers

Euroclima+ · Funded by the European Union · acciona · aecid

Main findings

Public policy and legal framework

In terms of public policy and legal framework, the countries and cities of the region have sought to guide and stimulate the development of electric mobility in various ways. Colombia and Costa Rica have comprehensive electric mobility laws in force and there are several others with initiatives underway for the formulation of similar legal instruments. Likewise, there is a wider group of countries with partial legislative or regulatory instruments, some providing fiscal and/or non-fiscal incentives, others regulate the efficiency of the vehicle fleet, and others promote the development of industries and ventures associated with electric mobility. Besides, Colombia, Chile, Costa

Table 2.

Instruments
for the promotion
of electric mobility.

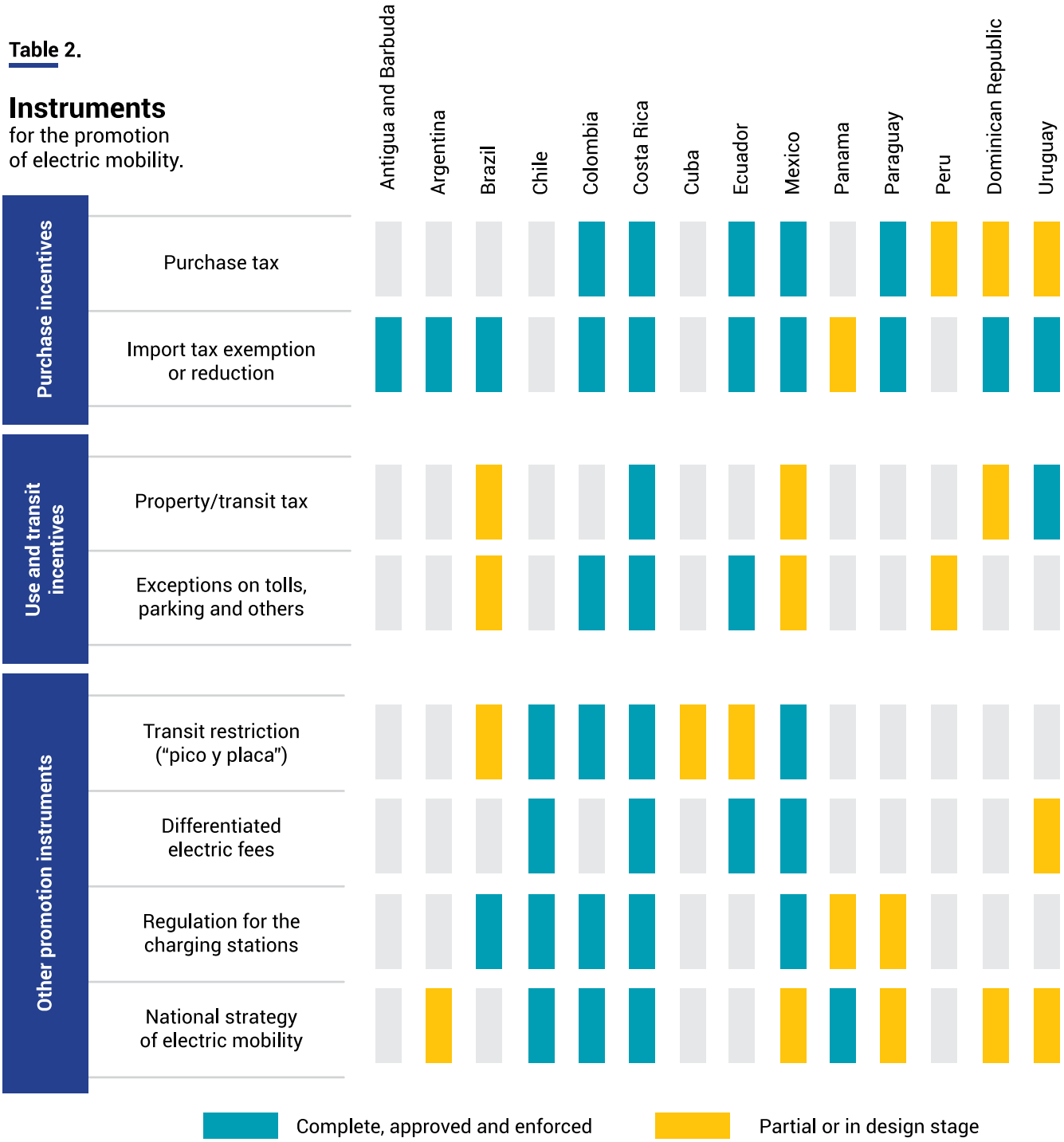


Table 3.

Goals

On electric mobility in the region.

Barbados

100% of renewable energy and carbon neutrality for 2050

Chile

100% of public transportation electrified by 2050

40% of the private transportation electrified by 2050

Colombia

600 thousand electric vehicles for 2030

Costa Rica

70% of buses and taxis with zero emissions by 2035

100% of buses and taxis with zero emissions by 2050

25% of the light-duty vehicle fleet will be zero emissions by 2035

60% of the light-duty vehicle fleet will be zero emissions, with higher percentages for commercial and governmental use by 2050

Ecuador

EVERY vehicle incorporated in the public transportation should be electric and will have preferential differentiated energy fees from 2025

Mexico

500 trolleybuses for the Zero Emissions Corridor of STE (Electric Transportation Services) in CDMX for 2024

Panama

10-20% of the total of private vehicle fleet will be electric for 2030

25-40% of the private vehicle sales will be electric for 2030

15-35% of the buses of the conceded authorized fleet will be electrified by 2030

25-50% of the public fleet will be electric vehicles for 2030

Paraguay

20% of the state vehicles will be electric by 2020

Rica and Panama already have national strategies or plans for electric mobility, while Argentina, Mexico and Paraguay are in the process of formulating and launching their own strategies. These efforts have been carried out through participatory processes with the different initiatives and actors involved to define priorities and guide the development of electric mobility and associated linkages. In this sense, it is worth noting the establishment of goals associated with the deployment of electric mobility by countries and cities, derived from the legal instruments or strategies mentioned above.

We are at an early stage to judge the impact of these public policy instruments and legal frameworks. What we can conclude is that there is no one-size-fits-all solution or approach in this regard and that there is great interest in the region to continue creating an enabling environment for the development and regulation of technologies such as electric mobility. Undoubtedly, it is worth following up on the impact of this type of instrument through periodic reviews to align the enabling environment with technological developments and the context and priorities of each country and city in the region.

Electric vehicles and charging infrastructure

According to estimates in this study, between January 2016 and September 2019, almost 6,000 light-duty electric vehicles were registered in Latin America and the Caribbean. During this period, the largest volume of these registrations has occurred in countries such as Colombia, Mexico and recently Costa Rica and the Dominican Republic. It should be noted that these estimates exclude two- and three-wheeled vehicles. In the case of Colombia, for example, 935 motorcycles were registered in 2018 and 1907 from January to October in 2019 [21].

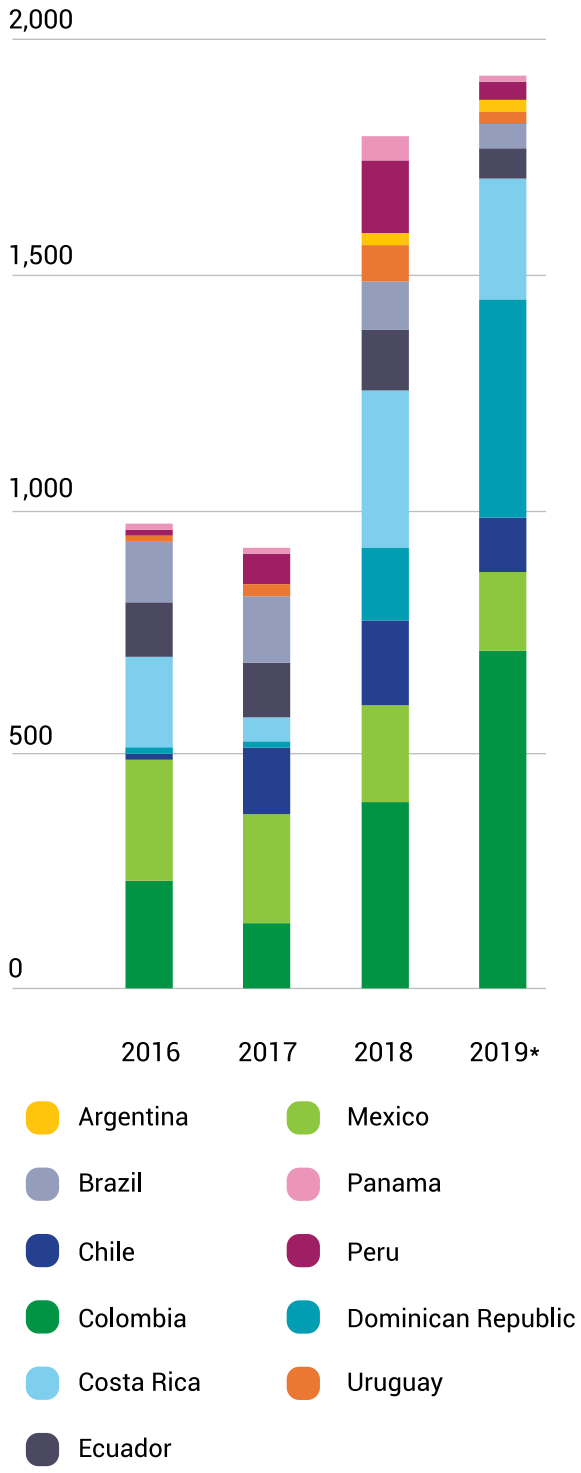
In 2019, the electrification of other segments of the transport sector, such as official fleets, delivery fleets, cargo and goods transport fleets, and public sanitation fleets, is beginning to become more evident. Most of these consist of pilot projects to evaluate the performance of the technology for subsequent scaling.

In terms of heavy electric passenger vehicle technology, it is important to note that there are some examples of continuous load vehicles such as trolleybuses in Mexico [22], Ecuador [23], Argentina [24] [25] or Chile [26], and also a hydrogen electric bus that was tested in Costa Rica [27].

However, the greatest progress is being made in battery-powered vehicles, especially with night-time charging, where three main findings are worth mentioning in relation to public charging stations. The first is linked to range anxiety. This continues to be one of the main barriers to the deployment of electric mobility and has contributed to the proliferation of charging infrastructure in the region. This development has been carried out by strategic investors such as energy and automotive companies that, in line with the global trend, have led these efforts. Examples of this are Brazil and Chile, which launched two electric vehicle corridors (also known as "electro-corridors") with approximately 730km. For its part, Uruguay was the first country in the region to install an electro-corridor.

Figure 2.

Light-duty electric vehicles
registered in countries of Latin America and the Caribbean.



* Cumulative values for September-October 2019
Source: ASOMOEDO, ANDEMOS, ASOMOVE, AMIA, AVEC, AEADE, ANETA, BNEF, AEDiVE, ADAP. Own elaboration.

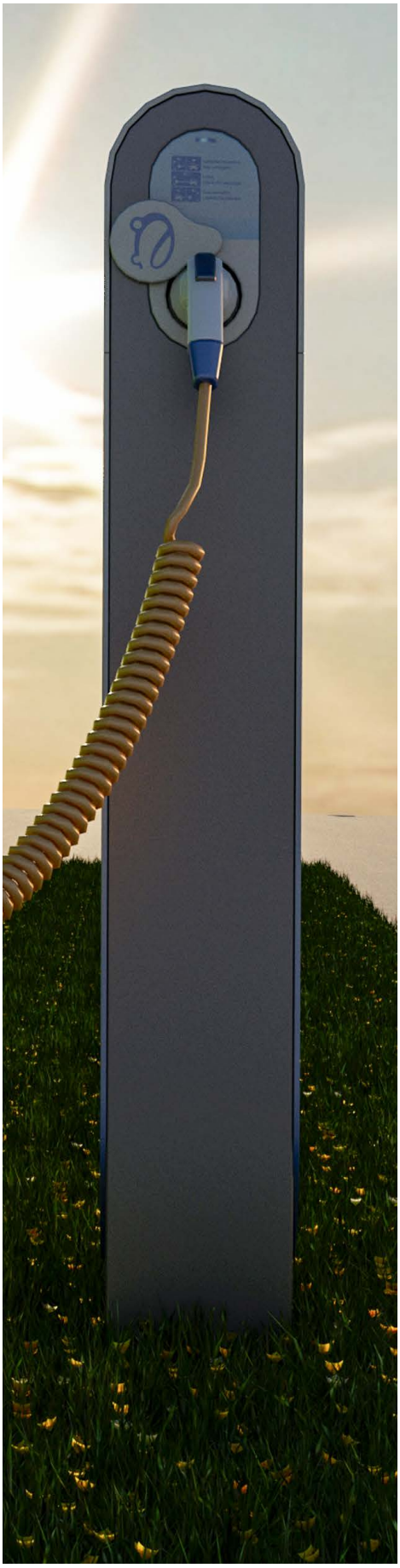


Figure 3.

Electro-corridors

for electric vehicles in Latin America and the Caribbean.

1 Mexico
- Corridor 620km S.L.Potosí-CDMX-Puebla .
- ChargeNow network with +660 charging stations.
- Tesla network with ~80 super-chargers.

2 Costa Rica
- Network of 47 DC Charging stations (4 installed).

3 Panama
- Network of 12 charging stations + solar panels (pending launch).

4 Barbados
- Network of 50 charging stations by membership.

5 Colombia
- Corridor with l5 charging stations Bogotá Medellín. (planned)

6 Brazil
- 434 km Corridor with 6 DC charging stations Rio de Janeiro-Sao Paulo

7 Uruguay
- ~30 Semi-fast charging stations network from the electricity company.
- First corridor installed in LAC.

8 Chile
- Corridor from Marbella to Temuco 730km, operates on a fee basis.
- Corridor Temuco to Chiloé 500km + Coyhaique and Aysén 70km.

9 Argentina
- 212km corridor in the province of San Luis.
- Argentina-Chile integrated charging station in Neuquén.

Secondly, Barbados, Costa Rica, Chile and Mexico already have networks for charging electric vehicles - other countries are in the process. This type of network enables management and billing systems for charging services. However, it is interesting to highlight that, so far, few public charging stations charge for this service. This is due, on the one hand, to the fact that this type of service is still considered a way to promote technology and, on the other hand, to the existence of restrictive legal frameworks for the sale of electricity by companies or individuals outside the sector.

Finally, together with the above findings, it is becoming increasingly evident that as electric vehicle fleets and associated charging infrastructure increases, it becomes more and more relevant to promote interoperability and standardization of infrastructure, management systems and charging commercialization.

Electric public transport

Even though the electrification of public transport in most countries is in the pilot phase, in other countries it is already in an incipient phase of deployment, with this segment being the one electrifying at the highest speed. Decision makers continue to promote the transition to zero-emission public transport. The downward trend of electric bus prices, as well as growing concern about the health and environmental impacts of emissions from combustion vehicles in cities, are the main drivers of this transition. In terms of electric buses, Chile stands out in 2019 for the implementation of the first 100% electric public transport bus route [28]. In this sense, Chile also stands out as the country with the largest number of electric buses in Latin America and the Caribbean - 386 units, most of which are in the city of Santiago. Colombia announced the award of 379 electric buses for the city of Bogotá and already has fleets in operation in other cities [29]. In the Caribbean, several countries have expressed interest in electrifying public transportation. Antigua and Barbuda have a pilot project for student transport and Barbados has launched a tender for the purchase of electric buses. As of the date of publication of this document, the number of electric buses awarded is unknown.

In terms of electric taxis, like electric buses, most implementation cases consist of pilot projects. However, the Dominican Republic stands out with the introduction of a fleet of 200 electric taxis by the Unified Transporters National Central (CNTU, by its Spanish acronym) [30][31].

Santiago, Chile
Credit: Marcela Castillo

Figure 4.

Electric buses (e-buses)

in Latin America and the Caribbean.

In operation

Planned or in bidding process

0 — 400

1. **Mexico** is preparing tenders and studies in Guadalajara, Monterrey, CDMX and Hermosillo.
2. **Costa Rica** has 2 demonstration e-buses and 3 more e-buses on the way.
3. **Panama** is testing its second e-bus on commercial routes.
4. **Barbados** has launched a tender for the purchase of e-buses, which is in the process of being awarded.
5. **Antigua & Barbuda** acquired 2 e-buses for a student transport pilot.
6. **Colombia** has pilots in Medellin (64), Cali (26) and soon in Bogota (379).
7. **Ecuador** introduced 20 e-buses in Guayaquil, plus 3 pilot e-buses in Quito.
8. **Peru** has 4 eBuses that have been tested in the city and in a mine at 4000 meters.
9. **Brazil** produces e-buses in Campinas and has pilots in Sao Paulo (15), Campinas (13), Rio de Janeiro 2018 (3), Brasilia (2), Salvador de Bahia (1) and Belo Horizonte (1).
10. **Chile** has +386 e-buses in operation and the first 100% electric bus corridor.
11. **Paraguay** has 20 e-buses.
12. **Argentina** has pilots in Mendoza (12), Buenos Aires (2) and Santa Fé (2).
13. **Uruguay** has 2 e-buses.

For its part, shared mobility through electric bicycles and scooters has had an accelerated deployment in the region. There are nine countries in the region with services of this type, all located in major cities and usually have digital platforms to manage their operation and payment. Although in some cases, the electrification of shared mobility has emerged as a complement to existing systems, most emerge as new ventures by the private sector. This presents a great opportunity for cities to make a transition to more sustainable modes of mobilization for both their inhabitants and visitors.

It should be noted that these implementation processes must be complemented by infrastructure that is accessible and secure for all users, with special attention to the most vulnerable populations. Regulatory frameworks must also be generated to ensure that their adoption promotes sustainability in cities, in accordance with the proposed Sustainable Development Goal of sustainable cities and communities (ODS 11).

Figure 5.

Shared electric mobility

through electric bikes or scooter services has had an accelerated growth in the region.

Countries with shared electric bikes or scooter services

Characteristics of shared electric mobility systems (micro mobility)

1. Use digital platforms
2. Attend short trips
3. Can be parked anywhere
4. They present new challenges for the authorities and the citizenry
5. Electrification of bicycles to extend the service of existing shared systems
6. Charging the batteries generates new business opportunities

Citizen participation, education and business

The transition to clean mobility cannot be a step only led by governments. Although policies and mechanisms for promotion and financing provided by States have a crucial weight in the development of electric mobility, there are other factors and actors with great influence and potential to accelerate this transition.

In this sense, the role of civil society groups related to electric mobility stands out. In many Latin American and Caribbean countries, we find the existence of this type of groupings dedicated to promotion, education, information exchange, or policy development, among others. These partnerships demonstrate the importance of reaching a social consensus that accelerates the implementation of electric mobility in the region. The development of local and national events such as mobility fairs, discussion forums on the transition and electric mobility, talks between users and potential buyers, etc., show the interest of the region to learn, discuss and implement this type of technology. It is of great importance that civil society and the private sector participate, thus bringing together the different points of view of consumers, manufacturers, maintenance personnel, cargo infrastructure personnel, electrical companies, as well as the financial and insurance sectors. It is also significant to note the existence in countries like Barbados, Colombia, Ecuador, Costa Rica and many others, of collaborations with banking and insurance institutions, to finance the installation of charging stations, the purchase of private vehicles or the electrification of the public fleet. The incipient introduction of electric vehicles in the commercial fleets of companies is also observed, as well as the collaboration between electric, automotive or financial companies with the public administration, to promote and implement projects that help to measure the costs and benefits of this transition. The collaboration and coordination of all these actors in promoting electric mobility initiatives, such as the Electromobility Consortium created in Chile, should also be highlighted [32]. Finally, it is important to emphasize the creation of educational and professional programs, which are key to establishing and maintaining technology in the long term. Some countries such as Brazil, Chile, Costa Rica, Ecuador and Peru already have educational and training programs that range from seminars to technical, undergraduate and graduate degrees. This is clear evidence of the potential for employment generation that will result from the adoption of electric mobility technologies.

Bogota, Colombia
Credit: Carlos Bolívar (2011)

Progress in electric mobility in the region

The Latin American and Caribbean region faces similar challenges and opportunities despite a wide diversity of economic and social conditions. In any case, this heterogeneity defines the potential, breadth and scope of electric mobility and its future opportunities in each country. Below is evidence of the progress that is taking place in a wide range of countries in the region.

Antigua and Barbuda

Public policy and legal framework

The Antigua and Barbuda Sustainable Energy Action Plan mentions the use of incentives and communication campaigns to promote hybrid, electric and other low-carbon fuel vehicles as one of its main lines of action [33]. The plan also foresees that from 2025, energy consumption in the transport sector will have been reduced by 40 %compared to 2010 levels.

To this end, the government enacted a Low Emissions Development Strategy for the transport sector, which prioritizes the introduction of electric vehicles. As a result of the strategy, import taxes on electric vehicles were eliminated.

Electric public transport

The country is advancing in a pilot project to introduce two electric buses for the transport of schoolchildren [34]. Likewise, different types of vehicles that are part of the government's institutional fleet will be being tested [35]. This project seeks to evaluate the technology and its adaptability to conditions in Antigua and Barbuda, as well as to provide visibility and familiarize the population with the technology.

Antigua and Barbuda launched in early 2020 a call for expression of interest for the introduction of electric buses and charging infrastructure.

Argentina

Public policy and legal framework

Argentina has worked on public policies and specific regulations on electric mobility at the national and provincial levels. Currently seven different projects are pending discussion in order to advance in the

Antigua and Barbuda.
Electric vehicle photo by Health Watch Antigua & Barbuda [41]

formulation of a national legislation on the matter. In May 2019, Argentina hosted the first Latin American Legislators' Forum on Electric Mobility, held in the National Congress, with the participation of more than 20 people and legislative representatives from nine Latin American countries [36].

At the national level, Argentina is working on the elaboration of its National Electric Mobility Strategy [37]. On the other hand, the Transit Law was modified by Decree 32/2018, which highlights the incorporation of definitions and categories of vehicles with electric and hybrid motors according to their capacity (in kW), with emphasis on the requirements for their homologation [38]. Likewise, Decree 26/2019 modified the classifications of driver's licenses to include vehicles with electric motors [39]. Decree 331/2017[1] was repealed by Decree 230/2019, extending the reduction of the import tariff that was previously only granted to automotive companies based in the country to also include importers of vehicles manufactured abroad, directly affecting 6,000 vehicles for 3 years [40]. Decree 51/2018 establishes a tariff reduction for the import of electric buses of a maximum of 350 units for a period of 36 months, as well as up to 2,500 charging stations of power greater than or equal to 50kW [41].

At the provincial level, Santa Fe has Law N. 13781 to promote the industrialization of electric vehicles and technologies linked to alternative energies [42]. There are also bills in the province of Buenos Aires, the Autonomous City of Buenos Aires and the province of Neuquén, among others.

The Autonomous City of Buenos Aires approved legislation regulating the use of electric scooters through an amendment to the Traffic and Transport Code. Such law establishes a series of safety requirements, a maximum power of 500W and a speed limit of 25km/h. It also prohibits circulation on sidewalks and defines 16 years as the minimum age for their use [43]. For its part, the Argentine Institute for Standardization and Certification established IRAM 60020, which defines safety requirements for bicycles with electric pedal assistance [44].

Province of Neuquén, Argentina.
Inauguration of public charging station in the province of Neuquén
Credit: Neuquén Informa. Government of Neuquén Province [50]

1. Decree 331/2017 reduced the import tariff from 35% to 5% for plug-in hybrid and conventional vehicles. 2% for electric or fuel cell vehicles. This decree came into force in May 2017, for a period of thirty-six months, a maximum quota of six thousand vehicles and was restricted to companies in the automotive sector that were based in Argentina. [338] To date, has been observed the entry of conventional hybrid vehicles mostly because of this benefit, reaching almost half of the total quotas and more than 90% of the quotas used.

The Autonomous City of Buenos Aires approved legislation regulating the use of electric scooters through an amendment to the Traffic and Transport Code.

In terms of electric vehicle charging infrastructure, provision 283/2019 regulates the service of electric charging at fueling stations and defines safety specifications on the installation and registration of charging stations [45]. For its part, the AEA 90364-7-722 regulation, developed by the Argentine Electronic Association, defines the basis for the standardization of electrical installations intended for charging electric vehicles [46].

Electric vehicles and charging infrastructure

By the end of October 2019, 61 electric vehicles, 34 plug-in hybrids and 3,284 conventional hybrids had been registered [47]. In terms of charging infrastructure, the country has a public and private network of over 250 charging stations. Currently, 15 different brands are commercialized in the market, which has facilitated the deployment of charging infrastructure [47].

In the province of Cordoba, the Public Services Regulatory Entity (ERSeP, by its Spanish acronym) approved a special rate for the charge of electric vehicles using time segments - the rate is limited for those who can prove ownership of an electric vehicle [48] [49].

Electric public transport

In different Argentinian cities, electric buses are operated on public transport. The Autonomous City of Buenos Aires has two buses circulating on its line 59. The city of Mendoza has the largest fleet in the country, with 18 units. In the province of Santa Fe there are two trolleybuses manufactured nationally [51]. While the city of Rosario will soon begin with the

Buenos Aires, Argentina
Credit: Dan Gold, Unsplash.

introduction of two buses within its public transport fleet. It is estimated that a total of 22 electric buses will be circulating on Argentine roads by the end of 2019 [47].

Citizen participation, education and business

In terms of citizen participation, the work of the Argentine Association of Electric and Alternative Vehicles (AAVEA, by its Spanish acronym), made up of businessmen and professionals linked to this sector, stands out. AAVEA has played an active role in the formulation and review of regulations and legislation associated with electric mobility, as well as in information collection and the strengthening of capacities [52]. Although Argentina stands out for its automotive industry, its production of electric vehicles is still incipient. Currently, two brands of nationally produced electric vehicles are commercialized, Sero Electric [53] and Volt Motors [54] – both weighing less than half a metric ton.

In the area of education and training it is interesting to highlight the ninth edition of the ECO CHALLENGE [55], a competition of more than 1,000 students from technical schools throughout the country to encourage research into alternative, non-polluting transport systems, to design, produce, test and share using new technologies.

Barbados

Public policy and legal framework

The government of Barbados launched its National Energy Policy for 2019-2030 with a view to becoming a carbon-neutral and 100% renewable energy country. This strategy calls for replacing the use of internal combustion vehicles in the next decade and increasing the percentage of electric and hybrid vehicles; as well as improving the efficiency of public transportation [56]. This energy policy is accompanied by an implementation plan that proposes the start-up of pilot projects with electric vehicles. [57]

Electric vehicles and charging infrastructure

It is estimated that the country already has more than 350 electric vehicles [58], including light-duty vehicles as part of the commercial fleet of several companies [59] [58].

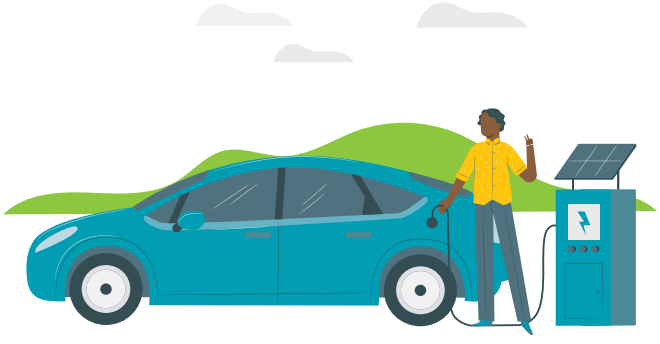
By July 2018, more than 50 charging stations had been installed (several of which are publicly accessible), including parking lots integrated with photovoltaic systems [60]. Given the size of the island, this provides a wide coverage of about "one charging station every 5km" [58]. Public charging stations available in Barbados can be used through membership and

Buenos Aires, Argentina.
Demonstration of zero emission E-Karts.
Credit: ECO Challenge YPF [55]

In the year 2019 the ninth edition of the ECO CHALLENGE was held, a competition of students from technical schools to promote research into alternative, non-polluting transport systems, to design, produce, test and share using new technologies.

Barbados.
Photograph by Joanna Edghill, entrepreneur in charge of Megapower Ltd.
Credit: Business Barbados [64]

special identification cards [61]. It should be noted that efforts to deploy electric vehicles and associated charging infrastructure in this country have been led by the private sector.



In 2018, more than 50 charging stations were installed (several of which are publicly accessible), including parking lots that integrate photovoltaic systems.

Electric public transport

In terms of public transportation, the Transportation Board has decided to modernize its fleet through electric buses [62]. At the end of 2018, a tender was launched to provide between 120 and 180 electric buses [63]. However, at the date of writing this report, it had not been awarded.

Brazil

Public policy and legal framework

The "Rota 2030" program was created in 2018 by Federal Law No. 13.755/2018 [65] and approved in 2019 by the current government [66]. Rota 2030 establishes mandatory requirements and incentives for the manufacture and commercialization of vehicles in the country for the next 15 years, including goals related to energy efficiency and investments in research and development. Decree No. 9,442/2018

modifies the Industrialized Products Tax (IPI, by its Portuguese acronym) between 7% and 18% for electric vehicles and between 9% and 20% for hybrid vehicles, depending on their weight and efficiency [67].

For its part, resolution 97/2015 reduces the import tariff from 35% to 0% for electric vehicles and fuel cells, and between 0% and 7% for plug-in and conventional hybrid vehicles, depending on the capacity of the combustion engine and whether it is imported disassembled or assembled [68]. At the state level, seven states provide full property tax exemption and another three provide partial exemption to owners of electric vehicles [69]. Senate Bill No. 454/2017 [70] which seeks to prohibit the sale of internal combustion vehicles by 2060, is currently under discussion in the Federal Senate [71].

Electric vehicles and charging infrastructure

In Brazil, 2.405 plug-in vehicles had been registered as of October 2019 [72]. The country has an electric bus assembly plant of the company BYD in Campinas since 2016 [73]. In 2019, the company Traton, a local subsidiary of Volkswagen, announced that it would begin production of buses and electric trucks at its production plant in the city of Resende, as well as the installation of battery charging and management centers [74]. For its part, the Rio de Janeiro City Council introduced nine garbage collection trucks to its fleet, making it the largest fleet so far in the region [75], [76]. Regarding charging infrastructure, this has been developed through energy distribution companies or vehicle manufacturers.The greatest growth has been in urban centers, although fast charging corridors have also been created. In the State of Santa Catarina, which already has three fast chargers between the cities of Joinville and Florianopolis, charging stations with energy storage and remote management are being tested [79]. In 2019, the electric company EDP announced the installation of a charging network of 30 ultra-fast chargers by 2022 [80].

The most extensive corridor in Brazil and in the region links the Iguazú Falls with Paranaguá (more than 700 km with 12 fast chargers). There are also others between São Paulo and Rio de Janeiro (434 km with 6 fast charging stations).

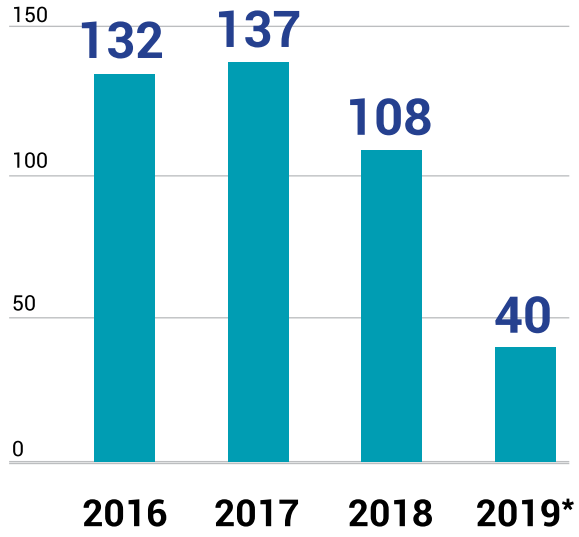
The Rio de Janeiro City Council introduced nine garbage collection trucks to its fleet, making it the largest fleet so far in the region.

Rio de Janeiro, Brazil
Fleet of eletric garbage collection trucks.
Credit: BYD [75]

In addition, the National Electrical Energy Agency (ANEEL, by its Spanish acronym) published regulatory resolution N. 819/2018, which establishes the procedures and conditions for the charging of electric vehicles by concessionaires and electrical distribution companies. Such resolution requires public charging stations to be compatible with open communication, monitoring and remote-control protocols. In addition, the resolution allows the commercialization of the charge by the distributors at freely negotiated prices [81].

Figure 6.

Ligth-duty electric vehicles
registered in Brazil from 2016 to september 2019



Source: ANDEMOS [82] and BNEF[83].

Electric public transport

In November 2019, the Sao Paulo City Council introduced 15 electric buses for public transportation, making it the largest fleet in the country now [84]. It should be added that the city of Campinas has published a tender to implement a project that involves incorporating more than 300 electric buses into the city's future BRT corridors, all within two years. Currently, Campinas has 13 electric buses in operation. The implementation of this project would be a major step forward for both the city and Brazil [85].

Several cities in Brazil carry out projects to test electric buses. For example, Salvador de Bahía has an electric bus on its public transportation lines [86]. The city of Volta Redonda, in Rio de Janeiro, incorporated three free electric buses for testing purposes [87]. Brasilia also has two buses in test phase on its public transport lines [88]. About taxis, Sao Paulo has put 15 electric taxis into operation on its streets, which have traveled over 900,000 km in two years [89]. For the Rio Olympics, eight Nissan Leaf electric vehicles were made available to the Olympic Committee [90]. These models were used as taxis, as well as in tests, by the military police and the fire department [91]. Other cities such as Campinas and Palmas are also testing electric taxis.

Citizen participation, education and business

Brazil currently has two civil associations that promote the development of electric mobility in the country: the Brazilian Association of Owners of Innovative Electric Vehicles (ABRAVEI, by its Portuguese acronym), which brings together the civil society sector, and the Brazilian Association of Electric Vehicles (ABVE, by its Portuguese acronym), which groups the private sector. Both have succeeded in organizing events to promote electric mobility at the local, state and national levels.

Regarding financing, the Brazilian National Development Bank (BNDES, by its Portuguese acronym) offers a preferential line of credit differentiated by vehicle technology, including electric buses and batteries for electric vehicles [92] [93]. On the other hand, the city of Sao Paulo participates in a regional project that seeks to promote the deployment of electric buses through the involvement and commitment of financial institutions and technology providers present in the region, as well as research into business models and financing associated with electric bus operations [94].

On the education side, some vocational education institutes have partnered with private companies to develop training programs. These partnerships aim to train the personnel needed to deal with electric vehicle technology in the future.

Chile

Public policy and legal framework

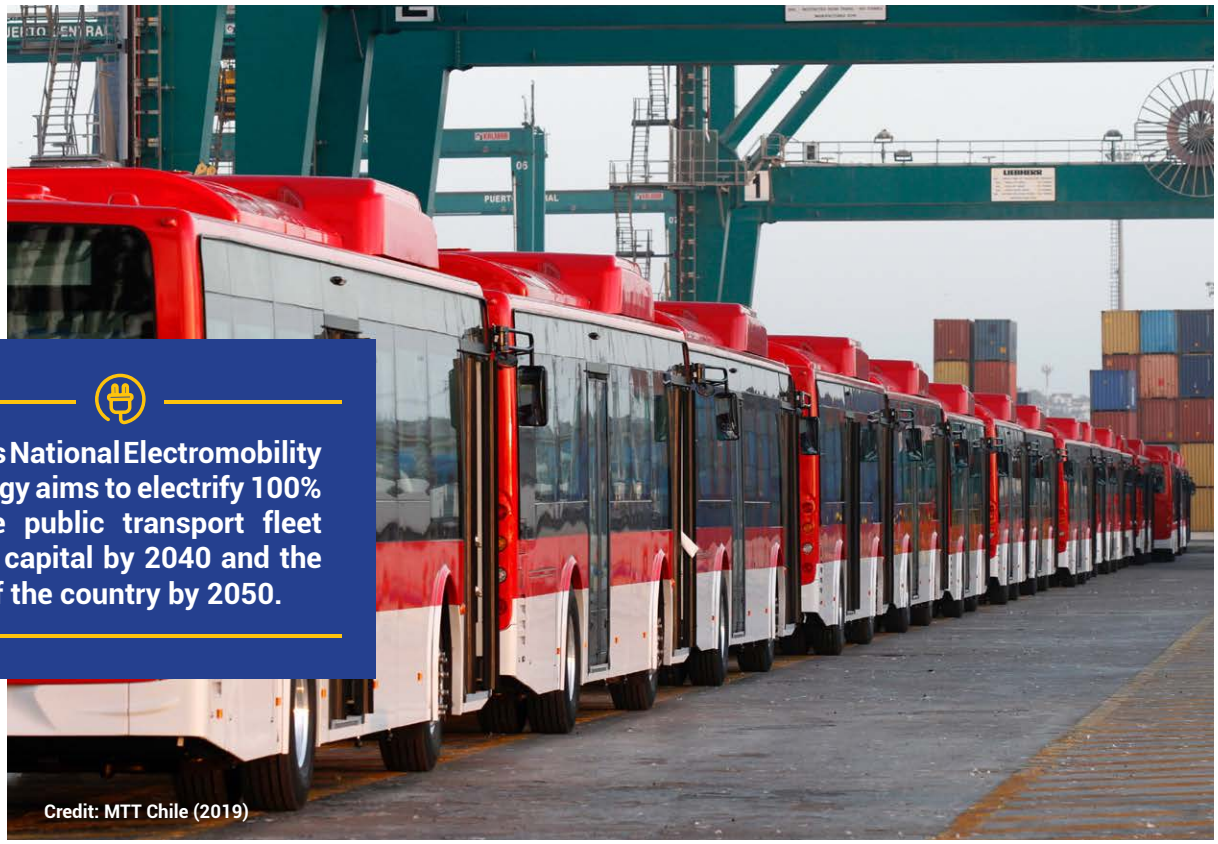
Since 2016, Chile has had its National Electromobility Strategy, which establishes five lines of action to achieve the goal of electrifying 100% of the public transportation fleet in the capital by 2040 and the rest of the country by 2050, although it could be brought forward to 2040 [95]. In addition, 40% of the private vehicle fleet is expected to be electrified by 2050 [96]. In 2018, a commitment was signed with more than 30 companies and institutions to promote electric mobility in the country [97] [98]. This commitment, which among other objectives sought to increase the number of electric vehicle chargers by five times, was reiterated in January 2020 by 54 companies.

The Ministry of Energy of Chile launched the Energy Route 2018 - 2022, which defines as one of its commitments to increase by at least 10 times the number of electric vehicles circulating in the country. Likewise, it establishes specific actions for the promotion of electric mobility in terms of regulation, standardization, research and development. In addition, this participatory process seeks to promote electric mobility in public transport fleets and intensive use fleets, as well as integration with electricity systems, among other matters. [99]

Currently, a bill on energy efficiency is being discussed in the Senate, which aims to set standards for the fleet of new motor vehicles, and also requires ensuring the interoperability of the vehicle charging system [100] [101]. From civil society, the Technical Commission of the Association of Electric Vehicles of Chile (AVEC, by its Spanish acronym), proposed a draft before five Chilean ministries with fundamental elements for the discussion of a law to promote electric mobility in the country [102].

Regarding rules and regulations, the Superintendence of Electricity and Fuels (SEC, by its Spanish acronym) issued Resolution N. 26339 to decree the procedure for the commissioning of electric vehicle charging infrastructure [103]. Likewise, the entry into force of Sheet N.15 of the SEC Technical Electrical Standard is expected, which establishes the characteristics,

Chile's National Electromobility Strategy aims to electrify 100% of the public transport fleet in the capital by 2040 and the rest of the country by 2050.



Credit: MTT Chile (2019)

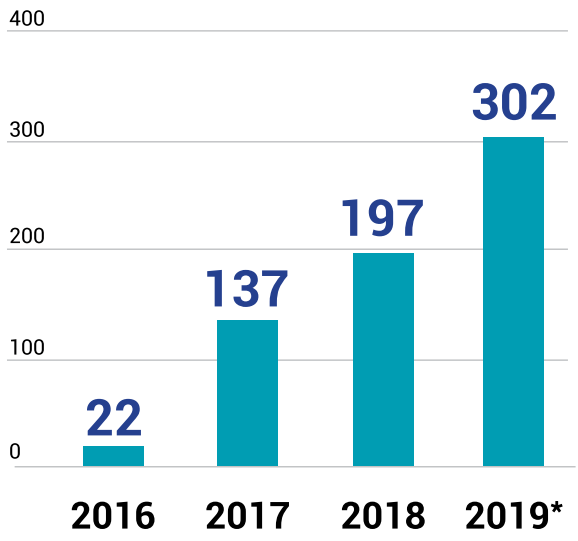
and safety and protection requirements for public, private and home charging stations, as well as their homologation and the standards to be considered in new buildings [101]. As of the writing of this report, the regulations were under public consultation.

Electric vehicles and charging infrastructure

According to Chile's Ministry of Energy, by September 2019, 677 light and medium duty electric vehicles and 86 charging stations had been registered [104]. Chile has opted for the electrification of fleets of intensive use vehicles. For example, the Municipality of Independencia incorporated 13 electric vehicles and charging stations into its fleet [105]. The Municipality of Vitacura added 15 electric vehicles for the mobilization of its employees, in addition to an electric bicycle program that was already in operation [106]. In the city of Santiago, six electric vehicles were introduced as part of the municipal fleet [107].

Figure 7.

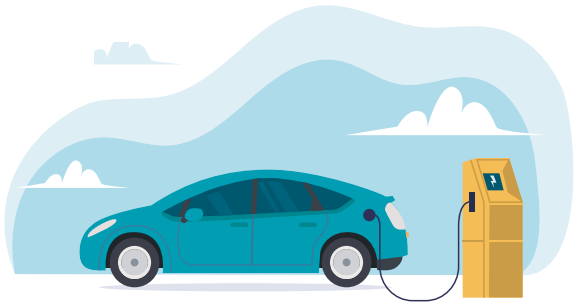
Ligth-duty electric vehicles
sold in Chile between 2016 and 2019



Source: AVEC [108].

From the private sector, electric units have also been incorporated into the transport fleets. For example, in 2017, the beverage company CCU introduced four Light electric trucks in the historic center of Santiago [109]. Meanwhile, the drinking water company Aguas Andinas launched a fleet of 23 Light electric vehicles of different capacities [110]. Other companies also offer electric vehicle acquisition programs for their collaborators.

The start-up of the charging infrastructure in Chile has been more accelerated than the adoption of electric vehicles. The country has two main fast charging corridors [108]. The first is known as VOLTEX and is located in the Central-South zone (from Puchuncavi to Concepción, in addition to the sections that connect Santiago with Valparaíso and Viña del Mar), at the moment it has 23 charging stations, located in fuel dispensing stations along 700 km [111]. This corridor is, to date, the only charging network operating with a payment system. The second corridor, located in the southern part of the country, is under construction by the electricity distribution company Grupo SAESA and will cover 1.200 km in length, connecting the regions of La Araucanía, Los Ríos, Los Lagos and Aysén [112]. The corridor of the South zone has the particularity of being in the process of integration with the incipient charging network of the Argentinean province of Neuquén, which would lead to an integrated grid between both countries [108].



Two fast charging corridors run through Chile: One in the Central-South zone with 23 charging stations covering 700km. And a second one in the South zone of the country, under construction, with an extension of 1200km, crossing several regions.

In addition, the company COPEC intends to deploy a network of 104 public charging stations in the 52 municipalities of the Metropolitan Region by 2020 [113]. COPEC also launched an initiative in conjunction with the Chilean Copper Promotion Center to implement

the "Electro Ruta del Cobre" (Copper Route), which plans to provide fast charging infrastructure along a thousand kilometers between Antofagasta, Calama, and San Pedro de Atacama [114]. By the beginning of 2019, the company Enel X had 80 electric vehicle chargers in more than 40 points throughout the country [115]. In addition, Enel X announced a plan to invest in 1,200 charging stations over the next five years [116]. For its part, the company ENGIE has 40 charging stations distributed throughout the country, including a pilot project with the mining industry [117].

Electric public transport

Currently, Santiago has the largest public transport fleet in the region and is the city with the largest number of buses outside China. As of the time this report was published, there were 405 electric buses in circulation [104], as well as one 12-passenger electric and autonomous bus, the first of its kind in the region [118].

The electric buses in circulation are distributed in the public transport system of the capital, among the concessionary companies MetBus (285), Vule (75) and STP (25) [108]. Also, 10 electric 8-meter buses are in operation in the municipality of Las Condes [119] and three buses in the municipality of La Reina [120]. In addition, one electric bus operates in the city of Concepción [121] and another in Antofagasta [122]. The city of Santiago also stands out for the start-up of the first 100% electric bus route in the Grecia Avenue corridor, with 183 of the 285 units of the MetBus company [28].

Regarding electric taxis, the company ENGIE has 30 units [123]. Furthermore, the company TEL (Electric Transports) is expected to introduce 90 additional units, mainly operated by women [108]. It is worth noting that Chile provides a differentiated subsidy between electric and hybrid vehicles for the renewal of collective taxis in the Metropolitan Region [124].

To date, the effort for the electrification of public transport has been driven by the private sector through the union between the bus concessionary companies and the electric companies. However, the electrification of public transport buses has emerged

Santiago, Chile.
The first electric corridor was inaugurated, with 183 electric buses and 40 bus stops.
Credit: MTT Chile (2019)

Santiago has the largest public transport fleet in the region, with 405 electric buses in circulation and a 12-passenger autonomous electric bus, the first of its kind in the region.

Santiago, Chile.
Credit: MTT Chile (2019)

as a result of a learning curve and a more complete scenario. This process covers, among other aspects, the development of regulations for electric buses and associated charging infrastructure, including the requirement of the Euro VI standard for heavy vehicles. In addition, the definition of a driving cycle for detailed performance analysis, as well as technical specifications for electric buses and the definition of the rules for a new operational structure for public transport services in the capital.

In this sense, the bidding process for buses and their open operation in the country establishes elements that encourage the entry of electric vehicles. The Road Operation Bidding Rules are in the process of revision and acceptance for their prompt publication [125].

Citizen participation, education and business

The Association of Electric Vehicles of Chile (AVEC, by its Spanish acronym), the Association of Electric Mobility of Chile (AMECH, by its Spanish acronym) and the Club of Electric Cars are three of the initiatives aimed at promoting electric mobility in the country. The main emphasis on promoting electric mobility has come from the public sector, the academy and the private sector; from a more commercial point of view. In the educational field, there are already professional and university programs, such as diplomas and training courses in electrical mobility at a technical level.

Colombia

Public policy and legal framework

The transport sector represents 36% of energy consumption in Colombia and emits 25% of its greenhouse gases. In addition, it is responsible for 80% of particulate matter emissions in cities, with serious effects on citizens' health [126].

Given Colombia's relatively clean energy matrix, electric mobility presents a great opportunity to reduce the negative impacts that the sector has on the country and its population. Law 1955 establishes the National Development Plan 2018-2022 [127], which provides a broad regulatory framework to promote the transition to zero and low-emission mobility. This law covers the definition of zero and low emission mobility, the sources of funding for public transport systems and sustainable mobility plans. This plan is aligned with other policies such as the Green Growth policy (CONPES 3934) which proposes to reduce energy intensity by 22%, greenhouse gas emissions by 20% and to have 600.000 electric vehicles on the road by 2030 [128]. Furthermore, the Policy for the Improvement of Air Quality (CONPES 3943) proposes to incorporate vehicles with clean technologies and to promote mechanisms such as informative labels, tax incentives and systems for discarding internal combustion vehicles [129].

In July 2019, the Colombian Government issued Law N. 1964 to provide incentives to owners of electric vehicles in vehicle tax rates, reductions in Mandatory Traffic Accident Insurance (SOAT, by its Spanish Acronym) and exemptions from traffic restriction measures ("pico y placa"). The law is pending to be regulated, so the incentives have not yet come into effect. Among the objectives of this law, it is established that by 2035 all vehicles in the Mass Transportation System will be electric or zero emissions. Annex 2 provides a synopsis of Law N. 1964 [130].

In August 2019, the National Mobility Strategy was launched, its objective is to generate the necessary regulatory and policy framework for the promotion of electric and sustainable mobility, to review and generate the necessary economic and market mechanisms, and to establish the technical guidelines to be developed to promote electric technologies in the different market segments [131].

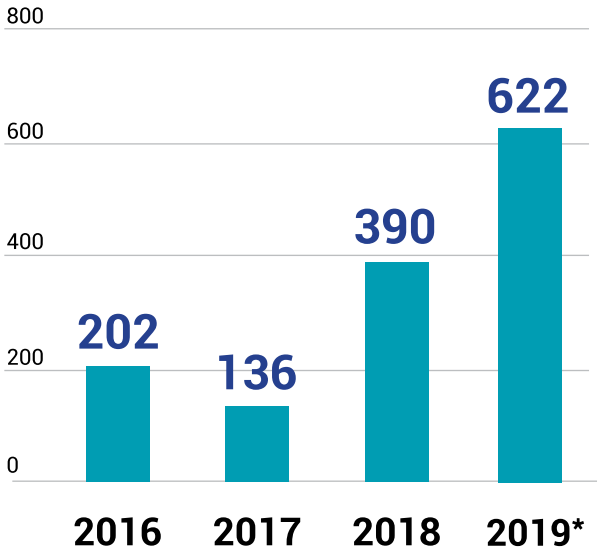
In November, the Ministry of Commerce, Industry and Tourism issued Decree 2051 which liberalizes the import of fully electric vehicles (with no limit on units as previously established by Decree 116 of 2017). In addition, it sets a 0% tariff rate and a reduction from 35% to 5% of the tariff rate for the import of cars powered by natural gas without limit of units [132]. Other important regulations promoting electric mobility in Colombia have been (i) Law 1819/2016, which decrees that electric and hybrid vehicles must have a preferential Value Added Tax rate of 5% [133], and (ii) Decree 1116/2017, which establishes temporary import tariffs for hybrid vehicles for a maximum of 26,400 units between 2017 and 2027 [134].

Electric vehicles and charging infrastructure

Colombia presented the highest sales of fully electric vehicles in Latin America in 2019. Sales of electric vehicles increased from 390 units in 2018 to 923 in 2019 [135]. Casi la totalidad de estas ventas corresponden a vehículos livianos (automóviles y utilitarios), por lo que existe aún un gran potencial para explorar otros segmentos vehiculares [136].

Figure 8.

Ligth-duty electric vehicles
sold in Colombia between 2016 and 2019

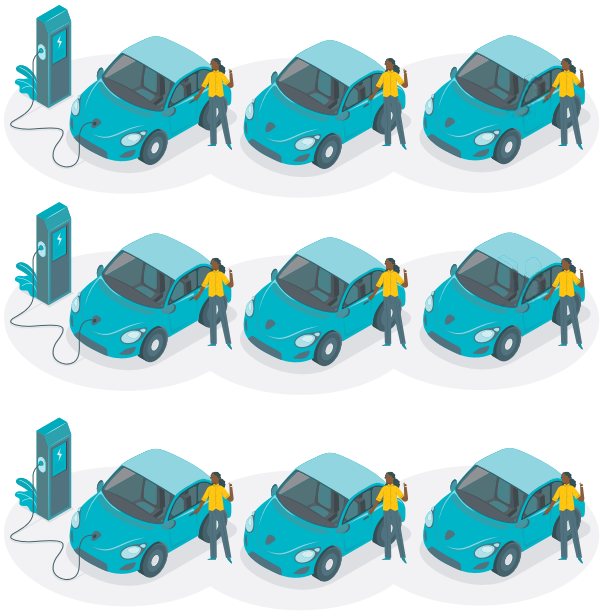


Source: ANDEMOS [136]

In 2019, the company Renting Colombia (of the Bancolombia group), in alliance with the firm Auteco, announced the launch of a fleet of 1,000 electric trucks for the distribution of goods (between 3 and 10 tons), which will be delivered to several of the companies that contract their services over the next three years [137]. The Bavaria brewery carried out a pilot in Medellín, with very positive results. In 2019, the company, in alliance with Bancolombia, decided to introduce 200 electric vehicles to its fleet by 2021, which would represent almost 20% of its fleet [138]. In the city of Medellín, a fleet of seven electric vehicles was added for traffic agents [139]. The EAN University in Bogotá provided a mobile laboratory to measure air quality on board of an electric vehicle [140].

As for public charging infrastructure in Colombia, there is a concentration in the main cities, and it is estimated that there is a total of about 50 charging stations. Medellín has the largest number of centers (28), followed by Bogotá (9) and Cali (5). Most of these centers operate with slow and semi-fast charging. All the investment to date has been made by the private

sector and there is still no charging infrastructure on national routes [136]. However, it was announced in October 2019 that a corridor is planned to be created between the cities of Bogotá and Medellín [141].



Colombia presented the highest sales of fully electric vehicles in Latin America in 2019 with 533 more units than in 2018. Almost all of these sales correspond to light-duty vehicles (cars and utilities), so there is still great potential to explore other vehicle segments.

Electric public transport

In 2019, several public transport buses entered Colombia. The city of Cali acquired 26 electric buses operated by Concesionario Blanco y Negro. They are feeder buses for the terminal stations, and are equipped with air conditioning and elements that facilitate physical accessibility for people [142]. This is the first step for a larger purchase for the MIO system (Masivo Integrado de Occidente), which expects to have 109 more units in 2020 to reach a total of 135 electric buses [143].

For its part, the Municipality of Medellín financed the acquisition of 64 electric buses in the Valle de Aburrá Integrated Transport System (SITVA, by its Spanish acronym) [144]. In November 2019, 17 of the 64 units acquired began operations on one of the public transportation routes [145].

The capital city of Bogota opened a tender for the purchase of 594 electric buses as part of the fleet replacement of its public transport system. In November 2019, the award of 379 electric buses was announced through an abbreviated selection process for feeder and zone lines[2] [29]. This makes Bogotá and Medellín pioneers in the use of the bidding mechanism for the acquisition of electric buses in the region [146]. In addition, 104 electric buses have been added to the contract with Transmilenio Phase III concessionaires, for a total of 483 electric buses [147]. For its part, the company ENEL Codensa will be in charge of the design, construction and supply of the charging infrastructure for 379 of these buses [146].

Cali, Colombia.
Credit: Alcaldía de Santiago de Cali.

2. Of the 594 electric buses that were initially tendered, 379 electric buses could be awarded for functional units 2, 4 and 5: the Fontibon I feeder functional unit (120 electric buses), the Cabecera de Fontibón zonal functional unit (126) and the Usme feeder functional unit (133). While 215 units of functional units 1 and 3 at Perdomo (117) and Suba Centro (98), respectively, were declared deserted.

In 2019, it was announced the introduction of more than 480 electric buses in the city of Bogotá, Colombia.

In the taxi segment, the city of Medellín maintains the announcement of incorporating 1,500 vehicles over the next three years, a project on which the Mayor's Office of Medellin and Empresas Públicas de Medellín (EPM) have been working since 2016. In 2019, four electric taxis were introduced [148] and the intention to replace 200 combustion taxis with electric equivalents was announced[3] [149]. This project is being carried out in conjunction with the taxi driver's union and vehicle concessionaires. In February 2019, the Ministry of Mobility of Medellín approved a differentiated rate for electric taxis [150].

Citizen participation, education and business

The proliferation of initiatives and ventures around the electric mobility ecosystem in Colombia has been quite noticeable. The companies Celsia and Haceb inaugurated a 100% Colombian-designed charging station [151]. For its part, the insurance company SURA offers a plan for electric vehicles [152]. Likewise, there are companies in several Colombian cities that are making conversions from internal combustion vehicles to electric vehicles. It is estimated that there are, at the date of publication of this report, about 60 vehicles converted and that will increase the figure for 2021 to almost 200 units. [136]

Cali, Colombia.
Photography of electric buses operating in the city.
Credit: Metrocali, SUNWIN

3. Empresas Públicas de Medellín set up a website for taxi drivers who wanted to replace their combustion vehicle with an electric one in order to access an economic incentive of 18,300,000 Colombian pesos (approximately US$5,500) [339]. In addition, some taxi companies offer other incentives to their members, such as free fare, subsidized registration or access to applications [338].

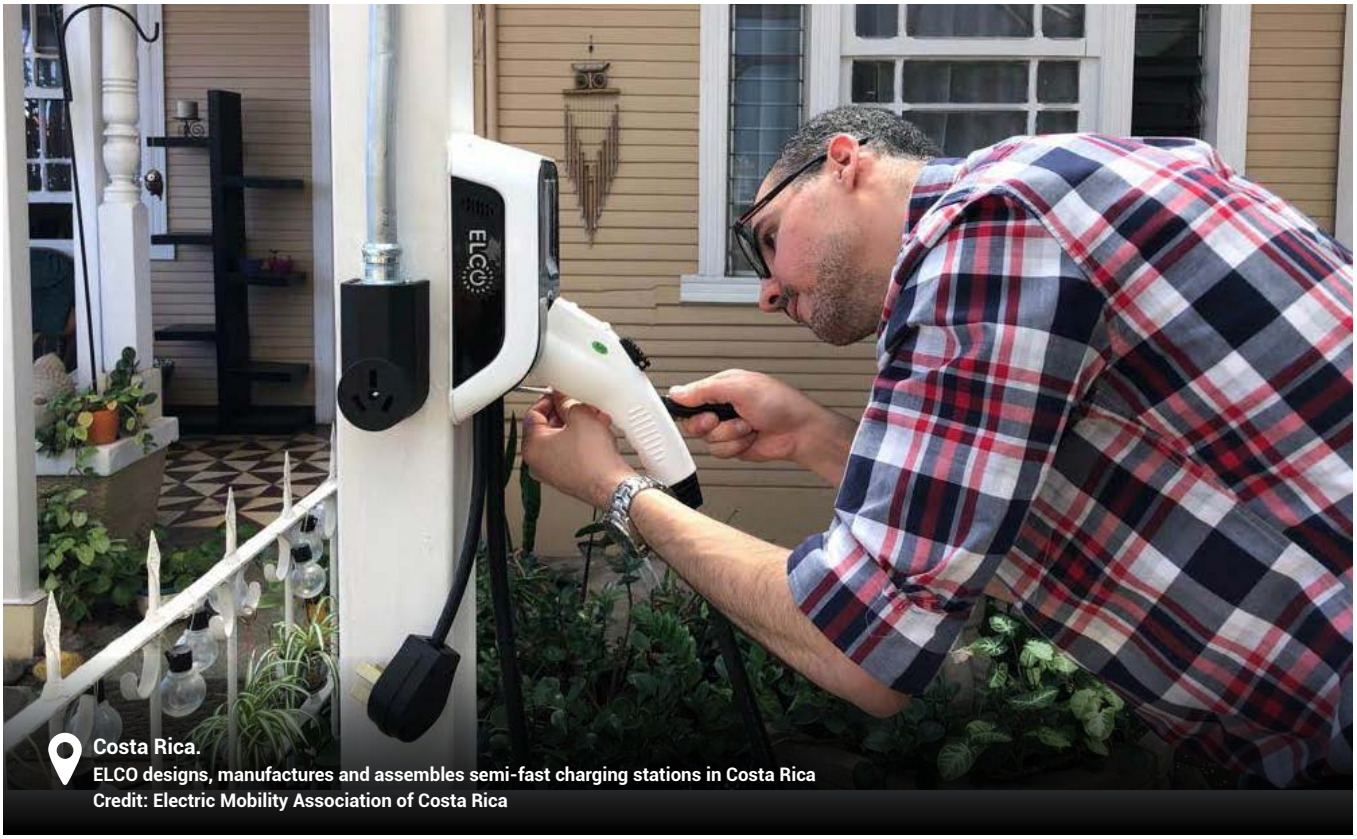
Costa Rica

Public policy and legal framework

Costa Rica has made significant progress in electric mobility in recent years. At a national level, the National Decarbonization Plan 2018-2050 was launched [17], which proposes electric mobility as a key component to achieve decarbonization of the economy. In terms of transport, the plan contains three main axes with specific targets for public transport (70% of buses and taxis zero emissions by 2035 and 100% by 2050), private vehicle fleet (25% of the light-duty vehicle fleet, private and institutional - will be zero emissions by 2035) and freight transport (20% reduction in emissions from the freight sector by 2050 through the introduction of new technologies) [17].

From this policy, emerges the National Plan for Electric Transport 2018-2030, which focuses on three uses for electric vehicles: public transport, institutional transport and private vehicles. Among the main aspects of the plan, the creation of multisectoral working groups is proposed to create enabling conditions related to charging infrastructure exemptions for components related to electric vehicles, electric rates for electric vehicle charging, among others [153]. In addition, to speed up the replacement of institutional fleets, Directive 033-MINAE-MOPT was developed, which requires public institutions to replace internal combustion vehicles with zero-emission vehicles [154].

The National Decarbonization Plan of Costa Rica defines as part of its goals that 70% of buses and taxis will be zero emissions by 2035 and 100% by 2050.



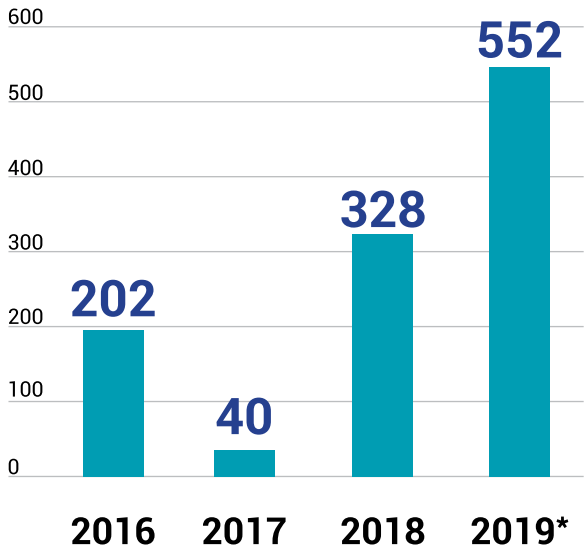
Costa Rica.
ELCO designs, manufactures and assembles semi-fast charging stations in Costa Rica
Credit: Electric Mobility Association of Costa Rica

In 2018, Costa Rica approved Law N. 9518, which is the first law on electric mobility in the region [155]. This law establishes fiscal and non-fiscal incentives to accelerate the transition to zero-emission vehicles. Some of the economic benefits stipulated in the law are in effect for a period of five years, which is effective as of its publication. Annex 2 provides a synopsis of Law No. 9518.

In this sense, regulation N. 41092 MINAE-H- MOPT was published to make law N. 9518 operational and clarifies the incentives defined in the law. In matters related to exemptions, as well as the procedures necessary to obtain them [156]. Executive Decree No. 41642-MINAE establishes the necessary construction and operating conditions that charging stations must have [157]. In addition, in 2018, incentives for hybrid vehicles were repealed [158] and benefits and incentives for second-hand electric vehicles less than five years old were extended [159]. There are also regulatory compendiums (INTE/IEC 61851[160] and INTE/IEC 62196 [161]), whose function is to decree different considerations for electric vehicle charging stations.

Figure 9.

Light-duty electric vehicles
registered in Costa Rica between 2016 and 2019.



Source: ASOMOVE [162]

Electric vehicles and charging infrastructure

Costa Rica has about 1,020 100% electric cars imported in the period from 2009 to 2019, 145 plug-in hybrid vehicles and 1,422 conventional hybrids (for the period 2017-2019). In the country there are institutional fleets that have incorporated electric motorcycles and cars, such as the Costa Rican Post Office, the Grupo ICE (Costa Rican Electricity Institute), as well as the Road Safety Council [162].

In relation to the charging infrastructure, by December 2019, the country had a network of 11 fast and 34 semi-fast charging stations installed by Grupo ICE, as well as other public charging stations installed throughout the country [162]. In the touristic sector, the Monteverde Electric Route was created as a community initiative in one of the most visited places in the country, where charging stations were installed in shops and lodging facilities available to visitors [163]. On the other hand, the Public Services Regulatory Authority defined a single tariff for the operation of the national network of fast charging stations for electric vehicles, administered by Grupo ICE, which is equivalent to 182.72 colones/KWh before taxes (equivalent to 0.32 US$/KWh, 2019) [164].

Electric public transport

The country is working on generating the enabling conditions for the electrification of the public transport system in all its forms (buses, trains and taxis). Currently, a working group is operating at a technical level and another at a decision-maker level to achieve the proposed goals for electric public transport. These groups meet regularly to discuss issues needed to enable the substitution of internal combustion vehicles with zero emissions vehicles, advance pilot projects to test different technologies, support the private sector, and train and raising awareness in all interested parties. To date, two electric buses operate in the country, one acquired by the CNFL electric company (a subsidiary of Grupo ICE) and used for exhibition purposes, and the other by the BYD company,which is being tested and managed by Grupo ICE on different routes such as at the University of Costa Rica (UCR, by its Spanish acronym) [162] [165]. A pilot project with three electric buses donated by

the German government is currently underway [166]. Furthermore, Costa Rica has the first hydrogen bus in the region, with a 340 km autonomy and capacity for 70 passengers. This bus is currently undergoing technical testing in Liberia, Guanacaste [167].

The country has three electric taxis that provide service in the provinces of San José and Heredia [168]. Other transport service platforms have incorporated electric units; however, since they are non-official services, the exact number is unknown [166].

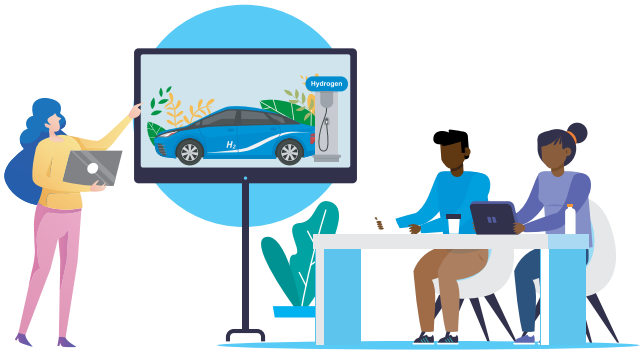
Likewise, the market for motorcycles and electric bicycles is quite developed. Only in 2019, 3,284 units of the TICA system were introduced according to data generated by ASOMOVE (Costa Rican Association of Electric Mobility). There are national companies that import and design these types of units that have had a major boost through consumer fairs [168], [170]. In October 2019, a bicycle sharing system called OMNI was established using electric bicycles with pedal assistance whose access and use is through an application [171].

Citizen participation, education and business

Civil society has played a very important role in promoting electric mobility at the national level. Organizations such as ASOMOVE (Costa Rican Association of Electric Mobility), which brings together more than 200 users of electric vehicles, Costa Rica Limpia, the Center for Urban Sustainability, academia and the community of Monteverde, to name a few, have been key in the organization of events to make visible the modes of electric mobilization and put citizens in contact with different technologies. Similarly, the private sector, consisting of vehicle, bicycle and motorcycle distribution agencies; companies dedicated to the installation and design of charging infrastructure; maintenance and training workshops on electric vehicles, training institutes; electricity distribution companies and the financial and insurance sector have supported the dissemination and awareness of electric technologies and zero emissions [162].

The country has also promoted better financial conditions for the acquisition of private electric vehicles, as well as for public transport. These improvements include better rates, longer payment terms, lower commissions and guarantees. For example, in October 2019, in compliance with Law No. 9518, three state banks announcedpreferential credit lines for both private electric vehicles and electric taxis and buses [172]. It is worth noting the creation of the Hydrogen Alliance, formed by an NGO and private companies, including a company dedicated to the design of space aircrafts, which aims to develop and promote the use of hydrogen as a sustainable alternative in transportation.

Costa Rica.
Photograph of a meeting of members of the Costa Rican Association of Electric Mobility (ASOMOVE)
Credit: ASOMOVE



Hydrogen technology is starting to gain strength. In Costa Rica there is already the Alliance for Hydrogen, which works with NGOs, the private sector and even a company dedicated to the design of space aircrafts.

Cuba

In response to the energy crisis that has impacted the country and the limited supply of imported fossil fuels, two-wheeled electric mobility has gained strength as an alternative form of mobility. In 2013, Decree 320/2013 enabled the import, commercialization and transfer of ownership of motor vehicles, including two- and three-wheeled electric vehicles - known as "motorinas" [173]. The popularity of motorinas has been such [174][175], that in 2019, given the large number of these type of vehicles in the country, the government published Resolution 35/2019, which requires the registration of mopeds by natural and legal persons [176]. Electric bicycles are also available for tourist services [177].

Electric motorcycles, known locally as "motorinas", are very popular in Cuba, and there are tens of thousands of units in circulation.

Cuba.
Photograph of the electric taxi operating in Cuba [182]
Credit: Excelencias del Motor

Since 2016, Cuba has an electric taxi that runs along a defined corridor, which belongs to the Taxi Rutero cooperative [178]. In 2017, an electric bus was introduced on one of Havana's public transportation routes [179]. Cuba also stands out as one of the countries with the greatest reserves and production of cobalt - an element used in the production of lithium-ion batteries for electric vehicles [180] [181].

Ecuador

Public policy and legal framework

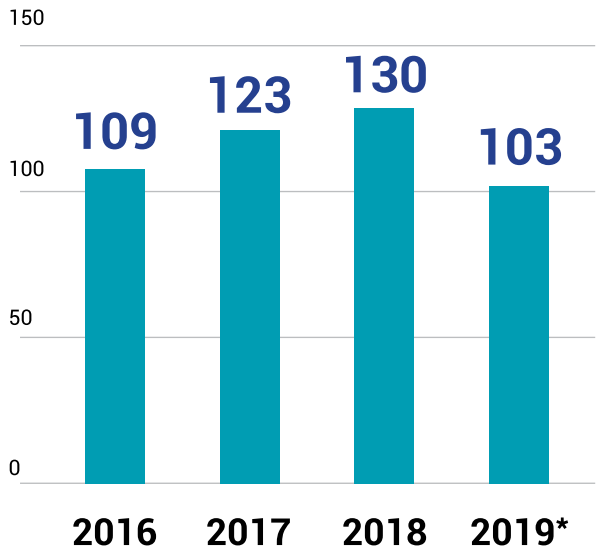
In Ecuador, various incentives are provided for electric and hybrid vehicles. The Organic Law for Productive Development eliminates value added taxes and the special consumption tax on electric vehicles for a period of five years [183]. The Organic Law on Energy Efficiency establishes as one of its axes the promotion of electric mobility in urban and interprovincial public transport. Likewise, it sets that, from 2025, all vehicles incorporated into public transport systems must be electric and will enjoy preferential energy rates. This law urges local governments to provide incentives to encourage the use, parking and circulation of electric vehicles [184]; it also establishes the possibility of creating business models for the electric charging of vehicles. Resolution N. 016/2019 offers an exemption from import tax for electric vehicles with a value of less than US$40.000, as well as charging stations and batteries [185]. In addition, Resolution ARCONEL-038-15 defines rates with differentiated hourly demand for the charging of electric vehicles in medium and high voltage [186].

Electric vehicles and charging infrastructure

According to data from the Association of Automotive Companies of Ecuador, between 2016 and 2019, more than 465 electric vehicles were registered [187]. In the specific case of the insular province of Galapagos, the Governing Council of the Special Regime of Galapagos issued Ordinance N 01-CGREG-2016, which contains regulations for the entry and control of vehicles and machinery. In this ordinance, the permanent entry of motorcycles and electric vehicles for personal use is allowed and the replacement of internal combustion vehicles with electric vehicles is promoted in specific cases [188]. According to the database of the Galapagos Government Council, provided by the Automobile Club of Ecuador, it is estimated that over 180 electric vehicles have entered the Galapagos.

Figure 10.

Light-duty electric vehicles
sold in Ecuador between 2016 and 2019



Source: AEADE [189]

The charging infrastructure has advanced in some shops and public facilities, in places like Quito, Cuenca, Loja and Galapagos, mainly by private initiative. The Ecuadorian Technical Regulation PRTE-INEN-162 establishes the specifications and requirements for charging accessories for electric vehicles [190].

Electric public transport

The city of Guayaquil has a fleet of 20 electric buses adapted to the country [191]. This project was financed by the National Finance Corporation (CFN, by its Spanish acronym), which created a specialized line of credit for public transportation companies. The financing reached US$7.6 million and allowed for the acquisition of the units, charging infrastructure and support for the service [192].

In December 2019, the National Government and the Municipality of Quito announced the commitment to acquire 300 electric buses [193]. To date, two electric buses have been tested on one of Quito's public transport lines [194], as well as an articulated electric bus [195].

The city of Loja ventured with the introduction of 35 electric taxis and a fast-charging station in 2017 [196] [197]. Currently, 51 electric units operate in this city [198]. For its part, Guayaquil introduced 50 electric taxis, as well as a complex with fast charging stations available for the buses and electric taxis that operate in the city [199]. It should be noted that the Municipality offered to pay 50% of the electricity bill for the first year of operation of electric buses and taxis, and offered a purchase voucher for taxi drivers who decide to change their combustion vehicle for an electric one [200]. The Metropolitan Transport Agency of the city of Quito operates a shared electric bicycle service, called BiciQuito, which has 658 bikes, although it seems that they are not currently operating [201].

Citizen participation, education and business

The Automobile Club of Ecuador (ANETA, by its Spanish acronym) and the Association of Automotive Companies of Ecuador (AEADE, by its Spanish acronym) have taken on the role of promoting electric mobility in the country. In 2018, ANETA delivered a bill to representatives of the National Assembly of Ecuador for the "Promotion of Sustainable Mobility and Development of Electromobility" [202], law which is currently in the last phase of presentation and discussion in the Plenary of the Assembly. Besides, in 2018, the Ministry of Transport and Public Works, together with other actors from the private sector and academia, organized the "First Forum on Electromobility" in the city of Cuenca within a framework of cooperation between the public and private sectors, with the support of international cooperation [203]. In addition, ANETA works with electric cars in two schools in Quito and Galapagos and is already planning the next acquisition of more units.

In terms of training, the National Polytechnic University of Ecuador (EPN, in Spanish) signed an agreement with the Chinese company BYD in order to generate continuing education programs in technical areas related to electrical mobility and mechanical assistance [204]. In terms of financing, several entities offer financing lines for electric vehicles. For example, Banco del Pacífico (state-owned) offers a line of credit for electric vehicles through a reference rate of 12.5% over five years; as well as Banco Pichincha, which offers specific conditions for light-duty vehicles [205]. Also, BanEcuador, a state-owned financial institution, offers microcredits for electric taxis with interest rates of 9.8% for two to five years [206]. In the same way, as mentioned above, the CFN (National Finance Corporation) has also provided funding for electric public transport projects. The credit lines provided by this entity range from US$50.000 to US$20 million, with interest rates from 7.5% and a term of up to 15 years [192].

Guayaquil, Ecuador.
Photograph by Jorge Burgos, member of the cooperative Taxistas Alfaristas, while testing an electric taxi.
Credit: BYD [207]

El Salvador.
Electric vehicle of the company Distribuidora de Electricidad del Sur (DELSUR), of the EPM Group.
Credit: National Energy Council of El Salvador [217]

El Salvador

Public policy and legal framework

In May 2018, the government of El Salvador and the company Distribuidora de Electricidad del Sur (DELSUR, for its Spanish acronym) announced the introduction of electric mobility in that country [208]. In November of that same year, the organization Mover El Salvador presented the draft of the "Law for the Promotion of Electric Transportation" [209], which includes differentiated tax incentives for electric and plug-in hybrid vehicles and their parts [210]. Said draft law is still being reviewed and discussed [211], [212].

Electric vehicles and charging infrastructure

El Salvador has two electric vehicles: the first was imported in 2018 by the company DELSUR [213], in conjunction with a public charging station [214], and the second was acquired by the José Simeón Cañas Central American University (UCA, by its Spanish acronym) for research purposes in 2019 [215].

Citizen participation, education and business

Electric mobility in El Salvador is being promoted by multiple actors. The organization Mover El Salvador, made up of non-governmental organizations, as well as international cooperation, union companies, private sector and other civil society representatives [216]. Several events have been organized in the country regarding electric mobility, among them, in 2018 the "Forum for the Promotion of Electric Mobility in the Region" was held in order to exchange experiences and accelerate the process in the country. The event was organized by UCA, the DELSUR electricity company and the support of the German Agency for International Cooperation (GIZ) [217].

Grenada

The Grenada government has declared its intention to be a leader in electric mobility in the Caribbean [218]. In 2015, the company Grenlec, in charge of electric service, launched a pilot project, where it put into operation three electric vehicles (two Nissan Leafs and a five-seat Nissan E-NV200 Plus), as well as a limited number of charging points [219]. The pilot was designed to test the energy efficiency, scope, cost savings, on-road performance and environmental benefits of electric cars compared to internal combustion engine cars.

Guatemala

Electric vehicles and charging infrastructure

According to the National Energy Plan of Guatemala, the registration of electric vehicles in the country increased from two units in 2005 to 52 units in 2016. According to the same document, it is expected to

Grenada.
Caravan with electric vehicles during its introduction in Grenada in 2015
Credit: Megapower Ltd [220]

reach almost 4.500 electric vehicles in circulation by 2032 [221]. Currently, a company in Guatemala has a fleet of 11 Nissan ENV-200 electric vehicles. Such fleet is currently more than three years in operation and, according to its owners, has generated clear benefits in cost reduction and maintenance [222]. For its part, Empresa Eléctrica de Guatemala S.A. (EEGSA, by its Spanish acronym) has developed tests with electric vehicles to determine their operation and performance [223]. In this sense, the electricity company has implemented an hourly rate for commercial and medium voltage clients with power demand [224].

Electric public transport

In 2018, a test project with an electric bus began in Guatemala City at the initiative of the company Luka Electric, an importer of electric vehicles, and the Municipality of Mixco [225]. In addition, the city is conducting technical and economic feasibility studies for a route to be operated exclusively by electric buses. Likewise, the entry of a shared electric scooter platform in Guatemala City was announced by the end of 2019 [226]; however, at the time of writing this report it was not possible to verify its entry into operation. On the other hand, the city is also finalizing the regulations for the use of shared bicycles and it is estimated that they will soon be available to the city residents.

Citizen participation, education and business

In 2019, the Association of Electric Mobility of Guatemala (AMEGUA, by its Spanish acronym) was formed by private companies and individuals from the country. AMEGUA is promoting a bill on electric mobility in Guatemala [227], [222]. In March 2019, the first Congress on Electric Mobility was held in the country, with the support and participation of 24 companies and institutions related to electric mobility and national and international exhibitors. The main

Cayalá, Guatemala.
First Congress on Electric Mobility in Cayalá, Guatemala.
Credit: Revista Energía

Cayalá, Guatemala.
First Congress on Electric Mobility in Cayalá, Guatemala.
Crédito: Revista Energía

sectors that attended the event were industry, energy and government, and nearly 400 people participated. AMEGUA plans to continue educating civil society through advocacy activities, through its social networks, monthly meetings with interested parties or people related to electric mobility, as well as through training to companies that require it [228].

Honduras

In early 2019, the Honduran Land Transport Institute, in conjunction with the Climate Change Office and the Secretariats of Energy and Economic Development, announced interest in developing a nationwide electric mobility strategy to introduce electric units as part of public transport fleets [229]. Also, that year an intersectoral working group on sustainable mobility and electric mobility was created. This was coordinated by the Secretariat of State of the Presidency, with the participation of representatives from the Presidential Office of Climate Change, the Honduran Institute of Land Transportation, the Secretariat of Natural Resources and Environment, the Secretariat of Energy, the Administration Service of Incomes, the Honduran Bank for Production and Housing (BANHPROVI, by its Spanish acronym) and the Central American Bank for Economic Integration (BCIE, by its Spanish acronym), among others [230].

At the end of 2019, the implementation of a triangular project between Honduras, Costa Rica and Germany began [231], with the aim of transferring technological, institutional and financial experiences and knowledge related to electrical mobility from Costa Rica to Honduras [232].

Jamaica

In September 2019, the Government of Jamaica, through the Ministry of Science, Energy and Technology, announced its intention to elaborate a national electric vehicle policy in order to generate conditions to promote this type of vehicle [234]. Such announcement was made after a study tour by Jamaican government representatives to the United States as part of a feasibility study for the introduction of electric buses in the country [235], [236]. In June 2019, the Jamaica Public Utilities Company JPSco announced its intention to deploy public charging infrastructure as a strategy to promote electric mobility in the country [233], [237]. The company JPSco has also been analyzing the feasibility of electrifying its fleets [238].

Honduras
Start of the triangular technical cooperation project between Honduras, Costa Rica and Germany on electric mobility that began in 2019 [232]
Credit: GIZ MiTransporte

Jamaica.
Electric vehicle of the Jamaica Public Utilities Company JPSco
Credit: Jamaica Public Utilities Company JPSco [233]

Mexico

Public policy and legal framework

At the federal level, incentives are offered to private electric vehicles. For example, electric, hybrid and hydrogen vehicles do not pay the federal new car tax (ISAN, by its Spanish acronym) [239] or the increase in the maximum amount deductible of Income Tax (ISR, by its Spanish acronym), related to the payments for temporary use of hybrid or electric cars up to 285 pesos per day. In addition, the Federal Electricity Commission (CFE, by its Spanish acronym) provides an independent meter for the charging stations that are installed in homes. At the state level, most Mexican states also exempt from payment of the annual ownership tax [240] and, in the case of states in the Valley of Mexico metropolitan area, electric and hybrid vehicles are not obliged to undergo environmental verification [241] and are therefore exempt from the restrictions on the use of private vehicles. In addition, in 2019, a 20% discount was offered on toll rates on certain urban highways in Mexico City for electric and hybrid vehicles, through a distinctive called "Ecotag". [242], [243].

In 2018, the development of the National Strategy for Electric Mobility in Mexico began, under the leadership of the National Secretariat of Environment and Natural Resources. The strategy involved a process of consultation and multisectoral work with other federal public sector institutions and representatives of the private sector, civil society and international cooperation [244]. Currently, its publication by the federal government is expected. According to the General Law for the Prevention and Integral Management of Solid Waste, lithium batteries are considered special waste. Therefore, large generators, producers, importers, exporters and distributors of batteries are required to submit management plans that seek the prevention and recovery of waste, as well as its integrated management [245].

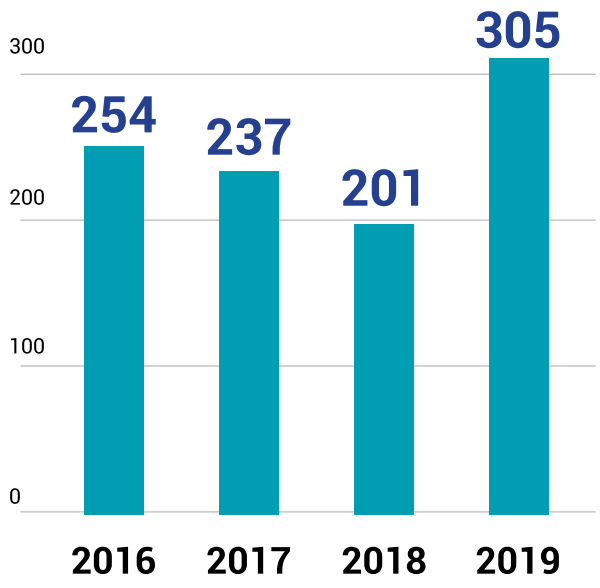
Electric vehicles and charging infrastructure

According to the Mexican Association of Automotive Industry (AMIA, by its Spanish acronym), between the beginning of 2016 and 2019, 305 electric vehicles, 1.339 plug-in hybrids and 23.964 conventional hybrids were registered in the country [246].

Mexico has the largest charging infrastructure in the region, with more than 2.000 charging stations installed around the country [247]. This deployment has been achieved through collaboration between the CFE (Federal Electricity Commission) and representatives of the private sector. There are proprietary charging networks in the country (i.e. Supercharger stations for Tesla users [248]), as well as public charging networks, such as the ChargeNow network, which has more

Figure 11.

Light-duty electric vehicles
registered in Mexico between 2016 and 2019



Source: AMIA [246]

than 1.500 [249] free charging stations and has been developed jointly by CFE, BMW Group and Nissan Mexico [250]. In Mexico, there is also a BMW Group fast charging corridor that links the city of San Luis Potosí, Mexico City and Puebla with an extension of approximately 430 km [251]. There is also a charging corridor under development between Monterrey and the U.S. border [251], [252].

Electric public transport

In relation to electric public transport, Guadalajara and Mexico City have respective trolleybus systems. The Mexico City system added 63 new units in 2019 [253] with the expectation of reaching 500 new vehicles by the end of the current legislative period. In addition, there are mass rail transport modes (metro, suburban trains and light rail) in the country. At the moment, Mexico lacks battery-powered electric buses in the public transport service.

However, at the state and city level, there are various initiatives analyzing or preparing tenders for the introduction of electric buses. Such is the case of the Government of the State of Jalisco, which plans to electrify some route of the Mi Macro Periférico system, a 41 km mainline corridor and feeder routes. Another example is Monterrey, where transport and technology studies are beginning to electrify the feeder routes (TransMetro) of line 3 of the metro in the metropolitan area. Hermosillo, meanwhile, wants to electrify about 24 km of BRT line that crosses the city from north to south [254].

In terms of electric taxis, the Electric Transport Service in Mexico City has a fleet of 20 electric vehicles [255]. In 2012, 50 electric taxis were incorporated in the state of Aguascalientes and then 15 more units were added [256]. However, at the end of 2016, its service was canceled and its use was modified for utility vehicles [257], [258].

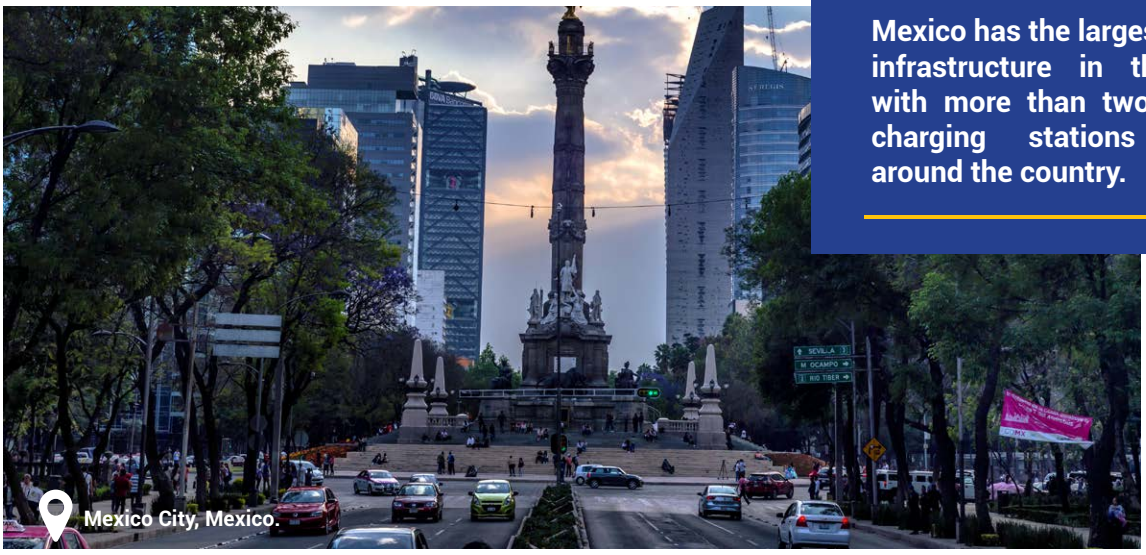
In terms of shared electric mobility, there are shared electric bicycle systems in Mexico City [259] and Querétaro [260]. Similarly, there are several shared electric scooter and motorcycle systems in operation.

Citizen participation, education and business

Various civil society organizations have participated in the formulation of the National Strategy for Electric Mobility of Mexico. Likewise, there is a National Association of Electric and Sustainable Vehicles (ANVES, by its Spanish acronym) in the country [261].

The trade associations have played a key role in relation to electric mobility. The Mexican Association of the Automotive Industry (AMIA, by its Spanish acronym) develops statistics on sales of electric and hybrid vehicles in the country [246]. While the Mexican Copper Promotion Center launched the 2019-2022 Strategic Plan of the "Alliance for Electromobility in Mexico," which proposes, as part of the vision to 2022, to achieve that 3% of vehicle sales in the national territory are electric [262].

Mexico has the largest charging infrastructure in the region, with more than two thousand charging stations installed around the country.



Mexico City, Mexico.

As mentioned, the development of charging infrastructure has been achieved through joint collaboration between the CFE and the private sector. It should be added that locally produced electric vehicles are also commercialized in the country [263].

Panama

Public policy and legal framework

Since August 2018, Panama began the development of its national electric mobility strategy, with the support of UNEP, the World Energy Council (WEC), as well as a multisectoral coordination table. Such strategy was launched by the outgoing government of President Juan Carlos Varela in June 2019 during the transition period and was welcomed by the incoming government of President Laurentino Cortizo through the National Secretariat of Energy, through Resolution 4433, which opened a public consultation process [264]. In October 2019, the Cabinet Council of the Government of Panama approved the National Strategy for Electric Mobility [265], which defines the following goals for 2030 [266]: (1) between 10% and 20% of the total private vehicle fleet will be electric; (2) between 25% and 40% of private vehicle sales will be electric; (3) between 15% and 35% of buses in authorized concession fleets will be electric; and (4) between 25% and 50% of public fleets will be composed of electric vehicles.

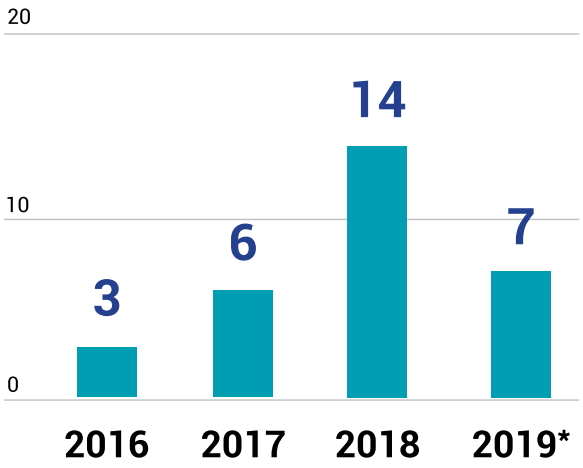
Panama launched its National Strategy for Electric Mobility in October 2019.

Electric vehicles and charging infrastructure

According to registration information provided by the Association of Automobile Dealers of Panama (ADAP, by its Spanish acronym), it is estimated that, from 2011 to October 2019, a total of approximately 30 battery electric vehicles, 190 plug-in hybrid vehicles and 2.040 hybrid vehicles were registered [267]. In terms of charging infrastructure, various charging stations have been installed in the country. For example, in February 2019, the company Celsia installed a public charging station with a capacity of 7.2KW in a shopping center in Panama City [268]. In May 2019, the company ENSA Servicios installed the first fast charging station in the country in the city of Colón, for public transport services [269].

Figure 12.

Light-duty electric vehicles
registered in Panama between 2016 and 2019



Source: ADAP [267]

Electric public transport

In terms of public transport, in August 2018, a pilot project began with a 9.35-metre BYD K7M electric bus, which operated until June 2019 on a special public transport route in Casco Antiguo in Panama City [270]. In August of that same year, the Panama City public transport company MiBus, together with the electric company ENSA Servicios and BYD, incorporated another 12-meter electric bus in order to evaluate its

functionality and performance on various commercial routes in Panama City [271]. Based on the success of this pilot, the public transport company has already approved the purchase of 35 9-meter buses for the city [272].

In September 2019, an announcement was made by various representatives of the private sector, including transporters, technology providers, electricity and insurance companies, to present the progress of negotiations in the framework of modernizing public taxi and bus transport nationwide, as well as the commitment to contribute to the country's goals regarding the national strategy for electric mobility in relation to electric public transport [273]. Apart from that, the country has the first 100% electric urban vehicle as part of a partnership between Banistmo, Cervecería Nacional and Truckslogic [274].

Paraguay

Public policy and legal framework

In 2018, Paraguay began working on its National Strategy for Electric Mobility. To this end, an inter-institutional working group was established, with the participation of around 20 public institutions and 15 representatives from the private sector, the academy, civil society and multilateral cooperation organizations [275], [276].

As part of the National Energy Policy, approved by decree N. 6092/2016, an action plan was proposed in which a program for electric mobility in the public sector is projected. In addition to goals to electrify the urban vehicle fleet of the National Electricity Administration (ANDE) in the Asunción metropolitan area, starting with 10% in the short term, 50% in the medium term and 100% in the long term. Likewise, it is proposed that the public sector's new vehicle fleet be electric, starting with 10% in the short term, 20% in the medium term and 50% in the long term [277]. The National Energy Efficiency Plan promotes the modernization and electrification of cargo and passenger transportation [278].

In terms of incentives, Law N 5.183/2014 exempts new electric and hybrid vehicles from the payment of import customs tax and value added tax.[4] Likewise, this law requests the Ministry of Industry and Commerce to establish quality standards for electric and hybrid vehicles that may enter the country, as well as the implementation of measures

Ciudad de Panamá, Panamá
Electric public transport
Credit: MiBus

4. Law No. 5.183/2014 amends Law No. 4.601/2012 [340] which granted the same tax benefits to second-hand electric and hybrid vehicles.

for the gradual establishment of charging infrastructure with preferential rates in the main cities of the country [279].

Electric vehicles and charging infrastructure

It is estimated that there are around 250 electric vehicles, 150 plug-in hybrid vehicles and more than 5.000 conventional hybrids in Paraguay [280]. In 2018, the state electricity generating company, ITAIPU Binacional, delivered six electric vehicles to government institutions in Paraguay [281].

On the other hand, the charging infrastructure network in Paraguay is incipient. To date, there are public charging stations in some shops and hotels [282], as well as two fast charging stations installed [283]. In March 2019, ANDE, National Administration of Electricity, entered into an agreement with the Yacyretá Binational Entity (EBY, by its Spanish acronym) and Petróleos Paraguayos (PETROPAR, by its Spanish acronym) for the implementation of charging infrastructure on national routes [284].

In 2019, the construction of the "Green Solar Route" was announced, the first electrical corridor in Paraguay, which will link Asunción and Ciudad del Este, on the border with Brazil, through four public charging stations. This project is led by the Itaipú Technology Park (ITP, by its Spanish acronym) and Itaipú Binacional [280], [285].

Electric public transport

The city of Asunción has two electric buses as part of a public transport line. With this initiative, it is expected to study the massive implementation of these vehicles in the country [286].

Citizen participation, education and business

In terms of citizen participation, the Paraguayan Association of Electric Vehicles (APVE, by its Spanish acronym) was formed to group, connect and create collaborations between people who own electric vehicles in the country [287].

On the other hand, in 2019, the International Automobile Federation (FIA, by its Spanish acronym) Region IV and the Paraguayan Automobile Touring Club organized the first Electric Mobility and Smart Cities Show, which sought to show to the public the jump that Paraguay is taking regarding the incorporation of electric vehicles [288].

Paraguay.
Vehicle test open to the public at the Itaipu Technology Park (ITP) in Asuncion, Paraguay, in early 2019
Credit: Paraguayan Information Agency [290]

In 2019, the International Federation of the Automobile (FIA) Region IV and the Paraguayan Touring Automobile Club organized the first Electric Mobility and Smart Cities show.

In 2006, ITAIPU Binacional launched the Electric Vehicle Program, through which several research, development and innovation activities have been deployed, including the development of prototypes of electric road vehicles, an electric airplane and the assembly of several electric passenger vehicles. Through this program, an electric bus, made in Paraguay, and an ethanol-electric hybrid bus were also developed [289].

Peru

Public policy and legal framework

In August 2019, the Ministry of Energy and Mines launched a decree for public consultation that declares the promotion of electric and hybrid vehicles and charging infrastructure of public interest [291], [292]. This decree defines: (i) conditions for charging stations, home charging and charging in buildings; (ii) the acquisition or replacement of vehicles and public institutions; (iii) energy efficiency labeling and preferential parking sites for electric and hybrid vehicles; and (iv) complementary measures for the issuance of associated technical regulations and the revision of the tariff categories for charging, among other topics [293]. At the time of publication of this report, this decree is pending publication by the government.

In terms of incentives, electric and hybrid vehicles are exempt from paying the selective consumption tax (ISC, by its Spanish acronym), which can vary between 10% and 20% [294]. For its part, the supreme decree N. 019-2018-MTC amends the national vehicle regulations to include vehicles and bicycles with electric pedal assistance and defines the implementation of a National Vehicle Approval Register [295], [296].

In the Competitiveness and Productivity Plan 2019 -2030, developed by the Government of Peru, several milestones related to electric mobility are established, including (i) a regulatory package for the promotion of electric and hybrid vehicles and their supply infrastructure by the end of 2019; (ii) pilot projects for the introduction of electric buses, cars and motorcycles by mid-2021; (iii) technical standards for charging stations by mid-2025; as well as the introduction of electric buses in operation in Lima, Arequipa and Trujillo by mid-2030.

Electric vehicles and charging infrastructure

According to the 2019 figures available, 205 electric and hybrid vehicles were imported (14 of them electric, 3 plug-in hybrids and the rest conventional hybrids) [297] [298]. In aggregate terms, since 2012, 346 hybrid and 320 electric vehicles have been counted [299] [297] [298].

In 2019, two electric bus initiatives were launched to transport collaborators in the mining industry. The first took place in the region of Cajamarca, for which a charging station was installed at 3.998m [300]. The second was inaugurated on a pilot route that connects the city of Lima with the city of Ica, approximately 300 km away [301].

The charging infrastructure in Peru is in an incipient phase. Several of the charging stations in operation provide support to the various demonstration projects underway.

Electric public transport

In 2018, a pilot project was implemented in the district of San Isidro, in Lima, thanks to an alliance between the Municipality, the power generation company ENGIE and the manufacturer BYD. As part of the project, the electric bus operated on a public transport route for a period of three months. The service was offered free of charge to the public [302]. In 2019, the introduction of an electric bus in Lima was achieved by a private consortium made up of the Global Sustainable Energy Partnership (GSEP) and its members Hydro-Québec and Enel X. This initiative is part of a larger project that seeks to develop charging infrastructure and study the replicability of electric buses in this country. This electric bus was introduced into a public transportation route, known as the Red Corridor [303], [304].

In relation to electric taxis, two units were incorporated in the city of Lima in 2019 as part of a six-month pilot project in order to assess their scalability [305]. Similarly, the company ENGIE introduced an electric taxi in the city of Arequipa to conduct tests with a taxi company in that city for a period of two months [306].

On the other hand, in the city of Pucallpa, in the Peruvian Amazon, converted motorcycle taxis which provide services in rural areas are being tested. This initiative is led by Ecoenergy S.AC, a local venture that was supported by an innovation fund from the Ministry of Production of Peru [307].

Citizen participation, education and business

The Association of Entrepreneurs for the Development and Promotion of Electric Mobility in Peru (AEDIVE PERU, by its Spanish acronym) is a multi-sector association comprised by manufacturers and assemblers, electrical and engineering companies, universities, private investment funds and electric mobility companies [308]. In addition, there is the Automotive Association of Peru, which also promotes electric and hybrid mobility in the country [297]. It should be added that several events related to electric mobility have been held at a national level, promoted by civil society. Both ministries, municipalities, and public and private universities have carried out multiple activities to discuss the issue.

Regarding training, there are already two programs (seminar and diploma) for the promotion of electric mobility in the country, offered by two universities; in addition, there are several other programs under development, in which universities partner with private companies to teach them [292].

In 2019, two electric bus initiatives were launched to transport collaborators in the mining industry, one in the region of Cajamarca, and the other that connects Lima with the city of Ica.

Peru.
Photography of electric bus in Peru
Credit: AEDiVE Peru

It should be noted that several of the initiatives around electric mobility in Peru have been achieved through alliances between various actors. For example, the introduction of the electric bus in 2018 in the district of San Isidro, Lima, followed the Sustainable Urban Mobility Pact [309], which had been launched by the Municipality of San Isidro in 2016 and to which 63 companies and institutions subscribed [310]. Similarly, the introduction of the first two electric taxis in the city of Lima was achieved thanks to a collaboration between one of the local taxi companies (Taxi Directo), an electricity supply company and a vehicle manufacturer [305].

Dominican Republic

Public policy and legal framework

The Dominican Republic is in the process of developing an Electromobility Strategic Plan which aims to produce an inter-sectoral diagnosis (energy and transport sector with public and private actors) and an action plan for the implementation of electromobility [311]. In addition, on the part of civil society, the Association of Dominican Electric Mobility (ASOMOEDO, by its Spanish acronym) has held events to put the issue on the table. Mainly, work has been done on raising awareness of the population and the benefits and opportunities that electric mobility would represent in the lives of Dominicans and for the companies of the country. All this seeks to engage the country so that in the coming years at least 60% of the electrification of the fleet of the country can be achieved.

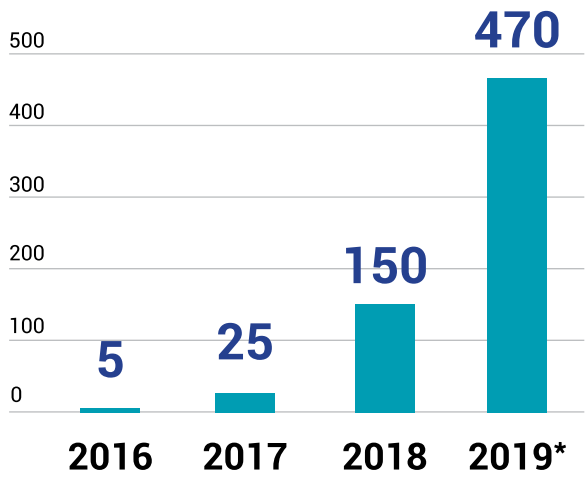
In 2013 the Electric Mobility Incentive Law 103-13 [312] was published, which decreed a 50% reduction in import tariffs, the tax on industrialized goods (ITBIS, by its Spanish acronym) and the charge for obtaining the first license plate for hybrid and electric vehicles.

Electric vehicles and charging infrastructure

It is estimated that around 620 battery electric vehicles circulate in the Dominican Republic. The charging infrastructure has been expanding and reaches 62 charging points nationwide. Businesses and tourist areas have seen the potential of this type of technology and have begun to introduce electric vehicles to replace those with internal combustion. The Punta Cana-Macao Energy Consortium (CEPM, by its Spanish acronym) acquired 10 units to put them into circulation in its tourist area, and also created the Inter Energy Systems division for the creation of a fast charge network called EverGo, which seeks to

Figure 13.

Light-duty weight electric vehicles
registered in Dominican Republic between 2016 and 2019.



Source: ASOMOEDO

reach 500 points in the country. Mainly, the internal transport in hotels in the area is carried out by means of electric vehicles. Similarly, it is worth noting the efforts made by Banco Popular Dominicano and Banco BHD León, which have installed charging stations that operate with photovoltaic solar energy to charge the electric vehicles.

Electric public transport

Other projects related to electric mobility are those proposed by the Central Nacional de Transportistas Unificados (CNTU) with Zero Emission RD and that of Diario Libre. In the case of CNTU, a pilot project was launched with 200 electric taxis in Santo Domingo and La Vega [30], [31]. The CNTU expects to gradually replace 20% of its units (22.000 of a total of 110.000) in a period not exceeding five years [313].

Citizen participation, education and business

ASOMOEDO has managed to create alliances with different sectors of the Dominican economy for the promotion of electric mobility. It has also made efforts to secure funding and insurance for electric vehicles. This association has participated together with the National Institute of Traffic and Land Transport (INTRANT, by its Spanish acronym) in the National Electric Mobility Week and the EcoRally held in 2018. Likewise, private companies such as Zero Emission RD, universities, and some commercial establishments have promoted electric mobility through talks, the installation of charging points and the creation of spaces to share experiences among current and potential users of electric vehicles. The talks have been focused on making visible the opportunities and challenges that the Dominican Republic has for the introduction and massive adoption of electric mobility. These activities have had representation from both the academic and the public and private sectors.

In 2019, the Central Nacional de Transportistas Unificados (CNTU) launched a pilot project with 200 electric taxis in Santo Domingo and La Vega. The CNTU expects to gradually replace 20% of its units within five years.

Uruguay

Public policy and legal framework

According to the NDCs presented in the Paris Agreement, Uruguay seeks to increase its energy independence and continue decarbonizing its economy to achieve carbon neutrality. Uruguay focuses on the transformation of transport and mobility to more efficient and sustainable modes. This is due to the great advantage of having an electrical matrix based on renewable energy (about 97% of its electricity production) [314].

Thus, since 2014, the Inter-institutional Group on Transport Energy Efficiency has been operating, comprising national government institutions and the city of Montevideo, as well as the country's energy companies. This group is tasked with generating, reconciling and promoting policies aimed to developing more efficient and sustainable mobility. The main actions promoted in these years range from the generation of a network of electric charging that will be expanded nationally, to the generation of incentives for the replacement of combustion taxis with electric ones and, more recently, the implementation of a subsidy for public transport operators to change their diesel buses to electric ones [315]. The NDC of Uruguay establishes, as part of its unconditional goals, the introduction of 15 electric buses, 150 electric public transport taxis and 150 electric utility vehicles by 2025.[5] [316].

Actions to promote the use of electric vehicles have also been implemented through decrees, resolutions and laws. Some of these are as follows: (i) Decree 246/012 reduces the specific internal tax for hybrid and electric vehicles [317]; while (ii) Decree 325/017 reduces import tariffs from 23% to 0% for electric vehicles [318]; (iii) Decree 219/019 also exempts lithium batteries for vehicle use and charging systems for electric vehicles from import tariffs for a period of four years [319]; (iv) Decree 02/012 allows companies that purchase electric vehicles for urban cargo transport (utility vehicles) to request a refund of between 27% and 50% of the value of the vehicles through exemption from business income taxes [320], [321]; (v) Decree 259/019 allows commercial vehicle rental companies to access tax exemption benefits, as well as a subsidy for the purchase of electric buses [322]. Likewise, progress is being made in further restricting the emissions standards that must be met by the different categories of internal combustion vehicles such as buses and light-duty vehicles [315].


Sierra de los Caracoles wind farm, Uruguay

5. By receiving assistance in the implementation of its NDC, the country commits to increase the level of ambition of these goals, increasing the number of electric vehicles by 2025 to 110 buses and 900 electric taxis on public transport, 900 utility vehicles, the replacement of 5% of the private vehicle fleet to electric by 2025 and the creation of a national network of charging infrastructure including direct current charging stations [316].

The NDC of Uruguay establishes the introduction of 15 electric buses, 150 electric public transport taxis and 150 electric utility vehicles by 2025.

Electric vehicles and charging infrastructure

In Uruguay, the fleet of electric vehicles until August 2019 reached 206 units, of which 92 are in operation at the national energy company UTE (electric utility vehicles) and 54 are taxis. In terms of hybrids, both plug-in and non-plug-in, until 2018, 1.005 units were sold [315].

For the charging infrastructure, charging stations were installed along the entire coast of Uruguay, constituting the first electric vehicle charging corridor in the region in 2017, located in several points in the interior of the country and in several areas of Montevideo. The goal is to install charging stations throughout the country, with a distance of no more than 60 km from each other, in the first half of 2020 [323].

In addition, the electricity company UTE offers differentiated hourly rates for charging electric vehicles for residential and medium consumers, as well as in its public charging stations [324], [325], [326]. In the country, a project financed by the Global Environment Facility (GEF) called MOVÉS (efficient and sustainable mobility) is being implemented, through which, among other activities, tests have been financed for companies so that they can test electric utility vehicles for a period of one month and free of charge [324]. From this project, a commitment was made to the State Insurance Bank through which a line of bonuses is offered for insurance of all types of electric vehicles (from electric bicycles to electric cars, trucks and buses) [327], [328].

The project also promotes the so-called Institutional Plans for Sustainable Mobility, through which companies and educational institutions carry out a participatory process to propose and implement measures that facilitate routine travel to them in more sustainable ways [329].

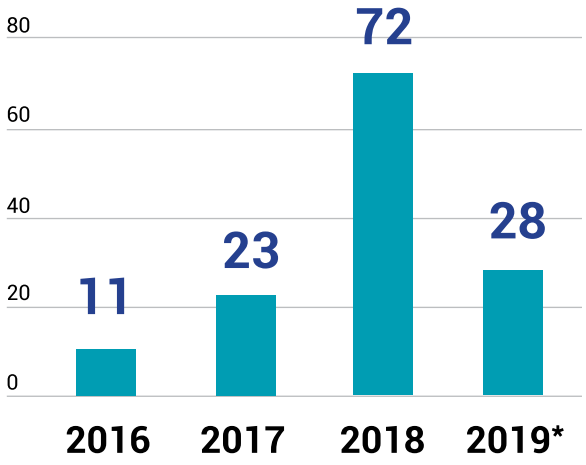
Electric public transport

The country has experimented with electric buses for public transport since 2016. To date, there are two electric buses in circulation and 11 hybrid buses. Due to the good results, it was determined that electric buses are adequately adapted to the operating conditions of the city of Montevideo, which led to the addition of 30 additional electrical units in 2020 [330].

To facilitate the introduction of electric buses in the Uruguayan city public transportation fleets, the government has implemented a new subsidy in addition to that granted to public transport

Figure 14.

Light-duty electric vehicles
in Uruguay between 2016 and 2019



Source: Ministry of Housing, Land Management and Environment of Uruguay [315]

through the diesel consumed [322]. To facilitate the introduction of electric buses in the Uruguayan city public transportation fleets, the government has implemented a new subsidy in addition to that granted to public transport through the diesel consumed [331], [332].

In terms of taxi services, Uruguay has 54 electrical units in circulation [315], which belong to various companies and even individuals. Electric taxis pay only up to 50% of the circulation permits compared to internal combustion equivalents.

Citizen participation, education and business

Different institutions have shown interest in the subject, but the institutionalization of a board to coordinate efforts and promote electric mobility in the private sector is still pending. The "MOVÉS" project [329] is working on the generation of an electric mobility board, which would be made up of private sector institutions and chambers of commerce, business chambers and associations, with the goal of coordinating integrated efforts from the private sector to join the promotion that the public sector has been doing for several years [333]. On the other hand, the Uruguayan Association of Renewable Energies (AUDER) is an civil society association and also works on issues related to electric mobility [334].

Since 2016, an annual electric mobility show (MUEVE) has been held to bring technology closer to different actors, with the first Electric Mobility and Smart Cities Show in 2018, led by the Automobile Club of Uruguay and the International Federation of Automobiles Region IV [335], [336].

RECOMMENDATIONS

Torre Mayor, Mexico City, Mexico.
Credit: Alexis Tostado, Unsplash.

This study shows that electric mobility is a reality and is beginning to gain traction in the countries and cities of Latin America and the Caribbean. The different countries of the region present multiple possibilities to undertake the transition towards a cleaner mobility, considering that there are significant differences between the trajectories, needs and opportunities of the different countries according to size, development of their industry, market, state of their legislation, etc.

However, we are still at an early stage of technology adoption. To put this in perspective, according to data from the International Organization of Motor Vehicles (OICA), in 2015 there were approximately 126.3 million vehicles on the road in Latin America and the Caribbean [337]. According to estimates in this study, a little over 6,000 new electric vehicles were registered between 2016 and 2019.

Electric mobility in Latin America and the Caribbean has enormous potential that goes beyond the transport sector. This technological advance brings integrated benefits in the rational use of energy; in the quality of the air that is breathed in urban centers, besides being an important measure of climate action that seeks to achieve the commitments acquired by the countries under the Paris Agreement. It also has the potential to become a new engine of development for the region.

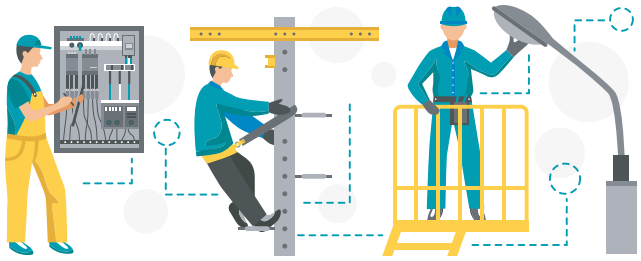
However, it must be understood that electric mobility is only one component in the broader picture of sustainable mobility. While efforts in this area will be extremely important, other improvements in mobility services in general should not be neglected, such as increased road safety, accessibility of infrastructure for pedestrians and cyclists, improvement of the

quality of service of mass mobilization modes, greater efficiency in cargo transport and logistics, among others. All these actions that can be carried out in the sector must ensure the well-being and quality of life of the inhabitants and contribute to the efforts in the fight against climate change and the improvement of the environment. In this sense, it is imperative to emphasize the role of cities. According to UN-Habitat data, nearly 80% of the population in Latin America and the Caribbean lives in cities, and the number of cities has increased six-fold over the past 50 years [9]. As a result, most energy consumption and mobility needs are in urban centers. While this represents a challenge, it also creates an opportunity to put cities at the center of the solutions to be implemented. Based on the analysis, common lines of action are identified among the countries for the promotion of electric mobility.

Establishing a strategy at different levels and time horizons

It is crucial to develop a clear medium- and long-term roadmap to provide certainty to private investment towards electrification of the transport sector. Countries should set goals that will facilitate subsequent monitoring and evaluation of the progress made and thus readjust their strategies and plans. Goals have mainly been defined for public transport and light-duty vehicle fleets. At the same time, countries must make efforts to adopt more demanding regulations on environmental quality and emissions from fossil fuels. To date, the countries of the region are still below the Euro 5 standard, many even in Euro 3 standard, and few are developing or have approved regulations to implement Euro 6.

Monitoring efforts and increased requirements apply to governments as well as to vehicle manufacturers, assemblers or importers. Decisions taken today in the transport sector will define the future landscape. Many cities are renewing large bus fleets with internal combustion technologies, which will remain on the market for at least 15 years. This will create a technological lock-in for many years and could divert the region from meeting the objectives of the Paris Agreement.



Planning the electricity network taking into account electric mobility

A vital aspect, and one that can still be explored further, is the integration of the electricity grid at national and local level with the charging infrastructure needed to enable the development of large-scale electric mobility. While consideration has been given to the need to study the expansion of electricity generation capacity, attention must also be given to the impact and potential for integration of the charging infrastructure with electricity distribution and transmission systems. Therefore, appropriate consideration should be given to the type of technology that is best suited to the service to be electrified, as well as the one that best serves the electricity system. As mentioned above, Latin America and the Caribbean have enormous potential for the development of renewable energies. Some countries have already managed to produce almost all of their electricity consumption from renewable sources, while others still depend mostly on hydrocarbons. At the same time, one of the largest energy consumers at the regional level is the transport sector. Thus, through the penetration of renewable energy sources for electricity generation and the electrification of the transport sector, dependence on hydrocarbon imports

would cease, improving the countries' position on energy independence. The coupling of these sectors can contribute to cost-effective decarbonization by realizing synergies and interrelationships between different parts of the economy, obtaining potentially higher economic benefits and greater climate change mitigation impact. Renewable energy management and transport electrification could offer economies of scale, better demand-side management, flexibility in energy storage and the generation of optimized investments in both sectors.

Promoting inter-institutional and intersectoral articulation

The promotion of electric mobility is bringing together sectors that have not traditionally had to work together. Although it is considered a transport issue, it involves the energy sector and all its actors in the electricity sub-sector, from generators to electricity traders. In addition, the ministries of finance or treasury must be part of the conversation, especially for the fiscal incentives that are to be provided. Public and private banks and the insurance sector must be involved in the discussions in order to know in greater detail what the needs are and the real associated risks, and thus create specific strategies for these sectors.

Prioritizing support for electrification of public transport systems

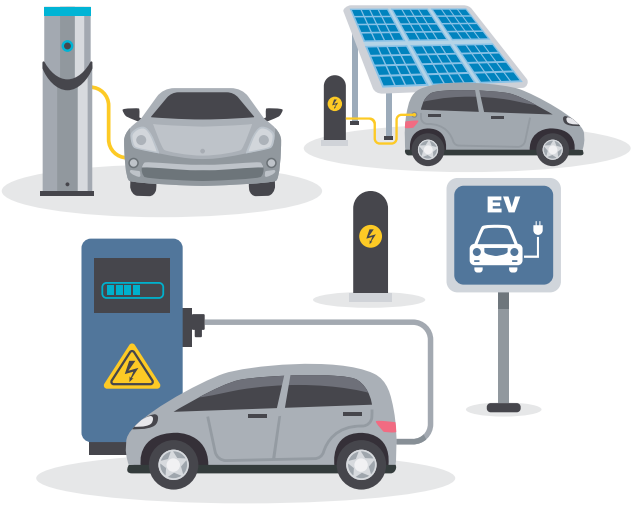
The region shows clear progress in the implementation of demonstration projects for electric buses and taxis. The high incidence of public motorized transport services in polluting emissions, as well as their social impact, justify the prioritization made by all the countries of the region for electrification.

Several countries are testing the technology to promote replication and further scaling up. The electrification of public transport offers the opportunity not only to improve transport units, but also to open the door to the formalization and modernization of these services. Pilot projects and associated analyses should be comprehensive and technology-demanding to determine their technical and financial feasibility, explore implementation processes, and document new partnerships to explore how electric public transport can provide a better experience for users and people who use the service and work in the sector.

In relation to taxis, there is a latent opportunity to remodel current regulations in order to update this sector in light of technological changes, as well as the entry of private transportation services. Due to the intensive use of these fleets, and the pollution they generate, specifications of technological characteristics of vehicles oriented towards electric mobility could be included.

Some countries in the region need to pay attention to the growth of their motorcycle fleets and how these and other three-wheeled vehicles can be electrified to seek improvements in energy efficiency, reduced air pollution and noise, with special attention to improving road safety.

No less important will be the support given to bicycles and other personal mobility devices that are powered by electric motors. These will be indispensable in the transition towards more sustainable and integrated mobility, as they will make it possible to solve the problem of the last kilometer or last mile and of short urban journeys.



Addressing electric mobility as a distributed energy resource

Initially, in several Latin American countries, the term "electrolineras" was coined to denote public charging stations for electric vehicles, as akin to stations that dispense liquid fossil fuels ("gasolineras"). However, this term fails to capture the potential that electric vehicle charging can bring. As discussed above, as electric vehicle fleets and associated charging infrastructure increase, it is increasingly important to promote interoperability and standardization of infrastructure, charging management and marketing systems, as well as the use of vehicles to provide ancillary services to the electricity grid.

In terms of electric vehicle charging, electric companies or charging operators could partner to increase the coverage of electric vehicle charging infrastructure and enable a universal system or network within countries and at the regional level. Electric vehicle users could identify themselves to this system and manage their energy transactions.

Similarly, a large number of new added values can be added to the electricity system, such as demand management and energy storage through two-way energy management between vehicles and the electricity grid, as well as services in remote or isolated areas and in emergency situations

Facilitating the exchange of experiences and strengthening capacities

At the regional level, the exchange of knowledge and experiences, both successful ones and lessons learned, should be encouraged. As stated, there is no single solution, but there are similar challenges that can benefit from a regional approach. This enrichment will allow the region to move forward more rapidly and, thus, be able to consolidate the entire region as an important driver in the global electric vehicle industry. At national and sub-national levels, countries and cities must create spaces for feedback with the different sectors related to electric mobility to facilitate this transition. Regular meetings, both at the technical and decision-making levels, are important for advancing the various instruments promoted by the countries. The training aspect is especially relevant both for the generation of new talent and for people who could see their work threatened by the deployment of electric mobility. An effort must be made to update the curriculum at the different levels and to give people the tools of knowledge so that they can be part of this technological transition. Likewise, technical and administrative training processes aimed at the public sector are crucial to generate capacity to plan, design, purchase and even operate fleets of electric vehicles.

Encouraging and accepting the introduction of new business models and financing structures

The different national and/or sub-national governments have encouraged the appearance of new business models that promote the massive deployment of electric vehicles: from the possibility of

selling electricity to companies outside the traditional industry to the integration of electricity distribution companies in the urban transport service business, including the commercial use of the second life of the batteries. Thus, the generation of new businesses and forms of financing, both structures and products, facilitates and encourages the process of transport electrification. On the other hand, in order to increase the possibilities of project implementation and to diversify financing sources, the search for alternative sources to the traditional ones has been encouraged, such as: international investment funds, development banks, green funds, concession debt, etc.

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Annexes

Annex 1. Synopsis of Law No. 1964 of Colombia

Law N° 1964

Source

https://dapre.presidencia.gov.co/normativa/normativa/LEY%201964%20DEL%2011%20DE%20JULIO%20DE%202019.pdf

Date of publication

11 July 2019

General measures

The rates applicable to electric vehicles may not exceed 1% of the commercial value of the vehicle

Purchase incentives

The rates applicable to electric vehicles may not exceed 1% of the commercial value of the vehicle

Incentives to use

• Temporary discount on the technical-mechanical revision

• 10% discount on insurance premiums

• Exclusion of vehicular restriction

• Designation of a minimum percentage of preferential parking

Charging infrastructure

• Municipalities, with their exceptions, must ensure within their territory at least 5 fast charging stations within 3 years
-- Bogota must guarantee at least 20 fast charging stations.

• The low supply of electric vehicles cannot be a reason to exempt municipalities from this provision

• Requires regulation of technical guidelines for electrical connections (or planned ones) of charging stations in residential and commercial buildings

Public transport

• Municipalities, with their exceptions, must have a minimum quota of 30% of the public transport fleet

• Cities with Mass Transport Systems should implement policies to require a percentage of purchased vehicles to be electric or zero emissions, gradually increasing from 10% in 2025 to 100% in 2035.

Sale of electricity

It does not refer to this issue.

Scope

• National implementation.

• Exclusive to zero emission and electric vehicles, auto parts, assembly equipment and charging stations

Annexes

Annex 2. Synopsis of Law "No. 9518 Incentives and Promotion for Electric Transportation" of Costa Rica

Law N° 9518

Incentives and promotion for electric transport

Source

http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=85810

Date of publication

25 January 2018

General measures

• Defines incentives for the purchase and use of electric vehicles and its parts

• Promote government fleet purchases

• Allocation of roles and responsibilities for government institutions, including investments in public charging infrastructure

• Replacement of 5% of the public transport bus fleet every 2 years

• At least 10% of new taxi concessions must be electric

• Empowers the national banking system to implement specific credit lines

Purchase incentives

• Sales tax exemption *

• Exemption from selective consumption tax *

• Exemption from customs value tax *

*** Exemption from 0 to 100%, depending on the CIF value of the vehicle within 5 years**

Incentives to use

• Exemption from annual property tax, 100% in year 1.80% in year 2, and so on up to 20% in year 5 and 0% in year 6

• Exclusion of vehicular restriction

• Exemption from payment of parking meters

• Use of preferential parking ("blue")

• Distinctive plate

Charging infrastructure

Requires the construction of charging stations every 80km on national roads and every 120km on cantonal roads

Public transport

• Replacement of 5% of the public transport bus fleet every 2 years

• At least 10% of new taxi concessions must be electric

Sale of electricity

• Limits electricity sales to distribution companies with their respective public service concession

• Designates to the Regulatory Authority the sale rate of the public charging stations

Scope

• National implementation.

• Exclusive to electric vehicles, auto parts, assembly equipment and charging stations