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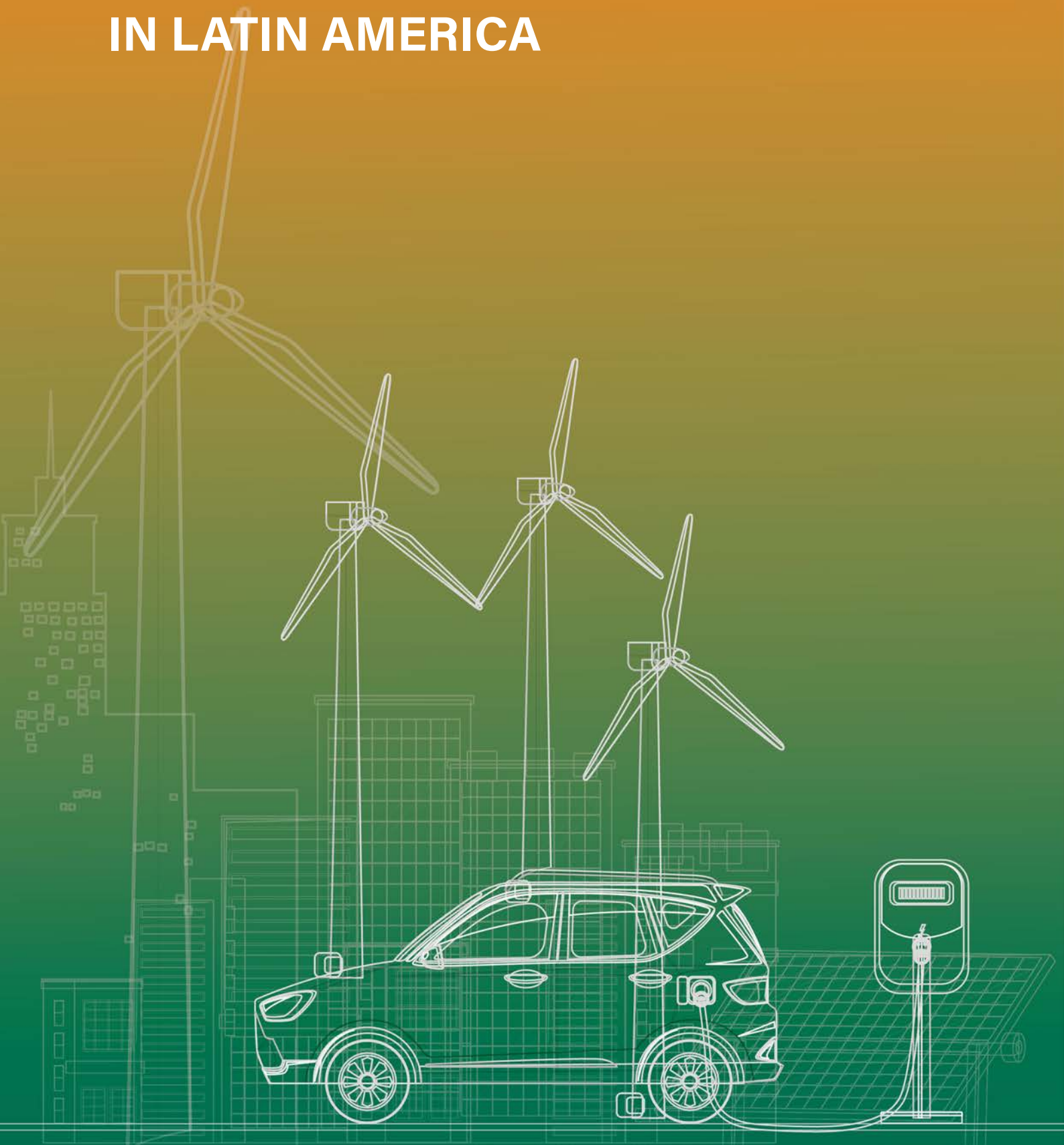
THE DISTRIBUTION GRID AS AN ENABLER OF ELECTRIC MOBILITY IN LATIN AMERICA



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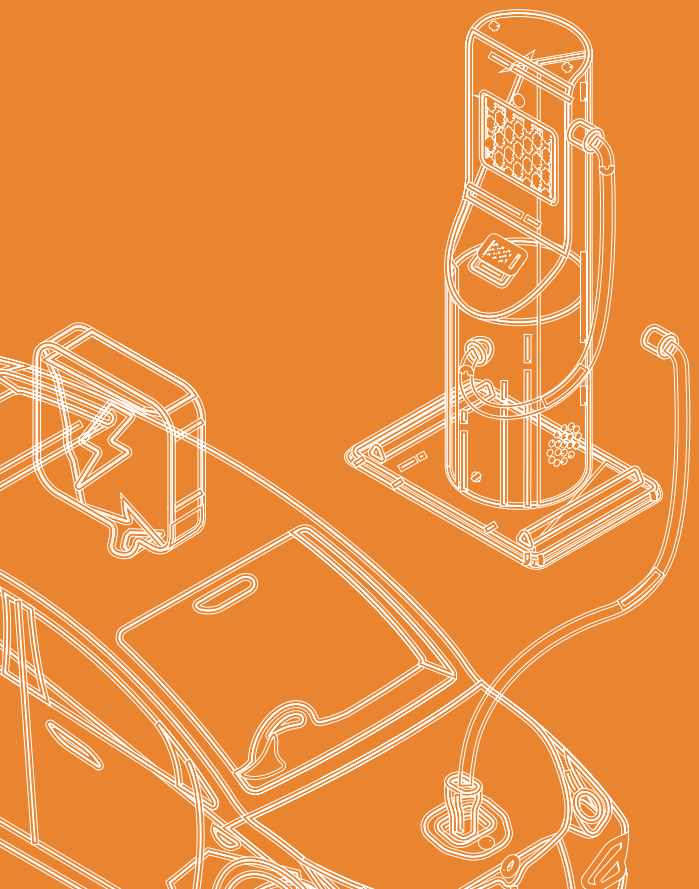

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PREFACE

The electrical grid, as a highly pervasive integrator, is essential not only for enabling electric vehicle charging but also for ensuring efficient and environmentally sustainable operation.

This involves not only providing the necessary physical infrastructure to deliver electricity to vehicles but also assigning a crucial role to the grid operator. The operator must adapt infrastructure, manage demand, integrate renewable sources, implement intelligent technologies, develop appropriate regulations, and ensure system resilience and security.

This enabling role is essential to provide the necessary confidence to electric vehicle users and to facilitate the growth and widespread adoption of electric vehicles, contributing to the transition toward a cleaner and more sustainable transportation system.

Jorge Sanchez Cifuentes
Innovation Focal Point at Enel Iberia

INTRODUCTION

The Sustainable Development Goals (SDGs) related to energy use seek greater energy efficiency across the entire consumption chain, which implies assigning equal importance to both energy generation and consumption in different sectors of society. Electric mobility emerges as a key component in these goals by enabling the integration of renewable sources with a low carbon footprint, and doubling energy efficiency compared to mobility based on internal combustion, while reducing emissions of particles and greenhouse gases.

The advantages of electric mobility are undeniable, but its real impact will depend on the implementation, the speed of its adoption, and the specific characteristics of each region. The purpose of this document is to provide a comprehensive view of the advantages and challenges of electric mobility development jointly with the development of electrical infrastructure for the Latin American context, emphasizing the importance of synchronizing these developments to facilitate the energy transition and leverage underlying new technologies. In this way, the document aims to offer a comprehensive understanding of the impact of electric mobility and the role of the DSO (Distribution System Operator) as an enabler of the sustainable transformation of mobility and energy in the region.

This document contains contributions from companies associated with ADELAT and input from members of the Latin American Association for Sustainable Mobility (ALAMOS).

02

CURRENT STATE OF ELECTRIC MOBILITY IN LATIN AMERICA

A. Growth in Adoption of Electric Vehicles

Electric mobility has experienced growth of more than 260% in the most representative countries of Latin America (Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Dominican Republic, and Uruguay) over the last two years. During the first half of 2023, Mexico experienced a 30% increase in electric vehicle sales, Chile recorded a cumulative increase of 17% between January and April, while Ecuador and Uruguay stood out with growth of 80% and 68% respectively in the first four months. Costa Rica saw significant growth, doubling the entry of electric vehicles during that semester. These data reflect a trend of electric vehicle adoption in the region, driven by a combination of factors, including environmental concerns, the reduction in battery costs, and the increase in the availability of electric vehicle (EV) models. However, the EV market is still emerging compared to developed countries.

B. Electric Charging Infrastructure

Likewise, the infrastructure for electric vehicle charging in Latin America is in an active development phase. The availability of charging stations is a crucial factor for the success of electric mobility in the region.

Currently, charging networks are being implemented in key cities, showing a significant effort to meet growing demand. Brazil already has about 2250 public charging points, while in Mexico there are around 1631, this same trend is observed in Chile (471), Costa Rica (400), Colombia (347), Argentina (149), and Uruguay (97).

Energy companies are playing a crucial role by investing in the expansion of this infrastructure, marking promising progress. This momentum reflects the growing awareness of the importance

of charging infrastructure to support the transition to electric mobility in Latin America.

C. Government Incentives and Regulations

The impact of public policies on the development of electromobility in Latin America is very important, as they can facilitate or hinder the transition to cleaner, more efficient, and sustainable transportation. Countries that have adopted public policies with comprehensive incentives or focused on promoting EV achieved better performance in sustainable mobility. Some of the aspects that public policies can influence are:

- The supply and demand of electric vehicles, through economic, tax, regulatory, and normative incentives that stimulate their acquisition and use.

- The charging infrastructure, through the promotion of public and private investments, the definition of technical standards, and the regulation of the charging services market.

- The integration of electric mobility with the energy system, by promoting renewable energy generation, demand management, and optimization of the electrical grid.

- The social and territorial inclusion of electric mobility, through the development of electric public transportation systems, the promotion of electric micro-mobility, and attention to the needs of the most vulnerable population.

- The innovation and industrial development of electric mobility, by supporting research, technological development, training, and creation of local value chains.

Many countries in Latin America have implemented incentives to encourage the adoption of electric vehicles. These include tax exemptions, discounts on the purchase of electric vehicles, and preferential parking policies. Regulations are also evolving to promote electric mobility as a key factor in achieving CO2 emission reductions. Local governments also have an important role in ensuring that city planning defines the enablers for the growth of networks, promoting space for substations, underground lines, and construction norms in dense regions. Some examples of government incentives are as follows:[1]

Chile: Has implemented economic and tax incentives to promote electromobility, as well as pilot projects for electric public transportation. It also has an energy efficiency law and a national electric mobility strategy.

Colombia: Has more than 1,500 electric buses and almost 640,000 with vehicular natural gas, making it the regional leader in clean public transportation. It has also promoted the bicycle as a means of transport, with more than 900 km of bike paths in the country.

Costa Rica: This country has established its incentives exclusively for 100% electric vehicles, and its goals are directed towards zero-emission mobility. It has an incentives law since 2018 and a charging network that covers the entire national territory. In 2024, it began the deployment of light and heavy-duty 100% electric vehicles, including trucks and vans of up to 40 tons.

El Salvador: The Law for the Promotion

1 - Regulatory incentives by country can be consulted at: https://blinkcharging.mx/beneficios-exclusivos-para-vehiculos-electricos-en-latinoamerica/

and Encouragement of Electric and Hybrid Transportation Means is pending legislative approval of reforms that will allow greater openness to the entry of electric vehicles. Dealers of recognized brands have introduced PHEV (Plug-in Hybrid Electric Vehicles) that are having a lukewarm acceptance in the market. In the next administration, the fleet of national 4-wheel vehicles is estimated to be replaced by 10% with electric units, and national motorcycles will be replaced by 20% with electric ones.

Mexico: Has developed public policies to promote sustainable mobility, such as the Hoy No Circula program, the Ecobici shared bicycle system, and the Metrobus.

Peru: Supreme Decree 022-2020-EM established that the Battery Charging Service for electric mobility has a commercial character and is carried out under competitive conditions (electrolineras); the Regulation for the Installation and Operation of the Electric Mobility Charging Infrastructure (ICME), has the following objectives: (i) to generate a regulatory framework to guide the different actors involved in the installation, adaptation, and operation of the electric mobility charging infrastructure; and (ii) to establish the minimum requirements for installation, operation, safety, and maintenance that the charging infrastructure must meet, as well as the design and construction of its facilities.

Uruguay: Has been a pioneer in the region in the electrification of transport, with a fleet of electric taxis, buses, and trucks. It has also encouraged the use of hybrid and electric vehicles through tax exemptions and tariff benefits.

The following table summarizes the comprehensive framework of policy, regulation, and incentives for electromobility in a sample of Latin American countries:

Tabla 1: Framework of Policy, Regulation, and Incentives for Electromobility.

Areas	Componentes	Argentina	Brazil	Colombia	Ecuador	Mexico
Standardization and Interoperability	Energy efficiency					
	Operation of electric vehicles					
	Charging infraestructure					
	Vehicle-to-grid communication					
	Emissions from light vehicles					
Circulation and Reliability	Access to exclusive HOV or bus					
	Preferential/free parking					
	Exemption from vehicular restriction					
	Discounts on circulation payments					
	Charging infraestructure					
Expansion of Offer and Facilitation of Acquisition for Users	Subsidies					
	Tax exemptions					
	Post-purchase discounts					
	Income tax credits					
Generation of Enviroments Promoting Electromobility	Shared transporation services					
	Secondary use for batteries					
	Leasing					
	Environmental commitments					
Interrelation with Electricity Sector	Distributed generation					
	Dynamic tariff by time of use					

Source: Kerrigan (2022). Políticas públicas relacionadas con la electromovilidad en América Latina y El Caribe.

Considering the current context and the forecast for future growth, it is essential to focus on the implementation of regulations that require charging stations in new buildings and parking lots, as well as the implementation of incentives to adapt charging points in existing buildings. Some countries already have such regulations, as is the case in Argentina. As the demand for electric vehicles grows, governments must balance attracting consumers with incentives while addressing concerns about an effective charging station network.

Investment in infrastructure, collaboration with stakeholders, adoption of technologies, and transparency are essential to create a robust ecosystem that supports the widespread adoption of electric vehicles. Only through a comprehensive approach can governments achieve a balance between incentives and the consumer's need for a reliable and accessible charging network.

These investments also require funding sources. In this sense, multilateral institutions such as the Inter-American Development Bank (IDB) have promoted and financed initiatives for the adoption of electric vehicles in the region, through loans and technical assistance for the development of charging infrastructure, electric public transportation systems, and incentive programs for the purchase of electric cars. It has also published studies and guides to help governments design policies and regulations that facilitate the transition to electric mobility, as seen in the following image:

Graph 1. IDB Activities in Support of Electromobility in Latin America

Source: Inter-American Development Bank (IDB).

D. Challenges and Obstacles

Despite evident progress, the adoption of electric vehicles in Latin America faces significant challenges. The initial barrier has been the high initial cost compared to internal combustion vehicles, but price reduction also depends on greater competition in the market by importers and sellers, which drives the need to implement strategies to reduce the price gap and promote tax incentives, so that electric vehicles are more accessible to consumers. In addition, the lack of public awareness about the technology, its benefits, and the perception of limited initial autonomy[2], requires educational programs to boost consumer acceptance and confidence.

From a technological and regulatory standpoint, it will be necessary to have clear and comprehensive standards for the development of an efficient and accessible charging network, promote battery manufacturing, drive battery management and recycling projects, provide specialized technical training, develop a local supply chain that encompasses components and services linked to electric vehicles, grant tax exemptions, provide incentives for electric mass transportation, and set more ambitious goals in emission reduction, among other initiatives.

All this requires a stable framework that attracts the necessary private investments and allows the recovery of investments with a reasonable profit. The remuneration model of electric utilities as key players can be decisive in undertake investments and it should be valued that the investments made are recognized from a real asset base (RAB) scheme, so adjustments may be required in the regulatory models of those countries where the remuneration scheme allocate a significant risk to the distributor that their investments are not fully recognized by the Regulator. The holistic integration of these efforts will significantly contribute to overcoming challenges and accelerating the mass adoption of electric vehicles in the Latin American region.

2- From the 100 km range of the first models, the models sold in 2023 stand out, allowing ranges according to WLTP greater than 400 km: https://autoesporte.globo.com/testes/comparativo/noticia/2023/10/byd-dolphin-x-gwm-ora-03-compare-preco-motor-autonomia-tamanho-e-equipamentos.ghtml

03

BENEFITS AND ADVANTAGES OF ELECTRIC MOBILITY IN LATIN AMERICA

Electric mobility offers benefits and advantages for Latin America that range from reducing pollution to boosting the local economy.

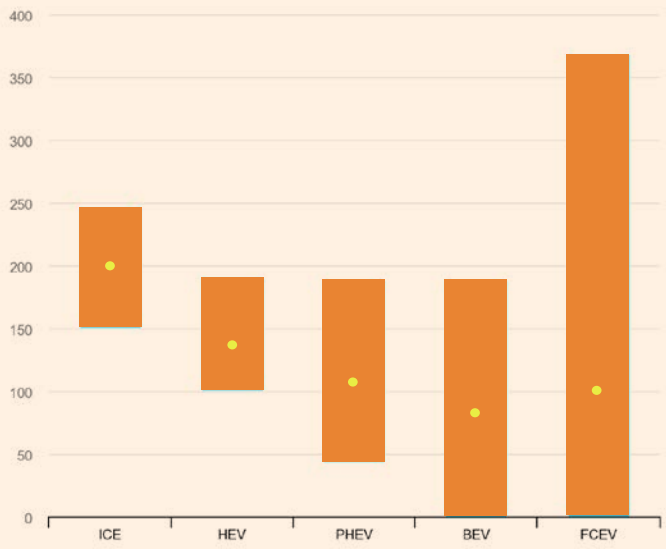
A. Impact on Emission Reduction

Latin America must reduce its carbon footprint by two metric tons per capita annually (2tpc) by 2050, especially in the energy and transport sectors[3]. Transport is the largest contributor to greenhouse gas (GHG) emissions in Latin America, where it accounts for 34% of global GHG emissions related to energy, in contrast to OECD countries where it represents 28%[4]. GHG emissions from the transport sector have been growing globally at the highest rate since 1970. Among the reasons is the increase in motorization with internal combustion vehicles as per capita GDP grows.

To mitigate the potential emissions of the sector, policies aimed at reducing the energy intensity of combustion vehicles must be promoted, so it is necessary to decisively advance towards emission-free mobilization modes, especially electric mobility. Without any change in policies, emissions from the transport sector could increase significantly more than those of other sectors, with the consequent environmental impact that this would entail. Electric mobility, together with renewable generation, contributes lower emissions compared to conventional mobility according to the IEA's "Global Electromobility Outlook 2022" report, which collects emissions for each type of technology:

3 - IDB (2013). "The Climate and Development Challenge in Latin America and the Caribbean".
4 - Kerrigan, G. (2022). "Public policies related to electromobility in Latin America and the Caribbean."

Graph 2. GHG Emissions, from Production to Use, by Vehicle Type (gCO2-eq/km)



Source: IEA, "Global Electromobility Outlook 2022".

For Latin America, the differences can be measured based on the generation mix of each country, and the savings in emissions by country can be seen in the following table[5]:

Tabla 2: Average Emission Savings by Country due to Electric Mobility.

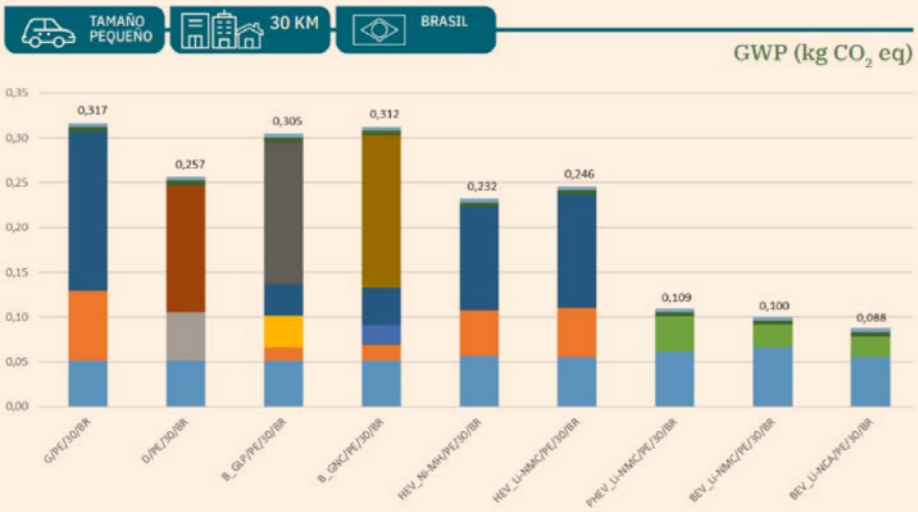
País	Emisiones de Electricidad gCO2/kwh	BEV kgCO2/100 km	BEV kgCO2/año	Economía promedio de emisiones BEV / ICE
Chile	392	6,27	627,2	63%
Argentina	413	6,61	660,8	61%
Perú	150	2,4	240	86%
Brasil	71	1,14	113,6	93%
Ecuador	319,3	5,11	510,88	69%
Colombia	168	2,69	268,8	84%
Guatemala	407	6,51	651,2	61%
Uruguay	43	0,69	68,8	96%
México	653,8	10,46	1046,08	38%

5 - Mexico: http://www.cec.org/sites/default/napp/es/greenhouse-gases.php
Ecuador: https://www.revistasocialfronteriza.com/ojs/index.php/rev/article/download/48/74/363
Rest of countries: https://app.electricitymaps.com/map

However, a more comprehensive calculation must consider the impact on both emissions and carbon footprint of both mobility solutions throughout their life cycle (LCA). These figures could increase by 50-60 gCO2/km for internal combustion vehicles according to the Goldman-Sachs study "New era in CO2 regulation: EVs to be tested across life cycle, not only on running performance", while for electric ones it will depend on the emissions of the electric generation, which could increase by 100-120 g CO2/km depending on the energy mix[6].

This effect is verified in the carbon footprint impact study conducted by the Basque Ecodesign Center (2020), which analyzed 405 cases on 9 propulsion technologies[7], and identified that, in the case of Brazil, when comparing a small vehicle that travels an average distance of 30km, it is observed that electric technology has an impact on emissions of just a third compared to the impact of its gasoline equivalent.

Graph 3. Comparative Impact on Climate Change by Vehicle Technology



Gráfica 66 – Comparativa del impacto en cambio climático de las 9 tecnologías contempladas para un vehículo de tamaño pequeño (PE) realizando el recorrido urbano de 30 km, que circula por Brasil (BR) (kg CO_2 eq.)

Source: Basque Ecodesign Center (2020).

Since electric vehicle emissions are zero at the point of consumption, emission points of both greenhouse gases and particles are concentrated in the generation and manufacturing centers, making it easier to control and reduce them using filtering means. In addition, non-renewable electricity production sources are usually located away from cities, so the impact of electricity use on air quality and population health is lower.

Benefits are also identified in relation to the reduction in the generation of hazardous waste such as used oils, greases, degreasers, among others, which cause high contamination to the soil and water as a result of their improper handling. In this same sense, there would be a reduction in the materials that may come into contact with these environmentally hazardous products, meaning less consumption of raw materials and emissions related to the logistics of oils.

6 - Transportation Energy Institute (2021). Life Cycle Carbon Emissions of Electric and Combustion Vehicles.
7 -Basque Ecodesign Center (2020). Environmental comparison between different vehicle alternatives.

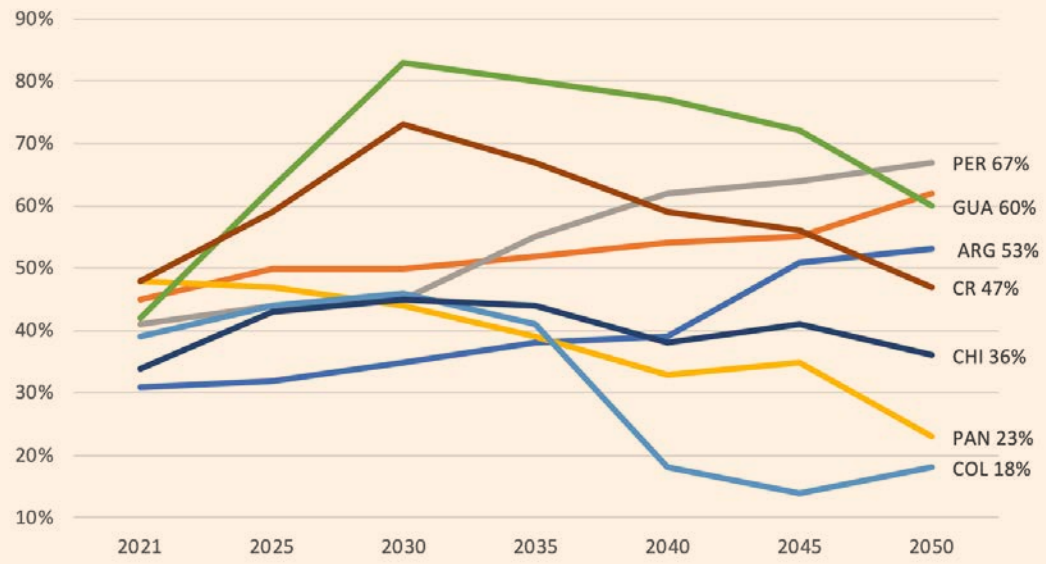
Potential for Emission Reduction in Latin America

In 2022, Enel Group - in collaboration with Deloitte - conducted prospective studies for the 8 Latin American countries where it operates on the Energy Transition Roadmap to 2050, projecting possible decarbonization trajectories for both energy supply and demand, as well as identifying the main enabling public policy recommendations to drive the transition and achieve net-zero by 2050.

The studies were carried out using the TIMES application, which is an optimization model that represents the interactions of the entire energy chain over a temporal horizon, modeling supply technologies and end-uses of energy. Simulations were conducted aimed at the technical-economic attention of demand subject to a restriction or path (horizon to 2050) of GHG emission reduction, to achieve net-zero in 2050. The exercise resulted in a set of optimal technologies to supply the end-uses of energy in the analysis horizon.

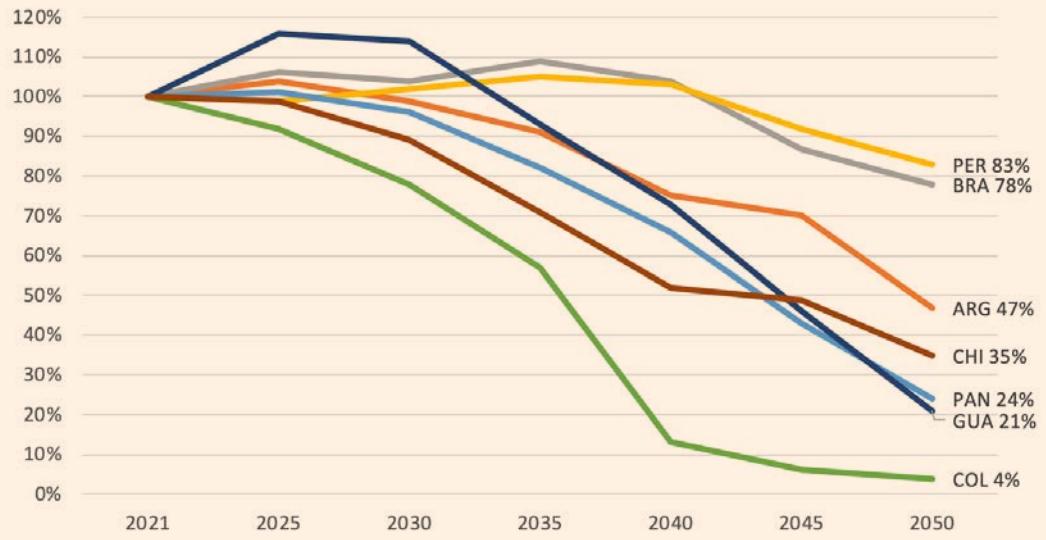
Among the notable analyses of this study, Graph 4 shows that, in 2021, the transport subsector contributed between 31% and 48% of the total emissions of the energy sector in each country analyzed, making it one of the niches where GHG emissions can be reduced the most. The results projected using the TIMES model establish that reductions of up to 96% (Graph 5, Colombia case) can be achieved if decisive policies are implemented in the electrification of mobility.

Graph 4. Transport Sector's Share of Total Emissions.



Source: Enel. Energy Transition Roadmap Latin America (ETR LATAM).

Graph 5. Variation in Transport Sector Emissions Compared to 2021



Source: Enel. Energy Transition Roadmap Latin America (ETR LATAM).

Table 3 presents the evolution of the absolute level of transport sector emissions in the roadmaps for the countries where the study was conducted.

The trend is decreasing in all countries (it is worth noting that each study was conducted by an independent consultant), which allows us to understand that the transition must unequivocally go through the path of transport decarbonization, especially through its electrification.

Table 3. Evolution of CO2 emissions from the transport sector

PAÍS	2021	2025	2030	2035	2040	2045	2050
ARG	47.64	49.58	47.38	43.13	35.51	33.46	22.27
BRA	195.00	206.00	202.00	213.00	202.00	170.00	153.00
PER	25.10	24.80	25.50	26.40	25.80	23.00	20.90
PAN	4.78	4.81	4.57	3.93	3.17	2.04	1.16
COL	38.30	35.20	30.00	21.70	4.90	2.20	1.60
GUA	13.37	15.47	15.29	12.48	9.73	6.20	2.77
CHI	29.31	29.00	26.00	20.90	15.16	14.30	10.31
CR	5.70	5.02	4.18	3.24	2.28	1.79	1.17

Source: Enel. Proyecto Energy Transition Roadmap Latin America (ETR LATAM).

B. Other Environmental and Economic Benefits

Air Quality and Noise Reduction

In a region that often faces air quality problems and noise pollution from traffic noise, the adoption of electric vehicles can significantly contribute to improving the quality and life expectancy of people.

In 2016 alone, more than 80,000 people in Latin America died from diseases related to fossil fuel emissions[8]. The complete transition to electromobility would produce savings of 30 billion dollars in public health in the Latin American and Caribbean region. An assessment of hybrid and electric transportation in operation in the cities of Rio de Janeiro, São Paulo, Bogotá, and Santiago showed the impact of electromobility on the reduction of local pollution. Pilot projects reported an average reduction of nitrogen oxides by 62% and sometimes up to 78%, as well as a decrease in PM1.5 particulate matter by an average of 72% [9].

Likewise, the effect that exposure to permanent noise has on health is important. In Europe, according to the EEA in its 2023 report, "there are at least 18 million people who suffer great discomfort and 5 million who suffer from serious sleep disorders due to prolonged exposure to transport noise." The electric vehicle can help in the reduction given that the noise generated by the electric vehicle can be up to 20db lower at low speeds than that of a combustion vehicle and can reduce the impact in highly populated areas such as cities[10] .

8- Canal Saude. "Cidades da América Latina precisam controlar poluição do ar, diz médica da Opas".
9- IDB (2019). "Electromobility: cleaner, safer and more efficient transportation".
10- Salleh, I. & Md zain, M. Z. & Raja, Raja. (2013). Evaluation of Annoyance and Suitability of a Back-Up Warning Sound for Electric Vehicles.

Economic Opportunities

The transition to electric mobility presents economic and social benefits that can contribute to the sustainable development of the region, as it implies an industrial reconversion that stimulates the adaptation of the automotive industry and generates new job and entrepreneurship opportunities in activities such as battery manufacturing and recycling, charge management, and new businesses in mechanics and review of electric vehicles. This process not only drives technological innovation but also creates high-quality local jobs, strengthening the industrial and technological infrastructure of the region.

On the other hand, the reduction of dependence on fossil fuels through electric mobility can have a stabilizing impact on energy prices, reducing the economic vulnerability of the region. In addition, solar generation presents better energy efficiency compared to the surface used by energy crops, such as ethanol. One hectare dedicated to solar generation produces 23 times more energy than an energy crop. This not only avoids direct competition with food crops but also contributes to reducing pressure on their prices[11] .

Finally, electric mobility can improve the competitiveness and productivity of companies that use vehicles, by reducing their operating and maintenance costs, and increasing the availability and reliability of transportation services.

C. Energy Diversification and Efficiency

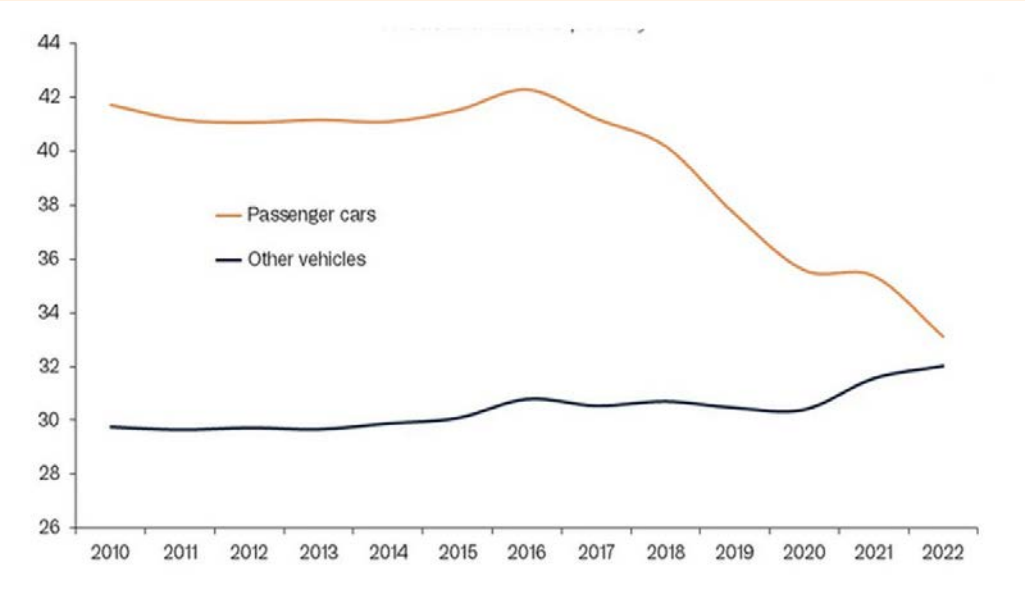
Electric mobility acts as a catalyst for the energy transition and renewable distributed generation. Latin America is rich in natural resources, including renewable energy sources such as hydroelectric, solar, wind, and marine energies. Electric mobility facilitates the integration of these resources into the energy matrix, promoting diversification and sustainability.

Electric mobility can leverage these resources to charge vehicles more sustainably, adding local value, reducing dependence on fossil fuels, and strengthening energy security. In the case of Norway, the high penetration of electric vehicles has allowed a reduction in the demand for hydrocarbons for light mobility by 10% in 2023 compared to the average of the years 2017 to 2019[12]), although its total consumption remains stable by not having reduced other sources of road transport consumption, indicating that it is also necessary to act on public transport and road freight.

“On the other hand, the reduction of dependence on fossil fuels through electric mobility can have a stabilizing impact on energy prices, reducing the economic vulnerability of the region.

11 - NovaCana (2021). “Etanol e gasolina ganharão um novo concorrente no mercado, a energia elétrica”.
12 - Rystad Energy (2023). “Mystery solved: Norway’s persistent road fuel demand won’t last amid rapid EV adoption”.

Graph 6. Estimated Fuel Use in Norway by Vehicle Type (Thousands of barrels per day)



Source: Rystad Energy (2023).

With electric mobility, an improvement in efficiency is projected due to the change in energy (electrification of demand), resulting in a decrease in the growth rate of energy consumption in the transport sector. In the studies carried out in the context of Enel's Energy Transition Roadmap project for Latin American countries, it is evident that, once the transport sector is electrified in the long term, the growth of its final energy consumption moderates or even decreases, as seen in Table 4.

Table 4. Final Energy Consumption Transport Sector (Mton)

COUNTRY	2021	2025	2030	2035	2040	2045	2050
ARG	16.07	16.71	16.29	15.50	13.91	13.59	12.00
BRA	86.09	93.57	99.58	112.94	129.08	139.07	157.35
PER	8.34	8.22	8.43	8.86	9.00	8.93	9.08
PAN	1.57	1.63	1.62	1.51	1.37	1.18	1.00
COL	13.46	12.81	12.47	12.36	11.99	12.60	14.49
GUA	4.37	5.17	5.66	5.41	5.20	4.94	4.72
CHI	9.78	9.86	9.27	8.24	7.09	7.54	8.16
CR	1.86	1.69	1.57	1.41	1.29	1.29	1.29

Source: ENEL. Energy Transition Roadmap Latin America (ETR LATAM).

On the other hand, the massification of electric vehicles encourages the installation of smart charging systems that can be managed to take advantage of periods of lower electrical demand. This flexibility contributes to efficient management of the electrical distribution infrastructure and improves the integration of intermittent renewable sources that enhance the diversification of the energy matrix.

The transition to electric mobility promotes research and development of technologies related to batteries, energy storage, and advanced charging systems. This technological boost not only benefits the automotive sector but can also have advantages due to its production economy to develop new applications that drive the energy transition, promoting a virtuous circle in the electrical sector.

In summary, electric mobility is not only a responsible answer from an environmental and public health perspective but also stands as an driver for economic growth, local job creation, and improvement of energy diversification and efficiency in Latin America. To materialize these benefits, it is necessary for Latin America and the Caribbean to move from pilot projects to the massification of low-emission transport, through comprehensive, coordinated, and participative planning that involves different public and private actors, and that considers the needs and characteristics of each country and region.

“

The massification of electric vehicles encourages the installation of smart charging systems that can be managed to take advantage of periods of lower electrical demand.

D. Experiences in Latin American Cities

Several countries and cities in the region have demonstrated that electric mobility can be successful. Below are the main experiences with the aim that they can serve as a reference and inspiration for other regions.

Argentina:

The government developed a National Sustainable Transport Plan that aims to replace 50% of the vehicle universe with electric ones by 2030 and 100% by 2050[13].

In 2023, the Argentine Association of Electric and Alternative Vehicles (AAVEA) presented the Bill 0126-P-2022 in the National Congress, based on the 'Electromobility Promotion Law' project presented the previous year by the National Executive Power with N° 0016-PE-2021; with contributions derived from the projects previously presented by AAVEA, as well as from legislators, union sectors, business sectors, and the general public.

Brazil:

In cities like Sao Paulo, distribution companies have installed various stations with 20 charging points for their own use and that of their customers. EDP has a charging center at its headquarters with 14 charging points and the E-Lounge with 6 charging points in the Pinheiros neighborhood. EZ Volt has an station with 8 charging points in the Mooca neighborhood.

The "Plug and Go" project of the EDP Group in association with Audi, Porsche, and VW, announced in 2019, has 18 ultra-fast stations that interconnect São Paulo with capitals such as Curitiba, Brasilia, Belo Horizonte, and Rio de Janeiro, in addition to the coast of Santos.

The "E-Lounge" project of EDP in association with Moura Baterias, created a charging center in the Pinheiros neighborhood with an energy storage system "BESS", enabling 6 charging points, two of them fast.

More recently, CEEE Equatorial announced the "Mercosur Electric Route" with 10 fast charging stations covering an extension of 1000 km which, together with the charging stations of Copel and Celesc, distributors of neighboring states, interconnect Uruguay with Paraguay through Brazil.

Electric vehicle manufacturers have also had a significant participation, although many of the charging stations are not connected to the Internet and are for exclusive use by dealers.

Between 2020 and 21, Audi, in association with EDP, installed 21 fast charging points and more than 60 slow charging points at its dealerships, with plans for expansion and change to ultra-fast chargers.

In 2024, BYD announced 600 charging points. BMW, Porsche, Audi, Volvo, Renault, JAC, invested in hundreds of slow and portable chargers delivered to partners and customers.

Logistics companies, such as DHL and Mercado Libre, began the electrification of their fleets, which already total more than a thousand electric vehicles, in projects that include the installation of charging stations at their bases and the use of external stations.

13 - Official Website of the Argentine State. National Sustainable Transportation Plan.

Various companies have emerged to meet this demand for charging stations and management, both focused on software, such as VoltBras and Tupinambá, as well as operational management, charging and installation of equipment, such as WeCharge, EZ Volt, Zletric, GreenV, among others. Some of them have received investments from companies in the energy sector.

Chile:

ENEL recently implemented the Charging as a Service model through which it feeds different fleets of electric vehicles, thanks to the expansive plans of charging points in the region, with more than 550 public charging points and Hubs that allow for larger-scale charges. The fleets served include:

- **TuCar (Uber operator)**, charging more than 250 electric vehicles in Chile monthly.

- **Mercado Libre and Chilexpress**, charging services for more than 120 last-mile delivery vehicles in Chile.

Some of the slow and fast charging centers installed during the year 2023 are:

- **Arauco Park Charging Hub:** 180 alternating current chargers with a power of 7.4 kW and a 150 kW charger at the country's main shopping center. During the day, it is available to the general public, and at night it charges a fleet of electric vehicles for UBER drivers.

- **Las Condes Charging Hub (Santiago Commune):** A rapid charging center in partnership with the municipality.

- **Buenaventura and San Francisco Charging Hubs (Santiago Commune):** Two charging hubs that add up to more than 10 rapid charging points in a logistics area of the Santiago commune.

The alliance between Enel X, Metbus, BYD, and the Ministry of Transport has contributed 86% of the electric buses to the public transport network of the Metropolitan Region[14], through a flexible business model that provides comprehensive support from the acquisition of electric vehicles to the building and maintenance of charging points. With more than 2,000 buses circulating daily through the capital, a reduction of more than 218 tons of CO2 has been achieved in the last 5 years, marking an important milestone on the path to the development of sustainable mobility in the country.

Colombia

The National Government has made commitments and developed policies to promote electric mobility. Through Law 1964 of 2019, the use of electric vehicles in Colombia is promoted through economic and non-economic incentives. It also states that by 2035, 100% of the mass transit system's fleet must be electric, with intermediate goals starting in 2025. The National Electric Mobility Strategy presents actions to accelerate the transition to electric mobility with a goal of 600,000 electric vehicles by 2030. The CONPES 3934 Green Growth document reiterates the goal of 600,000 electric vehicles by 2030, and in the CONPES 3943 Air Quality document, it is established that by 2030, 3% of vehicles must be

14 - BID (2023). Transporte 2050: el camino hacia la descarbonización y la resiliencia climática en América Latina y el Caribe.

zero and low emissions, while 100% of the mass transit system must be operated with electric and natural gas vehicles.

Similar to Chile, Enel has extended the charging as a service model, enabling the development of zero-emission mobility services:

- **Bogotá Charging Hub:** Two charging centers that cover the country's main electric fleet belonging to VEMO (UBER operator) with 120 electric vehicles. The contract's consumption is estimated to be over 1.5 GW.

- **Turnkey Solution Project for Vemo:** 10 chargers of 30 kW to power 90 electric vehicles, with an estimated consumption of 82 MW/month.

The implementation of electric buses in Transmilenio mass transit system in Bogotá has been an innovative response to address environmental challenges and improve air quality in the city. Currently, Transmilenio has 1,485 electric buses (13% of the total fleet) and 10 recharging yards, with approximately 2 buses per charger. Enel owns 6 yards and serves 878 electric buses, 401 of which are its property.

These vehicles operate with an electric motor and rechargeable batteries, eliminating the emission of local pollutants and contributing to the reduction of noise compared to traditional buses that use fossil fuels.

Figure 2. Scheme of the business model implemented by Transmilenio

Source: Transmilenio

The implementation of electric buses has also improved the operational efficiency of Transmilenio. These vehicles have lower operating costs over their lifespan compared to conventional buses that rely on fossil fuels.

The following are some benefits of electric buses identified by Transmilenio:

- With 1kW, an electric bus travels 1km, while a Euro V diesel bus travels 250m.

- The incorporation of electric buses has generated savings of 292,850,000 kWh/year.

- 94,300 tons of CO2 per year have been prevented from being emitted.

Costa Rica:

Costa Rica has set a goal of 100% electric mobility, aiming directly at zero emissions and bypassing other transition technologies, which has allowed it to achieve significant imports of electric vehicles.

Since 2018, Costa Rica has the Law 9518 of Incentives and Promotion for Electric Transport, with a series of fiscal and non-fiscal benefits that have allowed the population to access this technology, with better prices and a very good offer. Additionally, in 2019, this country launched its National Decarbonization Plan, with 10 axes of action, the first three referring to transport: Public Transport, Private and Institutional Transport, and Cargo Transport.

Costa Rica's regulations also refer to charging infrastructure, defining a rapid charging point (type L3) every 120km on regional roads and every 80km on national roads, which has allowed this country to have a robust network of chargers throughout the national territory.

Projects for fleet replacement in delivery units have also been generated, for example, Correos de Costa Rica with its "Zero Emissions Delivery", electric bicycles, and motorcycles on delivery and distribution platforms. Projects for corporate and cargo fleets are also advancing; companies such as Bimbo, Automercado, DHL, Beirute, Bioland, and Walmart already have 100% electric vehicles for administrative tasks and merchandise delivery with SUVs, pickup trucks, trucks, and cargo panels. Recently, the first electric heads with a 50-ton load capacity that operate in the Cutris Sugar Mill were presented.

Ecuador:

The first experience of electric taxis in Loja and electric patrol cars in Cuenca was not successful[15] due to a lack of planning in the sizing of the charging infrastructure consistent with the capabilities of the electric vehicles. However, this situation has provided lessons learned that will be useful for other use cases.

Guatemala:

Decree 40-2022, "Law of Fiscal Incentives for Electric Mobility in Guatemala," aims to promote the use of electric vehicles by facilitating importation through a direct reduction in the import tax, which has increased the number of individual and corporate users.

Recently, the incorporation of electric vehicles into the fleet of a courier company and a well-

15 - La Hora. "Proyecto de taxis eléctricos en Loja fue un fracaso". 14 de julio de 2022.

known beverage company was announced.

It is estimated that by 2029, the country will have more than 7,000 electric vehicles, with a consumption of 5,493 MWh.

Peru:

Some companies in the electric sector are also developing initiatives to promote electric mobility in Peru. In the Ica Region, Electro Dunas, in agreement with the transport companies BYD and Cruz del Sur, installed the most powerful and fastest electric recharging device in Peru. For its part, Enel promoted the first pilot of electric taxis in Peru (a pilot project that was implemented in 2019 and lasted 6 months[16]) and a pilot of a public transport bus.

Generally speaking, there are regional actors that promote the development of sustainable mobility. Such is the case of the Latin American Association for Sustainable Mobility (ALAMOS), which develops activities to promote public policies, strategic alliances, dissemination of good practices, technical advice and training, knowledge and information exchange. In particular, the Association has promoted the creation of networks of electric chargers throughout the region and has led the creation of electric routes in Latin America (Caribbean, Central America, the Andes, North America, and the Southern Cone routes) that connect countries and promote electric mobility at a regional level.

16 - Enel X (2019). "Enel X presentó el primer piloto de taxis eléctricos del Perú."

04

DRIVERS OF ELECTRIC MOBILITY IN LATIN AMERICA

A. Automotive Industry Investments

In the automotive industry, the development of electromobility is an opportunity to relaunch industrial support policies for regional vehicle manufacturing, complementary infrastructure, and control systems, with an integrative vision that takes into account new realities of urbanization, technological developments, and demographic transition.

Brazil, Mexico, and Argentina are the Latin American countries with the greatest automotive manufacturing capacity. Strong Asian competition will largely force the current capacity to be converted to the production of electric models.

The opportunity is unique to grow not only in vehicle assembly but also to take advantage of the region's benefits, such as the availability of lithium (Argentina, Chile, Peru, and Bolivia) and graphite (Brazil), to establish a processing and battery assembly industry key to the development of electric mobility.

B. Business Models, Strategic Alliances, and Collaborations

During the implementation of a new technology, different business models can emerge. Each will determine the speed of implementation, without being exclusive. The development of a recharging network for electric vehicles is crucial to promote electric mobility, and without vehicles on the market, there will be no demand to make it possible. Various approaches have emerged globally to address this challenge, which may be of interest when defining different actions in the region:

- Public Development through Government Investment: Investment in public charging infrastructure to support the adoption of electric vehicles is established by the government through public tenders or remuneration to public service companies. Electric distributors as neutral agents and natural monopolies can be a key piece in the installation of chargers on streets, public parking lots, and urban areas.

- Public-Private Collaboration: Collaboration between the public sector and private companies to develop and operate charging stations. This may include tax incentives or partnership agreements to facilitate private investment, such as the obligation to install chargers at existing service stations or in parking lots, development of charging corridors along strategic routes and highways to facilitate long-distance travel and address range anxiety.

- Private Business Models: Pay-per-use charging stations where users pay for the electricity they consume, similar to how gasoline is paid for at a service station. They will have difficulty finding short-term profitability, so they will require incentives for their development.

- Subscription Models and Flat Rates: Charging by subscription or monthly fees that allow users to charge their vehicles for a fixed monthly fee and will allow the charging station network to grow parallel to vehicle purchases.

- Incentives for Businesses and Commerce: Installation of charging stations in shopping centers, hotels, and other destination places. It can become a commercial strategy to attract customers who own electric vehicles.

- Residential Charging Development: Accelerate the installation of residential charging stations through financial incentives and government programs with the aim of generating demand and reducing initially high purchase prices.

To facilitate this, it is important to streamline the administrative procedures and the connection of charging points. For instance, in Spain, it was necessary to change the horizontal property law so that homeowner communities could not block the installation of private charging points where part of the infrastructure would pass through common areas. Additionally, it is allowed to connect the charging point to the same measurement point of the dwelling, instead of requiring a separate one, which reduces installation costs.

- Strategies for Urban Areas: Prioritizing the installation of chargers in urban areas to meet the needs of electric vehicle owners who live in apartments and do not have access to private parking.

- Smart Charging Programs: Implementation of intelligent charging management systems that optimize the availability of the electrical grid and take advantage of dynamic rates. In this way, demand is balanced, and operational costs for users and charging service providers are reduced.

- Electric Shared Vehicle Initiatives: Collaboration between shared vehicle companies and electric mobility providers to integrate fleets of electric vehicles. In this way, access to shared electric vehicles is provided, increasing the visibility and acceptance of this technology.

- Integration with Renewable Energies: Collaboration between electric mobility companies and renewable energy producers to supply chargers with clean energy. It contributes to more sustainable mobility by using renewable energy sources and reducing the carbon footprint.

- Digital Charging Service Platforms: Development of digital platforms that allow users to easily find and access charging stations, make payments, and monitor consumption. In this way, the user experience is improved, and efficiency in the use of charging infrastructure is promoted.

- Agreements with Battery Manufacturers: Alliances between electric mobility companies and battery manufacturers to drive research and development of storage technologies. In this way, innovation in batteries is encouraged, improving the autonomy and efficiency of electric vehicles.

- Collaborative University Pilot Projects: Collaboration between companies, governments, and universities to implement pilot projects that assess the viability and impact of electric mobility. In this way, research, development, and joint learning are facilitated to adapt solutions to local needs.

- Education and Awareness Programs: Collaboration between governmental entities, NGOs, and companies to educate and communicate to the public about the benefits and proper use of electric mobility. In this way, public acceptance is fostered, and a base of informed and committed users is created[17].

- The DSO as an Enabler of Technology: Adaptation of the electrical grid as a platform to connect, dispose, exchange, and enable a new set of uses, exchange models, and actors associated with electric mobility.

C. Technological Innovations in Electric Vehicles

Electric vehicle technology will continue to advance with changes in charging systems that will allow energy to be returned to the grid, improvements in battery autonomy, and the need for superchargers of more than 300 kW that will allow faster charging times and enhanced safety features.

Innovation in battery chemistry and manufacturing will also play a key role in the development of electric mobility, improving energy density, reducing charge anxiety, and altering the topology of charging networks.

The hybridization of chargers with storage systems and other energy sources such as hydrogen will be essential to define the charging station of the future in an efficient and clean manner.

The transformation of mobility also involves the development of new enabling technologies that will be fundamental to take advantage of the new industrial revolution, among which three can be highlighted:

- 5G and V2X (Vehicle-to-Everything) Communication Technologies: These involve the interconnection of vehicles with various elements of their environment, ranging from vehicle-to-vehicle (V2V) communication, to communication with

17 - In Argentina, AAVEA created the Emergency Studies Commission, which analyzes issues related to fires and accidents involving electric vehicles, training firefighting teams on this new topic.

road infrastructure (V2I), pedestrians (V2P), and other devices (V2D). This holistic approach allows vehicles to exchange critical information with their surroundings, such as imminent collision alerts, traffic signals, road conditions, and more. V2X communication is essential for the development of autonomous driving systems and for improving overall road safety.

- Artificial Intelligence Technologies Driven by Advanced Driver Assistance Systems: These allow the integration of autonomous systems, artificial vision, and intelligent assistants in electric vehicles, improving safety, comfort, and driving experience, bringing mobility closer to the individual.

- The Development of Advanced Methods or Technologies for Recycling and Reusing Battery Components: This encourages the mitigation of environmental impacts, promoting circularity and sustainability in the battery life cycle.

D. Drivers of Sustainable Mobility

The path to sustainable mobility may vary depending on the region, the country's idiosyncrasies, strategic plans, and its financial and industrial capacity. Although there are no pure development models, some key drivers that have boosted development in other regions can be identified, and specific plans can be designed for Latin America:

- Political Drive: In the case of China, electric mobility has been largely driven by strong governmental policies. Subsidies for the purchase of electric vehicles have been implemented, as well as strict emission regulations to encourage the adoption of clean technologies.

- Regulation and Collaboration: In Europe, strict regulations on vehicle emissions have been established and ambitious goals have been set to reduce greenhouse gas emissions. Many European countries are promoting electric mobility through tax incentives, toll exemptions, and access restrictions in urban areas. In addition, public-private collaborations between car manufacturers, governments, and public service companies are being carried out to boost charging infrastructure.

- Incentives and Infrastructure Development: In the United States, several states offer incentives for the adoption of electric vehicles. In addition, federal government has established tax credits for the purchase of electric vehicles. Investment in fast-charging infrastructure has also been a priority, with the expansion of charging networks along highways and urban areas.

- Financial Incentives: Norway is a world leader in the adoption of electric vehicles. Financial incentives, such as tax exemptions, tolls, and free parking for electric vehicles, have played a crucial role in the development of electric mobility.

- Innovation and Industrial Collaboration: Japan has adopted an approach focused on innovation and industrial collaboration to promote electric mobility. Cooperation between car manufacturers, technology companies, and the government has led to the development of advanced technologies and the promotion of charging infrastructure.

- Gradual Approach: Other countries, like India, are adopting a more gradual approach

to electric mobility, with an emphasis on the electrification of two and three-wheeled vehicles, as well as the development of charging infrastructure in urban areas.

Regardless of the predominant approach, policies must address various drivers integrally, as recommended by the IDB's electromobility platform, which supports countries in defining national electromobility policies and strategies, feasibility studies, pilot projects, and investments in institutional fleets and transport companies[18].

18 - BID (2019). "Electromovilidad: transporte más limpio, seguro y eficiente".

05

IMPORTANCE OF THE DISTRIBUTION GRID IN ELECTRIC MOBILITY

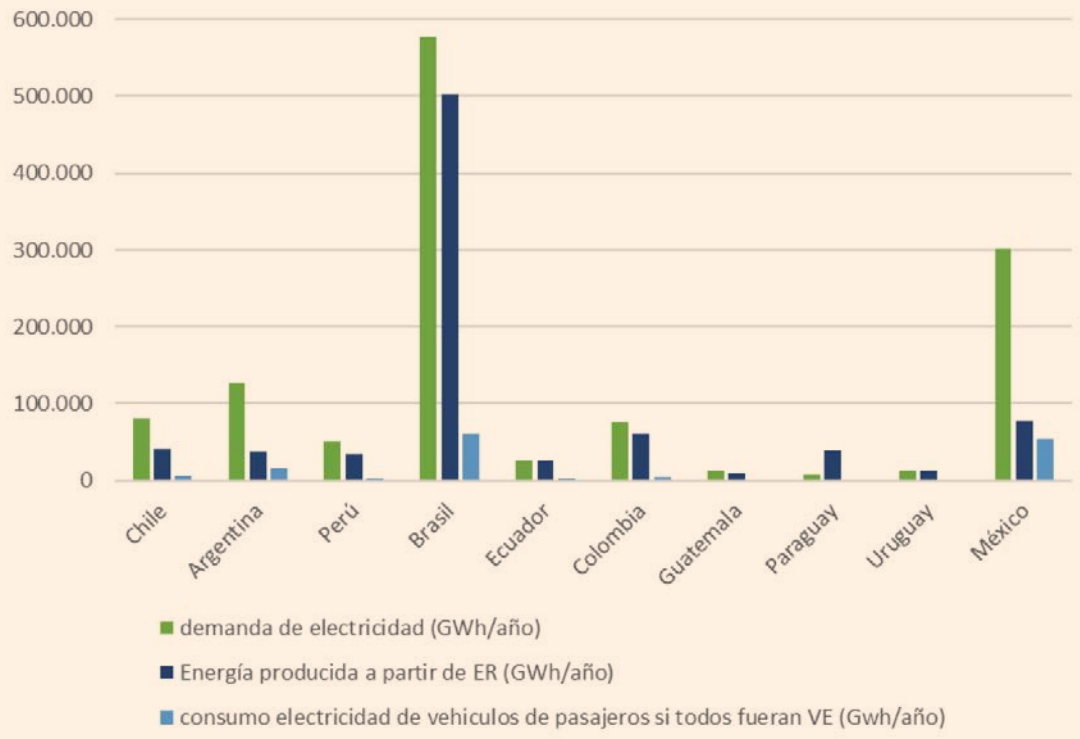
Another aspect of great relevance to meet the growing electrification of consumption that electric mobility entails is the need for a modern, digital, automated, secure, resilient, flexible, sustainable electric distribution network with sufficient hosting capacity, which will require new investments that should be supported by the regulatory frameworks of Latin America.

In this regard, the ADELAT Policy Paper "Challenges and Regulatory Improvements of Electric Distribution for the Latin American Energy Transition" highlights that "regulation must seek the maximization of social benefits and the most efficient use of the DSOs' digital platform, enabling the development of the principles of Decarbonization, Electrification, Digitalization, Decentralization, and Democratization of the market and access to new energy services," so "it is essential that regulation generates the appropriate incentives for investments to be made efficiently and timely," generating certainty in returns and allowing efficient planning that encourages innovation and technological improvements.

A. Interaction with the Electrical System

The impact of the total electrification of mobility on system demand is estimated to be between 6% and 25% of the total electricity demand of national systems, so a gradual evolution is necessary to adapt to the new demand due to mobility. According to a case developed by Euroelectric for the Argentine case, for an average consumption of 15 kWh/100 kilometers on a base of ten thousand kilometers-year, the electricity demand of 1 million electric vehicles would be 1.6 TWh/year, which could represent 1.3% of Argentina's internal electricity demand. For a passenger vehicle fleet of 10.6 million, this would represent just over 13% of the total annual electricity demand.

Graph 7. Electrical Demand and Estimated Consumption if All Vehicles Were Electric.



Source: Own elaboration with data from https://datosmacro.expansion.com/

Electric vehicles, due to their characteristics, can be assimilated - from the point of view of their energy consumption- to highly electrified homes, so while they do not involve short/medium-term power problems for regional low-voltage electrical systems, some exercises have identified requirements for adaptation and expansion of the grid at medium voltage levels. From the experience observed in countries where electric mobility has greater penetration, nighttime charging will be the most used, so attention must be paid to the effect that peak hours could have on the system, derived from the power and duration of the charge.

Considering the necessary power based on the charging patterns of EVs, investments in distribution networks will be required to optimize the electrical infrastructure according to the degree of penetration of electric vehicles. This will enable an interaction between the DSOs and electric vehicles as active participants in the electrical system that contribute to the stability of the supply, within the following parameters[19]:

- Node Congestion: Based on instantaneous demand.

- Simultaneity Factor: The duration of low-power nighttime charging implies an increase in the simultaneity factor, which may require the punctual reinforcement of transformer centers and management systems. This reinforcement will be greater if intelligent charging systems capable of rationalizing demand at supply points are not used.

- Low Voltage Generation Assets: These assets provide power close to consumption points, which will decrease the need for transformation during charging, although during low demand hours they can produce reverse flow effects in transformer centers.

- Electric Vehicle as a Flexibility Element: Greater integration of low voltage generation assets with chargers and control centers of DSOs can make the necessary investments more

19- IRENA (2019). Innovation Outlook: Smart Charging for Electric Vehicles.

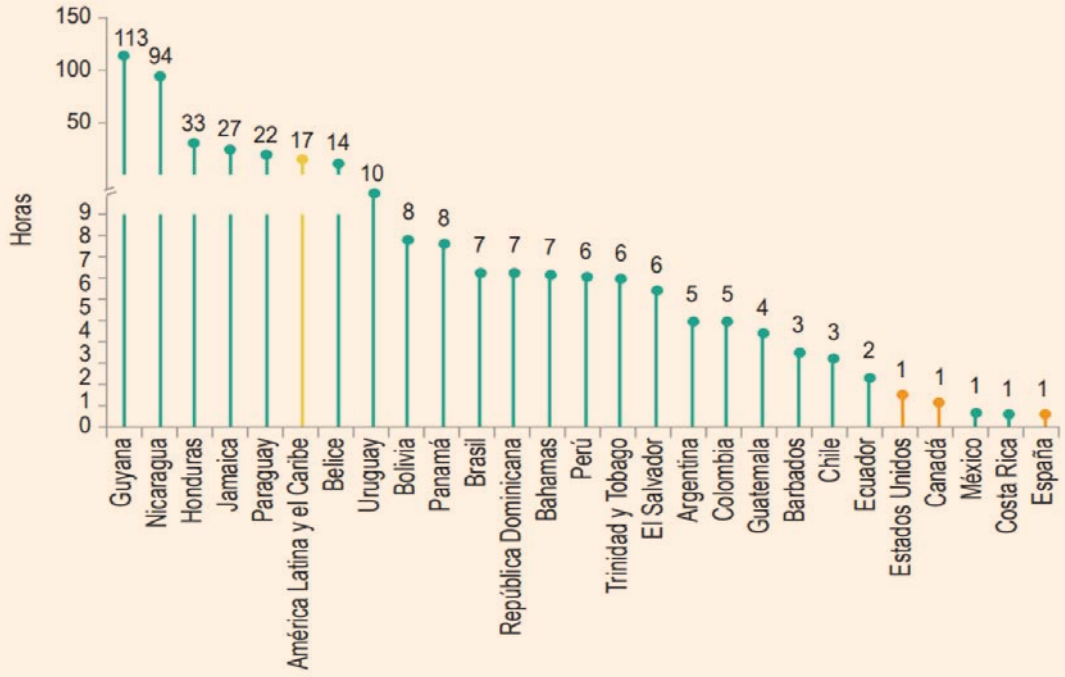
flexible, increasing the penetration of renewables and reducing system costs.

- Limits of the Network Code and Other Regulations: National grid codes define physical restrictions in terms of voltage and frequency variations that system operators must observe, and investments in network reinforcement if these specific country limits are exceeded due to electric vehicle charging.

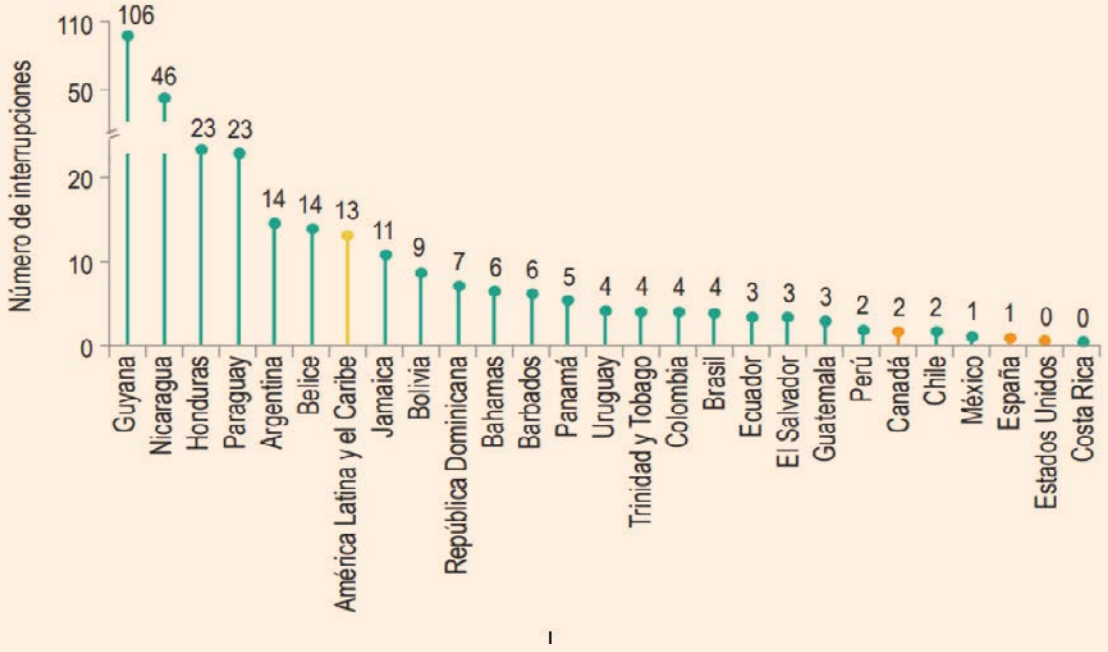
Furthermore, the relationship between the improvement of infrastructure quality and the development of supported services is key, as in the case of electric mobility, its dependence on the quality of the distribution grid is vital. If we look at the most commonly used quality indices in the industry, such as SAIDI and SAIFI, which measure interruption time and the number of interruptions, the region's average unavailability is 17 hours per year, with an average of 13 interruption events. Additionally, as stated in the ADELAT Policy Paper (2023) "Challenges and Regulatory Improvements of the Dx for the Latin American Energy Transition," "Although it is evident that there have been improvements in quality in the region, SAIDI is still between 5 and 8 hours for the main cities, and can reach cut times 10 times greater in rural areas, which shows a significant gap for improvement."[20]

20 - BID (2020). From Structures to Services: The Path to Better Infrastructure in Latin America and the Caribbean.

Graph 8. System Average Interruption Duration Index (SAIDI).



Graph 9. System Average Interruption Frequency Index (SAIFI).



Source: IDB (2020). From Structures to Services: The Path to Better Infrastructure in Latin America and the Caribbean.

This raises the need for DSOs in Latin America to have the appropriate incentives to make the required investments to improve the quality of distribution in the medium term, so that the new uses associated with the electrification of mobility have adequate system support that ensures capacity and continuity.

B. Role of Electric Distribution Regulation

The transition towards a greater penetration of electric vehicles requires careful and advanced planning in the electric sector. Investments in infrastructure are costly and require considerable time for implementation. This raises the need for DSOs in Latin America to have the appropriate incentives to carry out the required investments for the improvement of distribution quality in the medium term, so that the new uses associated with the electrification of mobility have adequate support from the system that ensures capacity and continuity.

Electric regulation plays a crucial role in this context, as it must facilitate advanced and proper planning of investments by the DSOs. Without regulation that promotes this planning, operators may find it difficult to meet the growing demand for energy, which could result in grid overloads and uneven development of charging stations. In this sense, the development of regulation should consider the following aspects:

- Demand Forecasting: Regulation should encourage DSOs to use advanced modeling and simulation tools to predict demand growth and plan accordingly. This forecast should include not only the expected number of electric vehicles but also usage patterns and the location of charging **stations.**

- Incentives for Early Investment: Regulation can establish financial and other incentives to promote early investments in charging infrastructure. These incentives can be given through tariff remuneration schemes, subsidies, or specific financing mechanisms.

- Tariff Structure: Regulation that establishes appropriate tariffs can promote efficient use of the electrical grid, encourage charging at times of lower demand, and ensure the economic viability of infrastructure investments. Time-of-use rates can incentivize users to charge electric vehicles during off-peak hours (usually at night), which helps to distribute the load more evenly throughout the day and reduces the need to expand grids to manage demand peaks. Variable tariff structures would avoid penalizing developers of public infrastructure while the degree of transport electrification is low.

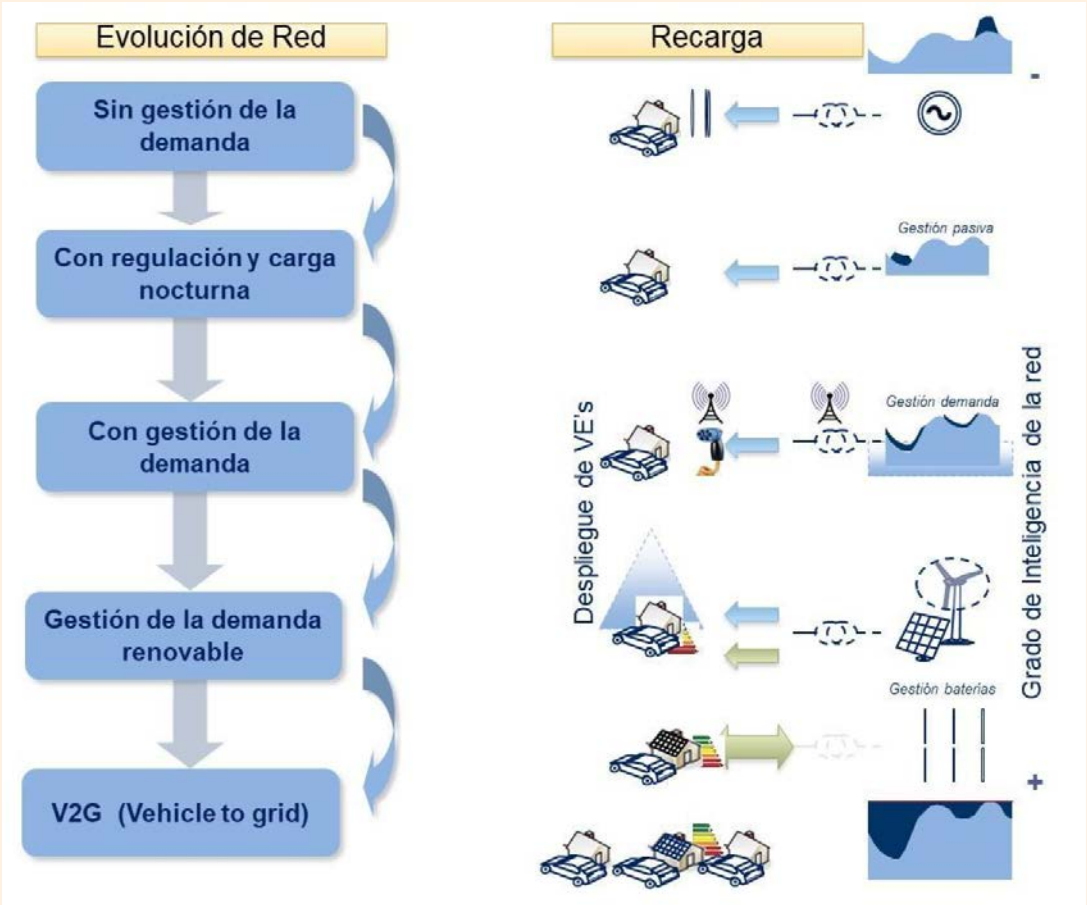
- Collaboration and Coordination: It should also promote collaboration among the different actors involved, including governments, DSOs, electric vehicle marketers, and other stakeholders. Coordination is key to ensuring that investments are efficient and aligned with long-term needs and goals.

C. Role of DSOs

The distribution grid plays an enabling role in the recharging service, indispensable for the development of electric mobility. Therefore, the management of the DSO will be key in executing and rationalizing the investments that address the following identified needs:

- **Charging Infrastructure:** DSOs could be responsible for planning, building, and maintaining the charging infrastructure for electric vehicles in their service areas. This includes the installation of charging stations in strategic locations, such as public parking lots, shopping centers, urban areas, and highways. This requires appropriate regulatory signals that enable the development of these activities by the DSOs.

Figure 3. Evolution of the Grid vs. Deployment of Electric Vehicles



- Energy Supply: DSOs must ensure a reliable and high-quality energy supply for charging electric vehicles. This involves managing the available electrical capacity and planning to meet the growing demand for electric vehicle charging.

- Integration of Renewable Energies: Many distributors are working on integrating renewable energy sources, such as solar and wind, into their electrical grids. This is important to ensure that electric vehicle charging is as sustainable as possible and to reduce greenhouse gas emissions.

- Special Rates for Electric Vehicle Charging: DSOs, as established by the authorities, can offer basic information to create special electrical rates (binomial and with time differentiation) for electric vehicle charging, which can make it more affordable for vehicle owners to charge during certain hours of the day. The development of dynamic rates also has benefits related to the incorporation of DERs.

- Smart Grids Development: Smart electrical grids allow for more efficient energy and charging management. DSOs will need to invest in digital technologies that facilitate grid observability to rationalize investments and facilitate electric vehicle charging during off-peak hours and balance the load on the grid, which requires an adequate deployment of smart metering systems.

- Public Education and Awareness: Distributors can play an important role in public education and awareness about electric mobility. They can inform customers about the benefits of electric vehicles and provide information about the available charging infrastructure.

- Collaboration with Government and Industry: DSOs can collaborate closely with local and national governments, as well as with the automotive industry and other stakeholders, to develop technical regulations, policies, and regulations that transform the grid for electric mobility and establish alliances that promote the expansion of charging infrastructure and encourage the adoption of electric vehicles.

- Data and Charging Analysis: DSOs can collect data on electric vehicle charging, such as usage patterns and charging station locations. This data is valuable for infrastructure planning and demand management.

- Technical Support and Customer Services: DSOs can offer technical service and assistance to customers who wish to install chargers in their homes or businesses. This may include assessing existing electrical capacity and installing charging equipment.

- Grid Flexibility: In which the electric vehicle is part of the system, it allows providing auxiliary services for the stability and quality of the electrical supply, such as voltage compensation, congestion management, among others. This includes planning large-capacity vehicle charging centers, such as public transport, to balance the use of grids.

- Energy Storage: Although the battery of a vehicle does not have the storage capacity necessary to be relevant in an electrical system, millions of units will, representing a key tool for the energy transition. When connected at low voltage, it will be a principal role of the DSO to give them entry into the system in a way similar to self-consumption, and integrate their services.

06

PERSPECTIVES OF ELECTRIC MOBILITY IN LATIN AMERICA

The future of electric mobility in Latin America is promising, with prospects for continuous growth and accelerated technological developments.

A. Growth Forecasts

Forecasts indicate that adoption of electric vehicles in the region will continue to grow in the coming years. As battery prices continue to decrease and charging infrastructure expands, more people will be attracted to this technology. Deloitte has forecasted that global electric vehicle sales could reach 31.1 million units by 2030, representing 32% of total vehicle sales. For Latin America, a study by Frost & Sullivan points out that by 2025, around 114,700 hybrid vehicles will be sold throughout the region (+26% annually), while sales of plug-in hybrids could reach 20,300 units (+36% annually) and battery electric vehicles would reach 23,300 units (+50% annually).

B. Emerging Trends in Electric Vehicle Technology

Electric vehicle technology will continue to advance with changes in charging systems that will allow energy to be returned to the grid, improvements in battery autonomy, and the need for superchargers of more than 300 kW that will allow faster charging times and enhanced safety features.

Innovation in battery chemistry and manufacturing will also play a key role in the development of electric mobility, improving energy density, reducing charging anxiety, and modifying the topology of charging networks. Solid-state batteries are an emerging technology that will drive the development of electric mobility, as they will be able to store more energy in a smaller volume and weight, resulting in greater autonomy for electric vehicles, due to their lower risk of fires

and explosions, their longer lifespan, and because they can be charged at higher power levels, which will shorten charging times.

C. Role of Shared Mobility

Shared mobility, such as carsharing and electric ride-hailing, will play an important role in promoting electric mobility. These services allow more people to experience the benefits of electric vehicles without the need to own one, with various models depending on where the vehicles are located (station-based or free-floating), with parking regulation in cities being key.

This is a growing model in many of major European cities. For example, in 2023 Madrid had 3,150 shared vehicles with more than a million registered users[21] , and a global growth of 30% is expected by 2032.

D. Possible Changes in Government Policy

It is expected that governments in Latin America will continue to implement policies supporting electric mobility, including tax incentives and favorable regulations. Changes in energy policy could also further boost the adoption of electric vehicles.

21 - ABC (2023). "El negocio del 'carsharing' acelera y enfila lla ruta de rentabilidad".

07

CONCLUSIONS

A. Recap of Key Points

Electric mobility is already a reality, with a varied offer from automotive companies and charger manufacturers, and an ever-growing public charging network.

It has been demonstrated that electric mobility is effective and viable both in light mobility and urban public transport, as long as it is developed in a comprehensive manner, with public-private cooperation being of great relevance.

The impact of the total electrification of mobility on the system's demand in the region is between 6% and 18% of the total electricity demand of national systems, and the gradual evolution to accommodate the new demand is viable.

Investments will be necessary to optimize distribution grids based on the penetration of EV, enabling an interaction between DSOs and EV as active participants in the system that contribute to the stability of the supply.

Technical standards and stable regulatory frameworks are required that recognize investments in assets related to electric charging, and that promote demand forecasting, early investment, flexible tariff structures, and collaboration among the involved parties.

B. Importance of Electric Mobility for the Future of Latin America

Electric mobility in Latin America emerges as a strategic opportunity supported by positive projections and a growing adoption of electric vehicles. Despite advances, challenges such as high initial costs and lack of public awareness require comprehensive strategies for cost reduction, education, and improvement of charging and storage infrastructure.

The benefits and advantages of electric mobility in extend beyond the environmental impact, encompassing economic and social aspects. The generation of local employment, stabilization of energy prices, technological innovation, and improvement of energy efficiency are positive. Electric mobility also contributes to the diversification of the energy matrix, taking advantage of the rich natural resources in the region.

The electrical grid positions itself as an enabler, requiring investments and adaptations to manage the growing demand. DSOs play a key role in the development of infrastructure and the adaptation of the grid for electric vehicle charging. Smart charging presents itself as a tool to improve network flexibility and optimize energy consumption.

The network has to evolve both in digitalization (sensors that improve its observability) and in hosting capacity, in order to support the increase in power at low and medium voltage levels.

In the future, a continuous growth of electric mobility is anticipated, supported by positive forecasts. Emerging trends in electric vehicle technology, the role of shared mobility, and possible changes in government policy will be determining factors. It is expected that the reduction in battery costs will contribute even further to the massive adoption of electric vehicles in Latin America.

C. Call to Action and Recommendations

This call to action and recommendations seek to guide efforts towards successful, sustainable, and accessible electric mobility for everyone in Latin America.

- **Investment and Cooperation:** Sustained investment and cooperation among governments, companies, and civil society are urgently needed to strengthen the electric charging infrastructure. Public-private collaboration is essential to accelerate the deployment of charging stations and achieve an efficient transition to electric mobility.

- **Education and Public Awareness:** Implement educational campaigns to increase public awareness of the economic, social, and environmental benefits of electric mobility. General understanding of the technology and its advantages will significantly contribute to overcoming the barrier of lack of knowledge.

- **Clear Incentives and Policies:** Jointly with regulatory authorities, propose fiscal incentives and clear policies that encourage the adoption of electric vehicles. The reduction of economic barriers through tax exemptions and subsidies will boost demand, while effective regulations will support the orderly growth of the sector and infrastructure. This will be achieved through appropriate tariff structures that promote efficient grids utilization and ensure the economic viability of investments in infrastructure.

- **Development of Local Industry:** Promote local manufacturing of key components, such as batteries, to reduce costs and create employment. Establishing strategic partnerships between automotive companies, technology providers, and governments will foster innovation and growth in the electric industry.

- **Energy Planning:** Integrate the planning of electric mobility with energy strategies. Evaluate and anticipate the impact of mass charging of electric vehicles on the electrical grid, prioritizing investments and updates to ensure a smooth, flexible, and sustainable transition.

- **Research and Development:** Encourage R&D in innovative energy storage technologies, improvements in battery efficiency, and innovative solutions to address current challenges. Continuous investment in technological innovation will be key to maintaining competitiveness and long-term sustainability.

- **Commitment to Sustainability:** Promote companies' commitment to sustainable practices. Driving the adoption of electric vehicle fleets in companies and key sectors will contribute to emission reduction and set a positive example for society.

As the demand for electric vehicles grows, governments must balance attracting consumers with incentives while addressing concerns about an effective charging station network. Investment in infrastructure, collaboration with stakeholders, adoption of technologies, and transparency are essential to create a robust ecosystem that supports the widespread adoption of electric vehicles. Only through a comprehensive approach can governments achieve a balance between incentives and the consumer's need for a reliable and accessible charging network.

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