

SANTIAGO, CHILE 2025
OUR COMMITMENT TOWARDS CARBON NEUTRALITY







Avanzamos contigo

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With the support of the Centre for Sustainable Mobility https://cmsostenible.org/

April 2025 Santiago, Chile.

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Letters from our Authorities



"Successive efforts have meant that 38% of our fleet is now electric, and we expect that by the end of 2025 that figure will reach 68%, thanks to the implementation of our 100% electric tender that we launched in 2023, which was awarded in 2024."

JUAN CARLOS MUÑOZ ABOGABIR

Minister of Transport and Telecommunications

Chile has made a firm commitment to carbon neutrality by 2050, understanding that climate change is not only an environmental challenge, but also the only possible social and economic pathway. We know that its effects have an unequal impact, disproportionally affecting the most vulnerable groups, especially women and girls. That is why, from the transport sector, we are promoting a profound transformation that puts people at the centre.

Latin America is one of the regions where the transport sector has a greater relevance in climate impact, representing 40% of the total. In Chile, the transport sector accounts for one third of the climate mitigation challenge. Transforming public transport is not only a matter of sustainability; it is also an imperative of equity, health, territorial justice, an extraordinary opportunity to improve the level of service offered to users, and a space at hand to promote development and innovation.

The path initiated by Chile towards electromobility of its buses contained in this report is a concrete reality. The first electric buses that arrived in 2017 showed their attractiveness and effectiveness. These buses made it possible to glimpse that we were facing an element capable of generating a discreet leap in service quality and becoming a distinctive feature of the city. Successive efforts have meant that 38% of our fleet is now electric, and we expect that by the end of 2025 that figure will reach 68%, thanks to the implementation of our 100% electric tender that we launched in 2023, which was awarded in 2024. Santiago has pushed forward by more than a decade one of the most relevant goals of the Long-Term Climate Strategy: that, from 2035, all new additions to public transport should be zero emissions. In Santiago's public transport, we will make this a reality now. It also brings us closer to the goal that by 2040 every bus operating will be electric.

But this transformation does not only require the incorporation of new buses. It also requires a wide and distributed charging infrastructure, enabling 28 electroterminals that provide 89,000 KW of power to charge all these buses. This effort has required unprecedented interinstitutional and public-private coordination. And this network of terminals has been a great gift to the city, as they coexist better with their neighbourhoods compared to traditional diesel terminals as they emit less pollution and noise and have become an attractive source of jobs for women who see in them the opportunity to access a formal and quality job close to their homes. We are proud to report that 10% of the system's drivers are now women.

Today we can say that Red Movilidad System has taken historicstepsin multipledimensions. And most importantly: with results. Between 2018 and 2023, we reduced $\rm CO_2$ emissions by 28% and it is estimated that the noise reduction in high-flow bus routes such as the Alameda reached 44% at peak times thanks to electromobility.

Thus, we see our buses as the spearhead of a profound and necessary cultural shift away from internal combustion engines. Buses are complemented by our trains and have given way to the transformation of the network of collective taxis and delivery trucks. And taxis, tricycles, motorbikes, and gradually but still incipiently light cars are being added. We envisage that intercity buses and long-haul trucks will soon be added. We hope to complete the transformation process by electrifying the entire rail network, tackling ships with green ammonia or green methanol, and finally aircraft with Sustainable Aviation Fuels.

Returning to buses, electromobility has not only transformed public transport technologically, but it has also directly impacted the daily experience of millions of people. The driving staff declares more comfortable and safer driving conditions; the users value a series of

attributes that the new buses bring such as air conditioning, Wi-Fi or USB chargers; and the neighbours of Santiago recognise in this transformation a concrete sign of modernity and innovation for their neighbourhoods. And so, in a couple of decades, buses have made a huge leap forward, becoming a very positive attribute of Santiago. One that, together with our six Metro lines, suburban train and a growing number of electric collective taxis, allows it to proudly position itself in rankings that distinguish it internationally. This year Chile is chairing the International Transport Forum (ITF) which brings together transport ministers from 69 countries around the OECD. At its annual meeting in May in Leipzig Germany, these achievements will be particularly highlighted and visible.

For the first time, through this report, we quantify the social, environmental and economic benefits of this transition. RED Movilidad is not only a global benchmark in electromobility, but it has also become a driver for advancing sustainability and territorial equity.

I am deeply grateful for the work of all the institutions and sectors of society that have made this progress possible. This is a collective effort that will continue to grow and is already beginning to expand to other regions of the country, with the aim of improving our quality of life and continuing to position Chile as a reference in electromobility worldwide.

Letters from our Authorities



"Our country has committed to the modal transformation of urban public transport as a tool to accelerate our path towards decarbonisation."

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PAOLA TAPIA SALAS

Director of the Metropolitan Public Transport Authority

This first report on electromobility in the Metropolitan Public Transport System, Red Movilidad, shows the efforts and achievements to highlight environmental sustainability as one of the strategic pillars of this Ministry. The transport sector is the second largest emitter globally, and in Chile represents about a quarter of total greenhouse gas emissions, thus having a key role to achieve carbon neutrality.

Climate change is the greatest challenge of this generation and requires multi-sectoral efforts to comply with the Paris Agreements to avoid a temperature increase of more than 1.5°C and to adapt our economies and societies to become more resilient to climate phenomena that are increasingly recurrent.

Chile has positioned itself as a leader in climate action, being one of the first countries to publish and then update its Nationally Determined Contributions (NDCs) and then commit to a maximum emissions budget of 1.1 billion tonnes of CO_2 equivalent between 2020 and 2030, with the aim of achieving carbon neutrality by 2050 at the latest.

Our country has committed to the modal transformation of urban public transport as a tool to accelerate our path towards decarbonisation. As early as 2017, the first national electromobility strategy was drawn up, an unprecedented document in the region and globally, updated again in 2021, giving way to a state policy consolidated through three different governments, with the hope that by 2040 urban public transport will be 100% composed of zero-emission technologies. The transition towards electromobility in Santiago's public transport system has become a national and international benchmark, and its main objective has been to improve the quality of life of all the inhabitants who interact with the system on a daily basis by providing a clean and reliable system.

During the current administration we have taken increasingly important steps to strengthen and accelerate the transition to electromobility in Santiago's transport system. In 2022 we updated the National Energy Policy, incorporating electromobility as a local emissions reducer, and contributing to reduce noise levels in high exposure areas.

During that year we launched the bases for the first 100% electric system concession, which will come into operation this year 2025, and we managed to establish that electric buses reduced noise levels by 44% on the Alameda axis and 45% on the Santa Rosa axis at peak hours compared to 2019, improving the quality of life of the residents of Santiago.

In the same vein, we now know that only 3.3% of transport emissions in Santiago come from Red Movilidad, with private cars accounting for nearly 90%. Moreover, coinciding with the introduction of electromobility, we have observed over a 60% reduction in particulate matter. These results are supported by citizens and Red Movilidad team. Today, 65% of drivers perceive less fatigue compared to diesel buses, 79% of users believe that electric buses improve the image of Santiago. 84% believe it is a system to be proud of, and 89% of residents of electroterminals and major transit axes of electric buses believe that they have brought a sense of innovation and modernity to their neighbourhoods. This report is the result of the responsibility that we must deliver data and make information public to the industry, citizens and academia, as it is a collaborative effort that has allowed us to advance to this point, including views of the positive effects of electromobility from the economic, social and environmental points of view. We invite you to review this report to know in detail the progress of electromobility and environmental sustainability as the main axes of this management and open the doors to continue collaborating in the expansion and strengthening of a Red Movilidad that promotes a better relationship with our planet and environment.

Best regards.





II. Our commitment towards carbon neutrality

A. Chile and its leadership in climate action

Chile has taken a leading role in climate action, positioning itself as a global leader. This commitment is reflected in the implementation of several public policies and the submission of ambitious Nationally Determined Contributions (NDCs). In 2015, after ratifying the Paris Agreement, the country submitted its first NDC, with the goal of reducing emissions intensity per unit of Gross Domestic Product (GDP) by 30% by 2023, compared to 2007. Subsequently, in 2020, Chile in its role as Chair of COP25 of the Framework Convention on Climate Change (UNFCCC) reinforced its commitment by setting a maximum emissions budget of 1.1 billion tonnes of CO₂ equivalent between 2020 and 2030, with a peak in 2025 and the goal of achieving carbon neutrality by 2050.

In order to meet these goals, Chile's Long-Term Climate Strategy [1] was drawn up, an instrument that defines general guidelines and measures to be implemented in a cross-cutting and integrated manner. This document establishes that, by 2035, all new additions to urban public transport will be zero emissions and, by 2040, urban public transport systems will be 100% based on zero emissions technologies in all regions of the country.

Progress towards these objectives has been made possible by various public policy instruments that define that mitigation efforts in the transport sector should be oriented towards the promotion of electromobility in public transport and the promotion of modal shift as strategies to achieve sustainable mobility.

This effort has been consolidated as a State policy, led by the Ministries of Energy, Environment and Transport and Telecommunications of different administrations, with key initiatives such as: Energy Policy 2050 [2] and its update in 2022 [3], the first National Electromobility Strategy [4] and its update in 2021 [5], the Energy Efficiency Law [6], the Storage and Electromobility Law [7] and the Roadmap for the Advancement of Electromobility in Chile [8] which establishes concrete actions until 2026. Likewise, the policies and plans led by our Ministry such as the Sustainable Mobility Policy [9] and the Climate Change Adaptation and Mitigation Plan for the transport sector [10].

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B. Public Transport Subsidy

The State's commitment to climate action is aligned with efforts to mitigate the externalities of private transport, through the consolidation of an affordable, efficient and modern public transport system. This goal has direct social and economic effects on the city, facilitating mobility for all its inhabitants through actions to reduce pollution, congestion, noise and road accidents.

The decision to create, in 2009, a national subsidy for public transport with the enactment of Law No. 20.378 was fundamental. This public policy allowed a structural change in the business model of the System, ensuring long-term financing and guaranteeing a permanent social investment that allows not only to maintain the operation, but also to invest in key assets of the public transport system such as zero emission buses, terminals, part of the metro infrastructure and technology. In addition to this, an integrated fare structure was implemented, enabling transit users to transfer up to 2 times paying a single fare. The System's fare is regulated and

reviewed on a regular basis by a Panel of Experts whose function is to maintain the financial equilibrium of the System and to update the fares to maintain its real value.

The existence of a public subsidy has been indispensable for the rapid and efficient introduction of electromobility in Santiago. It made it possible to coordinate the different actors in the public transport system (operators, manufacturers, financiers, charging infrastructure providers and power supply companies) and to effectively improve the bus procurement model, reducing financial and operational risks for all participants. The transformation of buses into key assets of the System and other relevant changes that will be described in the following chapter, gave way to a new phase of public transport in Santiago, not only generating a better service, but also with fiscal responsibility and an efficient use of public resources.

¹ Producto Interno Bruto

C. Sustainability at the heart of the DTPM

At the Metropolitan Public Transport Authority (DTPM) we are firmly committed to environmental sustainability and in the fight against climate change, aligning ourselves with the goals defined by Chile and the international community.

We are also committed to the United Nations Sustainable Development Goals (SDGs), contributing to various targets related to climate action, innovation in sustainable infrastructure and the promotion of more inclusive and resilient cities.

The Red Movilidad System of the city of Santiago aims to achieve a significant percentage of electrification of the bus fleet by 2035, encouraging the incorporation of sustainable infrastructure and guaranteeing quality standards that support a reliable and efficient service. This commitment reflects our institutional vision and mission, stablished in the 2025 strategic planification:

Visión:

"To be a public bus transport system highly valued by the people, driven by the commitment of our team, being a national and international reference for quality, efficiency, safety, reliability, equity and sustainability in mobility, always at the service of users."

Mission:

Promote sustainable, safe, accessible and inclusive mobility, providing an excellent public transport system that improves people's quality of life and contributes to the sustainable and equitable development of society.

The main objective of the DTPM's environmental management, is to actively contribute to the construction of a more sustainable and resilient city, promoting public transport as a driver of change. In response to these global challenges and the climate crisis, in 2024 the DTPM created the Coordination of Operational Strategy and Sustainability, within the Operations and Maintenance Management. Its main purpose is to develop strategies that promote the efficiency and sustainability of the Metropolitan Public Transport System, as well as to demonstrate and track the impacts of electromobility in the various areas of sustainability.

On this issue, we have implemented innovative solutions that prioritise sustainable mobility, improve vehicle comfort and technology standards, and encourage modal shift towards an integrated System that includes buses, metro, commuter trains and the use of active mobility modes such as cycling and walking.

These strategies not only reduce emissions but also create significant benefits in the social and economic dimensions, improving air quality, reducing noise and promoting greater equity in access to mobility, aspects that are beginning to be valued by the different stakeholders of the Red Movilidad System.

D. About this report

Throughout this document we present the key indicators that reflect the impact and results obtained through the implementation of electromobility in Santiago's public transport, as well as the different milestones and measures that marked the process and that have allowed us to have the largest fleet of electric buses after Chinese cities.

This document, which includes data for the years 2023 and 2024 along with historical information, shows how the measures adopted contributed in a tangible way to a cleaner, more equitable and prosperous future for the inhabitants of Santiago, and how these results are aligned with the SDGs, becoming a referent for other transport systems in the world.



Table 1: Sustainable Development Goals contained in this report

SDG	Contained in this report
3 GOOD HEALTH AND WELL-BEING	D. Emissions, energy consumption and air quality / 1. Local and Global Emissions E. Noise F. Comprehensive assessment of electromobility in the RED System I. Road safety: reducing speeding
5 GENDER SEQUALITY	C. The role of human capital in the implementation of electromobility
7 AFFORDABLE AND CLEAN ENERGY	B. Electroterminals: green and climate-resilient infrastructure D. Emissions, energy consumption and air quality / 2. Energy consumption
S DECENT WORK AND ECONOMIC GROWTH	C. The role of human capital in the implementation of electromobility F. Comprehensive assessment of electromobility in the RED System
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	A. Evolution of the fleet to RED Standard B. Electroterminals: green and climate-resilient infrastructure.
sustainable cities and communities	A. Evolution of the fleet to RED Standard J. Initiatives promoting the use of public transport
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	G. Circular Economy H. Responsible consumption of water
13 CLIMATE ACTION	D. Emissions, energy consumption and air quality / 1. Local and Global Emissions F. Comprehensive assessment of electromobility in the RED System J. Initiatives promoting the use of public transport



III. How Chile transformed its public transport: Legal and financial keys for the electromobility era



The model that allowed the massive incorporation of electric buses in Chile has evolved significantly since its inception, transforming a System characterised by low competitiveness into a global reference for sustainable mobility. This process has involved a series of legal, financial and operational changes that have reduced entry barriers for new actors, promoted competitiveness, mitigated financial risks and optimised the use of public resources.

In its early years, the Public Transport System of Santiago faced major challenges, especially in terms of investment and market concentration. The high costs associated with the infrastructure of terminals and bus procurement limited the participation of new players, resulting in a market concentrated in a few operators with the necessary capital or high investment capacity. The lack of competition favoured established players, making it difficult to introduce the operational improvements and innovations required in any public mass transit system.

In order to create a more attractive ecosystem, a series of policies were implemented to encourage the participation of new players in the transport and financial

market. One of the main initiatives developed was to ensure the operational and financial stability of the System through the creation of the national subsidy to public transport and the strengthening the current legal framework, granting greater powers to the Ministry of Transport and Telecommunications of Chile (hereinafter Ministry or MTT). Based on this, competitive tenders were designed, and contractual innovations were implemented to reduce the financial risks of the agents and ensure the operational continuity of the System.

• Legal measures

Law No. 20.378 [11], published in 2009, creates a national subsidy for paid public passenger transport, ensuring permanent and long-term financing for the operation of the system. This has been fundamental for the incorporation of the electric fleet, enabling the creation of an attractive business model that has attracted industry and generated the right incentives for participation and competition. The presence of the subsidy has resulted in Santiago's Public Transport System becoming an attractive ecosystem for investment, both foreign and domestic, and a gateway to the Latin American market.

The key provisions of the law include an annually adjustable subsidy, ensuring financial stability and the availability of resources to make payments to the entities that compromise the System. These payments are made fortnightly, or monthly as stipulated in each contract, for the provision of the respective services, subject to oversight and prior approval of the Comptroller General of the Republic through a decree authorising the transfer of subsidy funds.

The Law also establishes a Panel of Experts responsible for determining quarterly fare adjustments to ensure the financial sustainability of the System as a whole. Revenues, consisting of fares and the subsidy, are managed by the Transantiago Financial Administrator (AFT), where the System resources constitute an autonomous fund that is separate from AFT's own assets. Thus, the MTT is responsible for coordinating and instructing payments to the companies that provide the services, in accordance with the required standards.

Additional regulatory instruments supporting this framework include Law N°18.696 [12], Law N°18.059 [13] and Supreme Decree N°212 [14]. These regulations grant the Ministry broad authority to intervene and regulate public transport at the national level. Article 3 of Law No. 18.696 empowers the MTT to tender the use of roads for transport services in case of congestion, environmental degradation or road safety risks, allowing the use of roads to be granted in concession for the provision of paid public passenger transport services.

Under this framework, two types of contractual instruments have been established that the MTT signs with the companies that provide transport services for the System: i) Concession Contracts for the Use of Roads and ii) Specific Operating Conditions. The former, resulting from the application of public tenders, while the latter, similar to the concession contract and with identical obligations, are signed directly with the companies that provide services to the System for a determined period, which can be renewable, while the design of the tendering processes is being carried out. These instruments allow for greater flexibility in the contracting of services and guarantee continuity without affecting the operation of the System.

These contractual instruments regulate critical aspects of transport services, such as the composition of the bus fleet, the technical characteristics of the vehicles and the levels of operation and maintenance, among

other key elements of the System's service quality. Since the implementation of these tools, the MTT has led contract renewal processes and has developed tenders, introducing significant improvements in service quality standards. These initiatives have allowed the progressive incorporation of low-emission diesel buses, electric buses and charging infrastructure for their operation. The permanence of these processes, conceived as a state policy, reinforces Chile's commitment to its environmental and climate objectives, consolidating a more sustainable and efficient public transport System aligned with global sustainability challenges.

• Financial measures

The evolution of regulatory instruments in the public transport System in Chile has played a crucial role in the configuration of the bus fleet, in the definition of its technical characteristics and in the acquisition of charging infrastructure to enable electroterminals. It has also enabled the development of a robust business model that lowers entry barriers, fosters competition, and mitigates risks, allowing for cost savings in both operation and financing. This model is built around the subsidy as a quarantor of the financial sustainability and consists of the separation of capital assets, such as terminals and buses, from the operation, while maintaining a proper relationship between specialized actors such as manufacturers and operators. Additionally, through financial management mechanisms, it ensures full payment for fleet and infrastructure throughout their lifespan, regardless of the operator. This model has served as a key structural element in the bidding processes for 2023 and 2025, and has been incorporated, directly or indirectly, into all contracts or operating conditions present within the System.

Specifically, the model is built around three key elements that interact in a virtuous circle: service provision contracts, fleet quotas and concession assets. Service provision contracts are legal instruments that allow transport operators to enter into agreements for the use and enjoyment of essential service assets, such as buses or freight infrastructure, if these are approved by the MTT. This ensures compliance with the required standards and contributes to the sustainability and efficiency of the System. These contracts and the legal frameworks supporting them, have mitigated various financial risks and created the right incentives to encourage investment in clean energy technologies, while also strengthening and refining the relationships among key private

stakeholders, including operators, bus manufacturers, freight infrastructure providers and financiers.

One of the essential elements regulated in provision contracts is the Fleet Fee, which refers to the fixed bus leasing payment that covers both capital and debt. This fee is transferred directly to the investment's financing entity, through the System Financial Administrator (AFT). To enable this, the concessionaire must assign a portion of the revenue it receives for providing its transport services, instructing AFT to make payments directly to the asset's financier. This mechanism significantly reduces the risk of delays or defaults in instalment payment to direct payment by the transport company. Furthermore, it ensures that payment is not contingent on demand levels or operational quality indicators, thereby providing greater financial certainty and stability.

In this process, the MTT rules on the conditions and requirements incorporated in these contracts, in addition to requiring that the assets involved be considered **Assets Affected to Concession** in accordance with article 3° nonies of Law Nº18.696, modified in 2015. This categorisation includes all movable and immovable assets essential for the basic operation of the services within concession areas for the use of roads. These assets are subject to a special regulation that ensures their immediate transfer, in case of remaining lifespan, to the new service provider once the concession or contract of the original operator is terminated. This mechanism quarantees service continuity and safeguards the System's essential assets, allowing for their use and full payment of associated fees throughout their lifespan, regardless of the operator.

Assets must be registered in the Register of Affected Assets, administered by the Regional Ministerial Secretariats, ensuring that all assets necessary for the provision of the service are duly registered in accordance with the regulations in force. Registration is a prerequisite for concessionaires to operate vehicles, infrastructure and other committed assets, which strengthens supervision and compliance with the System's standards.

• Charging infrastructure and energy competitiveness

Another key element in the transition to electromobility has been collaboration with the energy sector. Terminals have become efficient charging centres, where energy suppliers offer long-term contracts at

competitive prices. This has not only allowed stability in the face of diesel price fluctuations, but also opened the energy market, encouraging the adoption of electric vehicles as a viable and sustainable alternative.

This is due to the modernisation of the General Law on Electrical Services [15] which distinguished two categories of consumers: regulated customers and free customers. Regulated customers are those with a connected power equal to or less than 5 MW, who must purchase their electricity supply through distribution companies at tariffs set by the authority. On the other hand, free customers are consumers with a connected power greater than 5 MW, or those between 500 kW and 5 MW who opt for this modality, allowing them to directly negotiate the conditions of their supply with energy generators or marketers. In the public transport sector, the figure of the free customer has opened opportunities for operators to optimise their energy costs and adopt more sustainable solutions. By negotiating directly with generators or energy traders, operators can secure customized contracts with competitive rates and flexible terms, significantly lowering the operational costs associated with electricity supply. This is especially relevant in the context of electromobility, where electric buses rely on an efficient and accessible charging infrastructure, allowing operators to plan their energy consumption at off-peak times and thus reduce operational costs.

At the same time, in 2017 the MTT began the expropriation of 12 terminals through SERVIU RM and MIN-VU, facilitating infrastructure access for new concessionaires, removing entry barriers and promoting system expansion. Then, in 2021, a strategic alliance was established with Desarrollo País (Fondo de Infraestructura S.A.), which, through an investment plan, acquires the terminals and leases them to the MTT, that then leases them to the operators [16]. In 2025, a new phase will begin with the company, were, for the first time, it will be responsible for developing electric bus terminals, consolidating its role in the System's transformation.

The strategy aims to ensure that the selection of transport operators is based on service and cost efficiency parameters, without conditioning the ownership of terminals to participate in the System's tenders. For its part, Desarrollo Pais will be able to use the terminals of the transport axes for the future generation of relevant urban infrastructure,

such as road interconnection points to link different transport systems (interurban, metro, rural, etc.). These initiatives have proven effective, achieving economic benefits in both bus procurement and infrastructure contracts, while ensuring the long-term sustainability of the model.

• Bidding process of 2019

The introduction of provision contracts introduced an innovative scheme: it allows to independently identify the fleet quota and delegate its payment to the AFT through revenue assignments by the operators to be transferred to the financiers. This model established a closed financial security cycle, ensuring both service continuity and investment return. Moreover, the declaration of buses and terminals as concession assets has strengthened this framework, mitigating financial and operational risks, by guaranteeing its use throughout its useful life. Despite the learning process developed by the Ministry since the origin of the system, during 2019 it is decided to modify the tendering structure, creating a new tendering model.

As a result, in 2019, the MTT introduced a new bidding model that built upon key elements from previous processes: the provision of terminals by the State, a product of the procurement process initiated in 2017, the separation of the operation from strategic assets, and the reduction in the size of the concessions. However, it was decided to separate the process into two consecutive and dependent processes, which implied that in 2020 a tender was issued for the complementary service of Supply of Buses (LP SB N°001/2019) and then in 2021, the Concession for the Concession for Operation and Bus Supply (LP CUV N°001/2019).

In this way, applicants for the road use bid put together their fleet offer by choosing vehicles from bus suppliers awarded in a tender carried out a year earlier, integrating incentives to form a fleet with the best environmental standard in emissions and energy efficiency with electric and diesel Euro VI buses. Only once the road concession process is awarded, purchase orders are generated for suppliers, under the conditions stablished and fixed in the previous process, only for the buses chosen by awarded concessionaires. It should be noted that, in any case, the operator's fleet is established by new buses from the supply tender and by buses with remaining lifespan, acquired through provision contracts in the past.

The new model established shorter periods for the concession for transport operators, with 5-year contracts, extendable for up to 5 additional years, if they meet the established quality standards. To promote electromobility, contracts including more than 50% electric buses will have a duration of 7 years, extendable for up to 7 more years under the same conditions. In addition, the number of operators has been increased and the size of the units grouping the transport services assigned to each one has been reduced, thus minimising the risk of service continuity in the event of possible financial, labour or operational problems on the part of any concessionaire.

The bidding process for a complementary fleet supply service, incorporated the role of a fleet certifier, whose role is to oversee vehicle maintenance and operation. However, the competitive nature of the process was limited, and the economic benefits fell far short of expectations. Its main limitations included an inability to mitigate risks and uncertainties, increasing financial costs; the elimination of potential synergies between the operator and the manufacturer; the inclusion of a battery replacement that generated cost overruns; and implementation timelines, as the bus supply and road concession tenders had to be conducted separately and consecutively, limiting the scope for coordinating the transfer of services upon the termination of the previous contracts. Despite the difficulties, the effectiveness of the supply contracts, some of which had been in force since 2016, was verified and transferred without any problems or payment delays. Furthermore, the implementation process was successfully completed in less than nine months, were between December 2022 and May 2023, 1,600 new buses were added on 153 routes and 28 electroterminals were built, exceeding initial expectations and demonstrating the system's ability to adapt to new technological and operational requirements.

Public Tender for Road Use Concession 2023 and 2025

The lessons acquired have allowed optimising the following public tender for road use concession: the one carried out in 2023 and the one that will soon be published in 2025. In these tenders, the operation and the fleet are put out to tender jointly, requiring 100% of new vehicles to be electric, in line with Chile's commitments on climate change. These tenders establish an initial concession term of 10 years for road use, which may be extended up to 14 years, based on the results of the review instances applied during the contract, or reduced to 7 years.

This model is notable for its focus on reducing commercial uncertainties by unifying tendering processes, which optimises time, adjusts the scale of the business and fosters synergies between operators and manufacturers. This design also reduces warranty lockin periods, ensures manufacturer participation, facilitates fleet renewal and establishes an independent fleet quota, not subject to track concessionaires' service indicators.

Following the 2023 bidding model and considering its results, the 2025 bidding process will be a continuation of the process, maintaining the bus procurement model under the provisioning contract scheme. Additionally, the following aspects will be maintained: Maintenance certification by an external entity, ensuring uniform standards; the implementation of a contract with minimum content in agreements between bus concessionaires and suppliers; and a guaranteed battery autonomy for a defined period. In addition, the System will finance the fees associated with the acquisition or leasing of buses, including the cost of maintenance certification and other elements that ensure a useful life of at least 10 years. The price of these fees will be a key factor in awarding bids.

On the other hand, the evaluation of the bids will consider essential technical and economic aspects. In the technical field, points are awarded for experience in passenger transport (ETP), considering the number of buses operated and experience in urban public transport both in Chile and in foreign metropolitan areas. The

experience of bus manufacturers (EFB) is also evaluated, especially in the production of urban and electric buses. In addition, the energy efficiency of the vehicles offered (PEF), a relevant factor in the operation of electric vehicles, and the average annual expenditure on personnel (GPP) will be evaluated, encouraging proposals that allocate more resources to operational staff.

Meanwhile, the economic evaluation will include two stages: first, the economic value of each bid is determined based on the price per kilometre (PK), number of buses, fleet cost (CF) and the fee associated with infrastructure and terminals. In this scheme, a Charging Infrastructure Charge (CIC) is incorporated, clearly separating the costs associated with vehicles and charging infrastructure, which facilitates dynamic interaction between bus and energy providers. Finally, a relative economic score is assigned, considering all technically acceptable bids, ensuring the selection of efficient and competitive proposals.

This model, based on innovation, public-private collaboration and regulatory flexibility, demonstrates that it is possible to overcome initial barriers and implement large-scale solutions with environmental and social benefits that have a positive impact on the quality of service offered to users of the public transport System in the city of Santiago. The incorporation of mechanisms to ensure the proper functioning of buses and consolidate financial confidence has made Chile a benchmark for other countries seeking a transition toward sustainable mobility.





IV. Santiago's Public Transport System in numbers 2024



Demand







5,5 *Million public transport users*



926Million trips per year



Million transactions per de

Red Movilidad supply

1. Metro and trains











20,4Km of commuter ra



143



10



Intermodal hubs

Red Movilidad supply

2. Buses



Rec

6.500Base operating bus fleet



2.505
Electric buses



+400Bus routes



Complementary service companies (AFT, charging network, fleet management, bus supply)



Transport concessionaires (in addition to Metro and Train

Red



+12.000



73Bus terminals



28Electroterminals

Red Movilidad Supply

Red Movilidad Supply



3.150
Km of road network covered by buses



Km of priority roads for public transport (including segregated roads, exclusive roads and bus-only lanes)







+2.500
Maintenance personnel

^{*} For more details, please see our 2024 Management Report at www.dtpm.cl/index.php/documentos/informes-de-gestion



V. Road towards Carbon Neutrality

- Year | First National Electromobility Strategy with 5 strategic axes: regulation, public transport, promotion of R&D and human capital training, aligned with Chile's climate commitments.
 - Start of operation of the first 2 electric buses in the system. On Metbus route 516 and route 315a of Vule, benefiting 8 local governments: Quilicura, Maipú, Pudahuel, Lo Prado, Estación Central, Santiago, Ñuñoa, Peñalolén and Providencia.
 - 10 new Euro VI buses are introduced. Acquired by RedBus, the buses operate in the districts of Quilicura, Recoleta, Las Condes, Vitacura and Lo Barnechea, benefiting close to 12,000 users.
 - Initiates expropriation of 12 terminals, through SERVIU RM and MINVU, to reduce barriers and facilitate tenders with greater incentives for the entry of new transport providers.

Year

- Transantiago changes its name to Sistema Red Metropolitana de Movilidad, gradually expanding this model to other public transport systems in the country.
- 288 new electric buses and 613 Euro VI diesel buses enter the System.
- New RED Standard buses stand out for their red-grey colour and the obligation to incorporate the improvements started in 2017 in interior comfort: air conditioning, chargers with USB ports, Wifi, padded seats, universal accessibility, safe cabins for drivers and a more harmonious design of the internal spaces.

Year | • Chile updates its NDC committing to reduce 30% of the country's emissions by 2030 and achieve carbon neutrality by 2050. 20

- Replacement of 1,341 Euro 3 diesel buses with 836 electric buses and 393 Euro VI diesel buses, by reallocating 41% of Express services to STP and Metbus.
- Publication of the Bidding Terms for the Supply of Buses (LP SB N°001/2019) and the Concession for the Use of Roads (LP CUV N°001/2019). Launches new contracting model for the System, which separates the operation of strategic assets: the State provides terminals expropriated since 2017, tendering separately the complementary service of bus supply and the operation of services through the concession for the use of roads.

- Year | Chile announces its Intended Nationally Determined Contribution (INDC) pledging to reduce emissions intensity by 30% by 2030 compared to 2007 levels by integrating electric buses in its projected scenarios.
 - The Ministry of Energy's National Energy Policy 2050 incorporates as one of its goals that '100% of new vehicles tendered for public passenger transport include energy efficiency criteria among the variables to be evaluated'.

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- Year | Prevention and Decontamination Plan of Santiago (PPDA) of the Ministry of Environment requires Euro VI emission standard for new buses from 2018.
 - DTPM starts pilot tests with buses of different technologies: Euro VI diesel, electric, and double-decker, evaluating their performance for future tenders of the System. The buses include air conditioning, chargers with USB ports, padded seats, universal accessibility, safe cabins
 - For Transantiago, the Euro VI emission standard has been made mandatory for new buses entering the system.













Year | • 100 new electric buses enter the System,

management.

operated by Metbus on routes 507, 516

and 519, benefiting the local governments

of Maipú, Pudahuel, Lo Prado, Estación

Central, Santiago, Ñuñoa and Peñalolén.

• Two electroterminals are built in

Peñalolén and Maipú, with 63 and 67 electro

lane stations, including smart charging



CONTRIBUCIÓN DETERMINADA A NIVEL NACIONAL (NDC) DE CHILE

ACTUALIZACIÓN 2020



- Year | The new special 520 service created for the Pan American Games, that operates with the first 10 double-decker electric buses in Latin America, is launched.
 - Market Consultation: An unprecedented participation process was carried out for bus suppliers, through the first Market Consultation aimed at manufacturing companies with a view to developing the next bidding and renewal processes that would continue the transition to electromobility.
 - Publication of the Bidding Terms and Conditions for the Concession Bus Supply Operator No. 002/2023. It contemplates the entry of 1,200 new electric buses in 2025 and the construction of 20 electroterminals in the municipalities of La Florida, San Bernardo, Cerrillos and Estación Central. It is the first 100% electric tender and is expected to benefit 3.5 million people.
 - Roadmap for the advancement of electromobility in Chile. Strategy to 2026 with 5 key pillars that seek to massify electromobility in the country: charging infrastructure, education and training, road safety, regulation and public transport and decentralisation.
 - Noise reduction in the Eje Alameda, electric buses have reduced noise levels by 44% during morning rush hours (8-9hrs) and 40% in the evening (19-20hrs) compared to 2019.
 - Red System expands for the first time in 16 years to two new municipalities: Lampa and Padre Hurtado. Services B13 and I35 extend their route to Valle Grande in Lampa and Los Nogales in Padre Hurtado, the first two municipalities to be added to the original geographical design of Red Movilidad.
 - · Red System reaches the Airport fort eh first time. The new 555 service connects Metro Paiaritos with the Airport Intermodal. where a free bus from Nuevo Pudahuel Airport transfers to the terminals. This service currently uses electric double-decker buses.

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- Year | New service to the airport, service 444 20 connects from La Cisterna Intermodal to the Airport Intermodal, where a free bus takes you to the terminals.
 - 214 new electric buses operating in the municipalities of San Bernardo, El Bosque, La Pintana and La Cisterna are introduced. By the end of 2024, 2/3 of the System's buses will be RED Standard and 1/3 will be electric, exceeding 2,500 electric buses.
 - Manufacturer Consultation: The exercise was repeated, with a second consultation conducted with the market . A questionnaire was conducted with greater emphasis on aspects of the electromobility ecosystem, such as financing, batteries, and charging infrastructure.
 - Bus Supply Operator Process N°002/2023 was successfully concluded, having received 86 bids from 9 companies with broad expertise in operations, buses, financing, and charging infrastructure, generating savings of over 16% on the tendered units and highlighting national and international participation.

- 56% confidence in Red Movilidad, the highest level since 2014, according to CADEM survey N°568. This milestone reflects a historic improvement in citizen perception of the System.
- Publication of Essential Contents of the new 2025 Bus Supply Operator Tender.
- · Historic emissions reduction. In 2023, fine particulate matter (PM2.5) emissions reached 22.5 tonnes per year and greenhouse gas (CO2eq) emissions amounted to 346,102 tonnes per year. Compared to 2019, before the pandemic, these figures represent a significant reduction: 52.8% less PM2.5 and 22.32% less CO2eq.

- Year | Bus Supply Operator Tender Contracts N°002/2023 are implemented. The operating companies Voy Santiago, Gran Américas and Consorcio Conecta are awarded five new Service Units.
 - 50 new electric buses enter the north-west sector of the city, starting the year marked by the modernisation of the fleet that will add up to 1,800 electric buses for Santiago.
 - 68% of the RED System fleet will be electric, with 4,406 electric buses.



Policy 2050 of the Ministry of Energy:

exposure areas and reduce noise levels.

• Signing of Bus Supply Operators (LP CUV

N°001/2019). The transport operating

companies RBU, STU and Metropol are

awarded six new Service Units covering a

total of 153 routes, 29% of the total System.

• "Red avanzamos Contigo" campaign

aimed at coordinating and informing

the public about the gradual

implementation of the new buses and

transport services awarded, ensuring

operational continuity, fleet availability,

infrastructure and on-board equipment.

• At the end of 2022, the launch of

the largest tender of the System

since its inception begins. During the

implementation process (CUV N°001/2019)

1.636 new buses were incorporated

between December 2022 and May 2023,

reaching a total of 28 electric terminals.









Year | • Update of the National Electromobility Strategy: by 2035, 100% of new additions to urban public transport will be zeroemission vehicles, and by 2040, the entire fleet will be zero-emission technology.

- Strategic alliance with Fondo de Infraestructura S.A.: An investment plan is approved, expanding the portfolio of projects to expropriate and strengthen terminals in the RED System for future bidding processes.
- Signing of Complementary Bus Supply Service Contracts (LP SB N°001/2019): The awarded companies will supply 991 electric buses and 646 Euro VI diesel buses with RED standard between 2022-2023 and supervise the maintenance carried out by the operating companies.











VI. Electromobility in action: progress and results

A. Fleet evolution towards the RED standard

1. New technologies: low-emission diesel, electric and more efficient engines

The bus fleet of the Santiago Public Transport System has undergone significant changes over the past decade. A key element in this process has been the adoption of advanced engine technologies, particularly the introduction of electric and low-emission Euro VI diesel buses an investment that reflects the System's commitment to sustainability and the modernisation of urban transport.

Santiago has positioned itself as a regional benchmark in Latin America by advancing toward stricteremission standards to improve air quality and reduce local pollution. Through the Plan de Prevención y Descontaminación Atmosférica (Atmospheric Prevention and Decontamination Plan, PPDA), measures have been promoted that have accelerated the introduction of more advanced diesel engine technologies. As part of this strategy, the System adopted Euro III buses with Diesel Particulate Filter (DPF) as early as 2005 and was a pioneer in incorporating Euro VI buses in 2016, even before there was a commercial offer for our continent.

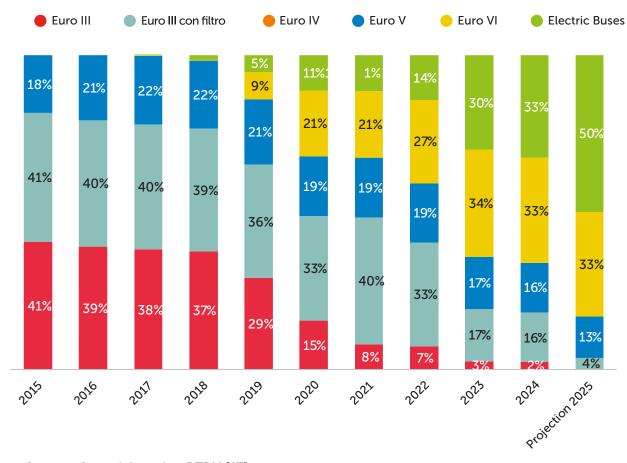
The impact of these actions is evident. In 2015, 100% of the fleet operated on low-sulphur diesel with most buses Euro III standards - with and without diesel particulate filter (DPF). By 2024, the proportion of diesel buses has been reduced to 62%, paving the way for cleaner technologies. A key milestone in the transition to electromobility occurred in 2017, with the commissioning of the System's first two electric buses and the incorporation of the early adoption of 10 Euro VI buses, ahead of the regulatory requirement.

These initial advances paved the way for the mass adoption of cleaner technologies and the consolidation of a higher standard for the RED System's fleet (RED Standard), in a process that has accompanied the evolution of public transport, reflected in the change of name from Transantiago to currently, Red Movilidad.

The new RED standard establishes that buses incorporated under the new concession contracts must comply with a more demanding environmental standard in terms of polluting emissions, cleaner technologies and energy efficiency. Vehicles must comply with current emissions regulations and meet the emissions and consumption cycle to ensure that they achieve a minimum efficiency, measured in megajoules per kilometre (MJ/km), according to the "TS-STGO" cycle. This efficiency and compliance must be accredited during bus type-approval at the Vehicle Control and Certification Centre (3CV).

By the end of 2024, the Red Movilidad System has 2,505 electric buses, representing 38% of the total fleet, by the end of 2025 is expected to reach 4,406 electric buses, allowing 68% of the fleet to be made up of this type of vehicle. This operation is backed up by nearly 55 electroterminals.

Figure 1: Technological Evolution of the Fleet 2015 - 2025

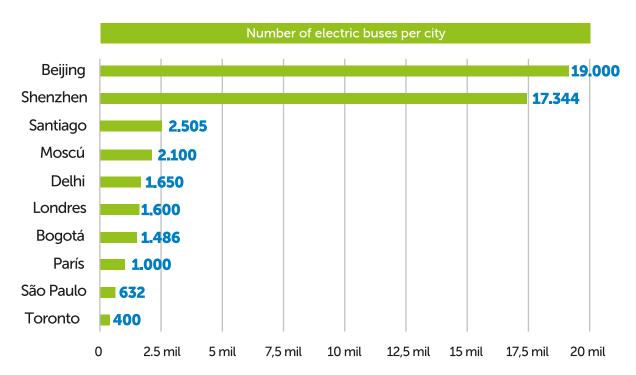


Source: Own elaboration DTPM [17]

This progress consolidates Chile as a leader in electromobility in the region and positions Santiago as one of the cities with the most electric buses in the world, surpassed only by Beijing and Shenzhen in China.

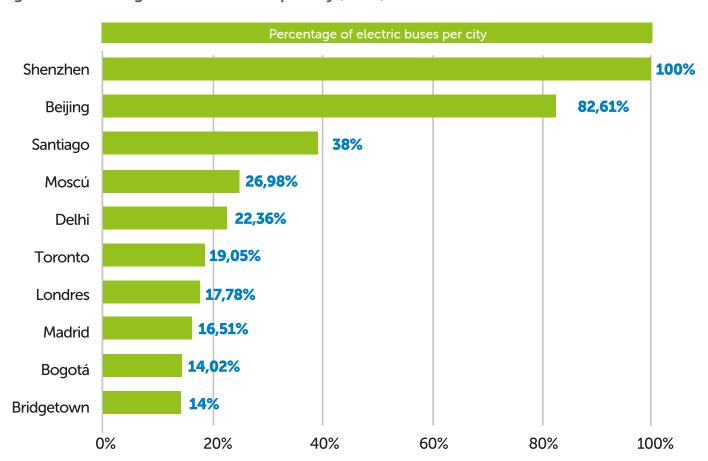
This recognition of leadership has been highlighted by the Centro de Movilidad Sostenible (Center for Sustainable Mobility, CMS), part of the ZEBRA (Zero Emission Bus Rapid-deployment Accelerator) alliance, which promotes the deployment of electric buses in Latin America and the Caribbean, fosters data transparency, and quantifies avoided CO2eq emissions. In its 2025 update, the CMS monitoring and geo-referencing platform reported over 49,000 electric buses in 49 cities across 18 countries, with Santiago de Chile standing out as the city with the largest electric bus fleet in Latin America and the Caribbean, and the third-largest worldwide, after Beijing and Shenzhen.

Figure 2: Number of electric buses per city, - 2025



Source: Centro de Movilidad Sostenible (https://cmsostenible.org/)

Figure 3: Percentage of electric buses per city (2025)



2. On-board technological improvements and inclusive design

The modernisation of the Santiago Public Transport System fleet has not only driven cleaner and more efficient technologies, but also significant improvements in people's travel experience, safety and accessibility.

This process has been accompanied by key regulatory updates defined in Decree N° 122 [18], which laid the foundations for the evolution of bus standards. In 2012 and 2017, adjustments were made to take into account the morphology of the national population, making it possible to optimise comfort and safety on board, incorporating the redesign of seats, a more efficient distribution of handrails, the incorporation of driver's cabins and other measures that have raised the standard of the system, which have been particularly appreciated by women. The regulations of the old vehicles did not detail basic aspects such as seat inclination, handrail height and handholds, among others, causing discomfort among users, who described the buses as uncomfortable and unsafe.

Given these first modifications, the new electric and Euro VI buses incorporate technological innovations that make public transport a more comfortable, safe and modern alternative.

Technological innovations for a better travel experience

Connectivity and comfort: The new Red Movilidad buses are equipped with Wi-Fi internet access, USB charging ports and state-of-the-art technology to improve the travel experience for users. In addition, the buses have a camera system with streaming transmission, allowing real-time monitoring, information screens, air conditioning, ergonomic seats, universal accessibility features and adequate space to ensure a more comfortable journey.

• Increased security: The incorporation of remote surveillance allows real-time access to the images captured by the cameras of 1,600 RED buses, covering areas inside and outside the bus, with high image quality standards, including night vision. This measure aims to offer greater safety to drivers and passengers, as well as contributing to crime prevention.

- **Driver Assistance System:** the buses have ADAS (Advanced Driver Assistance Systems) technology that helps to detect the presence of objects or people nearby, improving manoeuvrability and reducing risks in operation.
- Speed limiters: The implementation of speed limiters on buses is a significant advance in road safety and operational efficiency. These devices allow the maximum speed of vehicles to be controlled, reducing the risk of accidents due to speeding and improving the safety of both passengers and pedestrians. It also optimises operational efficiency, reducing mechanical wear and energy consumption.
- Separate cabins for drivers: to improve the safety and comfort of the driving staff, the buses include enclosed driver cabins, with greater comfort and harmoniously integrated into the vehicle design.

Accessibility and inclusive design The commitment to an inclusive and equitable public transport system has translated into concrete improvements for people with reduced mobility. Since its inception, the system has required buses to have low floors to facilitate access for people with reduced mobility, wheelchair access ramps, signposted areas inside the bus, seat belts, a differentiated bell in the areas where priority seats are located, and handrails with Braille signs to identify the stop bells.

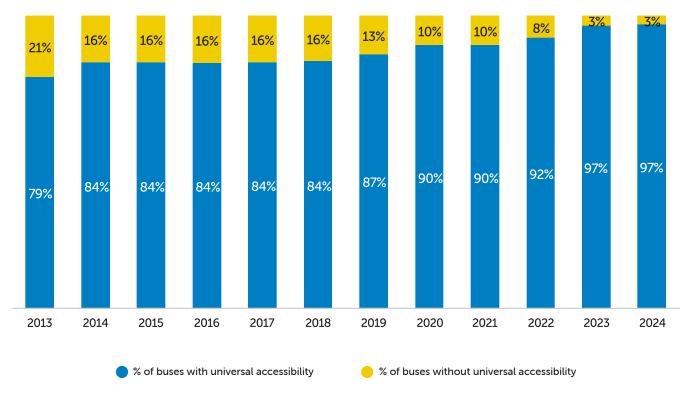
These measures are based on studies and consultations with diverse user groups, including focus groups and participatory sessions, whose contributions have been reflected in the regulations for new buses and in the 2024 edition of the Manual de Normas Gráficas (Graphic Standards Manual, 2024).

Source: Centro de Movilidad Sostenible (https://cmsostenible.org/)
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Given these improvements, the proportion of buses with low floors and inclusive equipment has increased from 79% in 2013 to 97% in 2024, consolidating a more accessible system for all people. The remaining 3% corresponds to non-standard RED buses of less than 9 metres, where.

due to their chassis configuration, it was not possible to require a low floor. These will be replaced at the end of their useful life by electric buses that do meet this standard, moving towards a more inclusive and sustainable system.

Figure 4: Fleet with universal accessibility features



Source: Own elaboration based on Red Movilidad bus register [16]

B. Electroterminals: green and climate-resilient infrastructure

• 1. Electroterminals

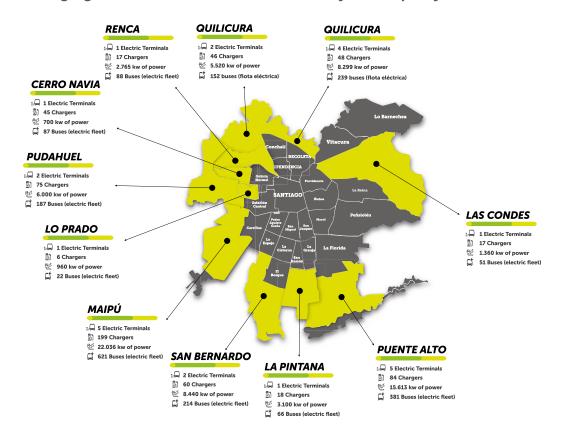
The massive incorporation of electric buses has required a profound transformation in the support infrastructure, giving way to a network of electroterminals designed to guarantee an efficient, sustainable and resilient supply to climate change.

Currently, the Red System has 73 bus terminals, of which 28 are electroterminals strategically located in 12 muni-

cipalities, facilitating the operation of the electric fleet in different areas of the city. Likewise, there are a total of 739 chargers with a total power of 89.8 megawatts (MW), with an average of 1 charger for every 3 buses.

The El Conquistador electro-terminal in the Maipú district is the largest of all, with an installed power of 8,933 kW and currently houses 205 electric buses and 174 diesel buses.

Ilustration 1: Charging infrastructure and electric fleet by municipality, 2024



Source: Own elaboration. DTPM.

To ensure adequate energy planning and the operational stability of the terminals, the new concession contracts have incorporated requirements that oblige transmission operators to report the power available at each facility. In addition, the electro-terminals have energy back-up me-

chanisms to ensure continuity of service in the event of possible interruptions to the electricity supply. Similarly, concessionaires are obliged to declare the origin of the energy used, promoting the use of renewable energies and further reducing the system's carbon footprint.

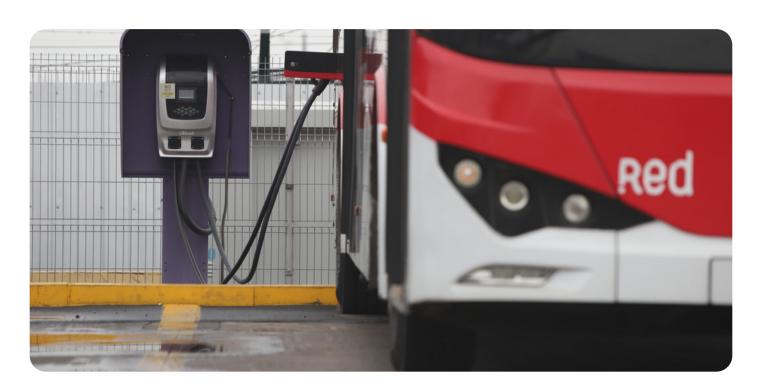
Another key aspect is smart charging management, which allows monitoring battery performance and optimising bus charging processes according to the operational needs of the transport services. This continuous monitoring not only improves the energy efficiency of the fleet but also contributes to prolonging the life of the batteries, reducing costs and reinforcing the sustainability of the system.

The charging management of electric buses responds to the operational dynamics of the transport system, prioritising the availability of the fleet during peak demand times. In particular, the periods between 06:00 to 12:00 hours and 15:00 to 19:00 hours require a high number of operational buses, which makes efficient energy supply planning essential.

The bus charging strategy focuses on times of lower transport demand, ensuring that the fleet starts the day with an optimal level of load. This also optimises operating costs by taking advantage of lower tariffs and reducing pressure on the electricity grid.

In addition, concessionaires monitor the average charging time per bus, expressed in minutes per hourly range, along with the average energy consumption per vehicle in kWh. These indicators allow assessing the efficiency of the chargers used and their energy supply ratio per hour, facilitating adjustments to improve the performance and autonomy of the fleet, to provide the best possible service to the customers.

Performance monitoring of charging management is fundamental for the DTPM, as it allows to continuously evaluate and optimise the operational efficiency of the electric fleet. To this end, a study is currently underway that will address this issue through different products, including a diagnosis of the state of charging stations, a follow-up of the management systems in 400 buses, opportunities on the second use of batteries and recommendations on control methods for charging management carried out by the operating companies.



C. The role of human capital in the implementation of electromobility

The implementation of electromobility in the RED System would not have been possible without the valuable support of the human capital that forms the backbone of its operation. In this process, the 18,141 drivers - 2,025 of whom are women - have been key players in guaranteeing a safe, efficient public transport service adapted to new technologies. Likewise, the maintenance staff, made up of 2,628 people, has played a fundamental role in the transformation, management and repair of vehicles, ensuring that the transition to electric buses is successful, efficient and, above all, safe for users.

Continuous Education. The transition process has required a strong investment in training and continuous education. During 2024, the concessionaires trained 9,433 people, including drivers, maintenance personnel, technicians, mechanics, instructors and risk prevention specialists, on topics such as manoeuvring, maintenance, loading and efficient driving.

As part of the process of adaptation to electromobility, training initiatives have also been developed for firefighters and Carabineros de Chile to respond appropriately to emergencies. Vehicle brand representatives, educational institutions and transport operators have led these initiatives, addressing key aspects of the structure, operation and specific risks of electric buses. These initiatives are key to guaranteeing an efficient response to incidents and reinforcing safety in the operation of the system. It is expected that these trainings will continue to expand,

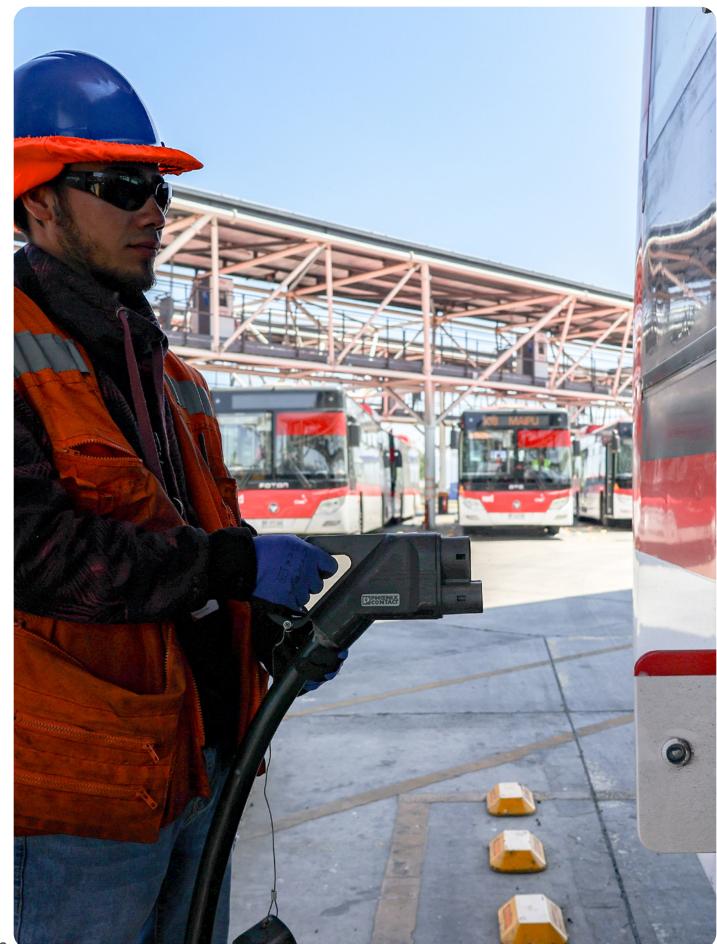
complementing the incorporation of new technologies and safety protocols in Santiago's public transport.

Transformation of employment. The introduction of electromobility has driven a transformation process in concession companies, service providers and other actors in the value chain, redefining job profiles and demanding new skills.

Concession companies have prioritised the training of their personnel, favouring internal mobility and the reconversion of technicians towards specialties in electricity and electronics, and this trend is expected to continue to grow as the fleet of electric buses increases.

Similarly, the need for advanced solutions for load management, real-time monitoring and operational efficiency is driving the recruitment of specialists in software, energy systems engineering and renewable energy integration.

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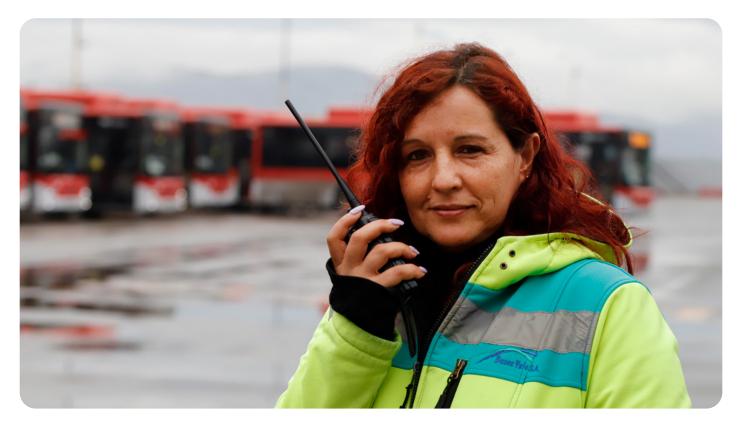
Effect on the education offer. In Chile, the training offer in electromobility has experienced a remarkable growth in recent years, reflecting a trend towards specialisation in this field. Several higher education institutions and technical training centres have incorporated specific programmes in their curricula as well as the creation of diploma courses to address the emerging needs of the sector.

For example, the University of Chile, through the Faculty of Physical and Mathematical Sciences, launched the Centre for Sustainable Acceleration of Electromobility (CASE) in October 2023. This centre seeks to strengthen the implementation of electromobility in the country, promoting research and training in this field [19]. Similarly, the Pontificia Universidad Católica de Chile offers the 'Diploma in Electromobility and Energy Transition', aimed at providing tools to identify and implement business opportunities related to electromobility and the transition to cleaner energy sources [20]. On the other hand, the Universidad Técnica Federico Santa María (USM) has developed several initiatives in electromobility, including the training of professors in collaboration with companies such as BYD and the creation of continuous training programmes [21]. The University of Santiago de Chile (USACH) and the Metropolitan Technical University (UTEM) also offer specialisations and diplomas.

Among the Institutes and Technical Training Centres IN-ACAP, with a focus on practical training, has incorporated careers such as Automotive Mechanics and Electromobility, as well as Engineering in Automotive Mechanics and Electromobility. It also has four electromobility laboratories, with the Maipú branch being the pioneer in its inauguration in 2018 [22]. DUOC UC includes the 'Electric Mobility Laboratory' in its syllabus, offers the DUOC UC Diploma in Electromobility and makes charging points available to the community at some of its campuses.

On the other hand, since 2017 driving schools have been integrating courses related to electromobility for drivers of lightvehicles or buses, with the aim of bringing corporations closer to the replacement of fleets towards electric buses.

This diversification in the educational offer responds to the growing demand for professionals trained in electromobility, showing a clear trend towards specialised training in this field in Chile.



D. Emissions, energy consumption and air quality

• 1. Local and global emissions

The massive incorporation of electric and Euro VI buses in the RED System has marked a milestone in the reduction of public transport emissions, contributing significantly to the improvement of air quality and progress towards carbon neutrality.

By 2024, more than 65% of the fleet is composed of low or zero emission buses, which has allowed mitigating the environmental impact of public transport in Santiago. This effort translates into a sustained reduction of the main local air pollutants and a lower

contribution to greenhouse gas emissions (CO2eq).

According to the Sixth Annual Report on Emissions of the RED System, prepared by SECTRA [23] emissions, RED buses accounted for only 3.3% of total CO2eq emissions from transport in the city, in contrast to the 90% generated by cars and motorbikes. In the case of local pollutants such as fine particulate matter (PM2.5), RED buses contributed only 3.7%, while private vehicles were responsible for 89.3% of these emissions.

Table 2: Reference Emissions Greater Santiago Transport System 2023

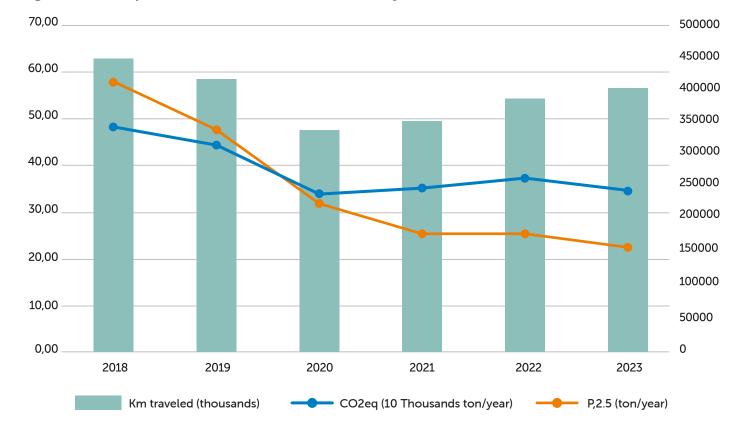
Categories	PM10*	PM2.5*	NOX	СО	COV	CC	CO ₂ eq
Categories	(Ton)	(Ton)	(Ton)	(Ton)	(Ton)	(Ton)	(Ton)
Taxis	3,4	2	18,7	57,7	33	13.301	41.736
Private buses	5,4	4,2	237,3	70,5	6	11.041	35.316
Comercial for private use	29,3	21,4	916,6	2.463,40	448,1	94.676	293.091
Motorbikes	81,8	71,1	273,7	19.523,60	4.262,10	116.848	378.414
Personal cars	782,6	465,6	5.561,90	25.056,40	4.761,20	2.890.558	9.183.200
Collective taxis	25	14,5	181	310,8	39,6	89.724,50	28.4147.4
RED System 2023	36,8	22,5	1.591,40	432,4	59,5	100.699	346.103
Total	964,1	601,2	8.780,70	47.914,70	9.609,60	3.316.847	10.562.007
% RED 2023	3,80%	3,70%	18,10%	0,90%	0,60%	3,00%	3,30%
% Motorbikes and personal cars	89,66%	89,27%	66,46%	93,04%	93,90%	90,67%	90,53%

Source: Own elaboration based on the Sixth Annual Emissions Report of the RED System 2024 [23]

Progress has been particularly marked in the last decade. In 2023, emissions of PM2.5 from the RED System were reduced to 22.5 tonnes per year, while CO₂eq emissions fell to 346,103 tonnes per year. Compared to 2019 (pre-pandemic), these figures represent a 52.8% reduction in

fine particulate matter and a 22.3% reduction in greenhouse gases, consolidating Santiago's public transport system as a benchmark in sustainability and energy efficiency.

Figure 5: Atmospheric emissions, 2018 -2023 (Ton/year)



Source: Own elaboration based on the Sixth Annual Emissions Report of the RED System [22]

Table 3: Monitoring of Annual Emissions from Red Movilidad Buses

Year	PM10 (Ton)	PM2.5 (Ton)	NOX (Ton)	CO (Ton)	COV (Ton)	CC (Ton)	CO ₂ eq (Ton)	Km/bus (Ton)	Intensidad emisiones (gCO ₂ eq/Km)
2018	74,1	57,8	3.890,20	990,9	180,1	151.882,00	483.966	448.394.192	1.079
2019	63	47,7	3.316,30	852,1	151,2	138.159,60	445.301	418.007.479	1.065
2020	44,3	31,8	2.273,40	585	101,9	102.591,10	339.293	340.013.392	998
2021	38,3	25,4	1.898,70	501,6	82	105.850,80	352.297	354.455.662	994
2022	39,2	25,4	2.285,00	596,7	95	112.714,20	373.081	389.736.932	957
2023	36,8	22,5	1.591,40	432,4	59,5	100.699,30	346.103	405.065.502	854
Variation v/s 2022	-2,4	-2,9	-693,6	-164,3	-35,5	-12.014,90	-26.978		
Variation %	-6,1	-11,4	-30,4	-27,5	-37,3	-10,7	-7,2		
Variation v/s 2019	-26,2	-25,2	-1.724,90	-419,7	-91,7	-37.460,30	-99.197,90		
Variation %	-41,6	-52,8	-52	-49,3	-60,6	-27,1	-22,3		

Source: Own elaboration based on the Sixth Annual Emissions Report of the RED System 2024 [23]

These reductions are reflected in the CO2eg emissions intensity (grams of CO2 equivalent per kilometre travelled) showing a constant decreasing trend be-

duced to 854 gCO2eg/km, representing a decrease of 20.9%. This decrease reflects greater efficiency in energy use due to the transition towards the electrifitween 2018 and 2023. In 2018, the indicator stood at cation of the fleet, contributing to a more sustainable 1,079 gCO2eq/km, while by 2023 this value was republic transport aligned with environmental objectives.

2. Energy consumption

Energy consumption in the RED System has undergone significant changes between 2018 and 2023, evidencing a transition towards more sustainable sources. In 2018, diesel consumption of the bus fleet was 180,811,884 litres, while by 2023 this figure was reduced to 119,880,154 litres, representing a decrease of 33.7%. In parallel, electricity consumption showed a significant growth from 20,149,226 kWh in 2019 to 100,322,335 kWh in 2023, an increase of almost 400%.

This increase reflects the electrification of the fleet. which not only reduces dependence on fossil fuels, but also contributes to the reduction of pollutant emissions. The combination of these two trends - lower diesel consumption and increased use of electric power - reflects a move towards a more sustainable transport model aligned with decarbonisation goals.

Table 4: Fuel consumption by source in the Red System

Year	Diesel (lt)	Energy (kWh)
2018	180.811.884	-
2019	164.475.697	20.149.226
2020	122.132.285	31.131.958
2021	126.012.898	35.612.965
2022	134.183.589	45.336.014
2023	119.880.154	100.322.335

Fuente: Own elaboration based on the Sixth Annual Emissions Report of the RED System [23]

3. Air quality

Within the framework of the Santiago Air Pollution Prevention and Atmospheric Decontamination Plan (PPDA), the RED System has implemented a series of measures to guarantee the continuity and efficiency of public transport, especially on days of Critical Pollution Episodes (GEC). These actions seek to speed up travel, mitigate the effects of vehicle restrictions and strength the supply of sustainable transport, for a cleaner and more efficient mobility. Along with the renewal of the fleet of electric and diesel Euro VI buses, the RED System has adjusted the operation of the service when significant variations in the demand for public transport have been detected. These modifications have made it possible to optimise the distribution of the fleet and reinforce services at strategic times and sectors, thus ensuring better coverage and reduced waiting times.

Likewise, the constant monitoring of priority infrastructure for public transport and emergency vehicles, such as 'Bus Only' corridors and lanes, has contributed to reducing travel times and improving the regularity of the service, facilitating more efficient mobility for users. In addition, in collaboration with the MTT's National Control Programme, a rigorous control is maintained on the emissions of buses in circulation and in terminals. ensuring compliance with environmental standards.

Along with this, the DTPM has reinforced communication to users and the community in general about the measures of the GEC Plan through social networks and other 52 information channels, encouraging the use of public transport and promoting complementary actions to reduce pollution.

These actions and others strongly focused on industry and residential heating, particularly discouraging the use of firewood, in 2024 the Ministry of Environment reported that this was the third year with better air quality since the implementation of the Decontamination Plan, with a 50% reduction in the number of critical pollution episodes compared to 10 years ago [24].

The strengthening of public transport and the in corporation of low- and zero-emission buses have been key to reducing air pollutants. Today, due to the modernisation of the fleet and the adoption of cleaner technologies, its contribution has been reduced to 3.7% of fine particulate matter (PM2.5) emissions, consolidating the RED System as a relevant player in the decontamination of Santiago by offering a clean and efficient transport alternative, less dependent on cars, especially on critical pollution days.

E. Noise

One of the most prominent benefits of electromobility is the significant reduction of noise pollution, as electric buses are much quieter than diesel-powered buses. This not only improves the travel experience for users and drivers but also contributes to a better quality of life in densely populated urban areas by reducing noise exposure and its negative effects on the health and well-being of the community.



• 1. Noise emission standard for electric buses

In the RED System, our buses not only comply with current environmental regulations, but far exceed them. New electric buses when certified by the Vehicle Control Centre (3CV) emit on average between 6 and 5 decibels (dB(A)) less than what is required by the regulations [25] (80 and 81 dB(A), respectively), under dynamic testing in interior and exterior noise. The figure is relevant, as it means that an electric bus emits between 75% and 68% less acoustic energy (noise) than required by regulations and diesel buses.

Table 5: Comparison between Noise Emission Limits and average emission levels of new electric and diesel Euro VI certified buses.

	Norm DS129/2003 Article 5 bis			tified buses 3CV	Differences with the regulations			tions
			Average leve	e emission ls dB(A)	Ele	ctric	Diesel E	uro VI
Essay	Position medition	Emission limit dB(A)	Electric	Diesel Euro VI	dB (A)	% accoustic energy	dB (A)	% accoustic energy
	Interior	81	74	75	-5	-80%	-6	-68%
Dynamic	Exterior	80	76	77	-4	-60%	-3	-50%

Source: Prepared by the authors, based on the bus list of certified buses from the 17.10.2024 of 3CV.

Noise inside the buses

In order to objectively evaluate the noise perception of both passengers and drivers inside electric buses, the DTPM contracted a study to analyse these effects during the months of December 2024 and January 2025.

The objective of the study was to measure the noise level inside different models and years of diesel and electric buses operating in the System, evaluating a total of 15 buses: 6 electric and 9 diesel in three different measurement conditions i) controlled track tests.

ii) in routes without passengers and iii) in routes with passengers, including measurements in the driver's cabin, in order to compare the differences between the different conditions and vehicle technologies.

The controlled track measurements were carried out at the Parque Bicentenario in Cerrillos to establish the baseline noise level of a bus. Meanwhile, the non-passenger runs aimed to identify variations caused, for example, by pavement conditions and other exter-

nal noises that could influence the results and analysis. The passenger and non-passenger runs were applied to 6 System services: 117c, 219e, 481, 516, G15 and G31.

Calibrated sound level meters and the reference standard of the Technical Protocol on noise measurement procedures for urban and rural public transport buses, Exempt Resolution No. 313/2019 of the Ministry of the Environment, were used in the measurements. Some additional tests were carried out on the use of the sound level meter, which validated the methodology, showing that the difference between measurements with the sound level meter held by a field engineer and attached to the bus structure were insignificant, which supports its use in prolonged measurements without interfering with the normal operation of the bus. Also, measurements 'without' and 'with' the air conditioning were considered to compare the performance in both conditions.

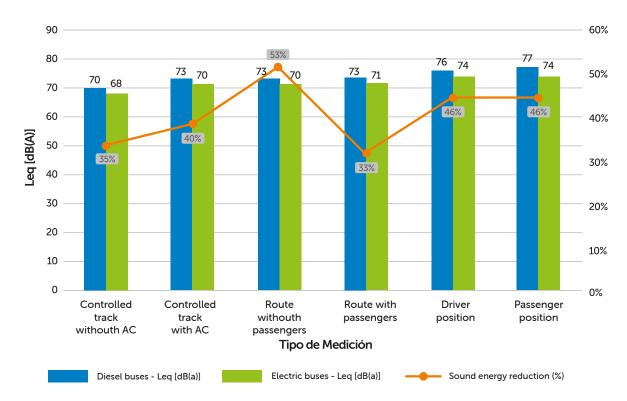
The results obtained in the controlled track tests indicate that, on average, the equivalent noise level (Leq) of the electric buses was 1.9 dB(A) lower than that of the diesel buses, representing a 35% reduction in sound energy. When air conditioning was activated, although noise emission levels increased for both technologies, the difference in favour of electric buses widened to 2.2 dB(A) less, representing a 40% reduction in sound energy.

During measurements on routes without passengers, the average equivalent noise level on electric buses was 3.3 dB(A) lower compared to diesel buses, with a 53% reduction in sound energy. When analysing passenger journeys, it was found that the equivalent noise level on electric buses was 1.7 dB(A) lower, representing a 33% decrease in sound energy.

Finally, measurements were made at the position of the driving staff and passengers. In the driver's cab, the equivalent noise level in the electric buses was 2.7 dB(A) lower than in the diesel buses, with a 46% reduction in sound energy. In the passenger position, the difference was also 2.7 dB(A), with a 46% reduction in sound energy.

The data obtained shows a significant reduction in the noise level of electric buses compared to a conventional diesel bus, as shown in the graph below built from data from the study:

Figure 6: Average noise emission level Leq [dB(A)] recorded inside diesel and electric buses and their sound energy reduction in percentage (%) in the different types of measurements



To facilitate the analysis and comparison between the 15 bus types, they were grouped into four categories (Group 1, Group 2, Group 3 and Group 4), considering similar models in terms of size, technology and age. When comparing noise levels according to technology type (diesel or electric) and year of manufacture, variable behaviour was observed. Although newer buses were expected to be quieter, in some cases the results were similar or even slightly higher. This may be due to the limited number

of measurements per group and the influence of multiple factors, such as the presence or absence of passengers and the characteristics of the route. Despite these variations, the comparison between the older diesel Group 1 buses and the younger electric Group 4 buses confirms that the electric buses are significantly quieter on average 2.2 dB(A) less and 40% less noise energy inside the buses measured in a passenger service.

Table 6: Average noise emission level Leq [dB(A)] inside buses grouped according to the similarity between models and age, measured under different conditions, differences and sound energy (%)

Type of measurement	Group 1 Diesel over 6 years old Leq [dB(A)]	Group 2 Diesel 2 years old - Leq [dB(A)]	Group 3 Electric over 2 years old - Leq [dB(A)]	Group 4 Electric under 2 years old - Leq [dB(A)]	Difference Group 1 vs. Group 4 Max. Leq [dB(A)]	Maximum sound energy reduction (%)
Controlled track without AC	69,8	69,7	68,6	67,2	2,6	45%
Controlled track with AC	71,9	73,5	71,3	69,2	2,7	46%
Route without passengers	73,1	73,3	71,0	68,8	4,3	63%
Route with passengers	72,6	73,1	71,7	70,4	2,2	40%
Driver position (with passengers)	76,6	76,4	75,4	73,1	3,5	55%
Passenger position	76,0	76,5	74,1	72,8	3,2	52%

Source: Own elaboration, DTPM.

The analysis of noise levels inside electric and diesel buses, in comparison with current regulations, shows significant improvements with the incorporation of electromobility. Two key regulations were considered: the DS 129/2003 of the Ministry of Environment [26] that establishes noise emission limits in the certification of new buses and the PREXOR Standard (Occupational Exposure to Noise Protocol) that protects the hearing health of workers, setting an action limit of 82 dB(A) for an 8-hour working day.

In tests carried out on a controlled track without air conditioning (AC), all electric buses recorded noise levels below the maximum permitted by the DS 129/2003 regulation. While the regulatory limit is 80 dB(A), dynamic tests on all measured vehicles showed an average of less than 70 dB(A), demonstrating that despite their age of operation, interior noise levels remain below the norm.

In measurements on commercial routes with passengers, noise levels were identified as reaching values classified as 'conspicuous' (greater than 65 dB(A)) and 'intrusive' (greater than 75 dB(A)). In acoustics, these terms are used to describe noise levels that can affect comfort and cau-

se considerable discomfort to people. Although there are no reference standards for these terms, they are generally associated with sound pressure levels that can affect comfort and the travel experience, for example, when there is external traffic noise, engine and body vibrations, crowds, loud music or conversations on public transport. On the other hand, measurements at the driver's position verified that all buses comply with the PREXOR regulation, maintaining noise levels below the critical threshold of 82 dB(A). This means that the exposure of driving staff remains within safe parameters, with no risk to hearing health on standard working days.

Every time passengers and driving staff switch from a Euro V or lower diesel bus to an electric bus, they experience a significant reduction in their exposure to noise. This decrease not only improves the travel experience and onboard comfort but can also contribute to the reduction of fatigue and stress associated with noise pollution in public transport. These results reinforce the positive impact of electromobility on the quality of service and the well-being of those who use and operate the system.





• 3. Noise monitoring stations on avenues

The progressive incorporation of electric buses in the main avenues of Santiago has had a positive impact on the reduction of environmental noise, benefiting passengers, drivers (male and female), as well as the communities near electroterminals and the city as a whole. To evaluate these effects, the Metropolitan Public Transport Board and the Ministry of the Environment conducted an analysis of noise levels at five monitoring stations located at strategic points in the city, considering the technology and composition of the fleet circulating in front of these stations.

The results show that the increased presence of electric buses has contributed to a significant reduction in noise levels in high-demand corridors. In the Alameda axis, for example, on a representative day in 2023, a 44% reduction in acoustic energy was recorded in the morning rush hour (8:00 - 9:00 hrs.) and 40% in the evening (19:00 - 20:00 hrs.), compared to 2019. This result is explained, in part, by the increase in the percentage of electric buses in circulation on the Alameda, which went from 12% in 2019 to 36% in 2023.

The positive impact of electromobility is also observed in other sectors of the city. At the noise monitoring station in the municipality of San Miguel, located on Santa Rosa Avenue, noise levels during the morning rush hour were reduced by 45%, while in the afternoon the decrease was 35%, compared to the values recorded in 2020.

In addition, the analysis included data from three stations located in the municipalities of La Florida, El Bosque and Puente Alto, which allowed us to broaden the understanding of the impact of noise in different sectors of the city. In the case of La Florida and El Bosque, the data reflect a period of transition in public transport, given that the base year of comparison (2022) coincides with the progressive recovery of activity after the COVID-19 pandemic, registering increases in noise levels despite the incorporation of electric buses. On the other hand, the Puente Alto station collects measurements taken during the summer period, when traffic conditions and transport demand present particular dynamics that complement the annual analysis. This context offers an opportunity to observe how noise levels evolve in scenarios of reactivation of the system. In addition, the study included a correlation analysis and

linear regression models, obtaining the following results:

Correlation analysis between noise and bus fleet composition. To evaluate the relationship between the noise level in dB(A) and the composition of bus flows, a Pearson correlation analysis was performed, considering diesel and electric bus flows as a whole and individually. The results show that the correlation between total bus flow and noise level is high and positive, implying that a higher bus flow is associated with an increase in ambient noise levels. However, when disaggregating the analysis by bus type, it is observed that the correlation with noise is significantly stronger for diesel buses than for electric buses.

In particular, the flow of diesel buses shows a strong positive correlation with ambient noise (coefficient of 0.766), indicating that an increase in the number of these buses is directly associated with an increase in noise levels. In contrast, the relationship with electric buses is weaker (coefficient of 0.609), showing that their impact on noise levels is significantly lower. These results show that the increased circulation of diesel buses has a much greater impact on noise levels compared to electric buses, whose effect is more attenuated.

Linear regression models and vehicle speeds. The study also included the development of linear regression models to analyse the contribution of public transportation to environmental noise relative to private transportation. Five models were evaluated, considering vehicle counts of light and heavy vehicles, as well as their speeds.

The model with the best fit (adjusted $R^2 = 0.88$) indicates that the flow of electric vehicles has a negative effect on noise, i.e., their presence contributes to the reduction of noise levels. However, the interaction flow and speed of electric buses shows a positive effect, implying that, as speed increases their acoustic impact increases. At speeds below 13 km/h, electric buses do not generate a significant increase in noise, but when they

exceed this speed, their contribution to environmental noise increases. For reference, at 30 km/h, an electric bus contributes 0.005 dB(A) while a diesel bus, regardless of speed, contributes 0.019 dB(A) to the noise level. In global terms, the results indicate that electric buses represent only 3% of the total noise recorded at the monitoring points, compared to 44% attributed to diesel buses.

Finally, it is necessary to highlight that the continuous monitoring of these stations is a key tool for the DTPM, since it allows generating precise indicators on the

evolution of noise levels in different urban contexts and their relationship with the transition towards more sustainable technologies. The results obtained confirm that electromobility is key to mitigate noise pollution in Santiago, contributing to a cleaner and quieter environment. The expansion of the electric fleet will not only continue to improve the quality of the urban environment but will also continue to reinforce the importance of moving towards a more efficient and friendly public transport for the city and its inhabitants.



Table 7: Noise levels in decibels (dBA) at Noise Monitoring Stations and distribution of bus dispatches by technology.

MMA monitoring stations		Date		levels in	D	istribution of in circula	buses by te	
			decibe	els (dBA)	DIESEL	ELECTRIC	DIESEL	ELECTRIC
Stations	Day	Year	8:00 – 9:00	19:00- 20:00	8:00	0 – 9:00	19:	00-20:00
	13/08/2019	2019	73,5	73,7	88%	12%	86%	14%
A1 (A1) N(000 4)	17/08/2023	2023	71	71,5	66%	34%	64%	36%
Alameda (Altura N°924)	Difer	rence (dBA	-2,5	-2,2				
	Percentage varia	tion in acoustic energy	-44%	-40%				
	23/09/2020	2020	67,9	66,6	100%	0%	100%	0%
San Miguel	12/09/2023	2023	65,3	64,7	68%	32%	73%	27%
(Santa Rosa N°3453.)	Diference (dBA		-2,6	-1,9				
	Percentage variation in acoustic energy		45%	35%				
	9/11/2022	2022	65,7	66,1	100%	0%	100%	0%
La Florida (Walker Martínez N°300-	14/11/2023	2023	66,5	65,6	100%	0%	100%	0%
380)	Diference (dBA		0,8	-0,5				
	Percentage variation in acoustic energy		20%	-11%				
	2/11/2022	2022	61,9	62	100%	0%	100%	0%
El Bosque	30/11/2023	2023	62,6	66,4	65%	35%	70%	30%
(Alejandro Guzmán 925)	Difer	rence (dBA	0,7	4,4				
	Percentage varia	Percentage variation in acoustic energy		175%				
	30/11/2023	2023	67,3	66,9	57%	43%	49%	51%
Puente Alto	1/2/2024	2024	67,2	65,3	51%	49%	54%	46%
(Av. Concha y Toro 2747)	Difer	rence (dBA	-0,1	-1,6				
	Percentage varia	tion in acoustic energy	2%	31%				

[1] Hourly average equivalent level in dB(A).

Source: Consultancy "Development of performance indicators for the Santiago public transport system, Stage V"



4. Noise and air quality in electro terminals

The incorporation of electroterminals in Santiago's public transportation system has generated significant improvements in the reduction of environmental noise and particulate matter emissions in the surrounding area. A recent study commissioned by Copec Voltex in coordination with the DTPM and developed by Dictuc S.A. [26] in 2023, compared the environmental impacts of a mixed terminal with diesel operation in Maipú and an electric bus terminal in Peñalolén, confirming the benefits of electromobility in electric bus charging infrastructure. The study determined that an electric bus terminal generates up to half the sound power of a diesel bus terminal. While the operation of a traditional terminal recorded a weekly average of 63 decibels (dB(A)), a level equivalent to a loud conversation or a busy restaurant. the analysed electroterminal presented a level of 59

dB(A), comparable to the noise of an average office and in line with OECD acceptability standards. This difference of 4 dB(A) represents a reduction of close to 50% in the sound power of the traditional terminal, which implies a lower acoustic impact both for the people who work there and for the surrounding community.

In addition to the impact on noise reduction, the study showed that the operation of electric buses in a terminal significantly reduces the concentration of fine particulate matter (PM2.5) in the environment. Compared to the mixed terminal in Maipú, the Peñalolén electroterminal had a 42.4% lower concentration of PM2.5. This reduction is key to improving air quality for the benefit of workers and nearby communities, reducing exposure to pollutants associated with respiratory diseases.



F. Integral evaluation of electromobility in the RED System

With the aim of understanding in depth the impacts of the implementation of electromobility in the public transportation system of Santiago, a study was contracted to evaluate environmental and economic effects of the incorporation of electric buses in the RED System. through a cost-benefit analysis for the 2015-2040 period.

The analysis comprised a study of the benefits of incorporating electromobility into two components:

• Economic:

This refers to the reduced consumption of resources by society by switching the propulsion of buses in the public transport system from diesel to electric traction. The value of resources considers the correction of private prices with factors based on current methodologies. In particular, it compares the investment in buses, energy costs, maintenance costs, and investment in charging stations.

• Environmental:

This involves the impact of atmospheric emissions associated with greenhouse gases and urban noise, and the impact on productivity and leisure activities.

To evaluate the costs and benefits of electromobility, the study compares three implementation scenarios, from a gradual transition to electromobility to accelerated adoption, compared to a baseline scenario in which diesel buses continue to be used.

- Base Scenario: Without electric buses, it only includes the incorporation of Euro V, VI and VII buses in accordance with current regulations.
- Tendential Electromobility (ET) Scenario: Renewal of electric buses at historical rates, without achieving the consolidation of a 100% electric fleet before 2040.

• Accelerated Electromobility (EA) Scenario:

Accelerated renewal through bidding processes in 2023 and 2025, to achieve a 100% electric fleet by 2040.

Results of analysis

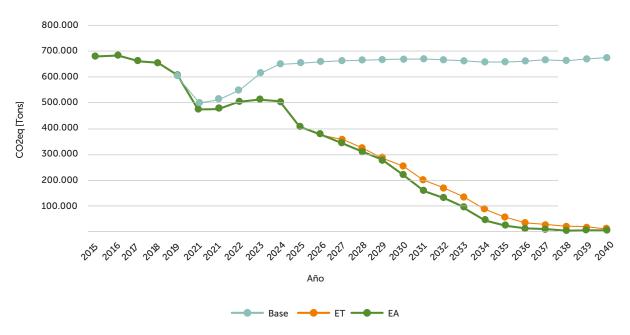
The cost and emissions projections associated with the evaluated scenarios are presented below.

Environmental benefit:

The introduction of electromobility into the Grid System has made it possible to avoid the emission of 370,000 tonnes of CO2eg in the period 2015-2024, with a projected reduction of 8.2 million tonnes of CO2eg additional by 2040 in the case of continuing with a trend electromobility (ET) scenario and 8.6 million tonnes in the case of accelerated electromobility (EA).

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Source: Consultancy "Development of performance indicators for the Santiago public transport system, Stage V".

In terms of economic valuation, the efficiency associated with electromobility in both social aspects is demonstrated. In particular, the environmental benefits derived from lower greenhouse gas emissions are estimated at more than USD 411 million for the period 2025-2040, considering the shadow price values for emissions reduction. USD 28 million in benefits have been achieved over the 2015-2024 horizon.

In terms of noise, the benefits associated with the effects on productivity were estimated, and the benefits associated with the accelerated scenario are projected to exceed the baseline of US\$450 million, considering the period from 2015 to 2040.

Economic benefit:

In order to carry out the economic analysis, it was necessary to define the cost parameters; the fleet renewal costs are presented in Table 8 and the maintenance costs are presented in Table 9.

Table 8: Fleet renewal reference values by bus type [USD]

Type of bus	2015	2020	2025	2030	2035	2040
A - Diésel	\$309.189	\$309.189	\$309.189	\$309.189	\$309.189	\$309.189
B2 - Diésel	\$316.572	\$316.572	\$316.572	\$316.572	\$316.572	\$316.572
C2 - Diésel	\$459.353	\$459.353	\$459.353	\$459.353	\$459.353	\$459.353
D - Diésel	\$450.739	\$450.739	\$450.739	\$450.739	\$450.739	\$450.739
A - Eléctrico			\$229.075	\$229.075	\$229.075	\$229.075
B2 - Electric		\$566.129	\$339.745	\$332.021	\$324.296	\$316.572
C2 - Electric			\$572.414	\$534.727	\$497.040	\$459.353
D - Electric	\$561.680	\$561.680	\$561.680	\$524.700	\$487.719	\$450.739

Source: Consultancy "Development of performance indicators for the Santiago public transport system, Stage V".

Table 9: Reference values of energy efficiency for each type of bus

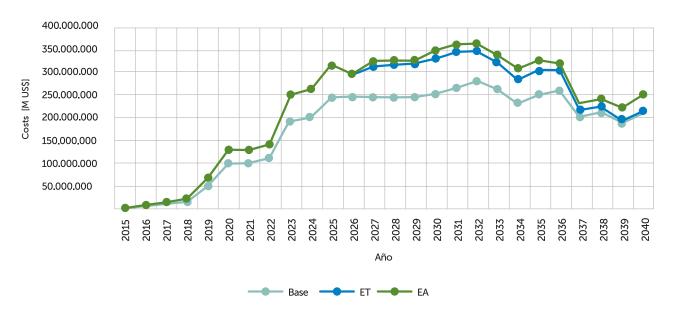
Type of Bus		CLP/km	USD/km
Diesel	А	126	0,14
	B2	180	0,20
	C2	234	0,26
	D	234	0,26
51.1	А	70	0,08
	B2	100	0,11
Elelectric	C2	130	0,14
	D	130	0,14

Source: Consultancy "Development of performance indicators for the Santiago public transport system, Stage V".

Additionally, estimated values were established for the electric chargers (US\$50,000) and electricity (109-160 CLP/kWh). The bus purchase is assumed to be made through instalment payments, covering 14 years of bus

operation and a monthly interest rate of 0.5%. This is similar to industry-wide estimates. Using these parameters, the annual costs for each scenario were estimated, as shown in Figure 8.

Figure 8: CAPEX for each scenario evaluated

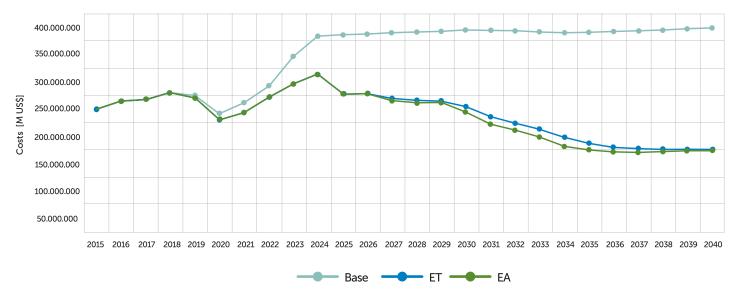


Source: Consultancy "Development of performance indicators for the Santiago public transport system, Stage V".

Figure 9: OPEX for each scenario evaluated

The deployment of electromobility in public transport has required a cumulative investment of US\$226.6 million in the acquisition of electric buses and their associated infrastructure through 2024. Achieving the full transi-

tion by 2040 is estimated to require an additional investment of US\$808.7 million in vehicles and US\$79.3 million in charging infrastructure and terminal modernization.



Source: Consultancy "Development of performance indicators for the Santiago public transport system, Stage V".

Regarding savings, the private assessment estimates US\$174.2 million in savings have been achieved in the 2015-2024 period, while projected savings are close to US\$2.8 billion for the remainder of the 2025-2040 period. This confirms that the decision to transform the public transportation system toward electromobility not only entails emissions reductions but also significantly reduces operational and maintenance costs, generating savings for the system and making the use of public resources more efficient.

Regarding cost projections, both investment (CAPEX) and operation and maintenance (OPEX), they were evaluated in present value through 2024. The scenario with the lowest Net Present Value (NPV) of private costs corresponds to the Baseline Scenario (BSS), at US\$9.189 billion, followed closely by the Accelerated Electromobility Scenario (AES), at US\$9.238 billion. The Baseline Scenario, without the addition of electric buses, presents the highest NPV, at US\$9.958 billion. This once again confirms that the decision to incorporate electric mobility into the system results in a lower-cost and more efficient system. The difference between the Baseline and AE scenarios is marginal, equivalent to 0.53%, which suggests that an accelerated electromobility strategy allows progress toward the commitment to have a fully electric fleet by 2040, without a significant increase in costs.

From a social perspective, the lowest NPV is also associated with the Baseline Scenario (US\$9.93 billion), followed by the AE scenario (US\$9.965 billion), and then the Baseline Scenario (US\$11.055 billion). The differences between ET and EA remain below 1% in present value terms, reinforcing the viability of the accelerated implementation strategy for electromobility. The EA Scenario stands out for its ability to align the public transport system with the country's decarbonization commitments.

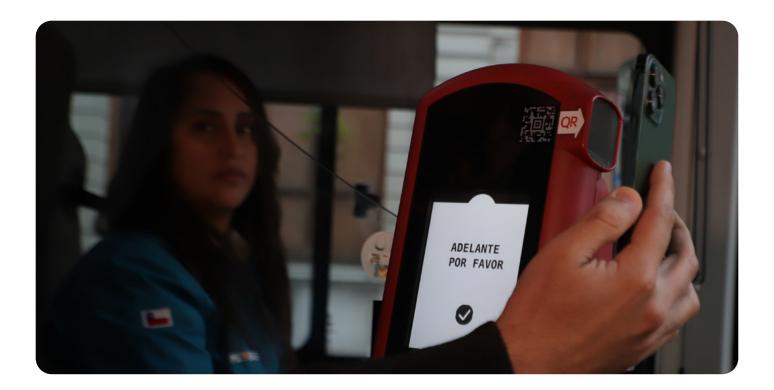
Finally, a sensitivity analysis was conducted on energy and diesel prices to identify which variations in these two elements generate changes in the comparison of the scenarios. Thus, it is established that the Base Scenario is only the most profitable in cases where energy grows 10% more than projected, along with a 1% reduction in diesel; or where the price of diesel is reduced by 10%

compared to projected and energy increases by 0.5%.

It is worth noting that the observed decrease in electric bus prices in recent years has been strongly influenced by recent bidding processes, characterized by intense competition in the industry. This has allowed operating companies to access more manufacturers, lower prices, and better financing, based on the interest generated in participating in the system. In this context, it is important to note that part of the cost evaluation and projection considers these lower prices as part of the ET and EA scenarios, assuming the market achieves an efficient equilibrium around them and that they are maintained even in non-bidding scenarios.

Conclusion and perspectives

The purpose of this chapter was to financially evaluate the incorporation of an electric fleet into the public transportation system, both from an environmental and economic perspective. The positive results are clear in all areas, with significant reductions in emissions and noise since its implementation in 2017. Projections are also encouraging, confirming that electromobility also entails financial savings due to lower operating and maintenance costs. While investment in buses could be higher, the savings generated always make the electric bus system more efficient than one with diesel. It is concluded, that for a city like Santiago, the process carried out with the electrification of the public transportation system has represented progress in terms of efficiency, highlighting the better use of public resources and lower social costs.



G. Circular economy

The transition to electromobility not only reduces emissions but also promotes a more sustainable transportation model in terms of resource and waste management. The reduced dependence on fossil fuels and lubricating oils reduces the generation of hazardous waste, representing significant progress toward consolidating a circular economy in the public transportation system.

In this context, the concessionaire companies of the RED System have strengthened their waste management through regulatory compliance and the implementation of recovery and reduction strategies. These actions, aligned with the Extended Producer Responsibility Law (REP) and other sectoral regulations, promote sustainable practices that support Chile's climate commitments.

Currently, the system's terminals and depots generate a significant amount of solid waste, mostly from maintenance workshops, bus cleaning, and administrative facilities. This waste is mainly classified into three types: residential, hazardous industrial, and non-hazardous industrial, with a relatively balanced distribution between the latter two categories.

As a result of recovery efforts, most of the waste generated is managed through recycling, composting, or trans-

formation into alternative fuels, while the remainder is destined for final disposal in sanitary or safety landfills. Among the recovered waste are metals, end-of-life tires, and certain hazardous waste such as sludge and car wash fluids, treated using technologies such as bioremediation.

The progressive incorporation of electric buses is projected to be a key factor in reducing the generation of waste associated with the system's operation, especially that derived from the use of oils, lubricants, and parts contaminated with hydrocarbons. This change will not only reduce the environmental burden on terminals and workshops but will also strengthen circular economy strategies within the RED System. Joint monitoring of these indicators with concessionaires will allow for an assessment of the environmental impact of electric mobility and generate new opportunities to improve the sustainability of public transportation in Santiago.

H. Responsible consumption of water

The implementation of electromobility has encouraged more efficient management of natural resources within terminals and depots. RED System concession companies have adopted various strategies to optimise water consumption, recognising that while this does not have a direct impact on their operations, it does influence their costs and the water crisis facing the country.

Some of the most relevant actions include:

• Measuring and setting reduction targets:

Several companies have set water efficiency targets based on monitoring their consumption in terminals, depots and administrative buildings.

• Optimisation of bus washing:

Systems have been installed that allow water recirculation, reusing 1 litre up to 5 times and recovering 80% of the volume used.

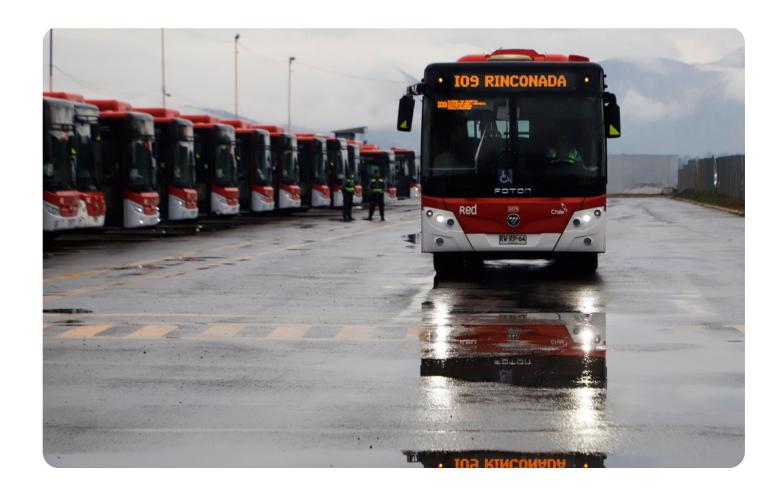
• Interior washing with less water use:

Products have been implemented that allow 'dry cleaning', significantly reducing water consumption.

• Efficient use of water in infrastructure:

Controlled irrigation systems have been installed for green areas in terminals and warehouses, optimising the use of this resource.

The adoption of electric buses has also indirectly contributed to this responsible consumption, as their lower maintenance requirements have reduced the demand for water for cleaning compared to diesel buses. This approach demonstrates that electromobility not only transforms transport in terms of emissions and noise, but also drives the adoption of broader environmental measures, strengthening the sustainability of Santiago's public transport system.



I. Road safety: reducing speeding

The DTPM has implemented a system of constant monitoring of the daily operation of the public transport system, rigorously supervising the speed of the buses. This work is carried out by the Operations and Maintenance Departments and the Public Liaison Department, using data from the recording of GPS pulses from the buses. This system allows the positioning of the buses to be recorded every 30 seconds, indicating both the speed and the service they are providing.

In this context, a bus is considered to be speeding when it exceeds 55 km/h⁴, because of the introduction of RED Standard electric and diesel buses with speed limiter

technology, a significant reduction in speeding has been achieved. These vehicles, in addition to being more sustainable, are equipped with systems that allow for more precise speed control, contributing to safer and more efficient operation.

Statistics reflect this improvement: in January 2022, 9.3% of dispatches (every time a bus starts a service) exceeded the speed limit; in January 2023, this figure decreased to 5%; and in January 2024, it was further reduced to only 1.7%.

67

Figure 10: Evolution of the % of expeditions with excessive speed (2022-2024)



Source: Own elaboration DTPM

⁴ Although regulations indicate that the maximum speed limit is 50 km/h, a value of 55 km/h is methodologically assigned in order to incorporate information errors related to pulses.

This positive trend is also the result of road safety education campaigns aimed at drivers, focusing on accident prevention through the identification of blind spots, the correct execution of turns and the promotion of good practices for better road coexistence. These initiatives seek to promote safer and more conscious driving, complementing the technological advances of the new electric and diesel buses of RED standard.



J. Initiatives that promote the use of public transport

Strengthening public transport as a preferential alternative to private car use requires the implementation of various strategies to facilitate access, improve its attractiveness and reinforce its competitiveness. In this sense, the RED Mobility System, while implementing improvements in vehicle technology and comfort, has made

progress in the application of structural and operational measures that promote modal shift towards an integrated system of buses, metro, commuter trains and the use of active mobility means such as cycling and walking.



1. Participative increase in service provision and coverage.

To respond to growing demand and make public transport a more accessible and efficient option, a strategy has been implemented to expand the supply of services and territorial coverage. New services have been incorporated in areas with high unsatisfied demand, improving connectivity in peripheral sectors of the city. Likewise, the operation has been strengthened at peak times with more frequent buses, in order to reduce waiting times and improve the quality of service.

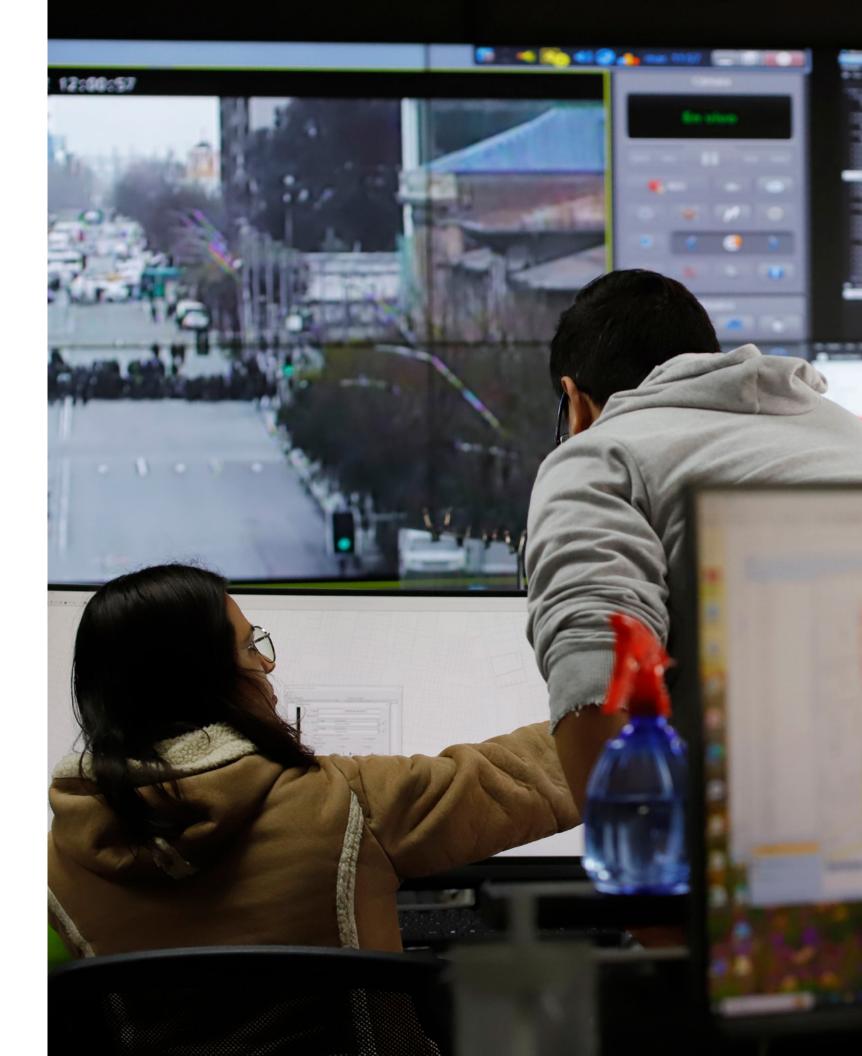
One of the main challenges in the promotion of public transport is to ensure that the services offered respond to the real needs of users. To this end, route modification processes have been implemented based on instances of citizen participation, in which communities, neighbourhood organisations and local actors have been able to express their needs and suggestions. These adjustments have made it possible to optimise coverage, improve connectivity between neighbourhoods and reduce travel times, generating a more efficient service that is more in line with passengers' expectations.

Between March 2022 and December 2024, 76 extensions 68 and new services were implemented to provide greater

connectivity to people. Thanks to these initiatives, more than 135,000 additional people can access the Red System in less than a 5-minute walk (300 m), reaching 94.22% coverage in the System's initial 34 municipalities. In addition, the first expansion of the System to two new municipalities was reached in 2023: Padre Hurtado and Lampa.

In 2024, 36 route modifications have been made, which have made it possible to provide new coverage and connections in the network, as well as to improve the operation and conditions of regulation points on public roads. These included 8 new services and 23 service extensions.

In addition, work has been done to improve the supply and service provided, focusing on sectors where increases in demand and citizen requirements have been identified, which has led to reinforcements at critical stops and services. These service improvements have helped to increase demand for the system and territorial equity, as well as providing better quality and accessibility in general.





Subsidy. The public transport subsidy has been a fundamental tool to guarantee an efficient, accessible, equitable and sustainable system. Associated with this social investment, it has been possible to implement differentiated fares that benefit students and senior citizens, ensuring that those who do not have a car or other private alternatives can travel with a more affordable fare and a quality service. The subsidy also seeks to attract users away from the car, reducing a number of social costs such as congestion, accidents, pollution and carbon emissions. In turn, it facilitates access to the city and its opportunities for more people, boosts the local economy and improves the quality of life of the population. Santiago has had a public transport subsidy established since 2009 in Law 20.378 [11], which allows financing operations, fleet, metro, technology, among others, and currently represents 65% of the system's income. This subsidy has allowed significant investment in the expansion of the system in terms of services, technology and geographical coverage. While the Santiago Metro and the commuter train (EFE) continue to expand their networks, the electric bus fleet has made the city a global benchmark in electromobility. Both systems have increased their coverage by reaching out in an integrated way to communities that have been requesting them for decades. These efforts have increased service coverage to millions of people who need to get around the city on a daily basis, improving their quality of life.

Fares. The system features an integrated fare system that promotes intermodality, allowing travellers to travel for up to two hours with a single payment, including two transfers. Similarly, the availability of differentiated fares makes public transportation a more affordable and competitive option compared to cars, benefiting specific segments of the population, such as students and senior citizens, as well as frequent commuters. In this way, the system contributes to reducing transportation costs for thousands of families while also encouraging the use of public transportation. The main fare benefits include:

- National Student Card (TNE): Allows basic education students who qualify for this benefit to be exempt from fare payment, while secondary and higher education students pay approximately 33% of the adult fare, i.e. \$250 in 2024. In addition, it maintains integration with buses, Metro and Tren Nos-Estación Central, allowing transfers at no additional cost.
- Senior Citizen Card (TAM): Always enables the use of all modes of public transport with a preferential fare of \$370. Available to adults over 65 years of age with no other reguirements, it has enabled 833,474 cards to be issued by December 2024 since its implementation in July 2020.
- Senior Citizen Metro Card (TAM-Metro): Exclusive benefit for Metro travel that allows seniors to travel for \$250, with no time or number of trips restrictions

Monthly limit and modernisation of the payment system 'Dale QR'. The public transport payment system has moved towards digitalisation and modernisation, aligning with the latest technological trends. Currently, more than 25% of adult fare payments are made using mobile devices via QR code, a technology that has enabled the development of the 'Dale QR' benefit, which limits monthly transport spending.

The Red App, with more than 1 million monthly active users, has been key to this transformation. Through it, the possibility of payment with QR has been implemented, which allowed the launch of the Dale QR benefit, granting free trips after reaching the equivalent of 47 trips in a month, benefiting more than 88,000people during 2024. In addition, the automatic recharge modality was incorporated and progress is being made in the implementation of payments with bank cards, which will facilitate access to the public transport system.



• 3. Infrastructure for sustainable mobility

Prioritising public transport, less congestion, more efficiency. The development of adequate infrastructure is key to improving the user experience and consolidating public transport as the backbone of urban mobilitv. Currently, most buses circulate on mixed-use streets. sharing road axes with private transport. This coexistence exposes public transport to congestion, reducing its commercial speed and affecting the regularity of service. To address this challenge, exclusive corridors and bus-only lanes have been built, and enforcement cameras have been installed on strategic axes of the city, where buses have been given priority. These measures not only improve the speed and punctuality of the service, but also reduce waiting times for users, directly impacting the quality of the service and optimising the costs of the system, making it more efficient.

By 2024, the Red Movilidad System has 446 km of priority roads for public transport and emergency vehicles, including segregated roads, exclusive roads and bus-only lanes. In addition, to ensure the correct use of the infrastructure. 470 enforcement cameras have been implemented at strategic points, with an investment of approximately \$4.5 billion to date.

Preservation of transport infrastructure and its contribution to urban development. Public transport corridor infrastructure not only prioritises buses and emergency vehicles but also integrates complementary works that improve the user and neighbouring community experience. These include universally accessible pavements, stopping points, street furniture, lands-

caping and photovoltaic lighting systems that reduce energy consumption. These improvements not only provide greater safety and comfort for passengers but also contribute to the urban development of the city.

Safe, accessible and gender-sensitive infrastructure. User experience is a key pillar of sustainable mobility. For this reason, safe, accessible and gender-sensitive stopping points have been set up, equipped with better lighting, universal accessibility and real-time information systems. As of 2024, there are 360 bus stops with alert buttons connected to municipal security centres, variable information panels (PIV) showing bus arrival times and audible buttons for the visually impaired.

Integration with active modes. Sustainable mobility is also built by integrating different modes of transport. In this sense, the expansion of bicycle lanes led by the Regional Government of Santiago and the provision of bicycle parking at strategic points of the Metro favour intermodality, encouraging the use of active modes such as cycling and walking.

Modalshiftdepends not only on operational improvements and infrastructure, but also on awareness-raising and education strategies. For this reason, the DTPM has developed information campaigns to highlight the environmental, economic and social benefits of using public transport. One of the most emblematic actions in this area has been the celebration of the National Car Free Day, coordinated by the DTPM since 2022, which actively promotes the use of buses, metro, suburban trains and their combination with other active modes such as cycling and walking.

In 2024, the event featured various urban interventions, participatory activities, and the distribution of educational materials. As part of the initiative, a new edition of the Mobility Walk was held, which included the temporary pedestrianization of Agustinas Street and various activities in Constitution Square. Information booths were set up here, environmental measurements were taken, and a mass bicycle parking lot was enabled.

The measurements showed an increase in public transportation use, recording 4.8 million transactions, surpassing the 4.7 million in 2023. Furthermore, pedestrian traffic on Agustinas Street increased by 126%, reaching a peak of 25,066, compared to the 10,649 recorded on September 6, the day when was held the previous year.

In environmental terms, the results were significant. Along the Agustinas axis, noise levels were reduced by 82% from their peak, while during rush hour (7:00 AM and 9:00 AM), the reduction reached 72% compared to a typical day. Regarding air quality, the level of PM2.5 remained stable at an average of 6.81 µg/m³, while measurements of Nitrogen Dioxide (NO2), a pollutant associated with vehicle combustion, showed a notable decrease, with concentrations below 40 ppb, well below the 50-ppb recorded at 9:00 PM the previous day. In the days leading up to the event, a communications



campaign was developed highlighting the benefits of active mobility (walking and cycling) and public transportation for the development of healthier, safer, and more sustainable urban habitats. The negative socio-environmental impacts of excessive car use were also addressed, positioning public transportation and active mobility as alternatives that promote people's physical and mental health.

The call was well received. 17 ministries joined in disseminating the initiative, reinforcing the message about the importance of public transportation and active mobility. Media and social media coverage led to high engagement: the number of people who clicked on the published content exceeded the estimate by 174%, while the ads reached nearly 2.8 million views, 145% higher than projected. Furthermore, the article published on the Red. cl website registered more than 50,000 views, more than double the usual rate for the most popular publications, which typically receive between 20,000 and 25,000 views. In parallel with these awareness-raising initiatives, DTPM has made efforts to inform the entire community about the operational changes and improvements made each year (see table 10). Together, these measures have made it possible to advance the consolidation of a more attractive and efficient public transportation system, contributing to the reduction of traffic congestion and polluting emissions, while improving the quality of life in the city.



Table 10: DTPM information campaigns, per year

Year	Campaign		
2022 -	Bus Safety Campaign		
	New payment methods (bip!QR and automatic recharge)		
	Network App (download, features)		
	Campaigns with monitors on payment methods and the Network App		
	Educational team in municipal schools (information about the system is provided to encourage its proper use)		
	National Car-Free Day		
	555 Service Campaign		
	Use of Red Movilidad (information provided at the airport as part of the 555 route)		
2023	Route improvements due to new tenders and Metro line extensions		
	"I pay online" fare evasion campaign (system improvements were highlighted)		
	Dale QR Benefit		
	Campaigns for services that began operating in Lampa and Padre Hurtado.		
	Campaigns with monitors on payment methods and the Red App		
	Educational team in municipal schools (information about the system is provided to encourage its proper use)		
	National Car-Free Day		
	444 Service Campaign		
2024	Use of Red Red Movilidad (information provided at the airport along the 555 and 444 routes)		
	"Bip a Bip! We're building a better network" fare evasion campaign (which continues to highlight system improvements and the benefits it provides)		
	Lollapalooza POE Campaign (on-site monitors promoting the use of public transportation to and from the festival)		
	Campaigns with monitors on payment methods and the Red App		
	Educational team in municipal schools (information about the system is provided to encourage its proper use)		
	"Let's be kinder" educational fare evasion campaign, focusing on the importance of fare payment, respect, and good practices on our public transportation.		

• 5. Creating Networks

To respond to growing demand and make public transportation a more accessible and efficient option, a strategy has been implemented to expand service offerings and territorial coverage. New services have been added in areas with high unmet demand, improving connectivity in peripheral areas of the city. Likewise, bus service has been strengthened during peak hours with more frequent buses. in order to reduce wait times and improve service quality.

One of the main challenges in promoting public transportation is ensuring that the service offering meets the real needs of users. To this end, the "Creating Networks" program has been implemented. Since 2022, it has implemented route modification processes based on citizen participation, in which communities, neighbourhood organizations, and local stakeholders have been able to express their needs and suggestions. These adjustments have optimized coverage, improved connectivity between neighbourhoods, and reduced travel times. In addition, they have strengthened direct connections with the community, generating a more efficient service aligned with user expectations.

In this way, the technical work of route planning, stop positioning, or analysis of regulation points, as well as infrastructure projects and meetings on agreements and best practices, open a space for the community that coexists with the transportation system and bene-

fits from the services involved. In some cases, for example, they can indicate the need to move a stop, extend or modify a route, propose transit times, or propose alternative spaces so that a regulation point has better reception, better operating conditions, and less impact on residential spaces. This enriches the information needed to make decisions and understand their direct impacts, with firsthand knowledge of their implications.

Between March 2022 and December 2024, 76 extensions and new services were implemented, providing greater connectivity for people. Thanks to these initiatives, more than 135,000 additional people can access the Red System in less than a 5-minute walk (300 m), reaching 94.22% coverage in the System's initial 34 municipalities. Furthermore, in 2023, a milestone was reached with the first expansion of the System to two new municipalities: Padre Hurtado and Lampa.

^oIn 2024, 36 route modifications were made, allowing for the provision of new coverage and connections to the Red System, as well as improving the operation and conditions of regulation points on public roads. These include eight new services and 23 service extensions. Additionally, work has been done to improve the supply and service provided, focusing on sectors where increased demand and citizen requirements have been identified. This has entailed reinforcements at critical stops and services. These service improvements have contributed to the increase in demand for the System and territorial equity, as well as providing improved quality and accessibility overall.

K. Effects on the perception of our stakeholders

Since the introduction of electric and low-emission buses in the Red Movilidad System, the perception of users has improved considerably. This change is not only due to the incorporation of these new vehicles, but also to the measures taken to encourage the use of public transport, which have been well received by the community. In 2018, a first study was carried out on user perceptions regarding the incorporation of the first electric buses.

One of the highlights has been the arrival of electric and low-emission buses with high standards of comfort, such as air conditioning and other improvements in the quality of service. These advances have had a direct impact on the travel experience, making a difference to the way users perceive the public transport system.

In 2023, a study on the perception of electric buses was carried out, which showed that 92% of the people surveyed indicated that they knew about the existence of electric buses in the Red Movilidad system. Of these, 87% consider the presence of electric buses to be beneficial for the city. Among the benefits mentioned, 'Better air quality' (85% of mentions), 'Less noise in the city' (72% of mentions), 'More modernity for the city' (66% of mentions) and 'Better image for the city' (54% of mentions) stand out.

Against this background, and to ensure that the renewal of public transport reflects the needs of the people, between March and May 2023, the DTPM carried out the citizen participation process '¿Qué te mueve? The initiative convened 15,300 people through three mechanisms: surveys (online and in person) with 14.638 responses; citizen dialogues in 20 districts with the participation of 555 neighbours; and workshops with interest groups, with the participation of 107 people from key sectors such as dri-74 vers, migrants, people with disabilities, road safety organi-

sations, caregivers, older adults, university students, children and adolescents, and experts in gender and mobility.

The process addressed three main pillars: buses (accessibility and comfort), operation and service (coverage, connection, frequency and schedules) and infrastructure (stops and access). One of the main findings was the demand for modern buses, better maintenance and cleanliness, along with the incorporation of accessibility and safety improvements. In particular, the survey highlighted that 30% of people consider it a priority to speed up the replacement of old buses with new ones.

These results reinforced the need to advance in the implementation of electric buses with better standards, aligning public policy with citizens' expectations and consolidating that the 2023 and 2025 road concession tenders will be 100% electric.

During December 2024 and January 2025, the perception study has been updated by expanding the stakeholders analysed, including users, drivers, maintenance personnel and the community neighbouring the axles and electric terminals, and the main results (presented below) coincide with the trend observed in the Annual User Satisfaction Survey presented in Chapter L.



Users identify significant benefits associated with electric buses: 56% believe they will improve air quality and 18% believe there will be less noise in the city. Furthermore, 62% believe there are no negative aspects associated with their introduction.

The study also inquired about the potential impact the implementation of 100% electric buses could have on certain aspects of life. 79% believe they improve the city's image and reputation, 77% value their contribution to air quality, and 72% highlight their impact on reducing noise levels. In terms of safety, 58% consider electric buses to be safer than traditional buses, primarily due to the presence of cameras and advanced stability and braking technologies.

Comfort is another key factor in the user experience. The most highly rated attributes include lighting (86% with scores of 6 and 7), the temperature inside the bus (81%), and the availability of handles and handrails (80%). Among the elements that most contribute to the feeling of comfort are air conditioning (57%), more comfortable seats (34%), and less noise during the trip (16%).

Finally, satisfaction with the implementation of electric buses is high. Users agreed and strongly agreed with the statements that the RED Movilidad System "is a system that promotes the use of clean technologies" (95%), "it is a system that encourages innovation in public transportation" (94%), and "it is a system that we can all be proud of" (84%).



For drivers, the difference between an electric and a diesel bus does not go unnoticed. In fact, 55% of drivers prefer to operate electric buses, while only 9% prefer diesel. When comparing the two technologies, the following advantages of electric buses stand out:

- Less fatique during the day: 65% of drivers perceive this to be the case.
- Less noise in the interior: 78% consider that they generate a guieter environment.
- Better working environment: 75% say that pas-

3. Maintenance personnel

For maintenance personnel, the difference between an electric and a diesel bus is also evident. In particular, when comparing the two technologies, the following features of electric buses stand out:

- Greater respect for the environment: 80% consider maintenance work to be more environmentally friendly.
- Greater demand for technical knowledge: 72% indicate t hat working with these buses requires a higher technical level.

sengers value them more, which contributes positively to their work experience.

The transition to electric technology has required driving staff to adapt to a new way of operating the buses. However, 90% indicate that the adaptation process was easy. Even so, 82% recognise that, compared to diesel buses, specific training is necessary.

- Easier maintenance: 58% perceive maintenance tasks to be simpler compared to diesel buses.
- Less time in the workshop: 56% indicate that they require fewer hours of mechanical intervention.



4. Neighbouring community to road and electro-terminal axes

The benefits of electromobility are not only perceived by users of the system, but also by those who live daily with the operation of the buses, whether as neighbours of a road axis or a bus terminal. According to the consultation carried out with the community neighbouring road axes and bus terminals, a large majority highlighted positive changes, such as quieter night-time traffic, a perception shared by 81% of the neighbours of road axes and 71% of the neighbours of terminals.

Table 11: Proportion of respondents who agree with the benefits of electromobility.

Question	Neighbours of the road axis	Neighbours of the electrical terminal
Bus traffic is quieter at night than before	81%	71%
2. Air pollution has decreased.	72%	67%
3. Noise has decreased in general.	70%	62%
4. Bus congestion has decreased.	58%	59%
5. The perception of road safety has improved.	54%	57%

Fuente: Estudio electromovilidad personal de conducción y personas usuarias, IPSOS 2025.

In addition, 89% of those surveyed said that electromobility has brought a sense of modernity and innovation to their neighbourhood.Ontheotherhand,57% perceivethestreets areas where the public transport system operates. to be cleaner and tidier since the arrival of electric buses. These results show the positive impact of elec-

tromobility not only on the travel experience, but also on the quality of life of those living in the

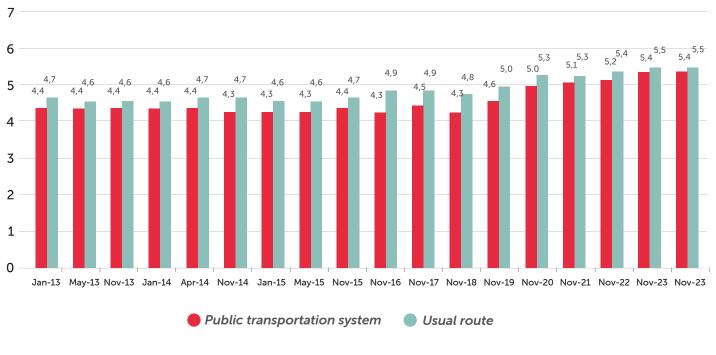


L. User satisfaction rating

The public transport system RED Movilidad has taken significant steps towards modernisation and improvement of service quality. The renewal of the bus fleet, the incorporation of new routes and the promotion of diversity with greater participation of women drivers are just some examples of the actions implemented. In addition, new payment technologies have been integrated, such as the innovative Dale QR system, and other benefits that enrich the user experience. These measures have been well received by passengers,

who, in the latest Metropolitan Public Transport User Satisfaction Study, developed by IPSOS in 2024 [27], have evaluated the service with a score of 5.5 out of 7 for the routes and 5.4 for the system as a whole, equalling the score of 2024, as one of the highest scores since the beginning of the evaluations in 2013, where it started with a score of 4.4.

Figure 11: Results of the System and Route Evaluation (2013-2024)



Source: Own ellaboration DTPM

Also, in the second half of 2023, Red Movilidad was elected 'outstanding brand for its social contribution' in 9th place out of a total of 270, according to CADEM [28]. In this same measurement, Metro ranked second in the Marca Ciudadana ranking, which is the highest in its history and brings together all of the country's brands. This ranking recognises brands that have a positive presence in public opi-

nion, are considered a significant contribution to society and, at the same time, are relevant in people's daily lives. Citizen Brands are characterised by their dual identity: they are present both in society and in people's daily lives.



Source: 15th edition of the Citizen Brands study [28]

In the second half of 2024, Red Movilidad ranked 16th, while Metro maintained its outstanding position. This result does not discourage us; on the contrary, we are proud to continue to be part of the 30 most recognised brands for their contribution to improving people's quality of life and their contribution to society.

Also in 2024, we have achieved a historic level of trust in Red Movilidad, according to the survey N°568 of Plaza Pública-CADEM, 56% of the inhabitants of the Metropolitan Region rate their trust in Red Movilidad between 5 and 7. This result marks the highest level of trust since the measurement began in 2014, consolidating as a key milestone in the improvement of citizen perception towards the System.

These recognitions are not fortuitous: they are the reflection of constant work and the measures implemented over the years, described in this report, which have allowed us to advance on our path of transformation.

Despite the historical challenges associated with the origin of the System, these achievements demonstrate that we are consolidating our position as a national and international benchmark, committed to sustainable mobility and the well-being of citizens.

M. Sharing our experience

The transformation of the RED Mobility System with the massive incorporation of electric buses has turned Santiago into a world reference in electromobility for public transport. With more than 2,500 electric buses in circulation, the transport system attracts the interest of governments, multilateral organisations and experts in sustainable mobility to learn from our experience.

Global recognition and international delegations. The DTPM's leadership in electromobility has generated sustained interest from delegations from various countries who have visited Santiago to learn first-hand about the implementation experience. These visits have allowed them to share knowledge on the planning, financing, operation and maintenance of electric fleets, as well as the environmental and operational impacts achieved. The following are the details of these visits:

Table 12: Delegations visiting the RED System.

Month – year visit	Delegation framework	Countries
July 2022	Ministries of Transport, Energy, and Environment	Ecuador
August 2022	Zebra – C40 – Mario Molina Center	Brazil, Colombia, Mexico
August 2022	Vice Minister of Transport	Costa Rica
November 2022	State of Santa Catarina – World Bank	Brazil
April 2023	Business Delegation	Czech Republic
April 2023	Santa Cruz de Tenerife	Spain
July 2023	Ministry of Energy and Mines	Guatemala
July 2023	Ministry of Public Works and Transport	Costa Rica
November 2023	Vice Ministry of Electricity and Alternative Energy	Bolivia
January 2024	Frances Sprei – Embassy of Sweden – Future Congress	Sweden
January – October 2024	Active	Netherlands
February 2024	World Bank, Cairo BRT	Egypt
March 2024	State of Minas Gerais	Brazil
March 2024	Transport for London	United Kingdom
April-July 2024	Ministry of Public Works	Paraguay
October 2024	European Union Delegation	European Union
January 2025	MiBus-CAF	Panama

Participation in the international space. Since 2022, RED Movilidad has participated in various international events, consolidating its position in the public transport sector. Eleven of these events were forums and platforms specializing in sustainable mobility and electromobility, where various DTPM professionals presented the progress of our electric fleet and other improvements implemented in the transport system. Participation in forums, fairs, and international cooperation forums has allowed us to incorporate learnings, strengthen strategic alliances, and foster

new development opportunities, reinforcing RED Movilidad's leadership at the regional and international levels.

Strategic Alliances. Collaboration with multilateral organisations, NGOs and countries has enabled the exchange of best practices and the adoption of new technologies. Details of our partnerships are as follows:

Tabla 13: Alianzas estratégicas.

Institution	Framework project	Countries	
UITP	Member Country	Organizations in more than 100 countries	
BID	Latin American Gender and Mobility Observatory	Colombia, Argentina, Mexico, Bolivia, Peru, and Chile	
CAF	Chilean Sustainable Public Transport Strategy (CLETS)	Chile	
C40	ZEBRA	Brazil, Colombia, Mexico, and Chile	

hrough these instances, the Santiago Transport System, RED Mobility has not only consolidated its leadership, but has also paved the way for other cities to re-

plicate this model, demonstrating that the transition to cleaner and more efficient public transport is possible.

N. Challenges

Electromobility has begun to transform Santiago into a cleaner, quieter, and safer city. Noise reduction, improved air quality, and the introduction of more accessible, comfortable, and safe buses are palpable signs of a new public transportation model that is fairer to people, more respectful of the environment, and more operationally and financially efficient.

This progress has not been a coincidence. It has required long-term vision, political will, and an innovative legal and financial architecture that allows for the long-term sustainability of an efficient, reliable, and expanding system. Behind every electric bus termi-

nal, every electric bus in operation, and every driver are strategic decisions, regulations, and a model that has been able to attract investment, mitigate risks, and quarantee service continuity for millions of people.

This report has allowed us to quantify the progress Red Movilidad has made and the contribution it has made to making Santiago a city prepared for the environmental challenges of the future. Santiago's experience shows that it is possible to move toward sustainable mobility, and this is the result of collaborative work between the public and private sectors, academia, and the public.





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O. Glosary

- PIB: Gross Domestic Product
- CO₂eq (Dióxido de Carbono Equivalente): Measure expressing the impact of different greenhouse gases in terms of CO₂.
- DTPM (Directorio de Transporte Público Metropolitano): Entity in charge of the management and planning of public transport in Santiago de Chile.
- SECTRA (Secretaría de Planificación de Transporte): Unit of the MTT that carries out studies and planning of urban and regional transport.
- PPDA (Plan de Prevención y Descontaminación Atmosférica): Environment Ministry's strategy to reduce pollution in Santiago.
- NDC (Contribuciones Determinadas a Nivel Nacional): Climate commitments made by Chile in the framework of the Paris Agreement.
- COP25 (Conferencia de las Partes 25): UN climate summit, at which Chile held the presidency in 2019.
- 3CV (Centro de Control y Certificación Vehicular): Body that certifies the compliance of vehicles with technical and environmental standards.
- BYD (Build Your Dreams): Chinese manufacturer of electric buses and vehicles.
- AFT (Administrador Financiero del Transantiago): Entity in charge of managing the revenues and payments of the public transport system.
- SERVIU (Servicio de Vivienda y Urbanización): Responsible for the implementation of housing policies, urban development and public infrastructure management.
- MINVU (Ministerio de Vivienda y Urbanismo): In charge of urban planning and infrastructure development in Chile.
- CNE (Comisión Nacional de Energía): Agency in charge of regulating and supervising the energy sector in Chile.
- COV (Compuestos Orgánicos Volátiles): Pollutant gases emitted by vehicles and industrial processes.
- PM2.5 / PM10 (Material Particulado): Airborne particulate pollutants, classified according to diameter.

- NOx (Óxidos de Nitrógeno): Air pollutants generated by the combustion of engines.
- GEC (Gestión de Episodios Críticos): Measures taken on days of high air pollution.
- ADAS (Advanced Driver Assistance Systems): Advanced driver assistance systems used in buses and cars.
- UITP (Unión Internacional de Transporte Público): Global organisation promoting sustainable public transport and efficient urban mobility.
- BID (Banco Interamericano de Desarrollo): Financial institution that finances development projects in Latin America and the Caribbean, including transport and sustainability.
- CAF (Banco de Desarrollo de América Latina y el Caribe): Agency that finances infrastructure and development projects in the region, including mobility and energy.
- C40 (C40 Cities Climate Leadership Group): Global network of cities committed to the fight against climate change and mobilisation.
- MMA (Ministerio del Medio Ambiente): Agency in charge of the formulation and application of environmental policies in Chile, promoting the protection of ecosystems and the sustainable management of natural resources.
- MTT (Ministerio de Transportes y Telecomunicaciones): Entity responsible for regulating, planning and supervising transport and telecommunications in Chile, ensuring their efficient and sustainable development.





