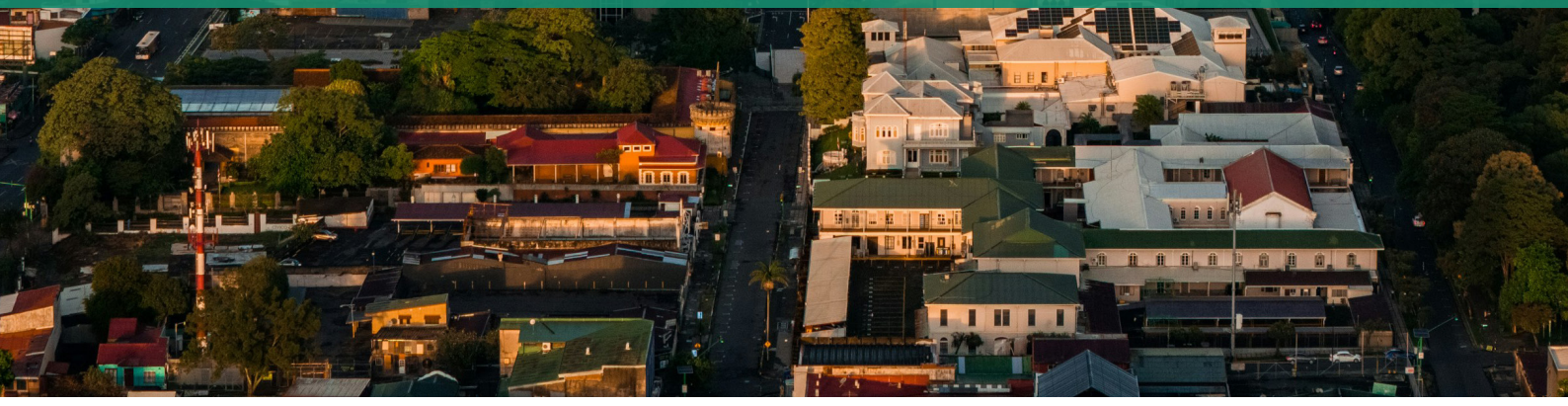
CITY ROADMAP FOR E-MOBILITY: EFFECTIVE DEPLOYMENT OF ELECTRIC BUS FLEETS



This project has received funding from the European Union Horizon 2020 research and innovation Programme under grant agreement no. 875041

PROJECT PARTNERS

ABOUT

This document describes the roadmap to achieve effective deployment of electric bus fleets in San Jose, Costa Rica

TITLE

City Roadmap for E-mobility Effective deployment of electric bus fleets

FINANCIAL SUPPORT

SOLUTIONSplus

DISCLAIMER

The views expressed in this publication are the sole responsibility of the authors named and do not necessarily reflect the views of the European Commission.

LAYOUT

Yasin Imran Rony, WI

PICTURES

All the pictures are provided by the SOL+ partners

June, 2024

City Roadmap for E-mobility

Effective deployment of electric bus fleets

Final Version

San José, Costa Rica

January 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 875041

Executive Summary

Costa Rica has had a considerably strong approach with regards to implementing specific actions to address climate change mitigation, with a prominent focus in the electrification of transportation. This is evident in national level policies such as the National Decarbonization Plan 2018-2050[1], the Nationally Determined Contribution 2020[2], National Electric Transport Plan 2018-2030[3], Law N° 9518: Incentives and promotion for electric transport[4], the Carbon Neutrality Country Program[5], the National Policy for Climate Change Adaptation 2018-2030[6] and the National Climate Change Adaptation Plan 2022-2026[7].

Costa Rica has a political framework to achieve a large deployment of electric buses in the short term, and sound technical knowledge provided by several years of studies from different sources.

There has been extensive research conducted in the transport sector to move towards climate neutrality and some attempts from public transport operators to improve operations, management, and fleets [8]. However, there is often a disconnect between best practice methodologies and pathways identified in research and on the ground implementation. Bridging this gap requires concerted and deliberate action, particularly when it comes to the deployment of electric buses for public transport. This has resulted in a situation where there must be a main thrust to act on recommendations given by several organizations, international and local, where a deployment of a fleet of electric buses for public transport is explicitly recommended, and several actions outlined in said reports.

As a joint effort between the GEF7 Global Electric Mobility Programme and the Solutions Plus Programme, and in recognition of the existing efforts on local and national level, a long-term roadmap for the electrification of bus fleets in the Metropolitan Area of San Jose is presented in this document. The roadmap is framed under the project *Accelerating the transition to electric public transport in the Greater Metropolitan of Costa Rica*, implemented by the United Nations Environment Programme (UNEP) and the Costa Rican USA Foundation for Cooperation (CRUSA).

Three workshops carried out in early 2023, complemented with previous knowledge from local technical organizations and global experience and existing reports, were systematized and used to prioritize short, medium, and long-term actions. These measures were also validated in consultations with the Ministry for the Environment and Energy (Ministerio de Ambiente y Energía, MINAE) , the Ministry for Public Works and Transport (Ministerio de Obras Públicas y Transportes, MOPT) and the Council for Public Transport (Consejo de Transporte Público, CTP). Each of the 5 focus areas in the roadmap has been identified and

[1] https://cambioclimatico.go.cr/plan-nacional-de-descarbonizacion/

[2] https://cambioclimatico.go.cr/contribucion-nacionalmente-determinada-ndc-de-costa-rica/

[3] https://sepse.go.cr/documentos/PlanTranspElect.pdf

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

[5] https://cambioclimatico.go.cr/programa-pais-carbono-neutralidad/

[6] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=86580&nValor3=112448&strTipM=TC#:~:text=El%20objetivo%20general%20de%20la,contribuya%20a%20la%20calidad%20de

[7] https://cambioclimatico.go.cr/plan-nacional-de-adaptacion/

[8] https://changing-transport.org/wp-content/uploads/2022_Retrato-del-transporte-y-movilidad-en-Costa-Rica.pdf

categorized in terms of highest priority (by level of urgency and their repeated reference in reports, workshops and stakeholder consultations)).

The roadmap focuses on:

- Prioritizing the delivery of identified priorities in Costa Rican policy documents;
- A commitment towards strengthening the nexus between research and practice lessons ;
- Increasing the cooperation of diverse stakeholders;
- Providing the technical details of electric bus deployment;
- Incorporating a gender perspective in measures and actions of the roadmap.

In order to achieve this, five focus areas have been proposed:

Focus area 1 - Capacity building: capacity shall be built in local actors including development and knowledge sharing for technicians and drivers, as well as soft skills for policy action, negotiation, and risk management

Focus Area 2 - Governance and regulation: aimed at the implementation of policies and regulations that promote electric buses, and the creation of specialized working coordination mechanisms that can support projects adjusted to the national reality.

Focus Area 3 - Economic and Financial measures: fleet leasing and a financial alliance between several stakeholders are prioritized, and long-term electricity contracts and fare costs that internalize charging infrastructure costs are prioritized within new or existing fare policies[9].

Focus Area 4 - Vehicles and charging infrastructure: new public-private partnership models to facilitate the purchase of electric buses and leasing/renting of buses was the most prominent measure in all sources, as well as the extension of concession terms to increase the viability of financial models with electric buses.

Focus area 5 - Gender inclusion: emphasized in the provision of the service (ie. towards improving all users' experience in riding the buses) and the management and operation (meaning equity in gender balance in all staff levels).

Given all of the above, the following is needed to move forward decisively into real-world change in the sector:

- A firm alignment and teamwork from all relevant government levels and divisions to deploy an electric bus fleet.
- A robust governance structure to support decisions and follow up processes.
- A public commitment from all stakeholders in the value chain (providers, distributors, government, and different sectors) to prioritize action and follow existing recommendations.

[9] Importantly, this could have an impact on fares if not well planned. There are some costs that operators must assume that have not been recognized through the current formulas. For example, facilities regarding the operations (vehicle washing and maintenance) and if extended to electrification might not be including the costs related to the charging infrastructure.

- Support from financial stakeholders at the national and international level to procure the necessary fleets and charging infrastructure for electric bus deployment.

Table of Contents

List of Abbreviations

AMSJ	Área Metropolitana de San José
ARESEP	Autoridad Reguladora de los Servicios Públicos
BCCR	Banco Central de Costa Rica
CFIA	Colegio Federado de Ingenieros y de Arquitectos de Costa Rica
CIEMI	Colegio de Ingenieros Electricistas, Mecánicos e Industriales
CONAPDIS	Consejo Nacional de Personas con Discapacidad
CTP	Consejo de Transporte Público
ICE	Internal Combustion Engine
ICE	Instituto Costarricense De Electricidad
INA	Instituto Nacional de Aprendizaje
INAMU	Instituto Nacional de las mujeres
INTECO	Instituto de Normas Técnicas de Costa Rica
MINAE	Ministerio de Ambiente y Energía
MINSA	Ministerio de Salud
MOPT	Ministerio de Obras Públicas y Transportes
RECOPE	Refinadora Costarricense de Petróleo
SBD	Sistema de Banca para el Desarrollo
SPS	Secretaría de Planificación Sectorial

1. Background – Where are we now?

1.1. Existing research and studies

The urban transport context in Costa Rica and specifically in San José has been thoroughly analyzed and reported in several high-quality documents from varied organizations as is referenced throughout this document in mentions and footnotes linking to reports, regulations and other documents. Hence, readers are directed to those reports to find a detailed description of context and policies, and this section will provide an overarching view of those findings, in order to focus on the formulation of the roadmap.

-

1.2. Urban mobility context in selected city

In terms of population, the **National State of the Nation Report 2018**[10] has projections for 2018 that indicate that 2,569,462 people live in the Greater Metropolitan Area, which is 51.3% of the total country's population. The population density for this same period is 74.12 inhabitants / ha. The 2022 version of this document[11] indicates that the growth in GDP at the end of 2021 was 7.8%.

According to the **Carbon Neutrality Country Program**[12], the transport sector is the highest energy consumer at the national level with more than 50%, while also being the main source of GHG emissions (42% according to the last **National GHG Inventory** covering 1990-2017 and published in 2021[13]). The sector contributes at least 3.8% of total GDP. In terms of national fleet composition, 81.5% use gasoline and 18% diesel (a majority of the local bus fleet is diesel, however).

A **diagnosis of the transport sector** conducted by GIZ in 2021 mentions that travel times in peak hours are up to 3.2 hours per trip[14]. This document also mentioned a modal split with high participation of trips by foot in 36%, followed by 26% using car and 26% by bus.

A **PIMUS (Integrated Sustainable Urban Mobility Plan)**[15], prepared in 2017, indicates that 24% of daily trips start or finish in the San José City center, while five city sectors have significant participation in the distribution of trips, establishing a polycentric behavior of transport demand thus:

- San Jose Center 23.9%
- San Pedro Curridabat 18.3%
- Guadalupe – Moravia 14%
- Uruca – Heredia 16.1%
- San Francisco – Desamparados 14%.

[10] http://www.asamblea.go.cr/sd/Documents/analisis/Inforne%20Estado%20de%20%20La%20Nación%202018.pdf
[11] https://estadonacion.or.cr/wp-content/uploads/2022/11/PEN_informe_estado_nacion_completo_2022.pdf
[12] https://cambioclimatico.go.cr/programa-pais-carbono-neutralidad/
[13] https://cambioclimatico.go.cr/inventario-nacional-de-gases-de-efecto-invernadero-ingei/
[14] https://changing-transport.org/wp-content/uploads/2022_Retrato-del-transporte-y-movilidad-en-Costa-Rica.pdf
[15] https://cambioclimatico.go.cr/wp-content/uploads/2018/09/PIMUS_INFORME-EJECUTIVO.pdf

However, the distribution of routes is radial and is highly concentrated in the city center. When the SUMP (PIMUS) was published, the lack of integration in the public transport supply forced 40% of the trips to have at least one transfer, generating extra charges and higher travel times (given the current regulations that determine the fare structure[16]). At that time, the average travel time in buses was 61.9 minutes, 35 minutes of this assigned to walking, waiting, and transfer time.

There are six sectors and six subsectors in the San José Metropolitan Area (AMSJ), with direct consequences on public transportation as regulated **by Decree N°28337**[17] In those sectors, and according to the project "**Accelerating the transition to electric public transportation in the great metropolitan area of Costa Rica**" ("Acelerando la transición al transporte público eléctrico en la Gran Área Metropolitana de Costa Rica")[18], the public transportation service is covered by 36 companies, using 1,650 buses as of 2022.

The company with the biggest fleet is Compañía de Inversiones La Tapachula S.A. with 158 buses. According to the actual regulation, the vehicles can't exceed 15 years of authorized operation, 32% of the total fleet (531 vehicles) are older than 10 years of service. 50% of the companies have fleets with less than 5 buses.

Though there are no reliable records, an estimated review of the emission control technology used by autobuses found that 57% of the fleet is Euro III, followed by 16% Euro II, and just 10% is Euro V. The implementation of electronic payment began in April 2022, including four routes in San José as part of a national scale pilot.

1.3. Current Policy Framework for deployment of e-mobility

Costa Rica has a **National Decarbonization Plan 2018-2050**[19] where the country commits to becoming a decarbonized economy with net-zero emissions by 2050. The plan contains ten decarbonization axes, the three of which are related to mobility, considering public transport, light-duty vehicles and freight. Specifically, axis 1 addresses the *development of a mobility system based on safe, efficient and renewable public transport and active mobility schemes*. One of the visions of this axis is that, by 2050, 85% of the public transport fleet will be zero-emissions. Nevertheless, it lacks specific actions or steps to accomplish those goals. One of the activities this axis includes is to promote the decarbonization of the public transport sector through the adoption of zero-emissions technologies.

Costa Rica is part of the NDC Partnership, and mobility is one of the main topics of the **Nationally Determined Contribution 2020**[20]. The document that mentions nine contributions and includes aspects such as the public transport concession renovation integrating decarbonization criteria. The goal for 2030 is to have at least 8% of the transport public fleet zero emissions.

[16] The Law N°3503 stipulates that fares have to be calculated aligned to the principle of "service costs".

[17] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=42773

[18] https://energia.minae.go.cr/?page_id=9655

[19] https://cambioclimatico.go.cr/plan-nacional-de-descarbonizacion/

[20] https://cambioclimatico.go.cr/contribucion-nacionalmente-determinada-ndc-de-costa-rica/

In addition, **Law N° 9518**[21], addresses the incentives linked to electric transportation, creating a framework to regulate the promotion of this type of vehicle. This law establishes institutional competencies and obligations related to funding and seeks to guarantee the substitution of 5% of the bus fleet operating public transport, every two years.

The **Carbon Neutrality Country Program**[22] is a voluntary mechanism in which organizations can subscribe and show their emissions reductions. This program includes the area of sustainable mobility for communities and companies.

Also, Costa Rica has developed a **National Policy for Climate Change Adaptation 2018-2030**[23] **and a National Climate Change Adaptation Plan 2022-2026**[24]Both documents mention the importance of urban planning and transport for resilience to climate change and include human rights and gender equity as cross-cutting topics.

The following documents contain important elements for electric mobility in Costa Rica:

- **National Transportation Plan 2011-2035**[25]: This is the main planning tool delivered by the Ministry of Public Works and Transport and has actions in the short, medium, and long term. The goals of this plan include integrating the different transportation modes, ensuring the sustainability of the system, and having a vision aligning transport with trade e. The topic of transport electrification is addressed in several chapters, one of these focusing on public transportation, considering the introduction of new technologies and fleet renovation (not as a proposal but as an acknowledgment).
- The **National Energy Plan 2015-2030**[26] works as a link between the energy and the transport sector, including to the promotion of fleet renewal incorporating new technologies that contribute to emissions reduction and increased use of public transportation.
- The goal of the **National Electric Transportation Plan 2018-2030**[27] is to use transport electrification to promote the transition to renewable energies, reduce GHG emissions and enhance air quality. It includes the development of pilots to collect data on electric vehicles, establishing Public-Private Partnerships, changing the terms of bus concessions, implementing an electric train, and redefining fees associated with transport service and electricity supply.
- The **Program for an Integrated Mass Public Transport System in the Great Metropolitan Area (SITGAM 2020-2035)**[28] aims to enhance the travel experience of citizens through physical, operational, multimodal integration and information access. It also includes the goal of reducing emissions from transport and gender inclusivity.

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

[22] https://cambioclimatico.go.cr/programa-pais-carbono-neutralidad/

[23] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=86580&nValor3=112448&strTipM=TC#:~:text=El%20objetivo%20general%20de%20la,contribuya%20a%20la%20calidad%20de

[24] https://cambioclimatico.go.cr/plan-nacional-de-adaptacion/

[25] https://repositorio-snp.mideplan.go.cr/handle/123456789/90

[26] https://cambioclimatico.go.cr/wp-content/uploads/2018/08/VII_Plan_Nacional_de_Energia_2015-2030.pdf

[27] https://sepse.go.cr/documentos/PlanTranspElect.pdf

[28] https://www.mopt.go.cr/wps/wcm/connect/3e44eb6c-%20c8f7-4b86-826a-408f01b15a3f/SITGAM+V10.pdf?MOD=AJPERES

- **Law N° 3503**[29] "Regulatory law for remunerated transportation of people in motorized vehicles" establishes that bus services 10hould be provided by the State directly or by public institutions giving concessions to the private sector.
- **Decree N° 28337-MOPT**[30] consists of regulation of policies and strategies related to upgrading public transportation.
- **Decree N°40186-MOPT**[31] is an executive document that reiterates the previous decree and gives conditions to audit and follows the implementation of this upgrading process, thereby reaffirming the government's commitment to implement the proposal contained in Decree N°2833.
- **Decree N°40545-MOPT**[32] consists of a declaration of public interest in the sectorial public policy to upgrade public transportation. This policy includes interinstitutional coordination, simplification of procedures, modal and intersectional integration, and fare model.
- **Law N°7593**[33] creates the Public Service Regulatory Authority (Autoridad Reguladora de los Servicios Públicos ARESEP), which has the obligation to set the fares and prices of the public services, among them the public bus services. It must set the fares for public transport according to the cost principle, as well as aiming to balance the needs of the users and the interests of the public service providers. ARESEP is also responsible, according to its attributions, to review and approve the contracts subscribed between public transport operators and the Public Transport Board (Consejo de Transporte Público, CTP), as established in the applicable regulations. The **Cross-sectional agreement for GHG emissions reduction in the transport sector**[34] contributes to the Decarbonization plan committing to facilitate and develop activities that enhance charging infrastructure and the service level of public transportation.

A **report published by GIZ** in 2021[35] provides insights derived from the pilot project of electric buses in Costa Rica. Additional regulations include:

- The **Decree N° 41642-MINAE**[36] which is a regulation oriented to the building and function of the network of electric recharging stations for electric vehicles. This regulation also establishes the creation of an informatic platform oriented to operative managing and network charging.
- The previous decree is complemented by **Resolution 0112-IE-2020**[37] by ARESEP which establishes a fee applicable to bus-based electric mobility and explains the calculation procedure for this fee,

[29] https://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=9433

[30] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=42773

[31] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=83476&nValor3=107212&strTipM=TC

[32] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=84655&nValor3=109318&strTipM=TC

[33] https://www.aya.go.cr/ASADAS/Leyes%20y%20reglamentos/LEY%207593%20REGULADORA%20DE%20LOS%20SERVICIOS%20PUBLICOS.pdf

[34] https://www.presidencia.go.cr/comunicados/2019/02/mopt-y-minae-de-la-mano-para-reducir-emisiones-en-el-sector-transporte/

[35] https://energia.minae.go.cr/wp-content/uploads/2022/03/7.Aprendizaje-de-un-Proyecto-Piloto-recom-para-escalamiento.pdf

[36] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=89191&nValor3=116987&strTipM=TC

[37] https://aresep.go.cr/resoluciones-intendencia-energia-2020/re-0112-ie-2020/

updated through **Resolution RE-0021-IE-2023**[38]. For private transport, the Resolution 0056 of 2019[39] did the same procedure including electric charging centers, updated through **Resolution RE-0020-IE-2023**[40].

[38] https://aresep.go.cr/resoluciones-intendencia-energia-2023/re-0021-ie-2023/

[39] http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=89413&nValor3=117351&strTipM=TC

[40] https://aresep.go.cr/resoluciones-intendencia-energia-2023/re-0021-ie-2023/

2. Approach – Methodology

This roadmap was prepared as a result of two main sources of information:

Firstly, the wide array of reports and documents that have dealt with issues related to public transport fleet electrification and exercises in prioritization of measures issued in the last 10 years. Reports related to the intersection between gender and electric transport were also explored. The most comprehensive of these are referenced in the previous section and were used here to reconfirm information from workshops.

Secondly, extensive stakeholder consultation in three workshops that were held during the first half of 2023 with the financial sector, relevant institutions, cooperation agencies and operators/providers of public transport. These workshops were designed in such a way that they would have an explicit output to feed the production of the roadmap, by having roundtable discussions and participatory exercises where participants would be asked by categories of actions, and what specific actions they felt would be necessary to effectively deploy fleets of electric buses. In addition, they were requested to discuss the term when these should be implemented. The broad categories proposed in the workshops were:

- Financial;
- Vehicles;
- Policies and regulations;
- Charging infrastructure;
- Fare-related.

The above was complemented by consultation and validation sessions in different stages of the preparation of this work, held with the Energy Direction of MINAE, Council Direction of the CTP and Sectoral Planning Secretary of MOPT.

These sources of information where compiled and compared to see how they relate, and how they were reiterative with previous studies or complementary in suggesting different measures. These were then systematized in a database that was thereafter used to produce this roadmap and that can be used as a basis for follow-up during implementation. The database is a dynamic spreadsheet in Spanish. A static version in English of the database is presented in the Annex of this roadmap.

3. The Roadmap – Where are we going?

As a joint effort between the GEF7 Global Electric Mobility Programme and the Solutions Plus Programme, a long-term roadmap for the electrification of bus fleets in the Metropolitan Area of San Jose is presented in this document. The roadmap is framed under the project *Accelerating the transition to electric public transport in the Greater Metropolitan of Costa Rica*, implemented by the United Nations Environment Programme (UNEP) and executed by the Costa Rican USA Foundation for Cooperation (CRUSA).

The purpose of this roadmap is to facilitate enabling conditions for AMSJ short, medium and long term results in an effective deployment of fleets of electric buses, that will arrive as soon as 2024 (short term,

with an emphasis on making thoughts turn into action) and will continue in the medium (2026-2030, focused on deployment and operation) and long (2031-2035, with an aim to strengthen a sustained operation) with a consistent framework.

3.1 Vision

When implemented, this roadmap will achieve the deployment of fleets of electric buses in public transport in AMSJ.

This vision, as aligned with current government policies, is aimed at the effective deployment of fleets of electric buses that addresses known obstacles and focuses on specific action in achieving results rather than in procedural activities, and in using the learned knowledge to move forward. It also emphasizes the cooperation between a large array of stakeholders who share an interest in this deployment, which will result in an improved quality of service and reduced emissions in the sector. This also contemplates key actions to reduce gender inequalities in the different axes of public transport, looking to improve aspects of user experience, women employability, capacity development and other crucial aspects in this area.

An effective deployment of electric bus fleets will go beyond the quality of service of public transport, as it will increase the likelihood of public transport use, that in turn is effectively a mode shift from other modes that are more polluting such as automobiles and motorcycles. It can also increase road safety for similar reasons: people using public transport will be in safer conditions than those using modes such as a motorcycle.

As is presented in previous sections, Costa Rica is a leader for Latin America in their commitment to e-mobility. There are policies in place and the government motivates strongly the deployment of electric mobility to transition from ICE vehicles. However, as has also been described in the rest of this document, public transport has had several stages that have progressively improved the sector, but continue to need more support (these are well presented in several documents listed in references and in sections above). There are also several grey areas in terms of the policies and legislation that enable effective action (e.g. laws and decrees exist but they are not specific enough as to how measures should be adopted or by whom, or need additional legislation to be sanctioned in order to move forward).

The deployment of electric buses is clearly aligned with sustainable mobility, as public transport is one of the core components of a sustainable mobility system, complemented by walking and cycling.

3.2 Objectives

Objectives are related specifically to the deployment of electric bus fleets. They relate specifically to:

- Creating suitable **financial** conditions for the procurement and deployment of electric bus fleets and its charging infrastructure.
- Creating an **institutional** setup that is adequate for the procurement and deployment of electric bus fleets and its charging.

- Producing effective **regulatory** conditions of electric bus import, deployment and operation.

- Agreeing on suitable **operating models** between operating companies and the government.

- Integrating a framework of **gender and inclusion** in the process of scaling up electric mobility.

3.3 Timeline

The timeline for this roadmap has three horizons:

- Short term: until 2025, a horizon focused on applying learned knowledge to effective action and overcoming existing (legal, regulatory, institutional, financial) obstacles;
- Medium term: between 2026 and 2030, aimed at procurement, deployment and operation;
- Long term: During 2031 and 2035, with the objective of ensuring sustained operation.

It must be noted, with regards to actions that are presented in the table below, that these present a significant proportion of actions that should be taken in the short term (34 of 85 total), which is evidently not actionable and it was necessary to reorganize these with feedback from consultation and literature. Hence, the actions presented for the short term are those which are reiterated in several reports produced for similar processes in Costa Rica.

Table 1. Phases of the roadmap and their characteristics, with actions.

Phase	*Thoughts into action*	*Deployment and operation*	*Sustained operation*
Timeline	*2023-2025*	*2026-2030*	*2031-2035*
Target/ Focus area	*Applying learned knowledge to effective action and overcoming existing obstacles*	*Procurement, deployment and operation*	*Ensuring sustained operation.*
Most relevant actions identified	- *Alliance between Central Government- Costa Rican Institute of Electricity -Fleet Providers-Municipalities and national or regional Banking to finance buses (SPV – Special Purpose Vehicle)* - *International donations of units or funds for the acquisition of units* - *Extension of public transportation operation concession terms to 15 years (for those who effectively substitute fleets for electric.* - *Standardization of vehicles and charging infrastructure to ensure system interoperability (e.g., certain chargers can serve different vehicle brands).* - *Creation of intersectoral, interinstitutional and interdisciplinary groups for the creation of projects*	- *Leasing of electric units for the service (incentive through income tax facilities for the operating companies)* - *Policies associated with the decommissioning of units that have reached the end of their useful life (scrapping, salvage values, etc.).* - *Consolidated purchases of electric buses to achieve more favourable conditions due to purchase volume* - *Enable long-term contracts for electricity consumption, in order to have greater certainty regarding the cost of energy in the long term which could improve legal, regulatory and fare security)* - *Disincentivizing diesel units for system operation* - *Capacity building on leadership and empowerment for women*	- *Create new public-private partnership models to facilitate the purchase of electric buses (especially for companies that do not have debt capacity, such as SMEs), especially through leasing or renting.* - *Guarantee fund, sovereign guarantees or trust to support the provision of buses, e.g., linked to the Development Banking System.* - *Creation of a comprehensive policy for public transportation at the national level and with details for the regions.* - *Improvement programs for driver license aimed at women.*

	adjusted to the national reality. - *Review of the regulatory framework to encourage the adoption of electric buses versus internal combustion buses, that includes a review of consistency between current regulations.* - *Strengthening the public interest of the public transportation service* - *Assessment of needs of charging infrastructure and network requirements and scale, strengthening of the electric network, based on an initial operating zone and "electrifiable" zones.* - *Redefine fare model to integrate electric vehicles* - *Assessment of organizational and financial capacities of current operating companies* - *Identify potential bus routes that can be electrified.* - *Assessment of the size of the fleet and analysis for "phasing out" existing fleets and adequate composition of electric/ICE fleet.*	- *Reduced and special fares for people who care for others, that recognize trip-chaining related to mobility of care.* - *Generating technological tools that allow users to have information of bus (and stop) location, routes, fares, etc.* - *Development of guidelines for the technical and financial analysis required to determine the specifications for e-buses and the charging infrastructure*	

	- *Mapping out studies underway and their insertion in this roadmap to avoid duplication of efforts.* - *Create awareness among decision makers and the general public of the reality of the sector (challenges, needs and opportunities) and the roadmap for electrificationDissemination and communication processes aimed at different stakeholders.Incorporate gender criteria in technical parameters of bus typology* - *Attention protocols in cases of violence in public transport vehicles that contemplates attention to gender-related violence* - *Planning the location of bus stops with criteria that include safety and accessibility, and relocate those that do not comply with those criteria.*		

4. Implementation plan – How do we get there?

4.1. Focus area 1: Capacity and soft skills

Soft skills are essential to shifting the status quo and a more detailed understanding of the "soft skills" and other cross-cutting characteristics that will create conditions for such a large-scale deployment is necessary. Specific soft skills include Liaising with operating companies, public engagement skills, negotiation skills and, in general, skills that do not relate specifically to the engineering, political, economic and "technical" side of the implementation but rather the knowledge that is required to facilitate actual implementation on the ground.

In terms of **technical knowledge** that has been identified by several stakeholders, this responds to the fact that electric fleets are not yet deployed massively, and staff, drivers, and other stakeholders are knowledgeable about ICE operation, fuel and mechanics and not so regarding electric mobility. While bus providers do include some of this training when delivering a fleet and in some cases the maintenance of the fleet is carried out by the manufacturers themselves, the following topics arose in discussions as those that technicians, drivers and staff in general should have in mind:

- For technicians: understanding the fundamentals of vehicles, the types of charging infrastructure, their application according to the needs of different types of vehicles, their optimization and in general training on mechanics and electricity; extending battery life through good vehicle charging practices (e.g., intelligent mobile charging systems);

For drivers: Ecodriving and efficient electric bus driving, to take advantage of regenerative braking systems and prolong battery life, including electric charging infrastructure, and components of electric vehicles.

For all staff: capacity building processes related to gender that allow for a greater awareness of all people who are part of the sector, with an objective to improve life conditions of women in the work field and in their role as users. Related to this, and highlighting aspects and actions formulated for the gender analysis in the transport sector, there are key actions:

- The implementation of capacity building programs on leadership and empowerment directed at women who represent the transport and mobility sector in the country, with an objective to improve their participation and representation in different aspects of the sector.
- An implementation of capacity building aimed at women. By offering capacity building programs for women, an inclusive and safe space is created where they can share experiences, develop technical abilities and overcome any obstacle or gender stereotype they may encounter. This promotes trust and empowerment of women to actively participate in the design, development and adoption of electric mobility technologies.

Creating capacity building programs aimed at women that increase capacities related to different jobs in the transport sector It is also considered important. This would include knowledge for technical staff, drivers, among others. According to GIZ (2018), when they take part in training, women are more willing to apply for bus driver positions.

The creation of information campaigns aimed at the citizenry is also crucial, with the objective of having people get closer to technology, but at the same time understand the value of electric mobility in quality of life, their surroundings and the environmental impact of the country.

- For all staff: training plans to promote the inclusion of women in the system (e.g. by having a goal to train more women as drivers or in other staff positions at operating and management companies related to the electric bus deployment).

In terms of **soft skills**, the following assumptions must be used as a basis to strengthen the probability of success:

- A thrust towards prioritizing action (that is, every measure should be focused in having a clear result “on the ground”);
- A commitment to take up learned knowledge (meaning that previous reports and studies already have a wealth of knowledge that must be used rather than duplicated, and if an update is needed it should focus on the relevant issues that are outdated and not the production of entirely new studies);
- Ensuring the cooperation of a large array of stakeholders (this will ensure greater impact);
- Technical details of electric bus deployment;
- Using a “gender lens” when implementing measures and moving forward (that is, understanding a wider scope of travel that includes mobility of care, trip chaining and other mobility needs and patterns in preparing and implementing measures).
- Create awareness of the reality of the sector (challenges, needs and opportunities and the roadmap for electrification, and dissemination among public opinion and key sectors with regards to planning and deployment of electric buses).
- Mapping studies underway and their relevance and insertion in this roadmap to avoid duplication of efforts.

To achieve this, the following capacities should be strengthened:

- Moving from reporting to implementation: This would include, for instance, understanding the routes that have greater potential for electrification and learning how to prioritize actions and move forward. This roadmap and implementation plan would serve as a guide for that purpose.
- Improving soft skills in policy action: Leadership, negotiation, cooperation are skills that could be taught and greatly benefit an implementation.
- Negotiation and risk management: The history of transportation policies in San José has demonstrated that a more proactive approach could be taken in moving forward with measures while ensuring that all stakeholders are engaged and in agreement, and also in protecting them

from legal action. This could involve building capacity on topics such as broad stakeholder engagement, negotiation skills during the preparation of regulations;
- Taking ownership and proactively addressing challenges: A risk tolerance mentality can be strengthened in key stakeholders related to the implementation of a massive fleet of electric buses.

In terms of stakeholders that should be included in the development of these capacity building issues can be divided into those who supply the technology, those who provide technical skills, and those who receive training, as well as other key stakeholders:

- Suppliers: Electric distribution companies, vehicle distributors
- Providing technical skills: INA (Instituto Nacional de Aprendizaje), CFIA (Colegio Federado de Ingenieros y de Arquitectos de Costa Rica), CIEMI (Colegio de Ingenieros Electricistas, Mecánicos e Industriales), private technical institutes, fire fighters and first responders in general, and academia in general.
- Receiving: Drivers, technical staff at operating companies, general staff at management and operating companies of electric buses.

4.2. Focus Area 2: Regulatory measures

Twenty-one measures are identified that would be part of a regulatory package in the implementation of the roadmap. The three most relevant (as per workshop results and reconfirmed by other reports) are:

- Extension of public transportation operation concession terms to 15 years: by increasing the length of concessions, financial models become more viable. However, these should be clearly aligned with the useful life of electric vehicles as these are the “natural” threshold for contract duration in any type of transport fleet;

- Policies and regulations associated with the decommissioning of (ICE) units that have reached the end of their useful life, as it relates to scrappage, salvage and associated processes and enables an orderly fleet renewal where older units are not resold. This also helps in increasing the odds of fleet renewal as older units can be received in exchange for something (e.g. cash incentive, or adding points to a proponent in a bid to operate a fleet, or providing “credits” for each old/ICE vehicle that is taken out of service); this can include regulation on the disposal of batteries that recognizes the social and environmental risk of those types of waste
- Review of the regulatory framework to encourage the adoption of electric buses versus internal combustion buses, where incentives are allocated to electric fleets, and/or charges are associated to internal combustion engine buses, and through more stringent emission standards (i.e. EURO VI)
- Creation of intersectoral, interinstitutional and interdisciplinary groups for the creation of projects adjusted to the national reality
- Policies and regulation related to work in the sector, with the objective to improve work conditions while also promoting professionalization of employment at different levels
- Assessment of organizational and financial capacities of current operations

- Assessment of different scenarios for the electrification of fleets (BAU vs reforms in the system) to inform detailed decision-making processes
- Analysis and detailed identification of legal and regulatory barriers that restrict the introduction of electric buses in the fleet (as identified by existing reports).

Other measures were also identified in reports and discussions. Some of the most prominent measures are:

- Accelerate the introduction of electronic payment in the system (also included in Focus area 4);
- Strengthening the public interest of the public transportation service
- Accelerated implementation of electronic payment (especially in AMSJ)
- Creation of intersectoral dialogue spaces (with stakeholders from e.g. Energy authorities, electricity utilities, bus operators, bus dealers, local governments, financing institutions, regulators (transport and energy),) to advance in the electrification of public transportation.
- Addenda to concession contracts to protect high investments in electric units (e.g., through guaranteed minimum revenues, term extensions, or other contractual guarantees).
- Disincentivizing diesel units for system operation
- Extension of concession terms for the operation of the service (to 15 years)
- Robust systems for traceability and transparency of service operation and concession processes to provide greater legal certainty, clarity and confidence in the system.
- Progress in the modernization of public bus transportation (sectorization, higher service quality, higher comfort standards for users, electronic payment, among others).
- Creation of a comprehensive policy for public transportation at the national level and with details for the regions.
- Study the conversion of diesel units to electric units.
- Study new energy sources or practices associated with electrification (opportunity charging, hydrogen – for interurban services-, etc.).
- Adaptation of the road infrastructure to the requirements of the new electric units (heavier weights, which could deteriorate the roadways sooner).
- Study for adjustments in the useful life of electrical units to assess whether to extend the useful life of the units.

The stakeholders that were identified as having a role in the implementation of these measures include:

- MOPT who can provide technical support and give weight to recommendations related to transportation for regulatory change;
- MINAE, who can provide technical support and give weight to recommendations related to environment and climate change for regulatory change;
- ARESEP, who can strengthen recommendations and provide support at the national level to incentivize regulatory changes for the benefit of electric buses;
- Legislative Assembly, who will be instrumental for the approval of changes in regulation (or creation of new regulation);
- Electricity distribution companies and bus operating companies, who can confirm their interest in these changes from the private sector directly involved.

4.3. Focus Area 3: Economic and Financial measures (including fare policies)

Fortunately, the deployment of electric mobility bus fleets has been frequent in Latin America recently, and this has generated considerable knowledge in terms of specific measures that increase the likelihood of success.

In **economic/financial measures**, two measures have been suggested by virtually all groups in workshop discussions, and they coincide with recommendations from other reports[41]:

- Fleet leasing: To address a frequent criticism related to the price of electric buses, an option to lease these fleets has gathered attention and has been successfully implemented in other places in the region. In the case of this project, discussions also resulted in a suggestion to implement an incentive through income taxes for operating companies.
- Financing alliance: This refers to the creation of an alliance between Central Government, Costa Rican Institute of Electricity, Fleet Providers, and Banks to finance buses, specifically through the use of a Special Purpose Vehicle (SPV) to make the disbursement of funds more efficient.

With regards to **fare policies**, two measures were also prioritized:

- Long term contracts in electricity: This refers to enabling long-term contracts for electricity consumption in order to have greater certainty regarding the cost of energy in the long term, and hence improve the legal, regulatory and fares security. This measure also relates to the separation of fleets from operating costs. A related idea was that associated to battery leasing or renting, given that batteries are the quickest component to deteriorate and one of the most expensive in the vehicle;
- Including charging infrastructure into fare costs: This means a recognition of charging infrastructure investment costs as part of infrastructure, and that this would be part of the fare methodology. While this would improve the financial sustainability of the system in principle, fare levels should not be loaded with "more than they can handle" as they would overburden users with a high fare level.
- Adjustments to fare models of bus-based fare models as well as electricity fares in depots.

Other financial, economic or fare measures that were identified included:

- Pledged loans in which installments are paid by means of substituted costs (flow assignment or fee income)
- Alignment of concession terms for the operation of public transportation with the periods of investment recovery and financing of operations.
- Measures associated to the effective inclusion of development banks and cooperating agencies in financing fleets;

[41] Loans are not considered as Costa Rica is not currently actively considering them as part of its fiscal strategy nationwide.

- Measures associated to the development of environmental financial instruments to obtain resources due to reductions in greenhouse gas emissions and local pollutants in the transportation sector. For instance, incorporating externalities (air pollution, greenhouse gas emissions) in public transportation fares to make the sector visible as part of the country's carbon market and worthy of investment through programs such as “Payment for Environmental Services”;
- Adjusting fare methodologies for the inclusion of electric buses (with local electric bus CAPEX and OPEX data).

The most relevant stakeholders associated to these measures are:

- MOPT and MINAE, being the main Ministries in charge of transport and environment;
- ARESEP, as they are the agency in charge of defining public transport fares;
- The banking sector in general (public and private), but specifically the Treasury,
- CTP as the Council in charge of defining public transport operation;
- Operating and Supplying companies related to electric buses.

4.4. Focus Area 4: Vehicles and charging infrastructure

The ”hard” side of the deployment of electric buses is a predominant component of the deployment of electric buses, which is divided here into measures for vehicle acquisition and deployment, and on the other hand the provision and operation of charging infrastructure.

With regards to **vehicles**, the most prominent measure in studies and workshops was the creation of new public-private partnership models to facilitate the purchase of electric buses (especially for companies that do not have debt capacity, such as SMEs), especially through leasing or renting. It could be said that this is a measure that complements the ones identified with regards to the leasing of vehicles, in that partnerships are especially relevant to make leasing successful.

Another set of measures that were deemed most relevant were:

- Consolidated purchases of electric buses to achieve more favorable conditions due to purchase volume
- Assessment of the fleet size and an analysis for “phasing out” existing fleets and the adequate composition of an electric vs ICE electric fleet. In the short term, contingency plans must be defined for buses that are due to leave service while a route is defined for all buses (for instance, operational adjustments, transition periods, among others).
- Assessment of the charging infrastructure needs and requirements and size of the network, strengthening of the electrical grid, based on an initial operating zone and “electrifiable” zones.
- Technical feasibility of electrification of routes in AMSJ and outside of it.

Other measures that were not so prominent but are anyway worth mentioning include:

- Accelerate the introduction of electronic payment in the system (also included in Focus area 2);

- Determination of charging infrastructure investments and their financing
- Establish an energy efficiency standard for both ICE buses and Electric buses.
- Updating emissions regulations for buses (to EURO VI);
- Socialization of benefits and changes regarding electric buses (e.g., noise, emissions, energy, comfort, etc.).
- Analysis of current demand for passenger transport service and how it could be improved by the use of electric buses.
- Technical determination (autonomy, charging conditions, ease of electrification) of the necessary vehicle typologies, by routes or zones, for an optimal purchase of units.
- Integration of the electrification project with sectorization plans and exclusive lanes for public transportation operation.
- Incorporate gender criteria within technical parameters of buses used in the country, since this is crucial to improve accessibility for users and service providers. Criteria that integrate aspects such as height of users, minimum width of open doors that enable use by strollers, height of vehicle floors, space inside the vehicle, dimensions of windows, width of aisles, additional space for shopping carts, lighting and other aspects that can improve service experience for users and increase accessibility, comfort and safety. This all makes public transport service more adequate and attractive for a wider array of population, benefiting companies who provide a service and improve the experience of those who provide it.

With regards to **charging infrastructure**, two measures are the most relevant:

Defining locations: a measure that can benefit other focus areas (but most useful to the identification of charging locations) is the development of studies to justify the electrification of a route which would include location of the site to be electrified, availability of three-phase network, number of units to be replaced, times at which charging would be carried out (as a result of electricity demand curves). This would also include gender criteria for those locations in vehicles, which include aspects such as safety and accessibility of charging locations.

Standardization: More specifically, an urgent measure is the standardization of vehicles and charging infrastructure to ensure system interoperability so that chargers can serve different vehicle brands. While the market is fairly standardized, special attention must be given to this issue in bidding documents and other measures related to vehicles.

Accessibility: creating guidelines for location of charging infrastructure that contemplates universal access parameters, contemplating characteristics such as heights, widths of charging spaces, types of charger, communication features, among others.

At the same time, other more specific measures have been identified:

- Development of regulations on the elements, procedures and requirements for the establishment of electric bus facilities;
- Development of technical guidelines on charging infrastructure for public transportation operators;

- Analysis of national generation and electricity demand to supply energy for the complete electrification of the fleet (linked to national "Electricity Expansion Plans"), and the estimated impact that such demand will have on the electricity grid for the short, medium and long-term deployment.
- Determination of the business model for the design and financing of the charging infrastructure together with the definition of the vehicle typology and its purchase.

There are more specific issues identified such as:

- Verification that products offered by manufacturers follow the Electrical Code and other defined standards (UL type or national standards created by INTECO - SUCOM-SUMEL-SUCAL-POASEN).
- Identify the real costs of charging infrastructure for Costa Rica and have an international benchmark.
- Include exemptions for charging infrastructure.
- Inclusion of the demand for electric buses in the national electricity planning, to guarantee consumption as the electrification of the fleet is developed.
- Development of maintenance and contingency support plans for operating companies.

Stakeholders identified to support these issues are similar to those identified for other focus areas:

- MOPT as a lead Ministry when it regards transportation topics;
- MINAE as a lead Ministry when it regards climate and environment topics;
- CTP and Aresep as national-level agencies that determine the routes and fares of public transport;
- Bus operating companies;
- Electricity distribution companies;
- Instituto de Normas Técnicas de Costa Rica (INTECO) as the national body that would help define standards for charging infrastructure;
- National Electric System (SEN, in charge of planning the national network).
- - CONAPDIS (Consejo Nacional de Personas con Discapacidad).

4.5. Focus area 5: Gender inclusion

In addition to the actions identified in the other areas of action related to gender, this section addresses other important aspects of the roadmap, mainly in 3 axes: service provision, employability and incentives for companies.

In terms of service provision, a challenge identified in terms of gender is the design of public transport services since historically the planning and design has been predominantly masculinized, which has resulted in a service with characteristics that exclude historically vulnerable populations. This includes as people with disabilities, children, older adults and women. Two major challenges are identified in this area: on the one hand, the safety of users as well as the accessibility of services for the entire population.

In terms of accessibility, it is essential to point out that this generates exclusion in populations that are vulnerable, such as people with disabilities. In turn, the challenges in terms of accessibility have an impact on aspects such as assuming care roles, which is related to a dynamic of mobility called care mobility, that refers to the trips that people make to attend to tasks of caring for dependent people or caring for the home. It is important to point out that different investigations identify that it is women who fall into this category of mobility due to the roles historically assigned.

With the aim of promoting electromobility and public transport, it is essential to strengthen or generate solutions that integrate the entire population and its various needs. With this objective the following measures are identified:

- Frequencies and hours of operation of buses sensitive to women's safety conditions and patterns of mobility of care
- Reduced or special fares for caregivers, which recognize the dynamics of chained trips of care mobility
- Fare integration, facilitating transfers, multimodality and travel efficiency
- Protocols for attention to cases of violence within public transport units, which includes attention to violence such as sexual harassment
- Periodic surveys in relation to the perception of the quality of public transport; said information must be disaggregated by gender, age, disability status and other analysis variables
- Improve public transport service feedback services
- Generation of technological tools that allow users to have updated information on elements such as the location of the bus, public transport stops, routes, costs, etc.
- Integration within public transport routes of stops at services or facilities that have a focus on care
- In order to improve the experience of public transport users and minimize the perception of insecurity, according to Barrios and San Gil (2016), it is important to post information about the service within the units, contemplating information on routes and stops, procedures for making a complaint regarding service or other information relevant to the provision of the service.
- Integrate gender responsive criteria in all the infrastructure associated with bus-based public transport, incorporating the 4 central aspects of safety, comfort, accessibility and care
- Implement gender-sensitive designs of bus stops, since having more inclusive criteria favors the experience of all people and generates better conditions for mobility
- Plan the location of bus stops with safety and accessibility criteria. Relocate those that do not meet these criteria.

In the area of capacity building, some fundamental measures have already been addressed for a greater integration of women into the sector, however, according to the Asia-Pacific Economic Cooperation (2022), there are great disparities in the representation of women in the transport sector, in all levels including leadership positions. With the aim of improving the employability conditions of women, the following are identified as key actions:

- Creation of a communication strategy that is aimed at women and that provides them with information about job opportunities, taking into consideration the use of channels aimed at this audience.
- Readjustment of working hours under the scheme of reconciliation of family and work life, which according to UNICEF (2021) are those policies that help maintain a balance between work and personal life. Said policies include elements such as paid parental leave, flexible or shorter working hours, comprehensive care services, among other elements with the aim of facilitating the labor inclusion of a wide diversity of populations, including those who are in charge of home care. According to the Mineta Transportation Institute (2019), the perception of the imbalance in terms of hours and time in the transport sector makes transport-related work unattractive to women, especially those who are mothers, since it is perceived that they are not very attractive work cultures. friendly to family life, therefore this type of change could make the sector more attractive.
- Creation from the governing institutions of leadership programs aimed at women, with the aim of strengthening capacities and promoting their integration within the sector.
- Check that the contracting requirements of the companies providing the public transport service are not exclusive.
- Improvement of conditions in the work environment by implementing actions such as protocols for dealing with discrimination or violence.
- Improve the security conditions of the schools by incorporating elements such as bathrooms, changing rooms, nurseries, among other supplies for women.
- License improvement programs that contemplate through specific training the achievement of public transport vehicle driving licenses.

Finally, in the third axis, incentives for service provider companies, the following are identified as actions:

- Clean Energy Works (2022) proposes as an impactful measure at the gender level, to promote through incentives those routes that have a large number of vulnerable users.
- Incentives for those service provider companies that have a gender inclusion roadmap within their operations.

Stakeholders identified to support these issues are similar to those identified for other focus areas:

- MOPT, MINAE as governing Ministries;
- INAMU as an expert institution on gender in the country
- CTP and Aresep as agencies at the national level that determine the routes and rates of public transport;
- bus operating companies;
- Electricity distribution companies;

- CONAPDIS

5. Conclusion and next steps – what do we need?

Costa Rica has a robust framework to achieve a large deployment of electric buses quickly, and sound technical knowledge provided by several years of studies from different sources. In order to move forward, key actions are needed:

First of all, a firm commitment from all relevant levels and divisions of government to deploy an electric bus fleet, materialized in regulation and timeline. This means that executive and legislative powers are aligned with the firm deployment of an electric bus fleet, and that they all have a common understanding of the major relevance of this deployment for the sake of improved quality of service, quality of life and achievement of transport, energy, social and climate change – related goals of the country.

Second, a public commitment from all stakeholders in the value chain is necessary to implement the different measures prioritized in all focus areas. This means that not only government but also fleet providers, bus operators (and their associations), distributors of relevant technologies and financial institutions are committed to prioritize action and follow recommendations given in previous reports related to the electrification of bus fleets.

Third, the firm support from financial stakeholders at the national and international level to procure the necessary fleets and infrastructure for electric bus deployment is a crucial step to achieve success. The financial requirements of this endeavor are significant, and they've proven to be one of the key elements in having a higher probability of success. Creativity in the creation of instruments to improve financial conditions will be a good complement to this commitment.

Fourth, coordination between institutions and their firm commitment and mechanisms to exchange views and make decisions will be a crucial aspect to move forward with the effective deployment of electric buses.

Finally, all these key actions must be made hand in hand with the implementation of a gender component in the deployment of electric buses since this is a fundamental task to achieve an equitable and sustainable transition. The inclusion of a gender perspective is aligned with the efforts of the country in matters related to human rights and is linked to the efforts to reduce gender gaps that exist in the transport sector, a challenge of the sector and topic.

References

Policies, legislation and relevant regulations

Carbon Neutrality Country Program (Programa País Carbono Neutralidad): https://cambioclimatico.go.cr/programa-pais-carbono-neutralidad/

Cross-sectional agreement for GHG emissions reduction in the transport sector (Acuerdo intersectorial para la reducción de emisiones de gases de efecto invernadero (GEI) en el sector transporte): https://www.presidencia.go.cr/comunicados/2019/02/mopt-y-minae-de-la-mano-para-reducir-emisiones-en-el-sector-transporte/

Decree N° 41642-MINAE (Reglamento para la construcción y el funcionamiento de la red de centros de recarga eléctrica para automóviles eléctricos por parte de las empresas distribuidoras de energía eléctrica): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=89191&nValor3=116987&strTipM=TC

Decree N°28337 (Decreto Ejecutivo No. 28337-MOPT del 16 de diciembre de 1999): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=42773

Decree N°40186-MOPT (Consolidación y ejecución de las políticas y estrategias para la modernización y sectorización del transporte público modalidad autobús en el área metropolitana de San José y zonas aledañas): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=83476&nValor3=107212&strTipM=TC

Decree N°40545-MOPT (Declara de interés público la Política Pública de la Modernización del Transporte Público Modalidad Autobuses del Área Metropolitana de San José): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=84655&nValor3=109318&strTipM=TC

Law N° 3503 "Regulatory law for remunerated transportation of people in motored vehicles" (Ley Reguladora Transporte Remunerado Personas Vehículos Automotores): https://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=9433

Law N° 9518, addresses the incentives and promotion linked to electric transportation (Ley de Incentivos y Promoción para el Transporte Eléctrico N° 9518 del 25 de enero del 2018): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?nValor1=1&nValor2=85810

National Climate Change Adaptation Plan 2022-2026 (Plan Nacional de Adaptación): https://cambioclimatico.go.cr/plan-nacional-de-adaptacion/

National Decarbonization Plan 2018-2050 (Plan Nacional de Descarbonización): https://cambioclimatico.go.cr/plan-nacional-de-descarbonizacion/

National Electric Transportation Plan 2018-2030 (Plan Nacional de Transporte Eléctrico 2018-2030): https://sepse.go.cr/documentos/PlanTranspElect.pdf

National Energy Plan 2015-2030 (Plan Nacional de Energía 2015-2030): https://cambioclimatico.go.cr/wp-content/uploads/2018/08/VII_Plan_Nacional_de_Energia_2015-2030.pdf

National GHG inventory (Inventario Nacional De Gases De Efecto Invernadero (INGEI)): https://cambioclimatico.go.cr/inventario-nacional-de-gases-de-efecto-invernadero-ingei/

National Policy for Climate Change Adaptation 2018-2030 (Política Nacional de Adaptación al Cambio Climático 2018-2030): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=86580&nValor3=112448&strTipM=TC#:~:text=El%20objetivo%20general%20de%20la,contribuya%20a%20la%20calidad%20de

National Transportation Plan 2011-2035 (Plan Nacional de Transportes de Costa Rica 2011-2035): https://repositorio-snp.mideplan.go.cr/handle/123456789/90

Nationally Determined Contribution 2020 (Contribución Nacionalmente Determinada De Costa Rica): https://cambioclimatico.go.cr/contribucion-nacionalmente-determinada-ndc-de-costa-rica/

PIMUS (Integrated Sustainable Urban Mobility Plan, Programa de Movilidad Urbana Sostenible Para San José), prepared in 2017: https://cambioclimatico.go.cr/wp-content/uploads/2018/09/PIMUS_INFORME-EJECUTIVO.pdf

Program for an Integrated Massive Public Transport System in the Great Metropolitan Area (Sistema Integrado de Transporte Público Masivo para la GAM SITGAM 2020-2035): https://www.mopt.go.cr/wps/wcm/connect/3e44eb6c-%20c8f7-4b86-826a-408f01b15a3f/SITGAM+V10.pdf?MOD=AJPERES

Resolution 0056 of 2019 (Tarifa aplicable en los centros de recarga rápida para vehículos eléctricos): http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=89413&nValor3=117351&strTipM=TC

Resolution 0112-IE-2020 by Aresep (Fijación tarifaria recarga buses eléctricos): https://aresep.go.cr/resoluciones-intendencia-energia-2020/re-0112-ie-2020/

State of the Nation Report 2018 (Informe de Estado de la Nación 2018): http://www.asamblea.go.cr/sd/Documents/analisis/Inforne%20Estado%20de%20%20La%20Nación%202018.pdf

Reports on the sector and bus electrification

"Business model design and financing mechanism oriented to electric buses in Costa Rica" by Stiftung BASE and IADB. Project website: https://energy-base.org/projects/financing-for-electric-buses-in-san-jose/

Accelerating the transition to electric public transportation in the metropolitan great area of Costa Rica conducted by CRUSA and UNEP ("Acelerando la transición al transporte público eléctrico en la Gran Área Metropolitana de Costa Rica"): https://energia.minae.go.cr/?page_id=9655 including two reports: Report on the baseline conditions of bus public transport services in the Metropolitan Area of San Jose (ASMJ) by UNEP and CRUSA Foundation (2022)" and "Report on assessment of existing bus public transport service fleets in ASMJ and gender-sensitive recommendations for their electrification by by UNEP and CRUSA Foundation (2023)."

Análisis de género del sector transporte en Costa Rica. Daket for GIZ: https://www.academia.edu/40034282/Análisis_de_Género_del_sector_Transporte_en_Costa_Rica ; https://www.daket.org/#!/-relacion-entre-genero-transporte-publico-y-huella-de-carbono/

Electric buses for Costa Rica, lessons and recommendations ("¡Buses eléctricos para Costa Rica! Aprendizajes de un proyecto piloto y recomendaciones para el escalamiento"): https://energia.minae.go.cr/wp-content/uploads/2022/03/7.Aprendizaje-de-un-Proyecto-Piloto-recom-para-escalamiento.pdf

Encuesta para conocer las percepciones de la población sobre el servicio de transporte público del Área Metropolitana de San José con enfoque de género. Prepared by A01 and Centro para la Sostenibilidad Urbana for GIZ: https://issuu.com/a-01net/docs/resultados_encuesta_mitransporte_18 ; https://gender-works.giz.de/competitions2020/costa-rica-genero-y-transporte-en-costa-rica/

Increasing ambition to mitigate greenhouse gases in the transport sector through electro-mobility by SLOCAT and GIZ. English report: https://changing-transport.org/publications/mitigate-greenhouse-gases-through-electro-mobility/ . Spanish report: https://www.changing-transport.org/wp-content/uploads/2019_EMobility-Policy-Recommendations.pdf

Retrato del transporte y la movilidad en Costa Rica. GIZ. 2021. https://changing-transport.org/wp-content/uploads/2022_Retrato-del-transporte-y-movilidad-en-Costa-Rica.pdf

Results from the pilot Project on electric buses in GAM (Resultados del proyecto piloto de buses eléctricos en el GAM). Operación Grupo ATD – TUASA by Heat International: https://energia.minae.go.cr/wp-content/uploads/2022/03/6.Resultados-del-proyecto-piloto-de-buses-electricos-en-el-GAM.pdf

Annex: workshop results

The following table presents the full set of actions as proposed by workshop participants, and their relationship to other reports:

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Finance	Financial	Alliance between Central Government-ICE-Fleet Providers-Municipalities and Banking to finance buses (SPV - Special Purpose Vehicle)	Short	MOPT MINAE Treasury ICE Municipalities Banking sector	3
Finance	Financial	International donations of units or funds for the acquisition of units	Short	MOPT MINAE Treasury RREE	3
Institutional	Vehicles	Extension of public transportation operation concession terms to 15 years	Short	MOPT CTP Asamblea Legislativa TP operating companies	3
Institutional	Charging infrastructure	Standardization of vehicles and charging infrastructure to ensure system interoperability (e.g., certain chargers can serve different vehicle brands).	Short	CTP MINAE Electrical distributors	3
Operator and supplier	Policies	Creation of intersectoral, interinstitutional and interdisciplinary groups for the creation of projects adjusted to the national reality.	Short	MOPT MINAE ARESEP Operating companies Electricity distributors Other interested parties	3

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Operator	Policies	Review of the regulatory framework to encourage the adoption of electric buses versus internal combustion buses.	Short	MOPT MINAE	3
Operator	Policies	Strengthening the public interest of the public transportation service	Short	MOPT Legislative Assembly	3
Finance	Financial	Separation of fleet supply from operation	Short	MOPT SPV (Public-Private Partnership) Supplier companies Operating companies	2
Finance	Policies	Accelerated implementation of electronic payment (especially in AMSJ)	Short	MOPT ARESEP BCCR Operating companies	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Finance	Policies	Training needs on: - Bus supply and suppliers - National studies associated with electric buses - Design, operation and financing of electric buses and their charging infrastructure - Batteries, their warranties and spare parts - Operating and acquisition costs and their incorporation into fare models - Bus acquisition methods, conditions and negotiations with manufacturers - After-sales service and reliable conditions - Knowledge of the most electrifiable routes at present.	Short	MOPT MINAE Treasury ARESEP INA Electricity distribution companies Supply companies Operating companies Banking sector	2
Finance	Policies	Determination of charging infrastructure investments and their financing	Short	MOPT MINAE ARESEP ICE	2
Finance	Policies	Creation of intersectoral dialogue spaces to advance in the electrification of public transportation.	Short	MOPT MINAE	2
Institutional	Vehicles	Accelerate the introduction of electronic payment in the system.	Short	CTP Central Bank ARESEP TP operating companies	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Institutional	Vehicles	Updating emission and energy efficiency standards requirements for buses	Short	MOPT CTP MINAE Ministry of Health	2
Institutional	Fare	Adjust fare methodologies for the inclusion of electric buses (with local electric bus CAPEX and OPEX data).	Short	ARESEP TP operating companies	2
Institutional	Charging infrastructure	Analysis of the power supply at the network level (near the bus depot)	Short	Electric distribution companies TP operating companies	2
Institutional	Charging infrastructure	Development of regulations on the elements, procedures and requirements for the establishment of electric bus facilities.	Short	CTP MINAE Electricity distributors ARESEP Operating companies INTECO	2
Operator and supplier	Vehicles	Socialization of benefits and changes regarding electric buses (e.g., noise, emissions, energy, comfort, etc.).	Short	MOPT MINAE ARESEP Operating companies Electricity distributors Other interested parties	2
Operator and supplier	Policies	Addenda to concession contracts to protect high investments in electric units (e.g., through guaranteed minimum revenues, term extensions, or other contractual guarantees).	Short	MOPT-SPS-CTP	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Operator and supplier	Vehicles	Technical determination (autonomy, charging conditions, ease of electrification) of the necessary vehicle typologies, by routes or zones, for an optimal purchase of units (integration of electrification project with sectorization plans and exclusive lanes for public transportation operation).	Short	MOPT-SPS-CTP Operating companies Distribution companies	2
Finance	Financial	Pledged loans in which installments are paid by means of substituted costs (flow assignment or fee income)	Short	Banking sector	1
Institution al	Vehicles	Market study of electric buses in Costa Rica (with national suppliers, assemblers or distributors).	Short	CTP TP operating companies	1
Institutional	Vehicles	Detail and clarity on how to apply Art. 28 of Law No. 9518 on technical and financial studies for the electrification of bus routes.	Short	MOPT CTP MINAE	1
Operator and supplier	Vehicles	Preparation of a catalog with the supply of electric buses, operating and maintenance costs, warranties and after-sales services, battery replacement and other relevant conditions for the operation and financing of electric fleets.	Short	MOPT MINAE International Cooperation	1
Operator and	Vehicles	Depreciation of vehicles to at least 15 years (adjustment in the fare methodology). This measure is linked to concession terms).	Short	ARESEP MOPT-SPS-CTP	1
Operator and	Financial	Alignment of concession terms for the operation of public transportation with the periods of investment recovery and financing of operations.	Short	MOPT-SPS-CTP	1

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Operator and	Fare	Creation of stabilization mechanisms in the event of shocks to reduce dependence on user fares	Short	MOPT	1
Operator and	Financial	Cost differentiation due to volume of operations (no system-wide generalization)	Short	ARESEP	1
Operator and supplier	Financial	Adjustment of goals on electrification of public transport fleets so that they are aligned and justified from a financial point of view (investment recovery times).	Short	MOPT MINAE Legislative Assembly	1
Operator and supplier	Financial	Structuring of a project for the electrification of public transportation with delimited implementation phases and priority roads (thinking about how to invest in conditions where electrification is not possible today).	Short	MOPT MINAE	1
Operator and	Fare	Recognition of transmission losses due to the electric transmission system in transmission fares	Short		1
Operator and	Fare	Recognition of energy fares for electric distribution companies undergoing network upgrades	Short		1
Operator and	Charging infrastructure	Development of technical guidelines on cargo infrastructure for public transportation operators.	Short		1
Institutional	Charging infrastructure	Analysis of national generation and electricity demand to supply energy for the complete electrification of the fleet (linked to the Electricity Expansion Plans).	Short	National Electric System (SEN, in charge of national planning)	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Finance	Financial	Leasing of electric units for the service (incentive through income tax facilities for the operating companies)	Short to medium	MOPT Treasury MINAE Supplying companies Operating companies	4
Finance	Policies	Policies associated with the decommissioning of units that have reached the end of their useful life (scrapping, salvage values, etc.).	Short to medium	MOPT MINAE Health Treasury	4
Institutional	Vehicles	Consolidated purchases of electric buses to achieve more favorable conditions due to purchase volume	Short to medium	TP CTP operating companies National and commercial banks Investors Investors Electricity distributors	3
Institutional	Fare	Enable long-term contracts for electricity consumption, in order to have greater certainty regarding the cost of energy in the long term (improve legal, regulatory and fare security).	Short to medium	ARESEP MOPT SPS CTP MINAE	3
Institutional	Fare	Recognition of charging infrastructure investment costs as part of the service support infrastructure recognized as part of the current rate methodology.	Short to	ARESEP Electrical distribution companies MINAE	3

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Institutional	Charging infrastructure	Technical studies to justify the electrification of a route: Location of the site to be electrified Availability of three-phase network Number of units to be replaced Times at which the load would be carried out Result = electricity demand curves	Short to medium	Electric distribution companies TP operating companies	3
Finance	Policies	Disincentivizing diesel units for system operation	Short to	MOPT MINAE Treasury	3
Institutional	Charging infrastructure	Creation of consolidated charging infrastructure facilities aligned with public transportation sectorization processes (optimizing and concentrating buses at single points instead of having one for each company).	Short to medium	CTP TP operating companies Electric distribution companies	2
Finance	Policies	Extension of concession terms for the operation of the service (to 15 years)	Short to	MOPT Legislative Assembly	2
Finance	Policies	Robust systems for traceability and transparency of service operation and concession processes to provide greater legal certainty, clarity and confidence in the system.	Short to	MOPT ARESEP	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Finance	Policies	Progress in the modernization of public bus transportation (sectorization, higher service quality, higher comfort standards for users, electronic payment, among others).	Short to medium	MOPT MINAE ARESEP BCCR Operating companies	2
Institutional	Charging infrastructure	Legal amendment (Law No. 9518) to broaden the definition of recharging centers to recharging infrastructure, to include electromechanical works, charging platforms (current recharging centers) and network adaptation, to benefit from the tax incentives provided.	Short to medium	Public Transportation Electrification Committee (MOPT, MINAE, CTP, Treasury, electricity distributors)	1
Institutional	Vehicles	Create new public-private partnership models to facilitate the purchase of electric buses (especially for companies that do not have debt capacity, such as SMEs), especially through leasing or renting.	Medium	CTPs National and commercial banks Investors TP operating companies	4
Finance	Financial	Guarantee fund, sovereign guarantees or trust to support the provision of buses, e.g. linked to the Development Banking System.	Medium	MOPT MINAE Treasury BCCR SBD	3
Finance	Policies	Creation of a comprehensive policy for public transportation at the national level and with details for the regions.	Medium	MOPT MINAE	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Finance	Financial	Development of a Payment for Environmental Services system in the transportation sector to finance the environmental and health benefits of the transition to electric buses.	Medium	MOPT MINAE Treasury	1
Finance	Financial	Securitization of ticket flows to feed a trust fund	Medium	MOPT BCCR ARESEP	1
Finance	Policies	Study the conversion of diesel units to electric units.	Medium	MOPT MINAE INA Electricity Distribution Companies Operating Companies	1
Finance	Policies	Study new energy sources or practices associated with electrification (opportunity charging, hydrogen, etc.).	Medium	MOPT MINAE Distributing companies RECOPE Operating companies	1
Finance	Policies	Adaptation of the road infrastructure to the requirements of the new electric units (heavier weights, which could deteriorate the roadways sooner).	Medium	MOPT	1
Institutional	Fare	Certifying the useful life of batteries for fares	Medium	Accredited entities INA Academy	1

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Operator and supplier	Financial	Development of environmental financial instruments to obtain resources due to reductions in greenhouse gas emissions and local pollutants in the transportation sector.	Medium	MINAE MOPT Ministry of Finance Ministry of Health Ministry of Health	1
Operator and	Financial	Formulation of non-bank financing sources (e.g., public investment for CAPEX or OPEX, public transportation funds, trusts, SPVs, among others).	Medium	MOPT Ministry of Finance	1
Operator and	Financial	Change of strategy on financing and governance of public transport to mitigate regulatory and demand-side risks	Medium	MOPT-SPS-CTP Legislative Assembly	1
Operator and	Fare	Adjustment of fare methodologies towards schemes that guarantee expected base revenues in accordance with demand and mileage (e.g., variable awards on people moved and km or differential awards).	Medium	ARESEP	1
Operator and	Financial	Development of business models suitable for operating companies of different sizes (large, medium, small and micro).	Medium	MOPT-SPS-CTP Operating companies Financial sector Electric distribution companies	1

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Finance	Financial	Public investment in bus service (in CAPEX or OPEX)	Medium to long	MOPT MINAE Treasury ARESEP Supplying companies Operating companies	1
Finance	Policies	Study for adjustments in the useful life of electrical units to assess whether to extend the useful life of the units.	Medium to	MOPT MINAE Legislative Assembly	1
Institutional	Vehicles	Create pilot projects for the management of electric vehicle battery waste	Medium to long	Ministry of Health Electricity distribution companies INA Academy PT operators Waste management companies	1
Institutional	Fare	Incorporate externalities (air pollution, greenhouse gas emissions) in public transportation fares to make the sector visible as part of the country's carbon market and worthy of investment through programs such as Payment for Environmental Services.	Medium to long	MOPT MINAE MINSA Academia	1
Institutional	Fare	Modification of fare models to move from cost-based models to options such as distance traveled or service provision-related models (reducing the dependence of the fare model on demand).	Medium to long	ARESEP	1

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Institutional	Fare	Determine the salvage values of electric vehicle batteries for inclusion in the fare methodologies.	Medium to	ARESEP TP operating companies Electricity distribution companies	1
CFP	Policies	Creation and/or modification of a regulatory framework for the importation, nationalization, registration and homologation of vehicles and their components e.g. batteries.			3
Institutional	Training	Types of charging infrastructure and their application according to the needs of different types of vehicles		Electric distribution companies TP operating companies Bus supplying companies INA	3
CFP		Generation and use of data			2
Operator and supplier	Charging infrastructure	Determination of the business model for the design and financing of the charging infrastructure together with the definition of the vehicle typology and its purchase.			2
Operator and	Training	Classroom training plans for efficient electric bus driving		INA (use of the driving simulator)	2
Operator and	Training	Specialization of technical personnel in mechanics and electricity		INA Private technical training organizations	2

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Operator and	Training	Driver training plans (in particular to promote the inclusion of women in the system)		International Cooperation	2
CFP		Risk management (shared)			1
CFP	Financial	Battery leasing and/or renting			1
Institutional	Training	Training in design of electric PT operations and optimization of charging infrastructure (e.g. through smart charging or other logistical improvements)		TP operating companies Electric distributors INA Academy	1
Institutional	Training	Basic electrical elements for the charging infrastructure of an electric bus plant		Electric distribution companies TP operating companies INA	1
Institutional	Training	Training in daily operating practices and safety processes at electric bus sites		Electric distribution companies TP operating companies INA	1
Operator and supplier	Charging infrastructure	Verification that products offered by manufacturers are in compliance with the Electrical Code and other defined standards (UL type or national standards created by INTECO - SUCOM-SUMEL-SUCAL-POASEN).			1

Actor	Category	Measure	Timeline	Responsible Parties/Co-Partners	Total recomm's
Operator and	Charging infrastructure	Identify the real costs of charging infrastructure for Costa Rica and have an international benchmark.			1
Operator and	Charging infrastructure	Include exemptions for charging infrastructure			1
Operator and supplier	Charging infrastructure	Inclusion of the demand for electric buses in the national electricity planning, to guarantee consumption as the electrification of the fleet is developed.			1
Operator and	Charging infrastructure	Development of maintenance and contingency support plans for operating companies.			1
Operator and supplier	Training	Extending battery life through good vehicle charging practices (e.g., intelligent mobile charging systems)		INA Electricity distribution companies MINAE CFIA-CIEMI	1

solutions plus