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E-Motion Country Intervention Strategy
Costa Rica

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Abbreviations

AC	Air Conditioning
AFD	French Development Agency
ARESEP	Public Services Regulatory Authority
BAU	Business As Usual
BCIE	Central American Bank for Economic Integration
BCR	Banco de Costa Rica
BEB	Battery Electric Buses
BN	Banco Nacional
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CF	Cash Flow
CNFL	Compania Nacional de Fuerza y Luz
CTP	Public Transportation Council
EIRR	Economic Internal Rate of Return
EV	Electric Vehicle
FA	Financial Assistance
FIRR	the Financial Internal Rate of Return
GAM	Metropolitan Area of San Jose
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIZ	German International Cooperation
ICE	Costa Rican Institute of Electricity
IDB	Inter-American Development Bank
IEA	International Energy Agency
LCV	Light Commercial Vehicle
MINAE	Ministry of Environment and Energy
MOF	Ministry of Finance
MOPT	Ministry of Public Works and Transport
NDC	Nationally Determined Contribution
OEM	Original Equipment Manufacturer
PPP	Public-Private Partnership
PT	Public Transport
PTO	Public Transport Operator
SPV	Special Purpose Vehicle
TA	Technical Assistance
TCO	Total cost of ownership
WACC	Weighted Average Capital Cost
WTW	well-to-wheel

Contents

1. Introduction

The country intervention strategy summarizes the results of the country diagnostic and the market assessment and adds the components of proposed project interventions (investment projects and technical assistance), proposed instruments and the direct plus indirect potential impact of the program.

2. Country Diagnostic[1]

2.1. General

Costa Rica has an area of 51,100 km^2 and 5.1 million inhabitants. In 2019, the GDP per capita was 12,200 USD. The metropolitan area of San José concentrates half of the population. Costa Rica has no vehicle manufacturing or assembly industry. A large number of people work currently in small garages for vehicle repair and maintenance. EVs require less maintenance and repairs due to having less moving parts thus less jobs will be available in this area. The major positive job impact of EVs is an induced impact: savings of consumers on petrol and maintenance result in increased spending on goods with a high income elasticity which tend to be labour intensive service-goods. The major macro-economic advantage of the country for deploying EVs will however be to spend less on the import of fossil fuels and to be less exposed to external fuel price shocks. With an increasing share of EVs the fossil fuel tax will erode and will need to be replaced with another tax base.

2.2. Climate and Energy Policies

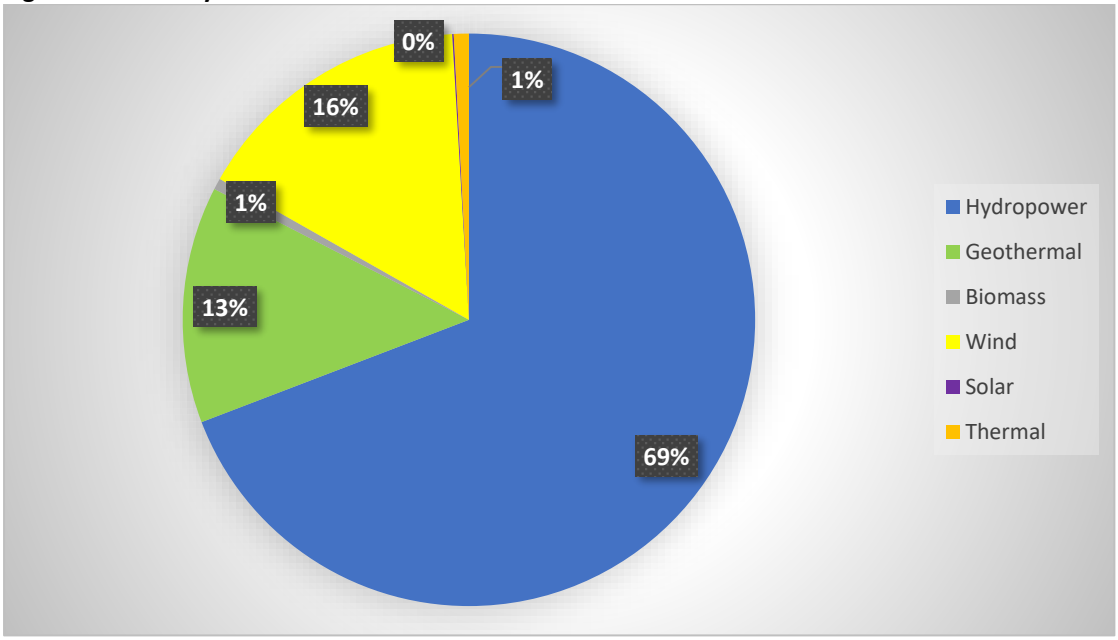
Costa Rica has a long tradition in being on the forefront of combating climate change. In its Nationally Determined Contribution (NDC), Costa Rica reaffirmed its aspiration of becoming a Carbon Neutral economy and aims for a decarbonized economy with net-zero emissions in 2050. Total GHG emissions of the country are estimated at 10.9 million tCO_{2e} in 2019 with land transport being responsible for more than 50% of total GHG emissions. Emissions under a Business as Usual (BAU) scenario are expected to increase by 45% by 2050. The updated NDC of Costa Rica includes as targets net emissions of 9.1 $MtCO_{2e}$ by 2030 (commensurate with a 2 degree scenario) and holds on to the net zero target by 2050. Greening the transportation sector is key to achieving these targets. Electrifying mobility is considered as essential and a national priority.

The updated NDC has concrete 2030 electric mobility targets for public transport, passenger cars and fleets (8% of the vehicle stock). For other vehicle areas e.g. motorcycles targets and measures shall be developed to migrate towards EVs. Costa Rica has also developed a national plan for electric transport which includes concrete steps towards electrification of vehicles and has approved 2018 the law on incentives and promotion of electric transportation which includes targets for EV penetration, the establishment of a public charging infrastructure as well as important tax incentives for private EVs. Costa Rica has therefore already various not always consistent policies, regulations and development plans (e.g. in terms of targets of EVs) important for the promotion of EVs. End 2020 some 3,100 EVs are circulating of which 1,300 cars and 600 motorcycles with the rest being “others” such as golf carts. While an increase in EVs can be observed, the percentages compared to total vehicle imports are still very low.

[1] See Report Grutter Consulting, 2020, Country Diagnostic Costa Rica for further details

Electricity is produced nationally with renewables, whilst 100% of fossil fuels need to be imported. In 2019 the fuel bill was equivalent to 10.2% of the goods imported. Costa Rica has produced in the last 5 years consistently more than 99% of electricity based on renewables (around 70% hydropower and 15% each geothermal and wind). Projections estimate that the share of renewables will remain constant at this level also in the future, with an annual increase of production by 2%. Electricity generation is sufficient to cover 100% of national demand year-round. The average projected carbon grid factor to 2030 is 0.015 $kgCO_2/kWh$. Costa Rica has a considerable renewable energy production potential not yet tapped.

Figure 1: Electricity Generation Costa Rica 2019



Source: (ICE, 2020)

2.3. Transport Sector

The vehicle fleet of Costa Rica has grown on average annually by 6% between 1980 and 2019 whilst the population has only grown by 2%. In 2019 more than 1.5 million vehicles were operating in the country including nearly 1 million passenger cars, 300,000 motorcycles, and around 200,000 light commercial vehicles. The emission standard Euro 4 is compulsory since 2018 for passenger cars and light commercial vehicles up to 3.5t and it is discussed to establish Euro 6 from 2023 onwards. Heavy duty vehicles only need to comply with annual inspections but for buses at minimum Euro III is required. The fuel quality is maximum 50ppm sulphur contents. More than 60% of vehicles circulating in the country are more than 10 years old. It is estimated that more than 50% of all vehicles circulate in the metropolitan area of San José resulting in high levels of air pollution.

Transportation emission costs modelled in this report are close to 500 MUSD for 2019 and 2030 with the cost of pollutants decreasing due to the modernization of the vehicle fleet whilst the cost of global warming emissions increases due to increased energy usage. In 2019 around 30% of these costs are due to local pollutants whilst by 2030 the share halves due to the introduction of cleaner fossil vehicles. Vehicle emission costs represents for 2019 0.7% of the countries GDP.

At the national level there are about 355 public transport operators with 5,000 buses whilst 70 operators with 2,000 buses operate in the metropolitan area of San José. There are some medium sized companies with fleets of more than 100 units whilst 45% of operators have less than 5 buses. By early 2020, 12 companies had publicly announced their intention to each acquire at least one electric bus. This plan was put on hold, given the impact on bus operators of the drop in demand due to the COVID 19 pandemic. Starting January 2021, 3 electric buses will operate within a pilot project of GIZ.

Bus operators do not receive direct operational subsidies i.e. the fare box must cover their expenditures. Indirectly subsidies are given as buses pay no import taxes and bus operators also do not pay for the infrastructure they use nor for external costs caused by their operations such as air pollution with the consequential health and environmental impacts. Buses can be used for 15 years - concessions are however only for 7 years.

In 2019, there were around 7,000 taxis registered in the country which are mostly operated in a double shift. 70% of units are gasoline powered and the rest diesel. Very few taxis are hybrids and two or three electric units circulate. The ride share market is composed of Uber and DiDi vehicles. Many Uber drivers run the vehicle based on daily or monthly renting agreements with individuals some of which own and rent out multiple vehicles.

The urban freight sector is atomized with many individuals owning a vehicle and renting services to 3rd parties. There are various companies interested in electrifying their fleet and the postal service has acquired various electric motorcycles and is testing 2 electric light commercial vehicles (LCVs). Currently there are about 143,000 LCVs in the country.

Transport GHG emissions of Costa Rica in 2019 are estimated at 6.35 million tCO_{2e}[2] based on a bottom-up transport model calibrated with top-down fuel consumption data[3]. Commercial vehicles including taxis, buses and LCVs are responsible for around 1/3rd of GHG emissions and 50% of pollutants ($PM_{2.5}$ and NO_x). GHG emission from the transport sector are expected to grow under a BAU scenario by around 30% reaching 8.1 million tCO_2 by 2030 (see table below). The target of total net emissions of 9.1 $MtCO_{2e}$ by 2030 of the NDC cannot be reached with such emission levels i.e. significant changes to the transportation sector will be required.

Table 1: Projected 2030 Transport Emissions

Vehicle category	NO_x	$PM_{2.5}$	CO_2 TTW	CO_2 WTW	Energy in TJ
Passenger car	2,589	102	3,816,949	4,626,413	54,657
Taxi	187	9	127,530	160,629	1,795
Motorcycles	1,702	19	329,812	396,704	4,759
small bus	2,376	19	225,886	290,439	3,048
standard urban bus	1,626	14	379,182	475,750	5,117
coach	741	6	128,998	162,584	1,741
LCV	4,191	203	1,635,140	2,153,184	22,426
Truck < 7.5t	197	1	38,661	48,413	522
Truck 7.5-16t	2,388	15	444,984	557,122	6,005
Truck 16-32t	2,301	14	401,921	504,053	5,424
Truck >32t	3,323	19	576,470	722,097	7,780
Total	**21,621**	**421**	**8,105,534**	**10,097,391**	**113,274**

Source: Grutter Consulting; for details of modelling data see Report 1

[2] Tank-to-wheel approach; well-to-wheel approach including Black Carbon: 8.4 $MtCO_{2e}$

[3] This is 15% more than projected by the national inventory for the same year

2.4. EV Policies and Activities

Electricity distributors are responsible for setting up the legally required minimum charging network. There are currently around 40 7.6kW chargers and 15 50kW fast chargers installed throughout the country with 28 100kW being added in this year. The law 9518 establishes that on national roads at least every 80km and on cantonal roads at least every 120km a public charging site must be established[4]. Fast chargers are basically on inter-urban roads and targeted towards private car users. No fast charging urban network exists currently which would support deployment of taxis or LCVs which operate in urban surroundings and cannot re-charge sufficiently during the night.

Costa Rica has established special electricity tariffs for e-buses and for public chargers. Basically the "special" tariff for buses is the same as the night tariff medium tension. The regulation also states that grid adjustments to allow for e-bus charging shall be prioritized by the power providers and costs are to be born by the power provider. For the charging infrastructure joint approaches between the operator and the power provider are possible.

The following table summarizes enabling factors and barriers towards the deployment of commercial EVs in Costa Rica.

Table 2: Enabling Factors and Barriers to Commercial EVs in Costa Rica

Enabling factors	E-mobility is a topic since many years in Costa Rica. The Government has issued important laws and regulations as well as national development plans containing EV targets, incentives and support structures. This has also resulted in some 3,000 EVs operating by 2020 including also a pilot of e-buses (3 units) and some LCVs and taxis. Public charging infrastructure (primarily for passenger cars) is being established and electricity prices for public charging as well as e-buses have been fixed. Costa Rica produces close to 100% of electricity based on renewables and has sufficient additional production capacity. Commercial EV deployment would not affect peak demand times. Fossil fuel on the other hand is 100% imported and creates a considerable financial burden to the economy.
Barriers	Lack of experience and know-how on creating for commercials EVs an enabling surrounding including regulations (e.g. concession contracts), business models and financial support policies which enable their massive uptake. Commercial EVs are perceived to lack profitability and have much higher upfront costs. The financial system has limited appetite for entering this market as it is not deemed to be profitable. For taxi and LCV deployment an urban public fast charging infrastructure is required. This is not yet available making operations of such vehicles problematic. Lack of significant financial support for the purchase or operations of commercial EVs. Kick-starting EV deployment in this area without concessional finance and subsidies covering part of the incremental investment will not be possible.

Costa Rica has very good enabling conditions for the promotion of e-mobility and considers this as a national priority. Many important steps have already been taken. The focus and the incentives provided are however to the moment primarily targeted towards private vehicles. Whilst it is well understood that commercial EVs are very important, the barriers in terms of regulations (e.g., concession contracts), profitability, business models, lack of tangible incentives and implementation risks continue to exist thus hampering EV deployment.

[4] This target has been achieved as of end 2020; see report 1 table 2

3. Actor Mapping

As the state's governing body in charge of regulating and controlling transportation, the **Ministry of Public Works and Transport (MOPT)** plays a central role regarding urban mobility. It also supervises other transportation related councils such as CONAVI (National Road Council), CNC (National Concessions Council), COSEVI (Road Safety Council) and the CTP (Public Transport Council). Within the MOPT is the Directorate of Sectoral Planning, with which studies have been coordinated for the optimization of public transport routes. Regarding electric transport, MOPT has not yet created guidelines or policies.

The **Public Transportation Council (CTP)**, overseen by MOPT, is in charge of assigning Bus routes via concessions of 7 years to public bus operators, and supervises its service delivery. In addition, it grants operating permits for buses of special services and taxis. The location of bus and taxi stops are also part of CTPs responsibilities. CTP has been actively involved in electric mobility regarding longer concessions periods for e-buses. No official pronunciation has yet been achieved, and due to this year concession awarding and COVID19 complications, its further interest might wane.

The **Public Services Regulatory Authority (ARESEP)** is responsible for the definition of prices, rates, and fees for public services. It also ensures compliance with the quality, reliability and environmental standards of public services. To determine better the demand and thus the profitability of routes, electronic payments shall be implemented in the following concessions renewals. In the past two year, it has defined the electricity price for e-buses and the charging fee at public chargers.

The **Instituto Costarricense de Electricidad (ICE**) is the country's biggest generator and distributor of electricity. It is a state-owned enterprise that has been providing electricity (mainly with hydropower) and distributing it all over the country for almost 80 years. ICE has its own E-Mobility strategy and has positioned itself as a strong ally for Costa Rica's decarbonization plan. They have installed over 40 EV charging stations (eight 50 kW chargers, known as fast chargers) and own the three electric buses donated by the German Government. Two of these buses are currently operating as a pilot project in different public transport routes. The other bus remains as a backup and serves ICE for capacity building. [5] They also own a fleet of 100 Hyunay Ioniq as company cars.

The **Compañía Nacional de Fuerza y Luz (CNFL)** is a sister Enterprise of ICE and distributes electricity in the GAM. The other distributors in urban areas are ESPH (in Heredia) and JASEC (in Cartago). COOPEGUANACASTE, COOPEALFARORUIZ, COOPELESCA and COOPESANTOS distribute electricity they buy from ICE in rural areas and many of them also have their own renewable energy production sites.

ICE and other electricity distributors are responsible for setting up the legally required minimum charging network. Art. 31 of the law 9518 establishes that energy distribution companies must install every 80km on national roads and every 120km on cantonal roads public chargers. Art IX of the Regulation 41642-MINAE regulating the construction and operation of a charging network by power distribution companies, states that it is the obligation of public service companies to establish the charging infrastructure even if this is not profitable. The regulation 41642-MINAE of 04/2019 obliges the power companies to establish at minimum the following quantity of public chargers:

- 9 in the urban area of San Jose (responsible: CNFL)
- 38 outside the urban area of San Jose (by ICE, COOPEGUANCASTE, COOPEALFARORUIZ, COOPELESCA, COOPESANTOS, JASEC, ESPH)

[5] https://www.siicecr.org/cms/images/conferenciasdia12018/ElectromovilidadICE5.pdf

The official leadership in electric mobility lays with the **Ministry of Environment and Energy (MINAE)**, its relevant duty is to promote projects that aim for the country's carbon-neutral goal. It is the governing body for the regulation for vehicle emissions. MINAE has, through various cooperation project, in close coordination with the MOPT, financed studies that guide the country towards sustainable mobility.

The **Ministry of Finance (MOF)** is the entity in charge of exempting imported electric vehicles from taxes. This exemption does not include all electric vehicles. It still needs to expand towards e-buses procured by a third party that is not an operator.

Public transport services are exclusively formal and carried out by a total of 355 private **Bus operators and Associations.** At the national level there are about 355 operators, and for the GAM around 70. There are 11 medium size companies with more than 90 units, and 45% of all operators have less than 5 units. The largest bus transport associations are CANATRANS and CANABUS. In early 2020, 12 companies might have acquired one e-bus each, if not by the impact of COVID19[6]. For the procurement of buses, these operators have access to loans. However, the limit of 7 year for concessions caps out the maximum loanable credit, and thus banks have not enough guarantee for the acquisition of e.g. an e-bus. This limitation has been recognized. The bus concessions will be renewed in September and the MOPT has presented a Proyecto to the parliament to extend all concessions for a period of 15 years in order to encourage bus companies to buy electric buses in compliance with the Law for the Promotion of E-Mobility. [7]

Ride-Hailing Services like UBER and DiDi operate in a legal grey zone. Their statistics and professionality of the services are officially unknow, yet they are very popular due to being significantly cheaper than Taxis. The regulated tariff for **Taxis**, is the reason for this disadvantage. ARESPE manages the renewal of taxi licenses every 10 years.

Lastly **Municipalities**, of which there are 31 in the GAM, have a diminished role in the public transportation. They are responsible for the waste collection and the cleaning of sidewalks and streets. These special vehicles (garbage and cleaning trucks) have a great potential to be electrified that has not yet sufficiently been explored.

Through the project MiTransporte, financed by the German Ministry of Environment, **GIZ** has been working together with the Costa-Rican government, as well as with private actors, to implement measures that reduce CO_2 Emissions in the country. Project advisory services are realized to the Costa Rican Government on (i) developing the necessary policies and regulations to improve public and private transport and freight transport services; (ii) the municipalities and local authorities on taking measures for improving urban mobility in the San José metropolitan area; (iii) on the electrification of local public transport; and (iv) on actively involving the public in the transition process and communicating Costa Rica's experiences at national, regional and international levels." Furthermore, GIZ implements a project in cooperation with the private sector that aims at creating the conditions for a circular economy of batteries from electric vehicles. Within the project the company FORTECH plans to install a battery recycling plant, and plans to establish a collection system for lithium batteries.

[6] LUMACA, TUASA, Pulmitan, TRANSVI, Auotransportes, Transportes 205, Guapilenos, ALRED, Tapachula, Tracasa, Contrasuli, Transtusa (Costa Rica amplía plan piloto de buses eléctricos como parte de la modernización del transporte público – Presidencia de la República de Costa Rica)

[7] https://www.crhoy.com/nacionales/gobierno-daria-concesiones-a-autobuseros-por-15-anos-para-encaminar-descarbonizacion/

Training capacities shall be developed and regulatory adjustments shall be prepared together with the corresponding institutions.

UN Environment has been implementing a series of regional projects that focus on capacity development in e-mobility. Through their platform "Move", funded by the European Union, they have imparted several webinars on various topics, as well as exchanges between different countries. This initiative also gives a yearly overview about recent developments regarding e-mobility in every country in Latin America. [8]

The **CRUSA Foundation** actively supports the adoption of environmentally friendly public transport models by aiding the design of public policies, legal mechanisms and financial instruments. Currently they are financing UN Environment on the implementation of the pilot e-bus project and are actively involved in the committee.

The **Inter-American Development Bank (IDB)** has been a strategic ally in the transition towards e-mobility. They financed ICEs 100 Hyundai Ioniq, and the fast-charging network being established by ICE. The Bank has also contracted some studies on business models for e-buses, and tariffs for charging among other. IDB is willing to grant technical assistance in 2021 for the MOPT, in order to achieve changes to concession contracts. IDB is also supporting MOPT in the public transport reorganization in line with Plan Nacional de Decarbonzacion.

The **Central American Bank for Economic Integration (BCIE)** supports the Costa Rican government with technical assistance. The regional program for electric mobility (PRELEC), was meant to start this year. However, it has been undergoing some changes in order to make it more comprehensive and to include more countries. The program is on sustainable urban mobility and is currently in process of selecting a consulting firm to develop sustainable mobility plans in Central America.

The **Agence Française de Développement (AFD)** is supporting the Costa Rica Government through a 140m Euro Policy Based Loan (PBL), along with IDB, to support the Plan Nacional de Decarbonicasion (PND) and the National Electric Mobility Plan (PNTE). AFD is also mobilizing a grant for a PBL cooperation program which intends to focus on Monitoring, Reporting and Verification (MRV), e-batteries roadmap elaboration, air quality and potentially complementary support to MOPT in line with the PND. Beyond that, AFD approved in December 2020 a EUR 56m loan to Banco Nacional de Costa Rica (BNCR) to support its climate change portfolio including its actions on e-mobility, and is managing a EU 3m grant including EUR 750,000 dedicated to electric mobility to support via BNCR or directly transport operators which are interested in entering the e-mobility business.

4. EV Deployment Scenarios

4 different EV scenarios have been constructed:

- EV15@30: The moderate EV scenario is based on the "EV new policies scenario" which has as target for 2030 15% instead of 30% EV share. The same approach is used as for EV30@30.
- EV30@30: The EV30@30 scenario of IEA has as target that 30% of all vehicles sold in 2030 are electric. The scenario is built on newly purchased vehicles (and not the stock of vehicles) in line with IEA scenarios (IEA, 2019). In addition to the IEA also motorcycles and trucks <7.5t are included with the same EV penetration rates.

[8] https://movelatam.org/

- EV scenario based on targets of Costa Rica: The targets are derived from the updated NDC. The NDC has as target 8% of the passenger cars and public transport vehicle stock in 2030 to be electric. The MINAE 2019 plan has as target that 10% of new taxi concessions are for electric vehicles. This is equivalent to asking for 10% of replaced taxis to be electric (Art. 3.1.3.4 page 108). For all other vehicle categories no explicit targets are formulated.
- EV "high growth" scenario focusing on the potential for commercial vehicles targeted by the E-Motion Program with an EV target of 100% of new registered vehicles for these categories by 2030. The "high growth scenario" shows what would be required to achieve the targets as set by the Paris declaration on e-mobility. In all other vehicle categories the maximum of the 3 other scenarios has been chosen.

The following table shows the results in terms of GHG reduction against the BAU scenario of no EVs as well as the additional electricity consumption due to EVs with the different scenarios.

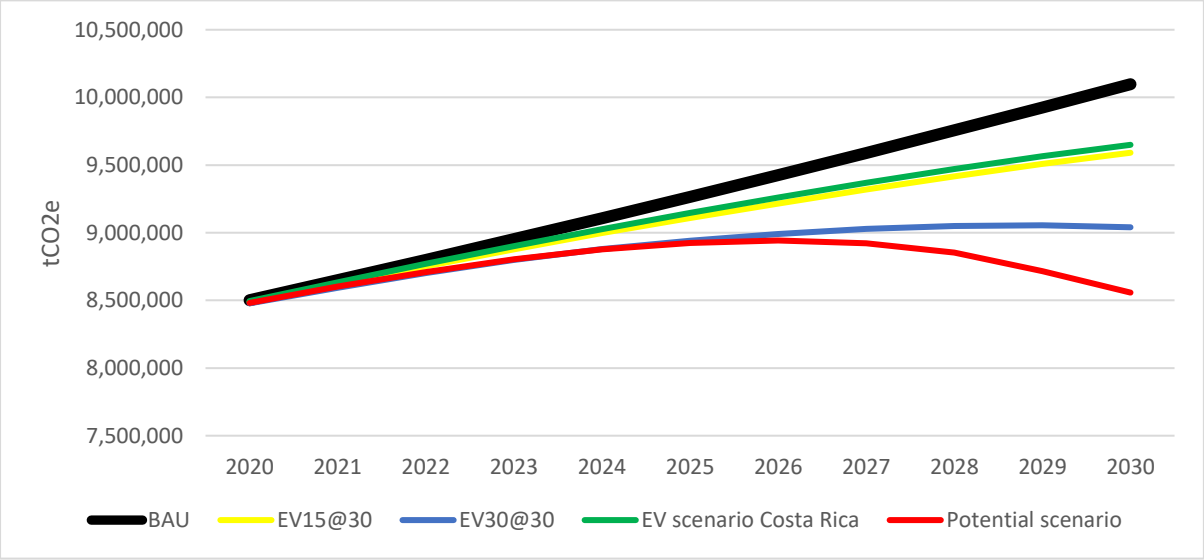
Table 3: Scenario Results

Impact	Scenario	By 2025	By 2030
GHG reduction WTW in tCO_{2e} per annum	IEA 15@30	157,000	507,000
	IEA30@30	325,000	1,057,000
	Costa Rica scenario	119,000	448,000
	"Potential" scenario	341,000	1,540,000
Electricity demand of EVs in GWh per annum	IEA 15@30	126	407
	IEA30@30	260	846
	Costa Rica scenario	104	390
	"Potential" scenario	305	1,335

Source: Grutter Consulting, see Report 1 for further details

The figure below shows the slow reaction of GHG emission reductions of the sector due to long permanence of vehicles once purchased. The introduction of EVs takes a long time to reduce in absolute terms GHG emissions of the transport sector as vehicle growth still occurs and as vehicle replacement rates are relatively low i.e. it takes time to achieve a large stock and therefore large impact of EVs. This highlights the importance of early actions. Waiting 5-10 years more until the market has evolved without support will result in a 5-10-year time lag of GHG reductions and thus non-attainment of climate targets.

Figure 2: Projected GHG Transport Emissions Costs Rica BAU with no EVs and with EV Scenarios (WTW)



Source: Grutter Consulting

The 2030 projected electricity demand of EVs represents 3% of same year electricity generation for the EV scenario using national targets and 9% for the highest growth scenario. The renewable energy potential of the country is 400% higher than the current production level i.e. an increase of 9% would not face any technical difficulties to be met 100% by renewables. The electricity demand increase resulting from EVs is very gradual and thus leaves enough time to the country to plan a potential production expansion.

The power system has a peak at midday and early evening managed with differential pricing. Fast as well as overnight charged e-buses can avoid charging during these peaks. Taxi fast charging could be managed through differential prices for charging at peaks, as already done in Costa Rica. Passenger cars and LCVs are basically charged overnight which minimises the need for incremental electricity generation capacity and investment in distribution infrastructure upgrades. Plugging EVs to the grid too early in the evening may however result in this additional demand coinciding with the evening peak electricity demand resulting in a higher risk of overloading of the power distribution network. This can however be managed with appropriate regulations or incentives of the grid manager.

5. Market Analysis[9]

5.1. Current EV Market and Finance Conditions

As of end 2020 less than 5 e-buses, less than 5 electric Light Commercial Vehicles (LCVs) and less than 5 electric taxis are circulating in Costa Rica. A pilot project for e-buses is being realized with GIZ (3 buses should start operations early 2021) and the postal system is testing 2 electric LCVs.

A special credit line for electric vehicles including specifically commercial units started operations in October 2020 with disbursements through the Banco Nacional (BN), the Banco Popular and the Banco de Costa Rica (BCR). Conditions vary between banks and are fixed also per project and credit subject. The offer of Banco Popular[10] (comparable for BN and BCR) for commercial EVs is currently:

- Loans in national currency or USD;
- USD interest rate is prime rate USA plus 2.5% - this equals to around 7%[11];
- Commission of maximum 1.5%;
- Tenor up to 10 years (in practice however loans are in accordance with each business and income streams e.g. as concession contracts for buses are for 7 years loan tenors are for maximum 7 years; for taxis BCR finances only for up to 5 years);
- Maximum 80% of vehicle investment (chargers or bus depot upgrades are not included).

Whilst banks have been quite successful in financing private EVs (which are basically upper-class vehicles; e.g. the Audi e-tron has been one of the most sold EVs in Costa Rica), the demand for commercial EV financing has been limited (involved banks have not yet financed any commercial EVs)[12].

[9] See also for further details Grutter Consulting, 2021, Assessment of Commercial EV Demand in Costa Rica
[10] Vehículos eficientes -Créditos Verdes | Banco Promerica Costa Rica
[11] BN fixes the interest rate at 7% for the initial 2 years and then applies a base-rate plus spread. BCR uses as reference rate LIBOR.
[12] See chapters 4 and 5 for reasons

5.2. Current Commercial EV Financial Viability

5.2.1. Introduction

The financial assessment is made per vehicle type with local data. Following parameters are assessed:

- Total cost of ownership (TCO) per kilometre comparing the fossil with the electric unit: The TCO is calculated in financial and economic terms; values are not discounted for the TCO;
- Incremental upfront capital investment required and incremental equity capital required with current financing schemes;
- Profitability of investing in an EV instead of a fossil vehicle by calculating the Financial Internal Rate of Return (FIRR) and the Economic Internal Rate of Return (EIRR) of the incremental capital expenditure: the FIRR is compared to the Weighted Average Capital Cost (WACC) for the EVs calculated at 6.9% and for fossil vehicles at 7.5%[13];
- Differential cash flow;
- Discounted payback time of differential investment (using the WACC as discount rate).

The financial analysis is a comparison of investment options. It does not assess the financial viability of operating the specific vehicle (as example in public transport diesel buses could be operating at a loss and e-buses could continue to be operated at a loss) nor the financial soundness and creditworthiness of an enterprise. For latter other factors need to be contemplated such as revenues, debt and equity levels etc. The financial analysis is a comparison of investing pari passu in electric instead of fossil units. All calculations are performed in constant real 2020 USD.

5.2.2. Electric Buses

The following table summarizes the financial assessment of BEBs (fast as well as overnight charged BEBs were assessed). The standard bus considered in the analysis is a 12m urban bus with AC. To comply with operating conditions in Costa Rica an overnight charged bus would require a battery set of 350 kWh whilst a fast-charged unit could be equipped with a 250 kWh battery set and 300 kW chargers (on average 1 per 8 buses)[14].

Table 4: Summary Financial Assessment 12m BEBs Costa Rica

Criteria	Result	Assessment
TCO	0.64 – 0.67 USD/km for BEBs versus 0.73 USD/km for diesel Euro IV bus[15]	Non-discounted the cumulated lifetime costs for BEBs are lower than for diesel buses.
Capital investment	280-310,000 USD for BEB[16]; 110,000 for diesel bus	Significantly higher capital requirement incl. higher loan demand; negative impact on debt to equity ratio
Equity investment	90-100,000 for BEB[17] versus 20,000 for diesel bus	Significantly higher equity demand which might overstretch the capabilities of small and medium enterprises
Profitability[18]	FIRR of 5-7%	Investment in e-buses is not profitable.

[13] The WACC is different due to differential loan terms; see report 2 for details of calculations
[14] For details see report 2
[15] TCO includes only CAPEX (including battery replacement; including bus, charging infrastructure, grid connection, bus depot upgrades), energy, maintenance, and financial cost but not driver or mgmt. Overhead. Calculated for 16-year lifespan.
[16] Includes bus, charging infrastructure, grid connection, bus depot upgrades
[17] Banks only finance 80% of BEB but not of charging infrastructure, grid connection and depot upgrades due to not being collateral
[18] FIRR of incremental investment compared to diesel bus

Discounted Payback	Incremental investment is not recovered with savings during asset lifetime (16yrs)	The investment in e-buses is not profitable and the payback time is extremely long, even going beyond the asset lifetime. This indicates a high risk profile of the investment.
Cash Flow (CF)	Negative cumulative CF until year 14	The investment in BEBs will affect the liquidity position of the companies in a negative manner and will affect negatively the solvency ratio and at least for the loan period the working capital ratio. Only from the year 10 onwards a stream of positive CF (compared to diesel buses) sets in to compensate for invested equity.

Source: Grutter Consulting, 2021, Assessment of Commercial EV Demand in Costa Rica: see Annex 3 for details including assumptions

The investment in BEBs with the current financial conditions and business models is not profitable, a high risk, requires a significant increase in owners capital and results in potentially serious liquidity problems. The TCO does give the indication that e-buses are potentially an interesting alternative. However, BEBs will require a different financial structuring and financial incentives to be a viable business proposal in Costa Rica.

5.2.3. Electric Taxis

The following table summarizes the financial assessment of e-taxis. The comparison is based on a Hyunday Accent with gasoline engine (most used taxi in Costa Rica) versus Nissan Leaf or BAIC e-taxi with a 60kWh battery set.

Table 5: Summary Financial Assessment E-Taxis Costa Rica

Criteria	Result	Assessment
TCO[19]	0.23 USD/km for e-taxis versus 0.27 USD for gasoline unit	Non-discounted the cumulated lifetime costs for e-taxis are lower than for gasoline units.
Capital investment	32,000 USD for e-taxi versus 13,000 USD for gasoline unit	Significantly higher capital requirement incl. higher loan demand
Equity investment	6,500 USD for e-taxi versus 2,500 USD for gasoline unit	Significantly higher equity demand which might overstretch the capabilities of taxi owners
Profitability[20]	FIRR of 24%	Investment in e-taxis is profitable.
Discounted Payback	Incremental investment is recovered in year 7 with savings	The payback time is long. This indicates a high risk profile of the investment.
Cash Flow	Negative cumulative CF until year 6	The investment in e-taxis will affect the liquidity position of the taxi owner in a negative manner and will affect negatively the solvency ratio and at least for the loan period the working capital ratio.

Source: Grutter Consulting, 2021, Assessment of Commercial EV Demand in Costa Rica; see Annex 3 for details including assumptions

The investment in e-taxis with current financial conditions and business models is profitable but with a considerable risk and higher owner capital requirements. One of the major risks is that revenues will be lower when using an e-taxi. Taxis are often driven with 2 shifts especially during weekends (Friday to Sunday) or on special days with double shifts or 24 hours as this is the most profitable period. During such days the driving range of the e-taxi will be insufficient without re-charging. Home-charging takes 6-8 hours and is too slow. Also public chargers available are in general too slow (most public chargers available in Costa Rica are 7-14 kW chargers). A fast-charging urban network of 100-150kW chargers

[19] Includes CAPEX, energy, maintenance and finance costs; does not include other costs such as the driver which are independent of the technology chosen

[20] FIRR of incremental investment compared to gasoline taxi

is a necessity to ensure that e-taxi owners do not lose a significant part of their revenues. Therefore currently e-taxis cannot be considered a financially viable investment except for special cases such as luxury taxis or low-mileage units with very regular schedules.

5.2.4. Electric LCVs

The following table summarizes the financial assessment of e-LCVs. The comparison is based on a Suzuki APV gasoline version as used commonly e.g. by delivery companies versus a Maxus E-Deliver, short wheel base with the smaller battery set of 35 kWh which is sufficient due to relatively low daily mileage of LCVs in urban settings.

Table 6: Summary Financial Assessment e-LCVs Costa Rica

Criteria	Result	Assessment
TCO[21]	0.22 USD/km for e-LCVs versus 0.23 USD/km for gasoline unit	Non-discounted the cumulated lifetime costs for e-LCVs is marginally lower than for gasoline units
Capital investment	33,000 USD for e-LCV versus 25,000 USD for gasoline unit	Slightly higher capital requirement incl. higher loan demand
Equity investment	6,500 USD for e-LCV versus 5,000 USD for gasoline unit	Slightly higher equity demand
Profitability[22]	FIRR of 12%	Investment in e-LCVs is profitable
Discounted Payback	Incremental investment is recovered in year 11 with savings	The payback time is very long. This indicates a high risk profile of the investment.
Cash Flow	Positive from year 4	The investment in e-LCVs has no large negative liquidity impact in initial years

Source: Grutter Consulting, 2021, Assessment of Commercial EV Demand in Costa Rica; see Annex 3 for details including assumptions

The investment in e-LCVs with current financial conditions and business models is profitable but with a high risk and a very long payback time. Also electric LCVs are not common in the market and are not offered by vehicle suppliers in Costa Rica. Also the information and know-how on electric LCVs is very limited of vehicle operators.

5.3. Sensitivity of Commercial EVs to Change of Finance Conditions

5.3.1. Introduction

Variations have been conducted by using concessional loan conditions and investment subsidies to assess their impact on the core financial parameters. The following table lists the base assumptions used for calculations. All values are tentative used as modelling assumptions. Project specific conditions will depend on a variety of factors such as risk rate or borrower status.

Table 7: Assumed Concessional Conditions for USD Loan

Parameter	Value	Source
GCF loan conditions	1.25% (0.75% interest rate + 0.5% service fee)	GCF conditions public sector non-vulnerable countries; GCF/B09/08
AFD loan conditions non-sovereign public sector	5.7%	AFD
Assumed shares	30% GCF and 70% AFD	
Bank spread for on-lending	1.5%	Assumed

[21] Includes CAPEX, energy, maintenance and finance costs; does not include other costs such as the driver which are independent of the technology chosen

[22] FIRR of incremental investment compared to gasoline LCV

Resultant minimum loan rate for buses if based on project finance with public lender e.g. municipality	4.4%	Calculated based on above data
Resultant minimum loan rate for LCVs and taxis based on lending through public banks	5.9%	
Lending rates for buses, LCVs and taxis	80% maximum	
Loan tenure	12 years buses 8 years taxis 10 years LCVs	

5.3.2. E-Buses

Concessional finance would result in an interest rate of 4.4% instead of 7%. The level of concessionallity would be dependent if the recipient is a public body e.g. municipality or public bank. The loan tenure would also increase to 12 years. An 80% lending rate on the total CAPEX is also assumed. Following impacts can be observed:

1. The TCO remains constant. The slightly higher cost with concessional finance is due to having higher total finance costs (higher lending rate, plus lending over total CAPEX) plus longer tenure.
2. The concessional loan does not change the FIRR by logic (the FIRR is calculated without financial costs). However, it lowers the benchmark value (WACC) and both types of BEBs now have a FIRR above the benchmark i.e. the investment in BEBs can be considered profitable versus diesel buses – however, with a marginal difference.
3. Owners capital requirements are reduced with the concessional loan (due to not only financing the bus but all investment components). Owners capital is however still 150-180% above the amount required for diesel buses.
4. The risk and the capital exposure of the entrepreneur can be reduced but the risk profile is still negative. The dynamic payback is only after 16 years which is far too long.
5. The liquidity situation is improved. A partially negative CF is however still present in the period years 8-14 due to investments in replacement batteries and new chargers.

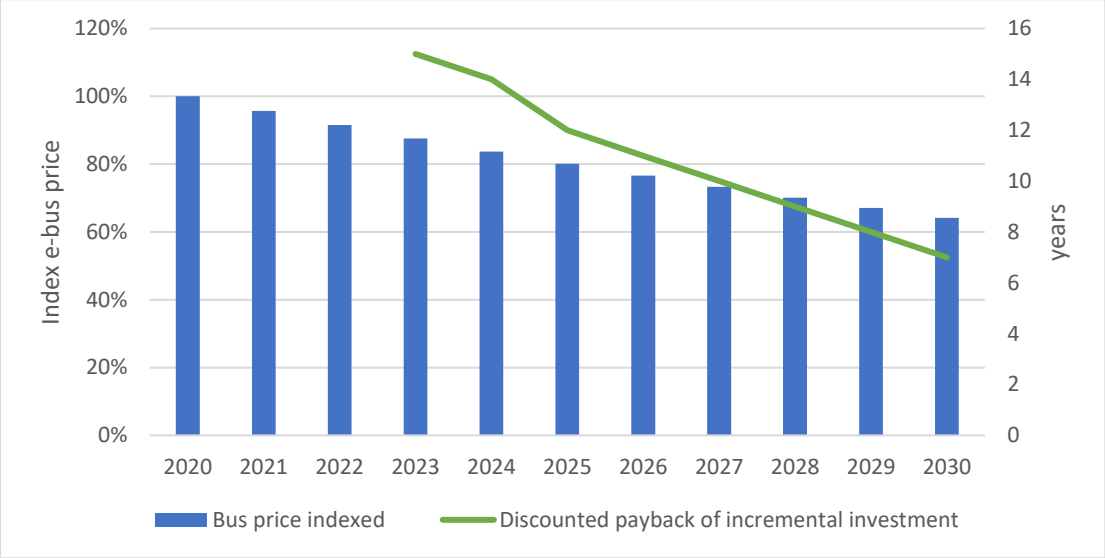
It can be concluded that the concessional loan basically helps to resolve the liquidity issues and results in a marginal improvement of the investment profitability but investment risks remain high with an unsatisfactory payback time. It is clear that concessional loan conditions are not sufficient to tilt an investors decision with the current risk profile of BEBs in the country.

An upfront grant of 20% on the total initial investment combined with concessional finance is modelled. The upfront grant would be 55,000-60,000 UD per e-bus. Following impacts can be observed:

1. The TCO reduces slightly thus making e-buses more competitive to diesel units.
2. The FIRR more than doubles from 6% to 14% i.e. the investment is now profitable.
3. Owners capital requirements are reduced although still double compared to purchasing diesel units.
4. The risk and the capital exposure of the entrepreneur is reduced. The dynamic payback is with minimum 9 years still long and still beyond the current concession period of 7 years.
5. The liquidity situation is massively improved. The cumulative cash outflow is from year 2 onwards lower with e-buses than with diesel units.

It can be concluded that the grant resolves to a large extent the profitability and risk issue. The payback period is still relatively long and longer than the concession contract. These conditions can be considered a minimum to interest investors to participate. The following graph shows how under decreasing e-bus costs the dynamic payback will also reduce (see chapter 5.4. for expected BAU deployment in absence of the Program).

Figure 3: Dynamic Payback versus Projected BEB Price Decrease



Source: Grutter Consulting; annual decrease of BEB projected at 4% based on decreasing battery price projections of BNEF[23]

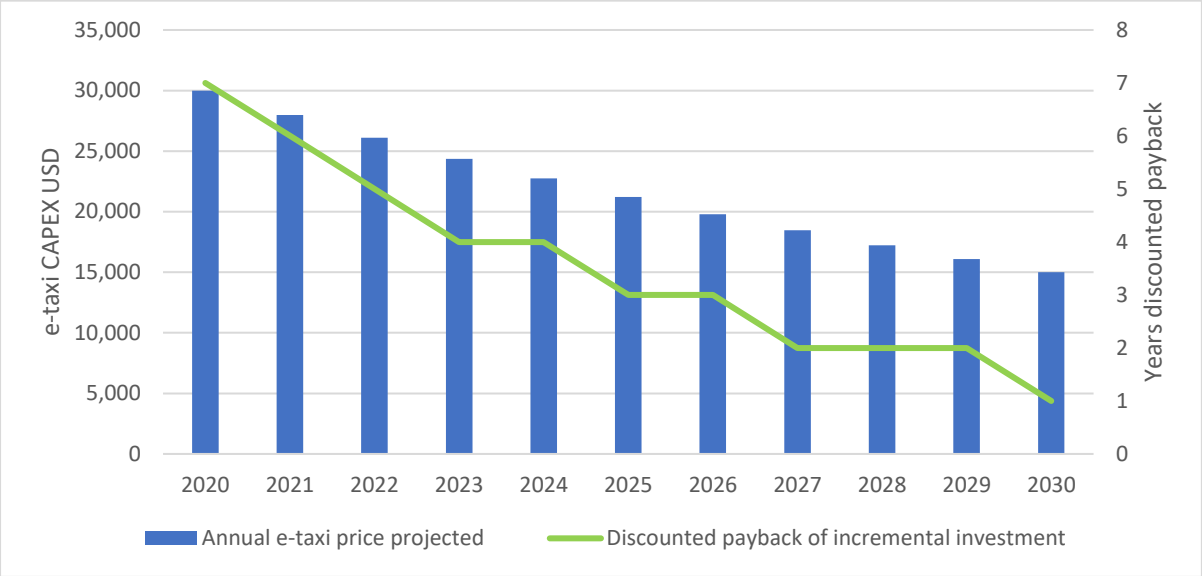
5.3.3. E-Taxis

For taxis the assumption is that a fast charging infrastructure would be established to eliminate the barrier of reduced revenues. The charging infrastructure would be managed by a 3rd party (e.g. ICE) and would be partially grant and concessional loan financed (see chapter 6 for a possible project). Taxis would thus just pay the (fixed) price for public chargers. Taxis are privately owned and managed. The assumed business model goes through loans managed by public banks (idem to the current loan structure) which would receive the concessional conditions of the Program. The on-lending interest rate would however only drop from currently 7% to 5.9% i.e. a relatively small change, which questions the usefulness of establishing a loan facility. This is due to the high lending rate of 5.7% of AFD. The main impact of the concessional loan is that the dynamic payback time is reduced slightly and that the CF would be positive from year 1. Whilst this is interesting from a liquidity perspective the core issue will remain to realize a fast-charging network.

The figure below shows the trend of decreasing dynamic paybacks of e-taxis. Clearly with decreasing prices they get more attractive. However, the graph below does not take into account the reduced revenues but only cost impacts i.e. as long as the charging issue is not resolved the investment in e-taxis remains commercially a risky undertaking.

[23] https://www.sustainable-bus.com/news/electric-vehicle-outlook-2020-bnef-electric-buses/#:~:text=With%20regards%20to%20electric%20bus,needed%20to%20keep%20prices%20falling%C2%BB.&text=But%20by%202030%20demand%20grows%20almost%2014%2Dfold%20to%201%2C755GWh.

Figure 4: Dynamic Payback versus Projected e-Taxi Price Decrease



Source: Grutter Consulting; annual decrease of e-taxis projected at 4% based on price parity expected by 2030 (see Electric vehicle trends | Deloitte Insights)

5.3.4. E-LCVs

LCVs are privately owned and managed. The assumed business model geos through loans managed by public banks (idem to the current loan structure) which would receive the concessional conditions of the Program. The on-lending interest rate would however only drop from currently 7% to 5.9% idem to taxis. The main impact of the concessional loan is that the dynamic payback time is reduced from 11 to 6 years which is significant.

5.4. BAU versus Project EV Market Deployment

5.4.1. Approach

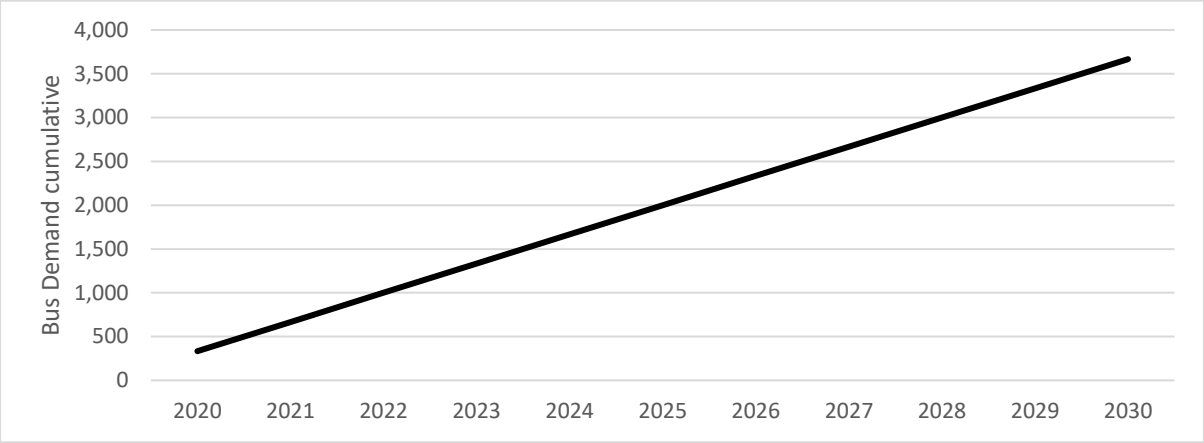
Under a BAU scenario EVs will pick up without commercial support. The question is when and how much. The following chapters will model the BAU deployment expected for the different commercial EV technologies due to decreasing EV prices and therefore increasing financial profitability of latter and the scenario of commercial EV deployment with program activities. This allows to model the with and without program scenario and the potential impact of the program beyond the singular fleet investments.

5.4.2. E-Buses

Market Demand for Urban Buses

The initial graph shows the total projected cumulative demand for urban buses in Costa Rica based on vehicle replacement and market growth rates.

Figure 5: Total Projected Cumulative Market Demand Urban Buses Costa Rica



Source: Grutter Consulting (see report 1)

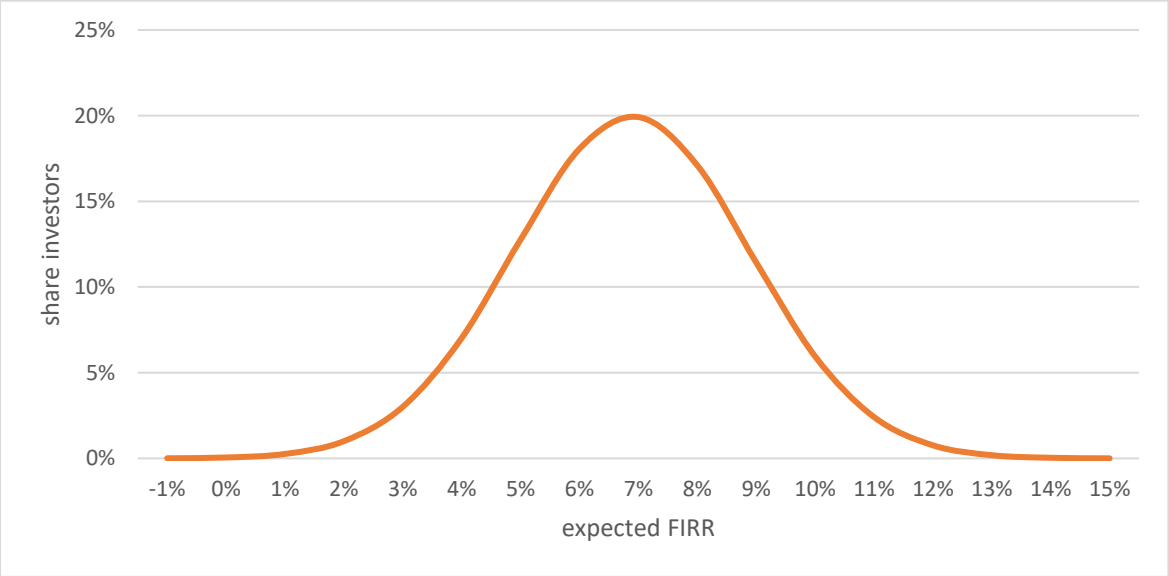
Projected BAU Demand for E-Buses

The BAU e-bus demand is based on comparing the FIRR with the WACC taking the decision rule that the investment is realized if the FIRR is higher than the WACC. The required WACC is adjusted for a risk rate based on being a new technology using the following criteria:

- Performance risk of BEBs with higher than expected energy costs (due to increasing electricity prices, more charging during high cost periods and/or higher than expected energy consumption of buses). The medium risk rate is modelled around 40%.
- Performance risk of e-bus maintenance costs. Whilst e-buses do require less maintenance of liquids and engine, their tyre usage is higher and spare parts are more expensive. Also maintenance savings might not materialize except for large fleets as only latter will allow for re-structuring the maintenance department and reducing for example workforce in this area. The medium risk rate is modelled around BEBs having equal maintenance costs as diesel units (observed by multiple smaller Chinese operators).
- Risk of battery costs not decreasing as fast as expected. Whilst the standard model assumes battery prices to decrease by 50% the risk-model assumes a decrease of on average only 10%. This is also based on the fact that cell prices are decreasing fast but battery package prices not as much. Also, BEBs might require new battery management systems with an additional investment in 8 years.
- The lifespan is assumed to be for diesel as well as for e-buses 15 years (instead of 16 years for e-buses). The impact of this factor is small.

Not all investors have the same risk appetite. The modelling assumes normal distributed risk propensities i.e. we have the same share of persons being risk averse and risk takers. The risk propensity distribution is used to calculate a normal distribution of risk factors, which is added to the WACC and allows to determine for each year the share of investors which are willing to invest at e-buses at the given CAPEX of that year. The figure below shows the assumed distribution of investors based on a normal distribution of investors around the base risk-free WACC of 6.9%.

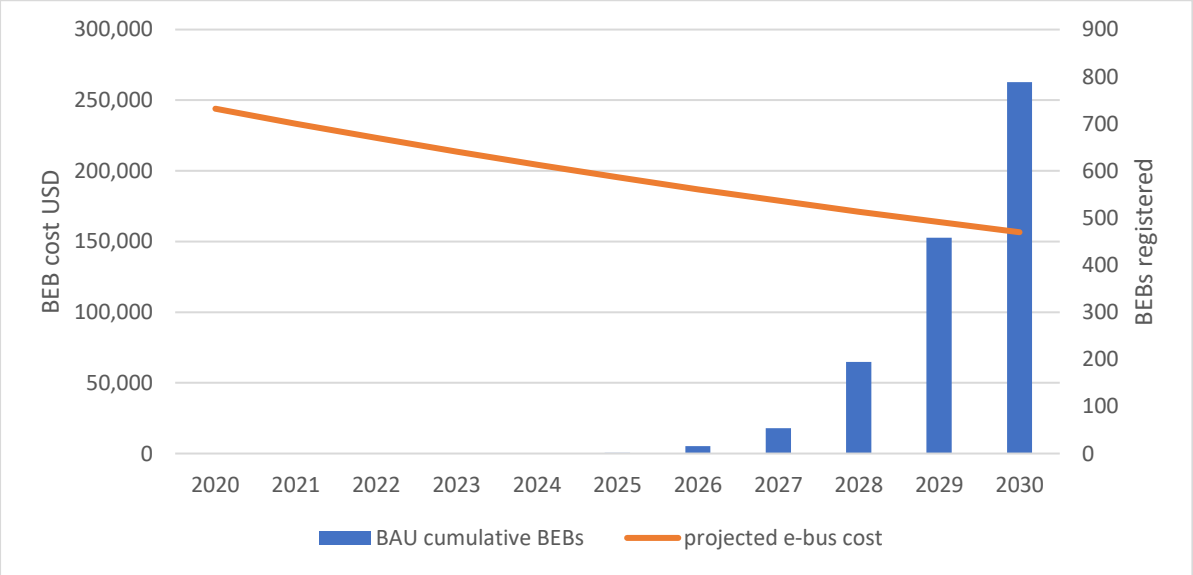
Figure 6: Expected FIRR of Investors



Source Grutter Consulting

The following curve shows the trend projection of decreasing bus prices and the BAU projection of uptake of e-buses without project intervention in Costa Rica.

Figure 7: BAU Projected E-Bus Uptake in Costa Rica and Price Trend of E-Buses



Source: Grutter Consulting

Under a BAU scenario BEBs in Costa Rica start to get commercially viable around 2027 and then increase rapidly. In practice this rapid increase might not be realistic if new concession contracts are not also established in the same years. With the BAU scenario the Costa Rica national target of 8% market share of electric buses by 2030 would be achieved with 16% of all urban buses being electric (the target is 8%). The “high growth scenario” with a target of 40% would however not be reached by far.

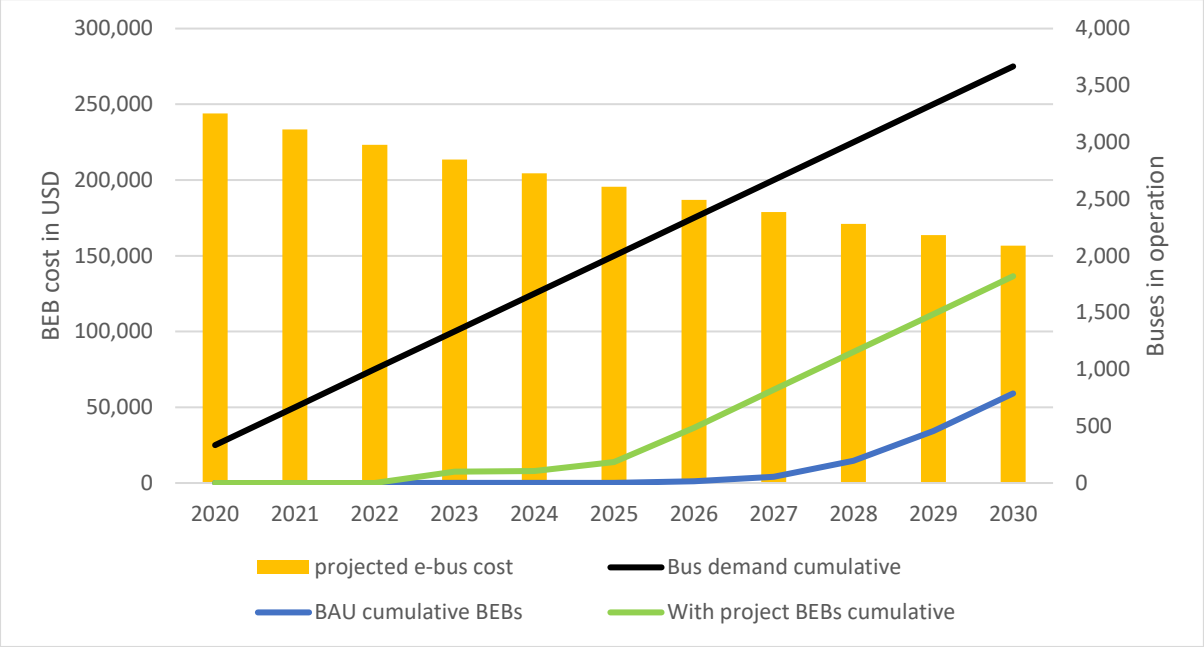
Projected with-Project Demand for E-Buses

The EV project has as basic function to accelerate EV deployment. It uses financial assistance (FA) to deploy an initial at-scale fleet. This initial fleet is used to reduce the performance risk perception of

future investors by having actual performance data of large-scale fleet application, by reducing risks and costs of new market entrants, by having appropriate maintenance facilities in place and by having new business models in place (if so required). Technical assistance (TA) is used to reduce entry barriers e.g. the length of concessions for e-buses, asset turn-over contracts and new business models e.g. based on leasing. At the same time capacity building and training reduce the performance risks.

The projected BEB demand with project is therefore based on reduced risk rates due to the initial fleet financed by the program and due to reduced performance risks. Even with this, risks are not assumed to be reduced to 0 immediately. A gradual risk rate reduction relative to BAU from 2024 to 2027 is assumed (it is assumed that a fleet of 100 e-buses financed by the project enters operations in 2023). The projected EV demand is then modelled with the changed risk rates, whilst taking the same BAU EV price development. The figure below shows the e-bus market deployment with and without project i.e. under a BAU and with the case of a project intervention.

Figure 8: BAU and with-Project Projected E-Bus Uptake in Costa Rica and Price Trend of E-Buses



Source: Grutter Consulting

Comparing the with and without project scenario we can state a doubling of the uptake speed (slope of the function). The e-bus fleet reaches by 2030 1,800 instead of 800 units with a BEB market share of 36% instead of 16% by 2030 i.e. the “high growth scenario” can be achieved. Thus the project has a decisive impact on accelerating climate friendly technologies. Compared with the BAU scenario this results by 2030 in the following impact (based on lifetime impact of cumulative incremental fleet operating by 2030):

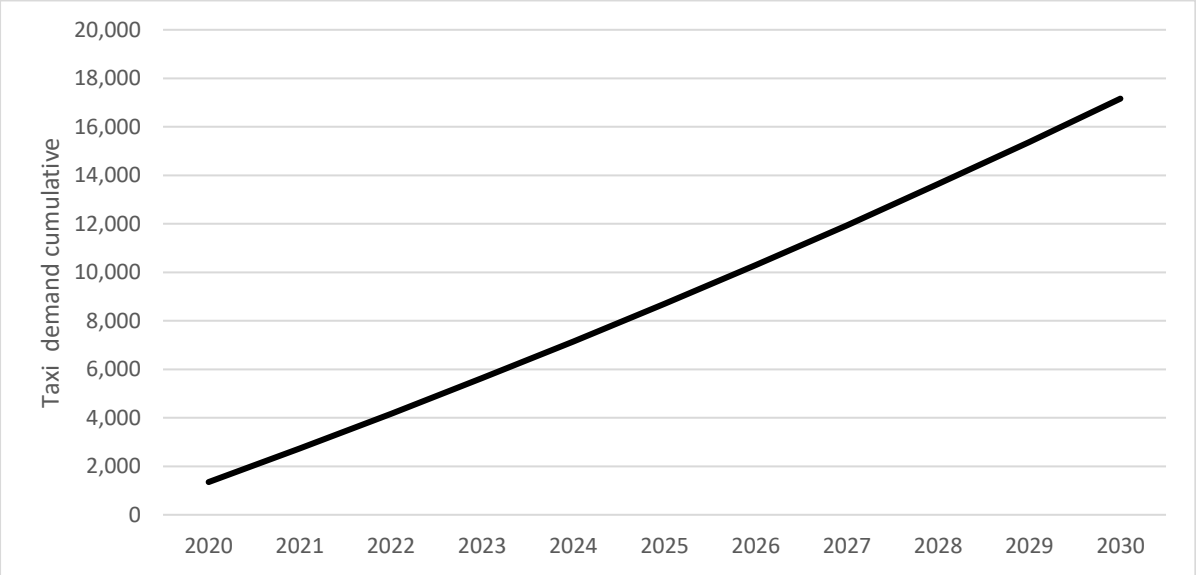
- Additional 1.56 million tons of CO_2 reduced;
- Additional 46 tons of $PM_{2.5}$ avoided;
- Additional 5,400 tons of NO_x avoided;
- Additional economic savings of 73 MUSD.

5.4.3. E-Taxis

Market Demand for Taxis

The initial graph shows the total projected cumulative demand for taxis in Costa Rica based on vehicle replacement and market growth rates.

Figure 9: Total Projected Cumulative Market Demand Taxis



Source: Grutter Consulting (see report 1)

Projected BAU Demand for E-Taxis

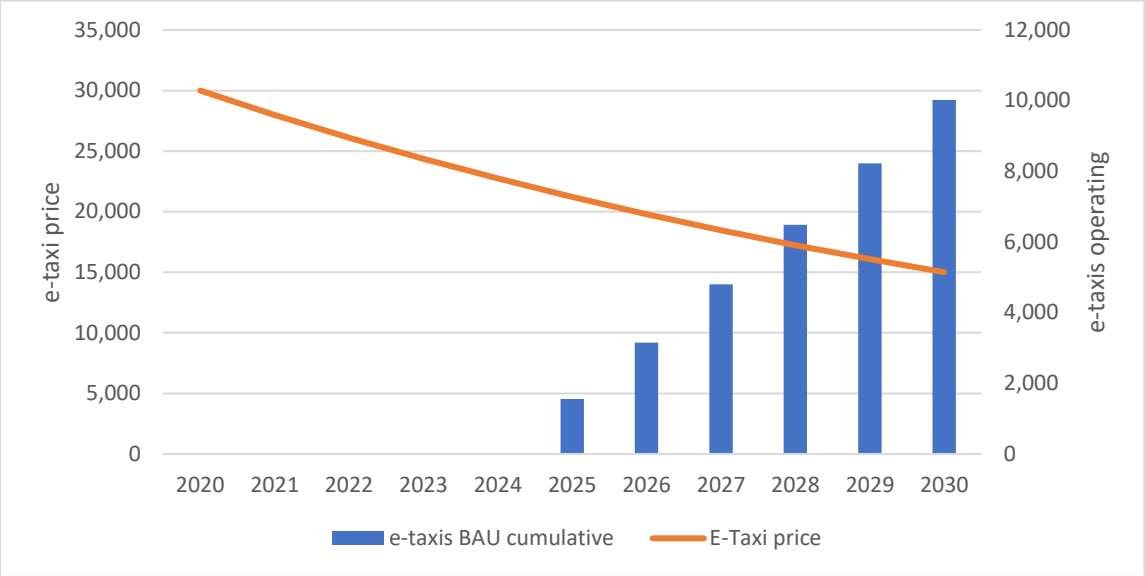
Idem to the e-bus approach, the e-taxi demand is based on comparing the FIRR with the WACC adjusted for a risk rate based on being a new technology using the following criteria:

- Performance risk of e-taxis with higher than expected energy costs (due to increasing electricity prices, more charging during high cost periods and/or higher than expected energy consumption of taxis). The medium risk rate is modelled around 20%.
- Performance risk of e-taxi maintenance costs: The medium risk rate is modelled around e-taxis having up to 20% higher maintenance costs than gasoline units primarily due to higher spare parts costs.
- Revenue losses modelled at medium of 2,400 USD per annum based on not being able to operate fully due to lack of a fast-charging infrastructure which results in driving range limitations[24].

Idem to e-buses the modelling assumes a risk propensity distribution. The following curve shows the trend projection of decreasing e-taxi prices and the BAU projection of uptake of e-taxis without project intervention in Costa Rica.

[24] The profit loss has been calculated with 5 days per month with 10 “lost” clients @ 10USD per trip with 40% variable profit.

Figure 10: BAU Projected E-Taxi Uptake in Costa Rica and Price Trend of E-Taxis



Source: Grutter Consulting

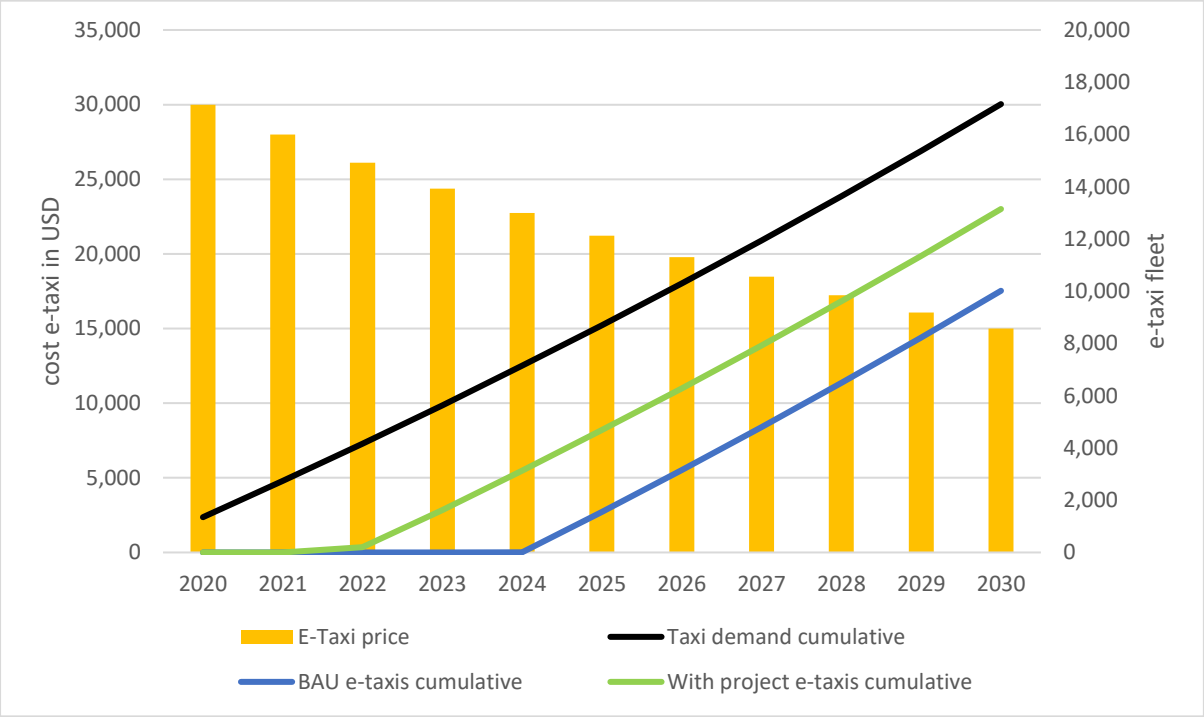
Under a BAU scenario electric taxis start to get commercially viable around 2025 and then increase rapidly. The share of electric taxis by 2030 could reach under BAU 70% i.e. this goes far beyond the national target (8% of taxis) and even beyond the "high growth scenario" i.e. BAU expected price decreases are a sufficient incentive to get high shares of taxis by 2030. The only issue is, that this movement would take another 5 years to commence.

Projected with-Project Demand for E-Taxis

The EV project has as basic function to accelerate EV deployment. It uses financial assistance (FA) to deploy an initial at-scale fleet. FA is also used to deploy an urban fast charging infrastructure. Technical assistance (TA) is primarily used to design the charging infrastructure, for performance measurement and for providing taxi owners with technical and financial information. At the same time capacity building and training reduce the performance risks.

The projected e-taxi demand with project is therefore based on reduced risk rates due to the initial fleet financed by the program and due to reduced performance risks. Even with this, risks are not assumed to be reduced to 0 immediately. A gradual risk rate reduction relative to BAU from 2023 to 2025 is assumed (it is assumed that by 2022 a charging infrastructure is deployed and an initial fleet of 200 e-taxis has been financed.). The projected EV demand is then modelled with the changed risk rates, whilst taking the same BAU EV price development. The figure below shows the e-taxi market deployment with and without project i.e. under a BAU and with the case of a project intervention.

Figure 11: BAU and with-Project Projected E-Taxi Uptake in Costa Rica and Price Trend of E-Taxis



Source: Grutter Consulting

Comparing the with and without project scenario we can state than a larger fleet is achieved in shorter time. This impact continues during the entire period due to vehicles being kept in operations for a long period. The e-taxi fleet reaches by 2030 13,000 instead of 10,000 units with an e-taxi market share of over 90% instead of 70% by 2030 i.e. the "high growth scenario" can be achieved. Thus the project has a decisive impact on accelerating climate friendly technologies. Compared with the BAU scenario this results by 2030 in the following impact (based on lifetime impact of cumulative incremental fleet operating by 2030):

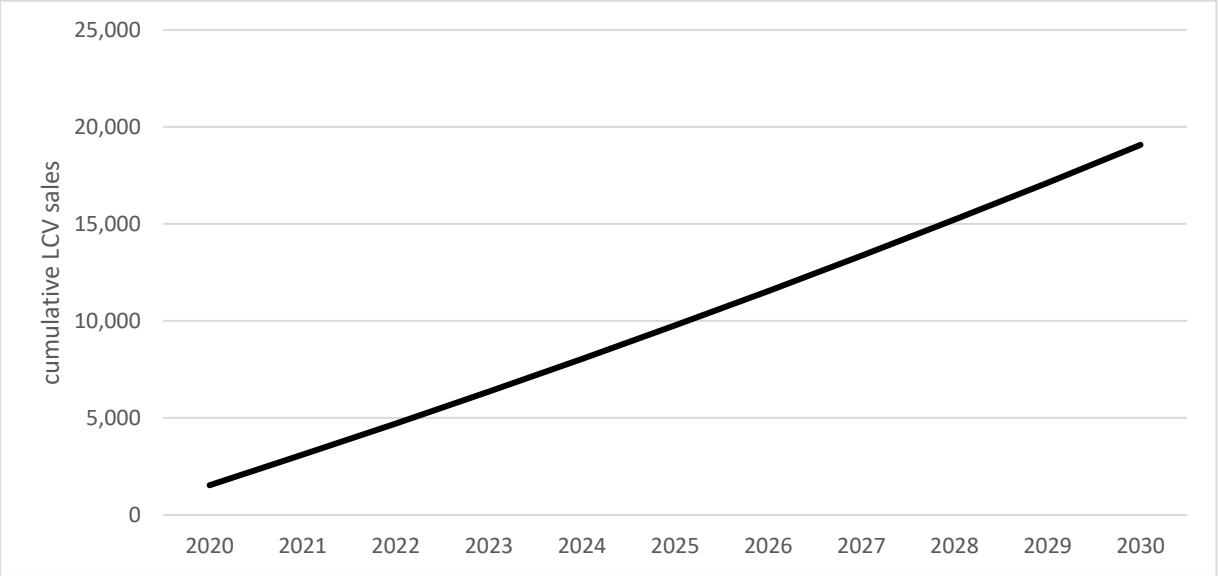
- Additional 370,000 tons of CO_2 reduced;
- Additional 2 tons of $PM_{2.5}$ avoided;
- Additional 90 tons of NO_x avoided;
- Additional economic savings of 15 MUSD.

5.4.4. E-LCVs

Market Demand for LCVs

The initial graph shows the total projected cumulative demand for LCVs in Costa Rica based on vehicle replacement and market growth rates. A large amount of LCVs in Costa Rica are privately used and not commercial units. Also it is a very popular vehicle in rural settings. Thus only 10% of the total LCV market has been taken as potential market for urban commercial LCVs.

Figure 12: Total Projected Cumulative Market Demand LCVs



Source: Grutter Consulting (see report 1)

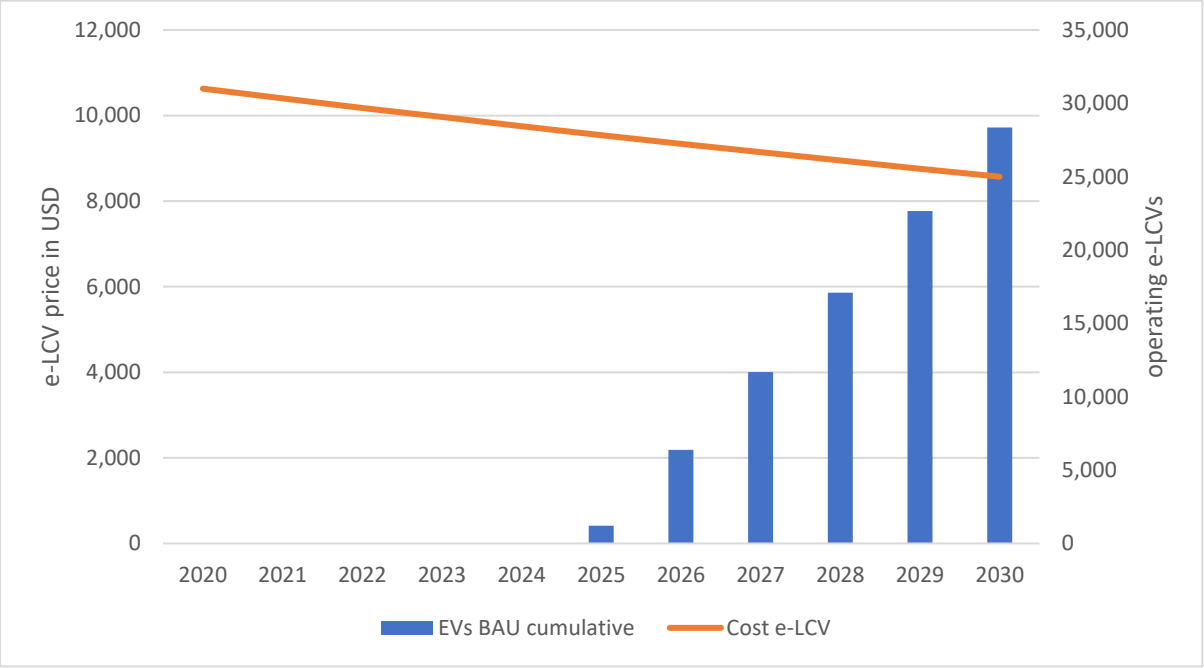
Projected BAU Demand for E-LCVs

Idem to the e-bus approach, the e-LCV demand is based on comparing the FIRR with the WACC adjusted for a risk rate based on being a new technology using the following criteria:

- Performance risk of e-LCVs with higher than expected energy costs (due to increasing electricity prices, more charging during high cost periods and/or higher than expected energy consumption of LCVs). The medium risk rate is modelled around 40%.
- Performance risk of e-LCV maintenance costs: The medium risk rate is modelled around e-LCVs having the same maintenance costs as gasoline units.
- Cost of battery replacement in year 7 without decreasing battery costs as the entire battery set and not only cells need to be purchased (idem to battery replacements offered e.g. currently for Nissan Leafs).

Idem to e-buses the modelling assumes a risk propensity distribution. The following curve shows the trend projection of decreasing e-LCV prices and the BAU projection of uptake of e-LCVs without project intervention in Costa Rica.

Figure 13: BAU Projected E-LCV Uptake in Costa Rica and Price Trend of E-LCVs



Source: Grutter Consulting

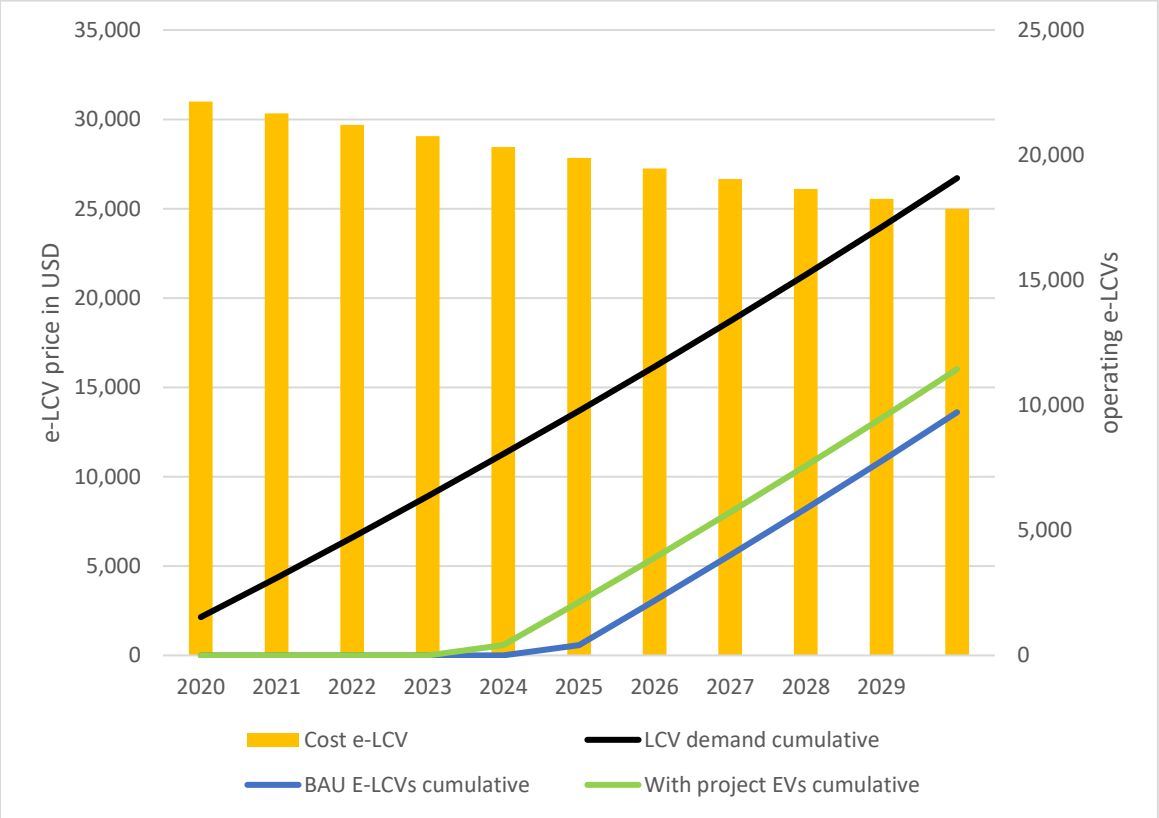
Under a BAU scenario electric LCVs start to get commercially viable around 2026 and then increase rapidly. The share of electric LCVs by 2030 could reach under BAU 4% which is below the Costa Rican target of 8%.

Projected with-Project Demand for E-LCVs

The EV project has as basic function to accelerate EV deployment. It uses financial assistance (FA) to deploy an initial at-scale fleet. Technical assistance (TA) is primarily used for performance measurement and for providing LCV owners with technical and financial information. At the same time capacity building and training reduce the performance risks.

The projected e-LCV demand with project is therefore based on reduced risk rates due to the initial fleet financed by the program and due to reduced performance risks. Even with this, risks are not assumed to be reduced to 0 immediately. A gradual risk rate reduction relative to BAU from 2024 to 2027 is assumed (it is assumed that by 2023 an initial fleet of 200 e-LCVs has been financed.). The projected EV demand is then modelled with the changed risk rates, whilst taking the same BAU EV price development. The figure below shows the e-LCV market deployment with and without project i.e. under a BAU and with the case of a project intervention.

Figure 14: BAU and with-Project Projected E-LCV Uptake in Costa Rica and Price Trend of E-LCVs



Source: Grutter Consulting

Comparing the with and without project scenario we can state than a larger fleet is achieved in shorter time. This impact continues as vehicles are being kept in operations for a long period. The e-LCV fleet reaches by 2030 11,400 instead of 9,700 units. Compared with the BAU scenario this results by 2030 in the following impact (based on lifetime impact of cumulative incremental fleet operating by 2030):

- Additional 120,000 tons of CO_2 reduced;
- Additional 1 ton of $PM_{2.5}$ avoided;
- Additional 30 tons of NO_x avoided;
- Additional economic savings of 5 MUSD.

6. Potential Investment Projects

6.1. Urban Buses

6.1.1. Barriers and Interventions Options

The following table summarizes main barriers towards massive e-bus deployment in Costa Rica. The barrier source gives an indication of what type of changes are required from an institutional perspective and the barrier elements which concrete aspects need to be altered.

Table 8: Barriers towards e-Bus Deployment in Costa Rica

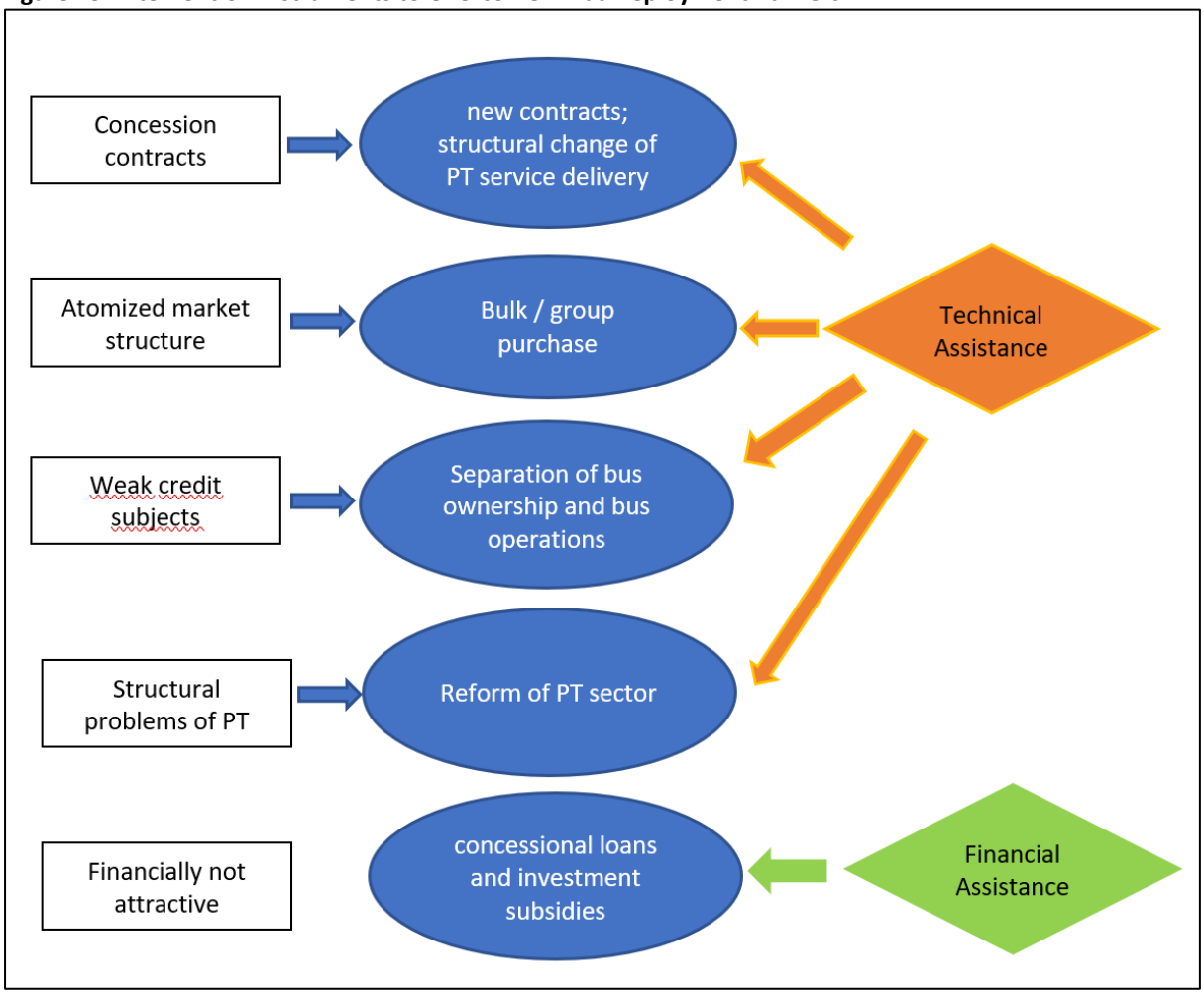
Barrier Type	Concrete Aspects
Concession contracts	7 year concession contracts limit the loan tenure which is for e-buses very short compared with their lifespan of 16 years. Concession contracts also do not offer to creditors guarantees that assets are kept and operated by another transport operator in case of default or loss of concession. Payments are fixed per route

	and go directly to the operator i.e. the creditor has no guaranteed direct payment from the fare box. However negotiations are on-going to prolong concession contracts to 15 years and should be closed soon
Atomized market structure of bus operators	Many small and some medium-sized operators exist in Costa Rica. Bus renewal, even for the largest operators is thus at very small numbers i.e. 10-20 units.
Financially weak operators	Operators have a fragile balance sheet. To access loans they need to provide real guarantees beyond vehicles. As they only take relatively small loans and are considered a high risk, the resultant interest rate is high and loaning levels are low.
Financial barriers	BEBs are not profitable. The FIRR is below the WACC and the repayment period for the incremental investment in electric buses is more than 7 years. The investor needs to invest up to 4x the owners capital required for fossil buses, increases significantly his debt levels and suffers from a negative cash flow for the initial 10 years with the current market offer for e-buses prevalent in Costa Rica. To reduce operational costs operators also do not insure vehicles against collision damage and full loss. This again makes it impossible to accept vehicles as loan guarantee to banks.
Structural barriers	The public transport (PT) sector in Costa Rica has some fundamental problems related to route structuring, fare system, financial support from government etc. which result in decreasing mode shares of PT. These problems are not specific to BEBs but affect the finances of PT operators and therefore their capabilities to invest in new units.

Source: Grutter Consulting

E-buses have major environmental and societal advantages expressed in large positive environmental and health impacts. Whilst the TCO of e-buses is slightly lower than of diesel units, the capital exposure, risks and lack of profitability make it an non-attractive investment. This combined with market conditions (atomized bus ownership) and a political/contractual framework which hampers e-bus deployment result in e-buses not being deployed. The following figure shows intervention instruments which can overcome these barriers.

Figure 15: Intervention Instruments to Overcome E-Bus Deployment Barriers



Source: Grutter Consulting

Concession contracts can be updated and changed to incorporate longer periods (e.g. 10 years extendable by 6 years) and with asset turn-over in case of default or concession loss. In the medium term a structural change to the system how public transport is delivered will be required to increase system efficiency and convenience for the customer. This will imply a change of ownership structure and potentially of service delivery structures. However, at first instance the major barrier is to increase the length of concession contracts. This step is being taken currently and should be implemented this year allowing for 15 year concession contracts.

The **atomized market structure** results in very small amounts of buses being purchased. This results in high purchase and maintenance/repair costs and potentially sub-optimal technology solutions. Also, operators lack the know-how on e-bus technologies and are thus dependant on claims of suppliers. Bulk purchase would resolve these problems. This can be based on different organizational models:

- Group purchase based on (ad-hoc) associations;
- Bulk purchase of buses through leading enterprises which thereafter sell buses to smaller companies. This model is favoured by some larger bus operators in Costa Rica, which are also linked up with suppliers. However, it has disadvantages as smaller companies might feel that they are being pushed out of the market by depending on larger operators and financing of such fleets is complex as assets are given along to 3rd parties and operators might not have sufficient solvency for such operations;

- Purchase of buses through a 3rd party and delivery for operations either credit- or leasing-based by operators. This model was extensively discussed with ICE since 2018 and matches the model as established in Chile. However, to the moment ICE has not expressed interest in participating in such a venture.

Technical assistance can be useful to further develop appropriate bulk-purchase business models and link them with concessional financial instruments.

The **weak credit subjects** will result in a problem of accessing loans and having favourable loan conditions. A separation of bus ownership and bus operations, as has been done successfully e.g. in Santiago de Chile or Bogota can bring in other and financially stronger players which can provide the required owners capital and which can access finance at more favourable conditions. This could also be done with the municipality or government purchasing buses and then leasing or renting them to operators as is done e.g. in various cities of Pakistan or in Medellin. To overcome the problem of guarantees and costly financial conditions a separation of ownership and operations is an important condition, especially in market conditions such as Costa Rica with many individual small and weak operators. Technical assistance can help to overcome these barriers and structure financially more viable solutions. To rely on financial assistance alone would be inefficient as this would require far more support resources and would maintain a non-efficient public transport system.

The **reform of the Public Transport Sector** is an important element to increase the commercial viability of PT services overall (not specifically of e-buses) and thereby improve the financial sustainability and creditworthiness of PT operators. This is also required to reduce the trend of dropping PT mode shares by making PT again more attractive through improved route scheduling, integrated fare models and integrated service models. The TA in this area will work together with other existing initiatives of IDB, BCIE as well as other parties which are already working on the reform of the PT sector together with MOPT and ARESEP and reinforce their activities.

Concessional loans and investment subsidies are critical to de-risk the investment and to create an attractive financial framework. This includes longer loan tenures, concessional interest rates, higher lending rates, payment guarantees and upfront investment subsidies worth around 20% of the total CAPEX which allows a 3rd party or a bus operator to invest in e-buses whilst receiving an adequate return on investment, an acceptable payback period, limits his equity and capital investment and financial exposure to a comparable rate as for fossil buses and allows for a positive cash-flow.

6.1.3. Possible Business Models

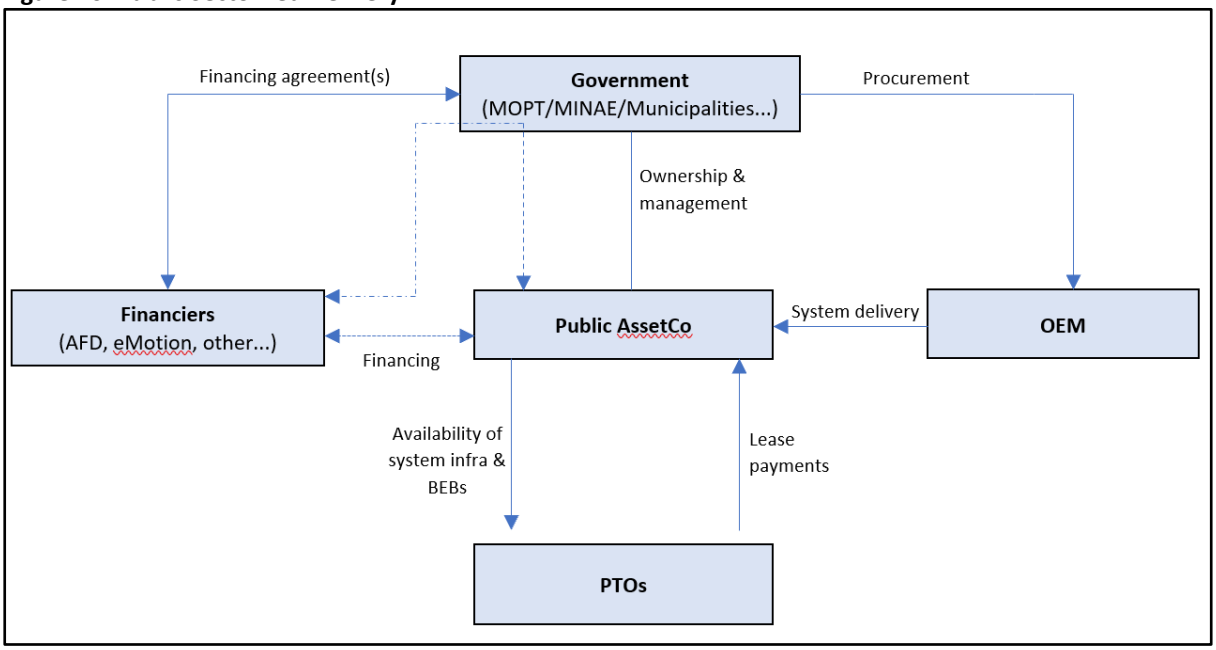
The typical structures that could be followed in the case of Costa Rica are:

- Public sector-led;
- Private sector-led (“PPP”); and
- Public Transport Operator (PTO)-led delivery.

Option 1: Public Sector-led Delivery

Public sector-led delivery is highlighted in the figure below.

Figure 16: Public Sector-led Delivery



OEM: Original Equipment Manufacturer; PTO: Public Transport Operator
Source: Grutter Consulting based on Grutter Consulting / RebelGroup report for IFC, 2021

In this structure:

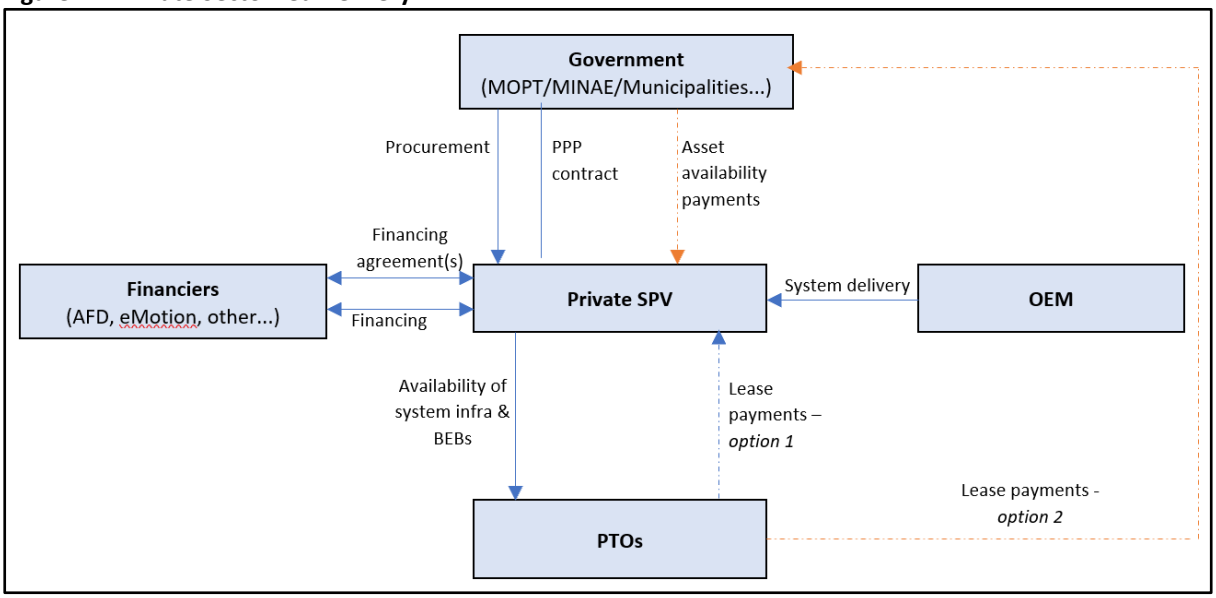
- Government (central government or municipalities) procures both financing and BEB system assets;
- Financing agreements are either with the government (public financing sourced e.g. from eMotion) and the government passing the financing through into the AssetCo, or directly with the AssetCo – with government guarantee in case the borrowing entity is not the Ministry of Finance providing the credit signature;
- Supply and deliver contracts (including an initial service & support agreement for maintenance training, initial spare parts, etc.) may be signed by the OEM with the government counterpart or with the AssetCo directly;
- The assets are held and/or managed in the AssetCo with government remaining the final legal owner; and
- PTOs are required to lease the BEBs from the AssetCo and are contractually bound to pay lease fees to the AssetCo, keep to a care and maintenance obligation, as well as a handover obligation for transfer of assets to subsequent concession holders should a PTO lose its concession.

Financiers are expected to require pledge/first claim on bus and charging infrastructure assets in case of default on debt service obligations. Government and/or AssetCo may require a PTO direct guarantee vis-à-vis the obligations of duty and care of the bus and charging assets, in particular concerning the state of asset maintenance at hand-over to any successor concessionaire.

Option 2: Private Sector-led Delivery

Private sector-led delivery is highlighted in the figure below.

Figure 17: Private Sector-led Delivery



OEM: Original Equipment Manufacturer; PTO: Public Transport Operator; SPV: Special Purpose Vehicle; PPP: Public-Private Partnership
Source: Grutter Consulting based on Grutter Consulting / RebelGroup report for IFC, 2021

In this structure:

- Government (central government or municipalities) procures a "PPP" for a consortium to deliver and finance the BEB fleet and charging infrastructure assets;
- The winning consortium sets up a private sector AssetCo (Special Purpose Vehicle or SPV) which (i) Structures and raises financing from selected financiers and investors; (ii) Procures the buses and charging equipment assets from an OEM; (iii) Ensures the availability to PTOs of buses and charging equipment; (iv) Provides maintenance training and additional spare parts inventory.

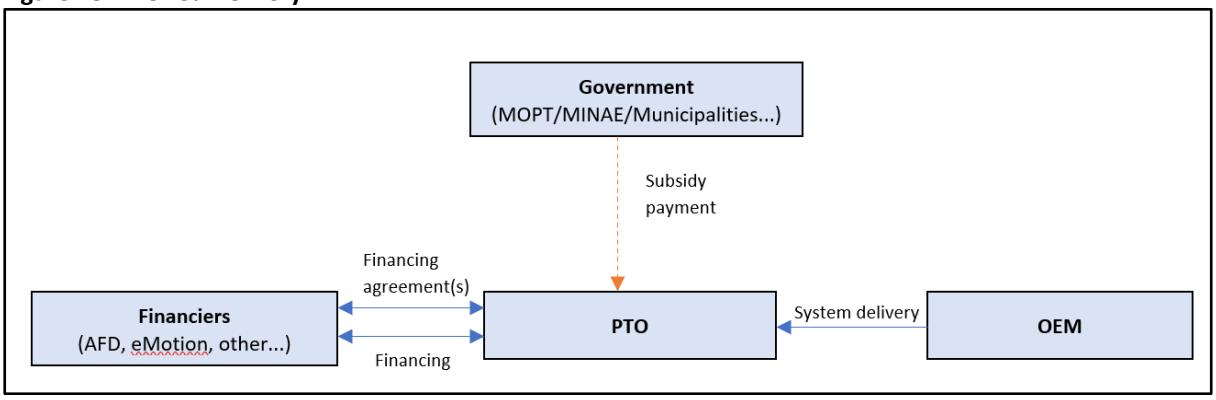
PTOs are required to use the BEB assets as made available by the SPV and are contractually bound to a care and maintenance obligation, as well as a handover obligation for transfer of assets to subsequent concession holders should a PTO lose its concession.

PTOs will either pay lease fees directly to the SPV – however as the overall cost of use of the assets must be at most equal to that of the existing diesel buses, an '*additional*' asset availability payment stream must in this case be paid by the government to the SPV (this would be the investment grant payment by eMotion) or pay the same lease fees to the government which in turns pays a fully-loaded asset availability payment stream to the SPV.

Option 3: Public Transport Operator (PTO)-led delivery

Public Transport Operator (PTO)-led delivery is highlighted in the figure below.

Figure 18: PTO-led Delivery



OEM: Original Equipment Manufacturer; PTO: Public Transport Operator
Source: Grutter Consulting based on Grutter Consulting / RebelGroup report for IFC, 2021

In this structure, PTOs:

- Procure the BEB fleet and charging infrastructure assets (including initial maintenance training, spare parts, etc.) from a selected OEM;
- Raise the necessary financing for this, possibly in combination with the procurement of the assets themselves; and
- Receive a subsidy from the government to neutralize the difference between the capital cost and operating cost of diesel bus operations vs. BEB operations over the life of the concession (eMotion support).

6.1.3. Potential Investment Project

A medium-term (by 2023) potential investment project is the purchase of 100 buses for various bus operators. Some 100-200 buses need to be replaced annually by bus operators pre-defined by ARESEP as appropriate for using e-buses. The following table summarizes core characteristics of such a potential investment project.

Table 9: Potential E-Bus Investment Project

Item	Description
Project contents	100 urban 12m standard e-buses[25]
Project owner	Not yet defined; for bulk purchase association/lead operator or 3rd party (see possible business models in previous chapter)
Total investment	28 MUSD of which 23 MUSD buses, 1 MUSD charging infrastructure, 3 MUSD grid connection and 1 MUSD bus depot upgrades
Loan components	17.6 MUSD loan for 70% of the total CAPEX @ 4.6% interest rate for 12 years
Subsidy	5.5 MUSD (20% of total CAPEX)
Environmental impact (cumulative lifespan units)	Reduction of 151,000 tCO_{2e}, 4.4 tons $PM_{2.5}$ and 520 tons of NO_x worth 7 MUSD economically

Source: Grutter Consulting

The proposed project might seem small from the market potential. However, it would be an important intervention to kick start the process it will require substantial efforts as well as adequate intervention instruments from the technical and financial area to overcome the current market barriers. Under a Business as Usual Development (BAU) these barriers ill not be resolved and no fleets of e-buses will operate in Costa Rica as the market conditions are not conducive towards adoption of e-buses.

[25] Calculations based on fast-charged buses

Market conditions are not yet given in Costa Rica for a mass deployment of e-buses. Next to this the pandemic has hit public transport operators hard. However, latter is also an opportunity to re-structure and consolidate the sector. Thus it is foreseen that initially TA will dominate and investment projects are not foreseen prior 2023/2024. Private investors such as Avolta Energy in Costa Rica have mentioned their interest in entering the market with equity capital to act as leasing company for buses under adequate market conditions (this could be a SPV or support a SPV as included under the PPP approach in 6.1.3).

6.2. Taxis

6.2.1. Barriers and Intervention Options

The deployment of e-taxis faces two technology related barriers and one generic barrier to the sector:

- Investments in e-taxis are financially risky. Whilst the profitability is fine, the payback period is long and taxi drivers need more than double of owners capital compared to a fossil unit.
- Lack of urban fast-charging network catering to the needs of taxi drivers. This makes the deployment of electric units a potential financial risk as drivers could loose considerable potential income and profit due to range limitations of e-taxis and lack of public fast-charging facilities.
- Serious financial problems of the sector: official taxis struggle under intense competition from ride-hailing services and latter are subject to legal intervention. The taxi sector is considered to be over-indebted and many loans have gone sour in this area. Not surprisingly bank managers ask for blanket guarantees which is an indicator that the sector is not creditworthy. Uber or related services lack a proper legal framework and operations are potentially financially not feasible if all costs are paid (e.g. appropriate vehicle and passenger insurance, tax and licence payments). It is expected that the market will undergo serious re-structuring. Investing in this area in the next few years thus entails a potential default risk which would need to be well managed.

To overcome the technical issues technical assistance is required to taxi operators as well as the government to prevent repeating the mistakes of other cities. Drivers need to be aware of range limitations and of charging speed of batteries and chargers. Average daily distances driven are thereby potentially a misleading figure as high-demand days like e.g. Friday/Saturday require longer ranges with less available charging time whilst constituting an important part of revenues and profits. Technical assistance is required to design an appropriate fast-charging infrastructure catering to the demands of taxis and ride-hailing vehicles. Cities like Amsterdam or London which have a clear e-taxi strategy fostering e-taxis whilst also establishing taxi-exclusive or taxi-preferential charging systems, show that the charging network needs not be established fully from the start. A minimum structure is however required with chargers located at strategic points where taxis often wait whilst also being distributed sufficiently over the urban area to avoid additional distances driven just for charging.

Financial assistance is required for the areas of concessional loans to taxis (vehicle subsidies are not deemed to be necessary). Basically loan conditions need to be softened in terms of more concessional interest rates and, potentially, an increase in loan tenure. Financial assistance in terms of a concessional loan plus grants is required for the establishment of a fast-charging network for taxis. Such a network will not be financially attractive and is not demanded by law. Thus no party will establish such a network. Once available and once a sufficiently large electric taxi fleet plus other EVs

is available the network can be run potentially profitable but initial investments in charging systems will be required.

However, TA as well as FA will only make sense once the market conditions make investments financially sound i.e. a market re-structuring including legal clarity on ride-hailing services as well as potentially debt re-structuring of current taxi operators will be required. Any taxi project is thus not considered to be feasible to start prior 2023.

6.2.2. Potential Investment Project

A potential initial investment project is the purchase of 200 electric taxis including the appropriate fast-charging network. This can be considered as minimal initial project to kick-start the project. The finance to taxis could be given through national banks idem to the already existing loan facilities for EVs, just at more favourable conditions.

Table 10: E-Taxi Initial Investment Project

Item	Description
Project contents	200 e-taxis combined with a fast-charging network of 20 150 kW chargers in the GAM
Project beneficiary	Charging network is owned by electric utilities depending on location; taxis are owned by individual taxi owners
Financial mechanism	For taxis concessional loan through banks already involved in EV loans (e.g. subordinate concessional loan given to banks for on-lending); charging network concessional loan for installation costs; grant for equipment; municipality gives space / land free of charge
Total investment	7.9 MUSD of which 6.4 MUSD taxis and 1.5 MUSD charging infrastructure including grid connection
Loan components	5.1 MUSD loan for 80% of the total CAPEX e-taxis and 0.8 MUSD for 50% of the investment cost of chargers (equivalent to the installation costs) @ 6% interest rate for 8 years
Subsidy	0.8 MUSD equivalent to 50% of total investment in fast-charging infrastructure
Environmental impact (cumulative lifespan units)	Reduction of 24,000 tCO_{2e}, 0.1 tons $PM_{2.5}$ and 6 tons of NO_x worth 1 MUSD economically

Source: Grutter Consulting

6.3. LCVs

6.3.1. Barriers and Intervention Options

The deployment of e-LCVs faces two major barriers:

- Investments in e-LCVs are financially risky. Whilst the profitability is fine, the payback period is long and the performance of units is unknown.
- Lack of an urban fast-charging network in case of necessity. The same fast-charging network could be potentially used by taxis, cars as well as LCVs.
- Lack of information and know-how of options and possibilities of e-mobility in this area. Companies are interested in EVs but do not have access to information on available models. Vehicle importers are not actively engaging in the business as they have higher profits selling fossil vehicles and their spare parts. In the urban cargo area also vehicles and customer demands vary widely.
- Ownership structures are often a barrier as vehicles are owned by individual drivers and not by the logistics companies or by the cargo company.

Currently companies are basically interested in pilots to test equipment and operations. Technical assistance would be basic at this point of time. This could be complemented by using the same concession loan instrument through banks as for taxis[26]. The slow-take up of the market and the requirement to still run first some pilot trials do not make feasible an investment project prior 2023/2024.

6.3.2. Potential Mid-Term Investment Project

A preliminary potential investment project for e-LCVs is described in the following table. This is an initial kick-off project.

Table 11: Initial E-LCV Investment Project

Item	Description
Project contents	200 e-LCVs
Project beneficiary	Logistics and distribution companies or vehicle operating companies which rent/lease vehicles to distribution companies
Financial mechanism	Concessional loan through public banks already involved in EV loans (e.g. subordinate concessional loan given to the three banks for on-lending)
Total investment	6.6 MUSD excluding charging infrastructure
Loan components	5.3 MUSD loan for 80% of the total CAPEX e-LCVs @ 4.6% interest rate for 10 yrs
Subsidy	None (potentially with charging network)
Environmental impact (cumulative lifespan units)	Reduction of 14,000 tCO_{2e} and 0.1 tons $PM_{2.5}$, 4 tons of NO_x worth 0.6 MUSD economically

Source: Grutter Consulting

7. Proposed Financial and Technical Assistance

7.1. Financial Assistance Instruments

The following table summarizes the FA intervention instruments for Costa Rica.

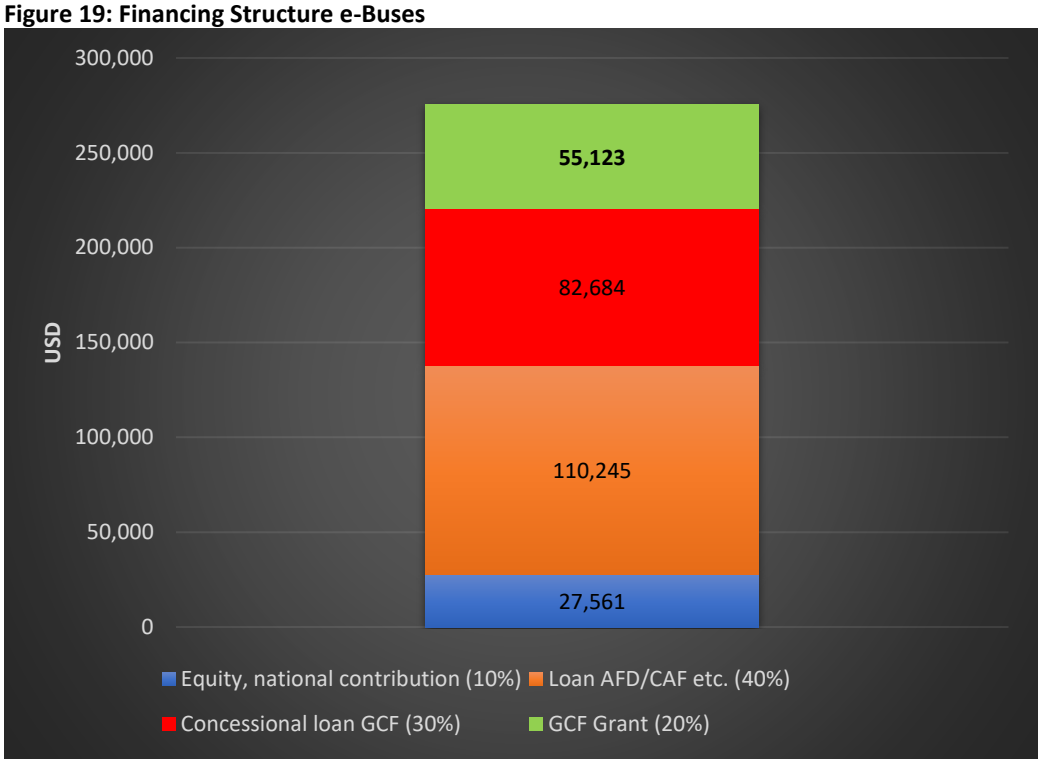
Table 12: FA Intervention Instruments

Instrument	Application	GCF Component (maximum)
Concessional loans	• Buses: 70% of total CAPEX including vehicles charging infrastructure, grid connection, depot upgrades • Taxis: 80% of CAPEX including home chargers • Urban fast charging infrastructure for taxis/LCVs: 50% of CAPEX • LCVs: 80% of CAPEX including home chargers	• Buses: 30% of total CAPEX • Taxis: 30% of CAPEX • Urban fast charging infrastructure: 30% of CAPEX • LCVs: 30% of CAPEX
Investment grants	For buses and charging infrastructure	• Buses: 20% of total CAPEX • Urban fast charging infrastructure: 50% of CAPEX

Concessional loans of GCF @ 0.75% interest rate

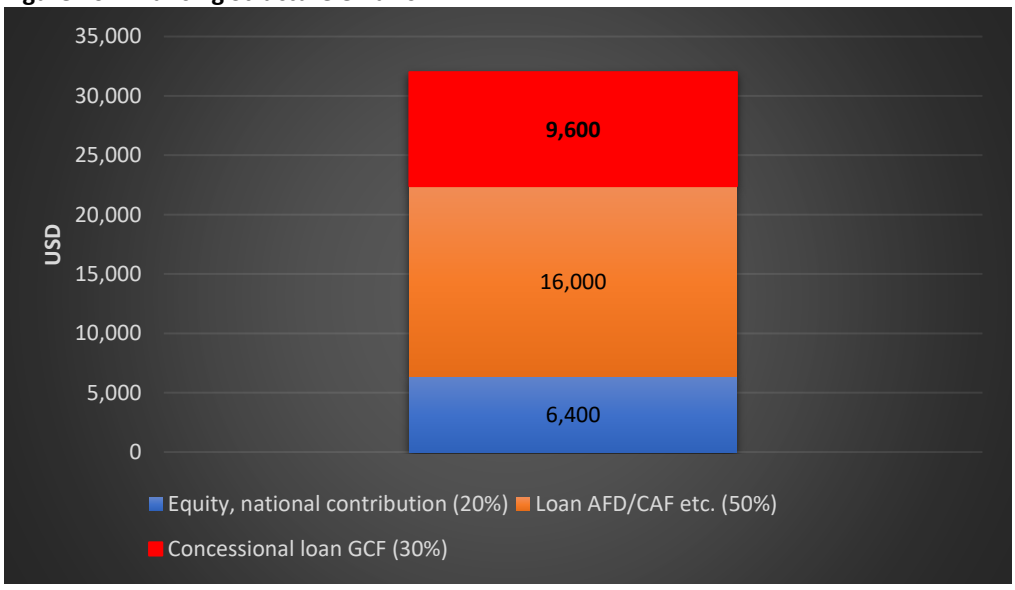
[26] At first instance the national banks which are currently engaged in financing EVs (BN, the Banco Popular and the BCR) could be targeted.

Figure 19: Financing Structure e-Buses



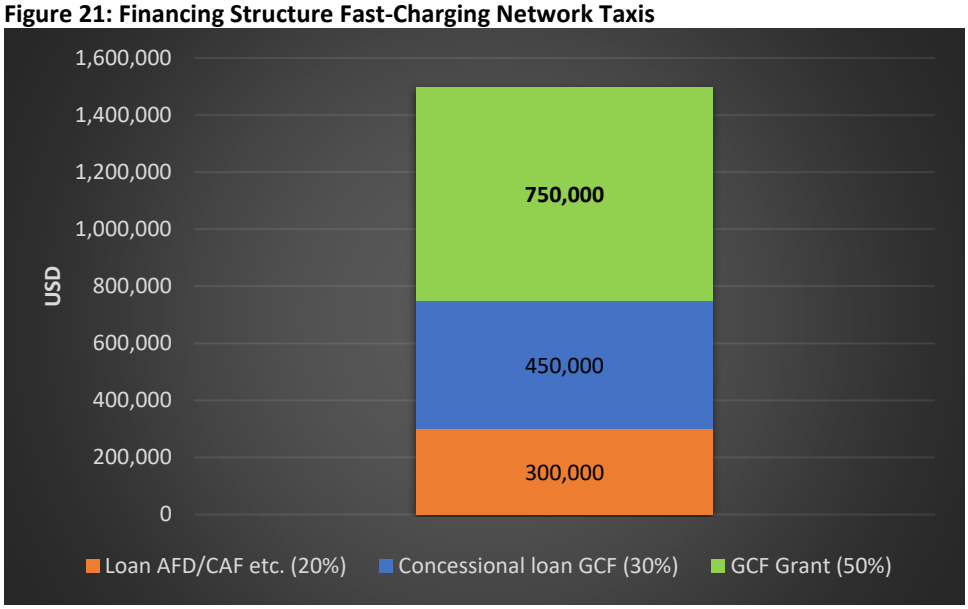
Note: Numbers are indicative based on an estimated total e-bus system price of USD 276,000 per unit including bus, charger, grid connection, depot upgrade based on a fleet of 100 units
Source: Grutter Consulting

Figure 20: Financing Structure e-Taxis



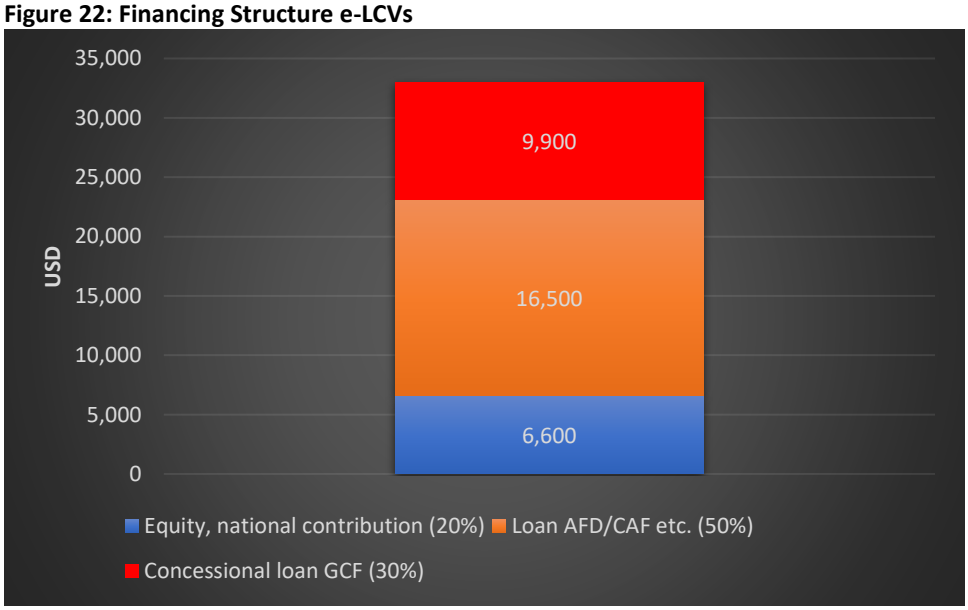
Note: Numbers are indicative based on an estimated e-taxi cost including home charger of USD 32,000 per unit
Source: Grutter Consulting

Figure 21: Financing Structure Fast-Charging Network Taxis



Note: Numbers are indicative based on an estimated infrastructure cost for 200 e-taxis of USD 1.5 million
Source: Grutter Consulting

Figure 22: Financing Structure e-LCVs



Note: Numbers are indicative based on an estimated e-LCV cost including home charger of USD 33,000 per unit
Source: Grutter Consulting

3 projects for FA have been initially identified:

- 100 e-buses to be realized 2023/2024
- 200 e-taxis including urban fast charging infrastructure to be realized 2023/2024
- 200 e-LCVs to be realized 2023/2024

The following table summarizes the FA proposed for these projects.

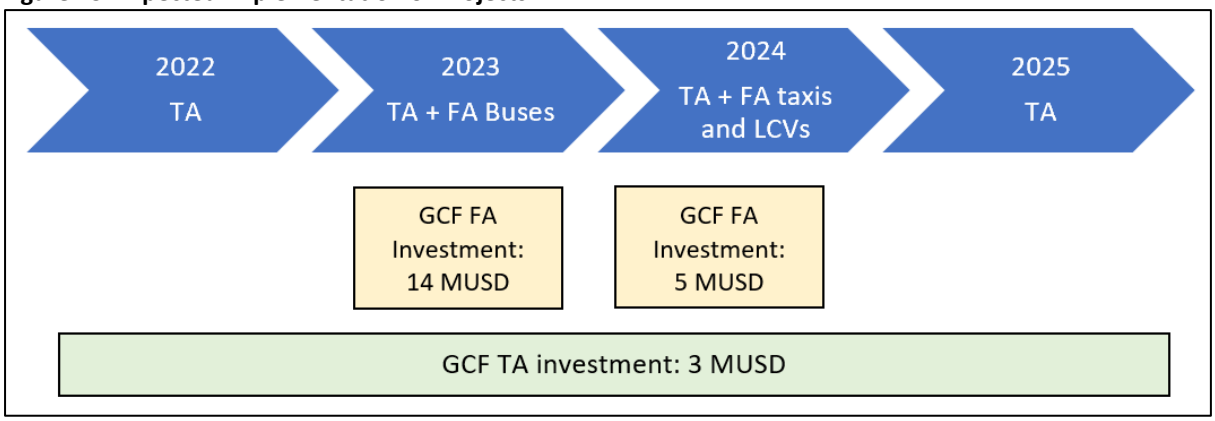
Table 13: FA Potential Projects Costa Rica

Parameter	e-buses	e-taxis	e-LCVs	Total[27]
Total CAPEX	28 MUSD	8 MUSD[28]	7 MUSD	42 MUSD
Total loan	18 MUSD	6 MUSD	5 MUSD	29 MUSD
Co-finance loan	*10 MUSD*	*4 MUSD*	*3 MUSD*	*16 MUSD*
GCF loan	*8 MUSD*	*2 MUSD*	*2 MUSD*	*13 MUSD*
GCF grant	6 MUSD	1 MUSD[29]	0 MUSD	6 MUSD
Equity and other co-finance	4 MUSD	1 MUSD	2 MUSD	7 MUSD

The delivery channel or business models for buses are described in 6.1.2. This can result in a public or non-public lending. However, for GCF contributions the same financing structure is requested. The delivery channel for e-taxis and e-LCVs is proposed to be through public banks with special loan facilities for EVs as these credit lines already exist today i.e. the instrument is already in place.

The total investment volume for Costa Rica is estimated at 42 MUSD. The GCF total contribution to Costa Rica is estimated at 22 MUSD of which 13 MUSD concessional loan, 6 MUSD grant for FA plus 3 MUSD grant for TA (see below). The following chart shows when investments are expected.

Figure 23: Expected Implementation of Projects



Source: Grutter Consulting

7.2. Technical Assistance Instruments

The following technical assistance activities to be managed through GIZ are deemed important to create favourable market conditions for mass deployment of commercial EVs:

- For e-buses: (i) assistance together with other partners (IDB, BCIE) in the re-structuring of public transport operations including route restructuring, fare management, legal arrangements, long-term financing structure (ii) Assistance in the structuring of appropriate concession contracts and concession conditions conducive to e-bus deployment incl. concession length, tariff structuring, concession contracts, guarantees etc. (iii) Assistance in the structuring of public transport models which result in stronger and fewer operators e.g. in direction of separation of bus ownership and bus operations; (iv) Assistance in the structuring of favourable enabling conditions to foster the entry of financially strong players into the public transport business e.g. as bus owners. This could be private companies or a

[27] Due to rounding values might not sum up
[28] Includes taxis as well as fast-charging infrastructure
[29] For charging infrastructure

municipal special purpose vehicle, a public private partnership or municipal/government led purchase of buses. Multiple models are available which need to be assessed to resolve the problem of an atomized bus ownership structure with weak credit subjects; (v) Assessment of optimal e-bus technology and charging systems to enable a robust and cost-effective e-bus deployment; (vi) Assistance in the structuring of bus tenders and bus contracts in accordance with the special requirements of e-buses; (vii) Roadmap for e-bus deployment which includes concrete steps and goes beyond just establishing targets.

- The following technical assistance activities are deemed important to create favourable market conditions for mass deployment of e-taxis: (i) Assessment of optimal e-taxi technology and design of fast-charging infrastructure (for government for structuring whist investment vehicles are for charging infrastructure electric utilities and for vehicles leasing funds, investment funds or FIs); (ii) Roadmap for e-taxi deployment including public incentives for change towards electric units (for government); (iii) Assistance in developing a market structure with clear rules and regulations for ride-hailing services (for government).
- The following technical assistance activities are deemed important to create favourable market conditions for mass deployment of e-LCVs: (i) Advisory service to interested companies in vehicle and technology available; (ii) pilot e-LCV project with deployment and monitoring of at least 10 different types/sizes of electric LCVs with a subsidy of 50% of CAPEX (iii) Roadmap for e-LCV deployment including public incentives for switching towards electric units for public entity; (iv) Design of shared public fast-charging infrastructure for public entity. (v) Development of policies to limit the use of fossil LCVs and incentivize electric units, e.g. low-emission-zones, access restrictions, etc.

TA for due diligence / feasibility assessment of 3 projects (buses, taxis including charging infrastructure and LCVs). This is managed directly with the financing agent whilst the other TA activities are executed by GIZ. The amount of TA reserved for this activity is 1.5 MUSD.

The Annex includes a detailed TA for the policy and capacity building areas.

8. Impact Assessment

The impact of the proposed FA and TA is assessed at 2 levels:

- Direct impact based on the emission reductions of the vehicles financed by the FA of the program.
- Indirect impact based of the program due to the kick-start of mass deployment of EVs initiated through the investment projects combined with the barrier reduction and the reduced performance risk of EV investments. This is reflected in the incremental amount of deployed EVs until 2030 versus the BAU development as shown in chapter 5. The lifetime impact of the incremental number of EVs is the base of calculations of the indirect program impact.

The following table shows the core indicators and the estimated direct and indirect impact in Costa Rica of the EV program.

Table 14: Program Impact

Parameter	Direct impact	Total impact
GHG reduction lifetime vehicles cumulative in tons	188,000	2,048,000
• *Buses*	*151,000*	*1,560,000*
• *Taxis*	*24,000*	*370,000*
• *LCVs*	*14,000*	*120,000*
$PM_{2.5}$ reduction lifetime vehicles cumulative in tons	5	48
• *Buses*	*4*	*46*
• *Taxis*	*0*	*2*
• *LCVs*	*0*	*1*
NO_x reduction lifetime vehicles cumulative in tons	530	5,490
• *Buses*	*520*	*5,370*
• *Taxis*	*6*	*90*
• *LCVs*	*4*	*30*
Energy savings cumulative lifetime vehicles in TJ	1,660	18,100
• *Buses*	*1,290*	*13,300*
• *Taxis*	*230*	*3,600*
• *LCVs*	*140*	*1,200*
Fossil fuel savings cumulative lifetime vehicles in Ml	59	648
• *Buses*	*45 million litre diesel*	*466 million litre diesel*
• *Taxis*	*9 million litre gasoline*	*138 million litre gasoline*
• *LCVs*	*5 million litre gasoline*	*44 million litre gasoline*
Economic savings cumulative in MUSD	9	93
• *Buses*	*7*	*73*
• *Taxis*	*1*	*15*
• *LCVs*	*1*	*5*

The following table shows the main financial indicators related to the GCF investment.

Table 15: GCF Financial Indicators

Parameter	Direct impact	Total Impact
Total CAPEX investment	42 MUSD	
GCF Loan	13 MUSD	
GCF Grant FA	6 MUSD	
GCF Grant TA	3 MUSD	
Total GCF	**22 MUSD**	
Co-finance ration	**48%**	
GCF investment cost per tCO_2 reduced	**117 USD/tCO_2**	**11 USD/tCO_2**
Total investment cost per tCO_2 reduced	**223 USD/tCO_2**	**21 USD/tCO_2**

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Annex 1: TA Project for Costa Rica

The proposed TA project includes only the components of policy advice, business development and general technical issues, not however the project due diligence and feasibility assessments including final technical design of projects.

OUTPUT 1: Policy Advice and Business Models

Policy and legal instruments to massively deploy commercial electric vehicles have been developed with the relevant stakeholders and are operational on a national and local level.

The diagnostic identified several legal barriers for the massive deployment of EVs. These barriers affect mostly the public transport sector and can be removed by assessing changes in the current legislation and strengthening the responsible institutions. Although stakeholders are already working on some of these improvements i.e. making changes on the EV Promotion Law, it is not expected that they will be approved by the parliament before the renewal of the concessions.

The government has also not been able to regulate Uber and other ride hailing platforms. This alternative has become more popular, offering more security for its users. With incentive programs that are partly funded by the users themselves, they plan to operate 100% electric by 2040. Aiding the transition to a fast-charging infrastructure for taxis, but also, assessing the government and the lawmakers in regulations for platforms will be key to electrify this growing sector.

Due to the higher purchase price, e-LCVs are not exempt from taxes under the current EV promotion Law. There is a committee working on these improvements. Local authorities can go a step further, and establish low emissions zones.

The **activities in this Work package (WP 1)** are to *strengthen institutions, ministries and the legal framework in order to massively deploy e-buses, e-taxis and e-LCVs*.

It is envisioned that subcontractors will be used in this work package. Specific topics include a) communication, mediation and conflict management as a methodological approach and b) legal assessment.

Activities WP 1

Activity 1.1: (Buses - Roadmap)

> To elaborate a binding roadmap for e-bus deployment which includes concrete targets, steps and responsibilities. The roadmap shall be elaborated together with the Public Transport Council (CTP) and the regulator Aresep, since these are the actors that will grant the concessions. Other involved stakeholders are MOPT, MINAE, electricity providers and the bus operators.

Activity 1.2: (Buses – Business models and operational framework)

> To structure together with CTP appropriate concession contracts and concession conditions conducive to e-bus deployment incl. concession length, tariff structuring, guarantees etc. The length of the concession (seven years) is established by law. In order to benefit operators with a longer concession period, a change in the law must take place. A close cooperation with lawmakers is required. Legal assessment will be provided thorough subcontractors. To assist the government in re-structuring public transport models that would result in stronger and fewer operators e.g. in direction of separation of bus ownership and bus operations. This would not only

make them financially stronger, and able to make bulk purchases, but it would also improve service delivery. For this activity, mediation between stakeholders (CTP, MOPT and PT operators) will be provided. In order to work on improving service delivery, this activity would involve working closely with one of the 9 sectors of the GAM. To develop and implement together with the government and lawmakers favourable enabling conditions to foster the entry of financially strong players into the public transport business e.g., as bus owners. This could be private companies or a municipal special purpose vehicle, a public private partnership or municipal/government led purchase of buses. Multiple models are available which need to be assessed to resolve the problem of an atomized bus ownership structure with weak credit subjects. This activity will also provide assistance on establishing subsidies for public transportation.

Activity 1.3: (Taxis – Roadmap and infrastructure design)

To elaborate a roadmap for e-taxi deployment including as core element the design of a fast-charging infrastructure for taxis and incentive schemes for deployment of electric taxis.

Activity 1.4: (Taxis – investment models)

Identify possible business and finance models for e-taxis including the participation of leasing and 3rd party investment funds. This includes also incentives for E-taxi deployment like improved access for e-taxis, preferential accessibility for EVs etc.

Activity 1.5 (LCVs)

Elaboration of a roadmap for e-LCV deployment including public incentives for switching towards electric units for public entity.

Activity 1.6 (LCVs)

Assessment of possibilities to establish low emission zones and differentiated access conditions together with local governments, commerce, delivery firms and the general population. Development of policies to limit the use of fossil LCVs and incentivize electric units, e.g. low-emission-zones, access restrictions, etc.

Activity 1.7 (Infrastructure design)

Design a shared fast-charging infrastructure including assessment of business models to operate the charging infrastructure.

OUPUT 2: Capacity Building, Training and Outreach

Capacities are strengthened for different stakeholders regarding new technologies, business models, charging infrastructure, EV hazards, battery lifecycles among others.

Activities WP 2

Activity 2.1

Capacity Building for insurance companies, drivers, mechanical workshops and first response staff (firefighters, police, paramedics) allowing e.g. insurance companies to better assess the risk and costs of insuring an EV, eco drive for EVs, training of firefighters and vehicle maintenance personnel (mechanics and depot managers).

Activity 2.2

Capacity building program for municipalities about the benefits of electric garbage trucks and cleaning trucks and further special vehicles.

Activity 2.3

Information and outreach events in the areas of buses, taxis and LCVs to inform about advantages of EVs.

Activity 2.4

Implement a pilot e-LCV project with deployment and monitoring of at least 10 different types/sizes of electric LCVs with a subsidy of 50% of CAPEX.

OUTPUT 3: Reform of the Public Transport Sector

Public transport in the GAM accounts form more passengers due to an improvement in its services via route structuring, integrated tariffs among others.

The public transport (PT) sector in Costa Rica has some fundamental problems related to route structuring, fare system, financial support from government etc. which result in decreasing mode shares of PT. These problems are not specific to BEBs but affect the finances of PT operators and therefore their capabilities to invest in new units.

Activities WP 3

Activities in this Work Package shall be carried out together with other partners such as IDB and BCIE. A binding Memorandum of Understanding with MOPT will be a requisite to carry out these activities. The approval of MINAE as the NDA is not enough to ensure the successful implementation of this WP.

Currently, each route has its own tariff, regardless of the milage. It is calculated based on demand. This results in unfair tariffs for people living in places with a lower population density. Further, in order to travel from one place to the other, passengers must sometimes pay up to four times within the same Metropolitan Area. The integration of tariffs with cross-subsidies is a must in order to make PT more attractive.

PT routes are not integrated. The sectorization plan will be gradually implemented as a requisite for the renewal of the concessions, according to MOPT. However, this plan is more than 20 years old and does not apply to the current OD-Matrix. Only 25% of the trips actually end in down town San José. Therefore, it is necessary to take next steps towards diametral lines, that cross San José. Working on a selected section will show, higher customer satisfaction.

Bus operators claim to have had serious losses during the pandemic. Even before, declining numbers of passengers have been affecting the operator’s solvency.

Activity 3.1

Assessment in the implementation of an integrated bus tariff within the San José Metropolitan Area. The same model can be applied to Cartago, Heredia and Alajuela. Technical and legal assistance, mediation, workshops with operators, ARESEP, MOPT and CTP will be part of the tariff restructuring activity.

Activity 3.2

Assessment in restructuring of routes. The activity will provide technical assistance on rout structuring, transport models, mediation and workshops with the relevant stakeholders.

Activity 3.3.

Assessment on a long-term financing structure. Strategies for a long-term financing will be elaborated together with operators and government stakeholders.

Budget

Unit Costs	
Item	**Cost in USD**
International consultants person months	15,000
National consultants person months	7,000
Trainings and events (venue) por aprox 30 people	1,100
Trainer/speaker person-month	15,000
International travel	4,000
Per diems international (days)	300
Subsidies e-LCVs	35,000

Units per item					
Item	**yr 1**	**yr 2**	**yr 3**	**yr 4**	**TOTAL**
International consultants person months	7.0	15.0	17.0	2.0	41.0
Trainers`	0	2	2	0	4.0
GCF Reports	0.5	0.5	0.5	0.5	2.0
International travel	3	7	7	1	18.0
Per diems international (days)	20	55	55	10	140.0
Trainings Venue	0	5	5	0	10.0
Workshops Venue	3	3	5	1	12.0
National Consultants person months	6	10	10	0	26.0
Purchase e-LCV	0	0	10	0	10.0
suma	40	98	112	15	263

Budget			
Item	**Quantity**	**Unit cost**	**Total cost in USD**
International Consultants	43	15,000	645,000
National consultants	26	7,000	182,000
Trainings and workshops average 30 participants (Venue)	22	1,100	24,200
International Trainers/Speaker	4	15,000	60,000
International travel	18	4,000	72,000
Per diems international	140	300	42,000
e-LCVs	10	35,000	350,000
Administration		10%	137,520
Contingency		10%	151,272
Total			**1,663,992**

Cost per annum (rounded to 10,000)				
yr 1	**yr 2**	**yr 3**	**yr 4**	**Total**
212,718	466,818	929,280	55,176	**1,663,992**
210,000	**470,000**	**930,000**	**60,000**	**1,670,000**

Annex 2: List of Interviewed Persons and Institutions

Organization	Name	Surname	Department
GIZ- Proyecto Mi Transporte	Claus	Kruse	Mi Transporte
	Andrea	Denzinger	Mi Transporte
Ministerio de Ambiente y Energía	Carolina	Flores	Dirección de Energía
Ministerio de Ambiente y Energía	Agripina	Jenkins	Dirección de Cambio Climático
Consejo de Transporte Público	Aura	Alvarez	Dirección técnica
	Rafael	Magaña	
	Manuel	Vega	
Casa Presidencial/Despacho de la Primera Dama	Alan	Blanco	
	Jenner	Alfaro	
Banco Nacional	Gerardo	Rojas	
	Reinaldo	Herrera	
	Silvia	Chaves	
Automercado	Roberto	Chaves	Sostenibilidad
Aresep	Victor	Valverde	Superintendencia de Energía
ONU Ambiente	Esteban	Bermudez	
	Arturo	Steinvorth	
Banco Popular	Heiner	Gonzales	
Banco Promérica	Gustavo	Calderon	
CTW Leasing	Andrew	Galen	
BID	Sofía	Fallas	
BCIE	Jeffry	Carmona	
Correos de Costa Rica	Jorge	Saborío	
Comité de Electrificación del Transporte Público			
Acepesa y Proyecto GIZ - NAMA RESIDUOS	Alexia	Quirós	
	Victoria Rudin		

Annex 3: Details Financial Calculations

E-Bus Data

Parameter	Value	Unit	Source
Distance driven per bus per annum	60,000	km	ARESEP
Workday distance driven daily	201	km	calculated based on 330 days and working days higher mileage
Specific electicity usage	1	kWh/km	Chinese average; ADB, 2018; includes AC
Diesel usage	47	l/100km	Aresep
Tyre usage diesel bus	0.04	USD/km	ARESEP data for tariff calculation
Maintenance engine and staff diesel bus	0.07	USD/km	ARESEP data for tariff calculation (55% liquids and materials and 45% staff)
Repair and spare parts diesel bus	0.12	USD/km	ARESEP data for tariff calculation
Tyre usage e-bus	0.04	USD/km	10% more based on data China; ADB 2018 assuming slightly higher bus weight and regenerative braking
Maintenance engine and e-bus	0.02	USD/km	75% reduction (90% reduction materials, 50% less staff cost (less staff but more qualified))
Repair and spare parts e-bus	0.10	USD/km	20% less (Less engine repairs but slightly more expensive spare parts; other repairs the same)
Lifespan bus diesel	15	years	standard Costa Rica
Lifespan bus electric	16	years	max based on battery age; can be 20% more than diesel
Lifespan battery @ 80% SOC	8	years	current guarantee levels

Financial defaults

Parameter	Value	Unit	Source
CAPEX diesel bus	110,000	USD	bus operators; Euro 4 coach style bus
CAPEX overnight charged e-bus	262,000	USD	based on coach bus offer Gold Dragon FOB*1.2 to get CIF plus 10k for lift
CAPEX slow-charged batteries	200	USD/kWh	LFP batteries
CAPEX fast-charged BEB	226,000	USD	Based on fast-charged bus coach bus style offers from Yutong, Foton, GD; FOB China *1.2 for CIF plus 10k for lift
CAPEX batteries fast-charged	250	USD/kWh	NMC batteries
Reduction battery cost in 8 years	50%		US DOE projections, 2017 have a decrease of 12% per annum; applied to 5 years; https://energy.gov/sites/prod/files/2017/02/f34/67089%20EERE%20LIB%20cost%20vs%20price%20metrics%20r
CAPEX charger excl. Installation per kW	120	USD/kW	Standard chinese chargers, 2 nozzles
CAPEX charger installations civil works	2,500	USD/bus	Civil works for chargers; 2 buses per charger; 5,000 USD per unit
Cost per bus depot upgrade	7,500	USD/bus	Coverage of bus and chargers with roof, no paving, includes labour (20m2 per bus, 250 USD/m2 material and 150
Cost grid connection of chargers per bus	30,000	USD/bus	Compact sub-stations for groups of chargers; 20kV cables from connection substation to the compact substation, 400V cables from compact substation to chagers; costs not born by electric utility
Lifetime chargers	10	years	standard value
Lifetime bus depot upgrades	20	years	standard value
Lifetime grid connection	20	years	standard value
Maintenance chargers, grid connection, depot	2%		of investment

Option A: Overnight Charging

Battery Size Determination overnight charging

Parameter	Unit	Value
Daily range workday (max)	km	201
Energy usage day	kWh	201
Risk ratio (higher energy consumption)		10%
Reserve ratio		20%
SOC loss year 8		20%
Battery size required year 8	**kWh**	**350**

Charging required at bus depot overnight

Parameter	Unit	Value
Battery capacity	kWh	350
Average daily consumption workday	kWh	201
Time available at depot night	hours	6
Power conversion efficiency of chargers		90%
Charging power required (incl. 1h reserve for slower charging last 20%)	kW	40

Option B: Fast Charging

Parameter	Unit	Value
Battery size	kWh	250
C-rate		0.65
Charging in 30 minutes	kWh	81
Average re-charge during day required with 20% reserve ratio	kWh	1
Average share of day electricity		0%
Fast-charger	kW	300
Power conversion efficiency of chargers		90%
Average required re-charge day with 300 kW charger	minutes	0
Number of buses per fast-charger	buses / charger	8
Night charger power		40
Other options are possible e.g. smaller battery and higher C-rate, buses per fast-charger based on max 12 units or time*2 for charging and 3 hour slot		

TCO Buses

12m standard bus, USD 2020

Parameter	Diesel	BEB overnight	BEB fast
CAPEX bus	110,000	262,000	226,000
CAPEX charging infrastructure	0	7,300	12,113
CAPEX grid connection	0	30,000	30,000
CAPEX depot upgrade	0	7,500	7,500
Total CAPEX	110,000	306,800	275,613
Battery replacement yr 8	0	35,000	31,250
Energy cost	20,586	5,400	5,400
Maintenance cost bus	13,800	9,450	9,450
Maintenance cost infra	0	896	992
Finance cost average p.a. during loan term	3,888	8,018	6,917
Economic costs yr 1	4,411	37	37
Lifespan in years	15	16	16
TCO financial per km	0.73	0.67	0.64
TCO economic per km	0.81	0.67	0.64

timespan of calculation: lifespan of e-buses with replacement investment for fossil buses; end of life value proportional to remaining lifespan: all other costs incl. insurance same independent of technology;

Taxis

Parameter	Value	Unit	Source
Average battery size	60	kWh	Nissan Leaf 2020; idem BAIC
Battery lifespan	10	years	idem to vehicle lifespan
Vehicle lifespan	10	years	
Annual mileage	52,000	km	ARESEP minimal value multiplied with 1.2
Daily mileage	168	km	Based on 310 working days (ARESEP 26d/month)
Charging at home average	70%		Assumption; only re-charge if above-average mileage or night shifts
Charging fast-chargers	30%		
CAPEX gasoline taxis	13,000		ARESEP based on Hyunday Accent (55% of taxis)
CAPEX e-taxi	30,000		
Capex home charger 7.4kW	2,000	USD	Nissan LEAF large battery or BAIC
Gasoline consumption	8.5	l/100km	urban consumption hyundai Accent (https://www.adac.de/_ext/itr/tests/Autotest/AT797_Hyundai_Acc
Electricity consumption	0.16	kWh/km	Nissan LEAF https://ev-database.org/car/1106/Nissan-Leaf
Charger lifespan	10	years	
Repair cost per km gasoline	0.13	USD/km	ARESEP
Tyres gasoline	0.01	USD/km	ARESEP
Maintenance cost gasoline	0.02	USD/km	ARESEP
Maintenance cost total e-taxi	0.121	USD/km	10% higher tyre cost; 70% lower maintenance; 20% lower repair cost
Loan tenure taxi	5	years	Bank conditions Costa Rica
Loan share taxi	80%		

gasoline versus e-taxi

Parameter	gasoline	e-taxi
CAPEX vehicle	13,000	30,000
CAPEX charger	0	2,000
Total CAPEX	13,000	32,000
Energy cost	4,199	2,030
Maintenance cost	8,320	6,292
Finance cost average per loan year	450	963
Economic costs yr 1	496	5
Lifespan in years	10	10
TCO financial per km	0.27	0.23
TCO economic per km	0.28	0.23

LCVs

1. Petrol Van

Parameter	Value	Unit	explanation
CAPEX van	25,000	USD	Suzuki APV
Petrol fuel consumption	8.5	l/100km	https://www.carsguide.com.au/suzuki/apv; Automercados indicates 9l/100km
Maintenance cost	0.04	USD/km	excludes tyres and repairs; data from Automercados
Lifespan	15	years	Based on annual mileage
Daily distance driven	70	km	Automercados; commensurate with annual mileage
Annual distance	20,000	km	95% usage

2. E-Van

Parameter	Value	Unit	explanation
CAPEX e-van	31,000	USD	Maxus E-Deliver (see https://saicmaxus.co.uk/edeliver3/); 4.8 m3 cargo volume; short-wheel base; small battery
Range WLTP	222	km	https://saicmaxus.co.uk/edeliver3
Battery size	35	kWh	
Cost battery	7,000	USD	Based on 200 USD/kWh per battery
electricity consumption	0.15	kWh/km	WLTP
Maintenance cost	0.02	USD/m	50% of fossil (as only engine maintenance is included; no tyres, no repairs)
Lifespan van	15	years	assumed same as fossil
Lifespan battery	8	years	
Capex home charger 7.4kW	2,000	USD	
Lifespan charger	10	years	
Charging at home average	90%		Assumption
Charging fast-chargers	10%		Exceptional if long distances were made

fossil versus e-van

Parameter	petrol	e-van
CAPEX vehicle	25,000	31,000
CAPEX charger	0	2,000
Total CAPEX	25,000	33,000
Energy cost	1,615	684
Maintenance cost	850	425
Finance cost average 10 yrs	787	1,038
Economic costs yr 1	192	2
Lifespan in years	15	15
TCO financial per km	0.23	0.22
TCO economic per km	0.24	0.22