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E-Motion Country Intervention Strategy
Dominican Republic

Client	AFD
Version	02
Date	03/04/2021
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Abbreviations

AC	Air Conditioning
AFD	French Development Agency
BAU	Business As Usual
BEB	Battery Electric Buses
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CF	Cash Flow
DR	Dominican Republic
EIRR	Economic Internal Rate of Return
EV	Electric Vehicle
FA	Financial Assistance
FIRR	the Financial Internal Rate of Return
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIZ	German International Cooperation
IDB	Inter-American Development Bank
IEA	International Energy Agency
INTRANT	National Transport Institute
LCV	Light Commercial Vehicle
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

The Dominican Republic has a territory that extends up to 48,442 km_2 (Ministerio de Turismo de la República Dominicana, 2020). According to the World Bank (2020) the GDP of the Dominican Republic as of 2019 was US$89 billion. The registered population for 2019 is 10.7 million inhabitants, resulting in a GDP per capita of US$8,282 (Banco Mundial, 2020).

It is estimated that about 23% of the total air pollutant emissions measured in the Dominican Republic are generated by transportation (Murillo, 2009).

2.2. Climate and Energy Policies

According to the first BUR of 2020, the country's estimated per capita emissions were 3.6 tCO_{2e}. In 2015 the gross Greenhouse Gas (GHG) emissions were 35 million tCO_{2e} (Gobierno de la República Dominicana, 2020). The transport sector contributes 35% (7.7 million tCO_{2e}).

According to the INDC-RD (2015) the aim is to achieve a 25% reduction of base year 2010 emissions by 2030. The INDC-RD Plan is based on the END, the National Climate Change Policy, the Plan for Economic Development Compatible with Climate Change (DECCC) and the National Adaptation Action Plan (PANA-RD).

According to the updated version of the Nationally Determined Contribution NDC-RD 2020 (Gobierno de la República Dominicana, 2020) the target is a 27% reduction in GHG emissions in relation to a Business as Usual (BAU) scenario by 2030. The NDC-RD 2020 provides for the implementation of a National Action Strategy for Climate Empowerment (ACE). In terms of electric mobility, the NDC-RD proposes:

- Electrification of the fleet of diesel buses.
- Renewal of public transportation vehicles, such as cabs and "conchos" with electric and hybrid vehicles.
- Introduction of electric buses for school transportation service.
- Regulation and creation of policies to encourage the transition to electric and hybrid mobility for private usage.

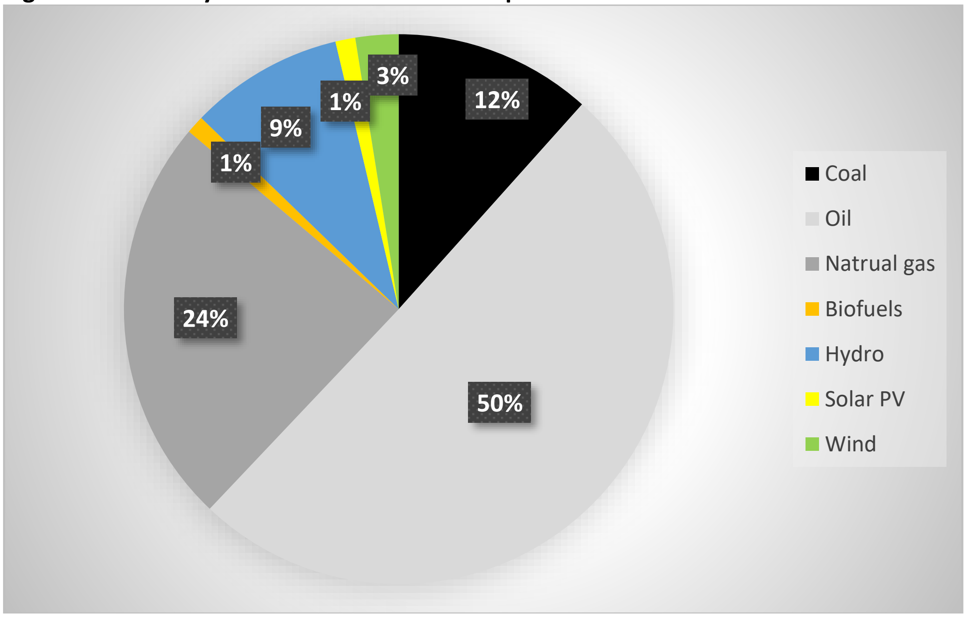
The Dominican Republic is highly dependent on imported fossil fuels. To reduce this dependence, the diversification of the energy mix has been promoted with the installation of important renewable

[1] See Report Grutter Consulting, 2020, Country Diagnostic Dominican Republic for further details

energy projects in recent years. The BUR foresees the installation of more than 1,000 MW in renewable energies (solar, small hydro and wind).

In 2018 the share of renewables in total electricity generated was around 15% (see following figure). Oil, natural gas and coal are the main generation sources.

Figure 1: Electricity Generation Dominican Republic



Source: IEA database

The carbon factor of the electricity grid of Dominican Republic is for 2019 0.643 $kgCO_2/kWh$[2].

2.3. Transport Sector

2018 some 4 million vehicles were operating in Dominican Republic. The country has the vehicle emission standard equivalent to Euro 4 since 2011.

Transportation emission costs modelled in this report are 560 million USD for 2018 and 700 million USD for 2030 with the share of local pollutants being around 35% in 2018 and dropping to 14% by 2030 due to more modern vehicles with lower emission levels. Vehicle emission costs represents for 2018 1% of the country's GDP.

Road transport GHG emissions of Dominican Republic in 2019 are estimated at 7 million tCO_{2e}[3] based on a bottom-up transport model calibrated with top-down fuel consumption data. Taxis represent in 2018 around 3% of GHG emissions, buses 14% and LCVs 10%. Noteworthy is also that the mentioned commercial vehicles represent 40% of $PM_{2.5}$ and 30% of NO_x emissions of the transport sector due to being primarily diesel vehicles whilst passenger cars and motorcycles used by private persons are predominantly gasoline and LPG powered.

GHG emission from the road transport sector are expected to grow under a BAU scenario by more than 70% reaching 12 million tCO_2 by 2030 (see table below).

[2] Calculation by Grutter Consulting based on data from IEA (Grutter Consulting, 2021)

[3] Tank-to-wheel approach; Using a well-to-wheel approach including Black Carbon emissions are: 9 $MtCO_{2e}$

Table 1: Projected 2030 Road Transport Emissions

Vehicle category	NO_x	$PM_{2.5}$	CO_2 TTW	CO_2 WTW	Energy in TJ
Passenger car	3,214	115	5,808,362	6,869,859	86,268
Taxi	143	3	433,565	488,534	6,871
Motorcycles	4,768	86	2,716,240	3,251,680	39,195
small bus	738	11	220,006	258,336	3,332
standard urban bus	319	3	69,674	87,535	940
Coach	4,388	34	764,103	963,046	10,312
LCV	1,484	70	750,750	958,141	10,565
Truck < 7.5t	4,286	28	841,056	1,053,198	11,350
Truck 7.5-16t	1,537	9	286,498	358,697	3,866
Truck 16-32t	2,222	14	388,158	486,793	5,238
Truck >32t	1,213	7	210,425	263,582	2,840
Total	**24,312**	**380**	**12,488,837**	**15,039,402**	**180,779**

Source: (Grutter Consulting, 2021)

Specific plans on sustainable urban mobility have been developed, such as the Strategic Plan for Sustainable Urban Mobility of Greater Santo Domingo and the National Strategic Plan for Electric Mobility in the Dominican Republic, both developed by INTRANT in collaboration with other ministries and international entities. In accordance with the Sustainable Urban Mobility Plan for Greater Santo Domingo (SYSTRA, 2019) collective transportation in the province of Santo Domingo is divided into publicly operated buses, and other means of transportation such as buses and minibuses belonging to unions and congregated in federations. The large majority of buses are tourism and private buses. Micro- and minibuses also represent an important share whilst the number of large urban buses is limited. In 2011, there were 14 public transport federations and 169 private operators.

2.4. EV Policies and Activities

In 2013 the first law supporting electric mobility was enacted, the Electric Mobility Incentives Law 103-13, which gives some import tax benefits to EVs. In 2020 the Dominican Republic has recently adopted a National Strategic Plan for Electric Mobility (INTRANT, 2020) developed by INTRANT in collaboration with the IDB. It provides for a short, medium and long term transformation of the transportation sector. The plan is aligned with both the UN Sustainable Development Goals (SDGs) 2030 and the Sustainable Development Plan 2030 of the Dominican Republic (Ministerio de Economía, Planificación y Desarrollo , 2012) and aims at all modes of road transportation.

The Dominican Republic's Strategic Plan for Electric Mobility is based on four fundamental axes:

1. The legal and regulatory framework;
2. Charging infrastructure development;
3. Increase of the number of EVs;
4. Improve institutional and professional capabilities.

30% of official vehicles and public buses shall be electric by 2030, whilst the target for the private sector is 10%. 14,000 public charges shall be operational by 2030. By 2050 the respective goals are 100% EVs for official vehicles and public buses and 70% of all private vehicles shall be electric. For the freight sector the target for 2050 is 50% of all units to be electric.

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

Table 2: Enabling Factors and Barriers to Commercial EVs in Dominican Republic

Enabling factors	• Enabling regulatory framework through the national policy on EVs, the tax incentive law, or the law to support renewable energies. • Political interest in electric mobility expressed through the Strategic Plan for Electric Mobility.
Barriers	• The lack of a regulations e.g. for charging infrastructure or pricing. • A high cost of EVs. • No specialized providers of maintenance of EVs.

3. Actor Mapping

Instituto Nacional de Tránsito y Transporte Terrestre (INTRANT)
INTRANT is the governing institution of the sector. For the development of its functions, INTRANT is based on Law 176-07 which legislates on the organization, competence, functions and resources of the mayors' offices.

Oficina Metropolitana de Servicios de Autobuses (OMSA)
Public company that provides public transportation services through buses. It was created in 1997[4] and its general function is to plan and organize the public transportation service of state buses, maintain and repair the vehicles in optimal conditions, manage the bus routes, and regulate the fare offered to the public.

Office for the Reorganization of Transportation (OPRET)
It is a public or mixed public-private company that provides rail transportation services. Established in Law 63-17[5], it focuses on the development and execution of the strategic plan for sustainable mobility.

Unidad Ejecutora para la Readecuación de Barrios y Entornos (URBE)
It is part of the Ministry of the Presidency[6] (MINPRE) and through urban interventions has motivated the creation of projects to connect marginalized neighborhoods to the transportation network of Greater Santo Domingo, such as the first cable car line. It is a multidisciplinary committee that oversees the execution of urban projects.

Ministry of Environment and Natural Resources (MIMARENA)
It is the ministry in charge of developing national policies on the environment and natural resources[7], ensuring the preservation and sustainable use of the environment and the proper management of natural resources.

Ministry of Energy and Mines (MEM)
MEM is in charge of promoting and fostering the development and sustainability of the hydrocarbons sector, promoting energy efficiency and savings, maintaining the energy infrastructure in good condition, promoting the use and development of sustainable, renewable and alternative energies, and developing the energy sector in all its aspects.

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[4] http://www.omsa.gob.do/index.php/sobre-nosotros/resena-historica
[5] *https://www.opret.gob.do/SobreNosotros/QuienesSomos*
[6] *https://www.urbe.gob.do/nosotros/quienes-somos.php*
[7] *https://ambiente.gob.do/quienes-somos/*

Superintendency of Electricity (SIE)

This is the government agency in charge of overseeing and supervising the execution and implementation of the legal and normative regulations that apply to the electricity sector. It also regulates the generation, commercialization and distribution of electricity, as well as electricity tariffs.

National Energy Commission (CNE)

CNE is the entity in charge of guaranteeing compliance with the Incentive Law for the Development of Renewable Energies, Law No. 57-07[8]. Among its functions are the development of projects, policies, regulation of activities related to conventional, renewable and alternative energies.

National Council for Climate Change and Clean Development Mechanisms (CNCCMDL)

This institution works in favor of reducing GHG emissions and promoting clean and sustainable energies.

Dominican Electric Mobility Association (ASOMOEDO)

Non-profit organization that promotes the implementation of sustainable and electric transportation systems.

AFD and European Union

AFD together with the European Union have been supporting the Greater Area of Santo Domingo in their peruse of reducing GHG emissions in the transport sector. In September 2020, they have committed to further support the implementation of the actions specified in the SUMP for Santo Domingo (also developed with AFD funding) with 10 Million Euros. Some actions include structuring the bus network, improving road connections, creating a pedestrian/cyclist network, road planning and traffic management. Likewise, organizing services and intermodality, establishing an integrated and social fare policy, managing demand and modernizing the vehicle fleet are among the objectives of the SUMP.

Feasibility studies are to be conducted for the establishment of bus lanes, capacity building as well as pilot projects. [9]

German Cooperation Agency GIZ

Through the project "Energetic Transition in the Dominican Republic", financed by the German Ministry of Environment, GIZ has been working together with the Dominican Government (specifically with the Ministry of Energy and Mines, as well as other 16 counterparts from the energetic sector, to implement measures that promote renewable energies and reduce CO_2 Emissions in the country. The project focuses on four different components i) legal framework and communication, ii) financing of renewable energies, iii) Climate Change Policies and MRV iv) capacity building in grid integration and v) pilot projects. Although there are no specific lines of action for e-mobility, it does lay the groundwork for the transition, since the diversification of the energy matrix with renewables plays out in more GHG reductions with EVs. Currently, the GIZ hired a consultancy to elaborate technical norms for e-mobility in the Dominican Republic and another one to establish differentiated tariffs for EV Charging.

[8] *https://www.cne.gob.do/sobre-nosotros/quienes-somos/*

[9] https://intrant.gob.do/index.php/noticias/item/655-afd-y-union-europea-destinan-fondos-al-intrant-para-acciones-de-movilidad-sostenible

UN Environment

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. [10]

InterAmerican Development Bank (IDB)

IDB has been a strategic ally in the transition towards e-mobility. They financed and developed the "National Strategic Plan for e-Mobility" together with INTRANT and the Ministry of Energy and Mines. This plan describes in depth the current panorama for electric vehicles in the Dominican Republic, identifies barriers and enables and defines some of the next steps to be taken by several actors in the energy and the transport sector.

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.
- National scenario based on national EV targets (INTRANT, 2020).
- 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 2 other scenarios has been chosen.

The following table shows the results in terms of GHG reduction against a 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	170,000	620,000
	IEA30@30	340,000	1,230,000
	National scenario	110,000	660,000
	"High growth" scenario	360,000	1,460,000
Electricity demand of EVs in GWh per annum	IEA 15@30	220	770
	IEA30@30	440	1,540
	National scenario	180	910
	"High growth" scenario	440	1,730

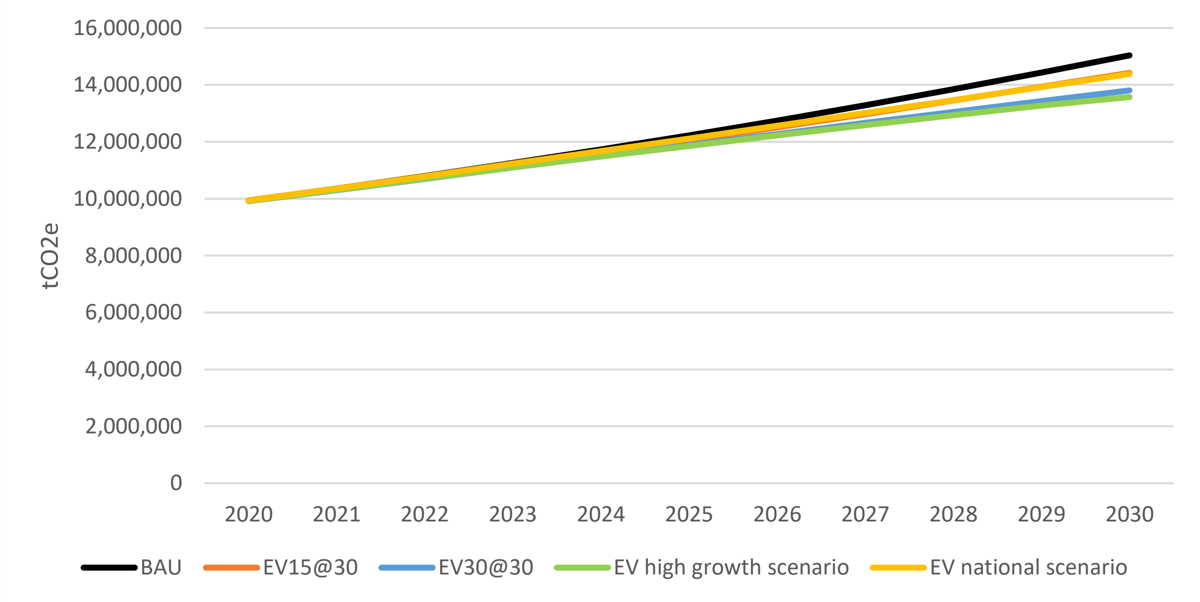
Source: (Grutter Consulting, 2021)

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

[10] https://movelatam.org/

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 Dominican Republic under Different Scenarios (WTW)



Source: Grutter Consulting

The 2030 projected electricity demand of EVs represents 6% of same year electricity generation for the EV scenario using the highest growth scenario. The electricity demand increase resulting from EVs is very gradual and thus leaves enough time to the country to plan a potential production expansion.

5. Market Analysis[11]

5.1. Current EV Market

The current EV market in incipient and based on pilot projects. The country has currently a public and private network of more than 250 charging points. In terms of infrastructure, Plug Share, a site that is responsible for mapping international charging infrastructure, estimates that there are about 150 public / private charging points installed in Dominican Republic, which are concentrated in the south and south-eastern axes of the country.

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. The TCO only includes parameters which are different between an EV and a fossil unit i.e. Capital

[11] See also for further details (Grutter Consulting, 2021a)

Expenditure (CAPEX), energy costs, maintenance costs and finance costs. Other (important) costs such as for example for bus operators driver, fare system, or management are not included as these are identical between technologies. This needs to be considered when comparing TCOs from different sources.

- 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 transport sector calculated at 10%[12];
- 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 (see for other characteristics Annex). To comply with operating conditions in Dominican Republic an overnight charged bus would require a battery set of 370 kWh whilst a fast-charged unit could be equipped with a 200 kWh battery set and 300 kW chargers (on average 1 per 8 buses)[13].

Table 4: Summary Financial Assessment 12m BEBs Dominican Republic

Criteria	Result	Assessment
Financial TCO	0.62 – 0.67 USD/km for BEBs versus 0.57 USD/km for diesel Euro IV bus[14]	Non-discounted the cumulated lifetime costs for BEBs are higher than for diesel buses.
Capital investment	290-320,000 USD for BEB incl. chargers, grid connection and bus depot upgrade; 130,000 USD for diesel bus	Significantly higher capital requirement incl. higher loan demand; negative impact on debt to equity ratio
Equity investment	100,000 for BEB[15] versus 30,000 for diesel bus	Significantly higher equity demand which might overstretch the capabilities of enterprises
Profitability[16]	Negative FIRR	Investment in e-buses is not profitable
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.

[12] See (Grutter Consulting, 2021a) for details of calculations
[13] For details see Annex
[14] 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 management overhead. Calculated for 16-year lifespan.
[15] Banks only finance 80% of BEB but not of charging infrastructure, grid connection and depot upgrades due to not being collateral
[16] FIRR of incremental investment compared to diesel bus

Cash Flow (CF)	Negative cumulative CF during asset lifetime due also to battery replacement in year 8 and charger replacement in year 10	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.

Source: (Grutter Consulting, 2021a); see Annex for details including assumptions

The investment in BEBs with the current financial conditions and business models is not profitable and entails a high risk. BEBs will require a different financial structuring and financial incentives to be a viable business proposal in Dominican Republic.

5.2.3. Electric Taxis

The following table summarizes the financial assessment of e-taxis. The comparison is based on a Hyundai Elantra with gasoline engine versus a Nissan Leaf or BAIC e-taxi with a 60kWh battery set.

Table 5: Summary Financial Assessment E-Taxis Dominican Republic

Criteria	Result	Assessment
TCO[17]	0.09 USD/km for e-taxis versus 0.10 USD for gasoline unit	Non-discounted the cumulated lifetime costs for e-taxis are comparable to gasoline units.
Capital investment	38,000 USD for e-taxi including homer charger versus 13,000 USD for gasoline unit	Significantly higher capital requirement incl. higher loan demand
Equity investment	8,000 USD for e-taxi versus 3,000 USD for gasoline unit	Significantly higher equity demand which might overstretch the capabilities of taxi owners
Profitability[18]	FIRR of 6%	Investment in e-taxis is not profitable.
Discounted Payback	Incremental investment is not recovered during the 10 years savings	The payback time is too long. This indicates a high risk profile of the investment.
Cash Flow	Negative cumulative CF until year 7	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, 2021a); see Annex for details including assumptions

The investment in e-taxis with current financial conditions and business models is a loss business with a considerable risk and high 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. A fast-charging urban network of 100-150kW chargers 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.

[17] Includes CAPEX, energy, maintenance and finance costs; does not include other costs such as the driver which are independent of the technology chosen
[18] FIRR of incremental investment compared to gasoline taxi

5.2.4. Electric LCVs

The following table summarizes the financial assessment of e-LCVs. The comparison is based on a Peugeot Boxer Diesel versus the electric version.

Table 6: Summary Financial Assessment e-LCVs Dominican Republic

Criteria	Result	Assessment
TCO[19]	0.38 USD/km for e-LCVs versus 0.24 USD/km for diesel unit	Non-discounted the cumulated lifetime costs for e-LCVs is higher than for fossil units
Capital investment	82,000 USD for e-LCV including home chargers versus 40,000 USD for fossil unit	Higher capital requirement incl. higher loan demand
Equity investment	18,000 USD for e-LCV versus 8,000 USD for fossil unit	Double equity demand
Profitability[20]	Negative IRR	Investment in e-LCVs is not profitable
Discounted Payback	Incremental investment is not recovered in lifetime of vehicles with savings	The payback time is very long. This indicates a high risk profile of the investment. This is also due to investment for replacement battery in year 7/8
Cash Flow	Cumulative negative entire lifespan	The investment in e-LCVs has a cumulative negative liquidity impact during the lifespan

Source: (Grutter Consulting, 2021a); see Annex for details including assumptions

The investment in e-LCVs with current financial conditions and business models is not profitable, has a high risk and a very long payback time. Also electric LCVs are not common in the market.

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 and 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/CAF loan conditions non-sovereign public sector	5.0%	AFD
Assumed shares	30% GCF and 70% AFD	
Bank spread for on-lending	2%	Assumed
Resultant minimum loan rate for buses if based on project finance with public lender e.g. municipality	3.9%	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; 5 years taxis; 6 years LCVs	

[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 LCV

5.3.2. E-Buses

Concessional finance would result in an interest rate of 3.9% instead of 6.9%. The level of concessionallity would be dependent if the recipient is a public body e.g. municipality or public bank. An 80% lending rate on the total CAPEX and not only on buses is also assumed. It can be concluded that the concessional loan helps to resolve liquidity issues and results in an improvement of the investment profitability but risks very remain high with an unsatisfactory payback and a negative profit rate. It is clear that concessional loan conditions are an important feature but are not sufficient to tilt an investors decision with the current risk profile of BEBs in the country.

A 20% upfront grant resolves only partially the profitability and risk issue. The payback period is still too long i.e. additional incentives are required. With current electricity prices in Dominican Republic e-buses, even with significant incentives, remain unprofitable[21]. Diesel buses are also used for a long period (beyond the 10 years stipulated in the IDB, 2020) with a comparable lifespan of e-buses. Overall, additional incentives or regulations requiring the usage of e-buses will be required to make urban e-buses financially feasible in the Dominican Republic. Even with decreasing e-bus prices latter will not be commercially viable by 2030.

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. electric utility) and would be partially grant and concessional loan financed (see chapter 6 for a possible project). Taxis would thus just pay the price charged for usage of public chargers (time/power/consumption relative prices possible). Taxis are privately owned and managed.

A concessional loan improves the liquidity but will not make a major change due to the fact also, that there is already a loan facility in place with favourable conditions. A 20% grant would however make investments profitable.

The figure below shows the trend of decreasing dynamic paybacks of e-taxis. Clearly with decreasing prices they get more attractive. The project trend price decreases only applies if national manufacturers start producing low-cost EVs such as used for taxis. Also, 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.

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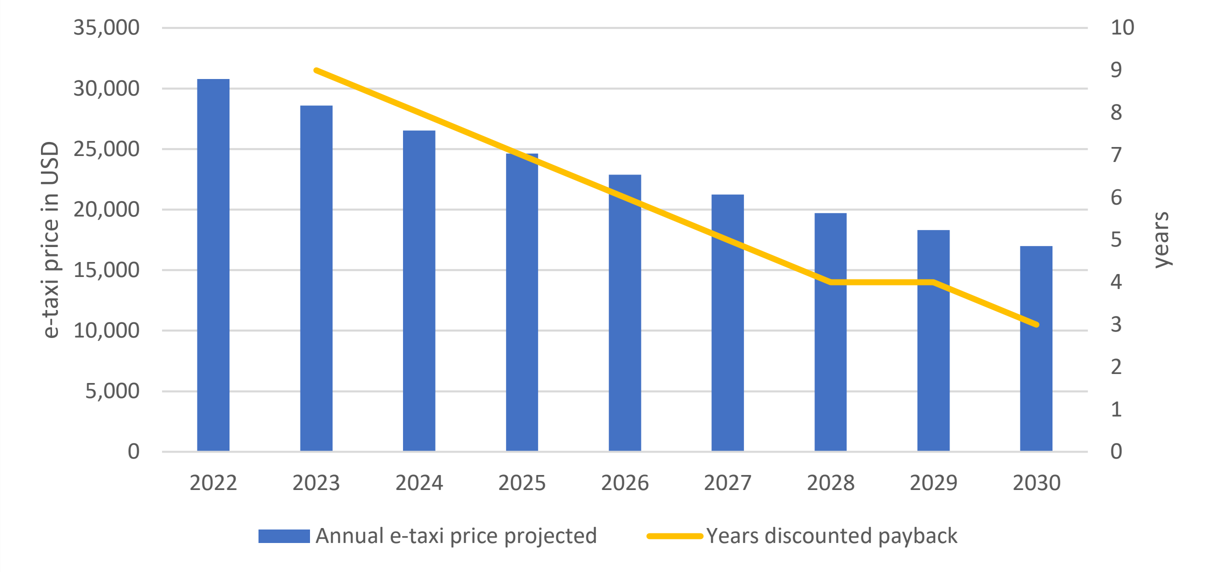
[21] The average electricity price is estimated at 0.16 USD/kWh which is based on medium tension consumption rates of 0.11 USD/kWh plus demand charge

Figure 3: Dynamic Payback versus Projected e-Taxi Price Decrease



Source: Grutter Consulting; annual decrease of e-taxi prices projected at 7% based on price parity expected by 2030 (see Electric vehicle trends | Deloitte Insights)

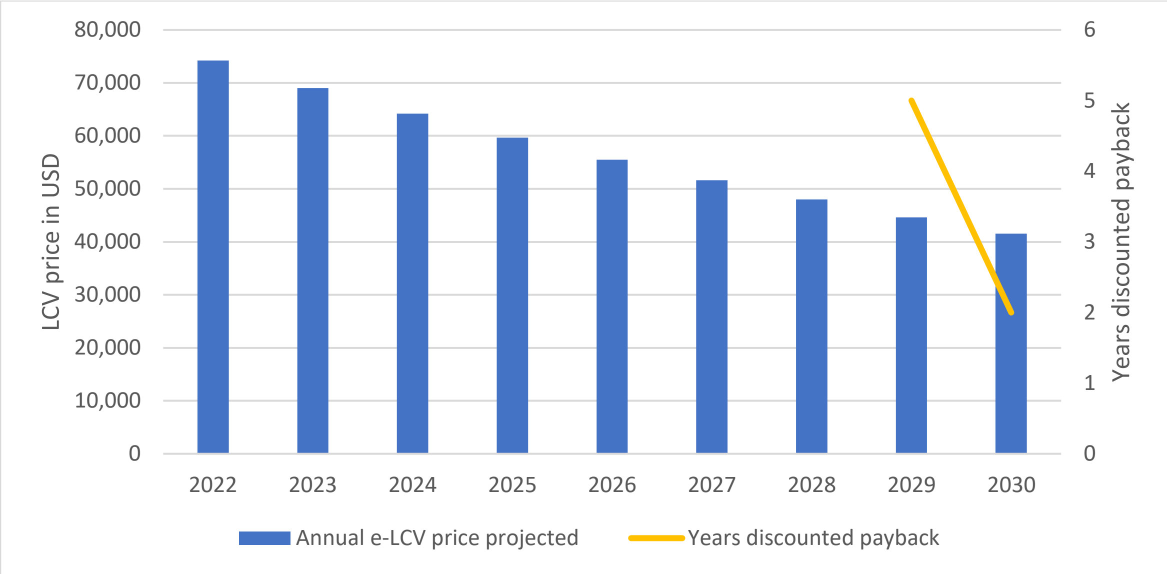
The conclusion for e-taxis is that these will get commercially viable within some years if the issue of a fast-charging infrastructure is resolved.

5.3.4. E-LCVs

LCVs are privately owned and managed. The assumed business model is that finance is provided through loans managed by public banks which would receive the concessional conditions of the Program. A concessional loan improves the liquidity situation and the TCOs without however having a major impact in other areas. Also a 20% upfront grant does not resolve the major commercial investment problems. Diesel LCVs have very low operational costs and a high energy efficiency. Electric versions still have a very high CAPEX with prices however decreasing. The differential CAPEX is not recovered even with incentive levels as modelled.

The figure below shows the trend of decreasing dynamic paybacks of e-LCVs. Clearly with decreasing prices they get more attractive, however only around 2029.

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



Source: Grutter Consulting; annual decrease of e-LCV prices projected at 7% based on price parity expected by 2030 (see Electric vehicle trends | Deloitte Insights)

The conclusion for e-LCVs is that these will get commercially viable – however investment projects in such vehicles will only make sense after 2025 to achieve a sustainable impact.

5.4. BAU versus Project EV Market Deployment

5.4.1. Approach

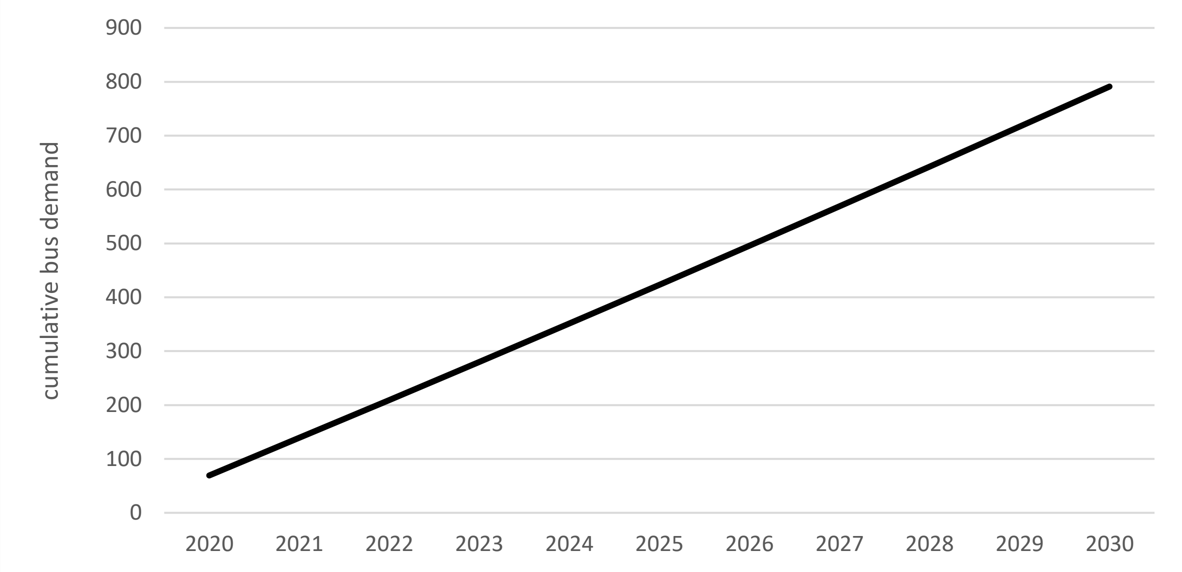
Under a BAU scenario EVs will pick up without commercial support. The question is when and how much. The following chapters will model the BAU deployment expected for the different commercial EV technologies due to decreasing EV prices and therefore increasing financial profitability of latter and the scenario of commercial EV deployment with program activities. This allows to model a scenario with and without program 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 Dominican Republic based on vehicle replacement and market growth rates.

Figure 5: Total Projected Cumulative Market Demand Urban Buses Dominican Republic



Source: (Grutter Consulting, 2021)

The cumulative projected urban bus demand for standard 10-12m buses is very limited. The majority of buses are used for inter-urban or tourist services (coach buses) or are minibuses. These are technically more difficult to electrify than urban buses (see chapter 6) and are thus not considered in this program.

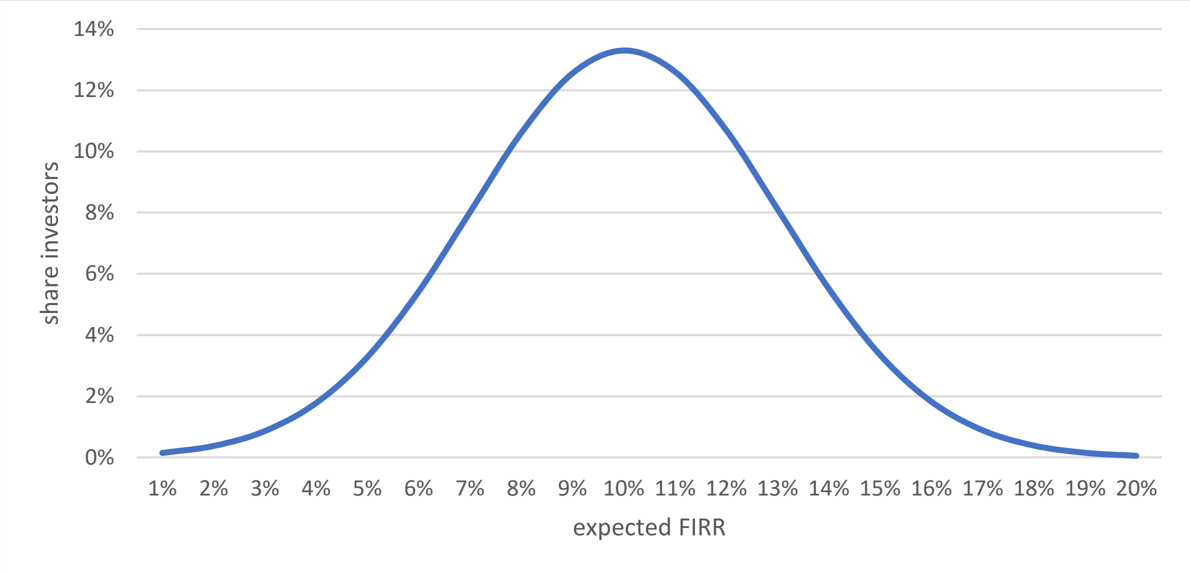
Projected BAU Demand for E-Buses

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 20% as buses might consume more energy or electricity prices might increase respectively costs depend on consumption pattern.
- 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 20% higher maintenance costs than expected.
- 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.

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 10.0%.

Figure 6: Expected FIRR of Investors



Source Grutter Consulting

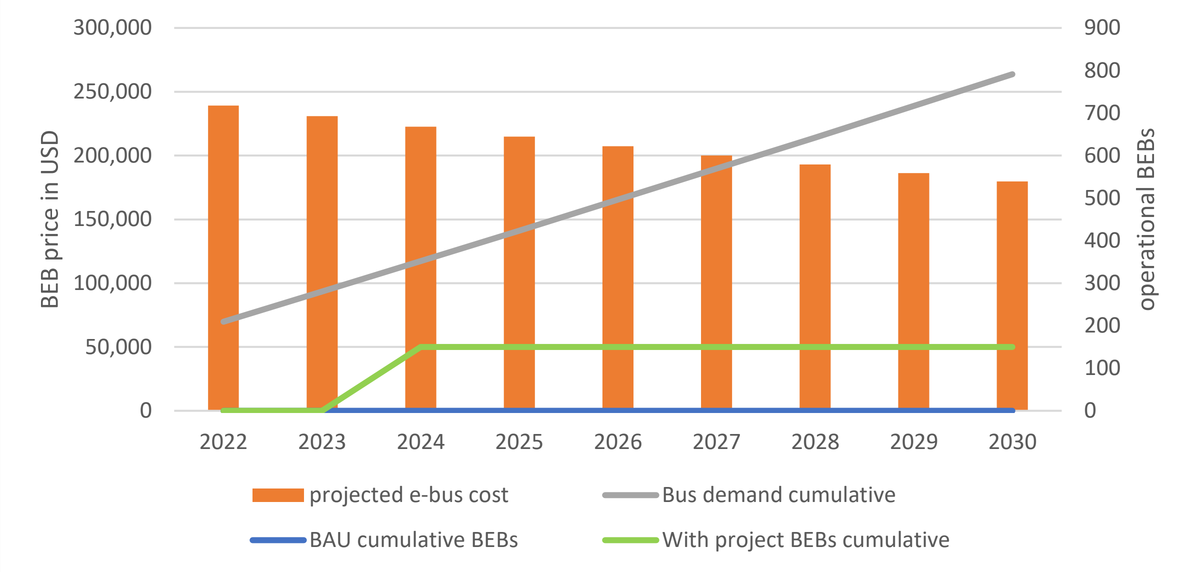
Even with 4% annually decreasing prices there is no commercial uptake of e-buses projected in the Dominican Republic by 2030.

Estimated 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 e-buses financed by the project enters operations in 2024). 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 7: BAU and with-Project Projected E-Bus Uptake in Dominican Republic and Price Trend of E-Buses



Source: Grutter Consulting; based on real constant USD; assumes constant real energy prices and other cost components except price of BEBs

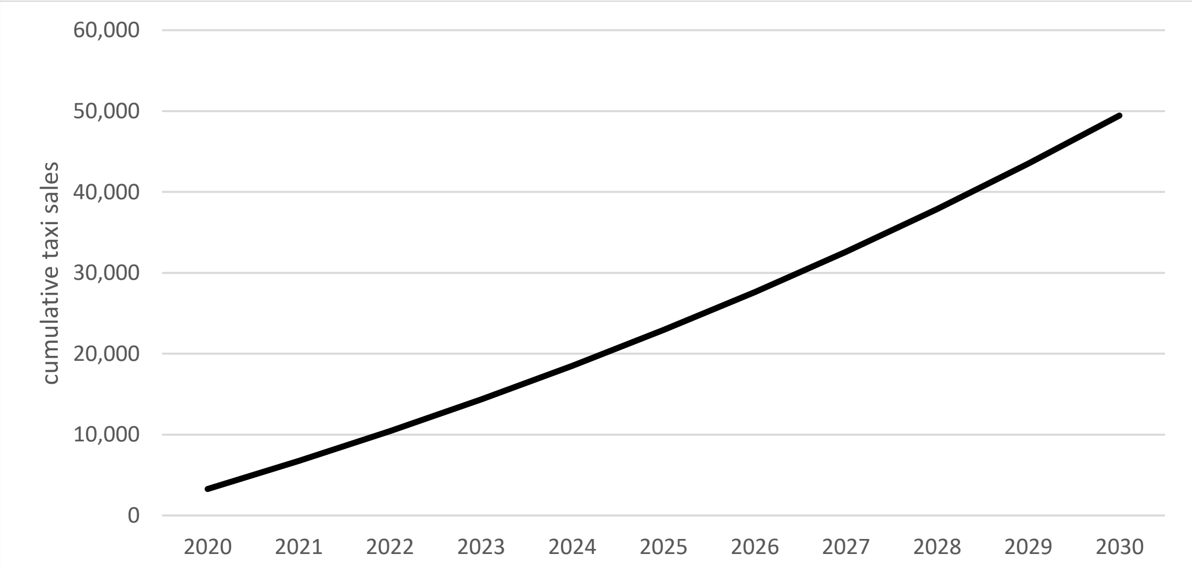
The project intervention helps to get an urban bus fleet on the ground. However, as long as no significant changes of energy prices occur this will not result in a commercial uptake of electric buses.

5.4.3. E-Taxis

Market Demand for Taxis

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

Figure 8: Total Projected Cumulative Market Demand Taxis



Source: Grutter Consulting (see report 1)

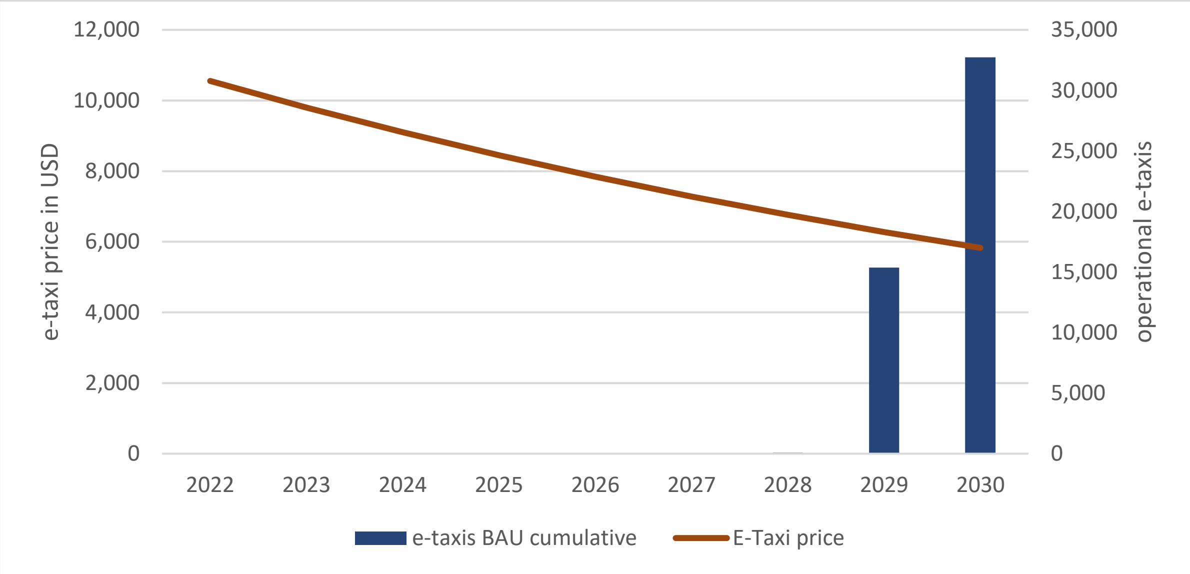
Projected BAU Demand for E-Taxis

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 10% 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[22].

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 Dominican Republic.

Figure 9: BAU Projected E-Taxi Uptake in Dominican Republic and Price Trend of E-Taxis



Source: Grutter Consulting; based on real constant USD; assumes constant real energy prices and other cost components except price of electric taxis

Under a BAU scenario electric taxis start to get commercially viable around 2029 and then increase rapidly. The share of electric taxis by 2030 could reach under BAU 20%.

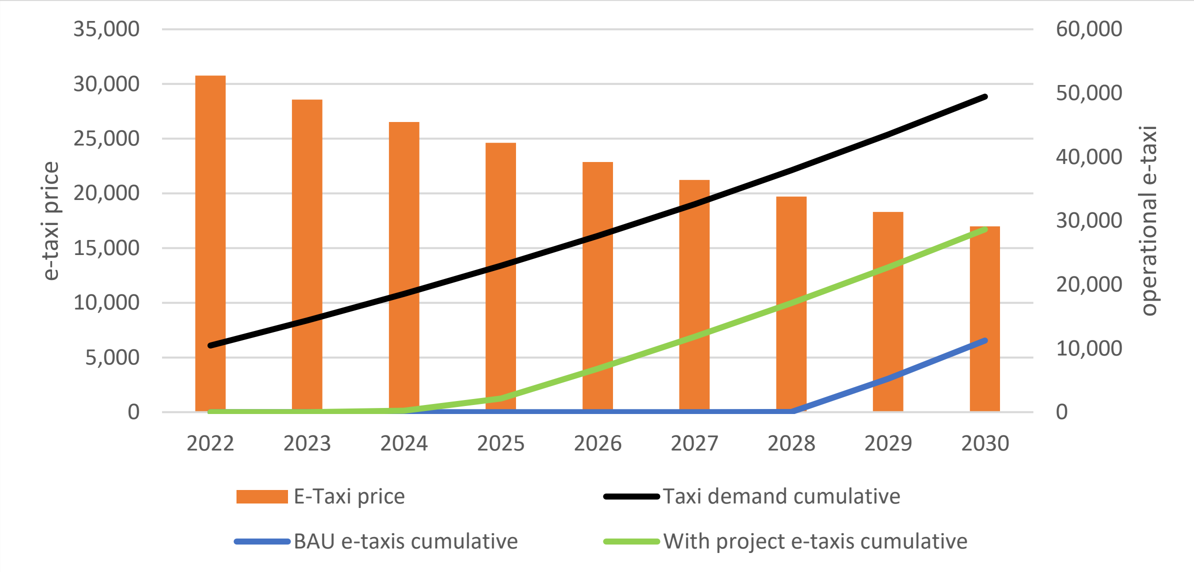
Projected with-Project Demand for E-Taxis

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.

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

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 2024 to 2026 is assumed (it is assumed that by 2024 a charging infrastructure is deployed and an initial fleet of e-taxis is deployed[23]). 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 10: BAU and with-Project Projected E-Taxi Uptake in Dominican Republic and Price Trend of E-Taxis



Source: Grutter Consulting; based on real constant USD; assumes constant real energy prices and other cost components except price of electric taxis

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 29,000 instead of 11,000 units with an e-taxi market share of over 50% instead of 20% by 2030. 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 1,280,000 tons of CO_2 reduced;
- Additional 15 tons of $PM_{2.5}$ avoided;
- Additional 820 tons of NO_x avoided;
- Additional economic savings of 52 MUSD.

5.4.4. E-LCVs

Electric LCVs are not deemed to be commercially viable until 2029. Therefore it is suggested that the program does not intervene in this area as financial assistance would not be sustained with market interventions.

[23] Charging infrastructure with financial assistance of the Program; e-taxis with market conditions prevailing including the special interest rate for electric taxis already in place

6. Potential Investment Projects

6.1. Urban Buses

6.1.1. Barriers and Interventions Options

Public transportation in Santo Domingo has been going through some important restructuration process, unifying individual operators into bigger consortiums that will operate on established bus lanes. Many of these, have significant fleets and will be replacing part of their fleet in the short term in order to be able to compete for the operation on some of the main bus corridors. One of the biggest barriers identified for the deployment of e-buses is the additional CAPEX. There is already an established SPV (FIMOVIT – Fideicomiso de Movilidad y Transporte), that could be used in order to cover the incremental initial cost of an e-bus. This option has also been presented in the strategic plan. This SPV gets funding from a percentage of the taxes on fossil fuels.

Another barrier identified is the lack of capacities in the institutions and the operators when it comes to making decisions on which BEB would be more suitable for the routes. Since a series of BRT lanes are being structured, there is a window of opportunity to work together with INTRANT and the operators in order to find the optimal technology for each corridor (dimensioning of the battery pack, charging facilities, training of drivers and maintenance personal etc.)

As seen previously, with the current prices for the electricity in the Dominican Republic, the TCO for buses remains higher than for diesel buses. Defining a preferential tariff for e-buses is therefore one of the main necessary intervention if the country intends to make the electrification of PT fleets attractive for investors. This is been currently assessed by a consultancy from GIZ which defines regulation for chargers as well as a differentiated tariff.

6.1.3. Possible Business Models

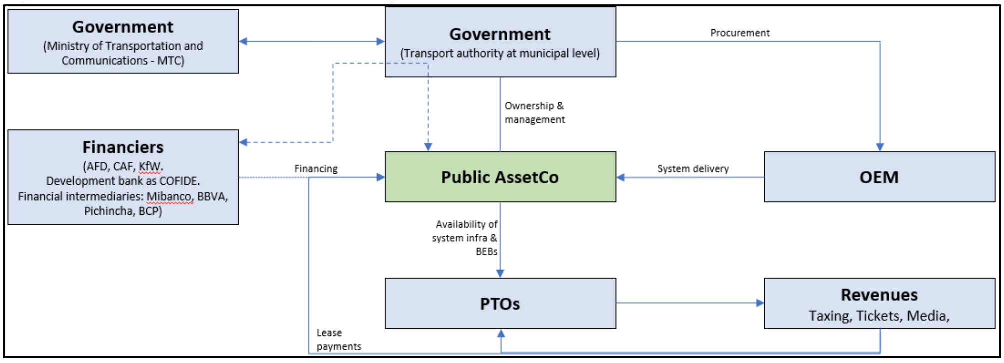
The typical structures that could be followed in the case of Dominican Republic are:

- 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 11: 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:

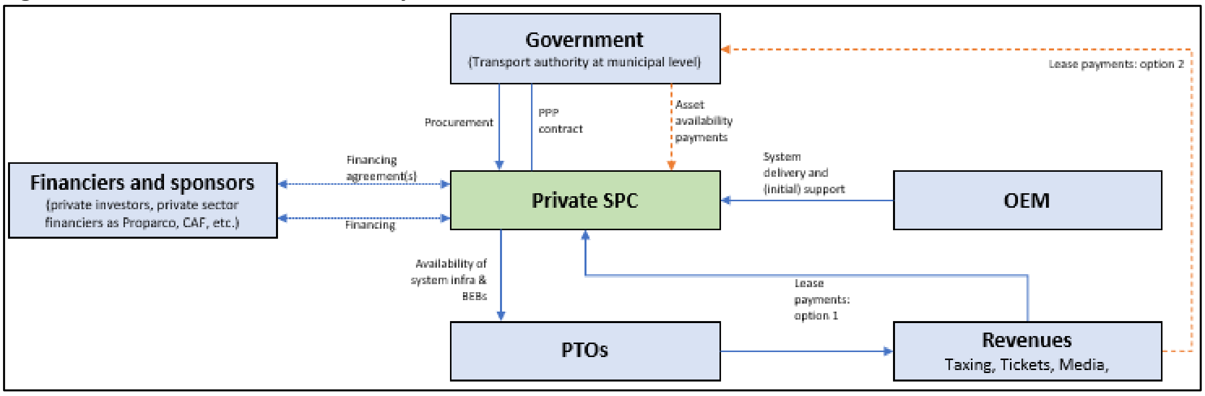
- Government (central government or municipalities) procures both financing and BEB system assets;
- Financing agreements are either with the government (public financing sourced e.g. from eMotion) and the government passing the financing through into the AssetCo, or directly with the AssetCo – with 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 12: 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.

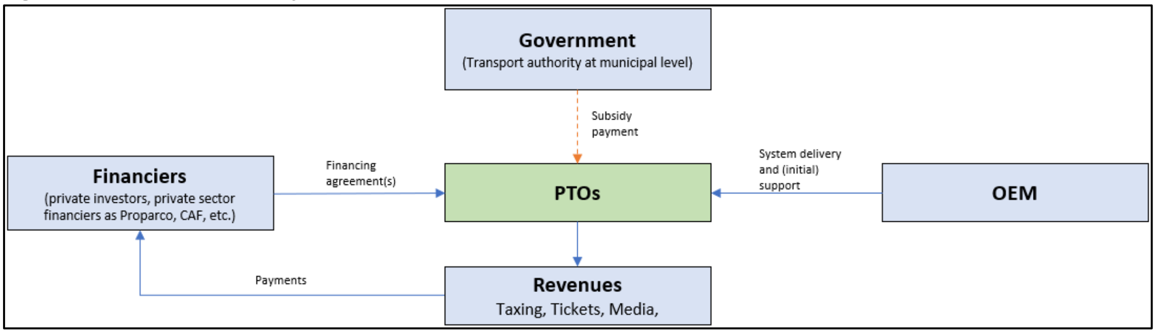
PTOs are required to use the BEB assets as made available by the SPV and are contractually bound to a care and maintenance obligation, as well as a handover obligation for transfer of assets to subsequent concession holders should a PTO lose its concession.

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 13: 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 2024) potential investment project is the purchase of 150 buses for the Metropolitan Bus Service (OMSA). The following table summarizes core characteristics of such a potential investment project.

Table 8: Potential E-Bus Investment Project

Item	Description
Project contents	150 urban e-buses of which 38 18m and 112 13m units
Project owner	Not yet defined; for bulk purchase association/lead operator or 3rd party (see possible business models in previous chapter)
Project beneficiary	OMSA
Total investment	62 MUSD
Loan components	44 MUSD loan for 70% of the total CAPEX @ 3.9% interest rate for 12 years of which the GCF 12 MUSD

Subsidy	12 MUSD (20% of total CAPEX)
Environmental impact (cumulative lifespan units)	Reduction of 123,000 tCO_{2e}, 3 tons $PM_{2.5}$ and 400 tons of NO_x worth 6 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 Dominican Republic as the market conditions are not conducive towards adoption of e-buses.

Market conditions are not yet given in Dominican Republic 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. INTRANT has recently been implementing bus corridors in Santo Domingo. These operations are accompanied by fleet renewal. Thus it is foreseen that initially TA will dominate and investment projects are not foreseen prior 2023/2024.

6.1.4. Coach Buses and Minibuses

The large majority of buses operating in the Dominican Republic are coach (inter-urban) units and minibuses. An electrification of such units is considered problematic at least for the short and medium term. Problems of coach buses are:

- Few suppliers of coach buses. European manufacturers are only planning to enter this market 2022 or later and also most Chinese manufacturers do not supply coach buses.
- Battery placement issues: with urban buses batteries are placed basically on the roof and underneath. This is not possible with coach units as such buses are already higher and adding batteries on the roof can cause stability problems whilst putting batteries underneath quits luggage space essential for inert-urban units. This limits the battery size one can pout on such buses.
- Range issues: with a limited battery pack the range will be limited of coach buses to 150-200km. Thereafter a fast charging will be required which however will take around 1 hour and with high temperatures more. This limits the usefulness of such buses.
- Profitability: at high speeds typical for interurban buses, diesel units are very efficient (the average fuel consumption drops for such buses from around 40-50l/100km for urban applications to 25-30l/100km for inter-urban buses) whilst the electricity consumption of e-buses is higher for coach units than for urban buses (limited electricity recovery with regenerative braking and higher speeds require more power and electricity usage). Thus, the relative profitability of a coach bus is much lower than for an urban bus.

Problems of minibuses are:

- Limited suppliers of minibuses.
- Battery placement issues: due to stability issues batteries are in general placed at the end of the bus and not on thereof taking away passenger space.
- Profitability: the cost of electric minibuses is 3-4x higher than a diesel minibus (for urban buses the factor is 2-2.5 times). Diesel minibuses are low cost and very cheap to maintain and highly efficient in energy usage. This makes it very difficult for e-buses to compete.

For these reasons the program will focus on urban buses.

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.
- 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.

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.

6.2.2. Potential Investment Project

Two potential investment projects have been identified including 230 electric taxis including the appropriate fast-charging network. However the project size is below 10 MUSD and thus too small for AFD. What is included is the eventual establishment of a fast-charging infrastructure which would only contemplate a 50% grant from the GCF and can this be managed with TA.

6.3. LCVs

Electric LCVs are not deemed to be commercially viable until 2029. Therefore it is suggested that the program does not intervene in this area as financial assistance would not be sustained with market interventions.

7. Proposed Financial and Technical Assistance

7.1. Financial Assistance Instruments

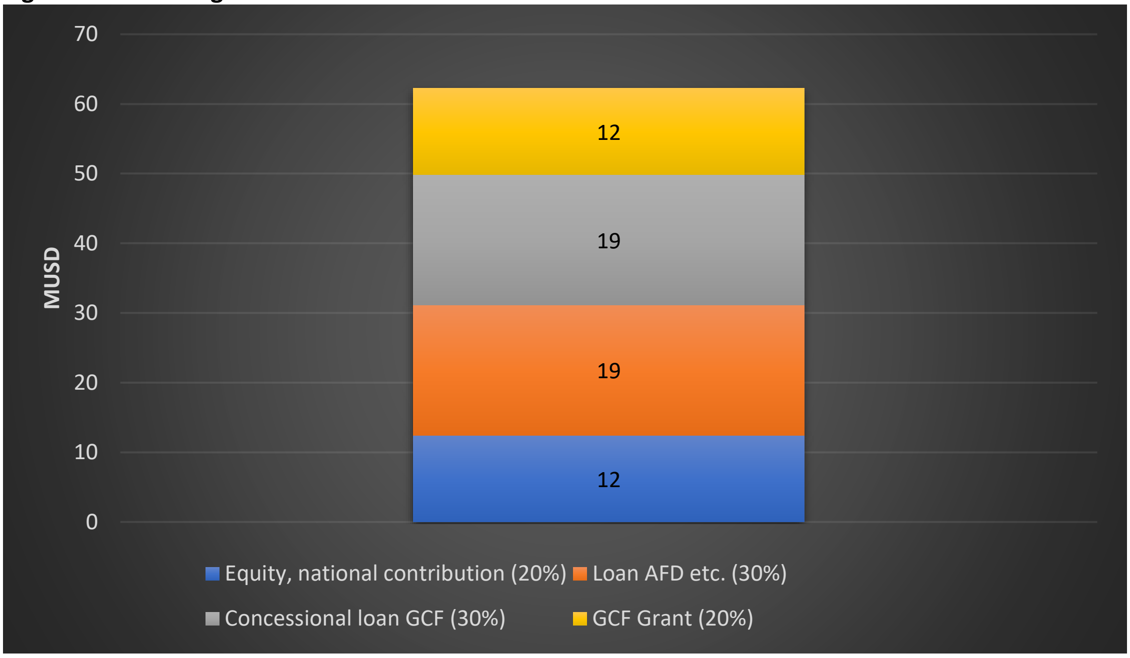
The following table summarizes financial intervention instruments proposed for commercial EV deployment in the Dominican Republic

Table 9: Financial Assistance GCF

Instrument	e-buses	e-taxis
Grants	20% of total CAPEX incl. buses, charging infrastructure, grid connection and bus depot upgrades	50% for fast charging infrastructure
Loans	30% of total CAPEX	

Concessional loans from the GCF are blended with co-finance and have a long tenure (12 years or longer for buses). GCF loan conditions have been estimated at 0.75% annual interest rate.

Figure 14: Financing Structure e-Buses



Note: Numbers are indicative; total of 150 buses
Source: Grutter Consulting

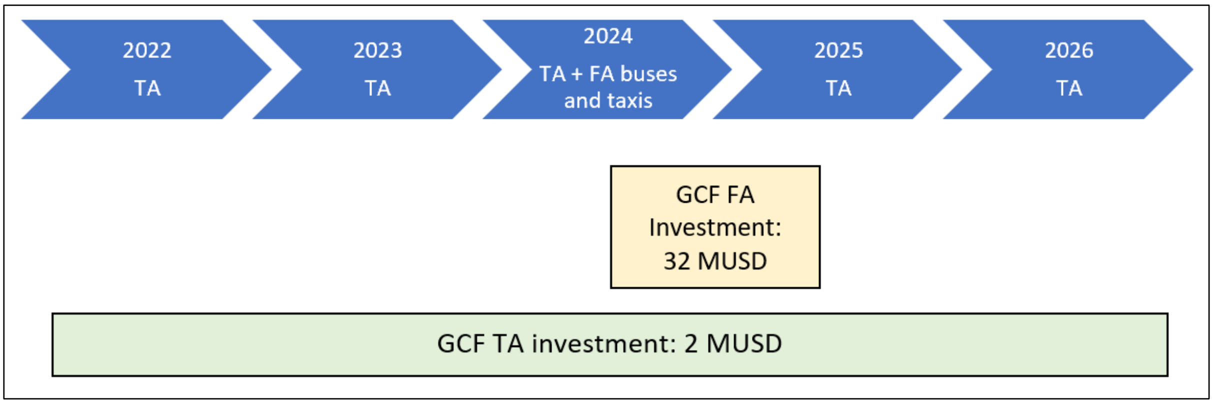
Table 10: FA Potential Projects Dominican Republic

Parameter	e-buses	e-taxi infrastructure	Total[24]
Total CAPEX	62 MUSD	2 MUSD	64 MUSD
Total loan	37 MUSD	0 MUSD	37 MUSD
Co-finance loan	*19 MUSD*	*0 MUSD*	*19 MUSD*
GCF loan	*19 MUSD*	*0 MUSD*	*19 MUSD*
GCF grant	12 MUSD	1 MUSD	13 MUSD
Equity and other co-finance	12 MUSD	1 MUSD	13 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. It is assumed as probable that a sovereign loan would be used for e-buses. The taxi infrastructure would only have a grant component with the delivery agent being the electric utility.

The total GCF contribution for the Dominican Republic from the GCF is estimated at 34 MUSD of which 19 MUSD concessional loan, 13 MUSD grant for FA and 2 MUSD for TA of which 1 MUSD for project preparation/feasibility and 1 MUSD for technical assistance. The following chart shows when investments are expected.

Figure 15: Expected Implementation of Projects



Source: Grutter Consulting

7.2. Technical Assistance Instruments

Possible TA interventions include the area of policies, business models and concrete specialized TA. The Strategic Action Plan (INTRANT, 2020), specifies four areas of intervention with a total of 27 activities. The four areas are: 1. Legal Framework, 2. Capacity Building, 3. Charging Infrastructure and 4. Public and Private Vehicles. The activities have already widely been discussed with the stakeholders and are therefore a binding guideline to define the logical framework for the project to be executed by the GIZ. Some of the most important areas are:

- Policy advice including the establishment of concrete sub-sector specific roadmaps on electrification of urban public transport buses, electrification of LCVs and public charging infrastructure.
- Advice on business models and sector re-structuring basically for the bus sector including new business models separating bus ownership and bus operations, integration of other players

[24] Due to rounding values might not sum up

with stronger financial background in the public transport sector, and adaptation of bus concession contracts and bus tariff structures.
- Information and knowledge dissemination as well as advisory services to companies and public entities interested in investing in LCVs.
- Establishment of low emission zones in city centres.
- On-going TA on specific conditions to improve the enabling conditions for e-mobility deployment such as capacity building for insurance companies and firefighters allowing insurance companies to better assess the risk and costs of insuring an electric vehicle and by training specialized fire fighters and vehicle maintenance personnel (mechanics and depot managers) on how to cope with the particular hazards of EVs.
- Battery management (“second life” and disposal) policies and regulations.
- Design of fast charging infrastructure for taxis and LCVs together with the private stakeholders.
- Further fiscal and non-fiscal incentives for EVs and charging infrastructure

TA for preparation / feasibility assessment of the projects worth 1 MUSD is managed and paid directly by the financing agent whilst the other TA activities worth 1 MUSD are executed by GIZ.

The Annex includes a detailed TA for the Program.

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 Dominican Republic of the EV program.

Table 11: Program Impact

Parameter	Direct impact	Total impact
GHG reduction lifetime vehicles cumulative in tons	140,000	1,400,000
• *Buses*	*120,000*	*120,000*
• *Taxis*	*20,000*	*1,280,000*
$PM_{2.5}$ reduction lifetime vehicles cumulative in tons	4	18
• *Buses*	*3*	*3*
• *Taxis*	*0*	*15*
NO_x reduction lifetime vehicles cumulative in tons	410	1,220
• *Buses*	*400*	*400*
• *Taxis*	*10*	*820*
Energy savings cumulative lifetime vehicles in TJ	1,820	26,000
• *Buses*	*1,500*	*1,500*
• *Taxis*	*320*	*24,500*
Fossil fuel savings cumulative lifetime vehicles in Ml	69	1,040
• *Buses*	*56 million litre diesel*	*56 million litre diesel*
• *Taxis*	*13 million litre gasoline*	*985 million litre gasoline*
Economic savings cumulative in MUSD	7	58
• *Buses*	*6*	*6*
• *Taxis*	*1*	*52*

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

Table 12: GCF Financial Indicators

Parameter	Direct impact	Total Impact
Total CAPEX investment	72 MUSD	
GCF Loan	19 MUSD	
GCF Grant FA	13 MUSD	
GCF Grant TA	2 MUSD	
Total GCF	**34 MUSD**	
Co-finance ration	**54%**	
GCF investment cost per tCO_2 reduced	**243 USD/tCO_2**	**24 USD/tCO_2**
Total investment cost per tCO_2 reduced	**527 USD/tCO_2**	**53 USD/tCO_2**

Bibliography

INDC-RD. (2015). *CONTRIBUCIÓN PREVISTA Y DETERMINADA A NIVEL NACIONAL- INDC-RD.* Santo Domingo : INDC-RD.

ADB. (2018). *Low-Carbon Buses in the People's Republic of China.*

Banco Mundial. (2020). *República Dominicana*. From Banco Mundial: https://datos.bancomundial.org/pais/republica-dominicana

Comision Nacional de Energia. (2014). *Prospectiva de la Demanda de Energia de Republica Dominicana 2010-2030.*

Embajada de la República Dominicana en Japón. (2021). *Geografía y Clima*. Obtenido de Embaja de Republica Dominicana en Japón: https://embadomjp.gob.do/index.php/es/republica-dominicana/geografia-y-clima

Gobierno de la República Dominicana. (2020). *Contribución Nacionalmente Determinada NDC RD-2020.* Santo Domingo: Gobierno de la República Dominicana.

Gobierno de la República Dominicana. (2020). *Primer Informe Bienal de Actualización de la República Dominicana ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático.*

Grutter Consulting. (2021). *Country Diagnostic Report Dominican Republic.*

Grutter Consulting. (2021a). *Assessment of Commercial EV Demand in Dominican Republic.*

ICCT. (2018). *Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions.*

ICCT. (2019). *Global progress toward soot free diesel vehicles in 2019.*

IDB. (2020). *Analisis y diseno de moldeos de negocio y mecanismos de financiacion para buses electricos.*

IEA. (2019). *Global EV Outlook 2019.*

INTRANT. (2020). *Plan Estratégico de Moviliad Eléctrica-República Dominicana.*

INTRANT. (2020). *Plan Estratégico Nacional de Movilidad Eléctrica República Dominicana.* Santo Domingo: BID.

IRENA. (2016). *Renewable Energy Prospects: Dominican Republic.*

Ministerio de Economía, Planificación y Desarrollo . (2012). *Ley 1-12 Estrategia Nacional de Desarrollo 2030.* Santo Domingo: Ministerio de Economía, Planificación y Desarrollo .

Ministerio de Turismo de la República Dominicana. (2020). *Sobre República Dominicana*. From Go Dominican Republic: https://www.godominicanrepublic.com/es/sobre-rd/

Murillo, J. H. (2009). *Inventario de Emisiones de Contaminantes Criterio del Aire de República Dominicana: 2009.* Santo Domingo: Comisión Centroamericana de Ambiente y Desarrollo (CCAD).

SELA. (2020). *República Dominicana*. From Sistema Económico Latinoamericano y del Caribe: http://www.sela.org/es/estados-miembros/republica-dominicana/#:~:text=Organizaci%C3%B3n%20administrativa%3A%2031%20provincias%20y,Plata%2C%20Pedernales%2C%20Peravia%2C%20Puerto

SYSTRA. (2019). *Plan de Movilidad Urbana Sostenible del Gran Santo Domingo.* Paris: MobiliseYourCity.

UNFCCC. (2019). *CDM Methodological Tool Investment Analysis Version 10.0.*

Annex 1: TA Project for Dominican Republic

The Dominican Republic has been advancing in several important steps to promote Electric Vehicles. INTRANTs e-mobility plan serves as a guideline for the steps need to continue paving the way. However, the financial analysis in this document states, that commercial EVs are still not financially attractive in this country. That is why the GIZ is currently working on the establishment of an electricity charging tariff, as well as the regulation of the charging infrastructure. Establishing a preferential electricity tariff could make EVs financially more attractive.

Nonetheless, the meetings held in the phase of the diagnostic reveal that there is an interest especially from the private sector in investing in EV Businesses. In order to capitalize the momentum e-mobility is experiencing, a TA Project is outlined to be carried out by GIZ with the following outputs and activities.

OUTPUT 1: Establishment of an e-mobility conducive national ecosystem

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*.

- Create a roadmap for e-bus deployment together with INTRANT
- Elaborate a roadmap for e-taxi deployment
- Identify possible business and finance models for e-taxis.
- Create a roadmap for e-LCV deployment with local governments, commerce and delivery firms
- Create and strengthen fiscal and non-fiscal incentives for the purchase of EVs and spare parts.
- Capacity Building for insurance companies, drivers, mechanical workshops and first response staff
- Strengthen transparency of the procedures for the nationalization and registration of electric vehicles
- Capacity building on battery management with best practices, second life and recycling. Also a strategy to dispose batteries shall be developed.
- Design a smart fast charging infrastructure for e-taxis and policies to encourage off peak charging.
- Implementation of a pilot project for bi-directional chargers in DR. This activity includes an analysis of the grid, costs-benefits, technical feasibility etc.
- Support to governance and coordination mechanisms

GIZ is currently working on the standardization of charging stations and the definition of an electricity tariff. There is no differentiation for nightly charging and day charging. This could have an impact on the grid when charging during peak-demand time, especially when it is a fast charging network necessary for the operation of e-taxis. The assessment will be concluded in July, thus, new necessities could come out of this.

Detailed description of activities:

- To elaborate a binding roadmap for e-bus deployment which includes concrete targets, steps and responsibilities. The roadmap shall be elaborated together with INTRANT. The Strategic Plan for Electric Mobility serves as a guideline, and targets a bus fleet with 30% electric buses in 2030. There are no specifications on how this target should be achieved.

- 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. Design a fast-charging infrastructure including assessment of business models to operate the charging infrastructure.
- 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.
- Roadmap for e-LCV deployment including public incentives for switching towards electric units This includes the assessment of possibilities to establish low emission zones and differentiated access conditions together with local governments, commerce, delivery firm and the general population.
- Fiscal and non-fiscal incentives: to have mechanisms in place to reduce the gap between the purchase price of electric vehicles and the internal combustion alternative. EVs get a 50% reduction of the VAT (which is 18% in RD). A reduction of 100% VAT for buses should be analyzed, and implemented for 5-10 years. Also, a reduction for the circulation tax should be analyzed as an incentive. Legal assessment on this behalf will be provided. Spare parts for EVs do not get a tax exemption. Regulations will be modified in order to make the purchase of spare parts more attractive.
- Capacity building on proper battery management (second life and recycling). This includes an identification of best practices, and an actualization of the regulation regarding dangerous waste. Together with identified stakeholders e.g. hazardous waste recyclers, a strategy to dispose batteries will be developed.

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).

OUTPUT 2: Establishment of an e-mobility conducive local ecosystem

- Structure appropriate concession contracts and conditions conducive to e-bus deployment with INTRANT
- Capacity Building for municipalities regarding benefits of electric special vehicles
-

OUTPUT 3: Establishment of an e-mobility conducive regional ecosystem:

- Information and outreach events in the areas of buses, taxis and LCVs to inform about advantages of EVs
- Dissemination focused on successful models implemented
- Preparation of knowledge materials including publications, webinars, benchmark and best-practice studies
- MRV Guidelines & Training
- Preparation of Capacity Building guidelines
- Dialogue with EV suppliers

Project Preparation TA (Implemented by AFD)

Apart from the general TA activities, the lenders will conduct project specific TA in order to prepare the investment projects.

The project preparation includes the following activities:

- Assistance with the tendering process (define technical specifications for the e-buses, e-taxis or e-LCVs, charging stations, battery size, after sales service etc.)
- Assistance with the selection of the vehicle type to be purchased
- Assistance with the supervision of the contract with the OEM.
- Removal of barriers during the import process (make sure the vehicles are exempt from taxes according to the current la for EV incentives)
- Assistance with the supervision of the contract between owner and operators.
- Assistance with communication and PR work (press releases, events etc.)
- Conduct a legal due diligence with the operators or stakeholders involved
- Assess grid conditions in the places where the vehicles will recharge and conduct the necessary assistance to upgrade the grid.

Annex 2: List of Interviewed Persons and Institutions

Organización	Nombre	Apellido	Departamento
Ministerio de Medio Ambiente y Recursos Naturales	Milagros	De Camps	Cooperación Internacional
	Nathalie	Flores González	Cambio Climático
Misterio de Economía, Planificación y Desarrollo	Leticia	Sánchez	Dirección General de Cooperación Bilateral
Consejo Nacional para el Cambio Climático y Mecanismo de Desarrollo Limpio	Emely	Rodríguez	
Cucama Do.	Rommel	Vicini	Gerencia General
Asociación de Movilidad Eléctrica Dominicana - Asomoedo	Charles	Sánchez	
	Carlos	Lantigua	Dpto. De Ingeniería
	Federico	Castillo	Dirección Ejecutiva
Ministerio de Energías y Minas (MEM)	Antonio Alfonso	Rodríguez	Viceministro de Ahorro y Eficiencia Energética
	Aníbal	Mejía	Energía Convencional
Superintendencia de Electricidad (SIE)	Cesar Augusto	Olivero Castillo	Dirección de Regulación
	Ramón	Carrasco	
Comisión Nacional de Energía (CNE)	Yeulis Vidal	Rivas Peña	Fuentes Alternas y uso racional de energía
EDEESTE	Augusto	Bello	Compra de Energía y Regulación
Empresa Distribuidora de Electricidad del Sur, S.A (EDESUR)	Miguel	Santana	Optimización de Suministros Departamento de Investigación y Desarrollo
APOLO TAXI	Gregory	Gomez	
GO ELECTRIC	Manuel	González	
Zero Emisión RD	Charles	Sánchez	
InterEnergy Holdings Ltd.	Roberto	Herrera	Gerencia General
EVERGO	Oscar	San Martin	Gerencia General
Consorcio Energético Punta Cana – Macao (CEPM)	Marcos	Ortega Fernández	Dirección General
TAINO EXPRESS (Courier)	Alexis	Troncoso	
GIGA AUTO	Carlos	Lantigua	Dpto. De Ingeniería
Caribe Tours (Transporte Publico y Paquetería)	Juan Eladio	Solano	
	Pol	Guerrero	
	Francisco	Marmolejos	
DHL	Johnny	Espinal	Operaciones

Oficina Metropolitana de Servicio de Autobuses (OMSA)	José	Martínez Orestes	Dirección de Operaciones
Central Nacional de Transportistas Unificados (CNTU)	William	Pérez Figuereo	
Intrant	Alexandra	Cedeño	Dirección de Movilidad Sostenible
	Sheyla	Guerrero	Dirección de Movilidad Sostenible
CONATRA	Luis	Rosado	
Emprendimiento Sostenible RD (AVA Electric)	Edison	Santos	

Annex 3: Details Financial Calculations

General Parameters			
Parameter	**Value**	**Unit**	**Source**
NCV of diesel	43	MJ/kg	IPCC, 2006, table 1.2
CO_2 emission factor of diesel	74.1	gCO_2/MJ	IPCC, 2006, table 1.4
Density of diesel	0.844	kg/l	IEA, 2005
Well-to-tank mark-up factor diesel	23%		UNFCCC, 2014, Table 3
NCV of CNG	48	MJ/kg	IPCC, 2006, table 1.2
CO_2 emission factor of CNG	56.1	gCO_2/MJ	IPCC, 2006, table 1.4
Density of NG	0.714	kg/m^3	IGU, 2012
Well-to-tank mark-up factor CNG	18%		UNFCCC, 2014, Table 3
Methane slip as % of NG consumption TTW	1.1%		Average low and high value of ICCT, 2015, table 4 for crankcase and tailpipe
Methane slip as % of NG consumption WTW	3.4%		Average low and high value of ICCT, 2015, table 4 for well-to-pump and fuelling station plus TTW slip
NCV of gasoline	44.3	MJ/kg	IPCC, 2006, table 1.2
CO_2 emission factor of gasoline	69.3	gCO_2/MJ	IPCC, 2006, table 1.4
Density of gasoline	0.741	kg/l	IEA, 2005
Well-to-tank mark-up factor gasoline	19%		UNFCCC, 2014, Table 3
GWP_{100} of BC	900		Bond, 2013; see also IPCC, 2013, Table 8.A.6
GWP_{100} of CH_4	28		IPCC, 2013, Table 8.A.
BC fraction Euro 2 gasoline passenger car and LCV	25%		EEA, 2020, tabla 3-92
BC fraction Euro 4 gasoline passenger car and LCV	15%		
BC fraction Euro 2 diesel passenger car and LCV	80%		
BC fraction Euro 4 diesel passenger car and LCV	87%		
BC fraction Euro II HDV	65%		
BC fraction Euro IV HDV	75%		
BC fraction Euro 1 Motorcycle	25%		
BC fraction Euro 2 Mot	25%		
Conversion kWh to MJ	3.6	MJ per kWh	https://home.uni-leipzig.de/energy/energy-fundamentals/03.htm#:~:text=Power%20units%20can%20be%20converted,%3D%203.6%20MJ%20%5B
Battery manufacturing emissions	110	$kgCO_2$/kWh	ICCT, 2018, table 1 (per kWh battery set); average value not taking into account 2nd life usage of batteries

TCO 12m Bus

Parameter	Value	Unit	Source
Distance driven per bus per annum	61,200	km	OMSA urban bus operator (180km/d)
Workday distance driven daily	198	km	based on 10% more than average of 180km/d
Specific electicity usage	1.1	kWh/km	Chinese average; ADB, 2018; includes AC
Diesel usage	44	l/100km	default Euro IV Tier 3 COPERT with 15km/h
Maintenance cost diesel bus incl. labor and tyres	0.07	USD/km	Various operators
Lifespan bus diesel	16	years	default 1 million km
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	130,000	USD	Standard Euro IV bus; Caribe tours
CAPEX overnight charged e-bus	274,000	USD	Based on bus with 350 kWh battery set and sur-cost for battery size
CAPEX slow-charged batteries	200	USD/kWh	LFP batteries
CAPEX fast-charged BEB	240,000	USD	Based on standard fast-charged bus
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%20m
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 125 USD/m2 labour)
Cost grid connection of chargers	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
Maintenance & repair cost of e-buses relative to diesel incl. labour	70%		Based on experience in PR China; ADB, 2018; 10% higher tyre costs; 75% lower maintenance staff and general maintenance; 20% lower repair and spare parts
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	198
Energy usage day	kWh	218
Risk ratio (higher energy consumption)		10%
Reserve ratio		20%
SOC loss year 8		20%
Battery size required year 8	**kWh**	**370**

Charging required at bus depot overnight

Parameter	Unit	Value
Battery capacity	kWh	370
Average daily consumption workday	kWh	218
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	50

Option B: Fast Charging

Parameter	Unit	Value
Battery size	kWh	200
C-rate		0.65
Charging in 30 minutes	kWh	65
Average re-charge during day required with 20% reserve ratio	kWh	58
Average share of day electricity		27%
Fast-charger	kW	300
Power conversion efficiency of chargers		90%
Average required re-charge day with 300 kW charger	minutes	13
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 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	77,500	km	310 wd
Daily mileage	250	km	apolo taxi
Charging at home average	70%		Assumption; only re-charge if above-average mileage or night shifts
Charging fast-chargers	30%		
CAPEX gasoline taxis	12,700		https://www.supercarros.com/hyundai-elantra/1123656/
CAPEX e-taxi	35,700		https://www.carrosrd.com/carros/Nissan/Leaf/SV/l-20994
Capex home charger 7.4kW	2,000	USD	Nissan LEAF large battery or BAIC
Gasoline consumption	7.3	l/100km	https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&path=1&year1=2019&year2=2019
Electricity consumption	0.16	kWh/km	Nissan LEAF https://ev-database.org/car/1106/Nissan-Leaf
Charger lifespan	10	years	
Maintenance cost gasoline	0.01	USD/km	https://www.autocarindia.com/car-news/car-maintenance-cost-comparison--part-2-premium-and-exec
Maintenance cost total e-taxi	0.004	USD/km	40% lower than gasoline
Loan tenure	7	years	Banco popular, see IDB, 202o, p.55
Loan share taxi	80%		
Interst rate fossil	13%		
interst rate electric	7%		

gasoline versus e-taxi

Parameter	gasoline	e-taxi
CAPEX vehicle	12,700	35,700
CAPEX charger	0	2,000
Total CAPEX	12,700	37,700
Energy cost	5,313	2,573
Maintenance cost	775	310
Finance cost average per loan year	734	1,076
Economic costs yr 1	637	319
Lifespan in years	10	10
TCO financial per km	0.10	0.09
TCO economic per km	0.11	0.10

LCVs

1. Diesel Van

Parameter	Value	Unit	explanation
CAPEX van	39,900	USD	https://www.supercarros.com/peugeot-boxer/973849/
Diesel fuel consumption	6.2	l/100km	https://motoreu.com/peugeot-boxer-combi-2.0-bluehdi-mpg-fuel-consumption-technical-specifications-58411#:~:te
Maintenance cost	0.02	USD/km	average price
Lifespan	6	years	DHL
Daily distance driven	142	km	DHL
Annual distance	46,800	km	DHL

2. E-Van

Parameter	Value	Unit	explanation
CAPEX e-van	79,800	USD	Peuegeot e-boxer
Range WLTP	180	km	https://commercialvehiclecontracts.co.uk/news/latest-vehicle-announcements/peugeot-e-boxer-revealed; small bat
Battery size	37	kWh	
Cost battery	7,400	USD	Based on 200 USD/kWh per battery
electricity consumption	0.19	kWh/km	WLTP
Maintenance cost	0.01	USD/m	50% of fossil (as only engine maintenance is included; no tyres, no repairs)
Lifespan van	6	years	assumed same as fossil
Lifespan battery	6	years	
Capex home charger 7.4kW	2,000	USD	
Lifespan charger	20	years	
Charging at home average	90%		Assumption
Charging fast-chargers	10%		Exceptional if long distances were made

fossil versus e-van

Parameter	diesel	e-van
CAPEX vehicle	39,900	79,800
CAPEX charger	0	2,000
Replacement battery cost	0	7,400
Total CAPEX	39,900	81,800
Energy cost	2,060	1,580
Maintenance cost	800	400
Finance cost average per year	2,305	2,405
Economic costs yr 1	900	223
Lifespan in years	6	6
TCO financial per km	0.24	0.38
TCO economic per km	0.26	0.38