grütter consulting

E-Motion Country Intervention Strategy Argentina

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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
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
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIZ	German International Cooperation
IDB	Inter-American Development Bank
IEA	International Energy Agency
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

Argentina has an area of 2,737,000 km^2 and 45 million inhabitants. Two thirds of the population is concentrated in Buenos Aires and nearby provinces. Argentina is one of the largest economies in Latin America, with a Gross Domestic Product (GDP) of approximately USD 450 billion. It is also, along with Brazil, Mexico and Colombia, one of the main producers of automobiles and auto parts in Latin America. GDP per capita was USD 8,317 in 2020. Lithium reserves represent a unique opportunity for the transition towards electric mobility.

2.2. Climate and Energy Policies

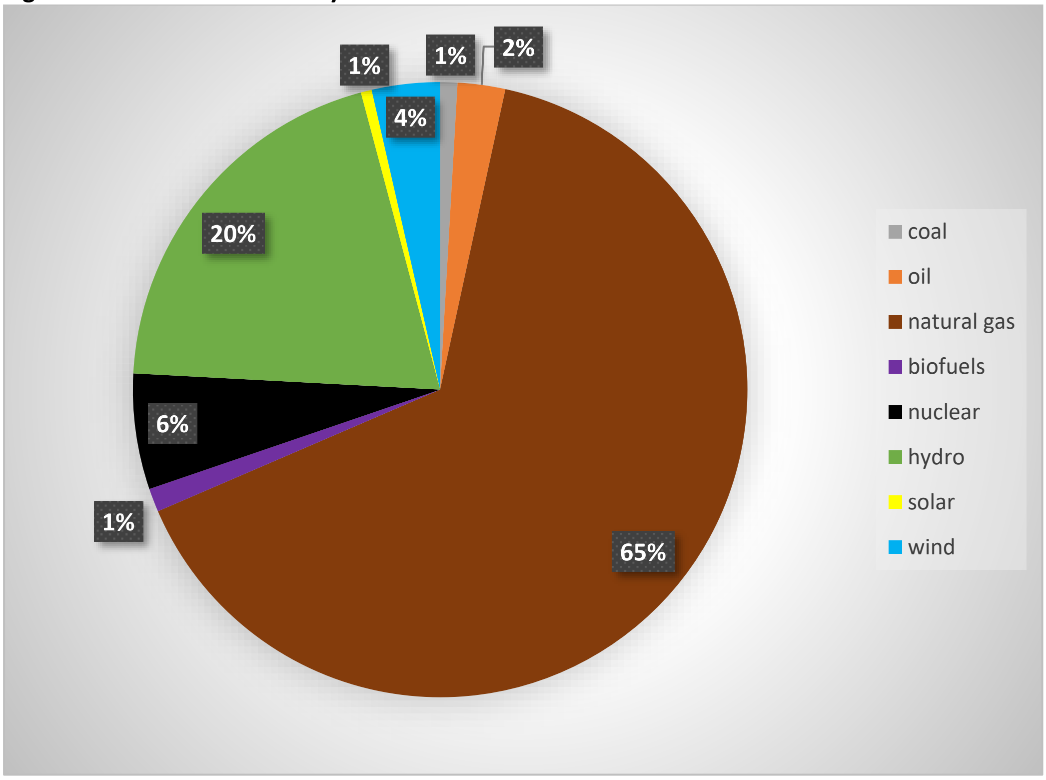
According to the NDC 2020, total emissions in Argentina in 2016 were 364 $MtCO_{2eq}$ (Ministerio de Ambiente y Desarrollo Sostenible, 2020). In this it commits to an absolute net emission of 359 million tCO_{2eq}. The transportation sector was responsible for the emission of 56 MCO_{2eq} in 2016, representing 15% of the country's total GHG emissions of that year (Ministerio de Ambiente y Desarrollo Sustentable, 2017, p. 13). Road transport, mainly trucks and automobiles, accounts for more than 90% of GHG emissions in the transport sector.

The National Action Plan for Transport and Climate Change (PANTyCC) represents the set of initiatives that Argentina has planned to do to reduce GHG emissions in the transport sector. The PANTyCC is based on strategic intervention axes and mitigation and adaptation measures.

In 2019 25% of electricity was generated by renewables including hydropower (see figure below).

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

Figure 1: Power Generation by Source 2019



Source: IEA database

For 2030 the share of renewables including hydropower is expected to increase to 49%, nuclear from 6 to 13% and thermal to decrease from nearly 70% to 38% (MINEM, 2017 based on tendential scenario). This would green the grid factor considerably. In the NDC, the country commits to increase the share of non-conventional renewable energies by 2030 (Ministerio de Ambiente y Desarrollo Sostenible, 2020, pág. 29). The carbon factor of the electricity grid of Argentina is in 2019 0.382 $kgCO_2/kWh$[2].

2.3. Transport Sector

2019 nearly 19 million vehicles were operating in Argentina. As of January 1, 2018, all new heavy-duty vehicles and engines (light vehicles partially 1 year earlier) were required to comply with the Euro V standard. Diesel fuel sold has various levels of sulphur ranging from 50ppm to over 2,000ppm.

Transportation emission costs modelled in this report are close to 6 billion USD for 2019 and 4.3 billion USD for 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 50% of these costs are due to local pollutants whilst by 2030 the share reduces to 30% due to the introduction of cleaner fossil vehicles. Vehicle emission costs represents for 2019 1.3% of the countries GDP.

Transport GHG emissions of Argentina in 2019 are estimated at 55 million tCO_{2e}[3] based on a bottom-up transport model calibrated with top-down fuel consumption data. Commercial vehicles including taxis, buses and LCVs are responsible for around one quarter GHG emissions and 30% of pollutants

[2] Calculation by Grutter Consulting based on IEA data
[3] Tank-to-wheel approach; well-to-wheel approach including Black Carbon: 73 $MtCO_{2e}$

($PM_{2.5}$ and NO_x). GHG emission from the transport sector are expected to grow under a BAU scenario by around 10% reaching 61 million tCO_2 by 2030 (see table below).

Table 1: Projected 2030 Transport Emissions

Vehicle category	NO_x in tons	$PM_{2.5}$ in tons	CO_2 TTW in tons	CO_2 WTW in tons	Energy in TJ
Passenger car	13,416	502	24,285,228	29,884,334	352,453
Taxi	1,175	46	1,964,054	2,688,963	30,568
Motorcycles	7,033	127	1,814,455	2,187,753	26,183
standard urban bus	12,228	104	2,669,596	3,353,960	36,027
coach	7,306	57	1,272,082	1,603,283	17,167
LCV	19,999	971	7,439,734	9,848,650	101,744
Truck < 7.5t	821	5	161,088	201,720	2,174
Truck 7.5-16t	10,022	61	1,867,836	2,338,539	25,207
Truck 16-32t	27,752	173	4,848,379	6,080,400	65,430
Truck >32t	84,774	493	14,706,953	18,422,212	198,474
Total	**184,527**	**2,539**	**61,029,405**	**76,609,815**	**855,427**

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

The transportation actors are mainly the governmental body in its three jurisdictions: national, provincial and municipal. This jurisdictional differentiation corresponds to the route of the line and the jurisdictions in which it operates, and therefore is the permit held by each transport line. That is to say, if the route of a transport line does not leave the municipal jurisdiction its permit is municipal, when the line crosses such jurisdiction without entering another province its jurisdiction is provincial and if it passes between two provinces its jurisdiction corresponds to the national jurisdiction. Small companies generally operate at the municipal level, whilst large ones are concession holders at the national level. Until 2019, the National Ministry of Transportation subsidized, through different mechanisms, all short, medium and long distance public services, with a mechanism instituted in 2002. In December 2018 this mechanism ceased its operations in this form. With the 2020 pandemic subsidies have again be implemented.

In Buenos Aires there are about 38,000 cab licenses. Generally, drivers rent the cab from the owner[4]. Uber is not legal in Argentina and the app is blocked. However, there is a similar application to order regular cabs through an app called BA Taxi.

2.4. EV Policies and Activities

Argentina launched the development of its National Electric Mobility Strategy in May 2018 with the support of UN Environment. Argentina is currently formulating specific legislation on electric vehicles, establishing the conditions for the installation or operation of charging centers, and at the same time, exploring possible options for the local development of the electric mobility industry. Because the country has large lithium reserves and a recognized industrial history in the region, the commitment to transport electrification extends beyond the environmental aspect of sustainable mobility: lithium

[4] https://web.archive.org/web/20070818135156/http://www.buenosaires.gov.ar/areas/obr_publicas/taxis/index.php

batteries are already being assembled with imported cells and investments are being explored to enter the lithium value chain, including the possibility of manufacturing battery cells[5].

Executive Decree 331/17 establishes, among other things, benefits for automotive companies through the reduction of tariffs for the importation of hybrid, electric and fuel cell vehicles for a maximum of six thousand units in a period of 36 months, depending on whether the vehicle is assembled in the country or not. The second, Executive Decree 51/18, applies to imports of electric buses and establishes a tariff decrease on the importation of up to 350 units, as well as up to 2,500 chargers with power greater than or equal to 50kW. Various legislative initiatives are currently being discussed through bills such as the presentation at the end of 2017, aiming to establish a new Electric Vehicle Mobility Law. The Argentine Association of Electric and Alternative Vehicles (AAVEA) also presented a citizen's initiative bill in August 2017 in order to encourage the development and use of electric vehicles and sustainable mobility systems in Argentina. For its part, the Argentine Automobile Manufacturers Association (ADEFA), made up of the country's automotive companies, submitted a formal request to the Ministry of Production in 2018 for a luxury tax exemption for electric vehicles. Provision 283/2019 regulates the provision of electric recharging services at fuel dispensing stations and defines safety specifications on the installation and registration of charging centers. In turn, AEA regulation 90364-7-722, developed by the Argentine Electronic Association, defines the basis for the standardization of electrical installations for electric vehicle recharging.

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

Table 2: Enabling Factors and Barriers to Commercial EVs in Argentina

Enabling factors	• The Government has passed some initial bills and regulations as well as a electric vehicle mobility law. • Argentina manufactures vehicles which can be a barrier or an enabling factor towards e-mobility (barrier if the industrial policy is backwards oriented and trying to preserve existing structures and an enabling factor if the industrial policy is geared towards fostering new technologies and future markets). • Argentina is also a producer of Lithium, which is an important ingredient for e-mobility promotion worldwide. • Argentina has realized various bus and LCV pilots and is thus gaining initial experience with EVs. • Argentina has a low carbon grid factor and a high potential to produce electricity with an increasing share of renewables.
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. • 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 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. • Argentina has large reserves of gas with the Ministry of Transport (MOT) favouring usage of Compressed Natural Gas (CNG) for vehicles.

[5] https://movelatam.org/argentina-avanza-en-la-elaboracion-de-su-estrategia-nacional-de-movilidad-electrica-a-traves-de-la-capacitacion-del-sector-tecnico-sobre-los-avances-y-proyecciones-de-la-industria/

Argentina has some good enabling conditions for the promotion of e-mobility. Whilst municipalities and transport operators express their interest for EVs, MOT favours CNG vehicles.

3. Actor Mapping

National Level:

The **National Commission for Transport Regulation (CNRT)** controls and audits all transportation modes in the national jurisdiction. Its main function is to promote a competitive transportation service regarding its operational, technic, safety, and functional aspects, such as the rights of the users, reliability, and social accessibility.[6]

The task of the **National Ministry for Transport** is to assist the president, and the chief of the cabinet of ministers regarding the field of transportation. For this purpose, it must understand, among other topics, the creation of policies for public transport permits, the promotion of technical and economic development of transport systems. Within its area of competence, it also must intervene in the elaboration of tariff structures.[7]

Created in 2016, the **National Climate Change Cabinet (GNCC)** is made up of ministries with the potential of mitigating climate change. Withing the National Plan for Mitigation and Adaption to Climate Change they created, the National Action Plan for Transport and Climate Chance (PANTyCC). It represents the set of corrective actions focused on transportation, to mitigate or reduce the undesired effects like GHG emissions. It aims to meet current and future transportation needs while prioritizing environmental sustainability.[8]

The **Air Quality Network (FEMA Network)** operates 33 air quality stations in Argentina which are mainly located in or close to the biggest cities. These stations continuously monitor typical pollutants such as CO, NOx, SO2, O3 and PM10. The network is used for real life functions air quality information and to guide a sustainable and adequate management of the environment and the preservation of biodiversity.[9]

Interministerial Roundtable of Sustainable Transportation

Provincial Level:

It is the responsibility of each **province**, included Buenos Aires, to assign or create an organization to implement, on the local level, the national plans formulated by the GNCC.[10]

Electric energy providers:

The N**ational Electricity Regulator (ENRE)** is the ruling body regarding electricity production and distribution. Its responsibility is to ensure a competitive market for energy providers, as well as promoting reliability, equality, free access, widespread coverage, and fair prices for end-users.[11]

In Argentina there are 30 electric energy providers.[12]

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[6] https://www.argentina.gob.ar/transporte/cnrt
[7] https://www.argentina.gob.ar/transporte
[8] https://www.argentina.gob.ar/ambiente/cambio-climatico/gabinete-nacional
[9] https://redfema.ambiente.gob.ar/
[10] https://www.argentina.gob.ar/normativa/nacional/ley-27520-333515/texto
[11] https://www.argentina.gob.ar/normativa/nacional/ley-24065-464/texto
[12] http://www.energia.gob.ar/contenidos/verpagina.php?idpagina=3886

Associations:

The **Argentine Association of Electric and Alternative Vehicles (AAVEA)** is made up of member interested in electric mobility from sectors such as energy, science, technology, and the public. The main objective is to promote the development and general adoption of electric mobility by society and the markets by proposing policies and strategies for a legal, economical, and technical framework.[13]

Composing the **Argentine Automobile Manufacturers Association (ADEFA)** are the industries that produce vehicles (cars, LCVs, HCV) as well as components such as gearboxes and motors. Its intent is to encourage investment, create jobs, increase production volume, improve competitiveness and to promote its international presence.[14]

Tranviarios Automotor Union (UTA) is a workers union for short-, mid- and long-haul-bus transportation. They are active in the betterment of the working conditions, health, and financial wellbeing of its members. Their Association for the Education and Training of Passenger Transport Workers seeks the professionalization of its workforce within public and private transport. [15]

International Bodies promoting EV:

The **Inter-American Development Bank (IDB)** is the largest source of development financing for Latin America and the Caribbean. Within Argentina and electric mobility, it has been supporting a transport initiative in Buenos Aires.[16]

Euroclima+ is the main EU program for environmental sustainability and climate change with Latin America. Its objective is to reduce the impact of climate change and its effects by promoting mitigation measures and adaptation to climate change. Its efforts are based on the complementary experience of seven agencies (AECID, AFD / Expertise France, FIIAPP, GIZ, ECLAC and UN Environment).[17]

The **United Nations Environment Programme (UNEP)** is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system, and serves as an authoritative advocate for the global environment.[18] Its regional e-mobility project "Move" in Latin America focuses on capacity development trough webinars and exchanges between countries.

The **Development Bank of Latin America (CAF)** promotes the sustainable development model trough credit, non-refundable resources, and support in the technical and financial structuring of projects in the private and public sectors in Latin America.[19] Within Argentina, it successfully supported a pilot test of electric buses in Buenos Aires, as well as aiding in pre-investment studies for sustainable transportation in the cities of Córdoba, Santa Fe and Rosario.

4. EV Deployment Scenarios

3 different EV scenarios have been constructed:

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[13] https://aavea.org/
[14] http://adefa.org.ar/es/institucional-mision-y-objetivos
[15] https://www.utaargentina.com/el-sindicato/
[16] https://www.iadb.org/en/about-us/overview
[17] http://euroclimaplus.org/inicio-es/quienes-somos
[18] https://www.unep.org/about-un-environment
[19] https://www.caf.com/en/about-caf/

- 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.
- 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.

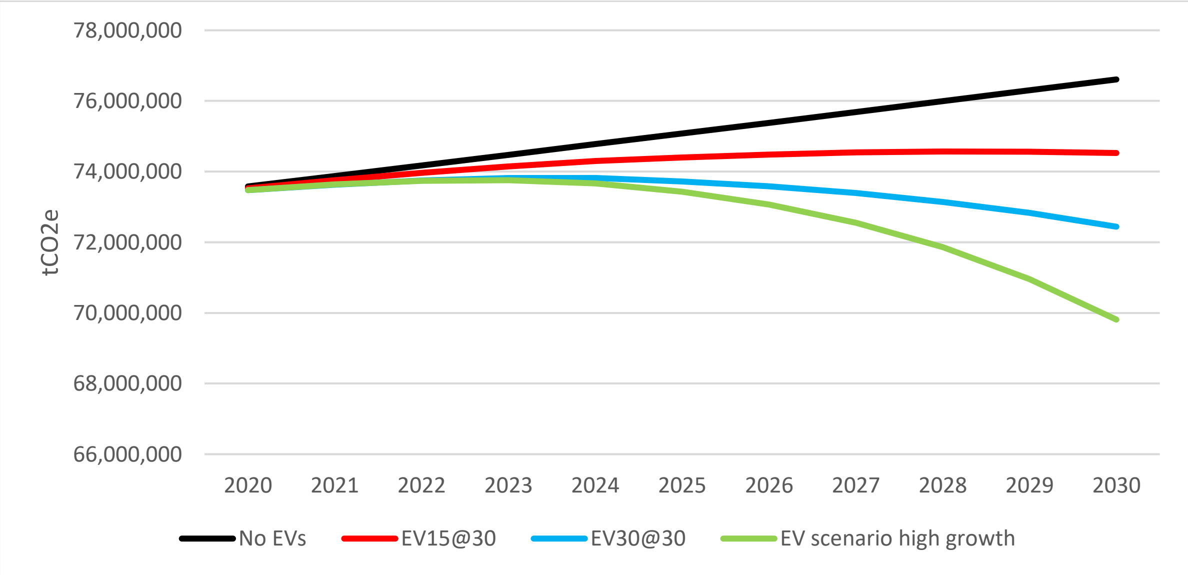
Table 3: Scenario Results

Impact	Scenario	By 2025	By 2030
GHG reduction WTW in tCO_{2e} per annum	IEA 15@30	680,000	2,080,000
	IEA30@30	1,360,000	4,170,000
	"High growth" scenario	1,650,000	6,800,000
Electricity demand of EVs in GWh per annum	IEA 15@30	1,330	4,070
	IEA30@30	2,650	8,140
	"High growth" scenario	2,560	9,500

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 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 Argentina under Different Scenarios (WTW)



Source: Grutter Consulting

The 2030 projected electricity demand of EVs represents 4% 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.

The grid system of Argentina has a pronounced peak between 1PM and 5PM and a smaller evening peak at 9-10PM. Electric buses can avoid using these peaks for charging. This is true for overnight charged buses as well as intermediate or opportunity fast charged buses. Taxi fast charging could basically be done outside the peak as well and fast chargers could apply significant differential pricing to avoid peak charging. 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 i.e. before 10PM may result in this additional demand coinciding with the evening peak electricity demand resulting in a higher risk of overloading of the power distribution network ultimately requiring additional generation capacity and network upgrades. Especially LCVs and passenger cars, but also taxis could be prone to be charged too early as people return home and plug-in their vehicle. This will require peak demand management involving e.g. controlled charging and using Demand Side Management (DSM) instruments.

5. Market Analysis[20]

5.1. Current EV Market

In May 2019, a pilot test was conducted to assess the feasibility of implementing electric buses in the Autonomous City of Buenos Aires[21]. In 2019, the Government of the Province of Mendoza purchased 18 electric buses. Various trials are also on-going with electric Light Commercial Vehicles (LCVs) e.g. by Corven Andreani, a local logistics companyor by the Government of the City of Buenos Aires. The country has currently a public and private network of more than 250 charging points.

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 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

[20] See also for further details (Grutter Consulting, 2021a)
[21] https://www.buenosaires.gob.ar/movilidad/noticias/circulan-los-primeros-colectivos-electricos-en-la-ciudad

capital expenditure: the FIRR is compared to the Weighted Average Capital Cost (WACC) for the transport sector calculated at 11.1%[22];

- 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 Argentina an overnight charged bus would require a battery set of 450 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)[23].

Table 4: Summary Financial Assessment 12m BEBs Argentina

Criteria	Result	Assessment
Financial TCO	0.74 – 0.83 USD/km for BEBs versus 0.82 USD/km for diesel Euro IV bus[24]	Non-discounted the cumulated lifetime costs for BEBs are lower than for diesel buses.
Capital investment	390-450,000 USD for BEB incl. chargers, grid connection and bus depot upgrade; 160,000 USD for diesel bus; Figures include VAT and 35% import tax	Significantly higher capital requirement incl. higher loan demand; negative impact on debt to equity ratio
Equity investment	120-130,000 for BEB[25] versus 30,000 for diesel bus	Significantly higher equity demand which might overstretch the capabilities of enterprises
Profitability[26]	FIRR of 5-9%	Investment in e-buses is not profitable (FIRR<WACC)
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 15 (also due to investments for 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

[22] See (Grutter Consulting, 2021a) for details of calculations
[23] For details see Annex
[24] 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.
[25] Banks only finance 80% of BEB but not of charging infrastructure, grid connection and depot upgrades due to not being collateral
[26] FIRR of incremental investment compared to diesel bus

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 Argentina.

5.2.3. Electric Taxis

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

Table 5: Summary Financial Assessment E-Taxis Argentina

Criteria	Result	Assessment
TCO[27]	0.15 USD/km for e-taxis versus 0.16 USD for gasoline unit	Non-discounted the cumulated lifetime costs for e-taxis are lower than for gasoline units.
Capital investment	40,000 USD for e-taxi including homer charger versus 16,000 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[28]	FIRR of 12%	Investment in e-taxis is 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 10	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 marginally 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. 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.

5.2.4. Electric LCVs

The following table summarizes the financial assessment of e-LCVs. The comparison is based on a Renault Kangoo gasoline versus electric version as already used for trials in Argentina.

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

Table 6: Summary Financial Assessment e-LCVs Argentina

Criteria	Result	Assessment
TCO[29]	0.18 USD/km for e-LCVs versus 0.19 USD/km for gasoline unit	Non-discounted the cumulated lifetime costs for e-LCVs is marginally lower than for gasoline units
Capital investment	30,000 USD for e-LCV including home chargers versus 17,000 USD for gasoline unit	Higher capital requirement incl. higher loan demand
Equity investment	6,000 USD for e-LCV versus 3,000 USD for gasoline unit	Double equity demand
Profitability[30]	FIRR of 10%	Investment in e-LCVs is not profitable (FIRR<WACC)
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	Positive from year 9	The investment in e-LCVs has a negative liquidity impact during 9 years

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 and are not offered by vehicle suppliers in Argentina. 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 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[31]	6.0%	AFD
Assumed shares	30% GCF and 70% CAF	
Bank spread for on-lending	2%	Assumed
Resultant minimum loan rate for buses if based on project finance with public lender e.g. municipality	4.6%	Calculated based on above data
Resultant minimum loan rate for LCVs and taxis based on lending through public banks	6.6%	
Lending rates for buses, LCVs and taxis	80% maximum	
Loan tenure	12 years buses 8 years taxis & LCVs	

[29] Includes CAPEX, energy, maintenance and finance costs; does not include other costs such as the driver which are independent of the technology chosen
[30] FIRR of incremental investment compared to gasoline LCV
[31] These conditions are tentative; actual financing conditions will be highly dependent on the evolution of the economic situation of the country.

5.3.2. E-Buses

Concessional finance would result in an interest rate of 4.6% instead of 14%. 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 from 8 to 12 years. An 80% lending rate on the total CAPEX and not only on buses is also assumed. Following impacts can be observed:

1. The TCO reduces considerably is now clearly below that of diesel buses.
2. The concessional loan does not change the FIRR by logic (the FIRR is calculated without financial costs).
3. Owners capital requirements are reduced with the concessional loan (due to not only financing the bus but all investment components).
4. The risk and the capital exposure of the entrepreneur can be reduced significantly. With fast-charged BEBs the investment can be recovered within 13 years.

It can be concluded that the concessional loan helps to resolve liquidity issues and results in an improvement of the investment profitability but investment risks remain high with an unsatisfactory payback time. 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.

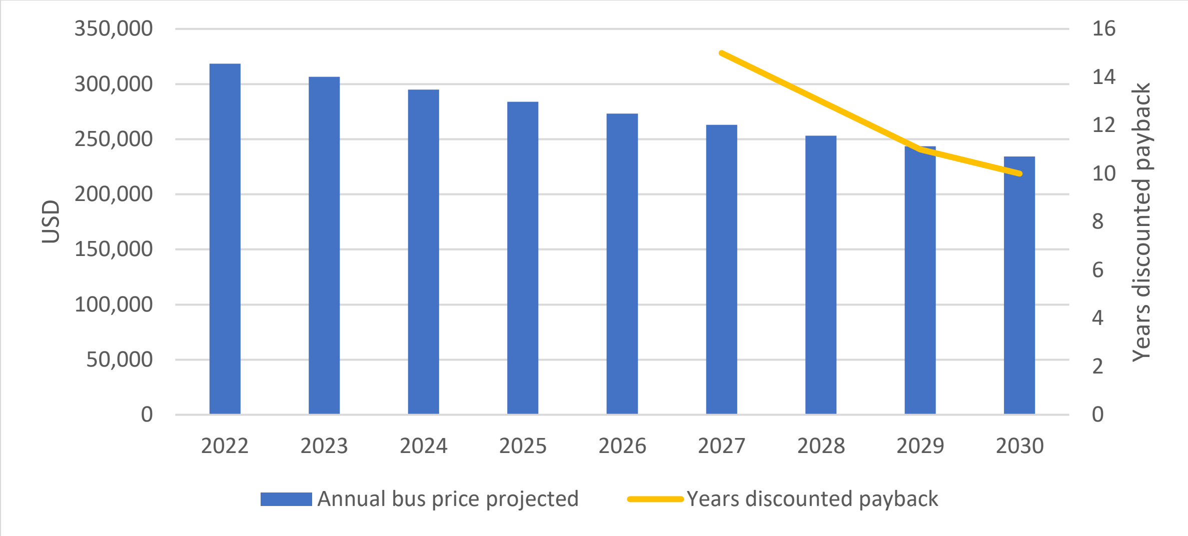
An upfront grant of 20% on the total initial investment combined with concessional finance is modelled. The upfront grant would be 80,000-90,000 USD per e-bus. Following impacts can be observed:

1. The TCO reduces considerably with values now much lower than for diesel buses.
2. The FIRR increases significantly and is now above the WACC for all types of BEBs indicating a profitable investment.
3. Owners capital requirements are reduced significantly.
4. The risk and the capital exposure of the entrepreneur is reduced greatly. The incremental investment is recovered within 7-10 years which is considered to be a reasonable time-frame.

It can be concluded that the grant combined with the concessional loan resolves fully the profitability and risk issue.

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). Until 2030 e-buses are expected to have a payback period of around 10 years instead of more than 16 years currently.

Figure 3: Projected E-Bus Price and Discounted Payback Time



Source: Grutter Consulting; annual decrease of BEB projected at 4% based on decreasing battery price projections of BNEF[32]; graph valid for fast-charged BEBs

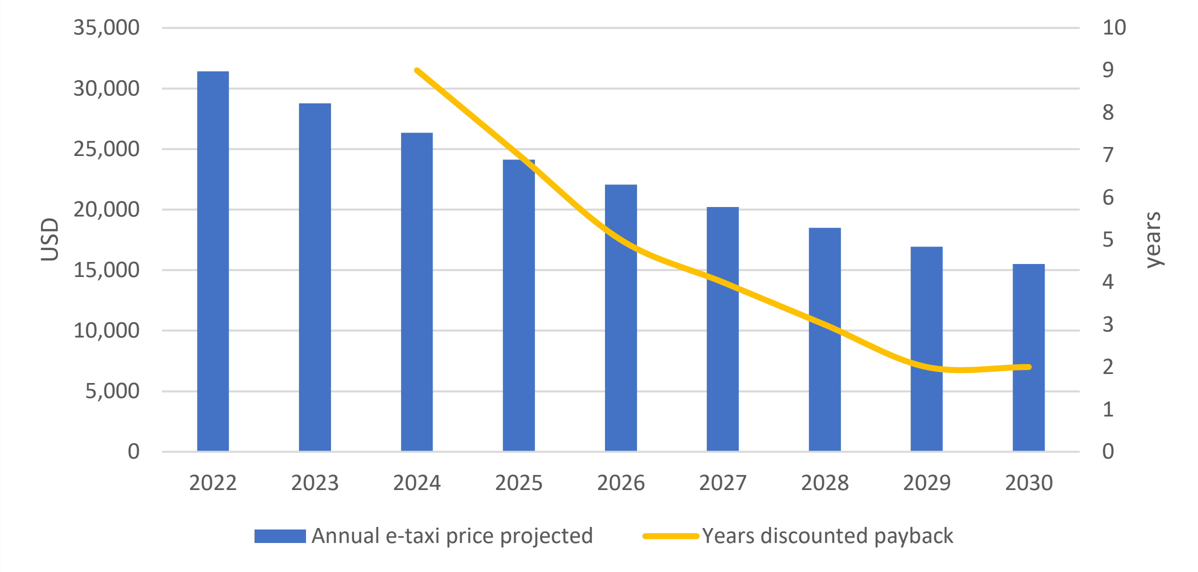
5.3.3. E-Taxis

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. The assumed business model is based on loans managed by public banks which would receive concessional conditions from E-Motion. The on-lending interest rate would drop from currently 14% to 6.6%. The concessional loan improves the liquidity and is sufficient to make the investment financially attractive.

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. Until 2030 e-taxis are expected to have a payback period of around 2 years instead of more than 10 years currently.

[32] 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-taxi prices projected at 8% 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 geoes through loans managed by public banks (idem to the current loan structure) which would receive the concessional conditions of the Program. However, for waste collection vehicles as requested by some municipalities, loans could also be direct public loans idem to buses. The on-lending interest rate would drop from currently 14% to 6.6% for private LCVs idem to taxis and to 4.6% for public owned waste collection vehicles. The concessional loan improves the liquidity situation and the TCOs significantly. However the profitability is still below the WACC i.e. investment grant subsidies are also required in the case of LCVs.

5.4. BAU versus Project EV Market Deployment

5.4.1. Approach

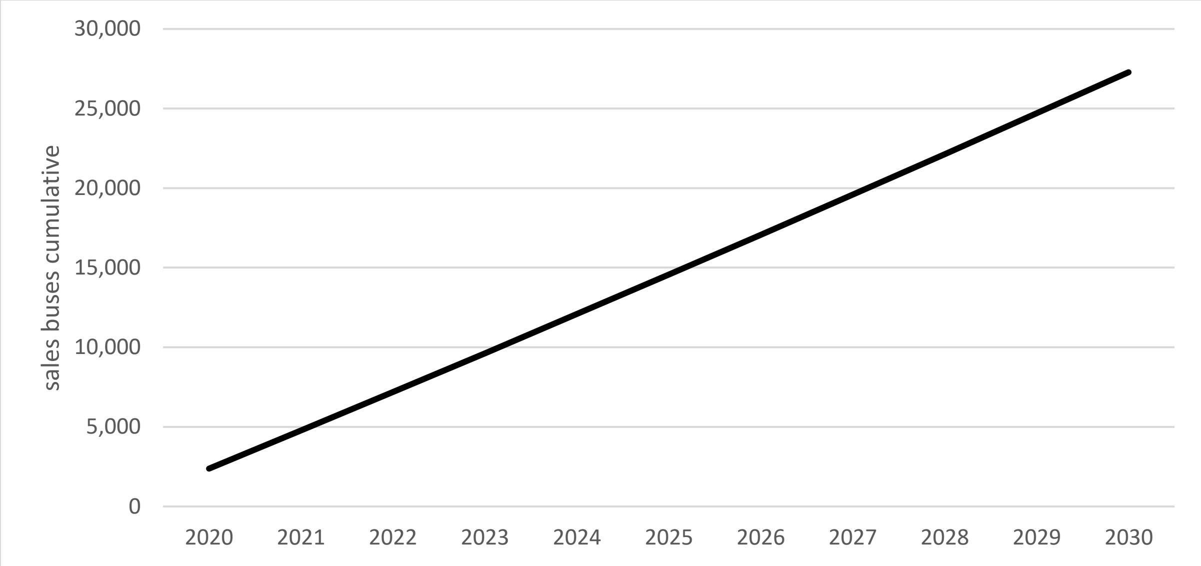
Under a BAU scenario EVs will pick up without commercial support. The question is when and how much. The following chapters will model the BAU deployment expected for the different commercial EV technologies due to decreasing EV prices and therefore increasing financial profitability of latter and the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

Figure 5: Total Projected Cumulative Market Demand Urban Buses Argentina



Source: (Grutter Consulting, 2021)

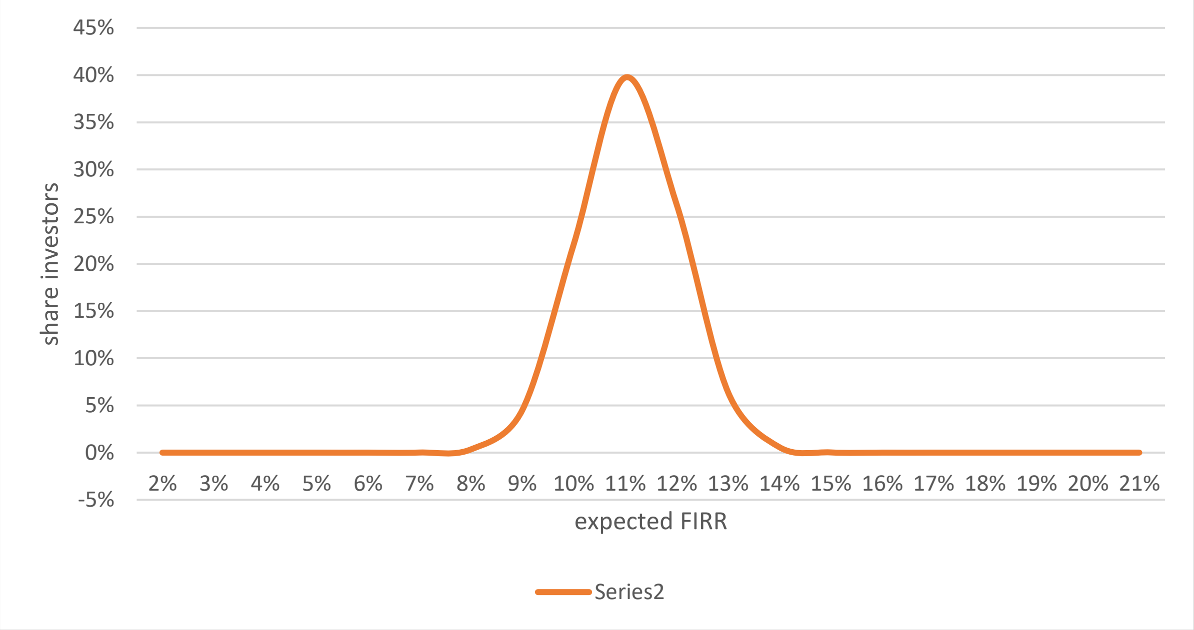
Projected BAU Demand for E-Buses

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 100% due to the fact that current prices do not include a demand charge and are relative to other countries very low which might change in the future..
- 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.

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 11.1%.

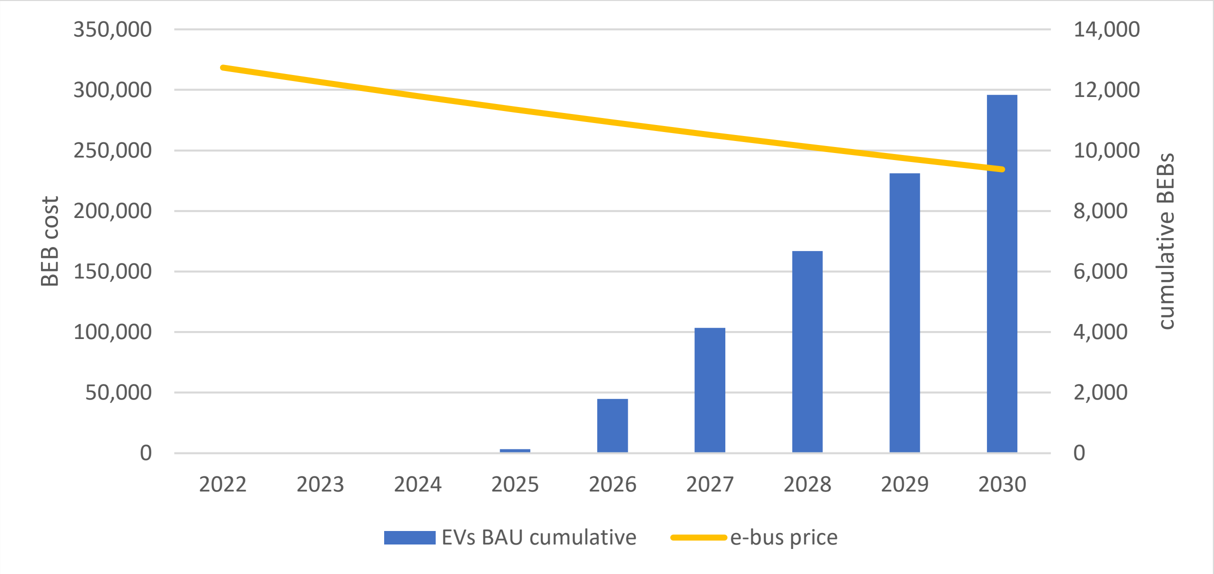
Figure 6: Expected FIRR of Investors



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 Argentina.

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



Source: Grutter Consulting

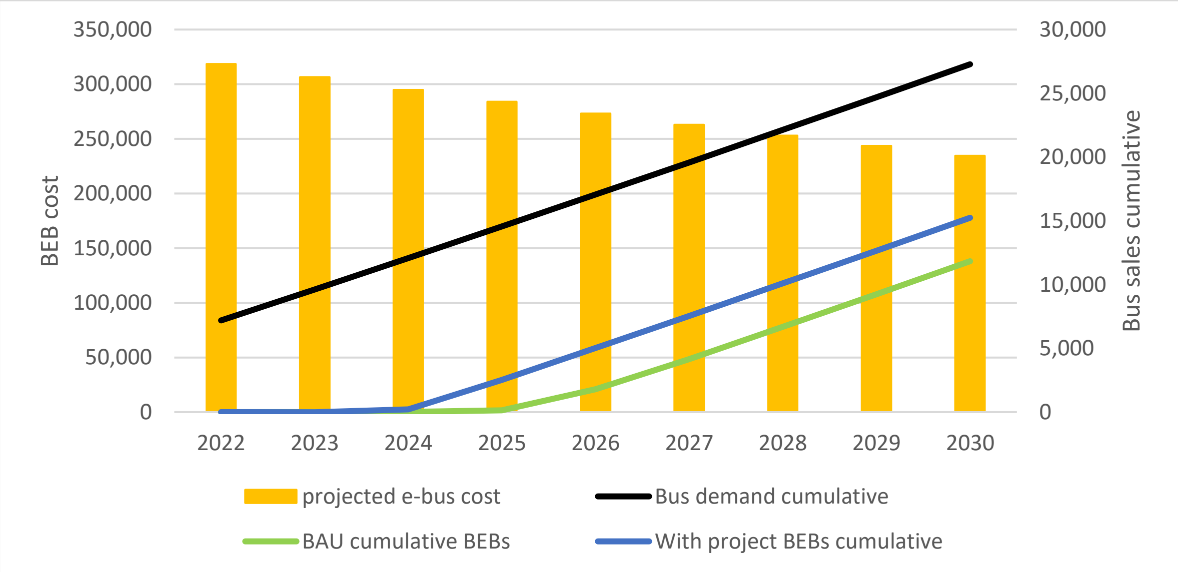
Under a BAU scenario BEBs in Argentina start to get commercially viable around 2026 and then increase rapidly.

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 2026 is assumed (it is assumed that a fleet of 100 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 8: BAU and with-Project Projected E-Bus Uptake in Argentina and Price Trend of E-Buses



Source: Grutter Consulting; based on fast-charged BEBs

Comparing the with and without project scenario we can state an increase of the uptake speed (slope of the function). 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):

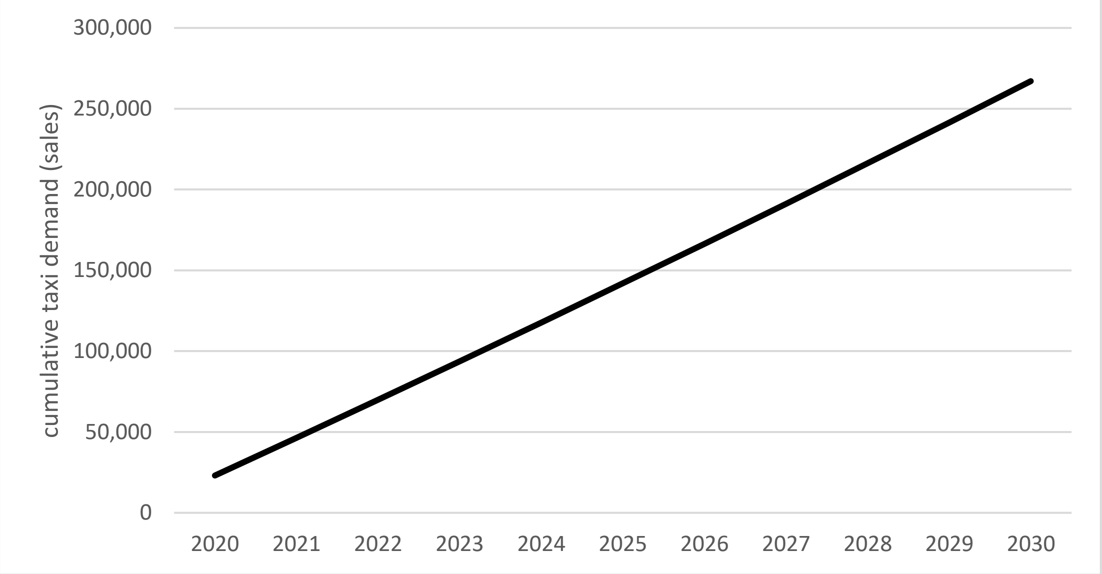
- Additional 4.9 million tons of CO_2 reduced;
- Additional 2179 tons of $PM_{2.5}$ avoided;
- Additional 21,000 tons of NO_x avoided;
- Additional economic savings of 308 MUSD.

5.4.3. E-Taxis

Market Demand for Taxis

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

Figure 9: Total Projected Cumulative Market Demand Taxis



Source: (Grutter Consulting, 2020)

Projected BAU Demand for E-Taxis

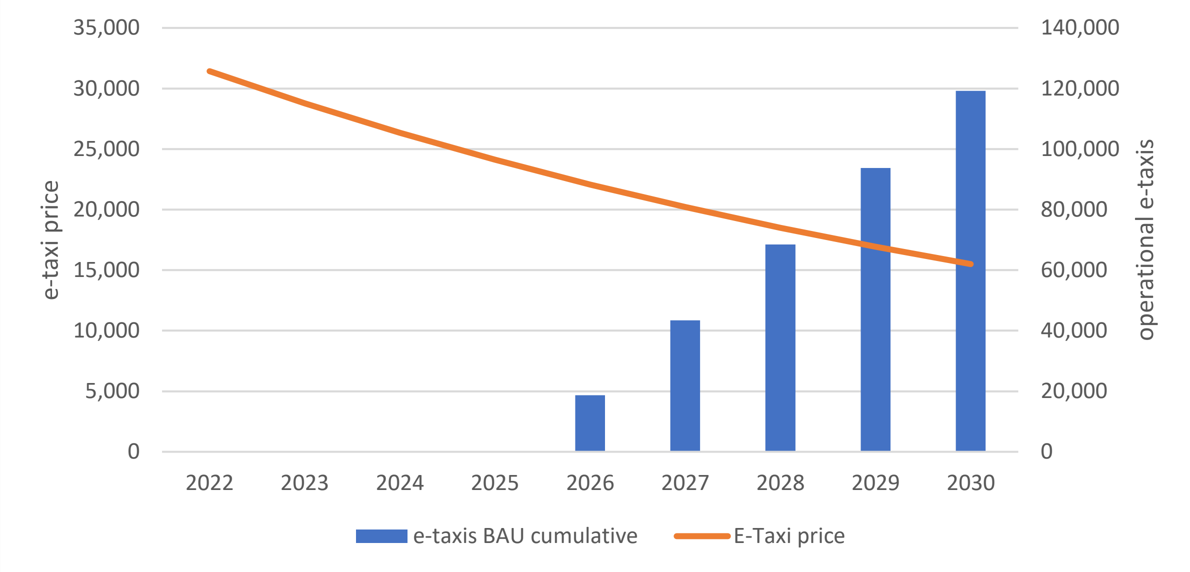
Idem to the e-bus approach, the e-taxi demand is based on comparing the FIRR with the WACC adjusted for a risk rate based on being a new technology using the following criteria:

- 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[33].

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 Argentina.

[33] 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 Argentina and Price Trend of E-Taxis



Source: Grutter Consulting

Under a BAU scenario electric taxis start to get commercially viable around 2026 and then increase rapidly. The share of electric taxis by 2030 could reach under BAU 50% i.e. this goes 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.

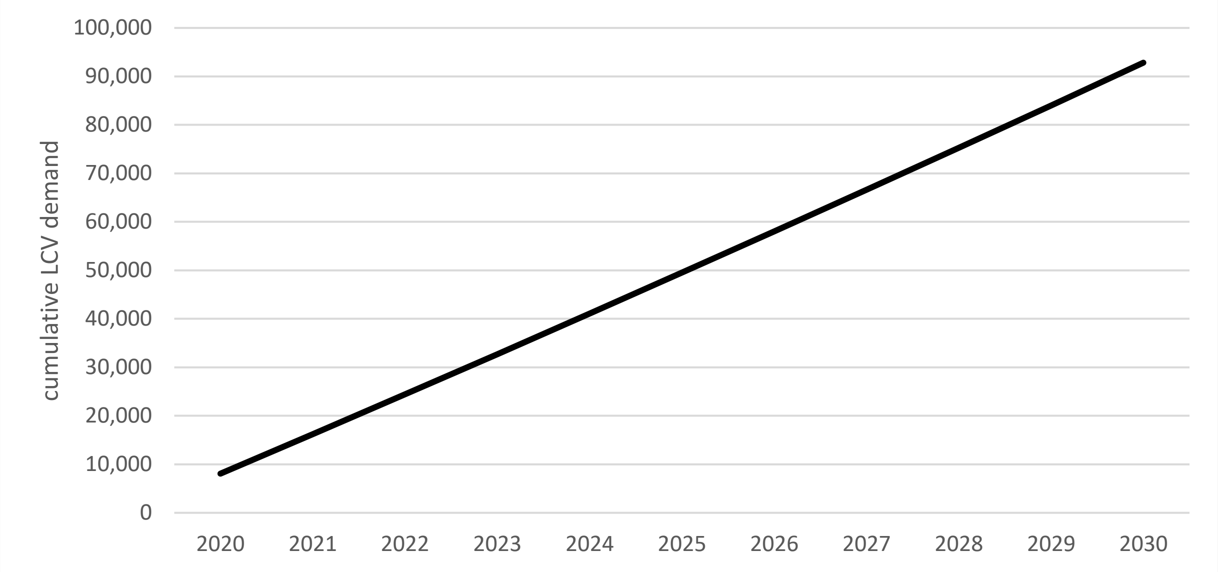
The EV project has as basic function to accelerate EV deployment. In the case of e-taxis the commercial BAU deployment is considered as promising and the value added of additional program incentives in this area is considered of limited. Therfore no investment program is included.

5.4.4. E-LCVs

Market Demand for LCVs

The initial graph shows the total projected cumulative demand for LCVs in Argentina based on vehicle replacement and market growth rates. A large share of LCVs is used by private persons. Thus the total commercial market is only estimated at 10% of the total LCV market.

Figure 11: Total Projected Cumulative Market Demand LCVs



Source: Grutter Consulting (see report 1)

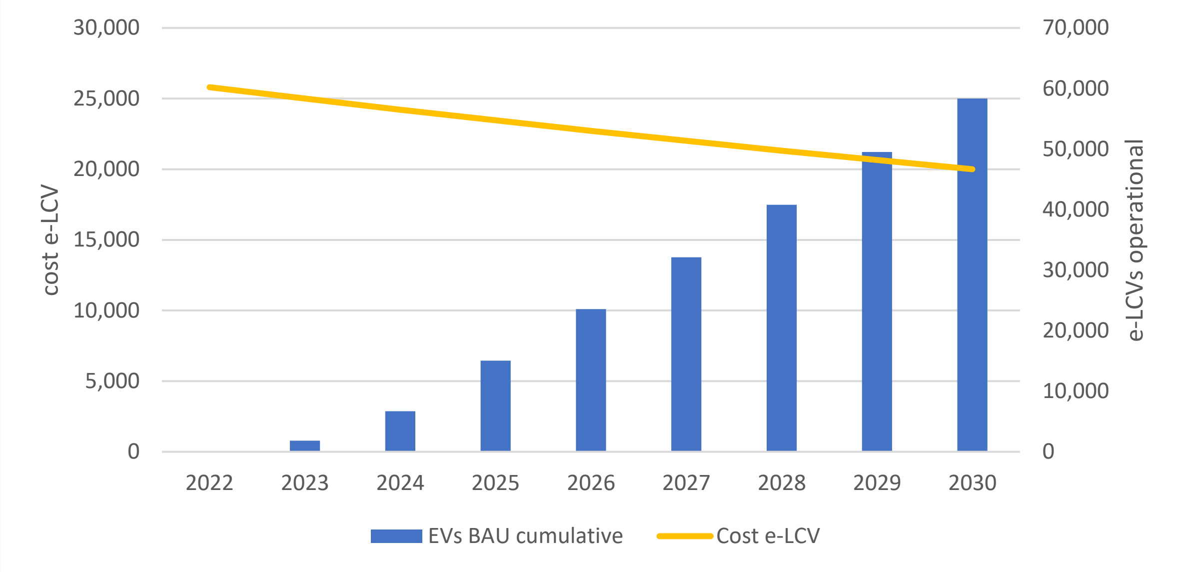
Projected BAU Demand for E-LCVs

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 50% (due also to risk of requiring more public charging than anticipated).
- 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 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 Argentina.

Figure 12: BAU Projected E-LCV Uptake in Argentina and Price Trend of E-LCVs



Source: Grutter Consulting

Under a BAU scenario electric LCVs start to get commercially viable around 2024 and then increase rapidly. The share of electric LCVs by 2030 could reach under BAU 4% of the total LCV market including the estimated private units.

Projected with-Project Demand for E-LCVs

The EV project has as basic function to accelerate EV deployment. In the case of LCVs the commercial BAU deployment is considered as very promising and the value added of additional program incentives in this area is considered of limited.

It is suggested to rather focus the emphasis on urban sanitation vehicles, where to the moment no unit has been deployed and where market readiness is less close than with e-LCVs, which in the case of Argentina are also very close to commercial viability without support due to local manufacturing as well as very low electricity prices.

6. Potential Investment Projects

6.1. Urban Buses

6.1.1. Barriers and Interventions Options

The major barrier towards massive e-bus deployment in Argentina that the initial investment is very high and combined with the risks of e-buses this results in an investment which is not profitable. In the case of private operators business models which tend towards asset and operation separation or leasing would be beneficial. E-buses have major environmental and societal advantages expressed in large positive environmental and health impacts. Whilst the TCO of e-buses is comparable to diesel units, the capital exposure, risks and lack of profitability make it an non-attractive investment.

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.

6.1.2. Possible Business Models

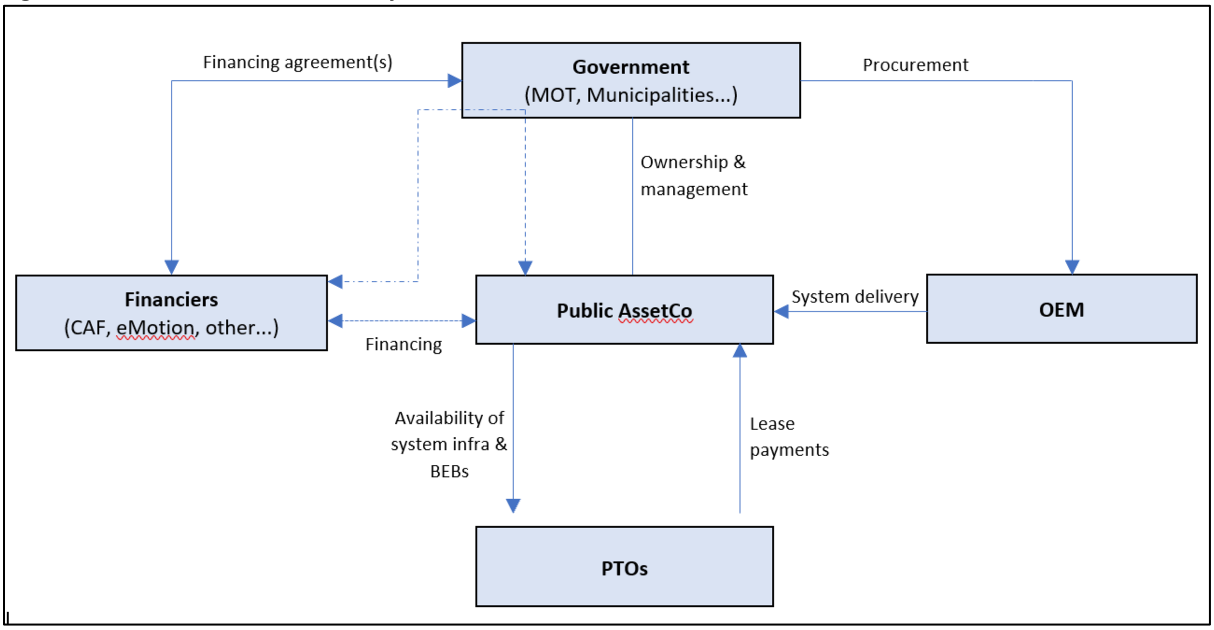
The typical structures that could be followed in the case of Argentina are:

- 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 13: 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

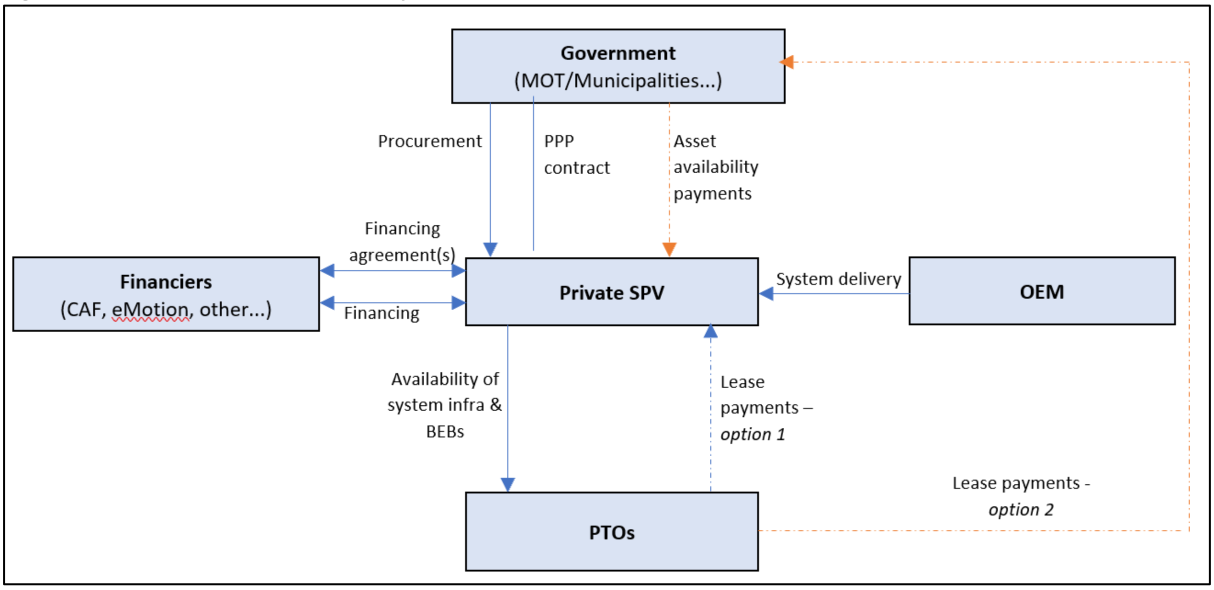
obligation for transfer of assets to subsequent concession holders should a PTO lose its concession.

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 14: 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.

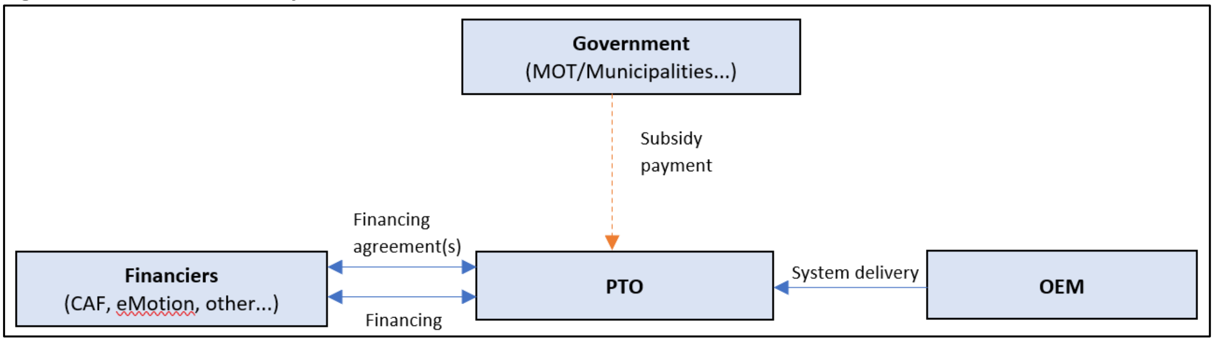
PTOs are required to use the BEB assets as made available by the SPV and are contractually bound to a care and maintenance obligation, as well as a handover obligation for transfer of assets to subsequent concession holders should a PTO lose its concession.

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 15: 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

Different potential investment projects have been identified. Based also on the current economic conditions of Argentina, an initial project for Buenos Aires for 2024 has been included.

Table 8: Potential E-Bus Investment Project

Item	Description
Project contents	100 urban 12m e-buses
Project owner	Municipalities / City Government
Total investment	42 MUSD including buses, charging infrastructure, grid connections and bus depot upgrades
Loan components	32 MUSD loan for 75% of the total CAPEX @ 4.6% interest rate for 12 years of which the GCF 13 MUSD
Subsidy	2 MUSD (5% of total CAPEX)
Environmental impact (cumulative lifespan units)	Reduction of 145,000 tCO_{2e}, 5 tons $PM_{2.5}$ and 600 tons of NO_x

Source: Grutter Consulting

The proposed project isan important intervention to kick start the process. Under a Business as Usual Development (BAU) e-bus barriers will not be resolved and fleets of e-buses will only start to operate in Argentina at a later stage as the market conditions are not conducive towards adoption of e-buses. Market conditions are not yet given in Argentina 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.

6.2. LCVs

The EV project has as basic function to accelerate EV deployment. In the case of LCVs the commercial BAU deployment is considered as very promising and the value added of additional program incentives in this area is considered to be limited.

It is suggested to rather focus the emphasis on urban sanitation vehicles, where to the moment no unit has been deployed and where market readiness is less close than with e-LCVs, which in the case of Argentina are also very close to commercial viability without support due to local manufacturing as well as very low electricity prices. 2 initial projects for waste sanitation trucks in Cordoba and Rosario have been identified which could form part of the package.

Table 9: Initial Investment Project for Waste Sanitation Trucks

Item	Description
Project contents	30 electric waste sanitation trucks
Project beneficiary	Municipalities of Cordoba and Rosario
Financial mechanism	Concessional loan and grant
Total investment	15 MUSD
Loan components	9 MUSD loan for 60% of the total CAPEX @ 4.6% interest rate for 12 yrs
Subsidy	3 MUSD (20% of CAPEX)
Environmental impact (cumulative lifespan units)	Reduction of 59,000 tCO_{2e} and 1. tons $PM_{2.5}$, 120 tons of NO_x

Source: Grutter Consulting

7. Proposed Financial and Technical Assistance

7.1. Financial Assistance Instruments

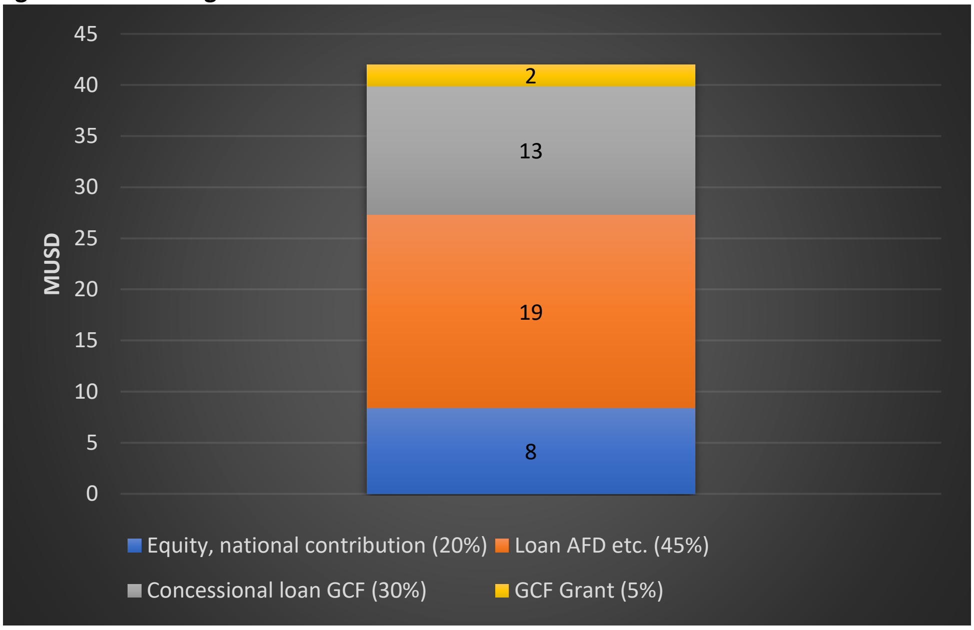
The following table summarizes financial intervention instruments proposed for commercial EV deployment in Argentina.

Table 10: Financial Assistance GCF

Instrument	e-buses	Electric sanitation vehicles
Grants	5% of total CAPEX incl. buses, charging infrastructure, grid connection and bus depot upgrades	20% of total CAPEX including vehicles and charging infrastructure
Loans	30% of total CAPEX	20% of total CAPEX

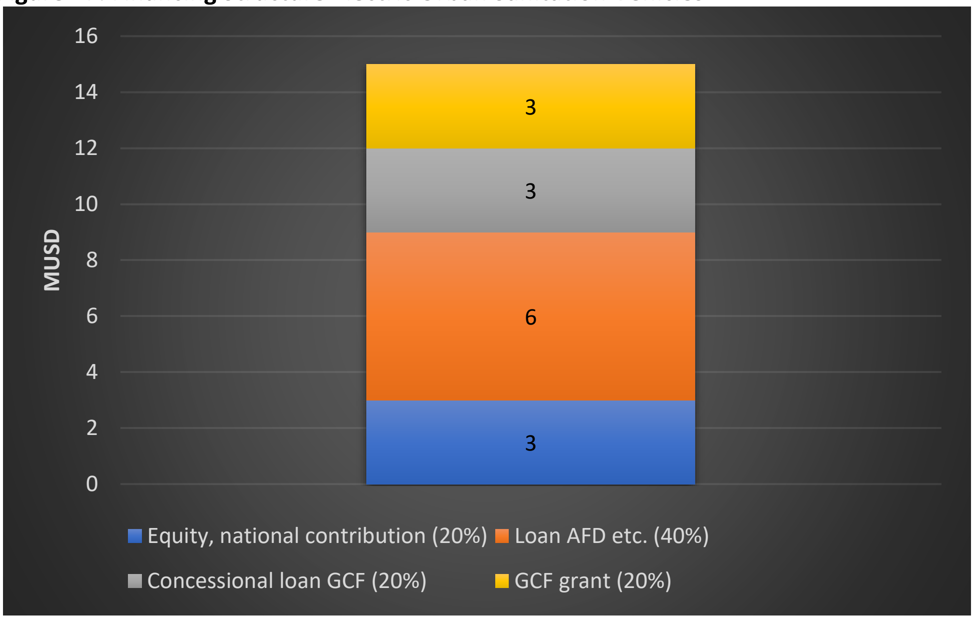
Concessional loans from the GCF are blended with CAF and co-finance and have a long tenure (12 years or longer)). GCF loan conditions have been estimated at 0.75% annual interest rate.

Figure 16: Financing Structure e-Buses



Note: Numbers are indicative; total of 100 buses
Source: Grutter Consulting

Figure 17: Financing Structure Electric Urban Sanitation Vehicles



Note: Numbers are indicative based on an estimated e-sanitation truck cost including charger of 0.5 MUSD for 30 units
Source: Grutter Consulting

3 projects for FA have been initially identified:

- 100 12m e-buses for Buenos Aires to be realized 2024
- 15 e-sanitation trucks for Cordoba to be realized 2024
- 15 e-sanitation trucks for Rosario to be realized 2024

The following table summarizes the FA proposed for these projects.

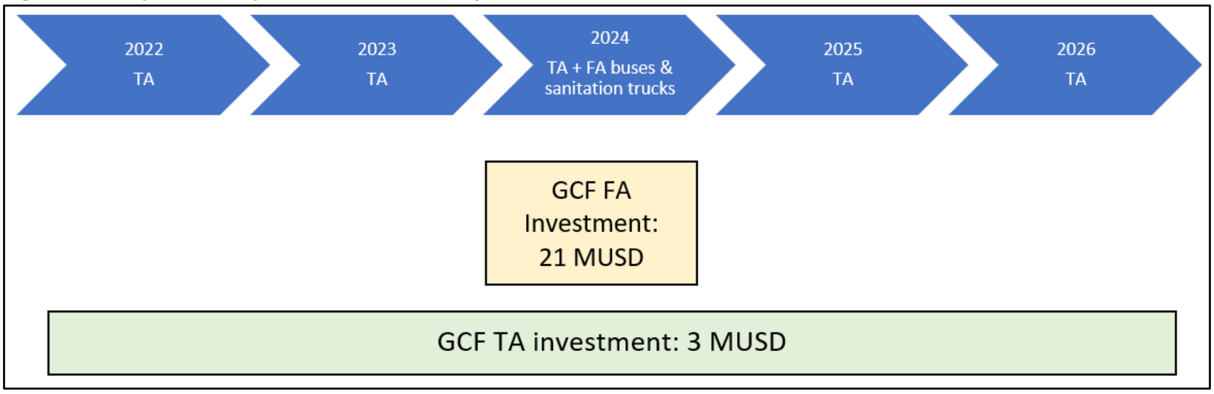
Table 11: FA Potential Projects Argentina

Parameter	e-buses	e-sanitation trucks	Total[34]
Total CAPEX	42 MUSD	15 MUSD	57 MUSD
Total loan	32 MUSD	9 MUSD	41 MUSD
Co-finance loan	*19 MUSD*	*6 MUSD*	*25 MUSD*
GCF loan	*13 MUSD*	*3 MUSD*	*16 MUSD*
GCF grant	2 MUSD	3 MUSD	5 MUSD
Equity and other co-finance	8 MUSD	3 MUSD	8 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. For sanitation vehicles the delivery channel is through municipalities, comparable to buses.

The total GCF contribution for Argentina from the GCF is estimated at 24 MUSD of which 16 MUSD concessional loan, 5 MUSD grant for FA and 3 MUSD TA grant. The following chart shows when investments are expected.

Figure 18: 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:

- Elaboration of vehicle specific roadmaps
- Structuring of concession contracts considering alternative business models.
- Elaboration of a common e-mobility strategy for a national and a local level.

[34] Due to rounding values might not sum up

- Capacities are strengthened for different stakeholders regarding new technologies, business models, charging infrastructure, EV hazards, battery lifecycles among others.
- Assessment on grid impact.
- General improvement of the public transport sector in order to operate e-buses more efficiently.
- Monitoring and evaluation of transport data.
- Training of the financial sector.

TA for preparation / feasibility assessment of the projects worth 1.5 MUSD is managed and paid directly by the financing agent whilst the other TA activities worth 1.5 MUSD are executed by GIZ.

The Annex includes a detailed TA.

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 Argentina of the EV program.

Table 12: Program Impact

Parameter	Direct impact	Total impact
GHG reduction lifetime vehicles cumulative in tons	204,000	4,940,000
• *Buses*	*145,000*	*4,940,000*
• *Sanitation trucks*	*59,000*	
$PM_{2.5}$ reduction lifetime vehicles cumulative in tons	6	180
• *Buses*	*5*	*180*
• *Sanitation trucks*	*1*	
NO_x reduction lifetime vehicles cumulative in tons	740	21,000
• *Buses*	*620*	*21,000*
• *Sanitation trucks*	*120*	
Energy savings cumulative lifetime vehicles in TJ	2,310	55,000
• *Buses*	*2,100*	*55,000*
• *Sanitation trucks*	*680*	

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

Table 13: GCF Financial Indicators

Parameter	Direct impact	Total Impact
Total CAPEX investment	57 MUSD	
GCF Loan	16 MUSD	
GCF Grant FA	5 MUSD	
GCF Grant TA	3 MUSD	
Total GCF	**24 MUSD**	
Co-finance ration	**61%**	
GCF investment cost per tCO_2 reduced	**116 USD/tCO_2**	**5 USD/tCO_2**
Total investment cost per tCO_2 reduced	**294 USD/tCO_2**	**12USD/tCO_2**

Bibliography

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

Grutter Consulting. (2021). *Country Diagnostic Report Argentina.*

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

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.*

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

Ministerio de Ambiente y Desarrollo Sostenible. (2020). *Segunda Contribución Determinada a Nivel Nacional de la República Argentina.*

Ministerio de Ambiente y Desarrollo Sostenible. (2020). *Segunda Contribución Determinada a Nivel Nacional de la República Argentina.*

Ministerio de Ambiente y Desarrollo Sustentable. (2017). *Inventario Nacional de Gases de Efecto Invernadero.*

(2017). *Plan de acción nacional de transporte y cambio climático.* Ministerio de Ambiente y Desarrollo Sustentable.

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

Annex 1: TA Project for Argentina

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

- To elaborate a binding roadmap for e-bus deployment which includes concrete targets, steps and responsibilities.
- Elaborate a common e-mobility strategy for governments, cities and provinces.
- To assist the national and local governments in re-structuring public transport models.
- Elaborate a roadmap for e-taxi deployment with fast charging infrastructure and incentive schemes
- Identify possible business and finance models for e-taxis including the participation of leasing and 3rd party investment funds.
- Develop a roadmap for e-LCV deployment including public incentives for switching to electric units. This includes assessing the possibilities of establishing low emission zones and differentiated access conditions together with local governments, trade, the delivery company and the general public.
- Capacity building for insurance companies, drivers, mechanical workshops and first response staff (firefighters, police, paramedics)
- 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. This activity will also take into consideration the lithium mining, however, good practices in mining and promotion of a local battery industry are out of the scope of the current project.
- Capacity building in public financial institutions to generate financing mechanisms to facilitate the adoption of electromobility.
- Detailed assessment on the impact of EVs on the national and local power grids.
- Design a smart fast charging infrastructure for e-taxis and e-LCVs and policies to encourage off peak charging.
- Set up a monitoring platform for GHG, PM and Ficus to assess the impact of commercial EVs. Also collect transport data.

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

- Structure appropriate concession contracts and conditions conducive to e-bus deployment
- Capacity building for municipalities about the benefits of electric garbage and cleaning trucks, and further special vehicles.
- Elaboration of sustainable urban mobility plans in smaller cities

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 Transporte	Gustavo	Rinaldi	Dirección de Impacto Ambiental
MOVE	Pedro	Scarpinelli	
MOVE	Leonardo	Ianuzzi	
Gobierno de la Provincia de Mendoza	Lía	Martinez	Departamento de Planificación y Proyectos Especiales, Secretaría de Servicios Públicos. Gobierno de Mendoza
	Daniel Jesús	Vilches	Presidencia Sociedad de Transporte de Mendoza S.A.U.P.E.
Dirección de Transformación Digital - Secretaría de Movilidad - Municipalidad de Rosario - Provincia de Santa Fe	Diego	Giordano	Dirección de Transformación Digital
CAF	Angie	Palacios	Proyectos Sector Público Argentina
CAF	Alejandro	Miranda	Proyectos Sector Público Argentina
CAF	Andrés	Alcala	Proyectos Sector Público Argentina
CAF	Abelardo	Daza	Proyectos Sector Público Argentina
Ciudad de Córdoba. Provincia de Córdoba	Micaela	Leuci	Departamento de Datos y Análisis Estadísticos en Municipalidad de Córdoba
AFD	Juan Martín	Sitja	Proyectos AFD Argentina
CAF	Augusto	Buda	Proyectos Sector Privado Argentina
Secretaría de Transporte y Obras. Ciudad de Buenos Aires.	Milagros	Garro	Programa bajas Emisiones. Gobierno de la Ciudad de Buenos Aires
MIT	Antonio	Cortes	ATM - Agencia de Transporte Metropolitano
EPEC. Empresa Provincial de Energía de Córdoba	Hugo	Di Tofino	Departamento Calidad de Servicio, Innovación,

			Movilidad Eléctrica y Nuevos Mercados
Gobierno de la Provincia de Mendoza	Lía	Martinez	Departamento de Planificación y Proyectos Especiales, Secretaría de Servicios Públicos. Gobierno de Mendoza
Dirección de Transformación Digital - Secretaría de Movilidad - Municipalidad de Rosario - Provincia de Santa Fe	Diego	Giordano	Dirección de Transformación Digital
Ciudad de Córdoba. Provincia de Córdoba	Micaela	Leuci	Departamento de Datos y Análisis Estadísticos en Municipalidad de Córdoba
Municipalidad de Córdoba	Andres	Michel	Departamento de Datos y Análisis Estadísticos en Municipalidad de Córdoba
AFD	Juan Martín	Sitja	Proyectos AFD Argentina
EPEC. Empresa Provincial de Energía de Córdoba	Hugo	Di Tofino	Departamento Calidad de Servicio, Innovación, Movilidad Eléctrica y Nuevos Mercados
Dirección Provincial de Energía de Corrientes	Martín	Amuchaste	Subgerencia de Estudios y Proyectos
TAMSE. Transporte Automotor Municipal Sociedad del Estado	Federico	Ingaramo	Gerencia
EPEC. Empresa Provincial de Energía de Córdoba	Hugo	Di Tofino	Departamento Calidad de Servicio, Innovación, Movilidad Eléctrica y Nuevos Mercados
Dirección de Transformación Digital - Secretaría de Movilidad - Municipalidad de Rosario - Provincia de Santa Fe	Diego	Giordano	Dirección de Transformación Digital
Gobierno de la Ciudad de Salta	Natalia	Vorano	Secretaría de Planeamiento urbano

Gobierno de la Ciudad de Tucumán	María Elena	Gerck	Unidad Técnica y de Control Municipal Servicios Transporte Público Pasajero
Grupo TEK	Javier Cardini	Mariano Jimena	Departamento de Ingeniería y Movilidad
Gobierno de la Provincia de Santa Fe	Martín	Molina	Energías Renovables y Eficiencia Energética
Andreani Grupo Logístico	Gabriel	Perez	Desempeño Ambiental

Comisión nacional de Tránsito y Seguridad Vial	Roberto	Domeq	
CETUBA. Cámara de Empresarios del transporte Automotor	Mario	Vaca	
Nueva Metropol. Empresa de Buses	Hernán	Vidal	
DOTA. Empresa de Buses	Daniel	Rodriguez	
Ministerio de Ambiente y Desarrollo Sostenible	Rodriqo	Tornquist	

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	71,000	km	Hinicio, 2020
Workday distance driven daily	238	km	Default
Specific electicity usage	1.1	kWh/km	Chinese average; ADB, 2018; includes AC but not heating
Diesel usage	50	l/100km	Hinicio, 2020
Maintenance cost diesel bus incl. labor excl tyres	0.21	USD/km	Hinicio, 2020
Lifespan bus diesel	14	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	160,000	USD	Hinicio, incl. VAT of 10.5%
CAPEX overnight charged e-bus	398,750	USD	Based on bus with 350 kWh battery set and sur-cost for battery size; includes 35% import tax (based
CAPEX slow-charged batteries	200	USD/kWh	LFP batteries
CAPEX fast-charged BEB	343,750	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
Maintenance & repair cost of CNG buses relative to diesel incl. labour	120%		Based on CNG and diesel bus operators
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	238
Energy usage day	kWh	262
Risk ratio (higher energy consumption)		10%
Reserve ratio		20%
SOC loss year 8		20%
Battery size required year 8	**kWh**	**450**

Charging required at bus depot overnight

Parameter	Unit	Value
Battery capacity	kWh	450
Average daily consumption workday	kWh	262
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	60

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	62
Average share of day electricity		24%
Fast-charger	kW	300
Power conversion efficiency of chargers		90%
Average required re-charge day with 300 kW charger	minutes	14
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 2019

Parameter	Diesel	BEB overnight	BEB fast
CAPEX bus	160,000	398,750	343,750
CAPEX charging infrastructure	0	9,700	12,113
CAPEX grid connection	0	30,000	30,000
CAPEX depot upgrade	0	7,500	7,500
Total CAPEX	160,000	445,950	393,363
Battery replacement yr 8	0	45,000	31,250
Energy cost yr 1	26,838	3,593	3,593
Maintenance cost bus yr 1	14,555	10,189	10,189
Maintenance cost infra yr 1	0	944	992
Finance cost average per year	10,683	26,623	22,951
Economic costs yr 1	6,852	1,194	1,194
TCO financial per km	0.82	0.83	0.74
TCO economic per km	0.93	0.85	0.76

timespan of calculation: lifespan of e-buses with replacement investment for fossil buses; end of life value proportional to remaining lifespan

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	50,000	km	average based on model
Daily mileage	161	km	Based on 310 working days
Charging at home average	70%		Assumption; only re-charge if above-average mileage or night shifts
Charging fast-chargers	30%		
CAPEX gasoline taxis	15,500		https://www.renault.com.ar/automoviles/logan.html
CAPEX e-taxi	37,500		Nissan LEAF large battery or BAIC incl. tax
Capex home charger 7.4kW	2,000	USD	Nissan LEAF large battery or BAIC
Gasoline consumption	10.0	l/100km	urban fuel consumption; https://autodata24.com/renault/logan/logan/16-i-90-hp/details
Electricity consumption	0.16	kWh/km	Nissan LEAF https://ev-database.org/car/1106/Nissan-Leaf
Charger lifespan	10	years	
Maintenance cost gasoline	0.02	USD/km	average rate exckl. Tyre and repairs
Maintenance cost total e-taxi	0.012	USD/km	40% lower than gasoline

gasoline versus e-taxi

Parameter	gasoline	e-taxi
CAPEX vehicle	15,500	37,500
CAPEX charger	0	2,000
Total CAPEX	15,500	39,500
Energy cost	4,150	732
Maintenance cost	1,000	600
Finance cost average per loan year	1,035	2,504
Economic costs yr 1	323	122
Lifespan in years	10	10
TCO financial per km	0.15	0.15
TCO economic per km	0.16	0.15

LCVs

1. Petrol Van

Parameter	Value	Unit	explanation
CAPEX van	16,700	USD	Renault Kangoo; https://www.renault.com.ar/utilitarios.html
Petrol fuel consumption	10.8	l/100km	urban: https://motoreu.com/renault-kangoo-1.6-16v-mpg-fuel-consumption-technical-specifications-9794
Maintenance cost	0.04	USD/km	excludes tyres and repairs;
Lifespan	15	years	Based on annual mileage
Daily distance driven	70	km	DPEC
Annual distance	23,000	km	DPEC

2. E-Van

Parameter	Value	Unit	explanation
CAPEX e-van	27,500	USD	Renault e-kangoo; preice difference international 8,000 USD plus 35%
Range WLTP	260	km	https://de.renault.ch/elektroautos/kangoo-ze/motoren.html
Battery size	33	kWh	
Cost battery	6,600	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	16,700	27,500
CAPEX charger	0	2,000
replacement cost batter		6,600
Total CAPEX	16,700	29,500
Energy cost	2,062	209
Maintenance cost	850	425
Finance cost average per year	1,115	1,970
Economic costs yr 1	281	53
Lifespan in years	15	15
TCO financial per km	0.21	0.18
TCO economic per km	0.22	0.18

;