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"Impact Assessment of Electro Mobility development in Buenos Aires City on GHG emissions, energy efficiency and noise levels"

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Summary

Electric vehicles have been introduced successfully in some cities in Europe, US, China and Japan. Instead, Latin America has not yet begun to draw a roadmap to introduce electro mobility solutions to the increasing demand for environmentally clean transport.

In this context, the present paper aims to analyze the impact of a gradual implementation of electric mobility in buses and cars in the Metropolitan Area of Buenos Aires City (AMBA), which shares common needs with other Latin American cities [1], in Greenhouse Gases (GHG) emissions reduction, necessary charging infrastructure, energy efficiency and noise level.

Keywords: electric vehicle, emissions, EVSE (Electric Vehicle Supply Equipment), noise, energy efficiency, Buenos Aires

1 Methodology

This paper is a continuation of the award-winning work presented at the World Energy Congress 2016: "Roadmap and Infrastructure Assessment to Introduce Electro Mobility in Buenos Aires City" [2], which explains the possibility and feasibility of implementing a gradual electrification of the urban transportation system in the city of Buenos Aires, that can apply to any Latin American metropolis.

The proposed method to evaluate the environmental and energy impact of the implementation of electric mobility and its charging infrastructure considers in the first place a projection of a progressive electrification of the bus and cars fleet according to international market trends. Secondly, an analysis was carried out by evaluating the energy demand of the Argentinian electricity sector and the emissions reduction based on the projected electrification of internal combustion engines. Subsequently, a projection of necessary investments in the charging infrastructure was made based on an updated market study that integrates electric fleet in buses and private cars. Finally, the noise reduction assessment was performed by estimating the affected population and electric vehicles (EVs) noise levels.

1.1 Transportation needs and GHG emissions in Buenos Aires

At the COP22 Argentina committed to reducing GHG emissions with an unconditional reduction goal of 18% by 2030 (on 2005 basis) [3]. The transport sector accounts for 12% of the total GHG of the country. Consequently, Argentina needs to encourage the electrification of its transport.

In order to understand the current situation in terms of GHG emissions in the Metropolitan Area of Buenos Aires (AMBA) an analysis of current transportation needs is performed considering buses and cars [4]. By cars, we consider taxis and private passenger light-duty vehicles (PLDVs[1]). In order to estimate future emissions of GHG and its potential reduction due to the electrification of internal combustion engine (ICE) vehicles two projection models are performed, one for buses and one for cars. The scope of this paper considers only electrification, i.e. pure battery EVs (BEVs). Plug-in hybrid EVs (PHEVs) and efficiency improvements in current ICE vehicles are left out of scope.

Buses

The AMBA area has 18.173 buses [5] on duty which on average make 1.806 million km/year transporting 7,9 million of passengers/day [6]. Considering the average emissions of 1.197 g of CO_2/bus.km [6], the total emissions due to buses in AMBA account for 2,2 million tons of CO_2/year on a Tank to Wheel (TTW) basis.

The average age of the fleet is 4,0 years [7], which means that the average lifetime of a bus is 8 years. Considering this, each year about 12,5% of the total bus fleet is renewed (2.250 units/year).

In the case of buses there is a commitment as the major of Buenos Aires City signed the C40 agreement to achieve the G20 objective of 25% of electric buses in 2020 [8]. That agreement means a total of 4.500 electric buses (e-buses) in 2020 which is an ambitious goal because they represent 3,5 times the total 2016 e-bus stock in Europe (1.273 units) [9], and that by the first semester of 2017 there are no e-buses implemented yet in Argentina. There is only one conventional diesel hybrid bus running in Buenos Aires since October 2016 [10].

In the case of buses three scenarios where considered to project the penetration of electric buses over current diesel fleet. The first scenario, the aggressive scenario, is coherent with the target settled by C40. It's feasible if keeping the actual level of replacement of ICE buses per year, which means not to retire ICE buses before the end of their life cycle, but requires high ratios of electric buses. Under this scenario, the bus fleet is 79% electric in 2025, coherent with the goal of others cities like Paris which aims to reach 80% of e-buses by 2025, deploying 4000 electric buses [11]. AMBA buses under this scenario are completely electrified by 2027. Meanwhile other cities like Shenzen in China have more ambitious goal of the total electrification of buses by 2017 [9]. To perform the projection the bus fleet is considered constant as in the last three years the total number of buses remained with non-significant variation [5]. A mild scenario is considered in which the C40 objective is achieved in 2024 and the total electrification of buses is reached in 2030. The conservative scenario (Fig. 1, Table 1) studies that C40 objective is reached in 2028 and that in 2035 total electrification of the bus fleet is completed.

[1] PLDVs include passenger cars and passenger light trucks but exclude two-wheelers, three-wheelers, and low-speed/low power four-wheeled vehicles.

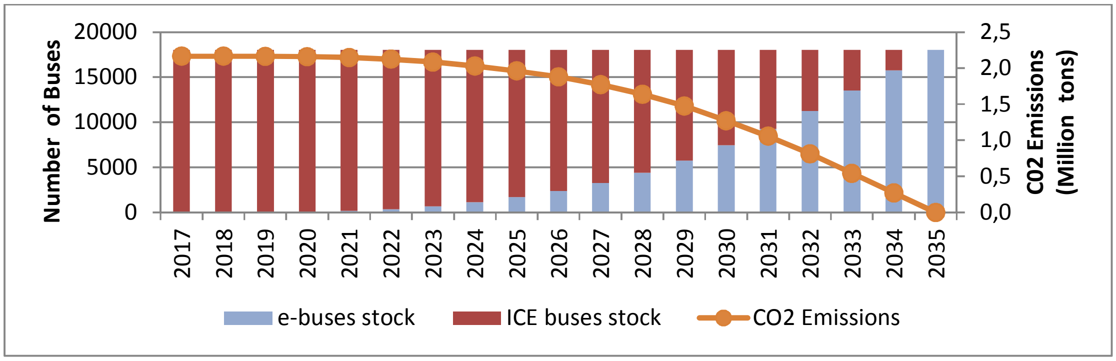


Figure 1 e-Buses Conservative Scenario (C40 Objective in 2028)

Table 1 e-Buses Conservative Scenario (C40 Objective in 2028)

	2017	**2020**	**2025**	**2030**	**2035**
e-buses stock (%)	0%	0,3%	9%	41%	100%
e-buses stock (No of Buses)	0	45	1688	7425	18000
ICE buses stock (No of Buses)	18000	17955	16313	10575	0
Renewed Buses (No of Buses)		2250	2250	2250	2250
Introduction of e-buses (No of Buses)		36	563	1688	2250
Percentage of e-buses / renewed buses (%)		2%	25%	75%	100%
CO2 Emissions (Million tons of CO2/year)	2,2	2,2	2,0	1,3	0,0

Cars

AMBA has 4,3 million of cars, on average those cars make 30.400 million km/year transporting 11 million of passengers/day [6]. Considering the average emissions of 196 g of CO_2/car.km [6], the total emissions due to cars in AMBA account for 5,9 million tons of CO_2/year on a Tank to Wheel (TTW) basis.

Argentinean car sales in 2016 were 709.482 vehicles in the whole country [12]. Car sales in AMBA were estimated based on a percentage of the population (31% of the country inhabitants, live in AMBA), resulting in 220.433 PLDVs. Based on those sales, each year about 5.1% of the total car fleet is renewed. AMBA population was projected based on 1960-2010 series of data [13], reaching 14,5 million people in 2035, 14,1% growth from 2017 values. Car sales were consequently affected with a 14,1% growth ratio.

Projection of electric car penetration (Fig. 2, Table 2) is 5% of sales by 2025 and 25% in 2030, similar to IEA B2DS Scenario [9] and reaching 35% in 2035 coherent with Bloomberg Finance (EV penetration by 2040 35-47% of new cars) [14]. In terms of the supply side projections, OEM announcements showed a fairly good alignment to 2025 with the Paris Declaration [9].
By June 2017 there are no electric cars on sale by OEMs in Argentina. A recent regulation from Argentinean Government published in May 2017, reduces the importing fee for electric, hybrid and fuel cell vehicles, from 35% of ICE vehicles to 5%, 2% or 0% depending on its categories [15]. This measure is expected to boost the demand of EVs.

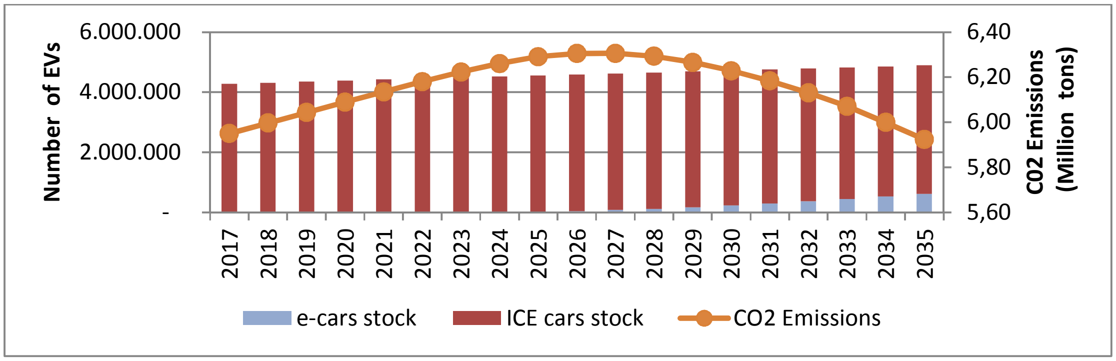


Figure 2 e-cars Conservative Scenario

Table 2 e-cars Conservative Scenario

Conservative Scenario	2017	2020	2025	2030	2035
e-cars stock (%)	0%	0,0%	0,6%	5,5%	14,5%
e-cars stock (No of cars)	-	610	24.358	238.195	625.757
ICE cars stock (No of cars)	4.285.312	4.385.929	4.530.895	4.485.771	4.266.921
Total cars stock (No of cars)	4.285.312	4.386.539	4.555.252	4.723.965	4.892.679
Renewed cars (No of cars)		225.640	234.318	242.997	251.675
Introduction of e-cars (No of cars)		400	11.716	60.749	88.086
Percentage of e-cars / renewed cars (%)		0,2%	5%	25%	35%
CO2 Emissions (Million tons of CO2/year)	5,95	6,09	6,29	6,23	5,92

1.2 Energy and Charging Infrastructure

In the last two years the Argentinian power generation sector has been showing the first intensions to drive a change in the technology mix and in the path of adding new capacity. The National Energy and Mining Ministry (MinEM), together with CAMMESA[2], have recently launched a tender package[3] with the aim of adding 2.152 MW of high-efficiency thermal units, two renewable energy auctions (RenovAr Round 1.0 and 1.5[4]) awarding 2.424 MW, mainly of wind and solar photovoltaic (PV) power purchase agreements (PPA), and the last announced in June 2017 combined heat and power (CHP) and combined cycles conversion tender[5], which also focuses on increasing the heat rate of a generation mix needed to renew its thermo fleet. In addition, the National Government has signed contracts to start the construction of two new Nuclear power plants totalizing 1.895 MW and two hydro power plants with a total capacity of 1.740 MW, which will deliver 5.100 GWh/year when reaching the commercial operation date (COD). Additional power is expected in the upcoming years with the nuclear Embalse Río Tercero life extension, RenovAr 2.0 for renewables, and long-term projected hydro and combined cycles.

Considering the new power capacity and the National Renewable Law 27.191 in force since last year, which aims to foster capacity deployment to deliver 8% of electricity from renewable energy sources (RES), starting from 2018 and reaching 20% by 2025, this paper has projected the power generation mix scenario towards the year 2035 (Fig. 3). This technology matrix is characterized by the reduction of the fossil dependence, the equivalent CO2 emissions, the increase of the thermal power generation efficiency and the introduction of innovative lithium-ion battery storage technologies in combination with wind and solar PV.

[2] CAMMESA: Compañía Administradora del Mercado Mayorista Eléctrico SA (Wholesale Electricity Market Administrator).
[3] Resolution SEE 21/2016.
[4] Resolutions MEyM 136/2016 and 252/2016.
[5] Resolution SEE 287/2017.

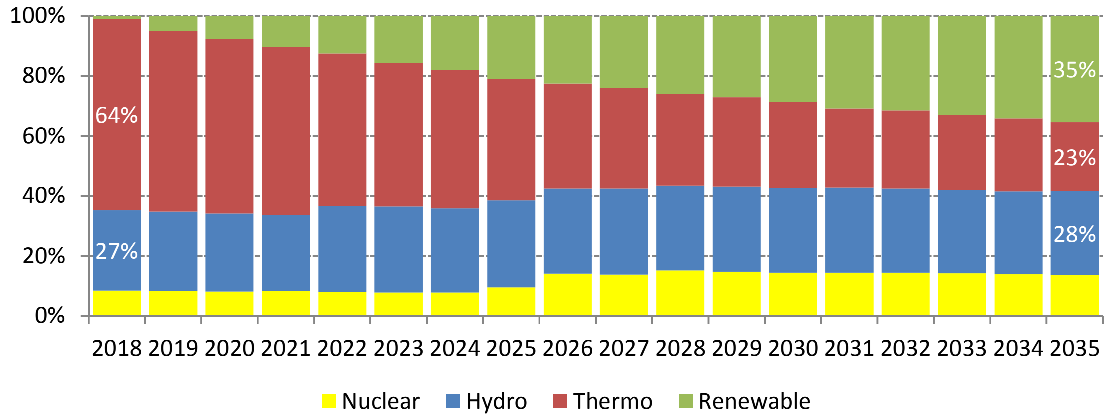


Figure 3: Power Generation Mix Shares Scenario towards 2035

From the Fig. 3, it can be observed the potential shift from a strong dependent thermoelectric capacity (mainly natural gas, fuel oil and gas oil) with 64% in 2018 to a diverse mix of 23%, 35% and 28% of thermo, renewables and hydro respectively. This change would be in line with the mentioned 27.191 Law, with the Argentina's commitments for COP 22 and mainly with the decarbonisation pathway, which would characterize the future energy transition worldwide.

Summarizing the assumed future generation mix scenario, the electricity demand projections towards 2035 were estimated under an energy efficiency strong policy scenario, accounting for 143 TWh/year in 2018 to almost 178 TWh/year in 2035 (Fig. 4). The introduction of more low-carbon technologies, RES, high-efficiency CHP and H/J Combined Cycles series will drive the reduction of GHG emissions from the Argentinian power sector in a significant amount, from almost 40,6 million Tn (MMTn) eq. CO2 in 2018 to 17,4 MMTn in 2035 (Fig. 4), representing almost the 43% on a 2018 basis.

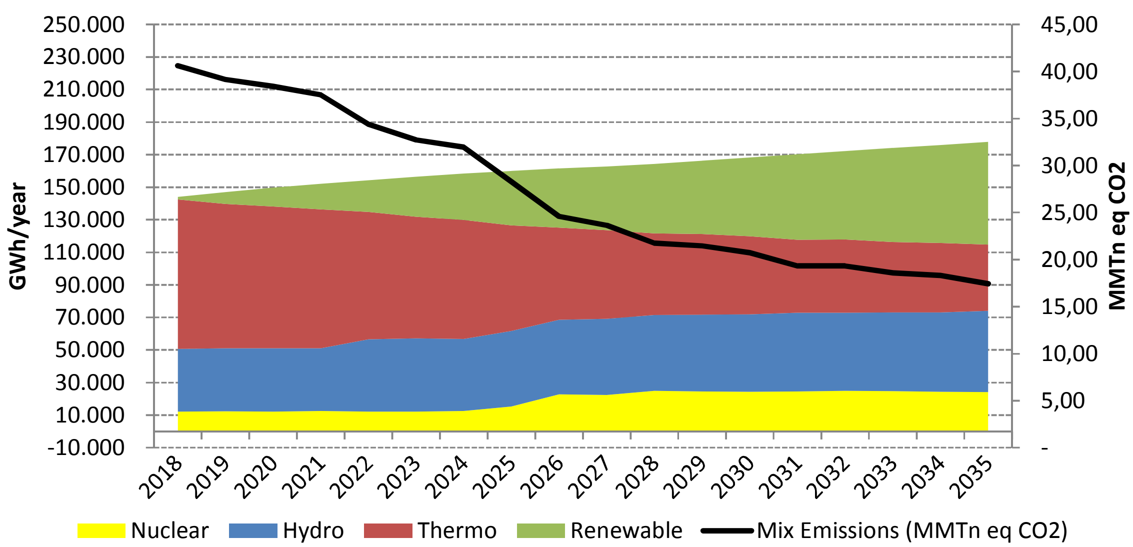


Figure 4: Electricity Demand Trend per Technology Scenario towards 2035

In line with these last assumptions and with the climate change goals to keep global warming below 2°C, energy transition will be driven also by the electrification of the transport sector. Policy makers and consumers will push for a rapid and large-scale action to help encourage electric vehicle growth.

As it was estimated in the previous section, the urban transport sector of Buenos Aires City would be electrified gradually according to local government commitment, in the case of e-buses, and in response to international market encouraging signs and regulatory framework, in the case of electric cars.
Energy infrastructure for charging and distribution networks also would put a threshold for electric vehicle deployment, but as far as smart charging control strategies are introduced together with grid expansion investments, a higher penetration of EVs would be permitted. For the case of e-buses, charging state of the art technologies were described in our previous study [1]. Regarding energy demand, 18.173 e-buses for Buenos Aires City would reach to consume almost 1.446 GWh/year by 2035, representing less than 1% of the total energy produced in the national system. Electric cars fleet would account for almost 650.000 units consuming less than 426 GWh/year (Fig. 5).

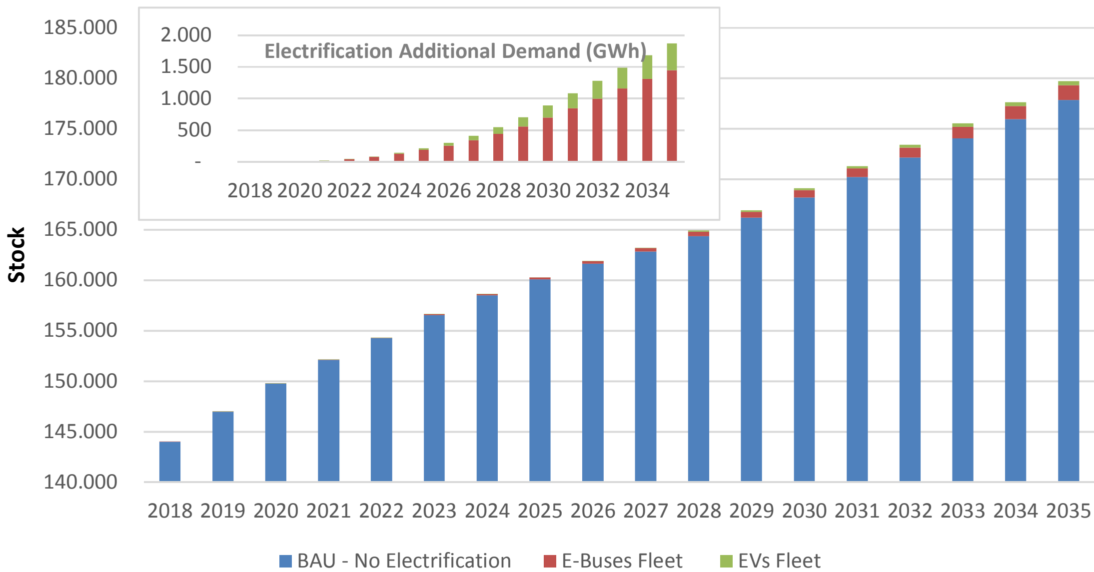


Figure 5: Additional electricity demand (GWh) due to electrification projections

On a Tank to Wheel (TTW) basis, we assumed for e-buses a consumption of 1,26kWh/km, starting from 2018 with gradually range enhancement. On a Generation to Wheel (GTW) basis, considering the assumed generation mix, this value would be 2,07 kWh/km and 3,25 kWh/year, for the case of a full thermoelectric generation based. Also, yearly heat rate enhancements were assumed for thermal power capacity. Energy savings derived from the full penetration of the e-bus fleet towards 2035 would account for 65,5% on a GTW basis considering a full thermoelectricity generation (Fig. 6), being even higher for the case of the mix.

For the case of the electric cars deployment in the City, on a TTW basis, we assumed for a consumption of 0,15kWh/km, starting from 2018 with gradually range enhancement. On a GTW basis, considering assumed generation mix, this value would be 0,25 kWh/km and 0,39 kWh/year, for the case of a full thermoelectric generation based. Energy savings derived from the partial deployment of the fleet towards 2035 would account for 61.9% on a GTW basis considering a full thermoelectricity generation (Fig. 6), being even higher for the case of the mix.

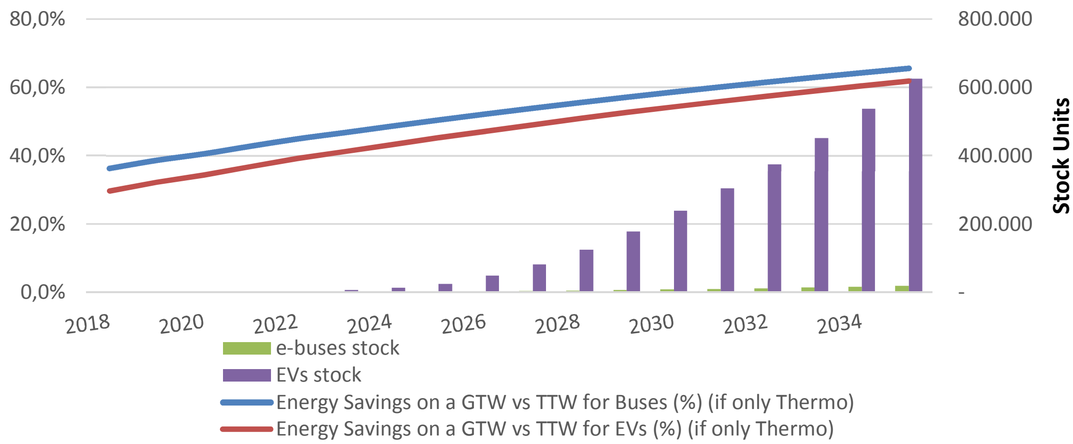
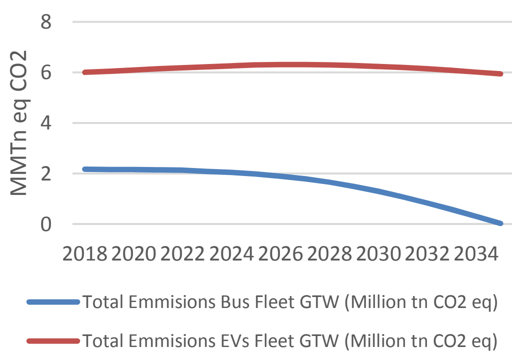


Figure 6: Energy Savings from Electrification GTW (Thermo basis) to a TWT (ICE basis) towards 2035

As it was described in the first section, EVs contribute in reducing GHG emissions substantially, as the stock penetrates into the fleet. But, as considered for the energy savings, the calculations should consider the emissions from the power generation mix, if we want to analyze the reductions on a GTW basis. Emissions from the well to the point of fuel combustion are out of the scope of this paper.



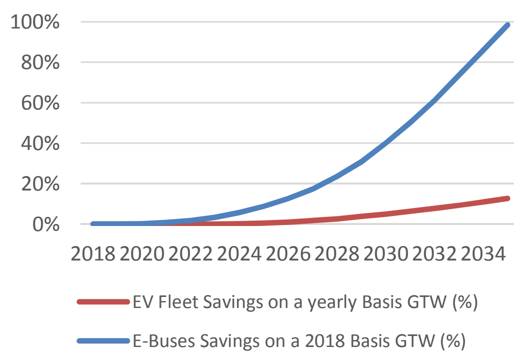


Figure 7: GHG Emissions Electrification Contribution and Savings (GTW) towards 2035

Thus, for both cases of electro-mobility gradual penetration, and in addition to the emissions reduction achieved by the partial decarbonisation of the generation mix (Fig. 4), there can be observed the significant contribution of the e-bus sector (almost 100% by 2035, on an annual basis) and the e-car sector (13%) (Fig. 7). For the first case, in the period up to 2035, emissions accounting for 11,2 Million Tneq CO2 would be avoided, which is equivalent to a total savings of 29% compared to what would be emitted if the electric bus fleet is not implemented, under a business as usual (BAU) scenario. In the case of electric cars, those savings would reach 8% (10,06 Million Tneq CO2) compared to BAU. It is important to underline that for the case of the private cars, emissions will continue to increase until 2027 due to the addition of new conventional cars (Fig. 7). From that moment, the contribution of the gradual change is observed thanks to the increase of sales of electric cars.

EV charging infrastructure

As it was stated by the European Strategy for Low-Emission Mobility the EVSE infrastructure is key for successful EV deployment, therefore after analyzing the EV penetration for AMBA and its energy impact, the EVSE needs for AMBA will be discussed. Currently, the most spread solution is plug-in charging where the vehicle has to connect fiscally to the charging point with a cable. Typically there are two use cases, first at home (AC charging), second in the public infrastructure where the charging point could support different standards from normal speed to fast charging (DC charging). The wireless charging is a similar solution to the previous one without the need of a physical connection. The wireless method currently is under discussion to arrive at a standard that would render it interoperable among different car manufacturers. According to the STILLE project wireless charging will get to the public interoperable and standardized by 2020 [10].

We conducted a survey to understand the profile of the Argentinean user and his expectations about where they would like to charge their EV. It was performed in June 2017 with a total of 706 respondents (Fig. 8).

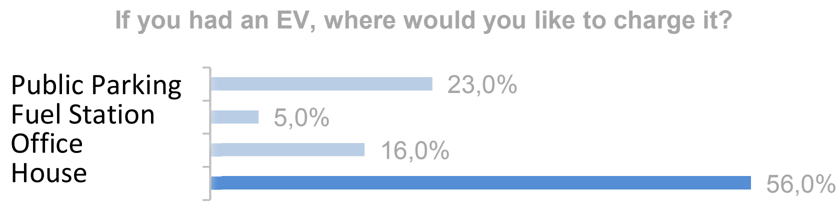


Figure 8: Online survey about EV charging places conducted in Argentina.

The results coincide with what previous studies revealed: a typical EV user prefers to charge it at home, however some chargers would be suitable in public space and fuel stations [18]. It is worth underlining that in most of the countries there is a variation of the electricity tariff along the day, being cheaper during night time, while in Argentina it is constant. To boost EV adoption, the tariff in Argentina should be differentiated in two or three hour bands as in other countries. With the cheaper night tariffs home charging preference would be even more significant.

To efficiently use renewable electricity, charging strategies have to adapt to the fluctuating supply reducing energy and electrical infrastructure cost. An energy management (EM) system would allow charging stations to charge simultaneously a large number of vehicles as quickly as possible while maintaining charging priority privileges, for example in case of power shortages that are rather frequent in Argentina specially during summer [19]. Another benefit would be to take advantage of the tariff variance along the day, but as it was mentioned before, this is not yet possible in Argentina. Such a system will have to consider the available power from the grid and run real-time measurements on the demand to act on the EVSE and apply a proper charging strategy.

For most of the fast EVSE currently available on the market, the supplier provides such a system to manage a cluster of EVSE. For the particular case of AMBA, it is expected to be composed by many EVSE coming from different vendors. The first two EVSE of the city were installed by YPF SA on July´17 within a plan to deploy 200 DC fast charging points in 110 company´s fuel stations along the country. Nowadays there are two energy distributed system operators (DSO), therefore an implementation of cross-vendor EM system that would allow balancing and managing the entire grid of a city it would be absolutely necessary.

Charging infrastructure for e-cars

The ICCT [20] measured the EVSE density in the principal European cities in 2015 (Table 3). This could be used to estimate the level of investment required for public EVSE needs for AMBA to satisfy the EV evolution in the market according to the estimations done in previous chapter.

Table 3: EVSE density [20]

City	Number of public EVSE per 1000 EV
Amsterdam	5,50
Oslo	5,20
Stuttgart	3,00
London	0,63
Paris	0,30
Berlin	0,29

From the previous table we can understand that there is a great variance in terms of EVSE availability. The reasons for this variance are geographical and, most important, specific government policies in terms of incentives or restrictions, such as the need to improve the air quality reducing the CO2 emissions or the noise pollution in particular areas.

Such a significant variance makes it difficult to establish a specific density in the case of AMBA. It can be considered it that the current scenario is a transition towards a steady state, whereas some cities are more mature but it is expected that all will converge. This is the reason why the average value of 1,8 EVSE for every 1000 EV is chosen (Table 3). Next step is to understand the mix of mode 2 (semi-fast) and mode 4 (fast) EVSE that could evolve with the gradual introduction of EV.
It is expected that by 2020 the availability of home-based semi-fast EVSE would be less significant as EV adoption is its early phase. Therefore more mode 4 EVSE would be required to promote EVs. This is the reason why the ratio Mode 4 / Mode 2 would start with 0,8 in 2020 and reaching 0,4 by 2035.
As a starting point in the first year a minimum number of EVSE must be introduced as a support for this new technology.

From an analysis made by the U.S. Department of Energy [21], it is possible to obtain the equipment cost of non-residential EVSE (Table 4). In order to assume a conservative scenario, the high-cost case has been chosen, which considers higher installations cost due to that the grid infrastructure has to be reinforced which is estimated to be the case in AMBA. The estimated cost projection of the gradual introduction of EVs in AMBA is shown below (Fig. 9).

Table 4: EVSE Mode 2 and Mode 4 costs

Mode 2 High Cost		Mode 4 High Cost	
EVSE Unit	$6.000	EVSE Unit	$17.000
Installation	$12.000	Installation	$40.000
Total (for 2)	$18.000	Total	$57.000

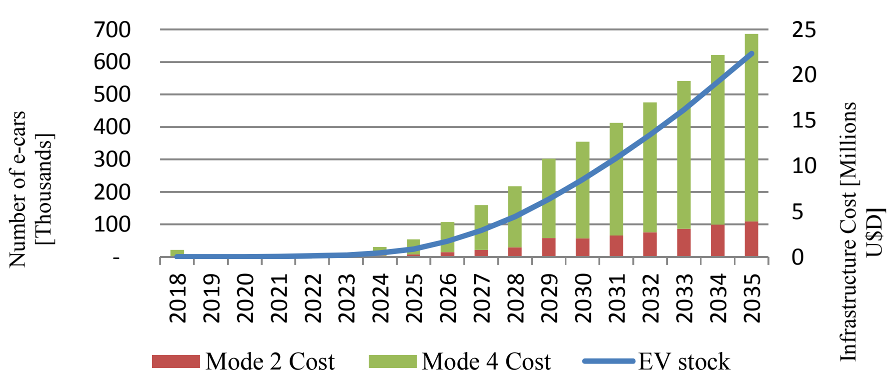


Figure 9: Charging infrastructure cost for e-cars in AMBA

Charging infrastructure for e-buses

For e-buses there are two possible charging methods: depot and opportunity charging. Depot charging usually takes longer time (around 6hs [2]) and should be complemented with a faster opportunity charging at the return point where usually the buses spend a couple of minutes before starting another journey. Opportunity charging can be considered as very special plug-in use case designed for buses. It uses a pantograph interface that offers a connection up to 600kW allowing a 2-5 minutes rapid charge at terminal stations. Installing such charging points has to come along with an energy management system to prevent overloads of the grid.

Table 5, source [21] and own calculation.

Depot /Fleet Charge Cost		Opportunity Charge Cost	
EVSE Unit	$17,000	EVSE Unit	$20,000
Installation	$40,000	Installation	$45,000
Total (for 2)	$57,000	Total	$65,000

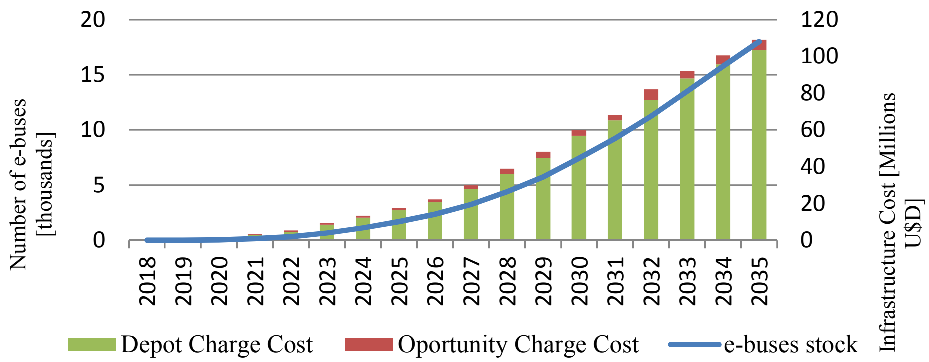


Figure 10: Charging infrastructure cost for e-cars in AMBA

1.3 Noise level impact of Transportation in Buenos Aires

Noise in modern cities

All citizens are affected by noise and this has an effect on their quality of life. According to the guidelines for community noise, about half of the citizens of the European community live in areas that do not ensure an adequate acoustic environment for their residents [22]. There is already evidence that exposure to sound levels above 50 dBA at night generates higher levels of blood pressure. Similarly, noise levels from road traffic exceeding 65 dBA increase the risk of having a cardiac arrest in men by 20%. [23]. The WHO has defined environmental noise as "Noise emitted by all types of sources except by noise from industrial work sectors". Since 1980, the WHO has focused on the problem of urban noise by developing different proposals aimed to the requirements of society in relation to policies aimed to reducing noise levels. When talking about the control of noise pollution, we usually talk about the costs that this entails. However, it should not be forgotten that noise itself generates costs in the area of health. The social cost related to vehicle traffic noise in Europe (EU22) is estimated at 30 to 46 billion euros per year, which represents 0,4% of GDP (Gross Domestic Product) [24].

Unfortunately, it has not been possible to find relevant historical data related to the evolution of acoustic pollution in the City of Buenos Aires and / or diseases that could be related to this phenomenon. That is why this work allows us to establish a starting point for future studies that can be carried out that intend to consider the noise variable and find a relationship for another specialties link psychology, neurology, social sciences, among others.

Noise from electric vehicles

A French study performed in 2012 analyzed the noise emitted from electric and hybrid dual-axel trucks [25], the results of the noise levels as functions of the speed can be seen in Fig. 11 and shows that there is an important difference between the noise emission from an electric and the ICE truck, especially at low speeds. At 20 km/h the difference is almost 10 dB, whereas the difference above 50 km/h is only around 1 dB.

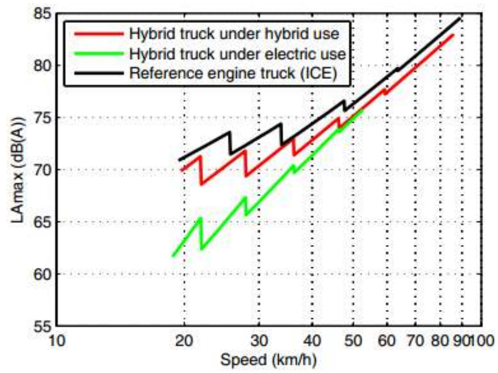


Figure 11: Noise levels as functions of the speed of Hybrid and ICE trucks.

The influence of noise coming from the contact between the tire and roads is also an important phenomenon. Fig. 12 shows the propulsion noise, tire/road noise and the total noise from a passenger car as a function of speed calculated with the Nord2000 model [26]. So, it can be assumed that for speeds above 60 Km/h the total noise emitted for a vehicle it is due to this reason.

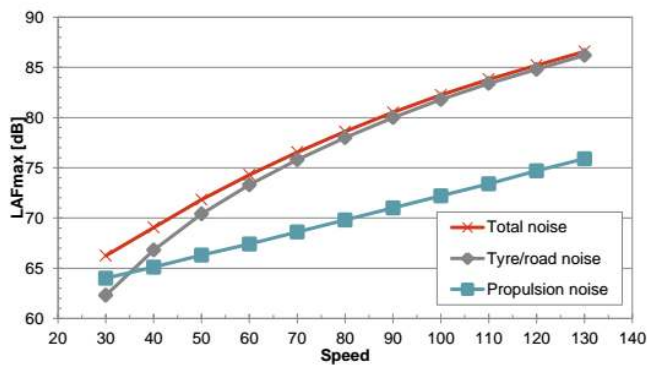


Figure 12: Noise levels in LAFmax as function of the speed [km/h] for a passenger car.

Population exposed in Buenos Aires

The Environmental Protection Agency of the City of Buenos Aires has carried out a study that evaluates the population exposed to noise levels that can influence in their quality of life. This was done by simulation of noise maps of districts 2, 3, 4, 5, 6 and 11 and it represents the 30,4% of the total area of Buenos Aires city. The noise maps levels from these areas can be seen on Fig. 13 and the main uses of these are commercial and industrial activities but it can be found in the residential areas, located in central as well as peripheral areas. Also, the main sources considered are heavy duty vehicles like buses and cars such as, taxis and private passenger light-duty vehicles. Finally, it is important to take into account that the population involved by these districts represents 38,4% of the total population of the city (percentage that is equivalent to 1.108.627 inhabitants) [27].

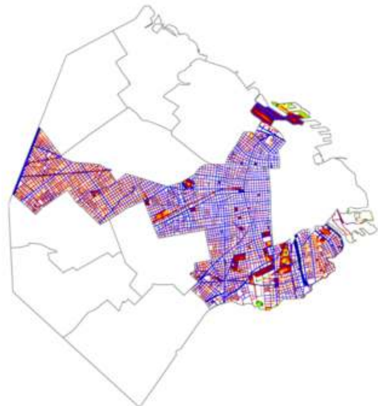


Figure 13: Noise maps for day-time developed by the Environmental Protection Agency of Buenos Aires.

The ISO 37120: 2014 standard "Sustainable development of communities - Indicators for city services and quality of life" recommends to estimate affected population through the Lden indicator (day-night-time noise indicator) at levels greater than 55 dBA [28]. Since actual legislation of Buenos Aires does not consider the period "evening" or late, the ISO standard suggests that in those cases where the Lden descriptor cannot be calculated, the noise pollution can be estimated by the indicator Ln (Noise indicator corresponding to the night time period), evaluating the Percentage of the population exposed to exceeding the 50 dBA limit. According to the noise maps, GIS model of inhabitants and by the use of the Miedema model [29], it can be can assumed that 94% of the population under study (30,4% of the total area of Buenos Aires Metropoli area) are exposed to levels above 50 dBA during the nighttime period (Ln)[27]. It can be observed on Fig. 14 that among 12 cities that present results about noise pollution of urban areas, Buenos Aires is the one with more population exposed to noise levels that can affect their quality of life.

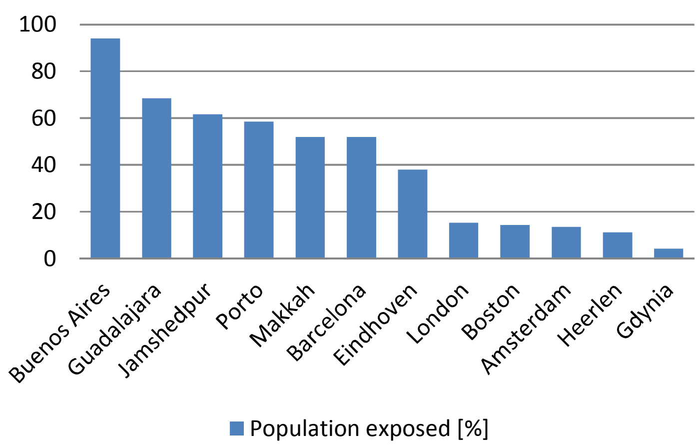


Figure 14: Population exposed to noise levels according to World Council on City Data portal.

An investigation conducted by the National Institute for the Public Health and Environment in the Netherlands shows that assuming that 90% of the passenger cars and 80% of heavy duty vehicles were electric an overall reduction of approximately 3 dB could be obtained near to main roads and peaks of about 4 dB could be found in crossings and secondary streets, leading to a decrease in the highly annoyed inhabitants of about 36% which can be considered as an important reduction [30].

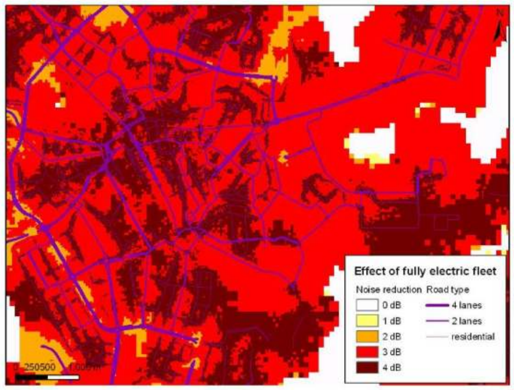


Figure 15: Noise reduction by replacement of actual fleet with fully electric fleet in the Netherlands.

Nowadays, there are 18.173 ICE buses circulating allover Buenos Aires city and their influence together with other heavy duty trucks is very important to the total amount of noise levels that is been observed in this city [33].

2 Conclusions

The conclusions present an impact assessment of the development of electric mobility solutions for Buenos Aires with a potential extension to Latin America, taking into account the state of the art in technology and the latest policies implemented in other countries.

This paper proves that it is feasible to achieve a total electrification of the bus fleet in AMBA by 2035 eliminating 2,2 Million tons of CO2/year on a TTW basis. A 14,5% of electric cars stock could be reached by 2035 slightly reducing the TTW CO2 emissions from 5,95 in 2017 to 5,92 Million tons of CO2/year even with a larger car fleet size in 2035.

The power generation mix scenario considered for Argentina is aligned with the international tendencies towards decarbonization and electrification of the energy systems. Argentina has a high potential in this context due to the availability of non-conventional gas, hydro, bio-energy and renewable sources. Innovation introduced by energy storage together with energy management systems will boost a growing integration of electromobility with a more sustainable energy system.

A gradual implementation of electric buses up to the year 2035 will allow reducing the amount of population currently outside the parameters recommended by the WHO. If it is considered the streets in which the buses have to be in constant periods of acceleration and deceleration, the reductions are highly important. The outlook is more than encouraging to be able to reduce the percentage of people currently exposed to levels of noise that are highly detrimental to their health in the long run.

With the objective of supporting electric mobility as a driver of change for the sustainable growth of society, this work shows a path to low-carbon energy systems, and measures the impact of the integration of renewable energies, energy efficiency and better life quality in Buenos Aires and other cities in the region.

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