POLITECNICO DI TORINO

COLLEGE OF ENGINEERING

Master's Degree in Automotive Engineering

Final Project

Commercialization of an electric car for urban mobility and the creation of a distribution network in Luxembourg. Case study with Estrima Birò.

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Introduction

In a constantly developing world where the population is growing at a rate of around 1,07%, where people start to speak about possible ways to reduce the global warming, where the city centers are becoming more and more congested, mobility and especially green mobility is starting to have a relevant role and future in people's everyday life.
The mentalities are changing since car sharing, car pooling are now well developed ideas, and in most capitals the need to use a 4 or 5 seats car is contrasted by the parking problems, the lack of parking spaces, the traffic jams and the restricted traffic zones.
Governments are also putting pressure on citizens to act in a responsible way for the environment and have the tendency since few years to incentive alternative mobility solutions in the cities.

In this thesis, a specific focus will be placed on an innovative vehicle called Birò which is 100% electric and which is used exclusively for urban mobility.
It will be studied in which way this type of vehicle is commercialized and how to create a distribution network in Luxembourg. The interesting point is to see also the differences with the most common approach to sell OEM's passenger cars in a dealership.

During the thesis development, the distribution project for the Birò in Luxembourg was founded by Andrea Drescher, being a strategy consultant and a private equity administrator, and by Côme Drescher being student at the Politecnico di Torino in the Automotive Engineering course.
Oxom Mobility & Lifestyle company was then created, having as a commercial entity « Birò Luxembourg ». The company bought and signed in July 2018 the exclusive distribution license for the Birò vehicle in Luxembourg. It will be seen together through the thesis, the steps and the creation process of this project, passing through the market analysis, market segmentation, target clients analysis, marketing plans, minimum stock order and sales.

In a first step, the history of the global car market will be explored, in order to see the evolution and to speak about the forecast for the next 10 years.
After that, a global market segmentation for the global car market will be performed. Focus will then be put on the electric vehicles (EV) with an history of sales, a forecast for the next years, a market segementation and eventually a study of the competitors that are present on the market.
Once the global electric cars market is presented, attention will be placed on the EV sales in Luxembourg, to perform a market segmentation for this very particular market and to study the competitors presence.

Obviously, without infrastructures, the EV market has no sense, and that is why a chapter on the current and future situation in terms of recharging infrastructures will be inserted.
At this point, the Birò product will be introduced, with a discussion on how it answers to the customer needs, its advantages with respect to the competitors and the incentives from the government for the customers (corporate or priavte) who buy the product. The service part for the distribution of the vehicle will also be presented and the reasons why the maintenance will be outsourced for the first years of the project.
For the last chapters it will be analized the targets clients, the target sales of the year, the sales strategy, the promotion budget with the events in which Birò Luxembourg participated, the sales contracts and the contract with the producer with the difference between the dealer contract and the importer contract.
As a last chapter, the business case will be presented with not sensible numbers in order to see the rentability and the feasibility of the project.

1. The global car market

1.1 History

In this chapter an analysis on the last four years will be performed, since there are sufficient information to have a clear idea of how the market has evolved and what are the macro reasons for this type of evolution.

Looking at the global car sales evolution from 1990 to 2018 as depicted in the figure 1.1, it is clear that there is a constant growth of the number of vehicles sold each year in the world.

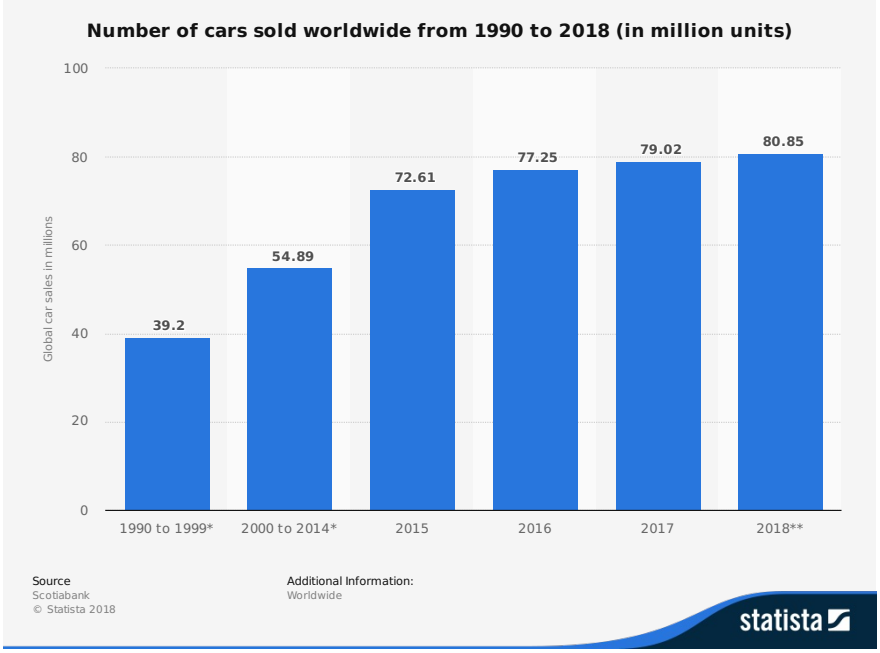


Figure 1.1 Number of cars sold worldwide from 1990 to 2018 in millions units

Notice that for the years 1990 to 2014, the numbers are based on a yearly average and that for the year 2018, the value is an estimate due to the fact that the document has been released on October 2018.
The first three markets in the world being China, Europe and USA, if we consider the statistic data of the first half of the year 2018, the China has the biggest growth between the three with a value of +3,9% with respect to the first half of 2017, corresponding to a number of around 12,2 millions of cars sold.
However, this growth is less representative if we consider that it is the second lowest sales growth for H1 (first half) since 2009. It comes from the fact that the gains of 8% from the sedans sales is offset by the lower sales of -7% for the SUVs (sport utility vehicle) and MPVs (multi-purpose vehicle) categories.

A relevant result is the one of India which appears now as a key market for the auto industry, and outsold Germany to become the 4th largest vehicle market after China, USA and Japan.

Let us see on the figure 1.2 the top 10 markets in terms of vehicle sales in the H1 2018 :

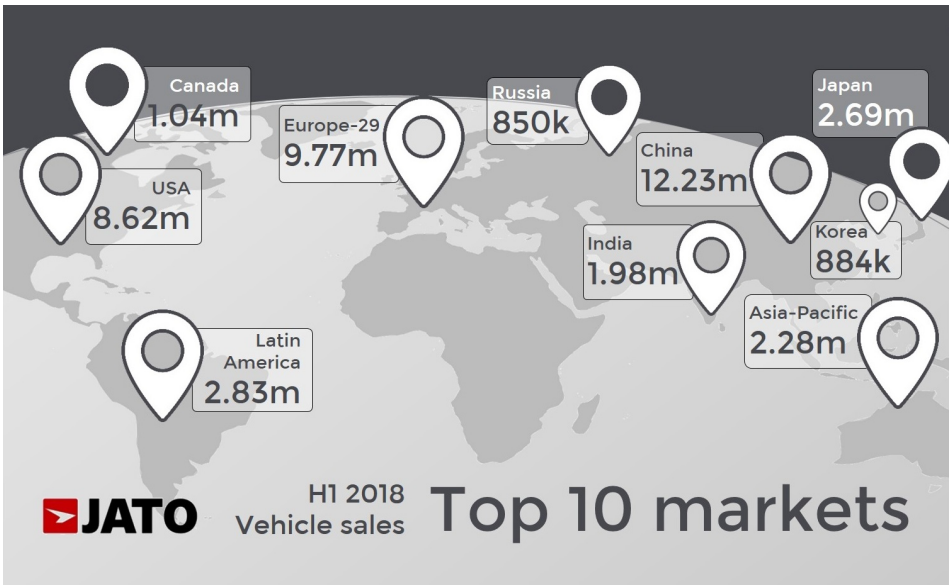


Figure 1.2 Top 10 markets in terms of vehicle sales for H1 of 2018

Clearly, Europe remains a considerable market with countries like Germany, France and Italy representing the top three in terms of car sales.

Having more precise results and numbers from Jato Dynamics concerning the sales performances from 2017 to 2018, it can be observed that the year 2018 is marked by a decrease of 0.5% on the global car and LCV (light commercial vehicle) sales with respect to 2017, since the analysis of 54 top markets found that 86 millions vehicles were sold this year.

This is mainly due to the fact that the European, Chinese and US markets stalled due to the increasing trade tensions between the biggest economies and the political changes in key markets.

This year, strong results in India, Brazil, Russia and South East Asia offset the stalling sales in the three previously presented markets. In Europe, the fallout from Brexit and the introduction of more complex environmental regulations are the major reasons from the less performant results.

In terms of good performances, it is worth to speak about the SUV segment who registered 30 millions vehicles sold, representing 36% of the total passenger car sales. Moreover, the electric vehicles recorded their best year with a volume increased by 74% which is a good performance.

As a conclusion, the year 2018 registered a slight decrease in terms of volume, with multiple particularities like for example the record in terms of EV sales. As expected, the SUV segment drove the sales volume and the pick-up segment had positive results with an increase of 5% in terms of volume, not thanks to the US market but thanks to the Thailand and Brazil.

The interesting points to explore now are the market share by segments and the sales by motorisation types.

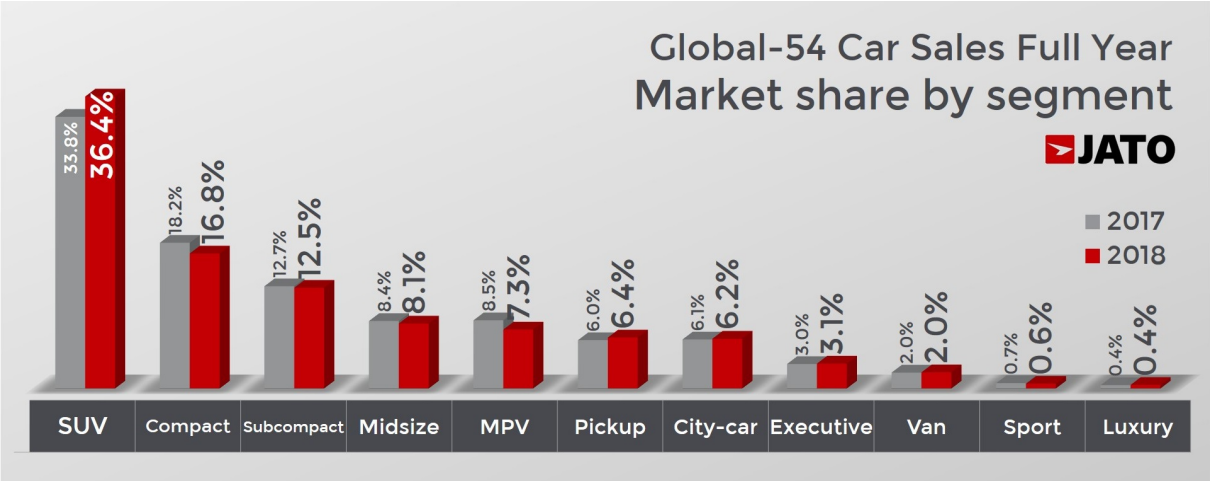


Figure 1.3 Market share by segments from year 2017 to year 2018

Growth in the SUV segment was largely driven by the mid size SUV subsegment (D-SUV) which grew by 16,6%. Large SUVs (E-SUV) posted a growth of 15,7%, representing in North America 2/3 of the cars sold and in China a doubling amount was sold for the year 2018 with respect to 2017.
An interesting growth is the city cars volume growth, mainly due to the Japan request (+14,4%) and it is of our interest in the following chapter to focus on this type of segment, since a focus will be laid on urban mobility in the following chapters.

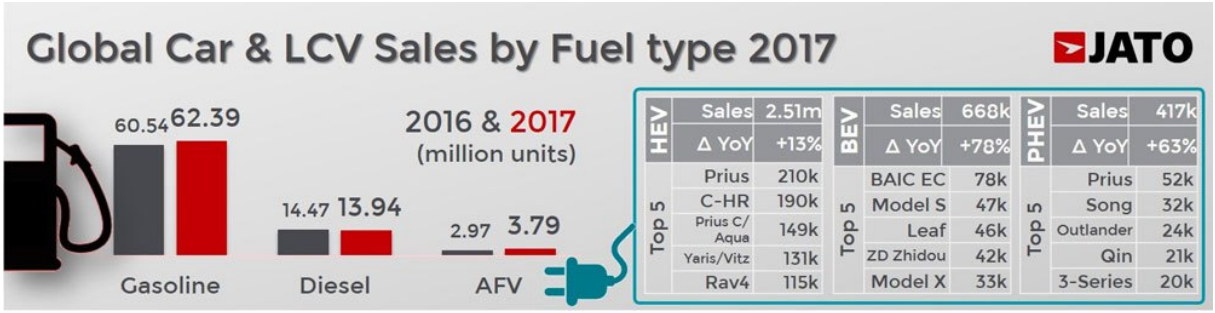


Figure 1.4 Global car and light commercial vehicle sales by fuel type from year 2016 to year 2017

As it can be observed on figure 1.4, the diesel cars suffered a slight decline due to many factors like the « diesel gate », the strict regulations against diesel cars in the city centers (in Europe mainly) that are slowly emerging for the next years and the increase of the price of diesel in some countries in Europe also.
The diesel decline was instead offset by the increase of around 3% of the Gasoline cars sales, for a total of 62,39 millions of units sold.
Eventually, the most significant growth is for the alternative fuel vehicles (AFV) including the hybrid electric vehicles, the battery electric (pure electric) and the plug-in electric vehicles. A growth of around 28% was registered but the more representative figure is the 78% growth for pure electric vehicles with respect to the previous year 2016.
A total of around 3.8 millions of AFV vehicles were sold during the year 2017, with a tendecy to grow each year. The forecast is presented in the following chapter.

1.2 Forecast for the next 10 years

- How many cars per year will be sold in the next years ?
- What will be the market share of vehicles by fuel type ?
- What will be the car of tomorrow ?
- In the future, will we buy a car or simply rent it ?

These are the main questions that we usually ask to experts when we think about the future of the automotive industry.
Of course, the precise and detailed reports made by Jato or even LMC are not available to the public but it is interesting to have a quick overview on the global trend of the automotive industry. The interesting point will be to see how different markets with their economic growth will influence the global car industry in terms of sales, innovation, etc.

Looking at different graphs like the ones in figure 1.5, it is clear that every year the volume of cars sold will increase. The decline of diesel cars will be compensated by the growth of gasoline, hybrid or electric cars sales. More in general, the EV sales will increase in volume, reaching in 2040 between 35% and 55% of the new car sales. A very precise forecast until 2040 is hard to perform because the global car sales in general but also the global car sales by fuel types is directly dependent on the different regions

situations all over the world, on their political situations, on their economical growth, on their demographical growth and on the environmental situations and legislations.

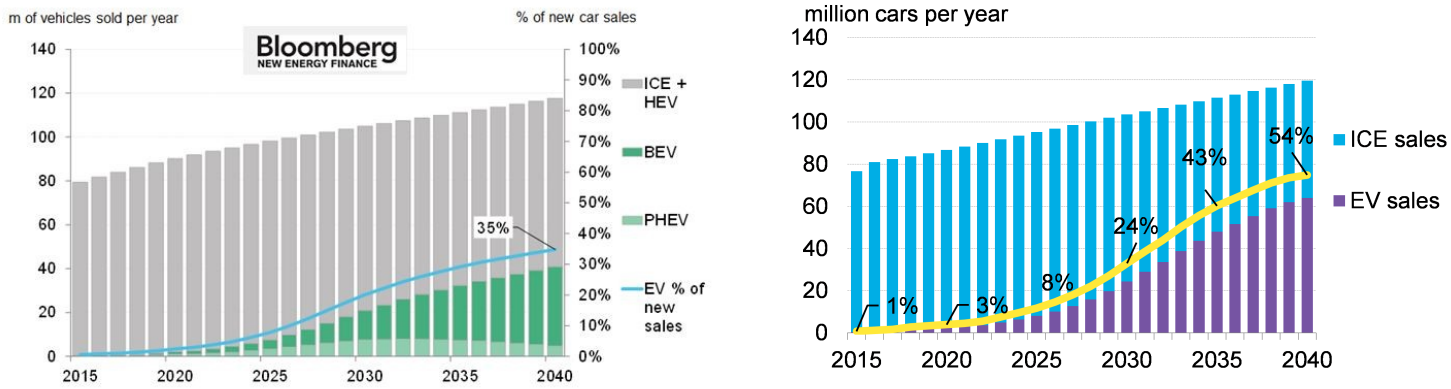


Figure 1.5 Light vehicles sales volume forecast until 2040 according to Bloomberg

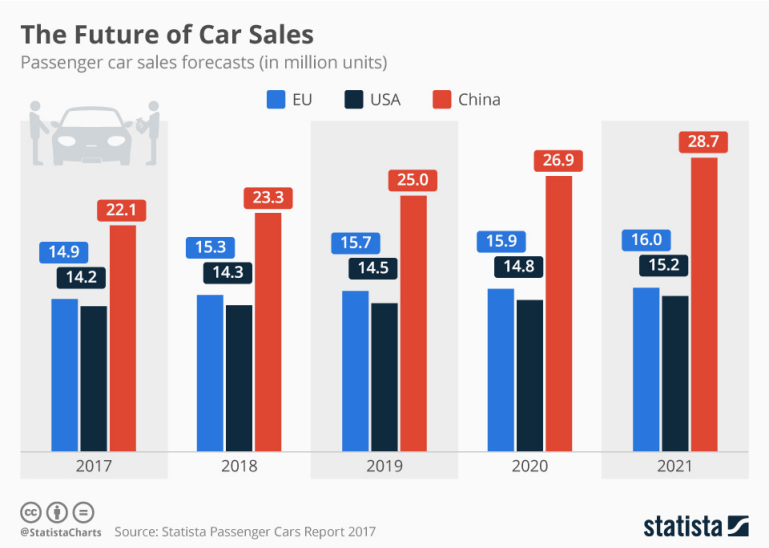


Figure 1.6 The future of car sales for the first three automotive markets

China being the first market in the world, still has a large potential. The other BRICs markets are either on the path to recovery like Brazil and Russia, or on the path to new highs. Of course the performances will be influenced by the economic conflicts being countries, import-export taxes fluctuations or even by the oil prices fluctuations, but the trend seems to be clear.

The question is, will the client of tomorrow still buy or rent a car ? It depends on many things, how interesting will be to rent or lease a car with respect to buying it. Of course with diesel cars, the leasing or simply the long term renting would be preferable, to avoid the problem of not selling the car in the future due to emission restrictions and to traffic restrictions in the city centers.

The other point is that in some cities, it will become a nightmare to own a car due to the traffic or to the parking problems and car sharing for example will become a preferable solution.

Nowadays, many financial solutions are proposed in order to buy a car and the most common ones are the leasing, personal loans, buy back solutions, permitting to avoid paying in a single transaction.
However, we observe that renting a car is having a huge potential since the short term renting represents billions of revenue every year and permits also to OEMs to directly sell big size fleets. Long term renting is usually for companies or persons holding a VAT, but in some countries and for example in Luxembourg we are observing that some banks are starting to offer private lease to clients that do not own necessarily a VAT.
Eventually, even if mobility services or renting services are developing and growing with two figures in the cities, we observe that the wish to own personally a car has still a primarily importance in some people mentality ; that is why the global car sales is not ready to decline and that is mostly thanks to new emergent markets (India, brazil, Argentina, etc..) and powerful and well performing markets (China, USA, Europe, Japan).

With the development of the automotive technologies, the two main subjects for which attention is kept are the autonomous vehicles and the pure electric cars.
It is clear that electric car definitely owns a big market share and that OEMs are investing huge amounts of money for the development of their new electrified range of models, but another technology with a huge potential for the automotive industry is the hydrogen with the hydrogen fuel cell engines as depicted in the figure 1.7.

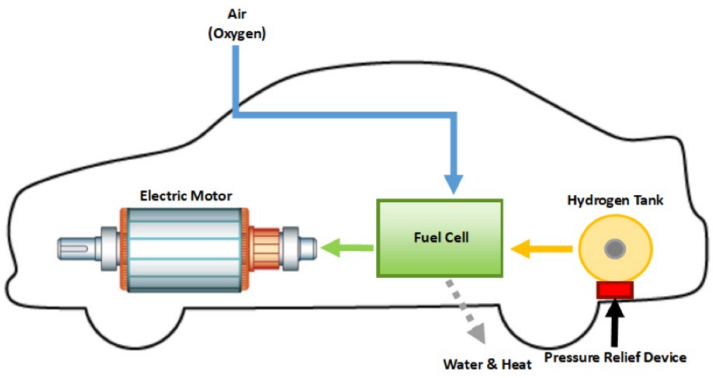


Figure 1.7 Hydrogen fuel cell engine with the electric motor

Photo 1.8 First public hydrogen station in Flanders

Toyota announced on January 2015 that the patents and the researches on the hydrogen engines were available and with its competitor Hyundai, they started to sell hydrogen powered cars like the Toyota Mirai, the Hyundai ix35 and the Hyundai Nexo, but with prices much higher than standard combustion engine cars (from 60k€ for the Hyundai to 75k€ for the Toyota). The problem is now the price of the cars and the lack of stations to recharge due to the fact that the storage of hydrogen is really costly and can be dangerous (due to high pressures or extremely low temperatures), but the technology has a huge potential.

Figure 1.9 Hydrogen fuel cell cars (on the left the Hyundai Nexo and on the right the Toyota Mirai)

The Japanese government being very interested in this new technology, has set a target price of 2.2 millions Yen (equivalent to 18 000$) for fuel cells vehicles by 2025.

The OEMs are stating that by 2030, more or less 25% of the cars produced will be hybrid or 100% electric.
The market will then be shared between internal combustion engines (mainly gasoline engines), hybrid, plug-in hybrid, electric and fuel cell vehicles.

What are the future challenges and opportunities ?

Appart from the increment of the sales volume per year, four major challenges will shape the near and middle term future :

- **Complexity and cost pressure** : With the more and more stringent regulations, the OEMs are developing alternative powertrain solutions to comply with very low emissions, but also the new safety standards and the increase in complexity of the car will increase the costs of development and production.
- **Diverging markets** : Emerging markets' share of global sales will increase a lot and current production sites are not yet fully aligned to suitable distribution in those emerging countries. More over, there is a potential « Portfolio mismatch » as said by McKinsey, due to the fact that small class vehicles demand are growing faster than expected, and especially in fast growing emerging markets.
- **Digital demands** : The next step for the purchase of a car will probably be to buy it online or to have an automatic distribution, and this could be an opportunity for car distributors but could be also a real threat for the traditional dealerships which did not face seriously the digital transition.
- **Shifting industry landscape** : Europe as an example will have to manage in an efficient way the restructuring of its industry, to face chinese penetration in new segments and markets. The big challenge will be to match in a competitive way the future demand in terms of alternative powertrain solutions and services related to innovative uses of a car (sharable, connected, traceable, intelligent (AI)).

1.3 Market segmentation

There are a lot of different market segmentations, even if the major ones are usually putting in evidence the same groups of consumers.
Let us present the following market segementation :

- « **Only functional use of the car** » are the clients that own a car just for functional use. They do not care about possible features like different motorisations, different colours. They even do not want to pay extra money for quality, they just want the car as a transportation mean from a point A to a point B as they can not do it with other means.
  For this category of clients, the car is not perceived as a status symbol and they seek for lower priced cars representing good value for money.
  Smaller cars are prefered as they are more convenient in terms of price but also in terms of mobility in the city. They usually switch brands easily to find the best deals which is completely different from the other categories of clients.
  In this study, it was considered that the following segment represents 30% of the global market.

Figure 1.10 Types of vehicles having for target the previsously presented segment

- « **Family needs** » are the clients searching for a car suitable for an established family with children still leaving in the household. They seek for spacious cars, more comfortable with a big trunk to transport the family.
  Usually the features prefered for this type of client are the larger seats, the drink holders, the entertainment units, the suitable visibility and so the space inside the cabin. Higher motorisations are not required but car accessories related to travel are of great importance as for example the bike racks at the back, the top carrier, the snow chains, etc. This segment represents around 25% of the global car market.

Figure 1.11 Family needs type of car

- « **Second family car** » could be a subset of the family needs category. They are usually families were both parents are working and so going to work with the car, or even families where the teenagers have the driving license.
  For this type of category, smaller cars are prefered for shorter travel as an alternative of the big car (first car) for the whole family used for long travels.
  Importance is given to the lower priced cars having good performances for safety with some additional features like the entertainment unit.
  It was evaluated that this category of segment represents more or less 10% of the global car market.

Figure 1.12 Second family car types of vehicles

- « **I've maid it** » is the class of clients that pay usually importance to the social status benefit of a particular car brand. They want the car to be a sort of mirror of their career or business success. Prefered cars are the expensive ones permitting a social distinction, and attention is not focused on particular features of the car but especially on the external aspect and the type of motorisation. The cars presented usually for this category of clients are the sport and luxury cars. This category of segment represents approximately 5% of the global market.

Figure 1.13 I've maid it types of vehicles

- « **Quality matters** » will be the clients spending a little bit more on the motor vehicles, asking for the latest models with the most advanced features. The big difference with the « I've maid it » clients is that they do not really care about the

status symbol benefit that a certain car could bring, but they really care about the higher quality and the innovative features that a car could have. The segment represents more or less 15% of the global market.


Figure 1.14 Quality matters types of vehicles

- « **Environmental aware** » is a quite new market segment. It gathers all the clients that are worried about the environmental impact that their car would have and so taking into account the environmental factors for their purchase decision. It is also a category for which we can insert clients that seek for innovative powertrain solutions and are sort of early adopters not afraid to pay a little bit more to drive a car being fun to drive and changing habits in a positive way.
  This type of clients usually are the clients deciding to buy hybrid, electric, plug-in electric or fuel cell cars, thus finding ways to install home (in the garage) charging devices in case they do not find a suitable amount of infrastructures for charging or refueling (in case of hydrogen powered cars) their cars.
  We can also insert the type of clients that decide to buy a smaller car, with a much lower level of consumption and mostly used in the city centers. This type of segment represents around 10% of the global market.


Figure 1.15 Electric vehicles being the type of vehicles for the environmental aware segment

- « **Off roaders** » are those clients that seek vehicles for a particular use like the off roading or bringing their cars in places were the driving conditions are difficult. They pay attention to cars having a high level of quality and a high reliability to permit a long life cycle and to reach a high number of kilometers.

They are clients with a high loyability for a special brand that they like and can decide to change brand in the case they are really disappointed about the previous one. It was evaluated that this type of segment represents more or less 5% of the global market.

Figure 1.16 Types of vehicles having for target the Off-roaders segment

As it can be observed, it is a global market segmentation, it must be adjusted for the specific type of market we have. For example in China the diversity for the types of clients will be much higher than in the North of Europe and taking the example of China, the market segmentation has changed also during the years due to the economic development of the country. In fact we observed the development of a very strong middle class and the development of niche clients that are asking for sport and luxury cars. In the last four years, the automotive niche market had a two digits growth in some cities of China like Shanghai or Beijing.

2. Electric vehicles

2.1 History

The electric technology is actually known from years since the first lead acid battery was invented by the French physicist Gaston Planté in 1859. After some improvements (in terms of battery capacity) thanks to another French scientist named Camille Alphonse Faure, the first electric car was built by Thomas Parker in London in 1884 with batteries that he developed himself with a particularly high capicity.

Figure 2.1 First electric car invented by Thomas Parker in 1884

As it can be seen, the electric car technology was already known from the end of the 19th Century. It can be listed some later practical applications as the East German electric vans of the Deutsche Post in 1953 or even the American Henney Kilowatt in 1961 as seen on the figure 2.2, that unfortunately was considered too expensive with respect to the equivalent internal combustion engine cars of this period.

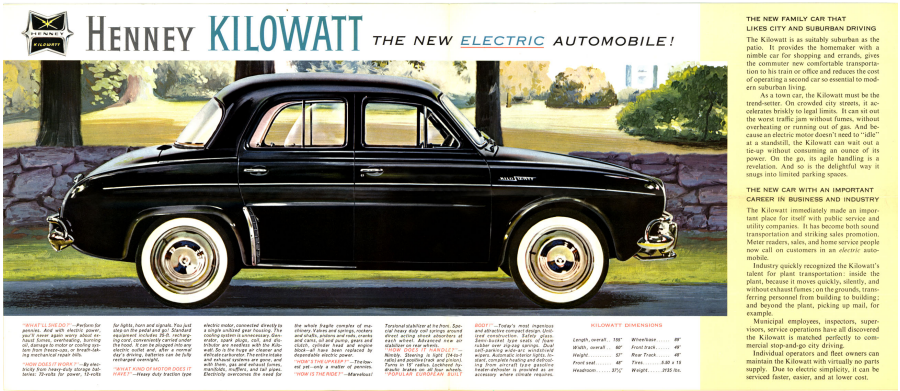


Figure 2.2 Henney Kilowatt based on the french Renault Dauphine chassis

Electric cars became less popular due to the improvements of road infrastructures, requiring long range vehicles and at this time electric cars had a very low range of autonomy and were particularly expensive, knowing that for example the Henney Kilowatt was produced in the 36V and in the 72V configurations with the latter having a top speed approaching 96km/h and having nearly an hour of autonomy for a single charge.
Due to those major limitations, the electric cars started to disappear from the market.
In more recent years, the electric cars development was mainly braked by a very strong fossil fuels Lobby but with the arrival on the market of the first aesthetically attractive electric cars from 2010 (Tesla Roadster, Nissan Leaf, Mia car, Volvo C30 electric, etc) with interesting ranges of 200km of autonomy for a single charge and the alarming environmental issues forecasted for the next years due to the traffic pollution, a stronger Lobby for the electrified cars started to emerge.
Actually at this time, a lot of Hybrid electric vehicles were already circulating like Lexus and Toyota cars, Chevrolet and Ford cars.

A graph showing the incredible boost of the Plug in electric vehicles (PEV) including Battery electric vehicles (BEV) and Plug in hybrid electric vehicles (PHEV) is the following : it actually presents the global annual sales from 2010 to 2018.

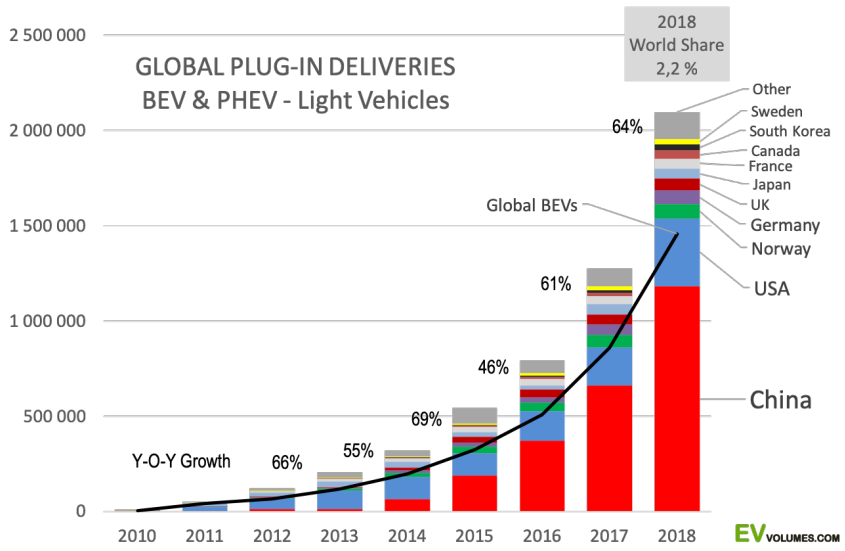


Figure 2.3 Global PEV annual sales from 2010 to 2018

In terms of global volume it remains marginal with respect to the total volume of sales but the interesting numbers are the growth in percentage, showing a huge potential in terms of market growth. From 2014 it is impressive to see how the EV sales evolved in China, and in 2018 we can see how the EV sales volumes increased in the first three markets (China, USA and Europe), with a big part of the volumes being concentrated in China.

The market share in terms of sales of PEV is marginal globally (2,2 % in 2018) but if we look in certain countries, it represents an important part of the total market as shown in the following example :

- In **Norway**, the PEV registrations reached a record in March 2018 for a market share of 55,8%. As a first step, the graph showing the new plug in passenger cars registrations in that country from January 2014 is presented in figure 2.4.

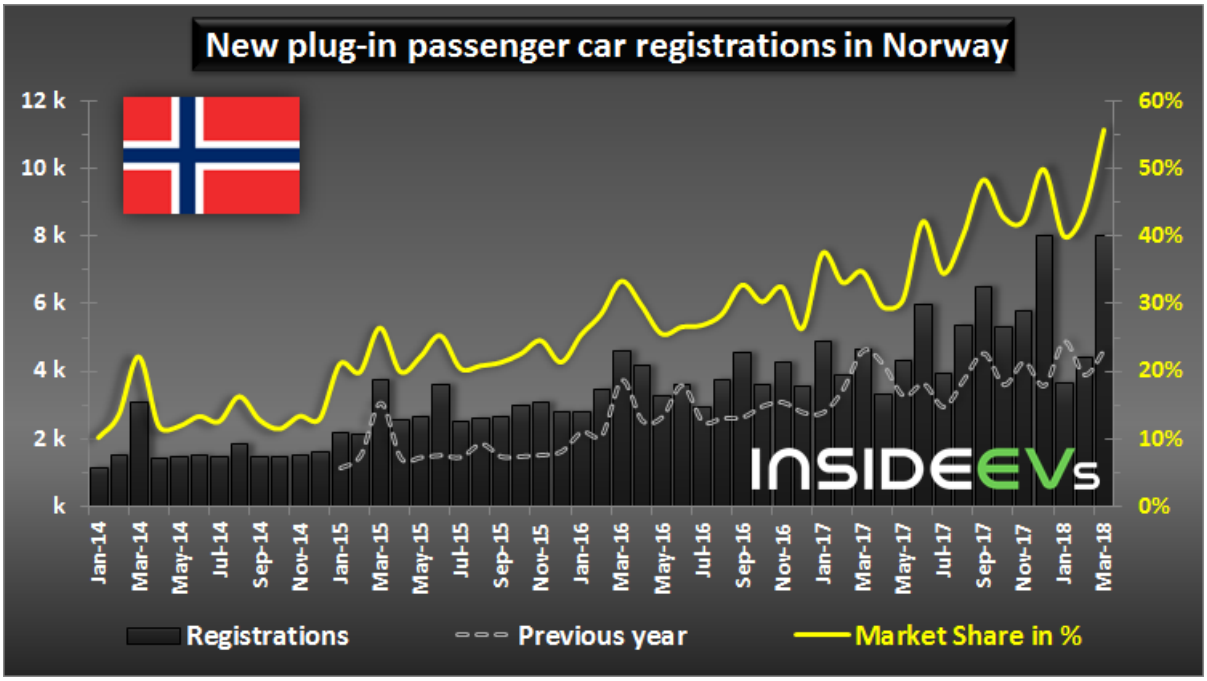


Figure 2.4 New plug-in passenger car registrations in Norway

As it can be seen, from year to year, the number of registrations is increasing and particularly when the ends of each years is approaching, probably due to the discounts on the stocks. Let us present a second graph representing the diesel versus the electric passenger car registrations in Norway from 2013 to 2018, then it will be interesting to speak about the reasons for this particular evolution.

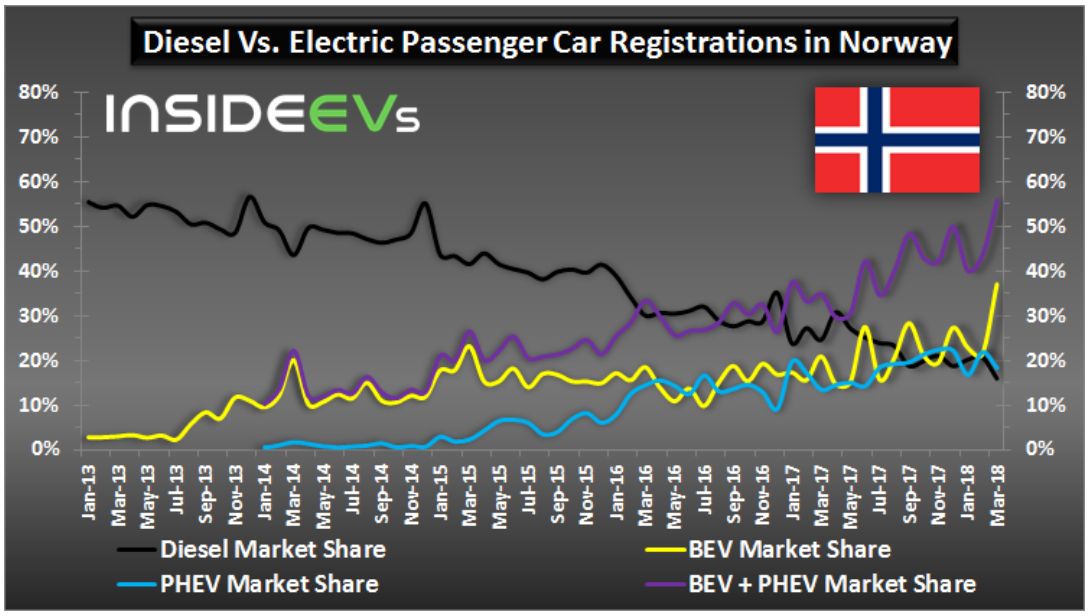


Figure 2.5 Diesel versus electric passenger car registrations in Norway

Observing the graph, one can clearly evidence the progressive decline of diesel car registrations in the country from 2013, losing in 5 years more or less 40% of the market share. Instead, from July 2013 one can observe a boost of the BEV (battery electric vehicles/ pure electric vehicles) registrations and then a progressive growth of the market share to reach a percentage up to 35% around March 2018.
The PHEV (plug-in electric vehicles) have a considerable increase later from the beginning of 2015, until reaching a market share of more or less 20%, three years later.

Those incredible results are quite surprising but looking at the fact sheet of the incentives for electric vehicles in Norway delivered to the Federal Ministry for the Environment, Nature conservation and Nuclear Safety of the Federal republic of Germany, we understand clearly the reasons for this evolution in 5 years.
It can be observed on the chronologic list of those incentives, that from 1996 the government introduced every year or every 2/3 years, new incentives for BEV like the following :

- Low annual road tax (from 370€ to 50€) – 1996
- Special registration plates introduction + free municipal parking – 1999
- Reduction of 50% of the company car tax – 2000
- Exemption from 25% VAT on purchase – 2001
- Access to bus lanes – 2005
- No charges on toll roads + no charges on ferries – 2009
- Exemption from 25% VAT on leasing – 2015

Other countries like the Netherlands and Sweden are following the Norway trend, since for example the BEVs dominated the Dutch market in 2018 with a market share (in terms of sales) hitting 31% in december 2018. Notice that in the Netherlands, a special VAT of 9% (from January 2019) is applied on BEVs.

Coming back to the global market, the biggest boost for PEVs registrations from 2015 to 2016 was thanks to China (+85% from 2015 to 2016), USA (+36% from year 2015 to 2016) and eventually thanks to Europe (+13% for the same period).

The first half of 2018 instead was the most incredible period, and forecast for the year 2018 was predicting an annual volume of sales of around 2 millions of PEV cars.
Among the fastest growing markets for the first 6 months, it can be mentioned China (+105%), Canada (+168%), Netherlands (+126%), South Korea (169%), Spain (+99%), Finland (+148%), Denmark (+691%), Portugal (119%) and Australia (+98%).

2.2 Forecast

Looking at the trend from 2014/2015 in terms of sales growth for electric vehicles, it is quite easy to predict a big potential growth for this particular type of vehicle. The major disadvantages nowadays considering electric vehicles are the cost of batteries (around 30% of the total cost of the vehicle) having a direct impact on the electric vehicles price (not yet competitive with repect to internal combustion engine vehicles), the lack of infrastructures in certain cities, the range of kilometers for a single charge which is not optimal for some models and the big decrease in batteries capacity due to weather conditions like for example the cold temperatures.

Knowing that few years ago we were still running with lead-acid batteries, and that nowadays we are running (for the majority of the vehicles) with lithium-ion batteries, and knowing also how fast the technology is changing and improving, it is clear that the problems presented above are not big issues since they can be solved in a short-term vision by the technology improvements.

It is worth to present some ideas taken from the report of Bloomberg speaking about the « Long-term forecast of global electric vehicles adoption to 2040 ».
According to their forecast, it is said that sales of electric vehicles will increase from a record of 1.1 million worldwide in 2017, to 11 millions in 2025 and then surging to 30 millions in 2030 as they become cheaper to make than internal combustion engine cars. China will lead this transition, with sales accounting for almost 50% of the global EV market in 2025.
This forecast is really optimistic since it is stated that in China the EVs will account for 19% of all passenger vehicle sales by 2025 and that in Europe they will represent 14% of the sales, followed by the U.S (United States) where the percentage will reach 11%.

An interesting graph is the one on figure 2.6 where the annual global light-duty vehicle sales is evolving by fuel type. Moreover the sales market share for EVs is represented :

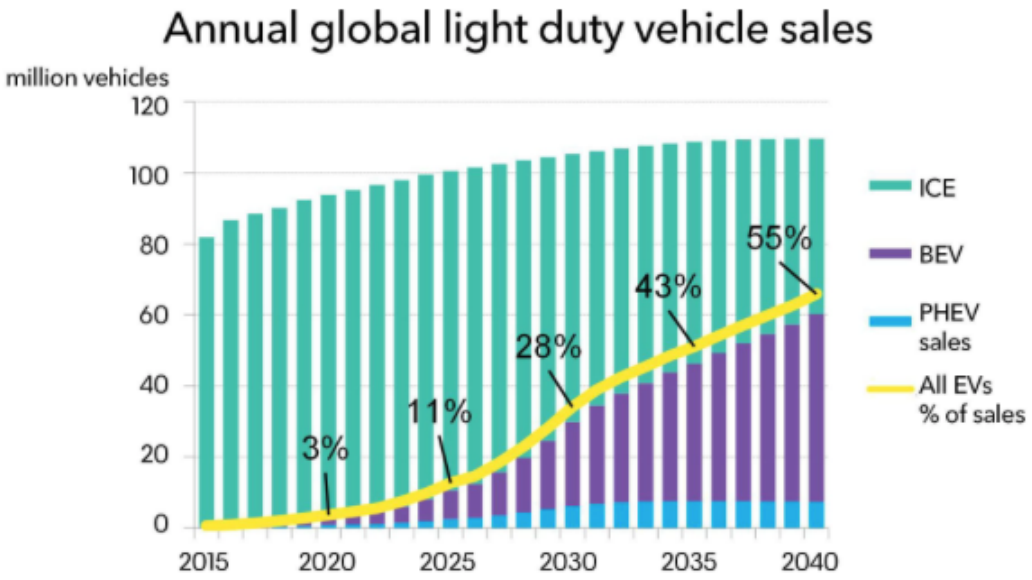


Figure 2.6 Annual global light duty vehicle sales evolution by fuel type (between ICE, BEV and PHEV). Source : Bloomberg New Energy Finance

It can be observed that every year, the BEVs market share is increasing while the one of ICEs is decreasing mostly due to the diesel decline in the next years. The PHEV sales is slightly increasing until 2030 more or less and start to stabilize during the years, while BEV sales keep growing.
As it can be seen, the sales market share of EVs (BEVs + PHEVs) will reach a value of 50% in 15 years more or less and will account for a total of around 55 millions of cars.

The key numbers according to Bloomberg are the following :

- In 2040, some **60 millions** EVs are projected to be sold, being equivalent to **55% of the global light-duty vehicle market**.
- **559 millions** is the forecasted number of vehicles on the road by 2040, representing **33% of the global car fleet**.
- **70$/Kilowatt-hour** is the average target price of the Lithium-ion battery pack in 2030, knowing that in 2019 the price is still on average equal to 200$/KWh. Knowing that in 2010 the Lithium-ion battery pack was equal to more or less 1000$/KWh, the target price for 2030 would not be impossible to reach.

The big challenges with EVs in the near future will be how fast the charging infrastructures will spread across the key markets and this will influence directly the EV sales for the next years. Second big challenge is how standardized will be the charging points between countries because there are a lot of different suppliers of charging infrastructures (around 130 in the world) and the plug types can vary between different countries (Mennekes, CHAdeMO, CCS, BS, etc) which is not comfortable for the traveler which will need to charge his car on the way (see figure 2.7). Of course for example in Europe there is the Mennekes type but it exists some variations of the Mennekes type between different countries in Europe and this is not acceptable for the user.

Figure 2.7 Different charging plug types (SAE american plug, Mennekes european plug, CHAdeMO japanese plug)

Moreover, the payment of this electric energy is not yet standardized since in different countries a different user card is needed.

A forecast from the IHS automotive shows the global cumulative deployment of charging stations :

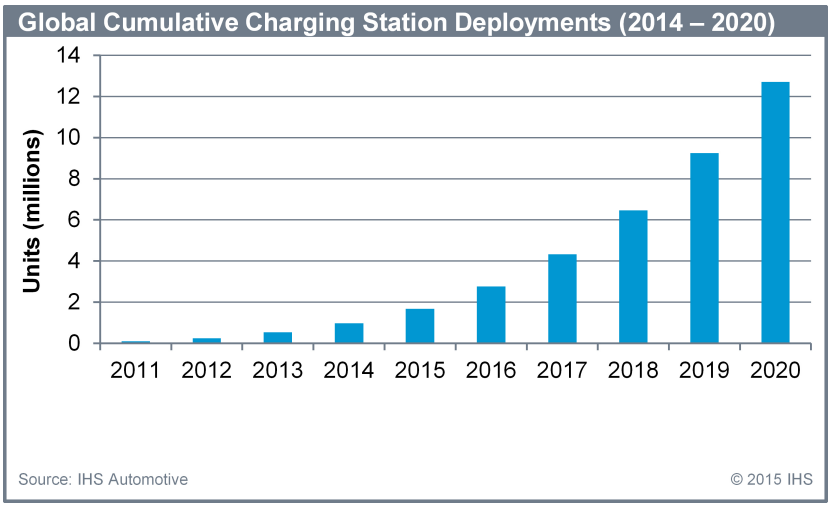


Figure 2.8 Global cumulative deployment of charging stations. Forecast in 2015 from the IHS Automotive, already showing the big challenge to face

Another big challenge will be when a big number of electric cars will be circulating, how the energy storage will be optimized and how the peak demands of energy will be managed during the charging hours of a big size fleet charging at the same time.
However a positive point is when a critical number of electric vehicles will be circulating, each electric vehicle will be taken as a small mobile energy storage element and the EVs fleet will be seen as a huge energy storage potential, and this will avoid to build very costly stationnary grid storage, thus solving problems of energy demand variability.

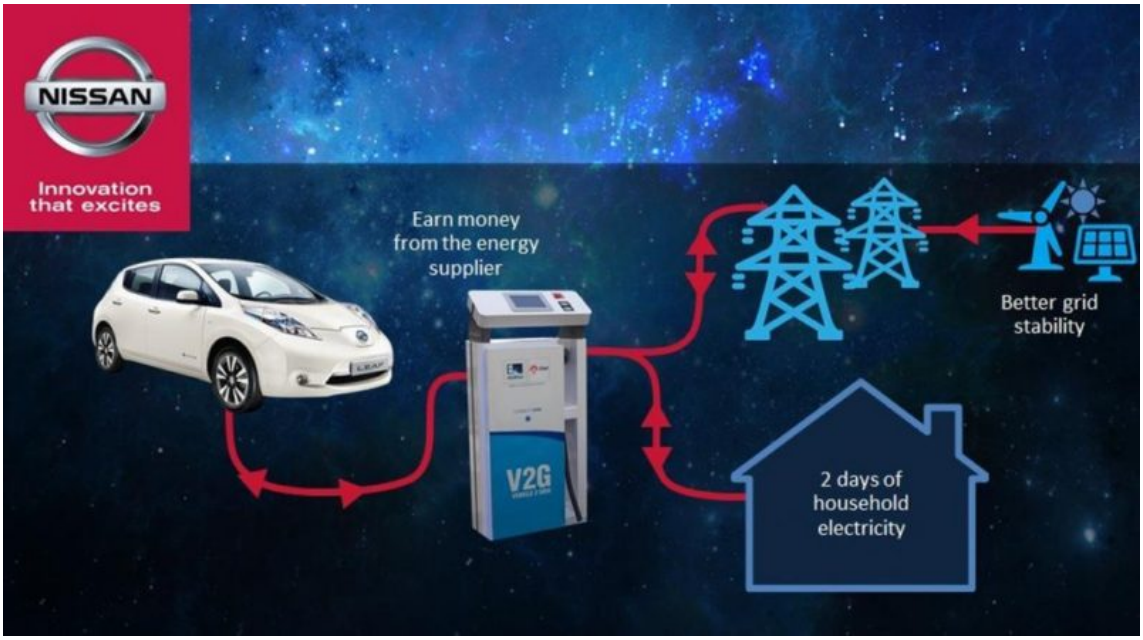


Figure 2.9 Electric vehicles as mobile energy storage

As it can be seen on figure 2.9, by supplying energy from a car, the user will earn money but will also contribute to the energy grid stability. During the night for example when the energy demand will be at a lower level, the user will be able to charge his car and use it during the day.

Eventually, a huge challenge in the near future will be to find proper solutions for the Lithium batteries recycling because this will cause big problems in terms of pollution and with the growth of EV sales, we will face a global problem for the environment.
For the moment the standard procedure requires to crush batteries and then melting them or dissolving them in acid. What comes after this is the separation of metals like Cobalt, Lithium, Nickel and Manganese, but this recycling procedure needs intensive amounts of energy.

Researches are made for a recycling process requiring less energy and a method having potential application is the following one : By taking Lithium cells having an energy storage capacity decreased by 50% due to a certain life cycle, the idea was to remove the cathode material from the aluminum foil substrate and soak it in a hot lithium salt bath. The next step is to dry the solution to get powder and quickly heat it at around 800°C and eventually cool it down very slowly.
This process simply restores the cathode material's atomic structure and re-injects lithium ions into it.
The big advantage is that it requires half the energy needed by the conventional process.

After the study of EV sales forecast, it is of great importance to perform a market segmentation for the electric vehicles.

2.3 Market segmentation

It is interesting to compare the EV market with the internal combustion engine (ICE) cars market, since for each vehicle category, the behaviour during the purchasing decision process is different.
Actually EV adoption seems to be generally more informed, takes a longer time due to the fact that it is a new technology and the vehicle costs generally 30% more than the equivalent ICE vehicle. That is why the EV purchasing decision comes from a rational evaluation of the car manufacturing process, the models and their attibutes.
Selling an electric car, we must focus on those aspects of rationality and conscience in order to build the key instruments to accelerate the transition towards this new technology.

A categorization of approaches in order to study car purchasing behaviour, being used to the examination of the behavioural transition towards the mass market EVs, is characterized in the following figure 2.10.

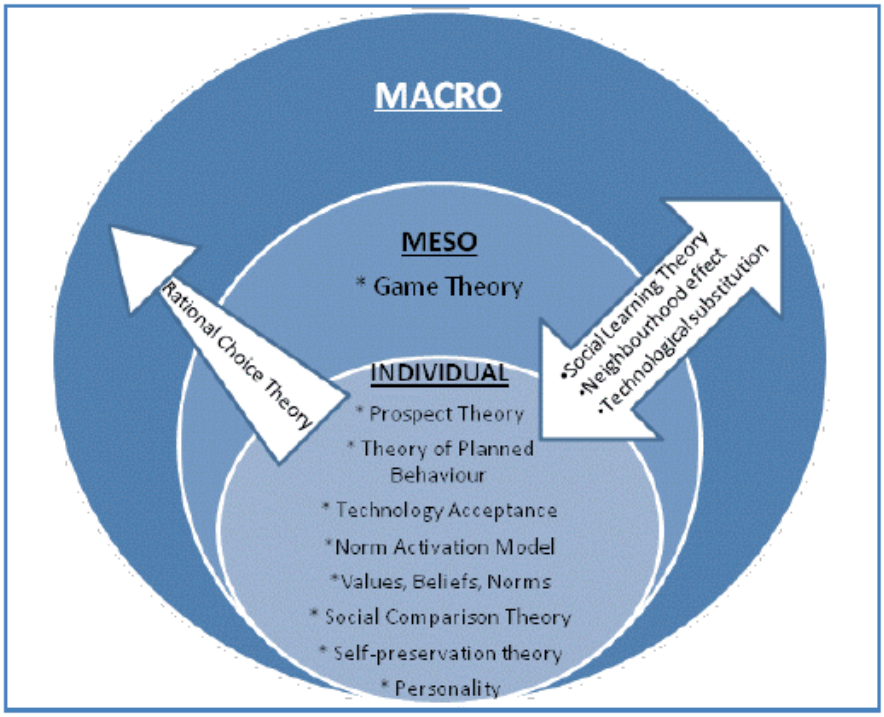


Figure 2.10 Levels and theories of behaviour change, applied to the EV adoption

It is of great importance to put in evidence that studies showed that individuals are likely to obtain asymmetrical information about cars, particularly for the early EV market, and are then unable to associate costs of these vehicles to the benefits.
Moreover, the customers do not have the suitable building blocks (like to know for example the miles per gallons of their current vehicle) to make detailed payback calculations. Researches concluded that most of the consumers have no idea of how

much kilometers they drive on a typical day, but place a high premium (when studying the EV options) on the option to drive long distances.

A very important point for the study of the purchasing behaviour is to know that the electric cars have some unfamiliar attributes to consumers like the recharging necessity and the range for a single charge, the noise levels (no noise), the safety and performance characteristics, and a number of unknows related to those factors such that battery lifespan, the future of electricity prices, and eventually the government taxation policy.
A market segmentation by mission could be made but it is mostly including the functional use dimension instead of including other dimensions, as distinctions can be made between :

- the instrumental and functional use of objects
- the emotional dimension, related to the pleasure and sensation of driving, the complexity and the perceived risk
- the symbolic meaning, subdivided into two components being the person's position and social status and the expression of personal identity and values. In this category, consumers use an object to express themselves or their social position.

Strong symbolic motives can be pointed out speaking about electric cars, like the independance from petroleum producers, advanced technology, financial responsibility, environment and resources preservation and finally opposing war.

Surveys and studies made across different countries, showed that 8 years ago, PHEV and EV were mainly used as a second car instead of a main car, probably due to the poor range of kilometers for a single charge and the enthousiasm mixed to the anxiety of the adoption of a new technology. Then, some countries like Norway, Netherlands and Sweden being early adopters, quickly had this consumers group of persons adopting EVs as a main car. In countries in Europe having a less flexible market for EV adoption, the adoption of PHEVs/HEVs as a main car is becoming much more widespread since 2 years and the adoption of BEVs as a main car is starting slowly to emerge since the range in terms of kilometers for a single charge is much wider than before (around 400km nowadays for the bigger car batteries, as theoretical value) and starts to be competitive with ICE vehicles.

As previsouly presented, the overall market is segmented into 7 main groups :

- Only functional use of the car
- Family needs
- Second family car
- I've made it
- Quality matters
- Environmental aware
- Off roaders

From this segmentation, we can select the segments of great interest for electric vehicles.

- First of all, the « Only functional use » are very volatile since they want to select the more convenient solution, and if they find attractive the idea of sparing money on fuel by having an electric vehicle with a competitive price, they could be a potential client type.
- The « family needs » people are not so attracted for the moment by the electric vehicle solution since they need bigger vehicles and vehicles with the maximum of flexibility to travel by car, with a quick refueling without being dependent on the charging infrastructures.
- The « second family car » segment is a potential type of client for EV since the young generation is attracted by the newest technologies and the second family car choice can be biased by the opinion of the youngest. It is also a car that does not necessarily needs a huge range of km per day because it is mostly a car to travel short to medium distances.
- Some elements of the « I've made it » segment could be attracted by an electric vehicle if it can bring a positive social image like the Tesla, the electric Audi e-tron or even the electric Mercedes EQC. Other elements will absolutely not be sensible to the EV cars.
- The « Quality matters » segment will be more loyal to famous brands having a good image for quality and reliability and proposing electric models than new brands proposing electric vehicles. It will be more attracted by HEV or PHEV.
- « Environmental aware » people are very enthousiastic about EV cars in general and so this type of segment has a big potential.

<u>Segments of real interest for electric vehicles sales</u> :

- Only functional use

Figure 2.11 The electric Hyundai Kona has a very attractive range of around 400km, and the public price is slighlty decreasing

- Second family car

Figure 2.12 Renault Zoe having a good entertainment interface

- Quality matters

Figure 2.13 Quality matters type of car

- Environmental aware

Figure 2.14 The Hyundai Ioniq being a famous model even if the Japanese design is very particular

From this main segmentation the EV market can be segmented into 8 main subgroups :

- a very early adopter group (the **Plug-in pioneers**)
- an early adopter of **zealous optimists**
- a group of **willing pragmatists** (PHEV specifically)
- a group enthousiastic about both types of EV but having a strong actual and perceived constraints to adoption (**Anxious Aspirers**)
- three sceptical groups which differ on how much they care about image and in terms of their demographic characteristics (**uninspired followers**, conventional **sceptics** and **image-conscious rejecters**)
- **company car drivers** who show signs of openness about EV but particularly as a second car

The five main factors distinguishing on one group from another are :

- **Identity** which captures in which way some consumers associate themselves as 'typical EV owners'.
- **Anxiety** which captures the perceived suitability of these vehicles, looking at the range and to the 'hassle' (worrying) factors.
- **Parking difficulty** related to the ease or not to find a place to charge or to have the possibility to charge the vehicle at home.
- **Willingness to pay more** for the EV having a potential environmental benefit

- **'Symbolic motives'** which capture the perceived status, the social acceptability or the potential embarrassment of owning an EV.

The most enthousiasmic segment tends to be largely male, wealthier and more highly educated than the sample average.
However, age is a more complex factor for the segment belonging since the Plug-in pioneers and the Company car drivers are the younger of all groups but the Willing pragmatists and the Zealous optimists are the older. The four less enthousiastic groups are a mix of male/female and old/young profiles, but they have the tendency to be less wealthy and educated than the other groups.

Eventually, demographic factors such as income, gender, education and employement status are important variables but are insufficient for predicting and understanding the various EV adopter groups. That is why profiling segments on variables such as identity, anxiety and symbolic motivations has enabled to understand in a deeper way the beliefs and motivations.

2.4 Competitors

Since years Tesla kept a competitive advantage thanks to its innovative strategy compared to the traditional OEM's. Actually it is not only an automotive company but a technology company who offered to the market a very performant and luxury sedan for rich people or companies that wanted to differenciate from others and showing their willingness for the technology transition.
The competitive advantage of Tesla was also stimulated by the creation of their own network of superchargers, battery swap stations and services stations, reinforcing a strong brand image as we it can be seen on figure 2.15.

Figure 2.15 Tesla charging stations – Photo courtesy of Tesla

Looking at the sales figures, it is clear that Tesla is still owning a big part of the market, especially in the USA with the delighting results of the model S and model X sales but also recently with the model 3, as it can be seen in the figure 2.16.

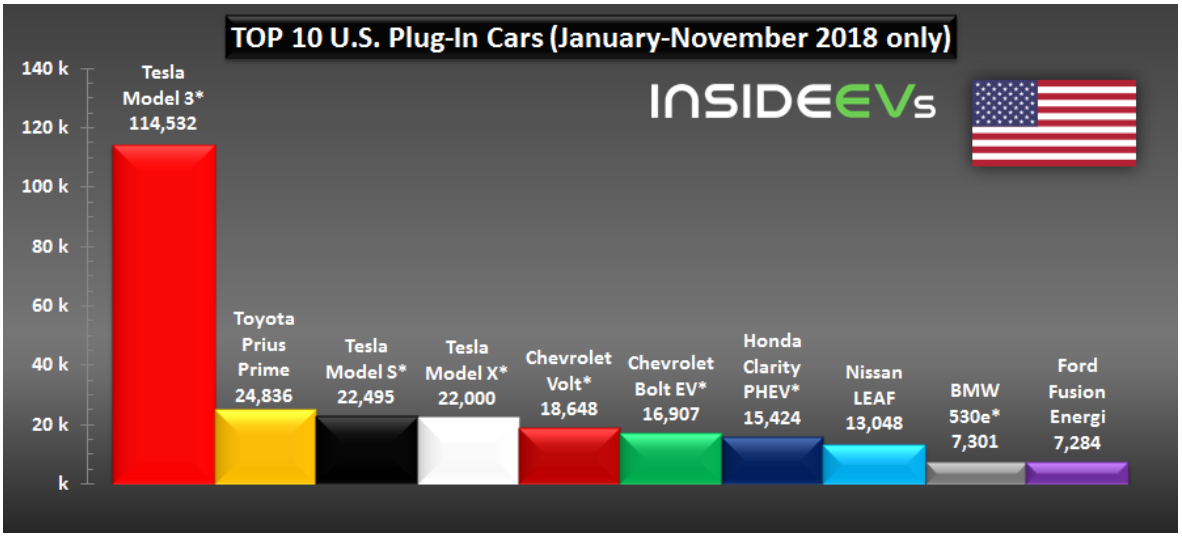


Figure 2.16 Top 10 U.S PEV sales from January to November 2018

One can see however in the last years, the emergence of strong competitors, slowly taking market shares and this is the case for example in Europe where actually the model 3 is not yet arrived, and where battery electric vehicles models like the Nissan Leaf or even the e-Golf have very good sales performances looking at the Year on Year growth in 2018. Other models like the Renault Zoe or the BMW I3 are maintaining satisfying results in terms of sales. The situation in Europe and the list of the different competitors is summarized in the following table with the sales performances in the first 2 quarters of the year 2018.

Europe Deliveries EVVOLUMES.COM		Segment	2018 Qtr-2	Change YoY	2018 Q1+Q2	Change YoY
1.	Nissan Leaf EV	Car-C	9 698	+112%	18 080	+58%
2.	Renault Zoe EV	Car-B	8 622	+8%	17 394	+1%
3.	BMW i3 EV / EREV	MPV-B	5 577	+14%	11 348	+10%
4.	Mitsubishi Outlander PHEV	SUV-D	4 886	-9%	9 771	-2%
5.	VW e-Golf EV	Car-C	4 556	+58%	9 820	+160%
6.	Tesla Model S	Car-E	3 788	+32%	7 700	+14%
7.	VW Passat GTE PHEV	Car-D	3 691	+29%	7 390	+19%
8.	BMW 530e PHEV	Car-E	3 438	+140%	5 825	+269%
9.	Volvo XC60 PHEV	SUV-D	3 411	+5068%	6 587	+9880%
10.	VW Golf GTE PHEV	Car-C	3 324	+43%	5 939	+83%
11.	Tesla Model X	SUV-E	3 309	+22%	5 679	+3%
12.	BMW 330e PHEV	Car-D	2 850	+18%	5 052	-1%
13.	Mercedes GLC350e PHEV	SUV-D	2 799	-8%	5 348	+2%
14.	Kia Niro PHEV	Car-C	2 715	-	5 181	-
15.	Hyundai Ioniq Electric EV	Car-C	2 050	+36%	4 611	+78%
16.	BMW 2-Ser. Active Tourer PHEV	MPV-C	2 024	-26%	4 383	-14%
17.	Porsche Panamera PHEV	Car-F	1 922	+153%	3 983	+400%
18.	Mini Countryman PHEV	SUV-C	1 878	+141%	4 014	+369%
19.	BMW X5 PHEV	SUV-E	1 876	+12%	3 189	-2%
20.	Kia Soul EV	MPV-B	1 824	+86%	3 530	+61%
21.	Mercedes C350e PHEV	Car-D	1 822	+20%	3 262	-8%
22.	Audi A3 e-Tron PHEV	Car-C	1 772	-22%	2 581	-34%
23.	Smart Fortwo EV	Car-A	1 705	+248%	4 511	+802%
24.	Renault Kangoo EV	LCV	1 688	+113%	3 406	+125%
25.	StreetScooter Work EV	LCV	1 633	+516%	1 950	+75%
	Others		18 227	+44%	34 410	+36%
	Total		**101 085**	**+45%**	**194 944**	**+42%**

Figure 2.17 List of EV sales performances in Europe for the quartiles Q1 and Q2 of 2018

Until 2018, the offer for BEV (battery electric vehicles) was relatively poor since the market was not considered mature enough, and OEMs mainly concentrated their forces on the sales of PHEV, while waiting for the BEV models to be ready to be launched on the market.

Considering the biggest OEMs, the BEV models that are already on the market are the following :

- **Toyota IQ EV** – A-segment car.
- General motors : **Chevrolet Bolt** as a B-segment car, having a lot of success in the U.S. In europe we have the **Opel Ampera EV** which is exactly the same.
- Volkswagen group : **e-Golf** being a C-segment car and the **Up EV** being an A-segment car.
- Nissan-Renault group : **Nissan Leaf** as C-segment car, the **Renault Zoe** as a B-segment car and eventually the **Renault Twizy** as quadricycle.
- Hyundai-Kia : the **Hyundai Ioniq** being a C-segment car, the **Hyundai Kona** and the **Kia Soul EV** being small cross-over B-segment cars.
- Ford Motor : The **Ford Focus EV** which is a C-segment car, mainly present in the U.S (not in Europe for the moment).
- Honda Motor : The **Honda Clarity EV** being an E-segment car available also with the fuel cell motorisation.

As it can be seen, the B and C segments are for the moment the major segments available on the BEV market. Tesla is mainly focused on the E-segment with the model S and the model X but entered the C-segment market with the model 3. The bad point for Tesla being the big launch delay of the model 3 for the European market, since some competitors have already settled a big part of the latter.

New BEV models arriving for the year 2019 are mainly SUVs, and we can list the following ones :

- The 2019 **Audi e-tron**
- The **Mercedes EQC**
- The **Kia Niro**
- The **Volvo XC40 all-electric**

Figure 2.18 New EV SUVs launched for 2019

Prices of the different EV models

In terms of prices, BEV are in general more costly than ICE (internal combustion engine) vehicles due to the battery cost representing more or less 30% of the total vehicle cost.

Electric quadricycles are the less expensive vehicles since they are not considered as cars and they are used essentially for urban mobility. The prices start from 7 000€ and can go up to 17k€ for the most expensive ones.

For A-segment and B-segment cars, the prices start from more or less 17k€ with the Renault Zoe and grow until 45k€ with the BMW i3 for example.
Around 31k€ to 35k€ we can find C-segment cars like the Nissan Leaf, the Hyundai Ioniq, the Ford Focus EV and the Kia Niro EV, but even the B-segment Hyundai Kona which is quite expensive (around 33k€) but has a considerable range capacity of 300km for a single charge.
The BMW i3 is particularly expensive and is usually for clients loyal to the brand or willing to pay more for a high quality small car. Another expensive car belonging to the A-segment is the Smart Fortwo which has a price starting from 22k€, but offers a limited range of 100 to 200km for a single charge. Anyway the Smart has a strong brand image since years and this is the reason why the market is present for this particular vehicle.

As a third price category, we have the sport and luxury cars usually being E-segment cars coming from carmakers like Tesla, Mercedes, Jaguar, Porsche, Audi, with prices starting from 70k€ to 150k€ for the most expensive ones.
Anyway the Jaguar i-Pace, the Audi e-tron and the Mercedes EQC have prices starting from 78k€ more or less, while Tesla has prices varying from 70k€ for the less expensive model S 75D, to 140/150k€ for the less expensive model S and model X P100D.

With elevated prices, Tesla should be careful about quality issues or even about the interior finishing because it will not be an easy task to compete against high quality cars like the Porsche Taycan, the Mercedes EQC or even the Audi e-tron.

3. EV sales in Luxembourg

3.1 History

In terms of sales, the EV market in Luxembourg at the beginning suffered a lack of demand even with the government incentives put in place in 2013, probably due to the lack of infrastructure for recharge in the Grand Duchy. The government decided then to suspend the incentives and to concentrate investments on public transports mobility with the creation of a tram network, on bike sharing and on some solutions of car sharing like Carloh or even Flex car sharing with the CFL company (Chemins de fer luxembourgeois).

However from 2015 the EV market started to grow in a significant way and the EV sales more than tripled from 2016 to 2017 as it can be seen on the figure 3.1. This graph does not give us the precise data for 2018 but it is sufficient to see in that case the performances of last year compared to the previous year.

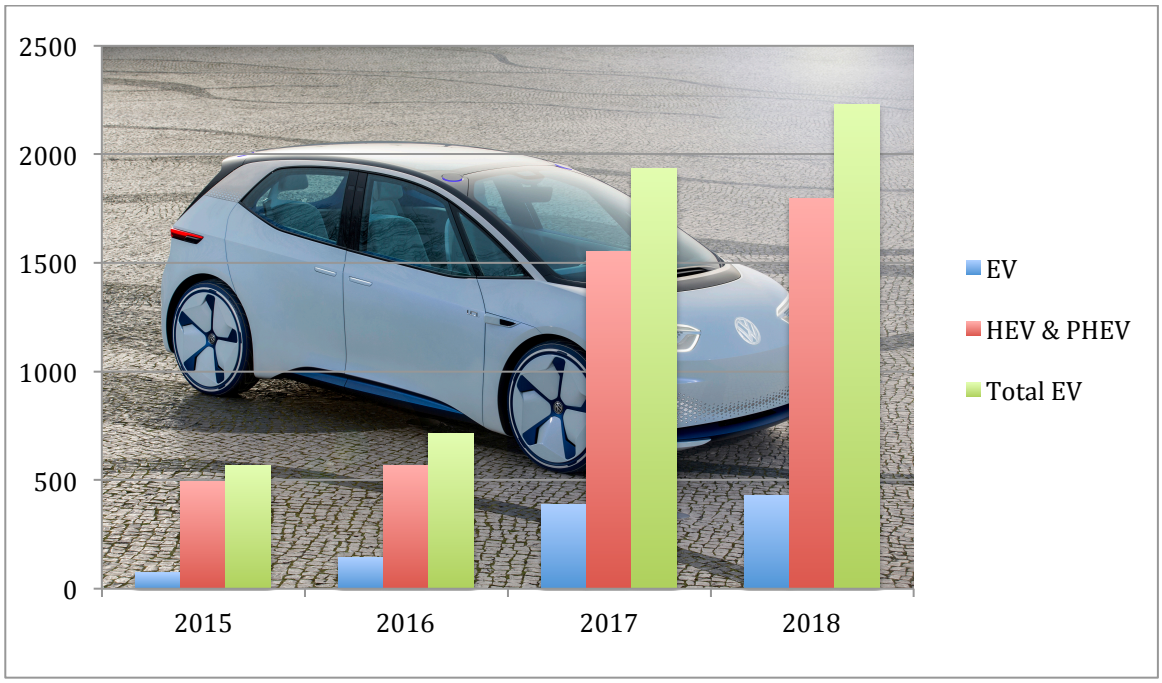


Figure 3.1 EV sales in Luxembourg from 2015 to 2018 (H2 2018 value coming from Delano data)

Actually in 2017 it was registered that 386 BEV (battery electric vehicles) were sold, which represents a performance of +166% with respect to the previous year for which it was calculated a total of 145 BEV sold in the Grand Duchy.
In the figures presented previously, the SNCA (Société nationale de la circulation automobile) confirmed that on those 386 purely electric vehicles the first three brands in terms of sales are Tesla, Renault and BMW, since 155 are Tesla's with 90 Model S and 65 Model X, 77 cars are Renault Zoe and eventually 33 vehicles are BMW i3.

3.2 Forecast

In Luxembourg, if we consider the number of cars registered in the country which reached a record of 52 811 in 2018 and the sales growth for EV as we can observe on figure 3.1, the potential of the green mobility in Luxembourg can be observed. For sure the Gran Duchy is not an example in terms of EV sales if we compare it to countries like Norway, Austria, the Netherlands, and it is mainly due to the lack of incentives from the government for EV purchases but also due to the delay for the construction of charging infrastructures around the country resulting in charging points concentrated in a limited area.

Actually to help people for the transition to electric vehicles, it is of great importance to correctly install the charging infrastructures because if it is well dispatched around the country, it helps and encourages the customer to use an electric vehicle for his quotidian itinerary without worrying about where to find a place to charge. A second important factor is the range of kilometers for a single charge because it must permit the user to perform his normal average daily distances without being stucked with no possibility to charge or with the constraint to wait for the car to recharge. Of course these are the mainly problems with BEVs since with PHEVs and HEVs the internal combustion engine permits to continue running even if the battery is nearly empty.

Luxembourg being a relatively small country with limited quotidian distances, the current average ranges that the different electric models offer is not a particular constraint. Of course depending on the type of car, the number of kilometers will vary and so the range of kilometers needed for a specific purpose will be different. Taking as an example a city car for which the mobility will be mainly concentrated in the city, the range needed is limited even to 100km while for an E-segment car, the mobility will be expanded to highways and so the range needed will be much larger (at least 300km).

A very interesting index to forecast and to study the EV potential in a country is the **EV readiness index.** Different companies and especially Leaseplan which is the biggest leasing company in Luxembourg are making studies on the EV market in european countries and they use the EV readiness index as an indicator of how the market is mature.
For Leaseplan, this index is taking into account for each country four different factors :

- The current EV market (the offer from the different carmakers, the country EV fleet taking into account the BEV, HEV and the PHEV).
- The quantity and the quality of the charging infrastructures.
- The government incentives for EV.
- The experience of Leaseplan in the specific country related to the EV products and services offers to its clients.

The results of the Leaseplan EV readiness index 2019 show that the first four countries in Europe that are already mature for the electric revolution are Norway, the Netherlands, Sweden and Austria.

However all the 22 european market analyzed during the study show better results from last year which means that the transition is slowly starting in every country of the continent, even if they do not show the same evolution pace due to the different charging infrastructures number and dispatching and due to the different incentives in each country which are not the same, when present.

If we compare the number of charging infrastructures to the number of inhabitants, the first three countries in Europe are the Netherlands, Norway and eventually Luxembourg. Actually it was calculated in Luxembourg a number of 1.9 charging infrastructure for 1000 inhabitants, which is not a bad result.

Eventually, the new incentives presented in the next chapter which have been put in place by the luxembourgish government from the 1st january 2019 will have a direct impact on the sales since the EV sales in 2017 were multiplied at least by 3 even without direct financial incentives from the government, knowing that there was only a fiscal advantage of 2500€ for the purchase of an electric car. As it will be present in the next chapters, the new incentives are much more interessant since they correspond to a direct financial aid from the government for the purchase of an EV in the gran duchy.

3.3 Market segmentation

Luxembourg is a very strong market with a high buying power but it has the particularity to be less flexible than the other markets of the Benelux for example, and it will be understood after performing a market segmentation.

Looking at the global market segmentation presented previously, the main segments that we find in Luxembourg potentially for electric vehicles are the following :

- **I've made it** as presented in the first chapter, representing an important part of the country since it can be estimated a percentage of **25% for this segment** which is very high with respect to the european average. The highest concentration of this type of segment is present in Luxembourg city since this class of customers usually live in the city centers where the cost of real estate is particularly high. In the country there is a strong symbolic image attached to the car owned by a person and this motivates successful businessmen or other people with a high buying power to buy a car in order to demonstrate the appartenance to a certain social class. If it is needed to select a range of age corresponding to this type of image-conscious customer, it would be essentially selected a range between 40 and 70 years old more or less, even if some yonger or older persons could be included as exceptions.
  In Luxembourg this type of customer is not so sensible to the green mobility transition but could be seduced by expensive cars like the Tesla, the plug-in hybrid electric Porsche, the electric Jaguar, the BMW, and other high standard vehicles usually belonging to the E-segment cars. They do not pay so much attention to city cars for example.

- **Environmental aware** segment **representing approximately 15%** of the market and which will continue to develop also thanks to the larger presence of the green government of Mr. Bausch since the national elections of October 2018. It is a class of customer being really sensible to the eco-social responsible behaviour and very interested in a transition to new engines technologies, being sometimes very early adopters. They are not necessarily a class with high buying power but they will always favorize the technologies with a positive impact for the environment.
  The companies in the country are pushed to be socially and environmentally responsible and they have the possibility to obtain the RSE label (responsabilité sociale des entreprises) in case they satisfy certain requirements imposed by the INDR (Institut national pour le développement durable et la RSE). For a company, purchasing an electric car is a favorable point for the delivery of the label and that is why certain companies can be placed in the environmental aware segment.
- **Only functional use** which represents always the biggest segment since it is estimated a percentage of **around 30%** for this category of customers. It is a segment of customer which is mainly attracted by the electric city cars or quadricycles that could solve a big problem of parking in the city center because they do not want to use spacious vehicles to go to work since they remain stucked in traffic jams and they want to optimize their time searching for a parking spot even in restricted areas. They do not pay attention to the comfort but they need the possiblity to drive every single day of the year, paying then attention to small vehicles which are closed, allowing them to circulate even during the winter.
- **Second or third family car** segment which is not negligible in Luxembourg with a percentage of **around 30%** like the previous segment, since a lot of households have 2 to 3 cars and this is not hard to believe it in a country where there are more than 660 cars for 1000 inhabitants.
  They are usually families with teenagers having a driving license, and asking for a second middle-size car or even a third small-size car which is preferably a zero emissions car, avoiding the young childrens to pay the fuel.

3.4 EV competitors in the Gran Duchy

In this chapter the idea is to present the different competitors for the EV market in Luxembourg and then to classify the different electric models by segment.
Like in every country, the strategic war between car dealers is really complex due to the new engine technologies introduced by the carmakers.
As it was seen in the previous chapter, the sales strategy is different when an ICE vehicle is considered or when an EV is considered.

If the EV are considered, the main common advantages between car dealers are the charging infrastructures development and the government incentives, thus boosting the EV sales in the country.

There are events like the Autofestival in January/February or other mobility events that are of great importance for car dealers since the Autofestival as an example represents more than 30% of the yearly car sales. It is a period of the year where the competition is the hardest and where marketing budgets are monopolized for the selected marketing strategy, based on the new arrivals.

In terms of competitors, we can find the major OEMs with the following brands :

- Volkswagen
- Audi
- Mercedes Benz
- Porsche
- BMW
- Hyundai
- Renault
- Nissan
- Tesla

And smaller car dealers selling electric quadricycles or even alternative mobility vehicles like the electric bike, the electric scooter, etc.

LCV vehicles

The Kangoo ZE is the main vehicle sold in the gran duchy with a price equivalent to 30k€. It is mainly used by delivery services companies, but the problem with this type of vehicle is the hard task to find a parking in the city center due to its large size.

Figure 3.2 Renault Kangoo ZE

E-segment vehicles

The E-segment is covered entirely by Tesla with the model S with prices starting from 65k€ to 120k€. The Honda clarity would be an E-segment competitor of the Tesla but it is not sold in Luxembourg.
A direct competitor of the Tesla is the Porsche Taycan which should be revealed later this year 2019, with a starting price estimated at around 100k€.

Figure 3.3 The Porsche Taycan, a future competitor for the Tesla

Still speaking about Tesla, the model X is the model covering the J-segment. As a competitor it can be found the Jaguar I-pace and in the near future, the Audi e-tron, the Mercedes EQC and the Kia Niro EV will be on the road.

C-segment vehicles

The C-segment is a dynamic segment with three main competitors being the e-golf, the Nissan Leaf having a great success and eventually the Hyundai Ioniq which won the sales podium in December 2018. Unfortunately, the ford Focus EV is not present on the luxembourgish market. In terms of prices, the e-golf is the most expensive car between the three with a starting price of 35k€, while the Hyundai Ioniq is a little bit more expensive than the Nissan Leaf with a price around 33k€ compared to 31k€ for the Ioniq.

B-segment vehicles

The most dynamic segment is the B-one with the two winners (in terms of sales) being the Renault Zoe and the BMW i3 with prices very different between each other, since the Zoe starting price is 17k€ and the i3 starting price is 38k€ with a price rising until 45k€ for the high standard version which is particularly expensive for a city car. Actually the price of the latter is one negative point for which the sales remain lower than expected in the country.
The two other models available on the market for this type of segment are the Opel Ampera which is the Europe version of the Chevrolet Bolt, anyway expensive with a starting price at around 43k€ which is even more expensive than the i3 but comes from the fact that the range of kilometers for a single charge is doubled with respect to the BMW. Eventually the fourth model is the Kia Soul EV which is a B-segment small crossover vehicle which is having success in Europe but needs some time for the luxembourgish market.

A-segment vehicles

As segment number six, there is the A-segment which is of particular interest in Luxembourg for institutions or companies having problems of parking in the city center

but needing anyway a car able to go on the highway in case it is needed. The distances on the highway are not necessarily long, between 15 and 30 minutes on average but for example with quadricycles the access is not allowed, that is why it is needed an A-segment car to access it.
As a known car having success on the market, there is the Smart ForTwo ED which is less expensive than the B-segment competitors but with a starting price rising up to 22k€ which is not cheap for a car having only two seats. On the other hand the Smart ForFour is not having success on the market probably due to the fact that it has not the major advantages as perceived by the customer for the ForTwo like the easiness of parking and the attracting design for younger people.
The eUp! is the Volkswagen A-segment car which is attracting but needs to demonstrate its advantages with respect to its competitors to justify an elevated price of 27k€.
As a last model, the market is still waiting for the Toyota IQ EV but still not available, probably due to launch delays.

Electric quadricycles

As a last segment, we will speak about the electric quadricycle with a distinction between the L6e (light quadricycle) and the L7e (heavy quadricycle) category.
A very important point is to see in a first step how is evolving the european quadricycle market and how big it is.
According to Persistence Market Research's latest report on the quadricycle market in Europe, the latter is expected to reach $ 456,9 Mn by registering global sales of over 37 000 units by 2027.
During the forecast period (2017-2027), the european market will soar at a Compound Annual Growth Rate (CAGR) of 4.8% which is very high. Moreover, by the end of 2027, over 68% of Europe Motorized quadricycle's revenues will be accounted by quadricycles operating with conventional fuels (mostly electric).

In Europe the major competitors are Renault SA with the Twizy, Automobile Chatenet, Ligier group, Aixam and finally Tecno Meccanica Imola with the Tazzari. Notice that all the different makers previously presented are offering on the market electric quadricycles nowadays (Twizy and Tazzari being only electrified models).

Pretty new quadricycles like the Birò (from Italy) and the City fun (from China) were launched on the market since 2010 more or less and are slowly earning market share thanks to their attractive concept.

As two major quadri-cycles in Luxembourg, there are the Renault Twizy and the Estrima Birò (Figure 3.4) presented with their L6e and L7e versions depending on the battery pack selected. The starting price of the **Twizy** is 7500€ batteries excluded, and it is needed to add as a minimum price a rent of 50€ per month for the batteries renting with a contract of 2 years at least. The twizy has two different models being the Urban and the Cargo models. The difference is that for the Cargo model the rear seat is sacrified to leave space for a storing space of 180 liters.
The second quadricycle sold in Luxembourg is the **Estrima Birò** presented in two versions being the Classic and the Bolt versions (L6e and L7e) but with 5 different models, being the Birò Summer, Birò Winter, Birò Big, Birò Box and Birò Black limited Edition. It is worth to add that the Birò Summer is not distributed in Luxembourg since

it is sold without doors, and the weather in the country is not favorable to a vehicle without doors. Considering the other four Birò, depending on the models and on the versions, the price varies with a starting price of around 10 900€ batteries included.
In the next chapter, the Birò product will be presented and the comparison with its current competitor will be made in order to understand the differences in terms of advantages for the two different vehicles.

Figure 3.4 The Renault Twizy and the Estrima Birò, two quadricycles sharing the market in Luxembourg

In the near future, the Luxembourg will welcome two other quadricycles being part of the L7e category, which are the electric Microlino, inspired from the BMW Isetta as it can be seen in the figure 3.5 with a starting price estimated at 12k€ and the compressed air propulsed Airpod (figure 3.6) presented with the Birò at the Link2fleet awards 2018 on December.

Figure 3.5 The Microlino, inspired from the BMW Isetta

Figure 3.6 The first compressed air quadricycle named the Airpod

It is worth to say that for the Birò, the presence of competitors like the Twizy, the Microlino or even the Airpod is not a bad point since it opens this new market of the quadricycles in Luxembourg being less flexible than other markets in Europe and it

permits to legitimate this particularly new type of niche products that suffered at the beginning the lack of knowledge from the customers.

After speaking about the EV market in Luxembourg with a study of the competitors, it is of great importance to open a subchapter on the different points boosting the EV sales in the country, which means the charging infrastructures present around the country with an overview of the current situation and the future one, and the incentives voted by the government.

3.5 Charging infrastructures and incentives from the government

Charging infrastructures

In Luxembourg, Chargy is responsible for the deployment and the maintenance of the EV charging network all over the country. It is from June 2017 that the electricity company launched the demployment of charging infrastructures across the country with already 20 charging points activated and the objective is fixed at 800 charging points before 2020.
This initiative was boosted also by the European Parliament who obliged from 2018 each countries of the European Union to have a predetermined minimum number of charging points.

Another important point is that all the public parkings of the Gran Duchy started from 2017 a program of refurbishment, with the installation of a wiring circuit for each parking spot with the possibility to install a charging point immediately or in the near future.

In a first step it is worth to present the standard charging infrastructure in Luxembourg, since it can be different from country to country. In Europe the main type of charging plug is the Mennekes Type 2.
Actually in Luxembourg, Chargy charging infrastructure has only the Mennekes Type 2 plug, but in very few stations (less than 5) all over the country it is possible to find even the CHAdeMO plug or the CCS/SAE plug. Of course the wall plug is present on some charging points but also in every parking since it permits to charge the electric scooter but also the electric quadricycles. The four different plugs are presented in figure 3.7 :

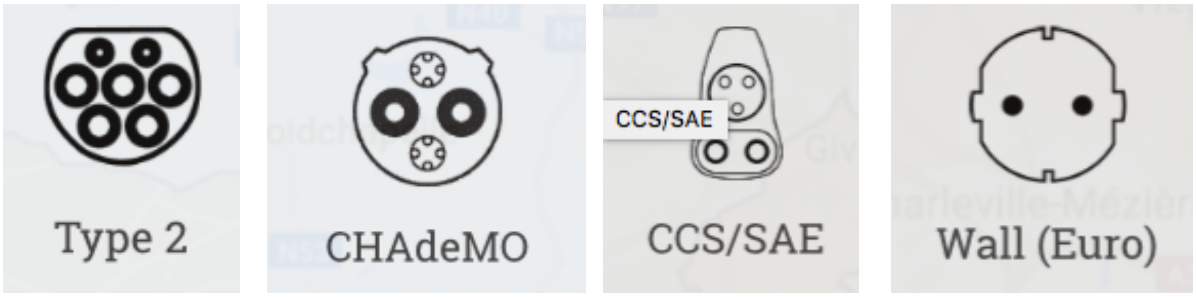
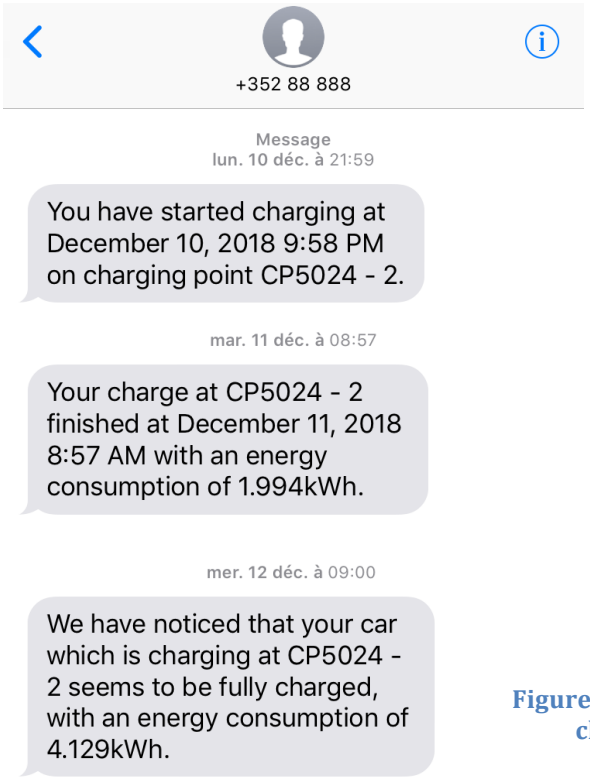


Figure 3.7 The four plug types present in the country for charging infrastructures

In order to use a charging point in the country, a simple card being the Chargy card (figure 3.8) is needed and is available at the Enovos offices in the city center. After waving it on the infrastructure reader, it recognizes the user and opens the plug allowing for the cable connection.

Figure 3.7 Chargy charging infrastructure and its user card

A message is then received on the phone, communicating that a charge have started, as follows :



As it can be observed, the charging point is identified and there is a real time traceability permitting the user to control its expenses in terms of electricity and to know where is the car in case the vehicle is shared. In case the vehicle is fully charged, the charging point sends a message communicating it and indicates also the energy consumption to be sure that it corresponds to a full charge.

Figure 3.8 Real time interaction with the charging point for traceability

An example of a Chargy account is presented in the figure 3.10 with the yearly consumption and the peak hours of charging :

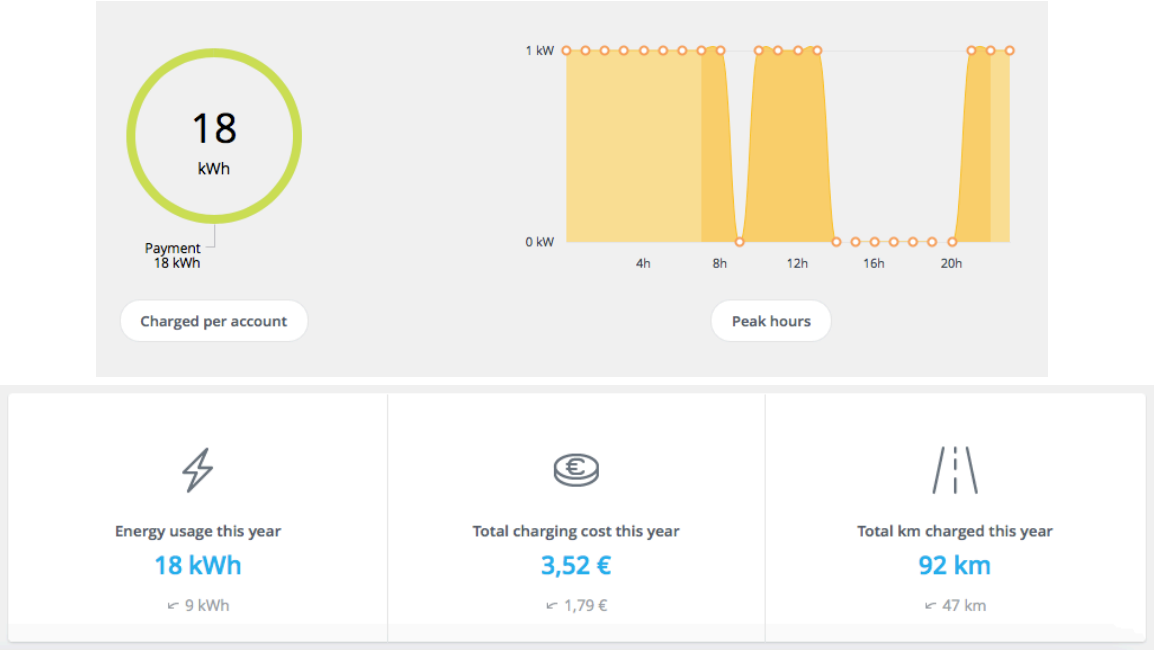


Figure 3.9 Yearly consumption and traceability on a Chargy account

On the figure it can be observed as expected that the charging hours are mostly during the night and this is because some parkings are usually free from 18 o'clock to 8 o'clock. During the working day the car is utilized and afterwards it is placed on charge for the day after.
As a remark, the energy consumption is very low due to the fact that the vehicle analysed here is the quadricycle Birò and so the consumption is much lower than a standard vehicle.

A real time Chargy map permits to know the current situation of charging infrastructures across the country, and the following map for the month of February in 2019 is obtained :

It can be observed that 332 charging infrastructures are already installed and active across the country.
However it is not homogeneously dispatched since it can be noticed a concentration of infrastructures in Luxembourg city, which is understandable since all the institutions, the financial headquarters and most of the offices are concentrated in this zone.
Actually most of the traffic problems are concentrated in the capital.

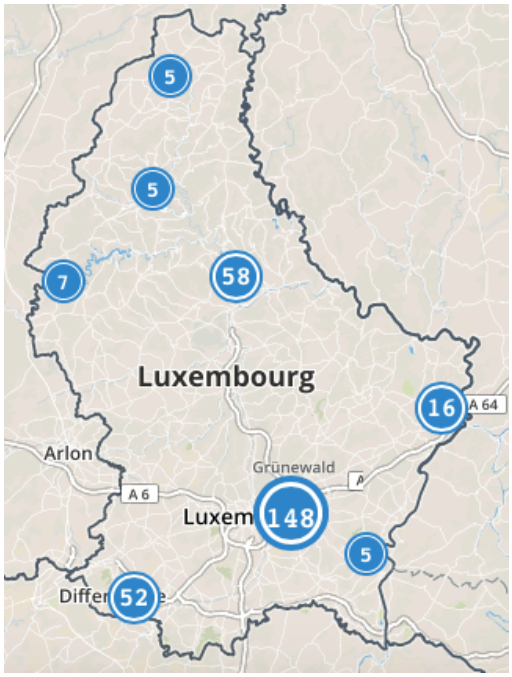


Figure 3.10 Current situation of charging infrastructures across the Luxembourg in February 2019

The current charging infrastructures are essentially placed on the public roads (73% more or less), on the Park and Ride zones (around 16%) and the other ones are charging points installed by other companies than Chargy which obtained the authorization (11%).

By the end of 2018, after 18 months of active charging network, some 481 400 kWh of electricity was used for EVs and this represents in terms of kilometers a distance of 2.5 millions of kilometers, being equivalent to 60 times the circumference of the world. The results are positive but in a country which has the highest income per capita, there is the possibility to do much better for the coming years, even for the charging infrastructures deployment.

Even if the number of charging points placed the Luxembourg as the country in Europe with the third highest number of charging infrastructures for 1000 inhabitants with a number of 1.9, it is far from the final objective since Chargy announced that before the end of 2019, 200 more charging points would be installed and active across the country and for the end of 2021, a total of 800 charging points would be present. The initial objective was to have 800 charging points before the end of 2020 but some delays in the parking renovations created this time shift.

Figure 3.12 Charging stations deployment around the country from 2017 to 2021 to reach the final objective of 800 points in 2021

Public incentives

One of the most motivating factor for a customer to adopt an electric vehicle is the public incentive put in place by the government and in Europe nearly all the countries have public incentives for EV, but they are all different.
It is obvious that incentives are different depending on the type of vehicle we are dealing with. For example the BEV cars will have more incentives than the PHEV and HEV, which is quite obvious considering the difference in cost since the BEV will have the tendency to be slightly more expensive than the HEV/PHEV for the same vehicle type.
Another difference is between the electric car and the electric quadricycle because the prices of the latter is usually much lower than the standard cars.
In most of the countries, the electric quadricycle has the same registration plate as the scooter and so usually for the public incentives, the quadricycles and the scooter are grouped together.

It is needed to distinguish two different types of incentives :

- Purchase incentives (Tax break and Subsidy)

- Operational incentives (Exemption of road tax, no toll payment, etc)

Anyway both the incentives types have a direct impact on the total **cost of ownership**, thus permitting the EV or the hydrogen fuel cell vehicle to be competitive with respect to the ICE vehicles.

In Luxembourg, the first purchase incentives put in place for EV in 2018 were tax allowances as follows :

- 5000€ for the purchase of a battery electric vehicle or hydrogen fuel cell vehicle registered after the 1st of January 2017. The vehicle must not have more than 9 seats, driver included.
- 2500€ for the purchase of PHEV/HEV registered after the 31 of December 2017.

Of course the tax allowance is less interesting than the subsidy because depending on the taxation of the country, the amount of money spared will variate but will anyway be much less than a direct financial subsidy.

It is one year later that the incentives from the government became much more interesting for the citizens, since from the 1st of January 2019, the government decided to promote in a more pragmatic way the EV with the following purchase incentives being direct financial subsidies :

- **5000€ refunds** on the purchase of a 100% electric vehicle or an hydrogen fuel cell vehicle.
- **2500€ refunds** on the purchase of a PHEV with CO2 emissions of 50g/km or less.
- Eventually a **refund of 25% excluding VAT** on electric bicycles, electric motorcycles, electric quadricycles and electric moped, without exceeding a limit of **500€.**

Concerning the **Birò**, further advantages like the free road tax, the free parking, etc, will be presented as it is considered as a light electric quadricycle.

The incentives put in place by the government will be effective during the year 2019 like a sort of test and then the EV sales will be evaluated. In the case corrective actions are to be taken, the new subisidies will be re-evaluated by the government for the following year.
Of course it is of great importance to have on one hand the suitable development of charging infrastructures as planned by Chargy and on the other hand the evaluation of optimal incentives for EVs in the Gran Duchy, in order to help the citizens for the adoption of electric cars and to help more generally the electric transition in the country.

As a personal opinion, the country and especially the main cities are suffering big traffic jams and huge parking problems due to the numerous offices concentrated in the same areas. It could be evaluated that the optimal incentive for EV in Luxembourg would be also dedicated parking spots in public parkings for EV and free parking for electric cars. It would for sure have a direct positive impact on a short-medium term since it would

not only motivate citizens for the adoption of EV but also people working in Luxembourg and coming from outside the country.

It is known that everyday in the country, 200 000 people are coming from the broder countries being Belgium, Germany and France, and that the number is progressing by 7000 every year, it can be imagined the potential market added to the luxembourgish market for a smart mobility in the city centers.
The car sharing is a new form of mobility which is developing in the big cities but in Luxembourg it is not having success due to the elevated costs of operation and due to the fact that the vehicles offered to the customers are not a direct and efficient answer to the parking problems the customers are facing because the vehicle used are standard cars and dedicated parking lots are only placed on predefined relay spots.

A big market in Luxembourg is the companies fleet market since the companies need a dedicated fleet with a large choice of vehicles types for the employees but also a choice of vehicles that could be shared during the working hours for small distances in order to assist business meetings, to travel from one office in the city to the other and to permit for example employees to leave their personal car on P&R parkings (huge relays parkings) and to use a dedicated and shared vehicle for the city travel distances.

4. Birò product

4.1 Presentation and segment type

Birò is a 100% electric quadricycle with two seats side by side that is especially designed for urban mobility. It is produced by an italian company called Estrima, based in Pordenone with production facilities in Portogruaron (VE).
The company was founded by Matteo Maestri in 2008 and the production of the vehicle started in June 2009.

As it was presented before, this electric vehicle is not considered as a car but as a quadricycle and belongs to the segment of micro cars like for example the Renault Twizy.
The numerous advantages with respect to a standard car will be presented in the next chapter.

The vehicle can be declined into two different versions :

- **Classic** version belonging to the L6e category being the light quadricycle one. The top speed is then 45km/h thanks to two brushless 48V electric engines. The total power of the vehicle is 4kW.
- **Bolt** version belonging to the L7e category being the heavy quadricycle one. The top speed is 60km/h and the vehicle fits two motors of 1.9kW each.

Figure 4.1 Birò Classic versus Birò Bolt

Aesthetically there are no particular differences apart from the front lights added on the Birò Bolt in order to comply with the european homologation requirements.
The differences are on the mechanical and electronical point of vue since on the Bolt version, the motors overall power has been increased thanks to a new control unit mapping. As known before, the top speed has been increased to 60km/h and that is why

the mechanical parts have been modified ; In fact it has been added on the new chassis a front anti-roll bar and a rear torsion beam to obtain higher stability. Moreover the suspensions are better performing but the disc brakes remain the same.

For each of the two versions, three different models are available as presented on the figure 4.2 and for the classic version, an additional limited edition is available. Notice that one model called the Birò Summer is not presented and sold in Luxembourg since it does not have any doors and so it does not permit to travel during the winter or even during the rainy days representing a characteristic of the weather in Luxembourg.

Figure 4.2 From left to right, Winter model, then Big one and Box one

The Limited edition is actually one of the three models presented before with additional aesthetic components as shown in figure 4.3.

Figure 4.3 Birò Limited edition and its additional aesthetic components presented in the bottom picture

In terms of batteries, there are two types of Lithium-ion batteries that are available for the Classic version. Notice that before, the Lead acid battery was used for the Birò but the new generation of batteries are not using lead anymore due to the problems of weight since lead acid batteries are heavy and bulky and due to problems also of short life cycle.

The two different batteries are the following :

- **Lithium MAXI battery** with a capacity of 100Ah, permitting to have a theoretical **range of 100km** for a single charge. For a complete charge, it takes between 3 and 6 hours and the absorption is around 1200W. The battery is fixed and placed under the seats in order to have a suitable center of gravity.
- **Lithium Re-Move battery** with a capacity of 50Ah, permitting to have a theoretical **range of 55km** for a single charge. For a complete charge it takes between 2 and 4 hours and the absorption is also around 1200W.
  The battery is removable which means that it is placed in a small storage space as shown in figure 4.4 and it is equiped with wheels in order to transport it like a trolley, to recharge it where it is needed (office, home, bar, university, etc). The weight of the removable battery is around 25kg which is half of the weight of the MAXI one, which is the reason why the range is divided by 2. Anyway with the

trolley system, the transport of the battery is easy and the mechanical system placed in the storage space permits to take out the battery without particular effort.

Figure 4.4 Re-Move battery system on the Birò

Notice that for the Bolt version, the MAXI battery is the only type available since a suitable range is needed to drive on dual carriageways.

The Birò is a keyless vehicle since it is equipped with an RFID card reader in order to open or close the vehicle and to start the electric engine (see figure 4.5).

Figure 4.5 RFID card reader on the Birò to open the car and start the engine

This permit the user to share the vehicle since for each Birò we can have until 10 cards. The cards are programmable and simply recognized by the VCU (vehicle control unit). In order to connect the vehicle to a car sharing platform, a black box is already inserted in the Birò and a SIM card can be placed inside to know the real time position of the vehicle.
Estrima company developed a platform called Birò share that permits the user to register its personal profile (private or company), to register the car and to manage the sharing of its vehicle thanks to an application that provides information on :

- The position of the vehicle
- In case of use, it provides information on the user and which card is active
- The percentage of the battery
- The amount of time for which a user reserved the vehicle

There is then a real time traceability of the vehicle, permitting the owner of the car to manage the sharing of its vehicle in a simple way and so to decide also about its own sharing prices.
The Birò share is well explained in the following video : https://www.youtube.com/watch?v=X98SYJdAkTY

In case a company or a private owner wants to use a different sharing platform, it is possible to insert a different black box and to connect it to the new platform since the vehicle is versatile.

In terms of prices, the Birò is sold with the battery which represents more or less 30% (2990€ VAT excluded) of the total cost of the vehicle as in all electric vehicles. The price list is the following :

Figure 4.6 Price list for the Birò Classic and the Birò Bolt

As it can be seen, the cost of the Birò Bolt is 1000€ higher than the cost of the Birò Classic which comes from the fact that in the Birò Bolt the chassis has been modified and additional components like the torsion bar and the anti roll bar has been added. Moreover the vehicle is equipped with two motors of 1.9 kW each for a maximum speed increase of 30% with respect to the Classic version, permitting to drive easily on ring roads or high speed roads.
Even if the speed is increased, the battery life remains high since the total range reaches **90km with a single charge**.

The vehicle is available in three different base colours being White, Black and Green. The base colours are free but it is possible to choose among 99 other colours for an additional cost of 399€+VAT for the frame and 199€+VAT for the varnished bonnet as seen on figure 4.7.

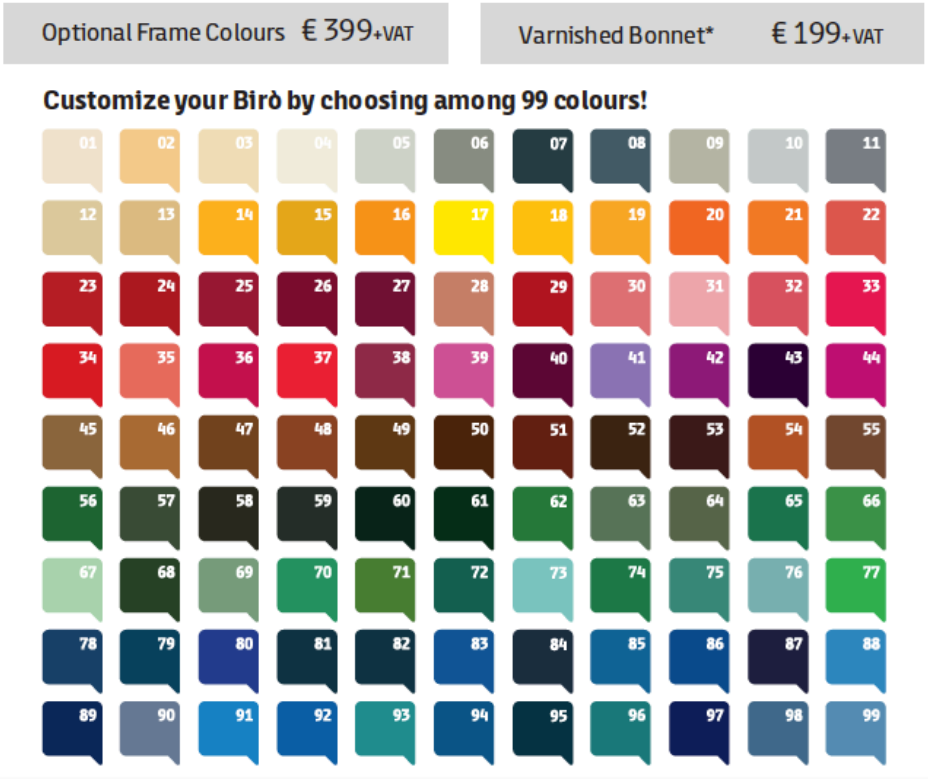


Figure 4.7 Optional colours available for the Birò

4.2 Advantages of the Birò

The Birò is especially designed for urban mobility and the L6e version has got many advantages since it is considered as a light quadricycle.
First of all it is of great interest to study the general advantages of the vehicle speaking about the different innovative functionalities it has.

Tiny dimensions for urban mobility - As it can be seen on the technical sheet in figure 4.9, the vehicle is only 1.74m long and 1.03m large, still having two comfortable seats side by side. This permits to have a perfect maneuverability in the city while driving, and

to park easily. Moreover it is worth to notice that on a standard parking spot, 4 Birò can be parked as seen on figure 4.8 and that would be a big advantage for all the companies having parking problems for their fleet.

Figure 4.8 Four Birò can be parked on a standard parking spot

Overview

Technical sheet

General features
- Security frame 3mm thick tubular steel
- 4 hydraulic disc brakes
- Openable, tempered-glass sunroof
- Reversing buzzer
- Electronic Birò Card
- 3 point safety belts
- 145/60 R13 tyres
- Lateral rear-view maxi mirrors
- USB port
- Two-speed selector + Boost
- Removable polycarbonate doors with electric lock on the driver side
- Defrost grid windscreen

Electric features
- 2 Brushless 48 V electric engines
- Max power: 4 Kw
- Braking energy's recover
- 220V battery charger

Performances
- Maximum legal speed: 45 Km/h
- Boost (to enjoy more power if you need be)
- Slopes able to exceed: up to 20%
- Sudden steer radius:
  From the center of the outside wheel: 2800 mm radius
  Minimum diameter of steering between walls: 6 m

New rear roto-moulded structures
Birò with
145/60 R13 front and rear tyres

Dimensions

Dimensions
- (A) Length: 1.740 mm
- (B) Width: 1.030 mm
- (C) Height: 1.565 mm
- (D) Height above ground: 190 mm

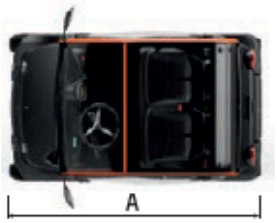


Figure 4.9 Technical sheet of the Birò Winter

RFID card reader for car sharing - As explained previously, the vehicle is keyless since it is equipped with an RFID card reader to open the car and to start the engine, and for each vehicle it is possible to have until 10 cards, thus permitting the Birò to be shared between users with the possibility to use a sharing platform as the **Birò share** or for example **Moovee** in Luxembourg being a specific sharing platform for the corporate world.
Since the vehicle is versatile, to connect it easily on the Moovee platform, it is sufficient to insert the proper black box **Wirma RS 3G**.

Freedom of recharge - Being 100% electric, the vehicle charging is of primary importance. The big advantage of the Birò is that it can be charged on a normal plug 220V without the need of a charging infrastructure and since the battery absorption is 1200W there is no risk of overload. Obvisouly in case it is needed to charge it on a charging station then a cable can be supplied to the client, so that he will have the possibility to charge it at home on a normal plug or to charge it on a charging station with the Mennekes Type 2 cable.

Figure 4.10 The client has the choice to charge the vehicle battery on a normal plug or on a charging station

Low cost of recharge - Another big advantage is the energy consumption because for a single complete charge on average, the energy consumption is 5 kWh. If we consider the price of electricity for the charging stations in Luxembourg being 0,20€/kWh, then the cost of a single charge can be evaluated as equal to 1€.
As a consequence, with the Birò the cost for 100km range is then 1€ which is very low.

Small plate and small license – Since the vehicle belongs to the L6e category with the speed limited to 45km/h, in Luxembourg it can then be driven from 16 years old with the AM driving license.

Moreover it has the scooter plate and so it can be parked on the scooter spaces as depicted in the figure 4.11, otherwise it can be parked at the perpendicular of the sidewalk and so consequently the parking is free of charges as seen on figure 4.12.

Figure 4.11 Birò allowed to park on scooter spaces

Figure 4.12 Free parking for the Birò in case it is parked perpendicular to the sidewalk

No road taxes – Being an electric quadricycle, the road tax is completely free for the Birò. This is not the case for the standard electric vehicles unfortunately and so this is a big advantage of the vehicle presented.

No technical control – In Luxembourg, after 4 years, the technical control should be performed every year and this includes supplementary costs. Since the Birò belongs to the light quadricycles category, it does not need to perform the technical control.

Cheap insurance – Another very interesting aspect are the insurance fees per year of the Birò. Depending on the type of contracts packages selected, the insurance price for a « mini casco » package is around 180€ per year. This type of competitive price is very hard to obtain even for a scooter.

Cheap maintenance – Having very few wearable parts and much less electronic components than a standard car, it is easy to understand that the maintenance of the Birò is extremely cheap, nearly equal to 0 for the first 3 years. Looking at the public prices of the spare parts in the next chapters, it can be seen that the reimplacement of a specific part is not expensive and mainly the labour which is not expensive at all since the parts can be replaced easily in a small amount of time.

Government incentive – For all the Birò registered from the 1st of January 2019, they receive a **government incentive of 500€** since it corresponds to 25% of the vehicle price with a maximum of 500€. The incentive is very important even if it is low with respect to what expected, because it shows to the client a wish from the government to promote electric vehicles in general.

4.3 Distribution and services

The after sales services and especially the maintenance are of primary importance because it will help to create a positive brand image and to obtain loyal clients.
On the other hand, the financial services will permit the client being a corporate client or a private client to find the proper solution of acquisition.

Concerning the maintenance, it was firstly decided to install a maintenance point in every distribution points of the Birò around the country because it is impossible to sell a vehicle without assuring the client of a suitable maintenance package and warranty on the vehicle.
Being too expensive to have a proper owned showroom with its own maintenance center, it was decided to sign contracts with specific car dealers around the country or even with smaller shops like for example electric bicycles shops selling all kinds of urban electric gadgets (electric scooters, electric skateboards, segways).
The advantages are that the **product sales and maintenance** are assured by a dealer already having experience in the automotive or urban mobility sector and so it can be a gauge of quality for the client who does not know yet the product.
Another advantage is the fact that the company Oxom Mobility can rely on a proper logistic previously settled by the dealers, and for the maintenance the company can count on tecnicians already availables, directly hired by the shop or the dealer.
The disadvantage is that a confusion can arise for the client in terms of brand identity since the Birò product is presented in a dealer or in a shop hosting other brands.
The ideal solution would be a Birò shop in the city center but it is easy to understand that the initial investment would be too high with respect to the sales volume for the first years.

Before signing proper contracts with the different distribution and maintenance spots, the idea was to follow a maintenance and after sales course in order to obtain a certification from the producer being Estrima srl as seen on the following picture :

Figure 4.13 Certificate of maintenance from the producer

During the month of October 2018 the first two distribution and maintenance points were simply the two ElectriCity stores in Luxembourg, being a dealer of electric urban gadgets like the electric bicycle, the electric scooter, the electric motorbike, the electric skateboard and eventually the segway. The principal shop is located in Belval in the south of Luxembourg, and the other shop is located in the city center, and is part of the Pianaro maintenance point being one of the older Bosch service spot in Luxembourg. Belval and Luxembourg city are the first two cities in the country in terms of economic activity and are then of great interest for Birò. The two different exhibition spaces are presented in the following figure :

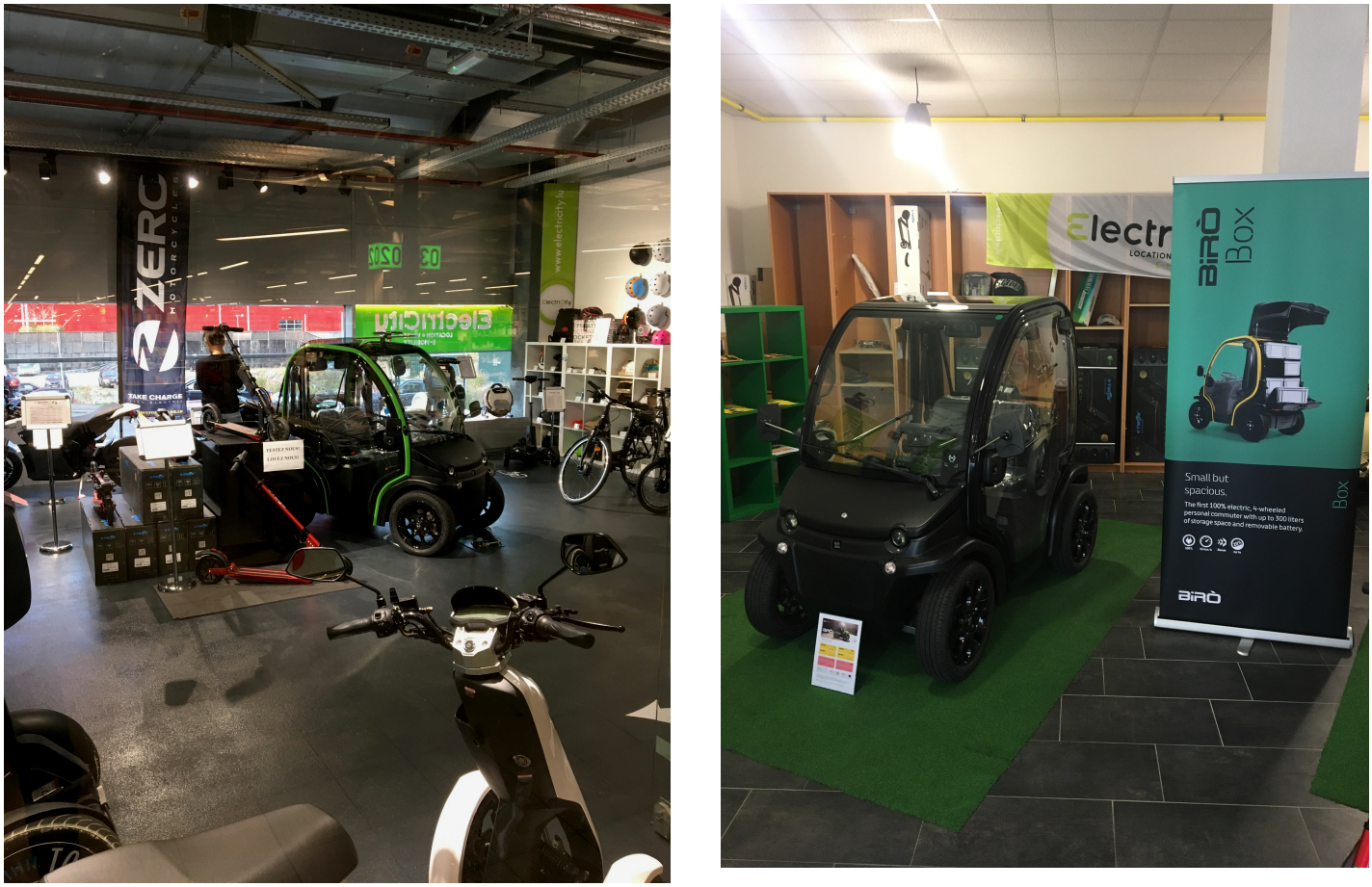


Figure 4.14 ElectriCity exhibition spaces for the Birò

Before the end of the year 2018, a meeting with David Sibaud being the CEO of **Rodenbourg and Etoile Garage dealers** in Luxembourg, permitted to start a collaboration in order to develop the electronic maintenance center of each of the two dealers. The Birò being a fully electric car with easy maintenance, it was a good way for the car dealer to develop with limited risk the electronic department of its workshop.
It is worth to notice that Rodenbourg dealer sells cars from the Peugeot and Kia brands, while Etoile Garage dealer sells cars from the Citroen and DS brands.

In order to properly start the collaboration and to present the Birò in Luxembourg, the car dealers previously introduced decided to buy two vehicles in order to offer them for

rent to the clients or even to propose them as a courtesy car instead of using a standard vehicle for urban mobility.
The **renting company** owned by the two car dealers is called Autolux and the strategy was to offer in the future competitive leasing packages with the latter in order to boost the sales volume.

Figure 4.15 An example of renting publicity for the Birò with Autolux

As a summary, the number of **distribution points** in the country are **four** for the moment, each one acting also as a maintenance center. One distribution spot is present in the city center (ElectriCity store), while two others are in **Luxembourg city** in the **Strassen** area (Rodenbourg dealer) and in the **Cloche d'Or** business area (Etoile Garage), and the fourth one is in the south of the country in **Belval** (Main ElectriCity store).

A **fifth** dealer will start to distribute the Birò in the north of the country in **Mersch** (Garage du Centre) before the end of July 2019. Since they are an authorized maintenance center for light quadricycles, they will be a maintenance spot for the Birò in the northern region of Luxembourg.

How the client can contact our team ?

For any request related to the Birò, the clients can directly refer to every distribution centers that are indicated in the home page of our website Birò Luxembourg as presented in the following figure :

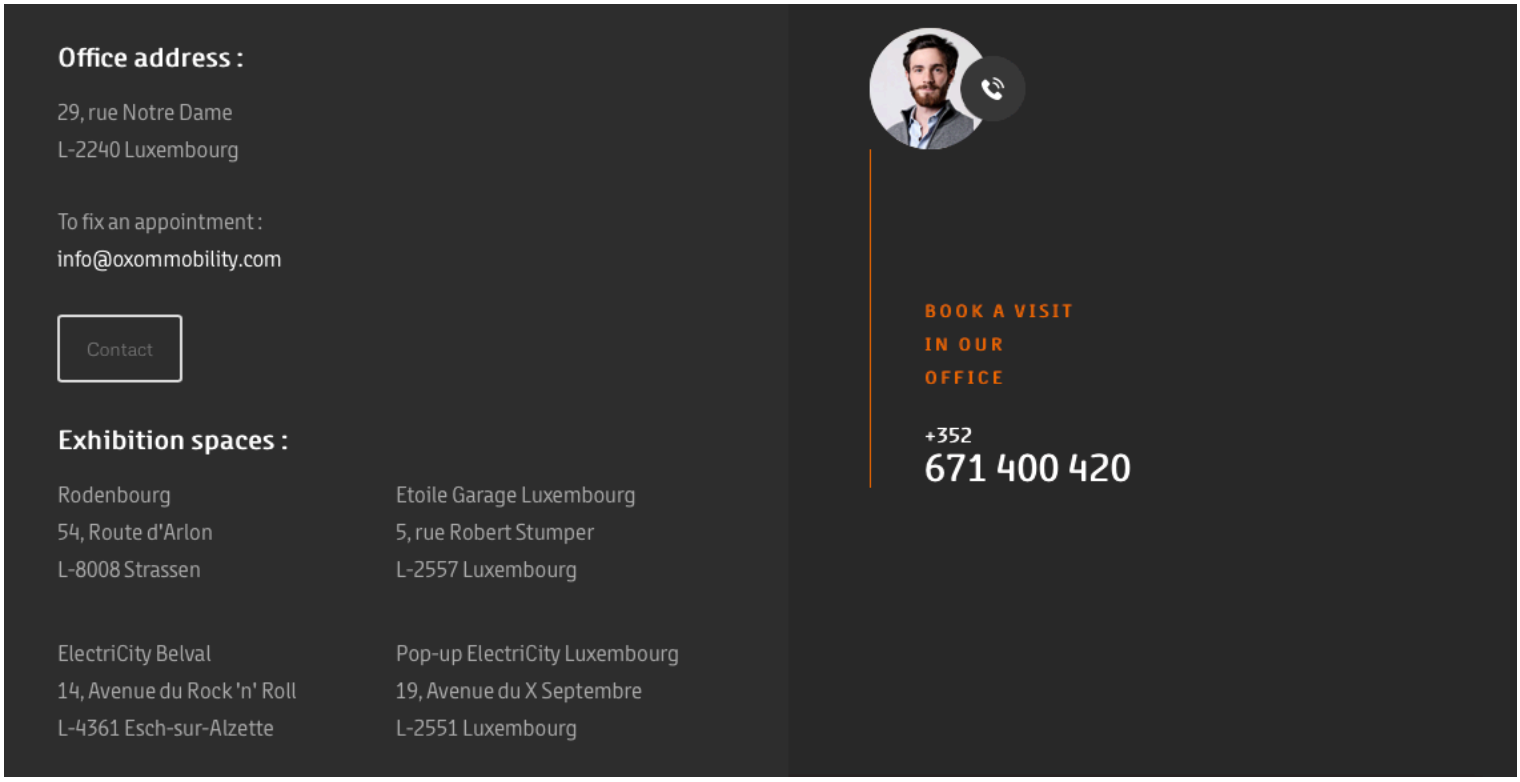


Figure 4.16 List of the distribution points in Luxembourg and contact information for the Birò

Another way to contact the team is directly through the website by sending a message which is transferred by e-mail to the main offices :

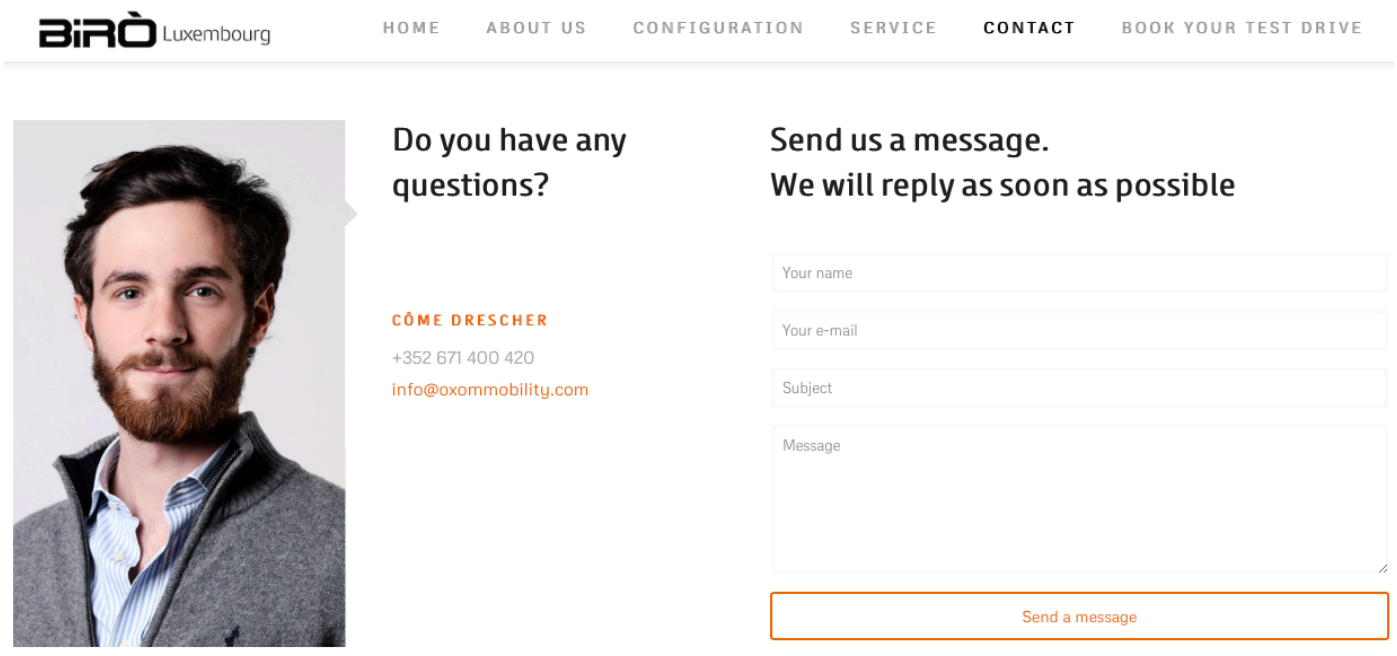


Figure 4.17 Contact information for any question the client might have

As it can be seen, the phone is also indicated, which permits the client to call directly and have an instantaneous answer to the question.

Concerning the service part, in case a client has a problem with his vehicle, the service page on the website permits the latter to explain the problem he faces without bringing the vehicle to the maintenance center and in case it is needed, the repair service can be performed directly on-site without transporting the vehicle to the nearest workshop. It is actually a way to improve the client experience.

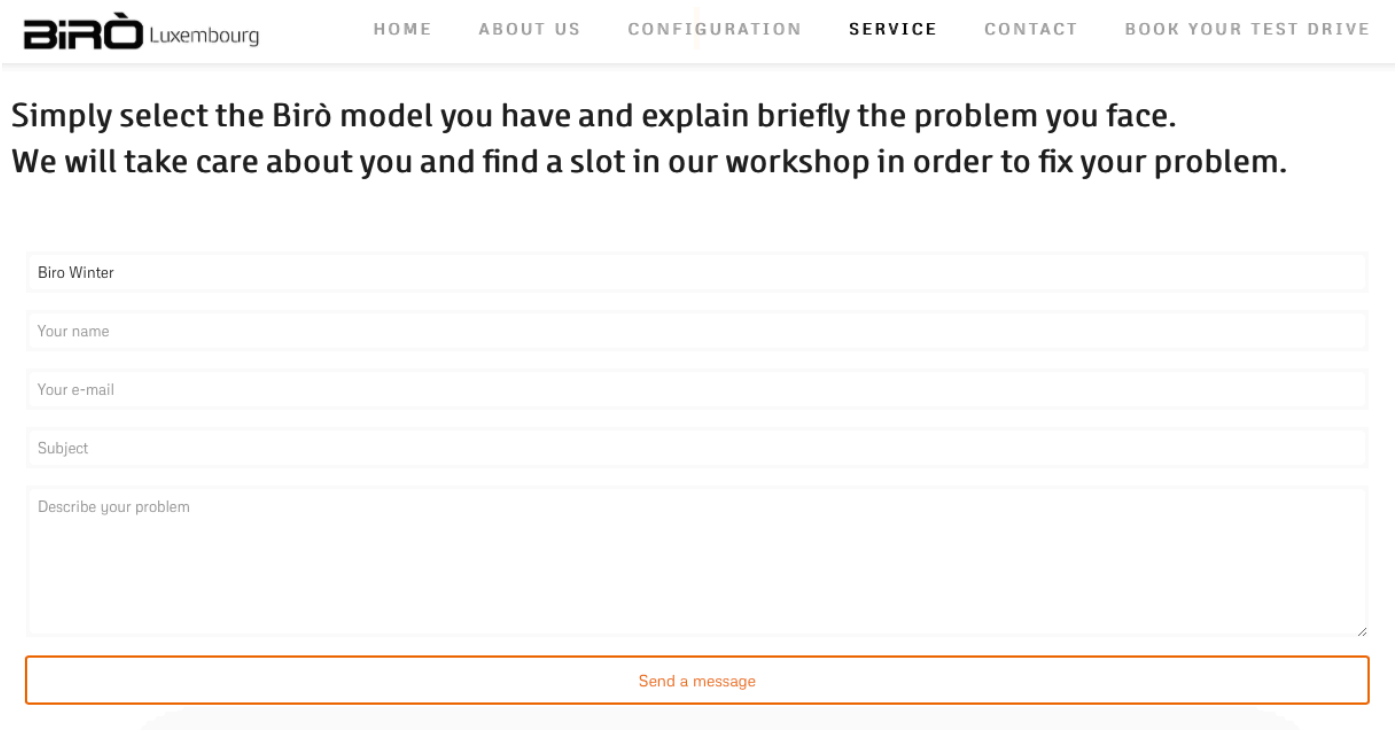


Figure 4.18 Service filling form to prepare a suitable maintenance service in advance and improve the client experience

In order to standardize the CRM process, every new or potential client is inserted in our Sales Force database. The database cost is highexpensive if the client number is not more than 100, but then it becomes very efficient for a high number of clients.

Before signing the maintenance contracts, the important point was to examine in details the different workshops and to see if they were in line with the expectations for the maintenance of this niche product. Nowadays, the OEM's being extremely careful on the after sales and the workshop of each of their dealers also for the client experience point of vue, it is easy to understand that the standards for the workshops organization in each of the car dealers were high enough for the Birò product.

In order to offer an additional service for the after sales in cooperation with the car dealers, it was decided to offer the possibility of an on-site maintenance since the vehicle has the advantage of a very simple maintenance (nearly zero for the first two years) requiring tools easy to transport and very few bulky spare parts.

The advantages of the onsite maintenance are mainly two :

- Firstly it offers an additional service to maintain the loyalty of the client
- By using the Birò Box as the service car transporting all the necessary tools, it contributes to the positive image of the brand with a zero-emission service car and it is an efficient marketing tool as seen on the figure 4.19.

Figure 4.19 Onsite maintenance Birò Box service car

In order to certify suitable and professionnal maintenance centers, the idea was to organize an initial maintenance course for all the technicians responsible for the maintenance of the Birò in Luxembourg, where they received a certification from Oxom Mobility authorizing through a contract the garage for the maintenance of the vehicles. This is of great importance since it is the only way to correctly manage the vehicles warranty.

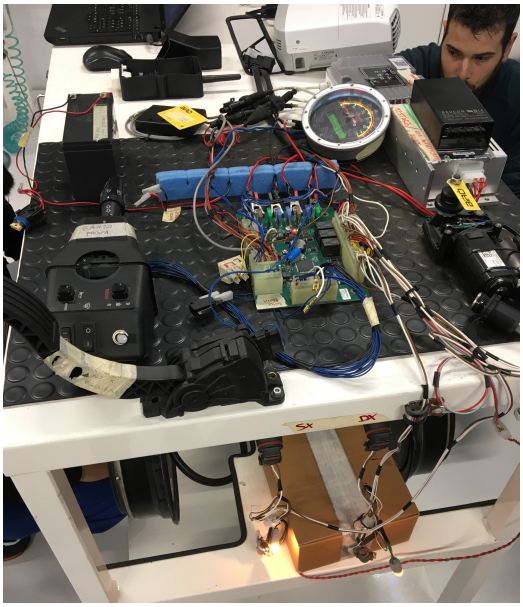
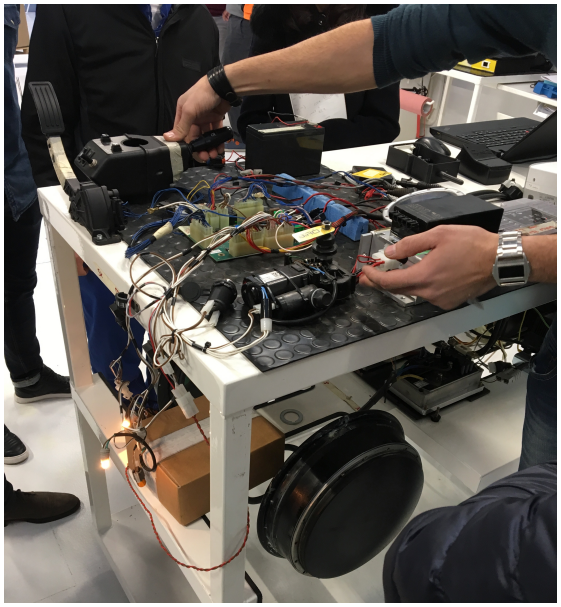
Maintenance training day for the technicians

- Initial presentation of the product with a visit of the production line (series production line + job shop)

On the above photo it is possible to observe the butterfly tubular structure of the Birò which guarantees good results in terms of strength.

As it can be seen, the chassis is pretty simple and directly shaped in the production site in Portogruaro, the metal tubular structure elements coming from Slovakia.

- Study of the electrical circuits on the vehicle control unit (VCU), the electrical connections and the different electronic elements.


- Presentation of the Box model, study of the rear axle on which are mounted the hub motors inside the rear wheels and study of the mechanical parts.



Notice that from the European law protecting the customer, the seller in Luxembourg must offer a « legal warranty » of at least two years to the final customer. That is the reason why the Oxom company is offering a warranty of two years on the entire vehicle and on the batteries. It is easy to understand that the warranty is not applied to the wearable parts, expect in case of non normal function of non wearable parts.

It will be seen in the contracts chapter that the producer Estrima is giving a warranty of two years on the products delivered to the distributor Oxom Mobility and that the warranty hours of labour offered by Estrima are equal to 50€ per hour, VAT excluded. Since the two companies (Estrima and Oxom) are exchanging services with an intra-community VAT, the latter is not applied.

An example of warranty hours for the substitution of the vehicle control units in order to reactivate a Boost function is presented in figure 4.20.

Oxom Mobility & LIFESTYLE s.à r.l.

27-29 rue Notre Dame
L-2240 Luxembourg
info@oxommobility.com

ESTRIMA srl
Via Roveredo 20/b
33170 Pordenone (PN)

Date : 14/02/2019
Facture réf: 20190214009
Client réf. : ESTRIMA

FACTURE

Service	Hours	Montant
Birò Winter ZK204KW0118002630 – Warranty hours to reactivate the Boost function	4	200€
Details of the work performed for the Birò		
Dismounting of the principal battery connections and of the 2 control units	1,75	
Mounting of the new control units and remounting of the battery with its connections	1,75	
Connection of the pink pin on the VCU for the boost reactivation	0,25	
Final validation tests before the delivery to the client	0,25	
	Total	**200 €**
	Acompte 25%	-
	Solde dû	-

Solde à payer : 200 €

RCS B151702 TVA LU23907420
LU93 0019 5255 4520 9000 BANQUE ET CAISSE D'ÉPARGNE DE L'ETAT SWIFT BIC BCEELULL

Figure 4.20 Warranty hours bill to reactivate a Boost function on a vehicle

Considering the spare parts, an initial stock of spare parts has been ordered from the Estrima company and is presented in the following figure.

Figure 4.21 Spare parts kit stored in a shelf

The price margin on the parts is the same for all the distributors and define previously by the mother company.
Finally, the price for the final client is standard and can be checked on the website Birò spare parts : http://www.spareparts-biro.com
On the latter, the distributors or even the final clients can order the required pieces and in case a warranty or a discount must be applied on the pieces ordered, before proceeding to the payment, a special code can be applied in order to calculate the correct or discounted final price.

The stock of spare parts can be easily monitored thanks to a QR code and a standard reference for each piece. Basically, if a piece is missing, by scanning the QR code (as seen on the figure 4.21) with a device or a mobile phone, the piece is directly ordered on the website and can be delivered in less than 48 hours. In fact, a big advantage of the Birò is that it is produced in Italy and so the spare parts are delivered all over Europe in a very efficient way.

Quality control

We all know that the weak point of an electric car and especially the lithium batteries are the cold temperatures since the battery has the tendency to lose capacity and the electronic components being sensitive to the cold can have some working problems.
By selling a niche vehicle that is not cheap and that is produced in Italy, it is very important to have a very accurate quality control in order to prevent possible defects.

Since the vehicle started to be sold in Luxembourg and other countries where temperatures can reach very low values, Estrima company decided to purchase a refrigerator in order to test the vehicle and the lithium batteries at temperatures reaching -20°C, thus preventing possible defects due to the cold and maintaining a certain level of quality no matter is the temperature level. It is worth to know that the vehicle has dimensions permitting to enter perfectly inside the refrigerator without the need to have a proper room for testing as it is required for standard cars.
The refrigerator from the outside and from the inside can be seen on the following figure.

Figure 4.22 Refrigerator used for testing the vehicles and the lithium batteries under temperature levels reaching -20°C

Financial services

In order to boost the sales, it is of primary importance to offer to the clients financial services or even leasing solutions. In Luxembourg, a very high percentage of the fleet around the country is under leasing contracts, and the private clients are progressively starting to avoid owning a car, by subscribing leasing contracts with the car dealers having their own leasing company or working with external leasing companies.
Before, the leasing in Luxembourg was exclusively for corporate clients with a VAT number but now the companies with the support of some banks, are proposing leasing solutions to private clients, called « private leasing ».
The two major solutions are the **financial leasing** or the **operational leasing**. It was observed that some companies offering services like for example post services, or even home nursing care services, thus using the vehicle as a principal tool for work, the operational leasing was the preferred solution since they do not want to worry about the maintenance logistic of a car and they prefer to pay a monthly rent to simply outsource the administrative and service intervals logistics of the vehicle.

The company is signing contracts with leasing companies like for example ALD Automotive in order to propose fleet for companies with the collaboration of Moovee,

being the fleet management company permitting also to manage a proper car sharing for the fleet of a company.
The second leasing company working with Oxom Mobility is Leaseplan, being an historical actor in the Gran Duchy, and finaly ING bank in Luxembourg permitting the private clients to subscribe private leasing or financial leasing contracts.

An **example of financial leasing porposition from ING lease** can be analyzed on figure 4.23.
The financial leasing is proposed for a period of 54 months, being usually the longest period possible.
It can be observed the price of the vehicle reported of 10 980€ vat excl. and in the second half of the document the first monthly amount of 3 211,65€.
After that, the client must pay for 53 months an amount of 166,79€ and if he wants to own the vehicle at the end of the leasing, he would have to pay an amount of 1 098€ vat excl. Otherwise the bank remains the owner of the vehicle.

ING LEASE

Offre indicative de Leasing Financier

Réf. : 2019/LE/00000023 Date d'émission : 09/01/2019

ING LEASE LUXEMBOURG S.A., soumet l'offre de leasing financier suivante au Locataire. La présente offre ne vaut pas accord de location. Tout accord de location de la part d'ING Lease Luxembourg S.A. reste soumis à l'acceptation finale de la demande de leasing par ses instances internes de décision et aux conditions supplémentaires éventuellement imposées par lesdites instances et la signature du contrat de location correspondant.

	LOCATAIRE
Dénomination	OXOM MOBILITY AND LIFESTYLE SARL
Date de constitution	10/03/2010
Adresse	27-29, RUE NOTRE DAME L-2240 LUXEMBOURG Luxembourg
Numero TVA	

MATERIEL LOUE : BIRO WINTER

PRIX D'ACQUISITION : €10.980,00 HORS TVA

En cas d'investissement d'un montant différent, le loyer ci-dessous sera adapté proportionnellement.

De même, en cas de livraison du matériel loué plus de deux semaines après la date d'émission du contrat par le Bailleur, ce dernier se réserve le droit d'adapter le loyer repris ci-dessous en fonction d'une augmentation éventuelle des taux d'intérêts (par référence au taux IRS correspondant à la durée du contrat) survenue dans l'intervalle.

DUREE DE LA LOCATION: 54 MOIS

PROGRAMME DES LOYERS :

NOMBRE DE LOYERS	LOYER HTVA	TVA	LOYER TVAC
1	€2.745,00	€466,65	3.211,65 €
53	€142,56	€24,23	166,79 €

MONTANT OPTION D'ACHAT : €1.098,00 HTVA.

Frais de dossier de 0.25% avec un minimum de €50

Les conditions financières reprises aux présentes restent valables pendant deux semaines après sa date d'émission.

ING Lease Luxembourg SA

Bon pour accord

(signature du locataire + date)

ING LEASE Luxembourg, S.A.
26, Place de la Gare L-1616 Luxembourg
T +352 45 88 48 F +352 45 81 03

No ident. LU 14203580
www.ing.lu
Email contact@lease.ing.lu

R.C.S Luxembourg B.31049
IBAN:LU06 0141 9250 0500 0000
BIC:CELLLULL

Figure 4.23 Financial leasing proposition from ING lease

4.4 Target clients

The target clients are mainly two types :

- The private client
- The corporate client

Each type of client requires a totally different approach and offer. For example in Luxembourg the corporate client will mainly ask for an operational leasing offer for two simple reasons : the first reason is that he will try to avoid to own the vehicle for fiscal reasons and the second reason is that he will be able to give it for an employee as a fringe benefit and it will be deducted from the taxes.
On the other hand, the private client has nowadays the tendency to start thinking about the private financial leasing and the operational leasing will have the tendency to be less common.

The overall big problem in Luxembourg is the traffic problem and the huge parking problems. Moreover, renting a parking spot or even a box is becoming more and more expensive. For example in the city center, in order to buy a spot the price of a parking spot can reach 200k€ which makes no sense when you can simply park one car.
Some offices like the ones of the Big four (Deloitte, PWC, KPMG, EY) face real parking problems since as an example, Deloitte in Luxembourg has 100 parking spots available for 2200 employees.
Moreover a study about Luxembourg mobility tells that the average filling of a car in the morning (pick hours of traffic) is about 1,2 persons and most of the cars have a capacity of 5 persons.
Another interesting study shows that most of the Luxembourg city residents have a distance to travel from home to the working place less than 10km which is very low and does not require the use of a five-seated vehicle.

As it can be seen on the graph of figure 4.24, the population in Luxembourg is increasing every year and the major reason is coming from the working opportunities. In fact the increasing population is mainly coming from the immigrating people and not necessarily from the births. It is then easy to understand that the mobility problems can only worsen if the number of working people increases.
As it can be noticed, from 2010 to 2019 the population number increased by more than 100 000 inhabitants and so the potential market is increasing every day.

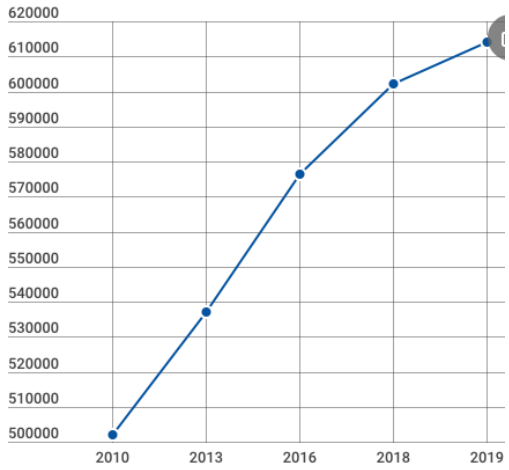


Figure 4.24 Evolution of the population in Luxembourg from 2010 up to now

It is very important to notice that the target clients for our type of vehicles will be different from the target clients of a standard vehicle.
But looking at the market segments for the electric vehicles in Luxembourg, some of them could be interesting for the Birò like for example :

- The **only functional use** segment where people do not want to use the car anymore for short distances, meaning distances of less than 10 km. It is worth to say that 1/3 of the overall population leaves in the center region of Luxembourg and a big part of this population works in the city center, which means that the quotidian distances of 1/5 of the population is not more than 15km. The huge parking problems in the city center are the reason why a part of this segment would be very interested in having a 1.74m long electric vehicle to perform quotidian distances and to park everywhere in the city center.
  A real study proved that with a standard car on average 20 minutes are required to find a parking spot, even in underground parkings during peak hours. Instead, using the Birò, on average 5 minutes where required to find a parking spot without the need of finding an underground parking.
  It can be understood that the use of the Birò is a real gain of time and brings the client from a point A to a point B in the easiest way, that is why the « only functional use » is a segment with a big potential for our product.
- In Luxembourg, the « green mentality » is spreading quite fast and is becoming also a lifestyle. The green political party of Mr. Bausch is having also a big success since it was during the elections the party with the most impressive growth.
  It is why the « **environmental aware** » segment is having every day more and more importance and must be taken into consideration because people belonging to this type of segment have a strong motivation to shift to the electric technology and to much smaller vehicles.
- A third segment that is of particular interest is the « second or even third family car » because the statistics from Statec shows that there are 662 personal cars for 1000 inhabitants and so it can be imagined that a high percentage of the households have a second or third family car.
  The Birò is not a first car but a second or a third car and can be seen also as a vehicle able to substitute the scooter (driven from 16 years old), in order to permit young teenagers in households to be more independent.

The segments mostly for private clients were presented. It is now important to speak about the corporate clients which is of great interest for the target sales since the Birò is an answer to the multiple mobility and parking problems that companies in Luxembourg face. It is also a marketing tool for a company to transmit a green and innovative brand image.
For example, speaking about sustainability and green image, Estrima company decided with its dealers to present a limited edition model produced at 80% of recycled plastic in collaboration with a design studio called Mandalaki and a famous creator called Rossana Orlandi as seen on figure 4.25.

Figure 4.25 Birò Limited edition with 80% of recycled plastic

This model could be for a company a very smart and efficient marketing tool, above all during a period of awareness against plastic use.

In Luxembourg, around 36 000 companies are currently active with 13% of companies with more than 10 employees.
Moreover the 20 biggest companies in Luxembourg have a number of employees in the country between 1800 employees and 4500 (Post Luxembourg) as presented in the following graph built by the Statec.

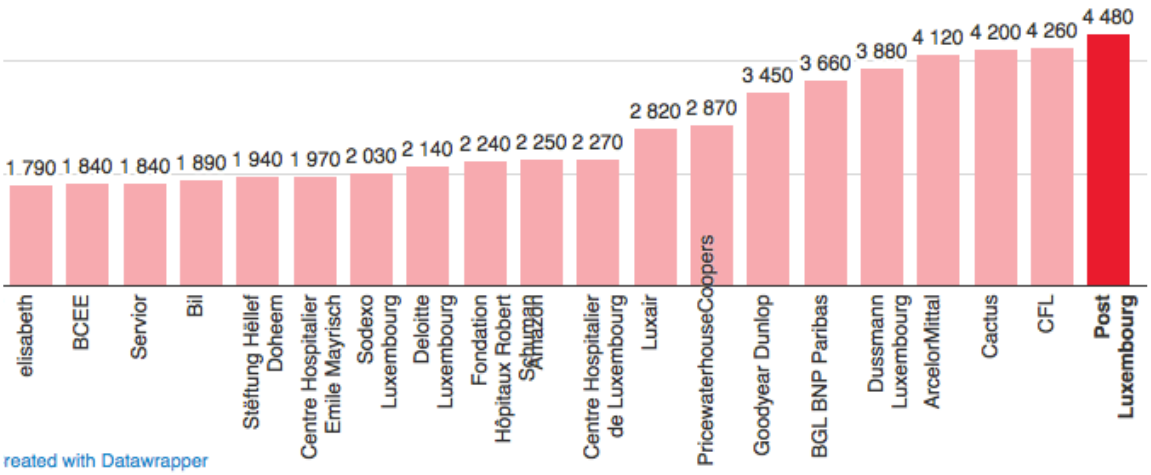


Figure 4.26 The top 20 of the biggest employers in Luxembourg 2018

A major part of the offices of those big employers are located in Luxembourg city in districts like for example Belair, Cloche d'or, Center district, Grund, Findel, Gasperich,

Kirchberg etc… having huge parking problems, suffering from a very poor density of parking spots in the streets. It can be imagined that the companies have a very limited number of parkings, thus seeking for new mobility solutions for their employees like the car pooling, the car sharing, public transports and bikes.

The Birò being versatile and being completely designed for car sharing, it can be an efficient solution for companies to propose to employees a car sharing of small urban electric vehicles to move around the city for business meetings.

Companies like for example KPMG as seen on figure 4.27 have already a car sharing fleet of 3 Renault Zoe but on the other hand they suffer from parking problems. Knowing that on a standard parking spot, 4 Birò can be parked, the car sharing Birò fleet would be a pure optimization of space ; Moreover when employees are using the cars for business appointments, they are not usually more than 2 and so using a four seated car for urban mobility is a complete non sense.

Figure 4.27 KPMG electric car sharing fleet since 2015

A second type of corporate client is a company offering **delivery services**, since the Box model is entirely designed for delivery of food or tangible goods like tools, clothes, objects, documents from post services (see figure 4.28).

Figure 4.28 Birò Box equipped with boxes inside, with the possibility also to put clothes on hangers, or even to store boxes of different sizes. Multifunctional use.

Another application of this model is for example the one presented on figure 4.29 by one of our client, going to the supermarket with the Birò and filling the boxes directly from the trolley without using bags, parking the vehicle in the garage and bringing the boxes home, with a completely eco-sustainable behavior.

Figure 4.29 Eco-sustainable client with the Birò Box

As a last example, a restaurant in the city center decided to use the Birò for short distances delivery, having possibility also to use the passenger seat to optimize the storage space as presented in figure 4.30.

Figure 4.30 The Birò Box used for short distances delivery. The passenger seat can also be used to optimize the storage space.

4.5 Target sales

In order to build the business plan to present it to the bank, the idea was to build a **base case scenario** and a **worst case scenario** in terms of sales. The business plan required by the bank was on 5 years because due to the constant evolution of the business, the values for the following years (from 2023) would have not been precise enough, and the initial working capital requested was equal to 150 k€ to be able to finance the initial stock of 14 vehicles.
Instead, for the target sales only, an idea for the following years can be drawn.

The 2 different scenarios are presented in the following figure :

Base case scenario

REVENUES	2018	2019	2020	2021	2022
Quantities Birò Summer	0	0	0	0	0
Quantities Birò Winter	2	20	30	36	36
Quantities Birò Box	1	14	24	30	30
Quantities Birò Big	1	14	24	24	24

Worst case scenario

REVENUES	2018	2019	2020	2021	2022
Quantities Birò Summer	0	0	0	0	0
Quantities Birò Winter	2	10	15	25	30
Quantities Birò Box	1	5	10	15	18
Quantities Birò Big	1	10	10	15	18

Notice that the complete business plan will be presented in the last chapter (chapter 4.9).

Since the official launch of the project was on July 24th 2018, the initial sales registered at the end of the year 2018 were the following :

- 2 Birò Winter (starting price of 10 980€ vat excl.)
- 1 Birò Box (starting price of 12 980€ vat excl.)

While opening a completely new market, the first 2 years are the most difficult ones in terms of sales since the product needs to be presented and well understood by the clients which are at the beginning scepticals since they need to know where it is produced, where it is distributed, where are the maintenance centers, which are the maintenance costs, which is the level of quality, etc.

For the first half of the year 2019, the sales are the following :

- 1 Birò Big (starting price of 12 480€ vat excl.)
- 2 Birò Winter
- 3 Birò Box

Since negociations with big companies like Post, Hellef Doheem, SEO, KPMG are on process, the base case scenario can still be reached for the year 2019.
The big constraint with companies having a lot of internal procedures are simply the internal discussions and decisions having lead times very high with respect to what expected, even if we are in direct contact with the purchasing department.

From 2023, as a worst case scenario, a **sales increase of 10% every year** is planned. This will mainly depend on the new partners and the new distributors that will emerge in the coming years.

4.6 Promotion budget

In order to boost the sales in Luxembourg, 2 of our dealers being Rodenbourg and Etoile Garage decided to offer the Birò as a courtesy car and for rent as seen on **figure 4.15 from the chapter 4.3**. The idea is to propose a **Rent to Buy solution**, meaning that the client will rent the vehicle for a certain period of time and at the end if he decides to buy the product, the price of renting will be deduced from the total vehicle price.
This permits the client to test the vehicle in real conditions and in everyday life and the distributor is not obliged to wait for the client to decide about a possible acquisition before starting earning money.

The only way to sell a vehicle that is new on the market is to have a critical mass circulating around the country, because even with proper advertising, if the client does not see the vehicle on the road he will not trust the concept and will be hard to convince.

At the beginning in order to present and to launch the product on the market, an initial promotion budget was dedicated to participate to events related to e-mobility and sustainability.

First event : HR one Gala organized by farvest at the European Convention Center – 20th of November 2018

The idea was to meet the HR managers and mobility managers which are directly responsible for the fleet or more in general for the companies mobility.

The advantage of participating to those types of fairs with Birò is that the space required for the stand is always less than for standard cars and so the cost of participation is much more affordable, and two cars can easily be exhibited.
Usually the interest is to exhibit one car on the stand and out of the fair to let another car for the test drives that are booked.

A view of the preparations and of the event is presented on the following pictures :

Figure 4.31 Stand preparation before the fair

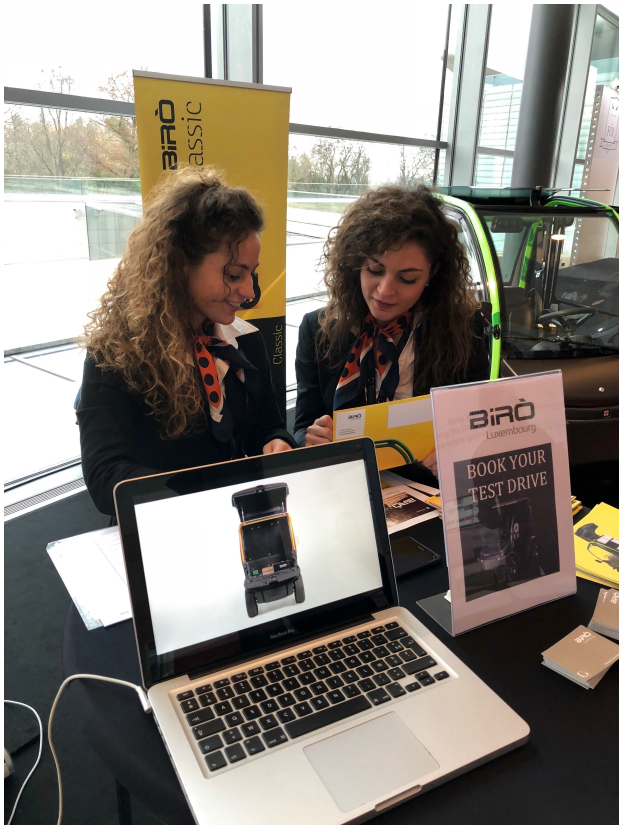


Figure 4.32 Merchandising preparation

The fair was from 2 pm to 8 pm and a lot of people were invited on the stand, that is why it was necessary to hire two hostesses in order to avoid missing clients because of the waiting time on the stand. At the beginning they were helping for the stand preparation and for the merchandising preparation, and during the fair they were introducing the product and the concept to the new potential clients.
As seen on picture 4.31, a table was prepared to register every client interested in the product and this permitted to book a test drive for them after the fair.

Figure 4.33 The hostesses were asked to register as much as possible of potential clients information

During the fair, we had the possibility to meet important persons from the Post group, from lawyers company like Hogan Lovells, from the big four (KPMG, Deloitte, PWC and EY) and to speak with human resources from smaller companies or recruitment offices. Some people really active in the mobility world in Luxembourg were present and so the idea was to make an introduction of the product.

Figure 4.34 Introduction of the vehicle technical characteristics and advantages to potential clients

At the end of the day, it was interesting to be present on the e-mobility part of the HR one gala but if a comment had to be written, the fair was not the ideal one for our project since it was an HR fair and the major part of the visitors were initially prepared for the HR conferences and workshops, and were actually surprised to see electric vehicles exhibited. For the next year it was decided to not participate to the fair and to focus on very specialized fairs on mobility.

Figure 4.35 End of the fair after the networking cocktail

Second event : Inauguration of 40 Charging stations at the Contern Campus in Luxembourg – 20th of november 2018

Unfortunately the event was on the same day as the HR one gala, but it was decided to exhibit the Birò anyway in collaboration with Move Different being a distributor of electric scooters and bikes, since the RTL TV was present to make a quick filmed report on the event and some important actors like Flex (car sharing), Shime (Mobility and sustainability consulting) and Blue corner (charging stations) were present.

It was possible to be present one hour with one of the hostess present at the other event in order to exchange business cards with useful contacts and to book meetings with some of the important actors of the mobility in Luxembourg.

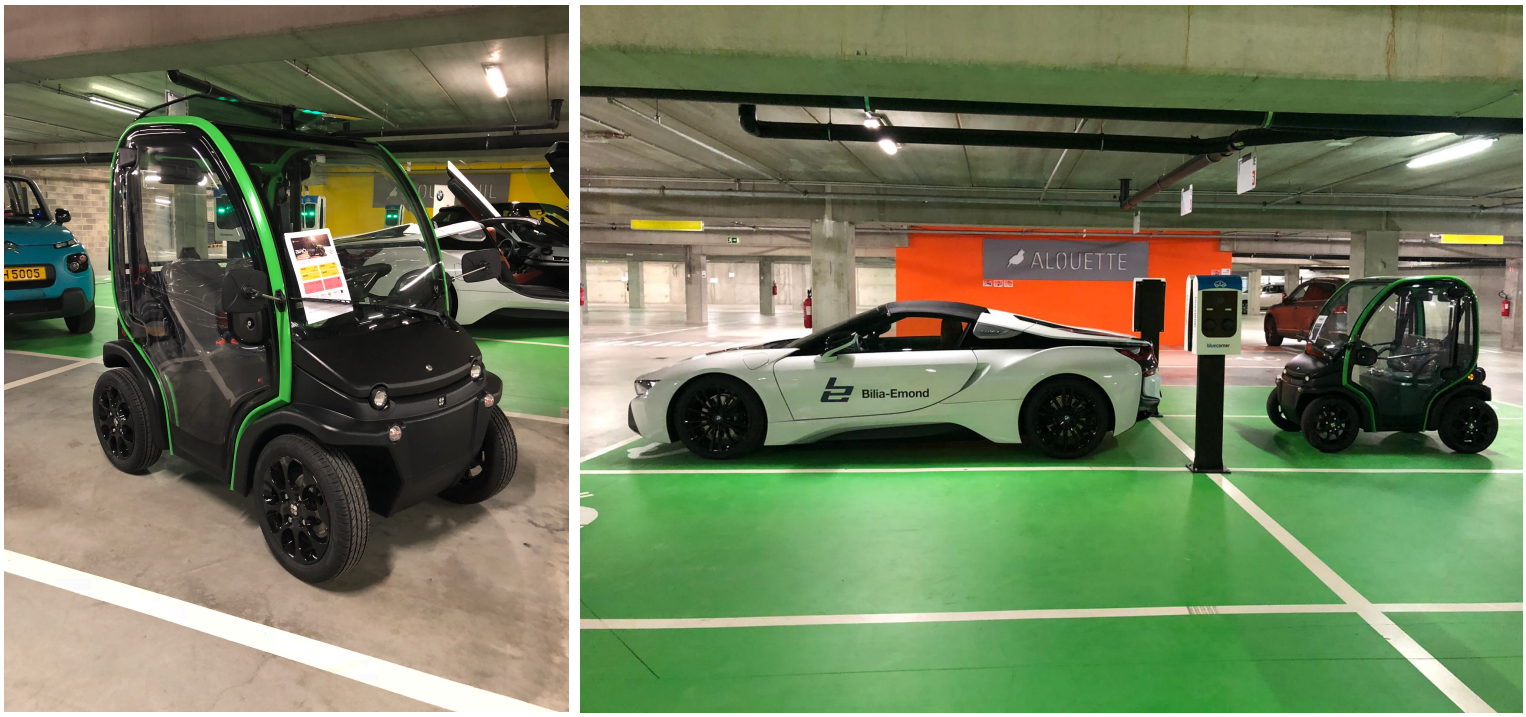


Figure 4.36 The Birò perfectly in line with the Contern Campus and contrasting the presence of the massive i8 hybrid supercar

Third event : Link2fleet forum & awards 2018 – 11th of december 2018

Link2fleet is a very active automotive & mobility media in Luxembourg. It is mainly visible and useful for B2B connections, but also visible for interested clients that want to know the latest news and innovations on the mobility in Luxembourg.

They published an article on our product the month before, as seen on the picture 4.37 and we had interesting feedbacks afterwards, that is why we decided to participate to the event of december and to participate also to the pitching competition with our project.

COMMERCIALISATION DE LA BIRO À LUXEMBOURG

Quand l'électrification fait renaître les Microcars

Alors que les besoins en termes de mobilité se font de plus en plus grands, le phénomène des microcars, né dans les années 50 avec la BMW Isetta, semble renaître grâce à l'émergence des motorisations électriques. Le meilleur exemple de cette nouvelle tendance semble être la Microlino (quadricycle lourd pouvant atteindre 90 km/h avec une autonomie pouvant aller jusque 200 km). Développée par les suisses de Micro Mobility Solutions et construite par Tazzari, cette microcar, renaissance électrique de l'Isetta justement, aurait déjà fait l'objet de 8000 précommandes, alors qu'elle est vendue 13.000 euros. D'autres modèles apparaissent comme la Unity One (Suède) ou encore la Biro (Italie).

C'est justement ce modèle, la Biro, que la société Oxom Mobility & Lifestyle a décidé de commercialiser à Luxembourg. Cette société, dont la vocation est de proposer des solutions de mobilité urbaine innovantes et faciles à utiliser, a été créée par les 2 frères Drescher. Côme est en train de terminer ses études en Ingénierie automobile à Turin alors qu'Andreas est un consultant en stratégies, passionné de mobilité urbaine. Ils connaissent bien ce modèle puisque leur famille utilise une Biro de première génération depuis 7 ans.

Ce modèle quadricycle présente la particularité de consommer beaucoup moins que les véhicules électriques traditionnels et peut se recharger à la maison sur des prises classiques. Vu son faible encombrement, le véhicule peut être garé perpendiculairement (3 à 4 véhicules sur une place de parking). Sa cabine est fermée, mais les portes peuvent être enlevées.

Ce modèle urbain devrait être commercialisé à des prix oscillant entre 10.980 et 12.980 euros HT (batterie comprise) et sera disponible dans 99 coloris. La société Oxom Mobility & Lifestyle projette de le commercialiser à travers un concessionnaire classique, mais aussi via des pop-up stores installés en ville. Dans un second temps, le véhicule sera commandable via internet sur le site www.biroluxembourg.lu.

La maintenance sera assurée chez un concessionnaire dont le nom sera révélé prochainement. Trois véhicules circulent déjà à Luxembourg et 10 nouveaux véhicules devraient être immatriculés prochainement. Ce véhicule, destiné notamment aux sociétés qui connaissent des problèmes de places de parking, devrait également, selon les distributeurs luxembourgeois, pouvoir être proposé en leasing d'ici la fin de l'année. link2fleet devrait avoir l'opportunité de le tester prochainement.

Caractéristiques de la Biro

- Homologation Quadricycle léger (permis de conduire à partir de 16 ans)
- Puissance maximum : 4 kW
- Autonomie : 80 km pour la batterie fixe (50 km pour la batterie mobile)
- Vitesse max : 45 km/h (60km/h pour une 2e version commercialisée en 2019)
- Temps de charge : entre 3 et 6 heures

AUTEUR Laurent GOUVERNEUR

Figure 4.37 October/November article on the Birò from Link2fleet Luxembourg

Figure 4.38 Exhibition stand with the Birò Box at the Link2fleet awards dec. 2018

The first part of the event was concentrated on the presentation of the different companies participating with a stand and exhibition space during a sort of « networking cocktail ».

After that, the pitching session started with 9 mobility startups being part of the competition :

- Birò Luxembourg (Oxom Mobility & Lifestyle)
- Movesion – Software for sustainable mobility
- Flex – Car sharing
- Maestromobile – Mobility as a service
- Mileswap – The future of car swap
- Moovee – Fleet management services
- Motion S – Optimizing corporate mobility
- Troty – Electric scooter sharing
- UFO drive – Rent of high standard electric cars

The time available for presenting the project was only 3 minutes and afterwards the public had the possibility to vote for the Mobility Startup of the year 2018.
As seen on the picture 4.39, we arrived second, just before Ufo Drive being a well established startup in Luxembourg. The result was very satisfying and permitted to discuss with very important decisioners like the Purchasing department of the Post company, the procurement director of cargolux (industrial site for the airport), the mobility manager of the home service company called Help, with a vehicle fleet of around 500 vehicles.

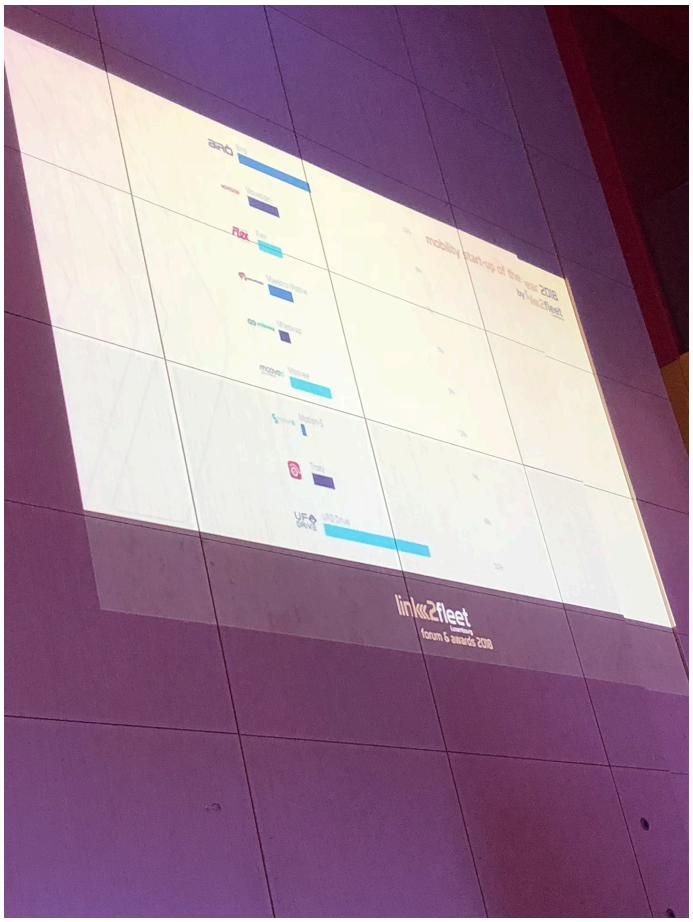


Figure 4.39 Pitching session with the results of the competition on the left. The results were presented during the awards diner on the evening.

Fourth event : Mobility event at the Chamber of Commerce in Köln

It is worth explaining that during the Link2fleet event, we met a German expert on Mobility which was really interested in presenting the product in Germany and especially in Köln since the configuration of the city is very similar to the one of Amsterdam, with very narrow streets for cars and very few parking spots being thus very expensive.

Moreover in Germany, depending on the region we are, the government incentive for electric vehicles is very different and can be very interesting like for example in the region of Munich where the incentive is the highest (until 4000€ for an electric car).

Even if the event was not in Luxembourg, it was interesting to present the product out of the borders in order to understand what are the feedbacks from other countries like Germany and what are the differences between the mobility subjects in Luxembourg.

As it can be seen on the picture 4.40, two Birò were exposed at the entrance of the Chamber of Commerce and test drives were possible for the public in order to discover the vehicles. After that, a very interesting conference on Mobility was presented and a project of car sharing in small cities around Köln was also presented.

Figure 4.40 Birò exposed at the entrance of the Chamber of Commerce in Köln

Figure 4.41 Director of the Chamber of Commerce in Köln testing the vehicle

The interested potential clients were mainly from different universities campus or from car sharing projects of the region.
Our contact in Köln is in charge for the follow up and is transmitting all the requests to the main office in Luxembourg. For example, after the event a leasing offer was sent to a car sharing project manager who would like to use the Birò as a test for a public car sharing project. The last step right now is to check with the Estrima mother company if their OTA black box could be inserted inside the vehicle, so that the latter could be connected directly to the German sharing platform.

Figure 4.42 In the middle our contact in Köln for the Birò distribution

Fifth event : Springbreak event at Luxexpo – 14-17th of March 2019

This last event is very different from the previous ones since they were mainly focused on the B2B market. Instead, the springbreak is organized for the B2C market and is not focusing on a single subject.
The interesting aspect is that they created an E-mobility village inside the event, permitting the mobility actors to gather in the same hall, having also available a testing track inside to permit the different distributors to present their products to the final clients.

Knowing that this year the fair attracted more than **35 000 people for the 4 days**, representing more or less **6% of the total population** in Luxembourg, it was a great opportunity to add visibility to the product and the testing track was a useful tool to attract potential clients and to permit them to test the product directly.

The testing session was a very useful tool in order to collect information on the potential clients because they were obliged to register by writing their personal information in a table and to sign for agreement. It was calculated on average a collection of **70 contacts per day**, permitting afterward to send (still respecting privacy rules) invitations to special events or fairs, or to send news on the product, and special offers to the most interested customers.

A view of the stand and of the Birò next to the testing track are presented in the following pictures :

Figure 4.43 From left to right, the Birò Box, the registering desk for the testing track and the Birò Winter with the Re-movable battery

Figure 4.44 The Birò on the testing track with the autonomous bus from Sales Lentz which can be observed on the background

As a conclusion of this fair, it was very interesting to present the product to the final clients as a sort of second launch with a massive interest on the testing track with people making photos, sharing photos and experience on the social media.

For the corporate world, few contacts were obtained but without a direct impact for the moment.
The other interesting point was the presentation of the product to the Prime minister and to Henri of Luxembourg, which found the vehicle quite interesting and funny.

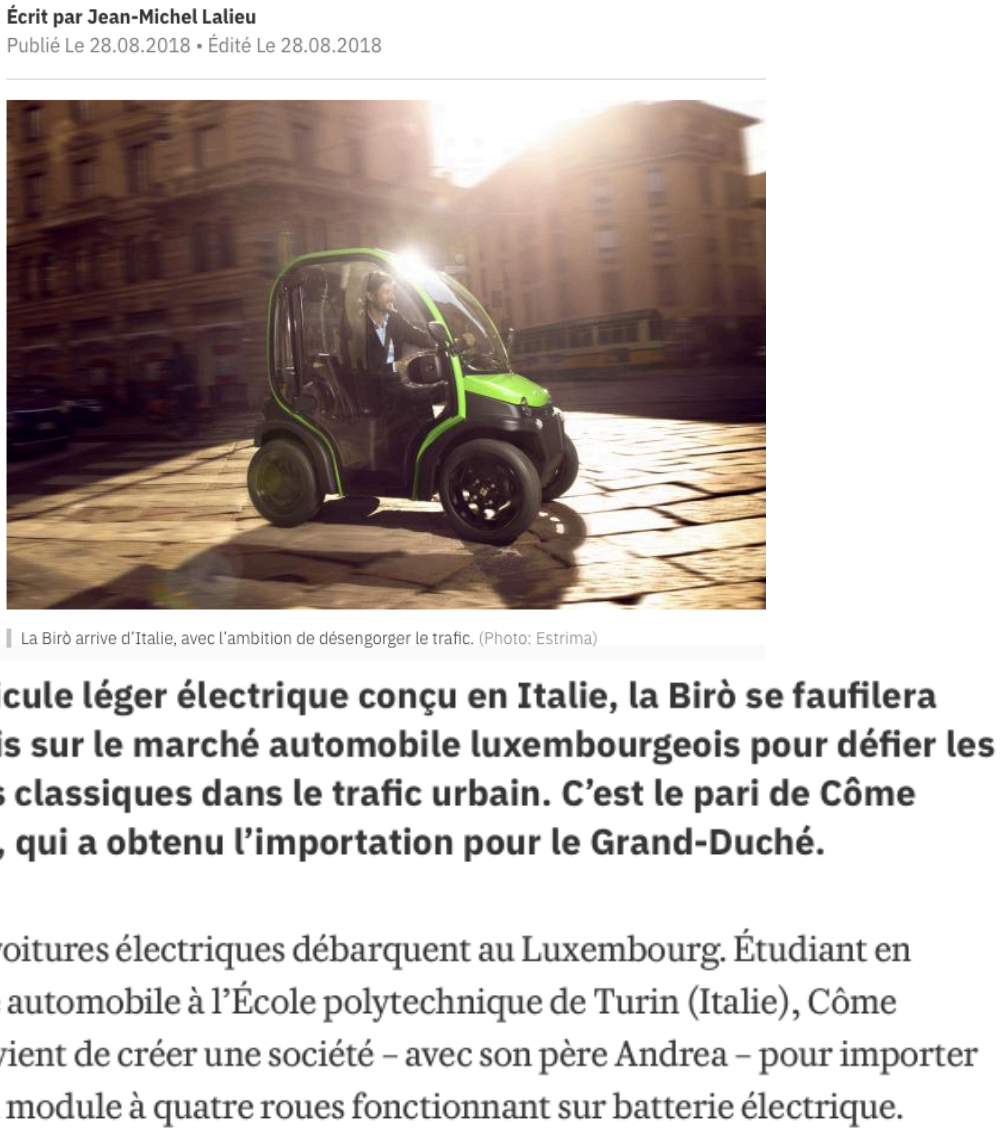
Figure 4.45 End of the fair, last day of presentation

Other very important tools for the promotion of the product are the media and the press articles.

Some of the articles are free since some media in particular wanted to write an article on the innovative product around a specific subject but after that, in most of the cases a certain initial investment is always required to present the concept and the product on carefully selected magazines, news paper, or on the web.

Paperjam

The first article having a great impact on the business was the article from the Paperjam written by the journalist Jean-Michel Lalieu and published on the web. They actually contacted us and asked for a phone interview in order to obtain preliminary informations on the project.
Afterwards they asked us to send detailed information on the product with prices and characteristics in order to write the article.
A screenshot of the article is presented in the following figure :



Écrit par Jean-Michel Lalieu
Publié Le 28.08.2018 • Édité Le 28.08.2018

La Birò arrive d'Italie, avec l'ambition de désengorger le trafic. (Photo: Estrima)

Mini-véhicule léger électrique conçu en Italie, la Birò se faufilera désormais sur le marché automobile luxembourgeois pour défier les véhicules classiques dans le trafic urbain. C'est le pari de Côme Drescher, qui a obtenu l'importation pour le Grand-Duché.

Les mini-voitures électriques débarquent au Luxembourg. Étudiant en ingénierie automobile à l'École polytechnique de Turin (Italie), Côme Drescher vient de créer une société – avec son père Andrea – pour importer la Birò, un module à quatre roues fonctionnant sur batterie électrique.

Figure 4.46 First article of the Paperjam on the Birò project

After observing the positive impact of this article on the business, it was decided to enter the Paperjam Club in order to access to networking events or to conferences and to gain visibility on their website.

The advantage being the choice of a subscribing package in line with the expectations for the business development and the access to strategic events permitting to build a proper network and ecosystem.

Speaking with the marketing department, the publication of further articles on the Paperjam are too expensive and also the sponsorship of dedicated events is way too expensive.
In the future the idea is to publish articles in collaboration with bigger car dealers having available a higher budget for marketing and promotion.

Link2fleet

After publishing the first article with the paperjam, the company was contacted by the Link2fleet team asking to organize a meeting in order to speak about an article in their magazine of October-November where electric quadricycles were introduced for the Gran Duchy. A photo of the article was previously presented in the figure 4.37.

We had the honor to meet Laurent Gouverneur being the country manager, which is currently working for the huge car importer called Losch (mainly VW, Audi and Skoda) and having created the new e-mobility department of the company as seen on the picture 4.47. Oxom Mobility is currently working on a possible collaboration with Losch for the smart mobility in Luxembourg.

Figure 4.47 The new E-mobility store of Losch Luxembourg

After the article written by Link2fleet, it was decided as presented previously to participate to the awards event of December. The overall feedback was very positive in terms of qualified contact information.

Infogreen

Infogreen is a media in Luxembourg completely focused on the green and sustainable subjects.
It is very similar to the Paperjam since it organizes events for its members, and the big advantage is that the publication of articles on their website and on their social media is free. The annual fee for startups is quite affordable and it is worth to be a partner because one have access to all the other partners personal information being thus part of the sustainable world in Luxembourg.

The most dynamic social tool they have is Linkedin since they have around 26 000 followers, thus permitting a great visibility.

The link for the Birò Luxembourg personal page on Infogreen is the following : https://www.infogreen.lu/biro-luxembourg.html

Since the partnership has been signed 2 months ago, it is hard for the moment to make conclusions about the general feedbacks of the partnership.

4.7 Sales contracts

Contract with the mother company

In order to be able to sell the Birò on a specific market, a contract between the mother company Estrima and the distributor Oxom Mobility & Lifestyle must be established.

Due to pure confidential information, it will not be possible to show it since the margin on the product and other confidential agreements previously negociated are present inside. But it is interesting to speak about specific points.

With Estrima there are two different types of contracts for distributing the product :

- The contract of distribution as a simple **dealer**
- The exclusive distribution contract for a specific territory as an **importer**

The general rule is that a dealer generally sells the product directly to the final client and the importer generally try to build a distribution network and sells the product to subdistributors accurately selected. Notice that the importer can directly sell vehicles to the final client at the beginning, because it is always hard to find a distributor taking the risk of selling the product without seeing the vehicle circulating in the streets, because before selling there will be a job of promotion in order to present the product on the market.

For the two cases there will be a minimum order volume to follow at the beginning in order to sign the contract. But the big difference is that afterwards with the dealer contract, one is free to choose the quantity and the date to order without having any conditions to respect in terms of volume, while with the importer contract a minimum volume of sales must be maintained every year with the contract revised annually. Of course the margin on the product is much higher for the importer and it will have the sales exclusivity for all the territory.

There are cases where one importer can have a client who wants to buy the product but lives in the country where another importer has an exclusivity contract. The decision of who is selling the product to the client is up to the local importer, and generally a fee of sale is given to the local importer who will accept the deal.

Practical example : Oxom Mobility had the example with a Luxembourgish client who decided to buy the Birò for his daughter living in Amsterdam, but there was an importer for all the Netherlands. Oxom Mobility called Birò Nederland in order to negociate on what to do and it was decided that Oxom was selling the product to the client and the company had to pay a fee (previously defined) to the dutch importer. For the warranty and the maintenance, Birò Nederland is taking care about the client based in Amsterdam.

Contract with the final client

After signing a purchase order and paying an invoice of generally 25%, the client will have to wait for the vehicle to be produced or prepared.

In case the vehicle requested is in the stock, then the client wait only few days for the registration to be done.
On the other hand if the vehicle needs to be produced, the **order lead time** is generally **two months** in order to have margin for delivery times after production. An optimistic time of production is usually **one month** from the day of a placed order (usually of at least 5 cars) but due to peaks of production during busy periods, the lead time can increase by 3 weeks, leaving only one week to the distributor to registrate and prepare the vehicle for the final client.

At the moment of the order, the client will pay an invoice of 25% after signing the purchase order, meaning that he agrees the sale contract inside it.

The sale contract will mainly specify the characteristics of the vehicle ordered, the delivery times conditions, the warranties and the penalities in case of non respect from both sides of the stated contract.
For questions of confidentiality, the sales contract will not be presented in the Thesis.

4.8 Business plan

In this chapter, it will be explained by using not sensible numbers, why the import and the distribution of the Birò is a business and how to safely start it, keeping tight control on the expenses.

First of all, when opening a startup the important point before reaching the break even point is to minimize the fixed costs in a strategic way and to maximize the cash flow. The problem is to find the suitable trade off because by trying to maximize the cash flow, the fixed costs have the tendency to increase and so the difficulty is to avoid the costs to increase in a fast way.

It was decided before to sign an exclusivity contract, to minimize the fixed costs and also the variable ones.
The advantage is that the variable costs are adjusted later, based on the volume of sales, so that the risk of financial losses is eleminated. In the future if the market is perfectly known and the volumes are constantly increasing, more risky decisions will be taken into consideration.

Strategies to control the fixed and variable costs

Distribution and maintenance spots.
While starting, the ideal way to sell was to open a concept store in the city center of Luxembourg with some vehicles inside and a renting service in order to promote the Rent to Buy solution.
But in Luxembourg the prices for a concept store in the city center (even if the shop size is not more than 40m2) is way too expensive and in a new market like this one, the risk was too high. Looking at the experience of previous importers and actual distributors, it

was decided to avoid having a store to rent and to maintain in the city center but to sign contracts with big car dealers having the necessity to be innovative and ready to exhibit and distribute the Birò.

For the beginning, the maintenance was outsourced to authorized garages in the country (3 in Luxembourg city, one in Belval in the south and one in Mersch in the north) and an on-site maintenance service was put in place.

A minimum stock of 14 vehicles was ordered so that the first clients could be satisfied and the next ones had the possibility to choose a vehicle from the stock with proper discounts and without waiting the lead time of 2 months on average.
The colours were chosen refering to statistical data collected by other experienced dealers from Birò in other countries and adapting the choice to our market.

At the beginning since the main distributors did not want to take the risk to buy the vehicle to present it to the final clients, the idea was to place in exhibition a vehicle from the stock in each distribution spot, to present it, and then to pay a direct fee to the dealer, previously aggred on a contract, for each vehicle sold.

Marketing and communication.
For the first year the idea was to invest an initial budget of 10 000€ for the marketing and communication, participating to targeted fairs, working with media in order to publish articles and organizing some events in collaboration with other startups in line with our business.

For the next years, the budget will be reajusted, based on the volume of sales and based on the experience and the return on investment from certain fairs.

A very dynamic and easy marketing are the social media since photos of the vehicles can be presented, fairs participations can be announced and potential clients can be sourced.

Wages and salaries.
For the first two years, if the sales volume are not the one expected (2018 and 2019) it was decided to not pay any salary to the two co-founders and since for the first years the company decided to not hire people, the fixed costs are kept to the minimum.
In case some aspects of the project can not be covered by one of the 2 founders, then the solution of outsourcing is prefered.
From the year 2020 if the sales volume permits to hire someone, then a commercial profile will be hired.

Mecanical profiles are not needed since the maintenance is completely outsourced to authorized garages and dealers workshops.

It is worth to know that the variable costs will be completely correlated to the volume of sales.

As an initial investment for the stock, it was decided to invest 150 000€ and it was not difficult for us to find funding sources since the project is attractive, the idea is innovative and the product answer directly to a huge mobility and parking problem.

In Luxembourg the purchasing power is very high since the country offers the fifth best buying power in the world according to Luxinnovation, Luxembourg times and Delano.
That is why launching on the market an italian niche product being electric and answering to the main mobility problems with limited fixed and variable costs, is a project with a very low risk.

In the business plan the base case scenario and the worst case scenario were evaluated. Unfortunately the figures can not be presented due to confidential reasons but the different points evaluated for each scenario are the following :

Wages based on :

- Andrea Drescher (Co-founder) owning 70% of the company shares
- Côme Drescher (Co-founder) owning 30% of the company shares
- Sales and marketing (from 2020)
- Maintenance in case the insourcing was interesting (from 2020)
- Adminstrative (from 2021)
- Accounting and tax services (Since 2018) being **Cogito Services in Luxembourg**

Total expenses based on :

- Office rent
- Maintenance spot & storage – Actually the storage space is paid monthly to **Streff** having a storage space in Aubange. Each vehicle corresponds to one pallet, and so each pallet has a monthly price and it is needed to add the insurance costs for each pallet.
- Wages introduced previously
- Marketing and promotion budget
- Accounting & tax returns
- Purchase costs for the vehicles (taking into account the margin)
- Transportation costs
- Costs of spare parts orders
- Costs of the outsourced maintenance
- Office equipment

Total revenues based on :

- Revenues Birò Winter
- Revenues Birò Big
- Revenues Birò Box
- Revenues maintenance services
- Revenues spare parts

Based on the previous data, the EBITDA (Earning before interest, taxes, depreciation and amortization) could be calculated.

Concerning the base case scenario, following values of EBITDA from 2018 to 2022 were calculated :

Year	2018	2019	2020	2021	2022
EBITDA	2125 €	32 110 €	93 605 €	150 675 €	189 375 €

Instead if we consider the worst case scenario, we obtain the following values :

Year	2018	2019	2020	2021	2022
EBITDA	2125 €	22 398 €	57 983 €	48 958 €	86 635 €

Notice that the underlying data (to build the previous tables for each scenario) are the following :

- Cumulated unit sold
- Revenues from the spare parts per car and per year
- Cost of spare parts per car and per year
- Total costs of spare parts
- Revenues from spare parts
- Cost per hour of maintenance being 70€
- Maintenance hours per car and per year being fixed at 4 hours for the first 5 years
- Maintenance hours in total per year
- Revenues from the maintenance
- Cost of the outsourced maintenance
- Hours of an FTE (full time equivalent) per year
- FTE maintenance workload percentage being 0.82% for 2018, 5.95% for 2019, 13.13% for 2020, 24.41% for 2021 and 37.95% for 2022.

As a summary, looking at the EBITDA it can be understood that the business is profitable and this is mainly due to the fixed and variable costs maintained at a low level and the maintenance work being outsourced with revenues concentrated on the spare parts sales.

Moreover since the end of the first half of 2019, it was decided to launch the renting service in order to boost the sales by inserting vehicles in the city center. This is an additional revenue (**renting service margin**) to be inserted in the business plan, all the costs related to the renting service being covered by the intermediate actor taking care of the vehicles fleet.

Conclusion

As a conclusion, we can see that due to the traffic problems in the Gran Duchy and the development of companies having an urgent need to solve parking problems, the Birò was an efficient answer to those problems with a positive feedback from the clients.
Anyway the most important way to success in the distribution project was to create an efficient ecosystem of actors and a good maintenance service in order to satisfy the client in an efficient way.

Even if the results were anyway positive in Luxembourg, the idea was to increase the portofoglio of activities, not restricting the main activity to the sales but also to the develop a market for the renting activity in order to decrease the risk of elevated stock.
An interesting renting option is the rent to buy one since at the end of the renting period, if the client wants to buy a vehicle, the rent bill is deduced from the total price of the vehicle.

Moreover, since the Luxembourg alone is a micromarket with respect to other markets like France, Belgium or Germany, it was decided to open new markets like for example Germany with an intermediary person who is in contact with the corporate clients.
He mainly focus on Köln but the idea is to expand to other cities of the North Rhine-Westphalia region. In Germany the interesting market is the car sharing one, and so the discussions are on process with small cities having low efficiency of the public transports.

Another interesting market was the south of France since an old importer was present, he decided to close the shops after 4 years of activity in order to change the activity and a small community of clients needed some maintenance services and a personnalized assistance.
It was decided to sign a contract with a first distributor in Menton called « Greenlines SAS » in order to distribute the product in all the region of the South of France. The Monaco market is a very interesting niche market since the government incentive for the Birò is equal to 3000€ which represents 30% of the vehicle total price.
It was also decided to offer a rent service in the region in order to attract also during the summer season the tourism market and not only the local one.

As a new market for the company, there is Paris since the contract of exclusivity ended this year for the previous importer. This third market is much more complicated since it is a big market with around 2 millions of inhabitants.
Having a dealer shop in Paris is way too expensive, and so the idea was to begin with a collaboration with other shops in order to offer a renting service to potential clients.
The problem when offering a renting service in a big city like Paris, is the very high risk of damages for the vehicles with then very expensive insurance contracts.
It was decided at the beginning to start with renting services for the students on the universities campus and then with some experience, to grow in a strategic way without taking high risks.

As a conclusion, the Project Birò Luxembourg is having a great success for the moment and is growing slowly every day, answering to mobility and environmental issues that are developing in European cities and which need to be solved in a strategic and structured way, which means with an overall change of habits of the population, a real awareness on those issues and an alliance of all the eco-sustainable actors fighting for the same objectives.

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