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Promotion & Dissemination Projects

Electric **C**ity **Tra**nsport – Ele.C.Tra

D.6.5 Feasibility Study for Lisbon

Project Co-funded by the Intelligent Energy Europe Programme of the European Union

01 July 2013 – 31 December 2015

Work Package 6	POST-OPERAM
Task:	Feasibility study fulfilment
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Electric **C**ity **Tra**nsport – Ele.C.Tra.

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1. SHORT OVERVIEW OF THE STATE OF THE ART

1.1. Introduction

The city of Lisbon has been playing an important role by its commitment and determination, due to its investment in electric mobility, namely in its municipality fleet, mobility plans' actions, participations and association in several studies about clean and more efficient electric transport.

1.2. Network charging

The charging e-network in Lisbon (as in rest of Portugal) is based on an universal and open-access platform that was developed at a national level as a pilot experience to promote sustainable mobility by MOBI.E.

MOBI.E is an integrated charging system for electric vehicles, based on a development of the system started in 2008 with the research and groundwork for both the software and the hardware required for the MOBI.E deployment. For that purpose, a large partnership was created including public R&D Institutions, private technological companies and energy suppliers.

MOBI.E was designed to be implemented in a "system of systems approach", thus overcoming the lack of interconnection between different systems, regardless of their location.

To use the system, a pre-paid MOBI.E Card is required. With this card it is possible to charge a car battery with electricity, supplied by any retailer at any charging station of the system.

The MOBI.E system also enables integrating other services, such as tolling, parking, public transportation, or car sharing. This means that the MOBI.E Card can be used as a payment card for most of mobility issues.

Through the Mobility Intelligence Center (MIC), MOBI.E integrates all the information flows among the users and all the companies involved, acting as a Clearing House. This solution reduces transaction costs and avoids duplication of systems.

MOBI.E is an integrated and fully interoperable system that can include all energy retailers, charging stations operators and automakers. Any operator can join the system and invest in charging stations, adding up to the initial infrastructure.

MOBI.E is designed as an integrator of systems; therefore it is possible to connect and integrate different initiatives in different locations, in Portugal, or in other countries.

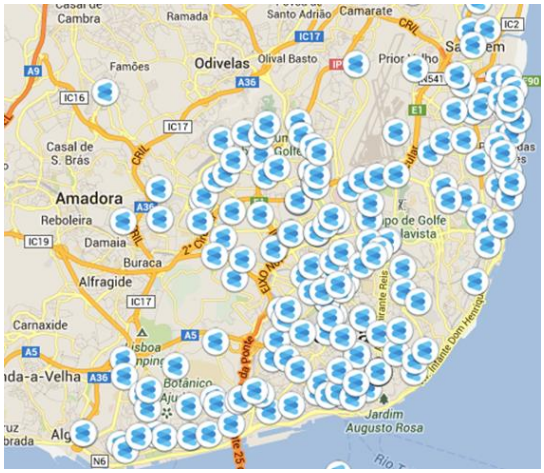
The MOBI.E network is more than a set of charging stations. The technology also includes a payment system (covering different mobility transactions such as parking or

tolling) and provides other services to users, namely identification and selection of charging stations, planning of routes and getting information about the charging level of the vehicles. This means that at any moment, using their personal computers, tablets or smartphones, the users are able to select the most appropriate charging station or analyze their own mobility bill, among other operations.

The major limit to further use and development of the MOBI.E network is related to the fact that the number of electric cars in Portugal is low, thus the system is under-utilized and is not generating revenues to recover the investment costs.

MOBI.E proposes an open business model that can be applied in different locations, incorporating all the operators willing to participate (e.g. energy retailers, charging stations operators) and ensuring interconnectivity among different systems. Therefore there are no significant technological barriers to its implementation.

The MOBI.E charging network is in operation. When concluded, the pilot network will have 1,300 normal charging points (charging a battery fully in 6-8 hours) in 25 municipalities and 50 quick charging points (charging a battery at 80% in 15-20 minutes), located in the most important motorways.



The first charging point was installed in June 2010 in Lisbon. Currently there are about 500 charging stations in Lisbon and a total network of 700 stations is foreseen, in the future.

On the MOBI.E site (www.mobie.pt) the drivers can search for the location of all the e-stations, through an interactive map that contains all the relevant characteristics of each station.

The major barrier to application results from the potential number of users. Considering that electric mobility is not (at least so far) a mainstream option, the economic and financial sustainability of the model will be at risk if the number of users is too low.

1.3. Lack of Parking Places

The other issue is connected to the lack of available places for parking the electric vehicles. The lack of parking places in Lisbon encourages conventional vehicles' drivers to park in the reserved places. Police can fine the offender only if there is a vertical sign that forbids conventional vehicles to park. EMEL, the municipality parking management company, has less than 5% of electric parking places (most of them are usually occupied by conventional cars), being very hard to park an electric vehicle in the city centre.

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1.4. Electric Mobility Stakeholders

There is an electric mobility network of entities that is very committed in the dissemination of electric mobility, namely non-profit associations, providers, media or social networks. APVE (Portuguese Electric Vehicle Association), Veículos Eléctricos Magazine (a bimestrial magazine – six issues a year) are examples of the most relevant active stakeholders.

In terms of e-light vehicles providers, Lisbon has three physical options: Zeev, Zevtech and Ecocritério.

Lisbon is the first European city to have 100% electric taxis operating. For now, it's still an experience, with two Renault Fluence ZE and a Nissan Leaf, being used in real conditions. This test is done through a protocol signed with Autocoop and the City of Lisbon. Besides the environmental factor, the reduced running costs were decisive for the largest cooperative of Lisbon taxis wanting to test the 100% electric cars.

The city of Lisbon is also a member of EUROCITIES and ENERGYCITIES EU Networks.

1.5. Climate Change Performance Index (CCPII)

Portugal is very committed to focusing on electric mobility, and was considered, in 2013, the third best country in the world in what concerns climate policy, in accordance with the Climate Change Performance Index (CCPI).

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2. SWOT ANALYSIS OF THE INTRODUCTION OF ELECTRA MODEL

In order to better understand the potential of Electra Model, a SWOT analysis was carried out, helping to point out the Strengths, Weaknesses, Opportunities and Threats.

Strengths	Weaknesses
✓ Charging network built about 1,200 slow charging points and 9 points of fast loading managed by three companies, all over the country ✓ Interoperability in all referred charging stations ✓ high percentage of green electricity (more than 62%) in Portugal ✓ No emissions and noiseless vehicles ✓ Use of 2 wheel vehicles on the restricted city space in a more efficient way ✓ Lower maintenance costs ✓ Electric vehicles users witness their good experience ✓ Legal framework encouragement of electric mobility in terms of business conditions and financial incentives ✓ Strong willingness to try electric vehicles as reported on Ele.C.Tra survey.	✓ Discouragement of pioneers investments due to economic instability ✓ High level of investment, without a long term analysis of long term benefits ✓ People's low income ✓ Excessive politicization of electric mobility, leading to a lack of consistent policies for the promotion of EV ✓ Low price of oil ✓ The battery's reduced autonomy ✓ Lack of EV experience ✓ Misinformed people as far as electric vehicles are concerned ✓ Lack of familiarity in sharing systems ✓ Driving 2 wheels vehicles in Lisbon is considered unsafe by most potential users.
Opportunities	Threats
✓ Paris COP21 country wide agreement ✓ Funding EU grants for green mobility ✓ Continuous development and innovation ✓ Increase of 2 wheels use ✓ Improvement of a fashion eco-image by companies that adopt electric mobility as an attitude very well accepted by the clients ✓ Increasing of renewable energy ✓ Autonomy suitable to most of the trips ✓ Reducing dependence on imported fossil fuels ✓ Improving Lisbon air quality ✓ Prone legal framework with incentives and taxes reduce and exemptions ✓ Easy access in an eco-vehicle to the Lisbon hills to access its beautiful panoramic views	✓ Reluctance to change mentalities: from car to scooter, from property to sharing and from conventional to electric ✓ Continuing economic crises and political instability ✓ Development of a very efficient combustion eco-friendly vehicle ✓ Development of other zero emissions technology (such as hydrogen) ✓ Petrol lower price makes ICE more desirable ✓ Petrol industry lobby with very influence in the markets ✓ Lack of compatibility among different vehicles manufacturers and energy providers that could disturb the effectiveness of the technology

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2.1. SCOOTER SHARING SYSTEM

There are no scooter sharing systems in Lisbon. In terms of sharing systems, the Municipality launched a tender for a bicycle third generation in 2008. During the negotiation only one bidder (JCDecaux) remained but due to budget unavailability the tender didn't come to an end. An international tender for a sharing system with 1400 bicycles and 140 station was just launched, being expected that it becomes operational in the summer of 2016.

As far as a car sharing is concerned (with conventional vehicles), Mobsharing was one of the pioneers. The system was launched in 2008 but it didn't survive due to the economic crisis and finished its services in June 2015. (http://mobcarsharing.pt/pt/default.aspx). Nowadays there are others car sharing operators (doing the first steps) that are available on a web platform that integrates them all (www.mobiag.com). The car sharing operators under Mobiag platform are:

- **playcar** (**www.playcar.net**)
- **Citydrive** (**www.citydrive.pt**)
- **Formula Zero**
- **Hertz Portugal** (**www.hertz.pt**)
- **ACP** (**www.carsharing.acp.pt**)
- **AEIST** (**carsharing.aeist.pt**)

2.2. PRIVATE OWNERS OF E-LIGHT VEHICLES

In terms of electric fleet there aren't any official figures updated, but in 2013 the total electric vehicles in Portugal was about 2010 vehicles, with the following breakdown:

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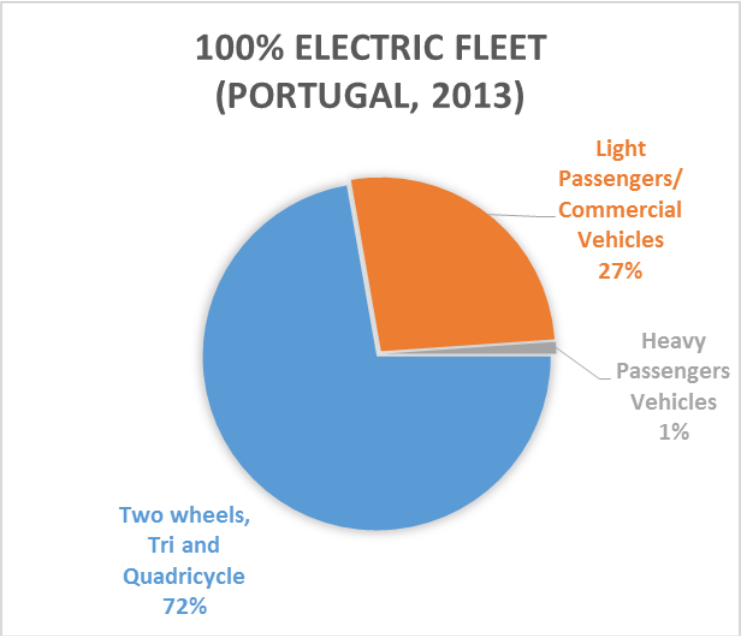

On January 2015, with the aim of improving electric sales, Portuguese government has readopted the Green Tax Legislation (it was suspended in 2011), with the following objectives:

- To increase taxation on pollution and resource degradation in order to decrease taxation on labour and families' income.
- Reduce external energy dependency. Induce more sustainable production and consumption patterns, strengthening the freedom and responsibility of citizens and companies.
- Promote the efficient use of resources, especially water, energy and materials.
- Foster entrepreneurship and job creation. Diversify sources of income, in a context of neutrality of the tax system and economic competitiveness.

The practical measures are:

- People who changed their 10 years old car or more will receive a subsidy of 4500€; Some vehicle providers add to this value another subsidy (Nissan, for example, added 4500€);
- Tax Exemption over the vehicle (ISV) for the buying of a new electric car.
- Exempt of tax of Circulation,

Scooters and motorcycles are not covered, showing the irrelevance of this kind of vehicles to the legislator and the weakness of the 2 wheels' lobbying group.

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2.3. BUSINESS OWNERS OF E-LIGHT VEHICLES

Business owners have the same advantages as the private ones, while adding some benefits only for companies, such as:

- VAT reclaiming;
- Exempt of autonomous taxation;
- Higher values about deductibility of depreciation costs.

In 2015, the more appealing green legislation gives companies more advantages to consider in their fleet's electric vehicles. Leaseplan (the market leader in Portugal for car and fleet rental) concludes on a recent report that with this new legislation the total cost of ownership of electric vehicles could have an impact of -12% especially due to 100% of VAT reclaiming.

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3. GUIDELINES FOR THE INTRODUCTION OF ELECTRA MODEL

Electra Model has several components that should be considered in order to better understand the concept. In this line, the Electra Model could be divided in four major areas:

1. Stakeholders involvement

The success of the Electra Model transferability depends on how enlightened and responsive is the community in what concerns electric innovative mobility. It's very important to increase the willingness to change mentalities and to make more understandable all pros (and cons) of this innovative concept. In order to settle this issue, Electra Model has foreseen an invitation to a written commitment of all stakeholders through a signed Memorandum of Understanding. To ease this task, a template of this MoU that was signed by all partners' stakeholders is part of the Electra Kit.

E-mobility issues have been discussed in every partners' countries with face-to-face meetings to get a deeper understanding of the current situation of the market and to catch different points of view in order to foresight the problems thus facilitating the implementation of the Electra Model. These two-ways meetings were very fruitful not only to disseminate the project but also to be more diligent in addressing the problems.

2. Documentation

During the project all partners produced several deliverables, containing very useful information to understand the differences and the similarities of the partners' cities. This deliverables are part of the Electra Kit in order to get a global view to this matter with different solutions and useful information.

3. Ele.C.Tra Kit

All the conclusions are written in a document in the Electra kit. This could be very useful to skip steps in order to achieve the goals. All the documentation are in the project website www.electraproject.eu.

4. Sharing Scooter System / rental system Implementation

In what concerns the sharing scooter system implementation in Lisbon, there are some important variables that we have to take into account. We could divide them in four: Driver, Environment, Climate and System.

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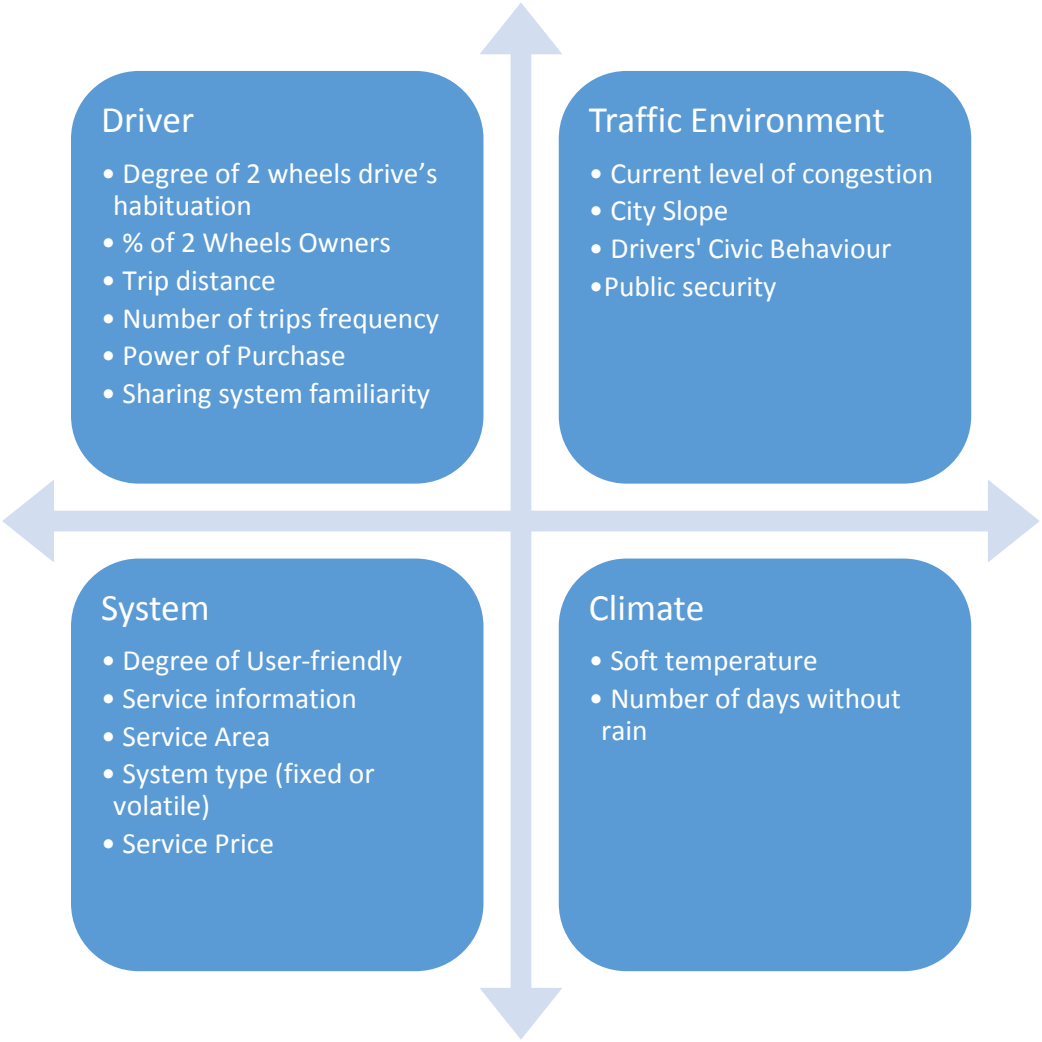

Scooter sharing system in Lisbon will be discussed in Chapters 4.1 and 5.

3.1. POLITICAL AND LEGISLATIVE SUPPORT

Legal framework in several levels (European, national and local) is increasingly providing better conditions for electric mobility, as expressed in the following, recent and important legislative and political documents and measures:

<u>European level</u>

- **Directive 2014/94/EU — deploying the EU's alternative fuels infrastructure**

  The European outlook approved the Directive 2014/94 / EU of the European Parliament and of the Council of 22 October 2014 establishing an infrastructure for alternative fuels which

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provides, inter alia, the obligation of states members to define goals for the number of public accessible charging points, to ensure that electric vehicles may move easily in urban and suburban environments, until December 31, 2020.

National Level

Portugal is one of the pioneers in the implementation of electric mobility. A Resolution of the Council of Ministers, No. 20/2009 of 20 February, created a Program for Electric Mobility in Portugal, which aimed at introducing electric vehicles and subsequently facilitating its mass adoption. In turn, Decree-Law 39/2010 of 26 April, regulated the organization, access and performance of electric mobility activities and proceeded to the establishment of an electric mobility network pilot phase.

- **Decreto-Lei 90/2014, de 11 de junho,**

  Through the approval of Decree-Law 90/2014 of 11 June, a change in the electric mobility strategy was implemented, focusing on its model and enhancing the demand and use by citizens, businesses and Public Administration, namely:

  - ✓ Evolution of the loading paradigm of vehicles and operating activity of charging points to a regime of free competition.
  - ✓ Focus on the charging of electric vehicles in dwellings, condominiums and businesses. Implementation of positive discrimination mechanisms, in particular local authorities.
  - ✓ Tax exemption on the purchase of electric vehicles, tax incentives, end of life programmes for older passenger car, VAT deduction on electric or hybrid passenger cars.
  - ✓ Technological development and updating of the network's charging points.
  - ✓ Technological evolution of batteries and expected growth in energy density and price reduction in the medium term.
  - ✓ Introduction of new services, such as integrated intelligent charging with micro or own energy and decentralized management, car sharing and bike sharing.

- **Despacho 8809/2015 - Action Plan for Electric Mobility**

  The fulfilment of the Action Plan for Electric Mobility will help Portugal achieve four main national objectives:

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- ✓ Increase the effectiveness and efficiency of the national transport system, with the aim of achieving the goals proposed in terms of CO reduction (index 2), and consequent reduction of the negative impacts on climate change;
- ✓ Reduction of the external energy dependency of Portugal with regard to imported fossil fuels;
- ✓ Internationalization, competitiveness and modernization of Portuguese industry;
- ✓ Stimulation of civil society in promoting smart mobility, well-being and quality of life.

City Level

In the city of Lisbon there are some positive measures for electric vehicles such as free parking for electric vehicles in EMEL parks (not under concession). In June of 2015, EMEL has assigned 305 green labels.

The MOBI.E network is still on a pilot phase; therefore all public charging is for free. In fact it should have finished but the lack of clients with electric vehicles resulted in an extension of the free phase.

3.2. CONSTRAINTS FOR THE DEVELOPMENT OF THE ELE.C.TRA MODEL

1. **Unfamiliarity with Electric Vehicles**
   One of the most important issues is the fact that the majority of people never used an electric vehicle. In an Electra survey, 88% of the residents never had that experience. Only 12% affirm that they used (or have already used), an electric vehicle but only 3.3% drive an EV on a daily basis. This is the big constraint as many people didn't try the benefits and the good feeling of driving an EV. Nevertheless, people have a strong interest in testing or even buying an electric vehicle (65% of people interviewed).

2. **Distrustful about electric mobility**

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Lisbon has a wide electric charging network but with very few utilization because the evolution of EV sales didn't match the expected evolution. There is no effective maintenance and more and more charging stations are getting broken, giving the impression that electric mobility has not been a good business. This leads to a general idea that electric mobility didn't result and people become distrustful as far as electric matters are concerned.

3. **Excessive politicization of electric mobility**
   Electric mobility is connected to an excessive politicization; this fact was very harmful for its implementation. The alternating political power (left and right parties in the government) and the consequent indifference for supporting the good legacy, had a bad impact in electric mobility.

4. **Unfamiliarity about sharing systems**
   In what respects sharing systems, the public is not very familiar with this kind of attitude preferring to own vehicle. In the past there were car sharing systems that didn't work because people were not prepared to adopt sharing systems.

5. **No need to change**
   Lisbon has a good public transport system and a good road network infrastructure that allows people to use their own car in an inefficient way (with the majority of private cars circulating with the driver only), without major problems. These aspects do not induce the need to change behaviours in order to improve the efficiency of space consumer (and the consequent reduction of trips delay), as the need to use 2 wheels instead of a car.

6. **Safety driving issues**
   Circulating in Lisbon in two wheels is an experience that could be a hard experience as car drivers do no respect this type of exposed way of driving. There is a general belief that driving a two wheels vehicle is a very unsafe way to drive. To get it worse tram rails on the pavement increase the risk of skidding, especially in rainy days.

7. **Misinformation about electric vehicles**
   Electric mobility suffers because of very destructive opinions of bad informed people or some companies linked to oil industry (with a great and efficient lobby) that are not interested that clients stop supporting their business.

8. **Batteries autonomy issue**
   This issue is not a problem for the great majority of daily trips but conventional vehicles have great flexibility in this matter. However electric vehicles need a different approach every time that you have to do a trip. You have to plan your trip taking in consideration the charging level of batteries. The conclusion of this restriction is that if you want to buy an electric vehicle you have to have a "safe harbour" to charge it. If you don't have it then you

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should think about sharing one. Nowadays, a restricted battery autonomy, raises a dilemma to electric mobility: at one side you have to make many mileage to compensate the first investment and, on the other side, you don't have batteries with a wide range. The conclusion is that the more suitable pattern trips for electric vehicles are many short trips. In this line, Lisbon is a good city because it has a great potential in terms of citizens; however batteries autonomy for electric vehicles owners could be an issue because the majority don't have a place to charge them and trips distance is long enough to force a frequent charging. In this point, it could be a good argument to implement a sharing system, sensitizing the users to those issues.

3.3. POSSIBLE SOLUTIONS FOR THE CRITICAL ISSUES

1. **Unfamiliarity with Electric Vehicles**

   The very first action that has to be done is to get the right information and to give it to all people in what respects the benefits of electric mobility. Actions related to EV test drives are very useful to bring people to electric mobility. This is one of the reasons for Ele.C.Tra project. According to the Sustainable mobility program for Public Administration 2015-2020 (July 2015), the Portuguese government is going to include a fleet of more than 1200 electric vehicles during the next 5 years. That`s a good example of electric mobility dissemination.

2. **Distrustfulness about electric mobility**

   In order to regain the consciousness of the benefits and feasibility of massive electric mobility, the MOBI.E pilot project has to be finished (in this period drivers can do free charging in mobi.e stations) and the future business model for electric mobility has to be decided. Lisbon (and Portugal) have already the infrastructure, whose inexistence was before one of the barriers for electric mobility.

3. **Excessive politicization of electric mobility**

   The benefits of electric mobility should stand out for all parties and become more technical. Users have to be confident that incentive policies cannot change every changing legislature. The Portuguese Association of Electric Vehicles and the Portuguese Association of Electric users could help pressuring entities to raise political pressure in order to ensure a consistent and stable legal and fiscal frame.

4. **Unfamiliarity with sharing systems**

   People are not aware of the benefits of sharing systems. It is more common to have a car instead of a scooter even if the costs are too high and the use is too low. The implementation of an efficient sharing system so that people get acquainted with all the procedures: use options for different profile users, booking, payment, take off and put on and other specific procedure. In this line, before having a scooter sharing system, Lisbon needs to have a

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bicycle sharing system because it is cheaper and more overarching, with more vehicles and stations, allowing more people to try it.
Other cheaper but more efficient options are the campaigns and advertising projects for the benefits of these sharing systems as Electra project did.

5. **No need to change**
The shift to a more efficient transport mode has to be forced not only with positive measures (fiscal incentives, special permission to access some prohibited city area, parking and tolls exemption, etc.) but also with negative measures for car users, especially when they have alternative transport mode, causing less congestion. Pedestrian zones in the city gaining space from cars and some recent prohibition for more polluted cars to circulate in the city centre are examples of what can be done in this matter.

6. **Safety driving issues**
At one side safety of 2 wheels driving is a strong constraint because it does not depend on the driver but on the traffic behaviour. U-scoot, an Ele.C.Tra project stakeholder, deals with a 2 wheels driver side in order to give practical classes on safety driving. At the other side, civic traffic behaviour is based on educational aspects so there should be more advertising and campaigns in order that people get more conscious about the driver's behaviour. It is a more long-term measure but it could be introduced in the first school years.

7. **Misinformation about electric vehicles**
The Association of Electric Vehicles Users (one of Electra project' stakeholders) is essential to clarify the citizens' doubts about electric mobility and raise awareness to the benefits of the shift to green mobility. Projects like Ele.C.tra are very important to help this type of association in order to spread all the news and actions promoting electric mobility.

8. **Batteries autonomy issue**
Technological advances in batteries lifetime and autonomy are evident and allow to predict that it is a question of time. It is expected that, in 2020 small EV models will have a range of 100 to 200km, mid class models 300-500 and high and luxury ones more than 500km. It is a question of time.

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4. SYNTHESIS OF THE POTENTIAL USERS' NEEDS

According to the Electra survey and other information collected, we can conclude that:

- ✓ Lisbon residents are very interested in electric mobility (65% of the interviewed). So they need to have available stores and exhibitions always with test drives in order to show the benefits of electric vehicles;
- ✓ Incentives to make electric vehicles competitive against conventional ones;
- ✓ Information and campaigns about sharing systems benefits, trying to avoid the buying of a second car and to clarify all doubts of potential adopters;
- ✓ Improve e-charging stations (low maintenance has led to an abandoned look that should be reverted).
- ✓ More consistent policies on electric mobility in order to gain confident from potential users.

4.1. SCOOTER SHARING SYSTEM

There are few scooter sharing systems in the world. Scoot in San Francisco (USA), Motit in Barcelona, and eMio in Berlin: another one is now giving its first steps as Sharen'go in Florence but with Light EVs (quadricycles).

Electric Sharing Systems in the world

Scoot – São Francisco
(Oct 2012; 50 Scooters)
(Aug 2015; 400 Scooters)

Motit – Barcelona
(Sep 2013; 75 Scooters ->275?)

motit

eMio – Berlin
(Jun 2015; 4 Scooters)
Aug 2015; 150 Scooters)

This few successful systems show that they are not suitable in all cities and it's not easy to implement systems with these characteristics.

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- ✓ In terms of a survey outcome, a large majority of people– 88% – **never used an electric vehicle.** So citizens need a large campaign to explain what electric mobility is and to clarify a lot of doubts.
- ✓ The strong interest (65% of people interviewed) in testing or eventually buying an electric vehicle are potentially good perspectives for shifting to electric mobility. They should be given opportunities to make test-drives.
- ✓ Faced with different solutions for using an EV, people tend to consider that full ownership is the best option (43%), while leasing is found to be the second best solution (23%). Nevertheless, sharing systems is mentioned by 11%. Soft measures could be campaigns to show how do they work, but an implementation of a bike sharing system should be a very fruitful action to help people, in a practical way, to understand sharing systems (with less costs and a more comprehensive system than a scooter one).
- ✓ Taking in consideration the surveys people need to have financial incentives motivating them to buy electric vehicles with discounts or exemption on local taxes (both mentioned by 45% of interviewees).

4.2. PRIVATE OWNERS OF E-LIGHT VEHICLES

The Light Vehicles fleet in Lisbon was estimated to be around **73 thousand units**, in 2012, according to the last available data published by ACAP, the National Association of Vehicle Retailers and Wholesalers (Associação Automóvel de Portugal). There is no official data referring to the existing fleet of LEV, but informal estimates suggest that electric vehicles will represent less than 2% of total motorcycles, in the Lisbon District. There is a great potential for optimizing the city space for mobility.

The recent legislation considers fiscal incentives for electric cars buyers (4500€ for those who shed a 10 or more years old vehicle) and also the tax exemption over the vehicle and for circulation. This measure should be extensive to 2 wheels electric vehicles. In terms of local incentives, the parking in Lisbon for EV is free but we could go further, for example:

- ✓ Financial and fiscal incentives for the implementation of equipment for home charging (it's very important that people have a safe harbour for charging);
- ✓ Real maintenance for actual public charging network (reliability);
- ✓ Some open restricted areas like bus corridors or some specific urban areas (non-polluting VIP persons);

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- ✓ free tolling (it's a very popular and a good marketing for companies with a low financial impact taking in consideration the very few EV that are now circulating);

4.3. BUSINESS OWNERS OF E-LIGHT VEHICLES

Adding to private owners' incentives the legislation considers the exemption of VAT and autonomous taxation. Higher values about deductibility of depreciations cost and a high coefficient to consider a higher value for the costs of electricity deducted from profits.

Some incentives to promote fleet renewal are already in place, towards electric mobility. A total amount of 60.000 euros was available to distribute among ANTRAL and FPT (the two taxi associations operating in Lisbon) in order to support the acquisition of 20 new electric taxis, which will replace old internal combustion engine vehicles, being European standard equal or inferior to Euro 3.

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5. POSSIBLE BUSINESS MODELS FOR THE IMPLEMENTATION OF ELECTRA

Taking in consideration the pros and cons (including the experience of pilot cities in Ele.C.tra project), we conclude that Lisbon is not prepared to implement an electric scooter sharing system. The main reasons are:

- ✓ Car drivers are not yet accustomed to have 2 wheels in the traffic. It is a matter of culture, civic, or other psychologic issues but 2 wheels drivers don`t feel safe in the traffic mix.
- ✓ The city pavement and the tram tracks make 2 wheels driving unsafe especially for people that are not used to drive in the city
- ✓ Citizens are not familiar with sharing systems. Knowing that Lisbon Municipality is launching a bidder for a public sharing system of e-bikes it is wiser to understand the impact of the system before implementing an e-scooter sharing system.

We also have an increase of tourists in the city and we need a quick solution for an own round trip; a renting electric system could solve this problem in a proper way.

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6. ECONOMIC AND FINANCIAL ASPECTS OF THE MODEL

General concept

The more suitable system in Lisbon in this stage is the short term rental scooters and quadricycles more focused on tourists. Due to its conditions (monuments, location, beautiful views, climate, etc.) Lisbon has been a very popular tourist destination, still with a great potential to grow.

Start-up costs

The first significant expenses to open the business are linked with the vehicles purchase, office, business license, site and marketing.

Office Space

Considering the type of clients, the business area where customers can go should be in the more visited areas (Belem or downtown). A big area is not necessary but it should be very appealing to tourists to have a front space to park the vehicles.

The cost of the vehicles to rent will be the biggest initial expenses in the rental business. It was considered that the space remodelling cost will be 4000€ (with all the equipment) and the rent price will be 700€/month.

Vehicles

The cost of vehicles you plan to rent will be the biggest initial expense in the rental business.

Taking in consideration the economic crisis at this moment, the financial model considers 20 quadricycles to rent with a gradual improvement of the system during the next 5 years.

The quadricycle chosen is the Renault Twizy, with an autonomy of 100 km. The price is about 7200€ (considering the commercial discount of 10%), with a monthly additional cost for battery rent of 50€.

Maintenance

Electric vehicles don't need too much maintenance costs due to their simple construction and lesser complexity when compared to conventional vehicles. This analysis includes a percentage of the investment that grows along the five years (5%, 7%, 9%, 11% and 13%).

Other assumptions

We considered that, in average terms, 80% of the fleet are rented during 200 days per year with 60 km/h. Although the official autonomy is 100Km we consider 80Km; the electricity cost is 0.15€/Kw and the rent price per day is 50€ (similar to prices that are on the market).

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Taking all the assumptions we could conclude that the breakeven (without considering the vehicles residual values) will be reached in 4 years.

Values in €$_{2015}$	Year 1	Year 2	Year 3	Year 4	Year 5
Office Space, licence	12400	8400	8400	8400	8400
Other company costs	6600	6600	6600	6600	6600
Vehicles Investment	144000				
Batteries rent	12000	12000	12000	12000	12000
Maintenance	7200	10080	12960	15840	18720
Electricity	3900	3900	3900	3900	3900
Staff: Manager + 2	56000	70000	70000	70000	70000
Total Costs	**242100**	**110980**	**113860**	**116740**	**119620**

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7. THE APPROPRIATE TECHNOLOGY AND INFRASTRUCTURE

In terms of public infrastructure Lisbon has already the charging stations and network that can complement a rental service that is now proposed. Twenty chargers and parking slots will be necessary to allow for the charging of all vehicles during the night.

The vehicle should be small to circulate without problems in the narrow centre streets but they need to have the power to climb up the hills of the city.

The autonomy should be around 80 km with a maximum speed suitable to circulate in the city.

In order to satisfy these needs the appropriated vehicle to this service is a Twizy (by Renault), with the following characteristics:

- ✓ Maximum speed: 80 Km/h
- ✓ Range: Up to 100km (80 km considerer in this analysis)
- ✓ Power: 13Kw/17cv
- ✓ Maximum torque: 57 Nm
- ✓ Gearbox Type: automatic
- ✓ Braking system; Disc brakes
- ✓ Seats: 2
- ✓ Kerb weight: 474Kg

Other service details

- ✓ The EV rental includes liability insurance but it doesn't include personal accident insurance;

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8. THE IMPACT OF THE SUGGESTED SCENARIOS ON THE ENVIRONMENT

To assess the impact of the project on the environment two scenarios were analyzed:

1. All the trips will be done with a conventional vehicle
2. All the trips will be done with an electric vehicle

In order to have quantitative indicators, the assessment was carried out in terms of emitted CO2 in the two scenarios as this is the most significant anthropogenic greenhouse gas. The analysis was done in terms of well-to-wheels in order to evaluate all the impact and not only the local emissions.

Values of energy consumption, engine efficiency were based on a study "Energy consumption, CO2 emissions and other considerations related to Battery Electric Vehicles. Where necessary values were validated/revised according to Portuguese reality.

CO2 emission impact

- **Electric Vehicle (Well-to-wheels analysis)**

  Well-to-Tank energy efficiency (from the primary energy source to the electrical plug) was 37% and the Tank-to-Wheel was 72% (Lithium batteries), given a well-wheels efficiency factor of 27%. This means that each kWh on the wheels has to have 3.75 kWh on the primary energy source. Knowing that with Portugal energy mix each kWh that is produced is responsible for 122.5 g CO2 (energy provider EDP information), we can conclude that, in Portugal, 331 g CO2 are emitted for 1 Kwh on the tank. Considering that a Twizy needs 16.3 KWh (on the tank) for 100 km that corresponds to 5.4 Kg of CO2/100Km.

- **Conventional Vehicle (Well-to-wheels analysis)**

  In a similar analysis for ICE gasoline vehicle, considering that 83% and 18% of the efficiency well-to-tank and tank-to-wheel, respectively, the result is a global efficiency of 15%.

  Taking in consideration the following assumptions

  - ✓ combustion energy from gasoline is 37 MJ/l;
  - ✓ 1Kwh=3.6MJ ;
  - ✓ 1 litre of gasoline produces around 2.28 Kg CO2[1];

[1] How to develop a sustainable energy action plan (Seap) – Guidebook (Covenant of Mayors);

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- ✓ Ratio between CO2 emissions Well-to-wheel / Tank-to-Wheels = 1.17%[2]

we can conclude that 1 litre of gasoline has 14.6 Kg associated. If we consider that an average consumption of a small car is around 5l/100km, the global emissions are 73 Kg of CO2 (near 13 to 14x the global emission of an EV).

In what concerns rental system, we consider that only 16 vehicles during 200 days/year are ready to use. With an average of 50Km per day, the adoption of an electrical fleet will reduce 108 tCO2 per year.

Other benefits

- **Changing mentalities**

  As time goes and increasing the use of electric mode (considering the positive testimonies from those who did it), people realize the benefits of those vehicles and are more likely to adopt them.

- **Electric vehicles reduce traffic and parking congestions**

  The fact that electric vehicles have to optimize their size and weight due to the autonomy issues, they are more suitable to city trips because they are more manoeuvrable in traffic and can be more easily parked.

  This contributes also to the reduction of traffic and parking congestions.

- **Electric vehicles reduce oil dependency**

  Portugal doesn't have oil production but produces almost all the electricity that it consumes. Adopting electric vehicles will contribute not only to reduce imports but also to the reduction of worldwide oil consumption.

- **Electric vehicles reduce urban pollution**

  Lisbon has a high level of pollution that surpasses levels allowed by European Commission. Restrictive measures were done by the municipality forbidding more polluting cars to access to the centre. Electric vehicles, as zero emissions vehicles, could help in the air quality improvement.

- **Electric vehicles reduce urban noise**

[2] EJRC-2006, European Comission Joint Research Center;

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Road traffic is responsible for the majority of noise in the cities. As Electric vehicles are very silent they contribute significantly to lower the city noise levels in order to improve quality of life for citizens and visitors.

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9. PLANNED ACTIVITIES FOR THE INTRODUCTION OF E-LIGHT VEHICLE SYSTEM

Ele.C.Tra project allows us to cross experiences in different levels of development. That is very helpful for a wide understanding of the most adequate system to implement in our cities. Taking in consideration Lisbon city specific issues, the best solution, in a short term, is a rent-a-LEV (light electric vehicle), focused on tourists' business.

Activities for the success of the electric rental system in Lisbon have to be done in multi steps and fronts:

ACTIVITY 1: Location Choice of the Office Place

- ✓ For this kind of business, the office and store have to be located in a strategic place. Taking in consideration the target it has to be set in a touristic place (in order of preference: Downtown, Belem or Park of Nations);

ACTIVITY 2: Business Information and Partnerships

- ✓ In order to strengthen the system development, it is crucial to inform all the potential stakeholders so that they try to have a business network. In this line, knowing the increasing number of cruisers` tourists, it is very important that tourists might have the opportunity of pre-booking on the internet in order to have vehicles prepared on the harbour at the ship's arrival.
- ✓ There are several tourist agencies that can refer the rental company to their clients with some advantages (publicity on the vehicles or site, percentage of the total amount, etc.)
- ✓ Places to visit with electric free charging could be added to a tourist route as a suggestion to the rental clients (restaurants, monuments, etc.)
- ✓ The e-rental should be put on the net through several channels (including on the Electra project app).
- ✓ The key stakeholders for the ELV system preparation and implementation are:
    - Lisbon Municipality (mobility, urban planning and environmental departments)
    - Lisbon Mobility Agency (EMEL)
    - Lisbon Tourism Association (ATL - Users)
    - Mobi.E (Charging points manager)

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- EDP (Energy provider)
- Portuguese Electric Users Association
- Portuguese Electric Vehicles Association
- Renault and other vehicles providers
- Most Relevant Traffic Generation Poles in Lisbon (General Administration for Cultural Heritage, Universities, Shops, Hotels and restaurants, etc.)
- Local media

ACTIVITY 3: Investment on the fleet (20 vehicles)

- ✓ The hard thing in the business is the investment to buy the fleet. It is very important to understand a way to finance this investment, namely an European project or a sponsor that wants to put advertisements in the cars.

ACTIVITY 4: Business promotion

- ✓ The system sustainability can't survive without a very good promotion of the system and its benefits. Lisbon Municipality is very committed with electric mobility and people are aware of the pollution problems. Vehicle design and the zero emission vehicles should contribute for the fashionability of the system and it should be promoted as an environmental conscientious company.
- ✓ Internet should be one of the most important promotional modes but offices should have a store front impact in order to hold the attention of potential clients;
- ✓ Promote information sessions in schools and universities in order to draw attention to the electric mobility benefits, including test drives to give people the opportunity to drive an electric car.
- ✓ Develop promotional campaigns with offers/discounts for a ride in off-peak hours.

ACTIVITY 5: Guarantee the sustainability of the system

- ✓ The company has to be part of Electric Associations (users and vehicles) so as to guarantee the operability of the charging network and to contribute to boost electric mobility (financial incentives, toll free, BUS corridor access, free restrict areas in the city, among others);

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- ✓ Be aware of European and Portuguese programs in order to catch eventual incentives for the system, namely for fleet renewal.

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