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Promotion & Dissemination Projects

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

D.6.5 Feasibility Study for Zagreb

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

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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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This document includes the main aspects regarding development of Feasibility Study (D.6.5) for all non-pilot cities

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CONTENTS

TERMS OF REFERENCE

Ele.C.Tra project is a project of electric city transport which is realized within the scope of the Intelligent Energy Europe programme (CIP-IEE 2012.).
Project objective is the reduction of CO2 emissions in passenger transport by promoting a new, sustainable model of transport using electric scooters in urban areas. Scooter sharing model will encourage citizens and tourists to use “green” transportation on a daily basis.
Ele.C.Tra project includes 11 partners, representatives of eight EU countries, and pilot actions in three cities - Genoa, Florence and Barcelona, where the use of scooters is frequent. Other participating cities will conduct all preparatory activities which will enable the implementation of such system in the future. Experiences gained through pilot actions will serve as good practice examples for at least 5 European cities, including the City of Zagreb, with the aim of including as many European citizens as possible.

The basic objective of terms of reference is to adapt the Operative Plan of Sustainable Mobility Model Application to Specific Features of the City of Zagreb taking into consideration model calibrations during the pilot implementation of project in Genoa, Barcelona and Florence. The study must contain the general characteristics of model which would be implemented after the completion of project by a private operator, taking into consideration the current state and activities conducted as part of the project.

Materials and documents produced by each of the pilot cities within the scope of work packages 4 and 5 which will be used as input data in conducting the Feasibility Study:

- D.4.4 Operative plan of sustainable mobility model application. Operative Plan is the main tool used by cities in defining:
    - The planned activities - preparatory (prior to pilot testing); activities promoting the pilot project itself and monitoring its implementation (for the duration of pilot project) (WHAT?);
    - Operative actions on the basis of determined needs and issues as well as proposed solutions for each of the pilot cities (HOW?) Contained in D4.1. *Local analysis review report* (identification of pilot cities' features – electric vehicles charging stations, scooter/motorcycle parking lots, legal framework, possibility of integration with the city public transportation) and D.4.3 *Service and product networks* (existing measures promoting the use of electric vehicles)
    - Target groups, for whom the actions are intended (FOR WHOM?);
    - Time limits for the implementation of each of the planned actions (WHEN?);
    - Project partners responsible for particular activities (WHO?).
- D.5.1 Technical monitoring report, aimed at verifying and monitoring progress indicators).

Materials and documents produced by the City of Zagreb within the scope of work packages 2 and 4 which will be used as input data in conducting the Feasibility Study:

- D.2.1. Report on actual mobility and network of the City of Zagreb
- D.4.2. Agreements with relevant stakeholders

The expected results of the feasibility study are clear guidelines for further development of ELE.C.TRA platform through the results of pilot activities in Genoa, Florence and Barcelona, and with the proposal of economically and technically justifiable models which could be applied on the territory of the City of Zagreb with a strong multiplying national and regional factor.

1. SHORT OVERVIEW OF THE CURRENT STATE

1.1. Mobility

With the population of 800,000 people and the surface area of 650 km^2, in terms of transport the City of Zagreb is quite demanding, where various measures need to be taken in order to make travelling the roads as efficient as possible, environmentally acceptable and cheaper and to reduce noise.

The following table displays shares in daily trips in years 2009 and 2012, given the type of transport. The largest share relates to the public transport in the form of trams and buses (around 37 %). Around 30 % of daily trips relates to walking, followed by privately owned cars (around 25%).

Table 0.1. Main traffic characteristics in the City of Zagreb

	2009	2012	2012/2009
Surface area (km^2)	641.29		
Population number	789 000	790 017	1
- Share of population older than 65	17,1%	17,5%	1.02
- Share of population under the age of	14,9%	15,0%	1.01
Car ownership (per 1000 citizens)	418	357	0.85
Average car occupancy	1.37	1.37	1
Daily trips given the type of transport	**%**	**%**	
- Privately owned cars (driver)	24.36	20.5	0.84
- Privately owned cars (passenger)	5.84	4.52	0.77
- Walking	31.44	30.34	0.96
- Bicycle	2.96	4	1.35
- Bus	10.78	15.98	1.85
- Tram	21.56	21.4	0.99
- Train	2.06	2.94	1.13
- Motorcycle	1	0.32	0.32

The share of motorcycles is decreasing and is less than 1 %, while the share of bicycles is significantly increasing and is over 4 %.

Having in mind this data and traffic indicators regarding the number of vehicles on the roads, traffic activity is at its peak in the morning hours when traffic congestion occurs, especially in the city centre, with heavier flow of traffic starting from the bridges over the river Sava and on roads in the direction east-west.

A total of 330 000 motor vehicles (cars, trucks and buses) was registered in the City of Zagreb in 2013. This number was significantly bigger in previous years (over 550 000 in 2008), but due to the global economic crisis, which also affected Croatia, the number of vehicles is on the decrease. Even with this decreased number of vehicles, as was already mentioned, traffic difficulties are significant and it is to be expected that the number of vehicles will once again increase to the level of previous years.

Therefore, the City of Zagreb initiated a number of studies and projects in order to improve the city traffic and to increase its effectiveness. One of them is a study on the construction of the underground metro system (from the year 1999), which hasn't started yet.

Strategic plans and general urban plan promote the concept of increasing the use of public transport to decrease the use of privately owned vehicles.

The objectives of the plan are the following:

- to enhance the system of public transport, with a special emphasis on the railway infrastructure and the establishment of Park & Ride system;
- to automate the traffic management system and to increase permeability;
- to replace in the public transport vehicles using oil for fuel with those using biodiesel or gas;
- to modernise and upgrade the rail hub in the City of Zagreb;
- to increase and modernize the rail fleet;
- to reconstruct the train stations and to increase the P & R capacity;
- to introduce the integrated system of public transport in the City and its neighbouring counties;
- to provide a sufficient number of parking places;
- to improve the cycling traffic.

In order to improve the plans for the development of traffic, a citizen survey was conducted which also analysed the movement habits of the citizens of Zagreb and the results the survey were published in the document D.2.1. Report on Actual mobility and network of the City of Zagreb.

1.2. Infrastructure

1.2.1. Road network

Given its importance, the City is the intersection of all important national and international roads, which causes significant tourist traffic, especially in the summer months. It also causes a large number of accidents and air pollution. The population of the City is also on the increase, which results in the increase of transport needs. In accordance with that, traffic infrastructure has grown, but it still doesn't correlate with the increase of traffic. In 2008, the total length of road network in the City of Zagreb was 775 kilometres.

1.2.2. Trams

Tram traffic is the basic type of public transport in Zagreb and it includes 116 kilometre long tracks, 193 trams, 256 tram stations and 15 daily lines. According to data from 2008, trams annually transport around 204 million passengers. Therefore, investments in the tram infrastructure are significant and in 2010 142 new trams were bought. Apart from being more comfortable, the most important novelty of the new

low floor trams is that they are able to generate power during braking, which is then returned into the power grid.

1.2.3. Bus traffic

The bus network has a crucial role in connecting the surrounding areas of the city with the tram network. The use of buses is wide-spread and the price is cheap. The bus fleet consists of 430 vehicles running on 132 bus lines. Buses annually transport around 94,000,000 million passengers. The expansion of the bus network is limited by the network of main roads and the topology of the city. In recent years investments were made to improve the bus fleet and replace the use of oil as motor fuel with biodiesel and natural gas. Another positive step forward was an education for drivers on the eco-driving, which resulted in drivers spending around 6% less fuel.

1.2.4. Suburban railway

Suburban railway connects the eastern, western and southern parts of the city. Suburban railway lines share the railroad track used for intercity lines and the 15 minute frequency is good, but it applies only to a smaller number of lines.

1.2.5. Cycling network

In 2014, the network of cycling paths and lanes was 260 km long, but some parts are not yet connected. Since city is situated mainly on the level ground, the potential for the development of the network is excellent. Public bicycle system is also implemented and contributes to the increase in the use of this transportation mode.

2. SWOT ANALYSIS FOR THE IMPLEMENTATION OF ELE.C.TRA MODEL IN ZAGREB

2.1. *Scooter sharing* system

As part of the Ele.C.Tra project, a survey on 300 citizens of Zagreb was conducted in order to determine the current limitation and potential uses of implementing the sharing of electric scooters, that is, of the concept of using light electric vehicles by private and business users. As main limitations of the entire concept, most surveyed citizens mentioned the problem of charging electric vehicles and the lack of general knowledge and information. On the other hand, as the main benefits of the potential implementation, surveyed citizens mentioned lower emission of greenhouse gases and lower fuel costs.

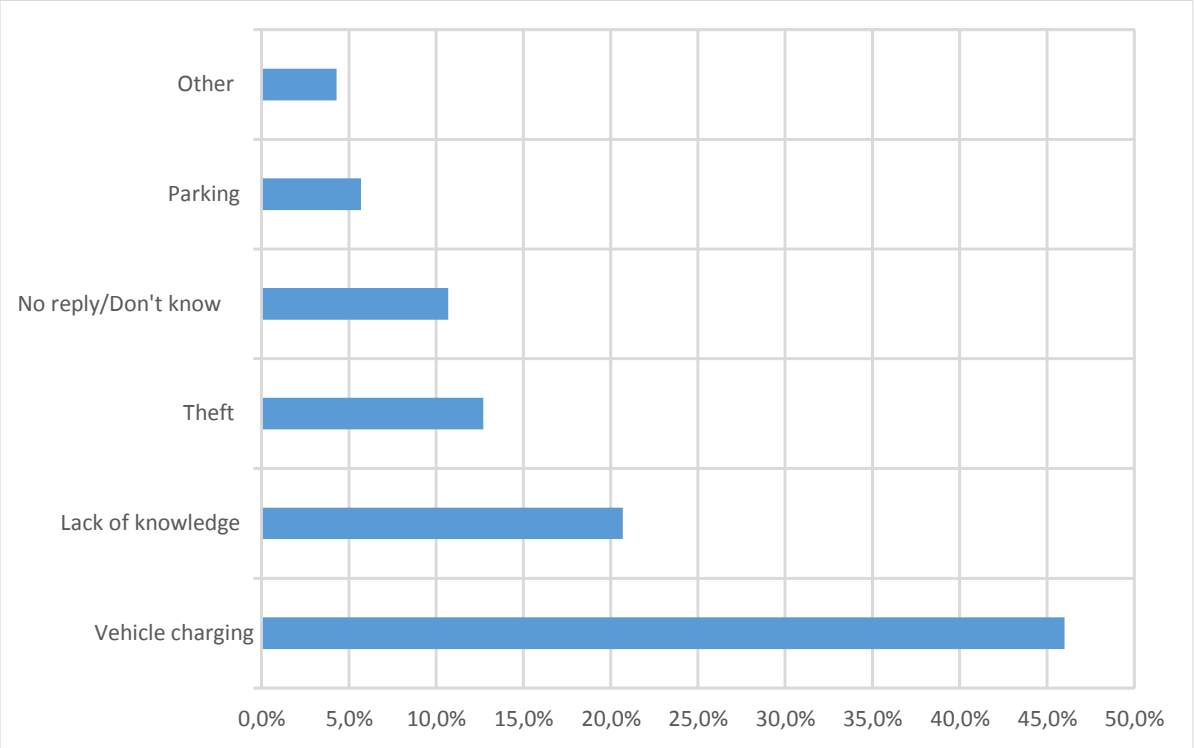


Figure 0.1. Limitations of the Ele.C.Tra concept implementation according to the survey

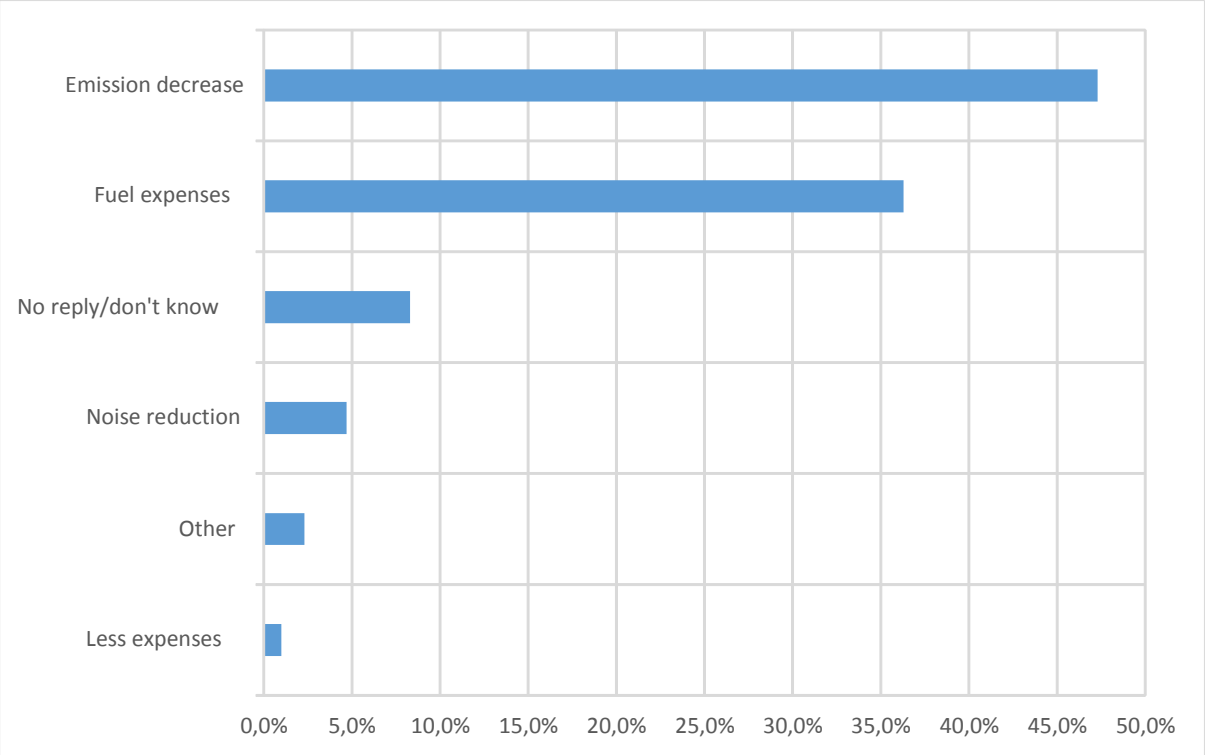


Figure 0.2. Benefits of the Ele.C.Tra concept implementation according to the survey

Following figure displays the main characteristics of the SWOT analysis of the potential implementation of the sharing of electric scooters in the City of Zagreb (straights, weaknesses, opportunities, threats).

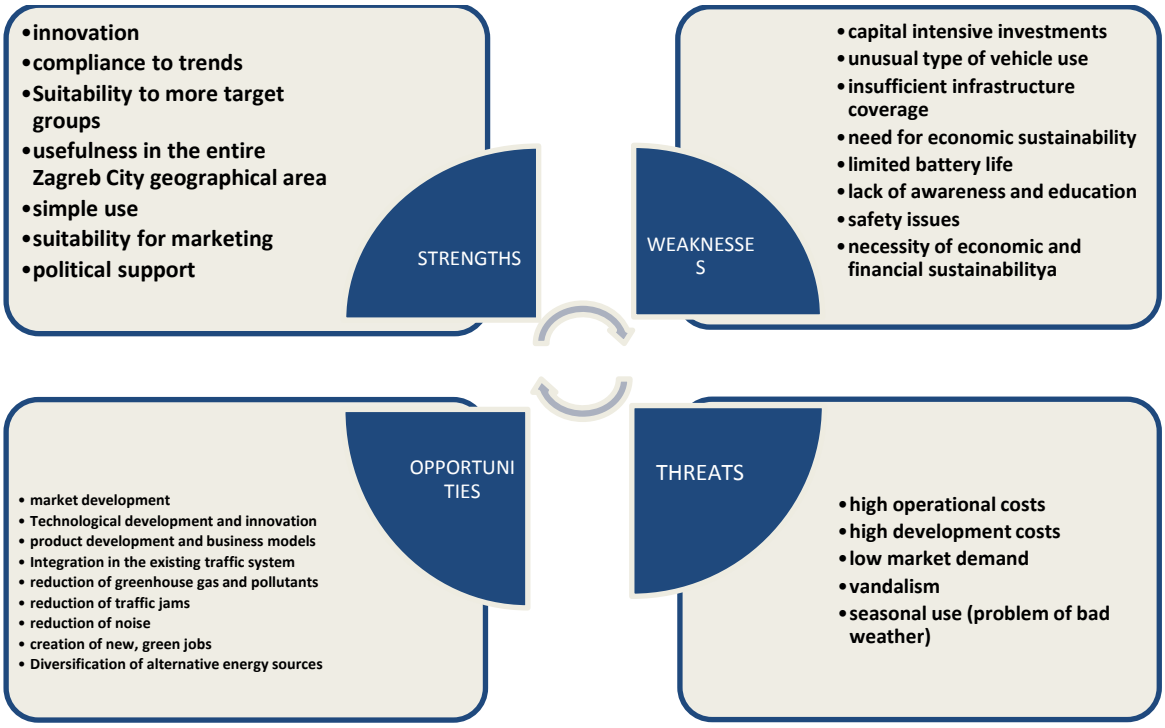


Figure 0.3. SWOT analysis of electric scooter sharing

2.2. Private owners of electric vehicles

For the purpose of popularising the concept of electric mobility, and with the purpose of increasing the number of private users and owners of light electric vehicles, the City of Zagreb can act through different monetary and non-monetary incentives.

The City of Zagreb can introduce an obligation that, in accordance with a given standard, all new buildings or residential objects contain a charging station for electric vehicles, while urban planning regulations can be used to influence where and how many charging stations can be installed in a given area. That is the key measure that can be used to influence the availability of charging stations in the future. Similar simplifications and acceleration of the permit issuance process is something the city can use to make the installation of the charging stations and the rest of the energy infrastructure easier and cheaper.

The City of Zagreb can also advocate that relevant organizations define adequate standards that will be applicable to local network conditions and to introduce them in the construction procedures in the shortest possible time.

As a rule, the city has two available models that it can use to actively participate in the development of infrastructure. The first one is full and partial ownership in the company which will be responsible for the development, investments and operation of the charging stations network. The second model is related to the legal involvement of the city in the regulatory framework that can be used to define compensation for the power supply services for electric vehicles. In that sense, it is justifiable to establish a department, work group or similar, on the municipal level, that will be responsible for the operative coordination of activities connected with the development of infrastructure for electric vehicles on the territory of the city.

The city could get involved independently in the construction of infrastructure for electric vehicles charging stations at street parking lots and public car parks or it could lease required area to the private sector that would, therefore, be responsible for the development of charging stations network, their management and maintenance. This model of public-private partnership is known as a concession, where the city grants a concession to private subjects for the entire area of the city or just some parts of it.

Additional strength of the city is the possible popularization of the electric vehicles through very strong public relations. By deciding to support the use of electric vehicles, which also means supporting consistent policy, Zagreb is in the position to gain huge positive and almost free publicity in the wider public.

Direct financial incentives for the procurement of electric vehicles could represent a problem for the local government, given the limitations and the policy regarding the management of fiscal resources. However, in cooperation with the central government and relevant institutions, local government could provide required resources for reducing the initial cost for the procurement of electric vehicle.

Given the limited fiscal flexibility, the city could offer a range of non-monetary measures, such as access to locations with limited movement possibilities.

2.3. Business owners of electric vehicles

In terms of integration of light electric vehicles in the business environment of larger companies, Ele.C.Tra model certainly has the foundation and potential for implementation.

The examples of good practice point to the fact that companies with larger fleets of vehicles play a key role in the initial popularization of new technologies in traffic, which generally relates to vehicles powered by alternative power systems and alternative fuels. Of course, electric vehicles are no exception.

Apart from participating though its political decisions, the city can also participate in the popularization of electric vehicles by example, that is, by replacing a part of its own vehicle fleet by electric vehicles. In that way (if it would be revealed as economically justified), a certain level of popularization would be achieved within the companies in the City of Zagreb. A facilitating element could be the fact that procurement of electric vehicles and the construction of required infrastructure could de facto be treated as a separate project in applying it for financing by the Environmental Protection and Energy Efficiency Fund.

3. STARTING DETERMINANTS FOR THE IMPLEMENTATION OF ELE.C.TRA MODEL IN ZAGREB

Innovation and research policy in the traffic sector significantly and consistently supports the development and introduction of new technologies that are required in order to develop a modern and efficient user-friendly system in the traffic systems of European cities. Introduction novelties is crucial for sustainable mobility and for achieving objectives of the European Union in terms of reducing pollutant traffic emissions.

Implementation smart technologies, such as the establishment of electric scooter sharing system, is the main factor that ultimately generates positive effect on the mobility of people, sustainability of the local traffic system, pollution reduction and economic growth.

Scooter sharing was already recognized as an organizational measure in some city centres at the European level (e.g. Barcelona) and is also being implemented in urban environments for the purpose of increasing energetic efficiency, decreasing traffic congestion, reducing exhaust gas and pollutants emissions in the environment and contributing to the sustainable development of cities.

3.1. Political and legislative support for implementing scooter sharing system

Traffic Development Strategy of the Republic of Croatia for the period form 2014 to 2030 as main priorities of the urban mobility sector, recognizes the introduction of integrated traffic systems with the application of measures for the increase of transport means with zero emissions of pollutants. In this context, the scooter sharing system fits in well, which will, as a system under discussion, be based on the use of technology of electric scooters.

Third National Energy Efficiency Action Plan of the Republic of Croatia for the Period from 2014 to 2016 clearly recognizes that traffic congestions are an increasing problem in cities, given that they lead to needless increase of fuel consumption and that is why sustainable development of urban transport systems should be promoted. According to the plan, citizens of urban areas will be provided with alternative mobility solutions that will have a direct positive impact on the needless usage of fossil fuels, reduction of environmental burden and on the overall increase of the citizens' quality of life. The introduction of the car sharing system and the support for the development of bicycle sharing infrastructure have been recognized as organizational measures, but the measure of introducing e-scooter sharing system certainly fits in well as another means to achieve these goals.

In 2014, in order to encourage cleaner traffic system in Croatia and to reduce air pollution, The Ministry of Environmental and Nature Protection and the Environmental Protection and Energy Efficiency Fund have initiated a joint project entitled "**Drive Economically**". The project is used to award grants to citizens and companies for the purchase of electric and hybrid cars, as well as electric scooters, motorcycles and quads.

The value of incentives depends on the type of vehicle, and those that are relevant and can be used for the scooter sharing system implementation program are the following:

- for the purchase of the L1-category vehicles (two-wheeled electric motor vehicles with engine swept volume ≤ 50 cm3, or electric motors with the maximum continuous rated power ≤ 4 kW and speed ≤ 50 km/h - including scooters, Segway ...) it is possible to obtain up to 7,500 00 HRK
- for the purchase of the L3-category vehicles (electric motorcycles with design speed of over 50 km/h) it is possible to obtain up to 10,000.00 HRK.
- for the purchase of the L6-category vehicles (light electric quads with less than 4kW of power) it is possible to obtain up to 15,000.00 HRK.
- for the purchase of the L7-category vehicles (heavy electric quads with less than 15kW of power) it is possible to obtain up to 30,000.00 HRK.

A public call was announced for citizens and companies for the co-financing of hybrid and electric vehicles, and the implementation of the said co-financing program is expected to continue until September 23rd 2015.

In April 2014, the Energy Efficiency Program in the Urban Traffic System of the City of Zagreb was completed, which emphasizes the need for the promotion and implementation of sustainable and energy-efficient measures in the transport system of the City of Zagreb. The concept of e-mobility was clearly introduced and the need for the integration of electric vehicles into the transport system of the city was recognized, where initiatives such as e-scooter sharing are certainly welcome and are supported by the City Administration.

In 2013, the Strategy for the Development of Energy Infrastructure for Charging Electric Vehicles in the City of Zagreb was finalized, which aimed to provide objective reasons and arguments for initiating the development of energy infrastructure for EV in the City of Zagreb. Based on that Strategy, which provides basic guidelines for the development of the e-mobility concept in the city of Zagreb, the City proposes considering making a decision on the initiation of operations to achieve the objectives that will include vehicles, infrastructure, incentives, marketing and communication.

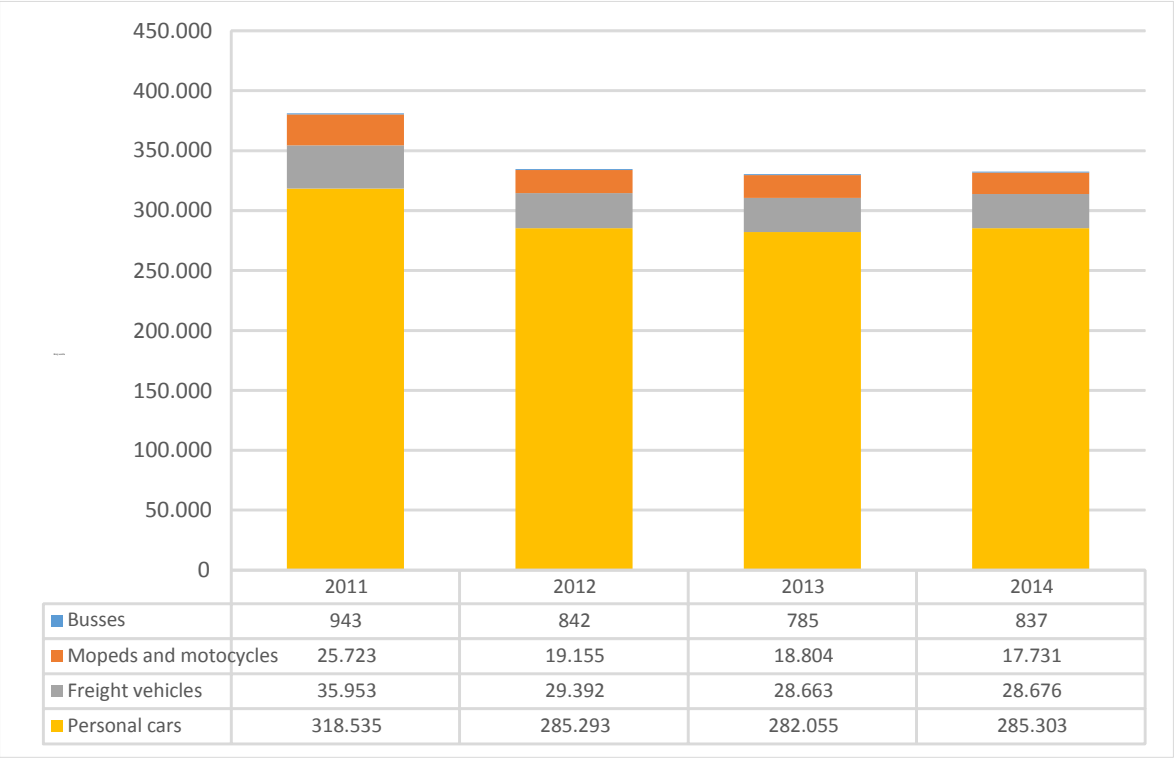
3.2. The structuring of existing users of the traffic system in Zagreb

Data on registered vehicles were obtained and subsequently processed from the database of registered vehicles in the Republic of Croatia, which was provided by the Department of Statistics of the Ministry of Interior. Below is an overview of the vehicle fleet structure of the City of Zagreb in the period from 2011 to 2014.

In accordance with the Decision on the borders of the area and the seats of city districts (Official Gazette of the City of Zagreb 7/09), the structure of the vehicle fleet includes the following metropolitan areas; Lower Town, Upper Town, Trnje, Maksimir, Peščenica - Žitnjak, Novi Zagreb, Trešnjevka, Črnomerec, Dubrava, Stenjevec, Podsused – Vrapče, Podsljeme, Sesvete and Brezovica.

The dominant share of passenger cars in the total number of registered vehicles is evident throughout the entire study period. Excluded from the analysis are tractors, working machines and working vehicles and trailers, as they do not represent a significant potential for the initial purposes of this program.

A relatively slight increase in the number of registered cars, trucks and buses in 2014, in comparison to 2013, confirms that the City of Zagreb is leaving the economic and financial crisis behind, which is manifested through the growing need for mobility, and, consequently, a larger number of registered vehicles.



	2011	2012	2013	2014
Busses	943	842	785	837
Mopeds and motocycles	25.723	19.155	18.804	17.731
Freight vehicles	35.953	29.392	28.663	28.676
Personal cars	318.535	285.293	282.055	285.303

Figure 0.4. Vehicles registered in the City of Zagreb in the period from 2011 to 2014

In the analysis, a special emphasis was placed on the L-category vehicles (owners of such vehicles are expected to be primary and initial users of the scooter sharing system). In the structure of registered mopeds and motorcycles (category L) subcategories that prevail are the **L1** category (two-wheeled motor vehicles with engine cylinder swept volume not exceeding 50 cm^3 and design speed not exceeding 50 km/h) with 9,329 registered vehicles at the end of 2014, and **L3** category (two-wheeled motor vehicles with engine cylinder swept volume exceeding 50 cm^3 or design speed exceeding 50 km/h) with 8,116 registered vehicles at the end of 2014. Other subcategories are represented with a significantly smaller number of registered vehicles; **L2** (three-wheeled motor vehicles engine cylinder swept volume not exceeding 50 cm^3 and design speed not exceeding 50 km/h) with 17 vehicles; **L4** (three-wheeled motor vehicles with wheels asymmetrically arranged with respect to the medial longitudinal axis of the cylinder engine swept volume which is greater than 50 cm^3 or design speed exceeding 40 km/h) with 10 vehicles; **L5** (three-wheeled motor vehicles with wheels placed symmetrically in respect to the medial longitudinal axis of maximum mass not exceeding 1,000 kg and cylinder engine swept volume exceeding 50 50 cm^3 or design speed exceeding 50 km/h) with 34 vehicles; **L6** (four-wheeled motor vehicles with unladen weight not exceeding 350 kg, without the mass of a battery in electric vehicles, with maximum design speed not exceeding 45 km/h

and engine cylinder swept volume not exceeding 50 cm3, in engines with forced ignition or with maximum net power not exceeding 4 kW, in other internal combustion engines or engines with maximum continuous power not exceeding 4 kW, in electric engines) with 28 vehicles; and **L7** (four-wheeled motor vehicles other than those listed under category L6, with unladen weight not exceeding 400 kg (550 kg for vehicles intended for the transport of goods), without the mass of battery in electric vehicles and with maximum net engine power not exceeding 15 kW) with 197 vehicles.

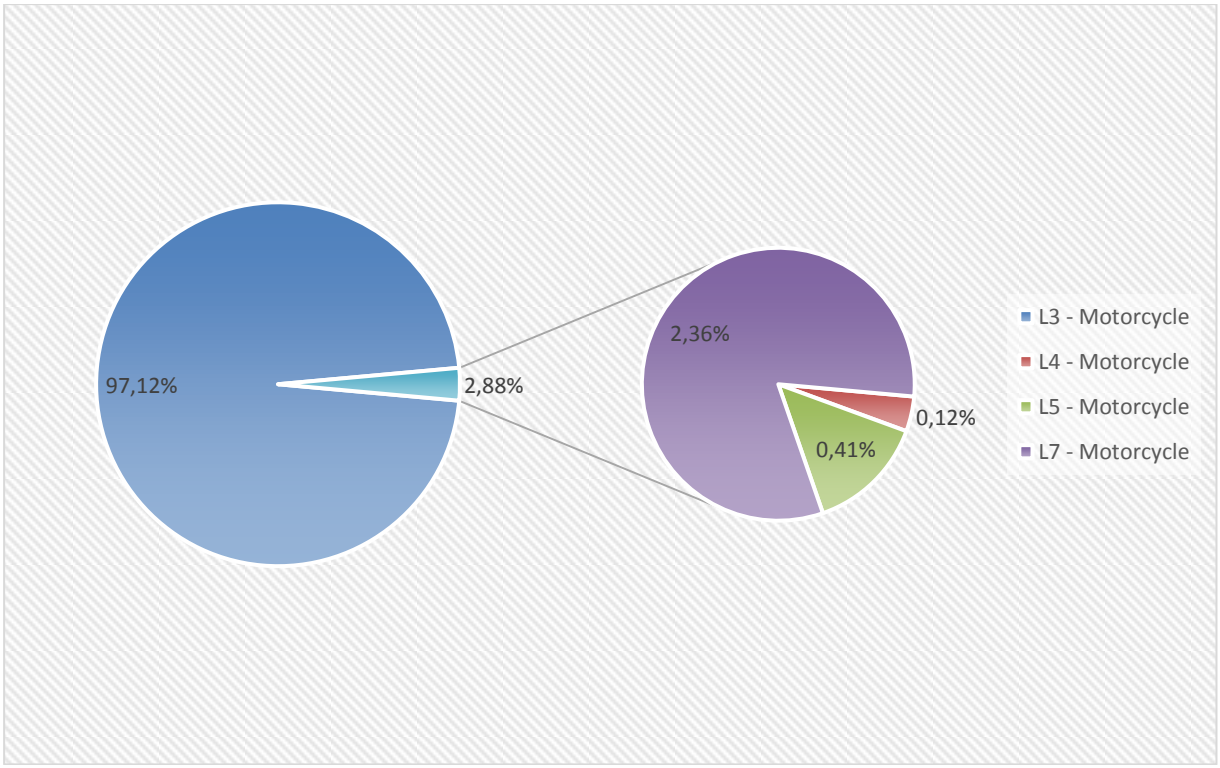


Figure 0.5. The structure of motorcycles in the City of Zagreb in 2014

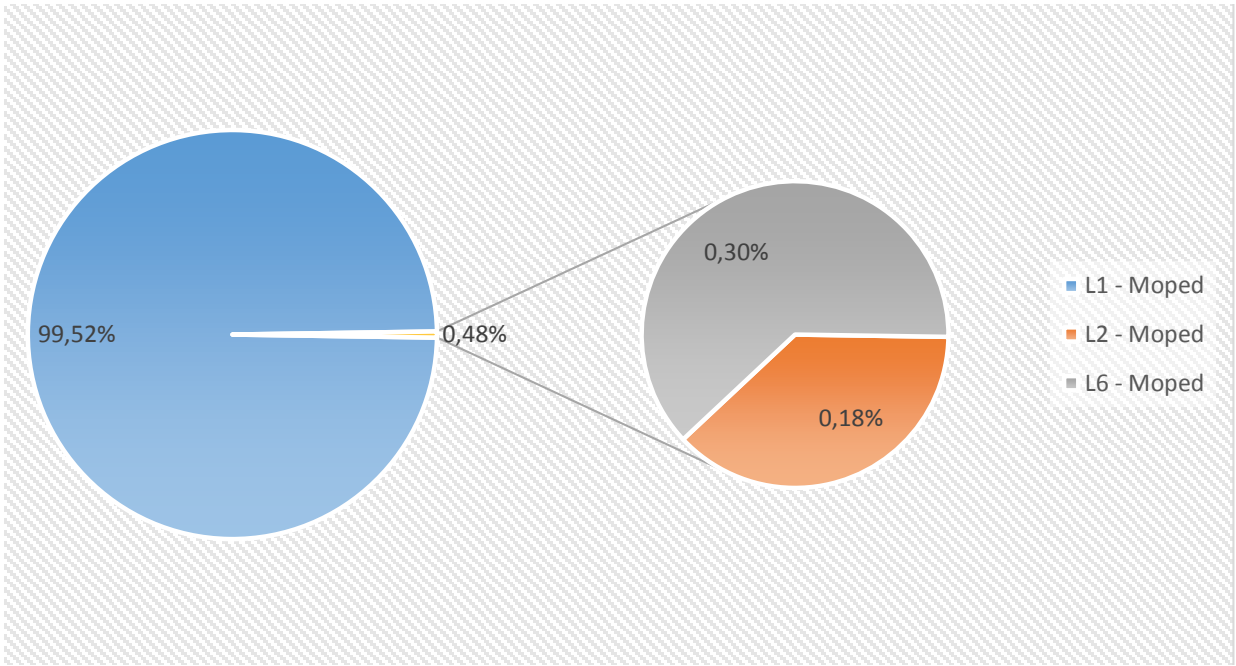


Figure 0.6. The structure of mopeds in the City of Zagreb in 2014

Analysis of currently registered L-category vehicles from the perspective of ownership, reveals that almost 81 percent of mopeds and almost 87 percent of motorcycles are privately owned by natural persons.

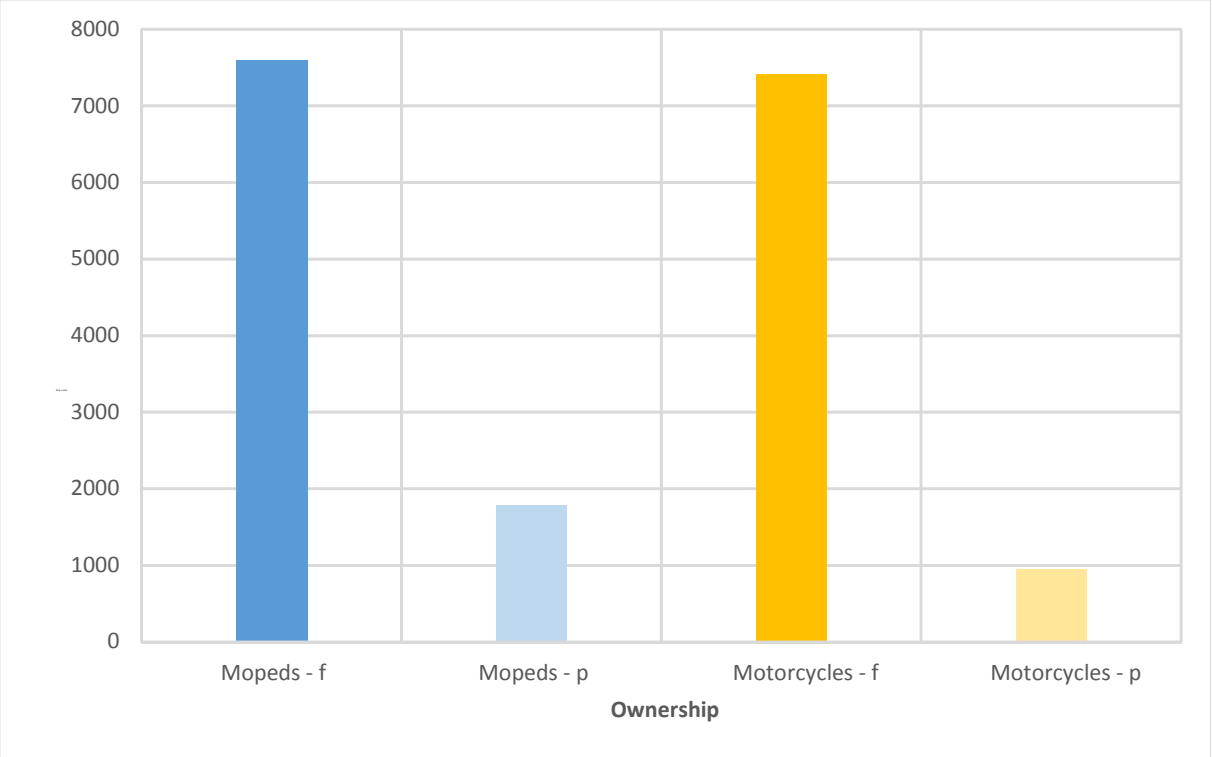


Figure 0.7. The ownership structure of mopeds and motorcycles registered in Zagreb in 2014

By the end of 2014, in Zagreb there was 16 registered e-mopeds (14 of which are owned by legal persons). That confirms that citizens have recognized the value of new technology and it is expected that this significant trend of L-category electric vehicles penetration in the market of the City of Zagreb will continue.

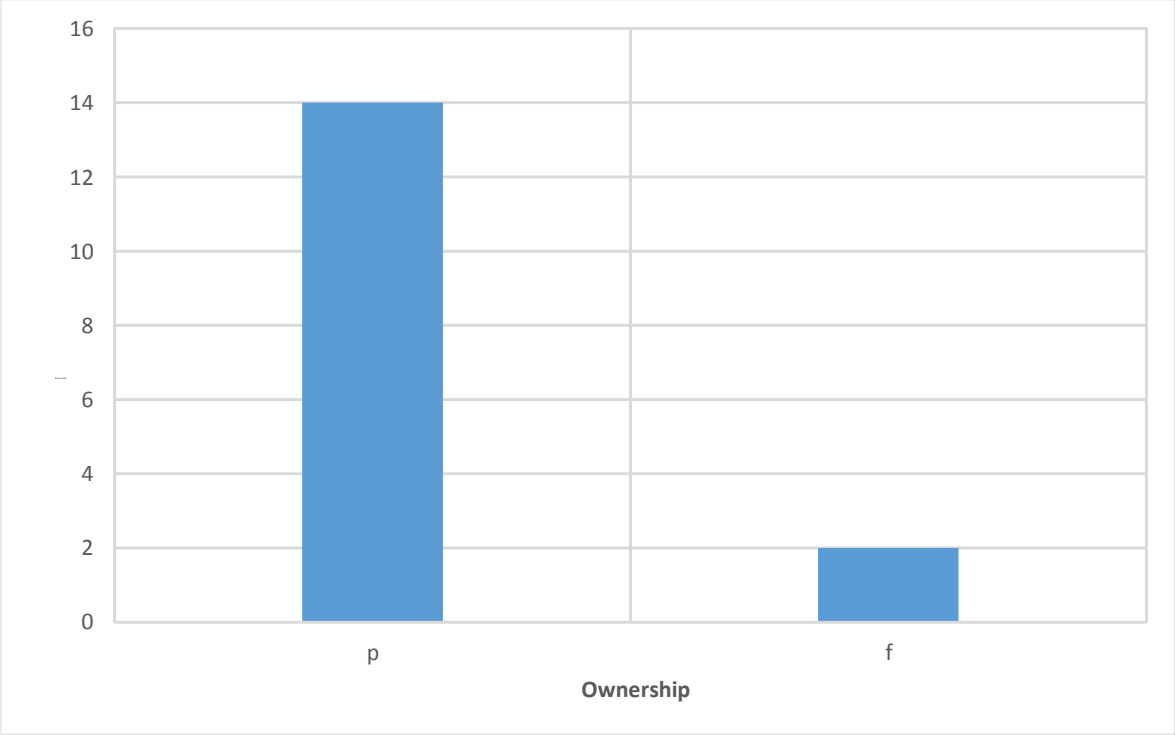


Figure 0.8. The ownership structure of e- mopeds registered in Zagreb in 2014

3.3. Constraints in the development of Ele.C.Tra model

Local government has a great potential to become positioned in different value chain stages of the energy infrastructure for electric vehicles, from regulatory decisions to the decision of the local government to actively participate in the investment process for the development of charging stations network or for providing various forms of incentives for the Ele.C.Tra concept. Ambiguous implementation policy in any of these elements, may represent a potential constraint in the development of energy infrastructure for electric vehicles in the City of Zagreb.

In order to achieve success regarding the inclusion of the private sector in the development of charging stations network, it is necessary to prepare a lucrative business environment. When considering the profitability of investments in the network of charging stations, it is necessary to keep in mind existing economic constraints (a minimum number of electric vehicles is required for the investment to pay off in a reasonable time). If we assume that a significant penetration of electric vehicles in the market is bound to occur very soon, this factor becomes mainly a question of time. The key question is when will consumers massively switch to electric vehicles and how quickly. Estimates regarding that question vary greatly and will likely depend on the political and regulatory environment in the City of Zagreb, as well as on the technological progress.

Limitation in terms of the minimum level of the charging service quality is determined based on the data which reveal how often will the user of electric vehicle charge his/her vehicle on a private/home charging station or on the public one. A low level of service quality will imply a relatively limited number of public charging stations in comparison to the number of private ones. A high level of service quality will imply high coverage of the charging stations network, which will allow greater usage possibilities for end users of electric vehicles. Different levels of service quality will require different demands in terms of size and structure of the charging stations network. The level of service quality can be measured through the actual utilisation of public energy infrastructure, and not through the perceived need of end users.

The limitation of the range is a psychological phenomenon that arises from the perception of the driver that his/her battery will run out before they get to the next charging station and will, therefore, expect them to be more densely distributed.

Some of the main constraints mentioned in the pilot cities of the Ele.C.Tra project is the lack of infrastructure for charging electric vehicles, the lack of parking lots for larger vehicles and the lack of parking lots for scooters, the inefficiency of interjection nodes, insufficiently implemented Park & Ride system and a general lack of knowledge and awareness among the citizens regarding electric vehicles and sustainable traffic system.

Other constraints should be classified into two groups: constraints on the development on infrastructure and constraints regarding the positioning of electric vehicles. First include political uncertainty, the uncertainty of demand, economics, licenses and technological uncertainty, while others include limited range, availability of infrastructure, prepayment, technological uncertainty, insufficient availability of vehicle models and the lack of awareness.

3.4. Possible solutions to key problems

When considering existing activities conducted by the City of Zagreb, as well as the support of strategic documents and the financial support for energy-efficient vehicles awarded by the Environmental Protection and Energy Efficiency Fund, it is evident that necessary foundations for the significant development of the electric mobility concept are in place.

As main problems of urban traffic environment, such as the traffic environment in the City of Zagreb, three critical issues are identified:

- dependence on privately owned cars, which generally results in traffic congestions, delays, accidents, increased noise, increased emissions of greenhouse gases and pollutants and longer journeys
- lack of parking infrastructure (with high parking costs and problem of illegal parking)
- public transport (crowdedness, slowness, inconsistent timetables)

Solution of the above mentioned problems requires a new approach in the form of implementing alternatives to the existing motorized transport, such as sharing systems of electric vehicles and general promotion of modern forms of mobility which includes the electrification of the vehicle fleet.

In conducting a systematic analysis of the electric mobility implementation (in this case those are light electric vehicles and scooters) in the City of Zagreb, it is necessary to consider several segments. From a strategic point of view, in the first phase it would be necessary to define activities which include the adoption of strategic documents on the local level, defining of financial support and additional supports and benefits for the users of such vehicles, and defining activities for the promotion of new technologies with an active implementation of the education for citizens.

Over the past several years, the City of Zagreb adopted a number of policy documents and other required documents in order to create an effective platform for the development of electric mobility. Electric mobility is recognized in every aspect of the local energy and transport sectors, and is included in the promotional and educational umbrella activities.

In accordance with its capacity, the City of Zagreb should provide support to citizens who own an electric scooter or a light electric vehicle. In addition to direct financial support (which is already allocated on the national level in a great extent), there is also a number of other measures which could have positive results with respect to the identified problems. Above all, those are free parking (maybe even free charging in the first phase), permission of driving along the lanes marked with a yellow line, lower local taxes, the possibility of entering the city centre etc. According to the European experience, these incentives and measures result in a faster penetration of electric vehicles in urban areas.

The main challenge of the Ele.C.Tra model transfer to the territory of the City of Zagreb is an equitable distribution of costs and benefits to all stakeholders, with a view to achieving sustainable development of the electric mobility system. As

displayed in the Figure below, in order to bring basic concepts closer to natural and legal persons, it is necessary to observe and act within environmental, sociological and economic aspects.

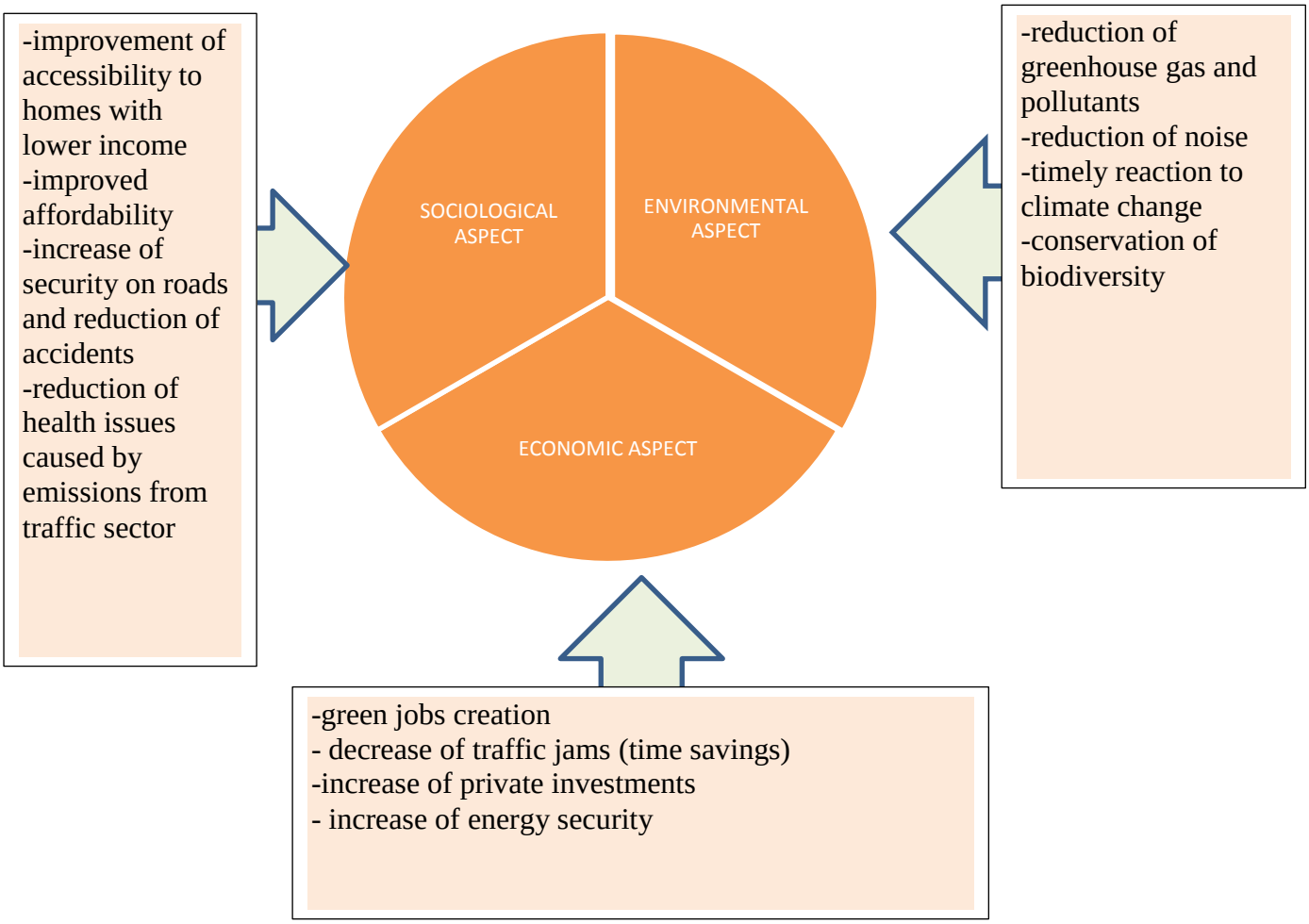


Figure 0.9. Economic, sociological and environmental aspects of introducing Ele.C.Tra model

The City of Zagreb has its own unique environment, in which different incentives will induce different responses from policy makers, consumers, charging services providers and infrastructure operators. Recommended as a solution to critical problems is the implementation of a number of measures, including simplifying the process of licensing for infrastructure, subsidies and tax incentives for electric vehicles, subsidies for infrastructure, tax relief for the production of components for the charging stations network, free parking for electric vehicles, exempting electric vehicles from fees drivers are required to pay when entering the inner centre of the city (if the introduction of such fees is planned), access to privileged lanes, construction of separate facilities for charging stations, zoning and adopting construction regulations, demonstration activities, popularizing the Ele.C.Tra concept by engaging celebrities and the procurement of electric vehicles for vehicle fleets used by public bodies.

4. SYNTHESIS OF POTENTIAL USERS' NEEDS

4.1. *Scooter sharing* system

The number of motor vehicles in the City of Zagreb, as in all other big cities, especially capitals, is constantly on the increase. Destination or transfer point of a large number of car journeys is the city centre, which is already constructed in terms of space and traffic and defined, from the aspect of traffic, by the infrastructure network of limited permeability. In a situation where we have such a great increase in the number of motor vehicles, as is the case in Zagreb, it is inevitable that significant difficulties will arise in the operation of the traffic system on the level of the entire city, especially in the historical centre where streets were originally built for pedestrians and carriages and cannot withstand such pressure. There are two approaches to solving these problems. The first includes an attempt to adapt the existing environment to the growing traffic load through the construction of new traffic infrastructure, primarily new roads, car parks and garages, often resulting in the loss of public land and the destruction of houses, buildings and cultural sites. This method was dominant in the 60s and 70s of the 20th century in the big cities of industrialized countries. Second method includes an attempt to adjust the traffic to the existing space, i.e., seeks to manage traffic flows in order to preserve the space. This is achieved primarily by applying a sustainable traffic planning strategy, which includes urban planning, development of public transport and cycling traffic, parking management, traffic demand management and influencing the traffic behaviour of citizens, which certainly includes the scooter sharing system. This method was first applied in the early 90s in the big cities of Western Europe and in recent years that trend spread to cities of other economically developed countries.

In setting goals that build on the clear mission and vision of the system (goals directly derived from them, which are established and determined by owners and users of transport services), the fist factor that is considered is the existing and projected traffic demand. Due to traffic and environmental problems as a result of rapid development of individual motorization, as well as due to the energy and economic crisis, the generally accepted view in the City of Zagreb is that a correct and socially acceptable plan to minimize difficulties resulting from traffic would be the introduction of new technologies, intelligent and innovative solutions, optimization of traffic flows, as well as the strengthening and the development of public transport.

Although general traffic conditions and organizational level of scooter sharing system vary in different cities and depend on the size of the city, traffic infrastructure etc., in terms of the basic development directions, it is possible to define common basic objectives and needs. Scooter sharing system should provide, within a planned time frame, the programmed number of trips and it should be able to constantly adapt to changes in transport demands. It should also operate economically and its overall operation within the socio-political community should be based on socio-economic relations. For the implementation of the system it is necessary to determine transportation needs within the planned time frame, as well as their distribution in terms of time and space, and to predict the basic characteristics of future passenger flows by establishing a scooter location network that will be optimally adjusted to the wishes of passengers. It is certainly necessary to provide a modern control and

management system and timely maintenance and repair of vehicles, which will provide reliability of the implemented scooter sharing system through the application of modern information sharing means. In addition to the time and space framework, is necessary to consider and specify limitations that could influence the achievement of objectives, which will make sure that planning preconditions are realistic. Some of these limitations can be: natural, physical, regulatory or financial limitations, limitations related to the protection of human environment, etc.

By analysing the behaviour patterns of traffic system end users, i.e. passengers, it was revealed that clustering on the basis of certain characteristics is common (children, employed, older people, usual working hours, the start of the school year, etc.). A systematic review of implemented scooter sharing models in the cities of Barcelona, Genoa and Florence (IEE project Ele.C.Tra), identified basic groups of potential and likely users of such a model in the City of Zagreb.
Existing models reveal the facts that confirm the target groups;

- young people aged 16 to 35 (current models have revealed an equal interest among women and men),
- students and employed,
- those who take short daily trips from home to school or to their office (a maximum of 30 minutes per single trip).

A survey was conducted in the City of Zagreb, which, depending on the received replies, involved nearly 300 respondents. The analysis of the respondents revealed that men were represented by 63 percent and that people older than 16 and younger than 35 years were represented by 50.7 percent. Of the total number of respondents, 7 percent of them owns a scooter.

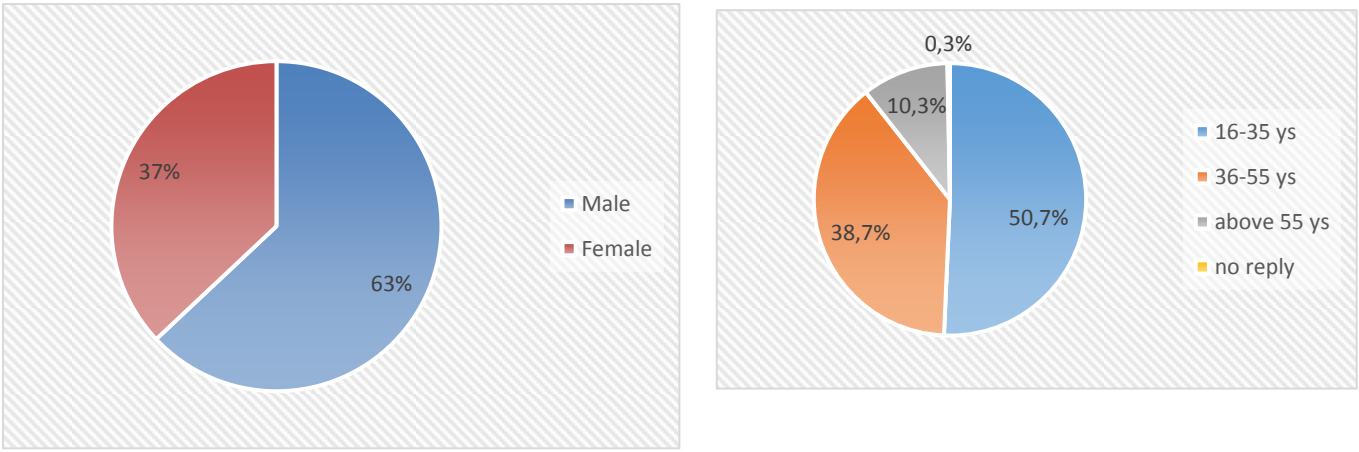


Figure 0.10. Survey distribution depending on respondents' gender and age

Analysis of the survey results revealed that nearly 38 percent of respondents said that they would consider using a scooter sharing system, if such a system would be established in the City of Zagreb, while approximately 20 percent of respondents confirmed that they would probably or definitely use such a system. Approximately 15 percent of respondents said they wouldn't use the system and an additional 20 percent said they probably wouldn't use the system.

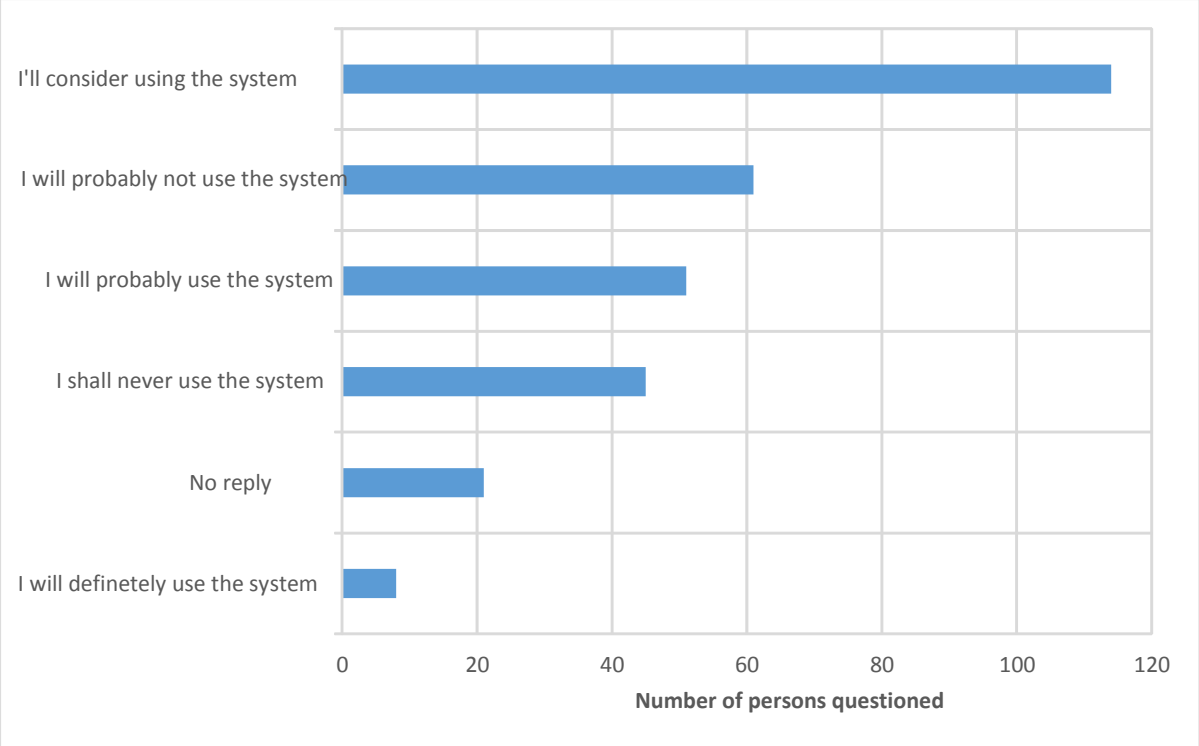


Figure 0.11. Respondents' interest for the scooter sharing system in Zagreb

In terms of preference regarding the use of potential electric scooters, bicycles or cars, nearly 38 percent of respondents said they would prefer owning them, while almost 23 percent of respondents said that they would prefer the system of sharing.

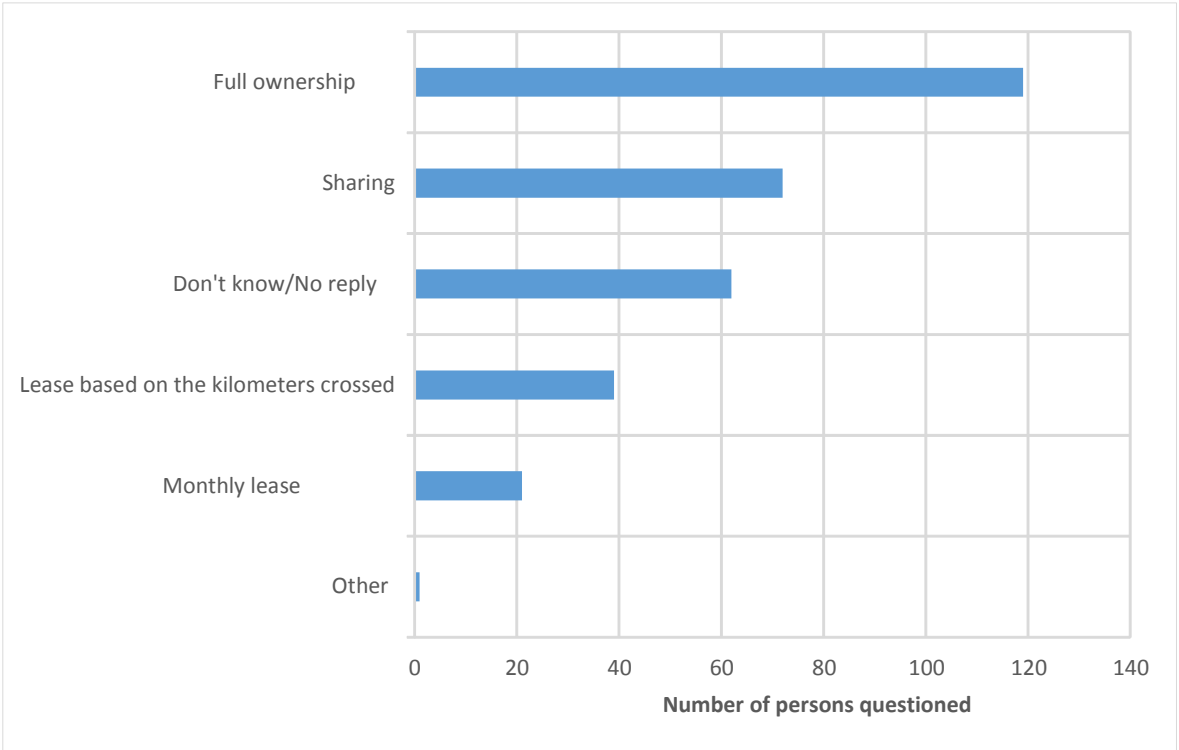


Figure 0.12. The preferred method regarding the use of electric scooters/bicycles/cars

Results of the survey conducted in the City of Zagreb on a sample of 100 tourists, revealed that tourists showed a relatively great interest for the use of the scooter sharing system. Almost 62 percent of respondents said that they would certainly or

almost certainly use the system or that they would consider using the system if such would be implemented in the City of Zagreb.

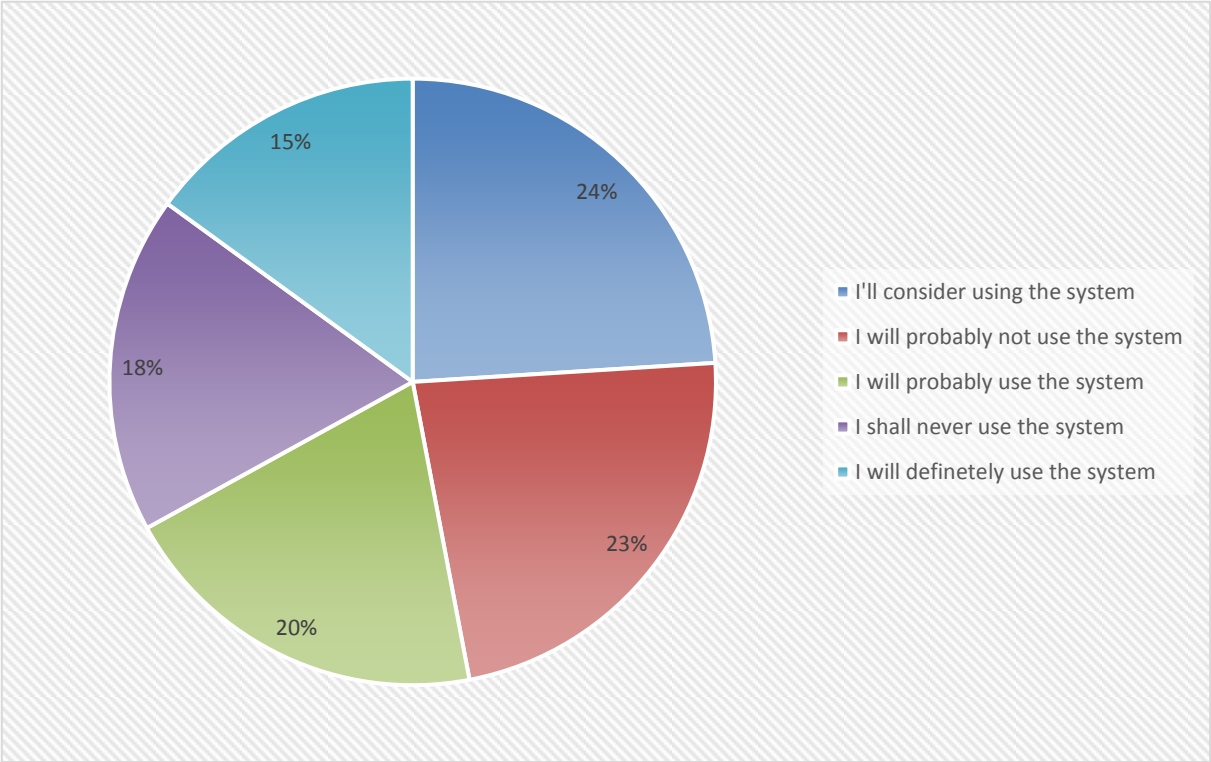


Figure 0.13. Tourist survey results in the City of Zagreb

Survey results reveal a definite interest in terms of potential use of electric scooter sharing system in the City of Zagreb. Survey results also confirm behaviour patterns and interest groups identified in the implemented models as part of Ele.C.tra project. As the main advantages of the proposed program, respondents have recognized the reduction of harmful emissions, as well as the reduction of fuel costs. As the main disadvantage of using electric vehicles in the city, they mentioned the charging problem.

Users of the public transport in the City of Zagreb experience major traffic congestions on daily basis and it consequently takes them long time to travel short distances. Current mobility trends indicate an increase in the use of public transport (research conducted as part of the Civitas Elan project). Research reveal decreasing trend in terms of car occupancy when it comes to cars that participate in the city traffic (in 2014 it was 1.38 persons per vehicle - Šojat, 2014), and relatively small differences in the average length and speed of the drive within the city, when taking into account the means of transport. In the city centre, the average travelling speed is 16.1 km/h, if you travel by car, 14.5 km/h, if you travel by bicycle and 12.4 km/h, if you travel by tram. Small tram speed is a problem experienced by majority of its users. That problem is difficult to resolve in places where congestions occur, because that would require implementation of significant construction projects in order to completely separate the route of tram tracks, and in doing so provide higher operating speeds. Citizens need to offered flexible, cost-effective and environmentally friendly alternative, which can be provided in the form of electric scooter sharing service. It is expected that users of such vehicles will significantly

reduce their travel time in comparison to other forms of transportation used for the same routes.

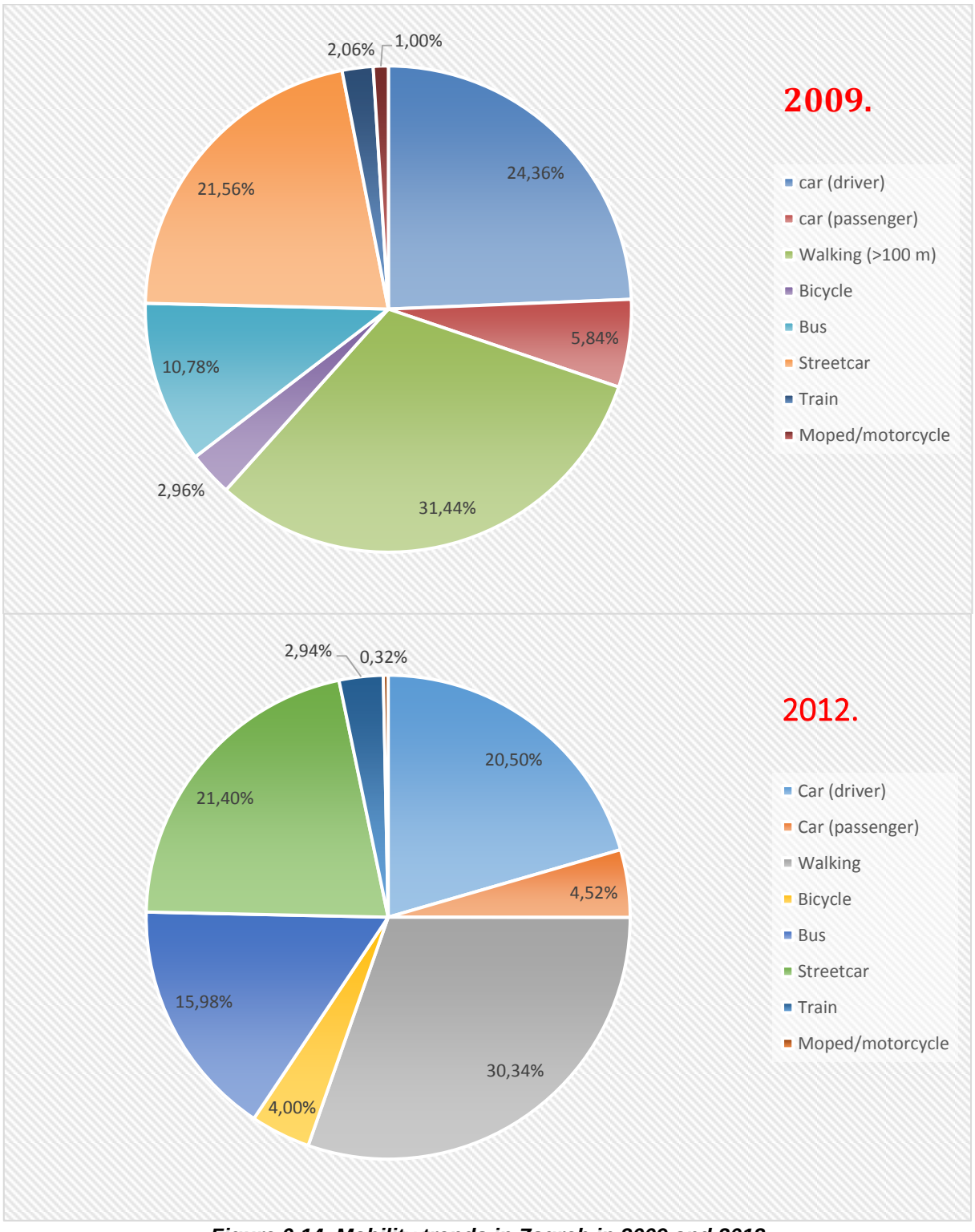


Figure 0.14. Mobility trends in Zagreb in 2009 and 2012

Analysis of activities that need to be implemented in the City of Zagreb in order to popularize systems such as e-scooter sharing system, which was conducted as part of the IEE project Ele.C.Tra, recommends promotional campaigns with a special emphasis on electric mobility, which would focus on the positive sides of such vehicles and the existing and planned economic and fiscal incentives. It also underlines the need for the construction of infrastructure, which includes electric

vehicle charging stations within the City of Zagreb, parking lots for electric cars and special parking lots for electric scooters. The priority is the development and the implementation of additional public transport facilities and efficient inter-modal nodes, which will make combining different means of transport relatively simple. These activities will certainly contribute to the reduction of traffic congestion and harmful gases and pollutants emissions.

Analysis of the pilot implementations of the scooter sharing systems and surveys conducted as part of the Ele.C.tra project, identified the main points of interest such a system could potentially include, if it were to be implemented in the traffic system of the City of Zagreb. Those are primarily:

- railway station and bus terminal,
- major tourist centres (museums, churches, theatres, monuments, stadiums, fairs, galleries, exhibitions, etc.).
- city centre and main pedestrian areas
- colleges, campuses and high schools
- main trade centres
- airport
- large companies

4.2. Private and business owners of electric vehicles

A survey conducted in the City of Zagreb as part of the Ele.C.Tra project on a sample of 300 citizens reveals a relatively high initial interest in electric vehicles. Almost 75 percent of respondents (those who have never used an electric vehicle) said they are interested in testing or purchasing electric vehicles.

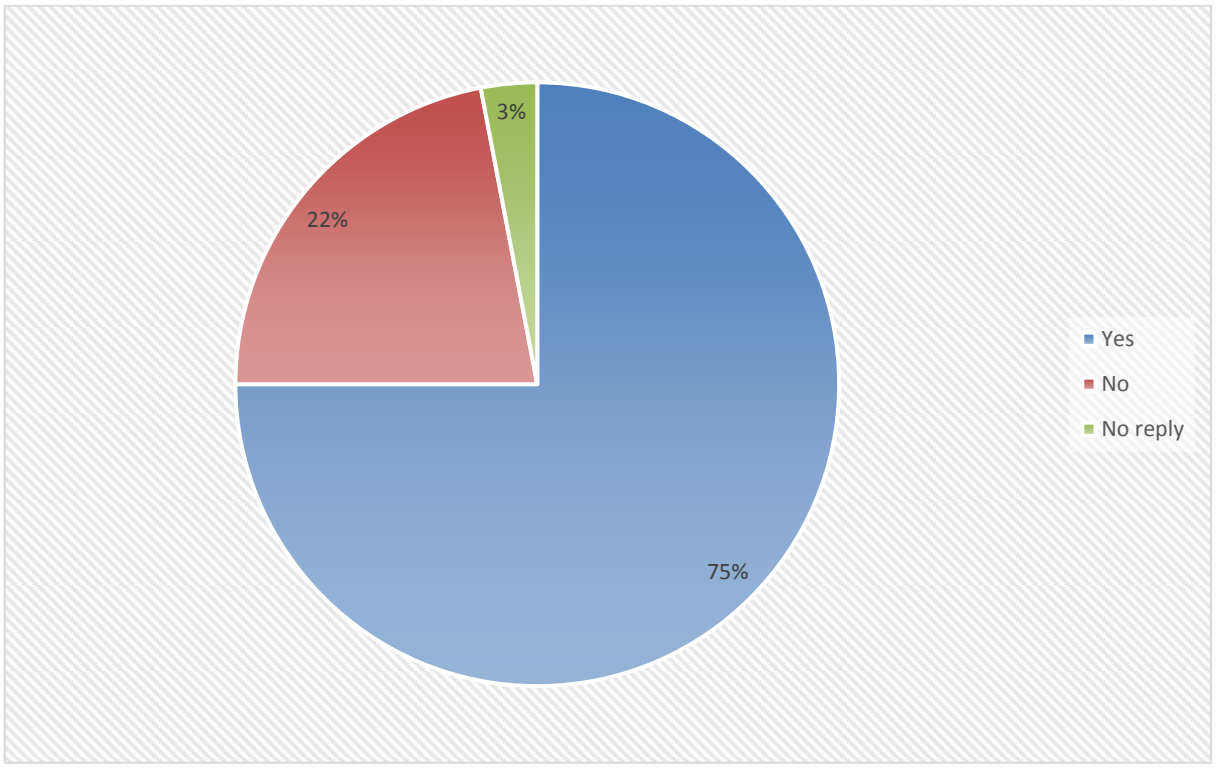


Figure 0.15. Citizens' interest in testing/purchasing electric vehicles

Potential business users of electric scooters are primarily those companies that deliver and distribute goods within the city and companies that have a number of facilities, and therefore have more employees within the city (with a need to communication between locations by using vehicles or a need to conduct business activities at different locations in the city). In such cases, it would certainly be optimal to perform a certain segment of those transportation needs by using an electric scooter.

The main determinant for the concept of wider-range business and private ownership of light electric vehicles, in addition to the economy and the assumption of infrastructural availability, is the technical limitation of the vehicles. Models implemented within the Ele.C.Tra project recognize the technical needs of users with regard to the trips they usually take;

- systematic short trips - employed and students (required power of electric scooter ≤ 4 kW)
- systematic longer trips - employed and students (required power of electric scooter > 4 kW)
- Non-systematic trips - tourists and citizens (required power of electric scooter respectively ≤ 4 kW and > 4 kW)
- larger companies whose employees make shorter trips within the city (required power of electric scooter ≤ 4 kW)

Displayed in the table below are technical parameters and specifications of electric scooters according to their power.

Table 0.2. Technical specifications according to the power of an electric scooter

	POWER	
	≤ 4 kW	> 4 kW
Speed	≤ 45 km/h	> 45 km/h
Range	30 km – 80 km	60 km – 80 km
Type of battery	Lithium, silica, silica gel, lead	Lithium, silica, silica gel
Required charging time	From 1 to 6 hours	From 1 to 6 hours
Battery charging cycles	From 400 (lithium, silica, silica gel, lead) to 2 000 (lithium)	From 400 (lithium, silica, silica gel) to 2 000 (lithium)
Fixed/changeable battery	Both types	Both types

5. A REVIEW OF POSSIBLE BUSINESS MODELS FOR THE *ELE.C.TRA* PROJECT IMPLEMENTATION IN ZAGREB

Within the Ele.C.Tra project, various potential models for the use and popularisation of e-scooters have been identified. Most important ones are the following:

- E-scooter sharing over a short period (up to several days); target groups are tourists and citizens
- Renting e-scooter over a longer period (up to 6 months); target groups are workers and students
- Purchase of e-scooter after the rental period
- Purchase of e-scooter by citizens or tourists (with a discount, if possible)

The above models can be classified into two separate groups - those where users become owners of an e-scooter and those where users rent an e-scooter over a certain period. In 2014 project called “Drive Economically” was initiated in Croatia which is used to award grants to citizens and companies for the purchase of electric and hybrid cars, as well as electric scooters, motorcycles and quads. In addition to awarding grants for the purchase of electric vehicles, education of potential users is also very important, as are promotional activities related to the purchase and use of e-vehicles.

Apart from the model that allows users of e-scooters to become their owners, a very good way to increase the share of e-scooters in transport and to inform users about the benefits of using e-vehicles in comparison to vehicles powered by fossil fuels, is the rent of e-scooters, that is, the establishment of e-scooter sharing system.

The establishment of e-scooter sharing system can be implemented using different business models. The choice of a business model depends on a number of factors and the most important ones are the following:

- potential stakeholders
- investment cost
- operating costs
- flexibility
- reliability
- availability
- environmental impact
- comfort
- efficiency.

So far, three business models have been developed in the world, regardless of whether we are talking about car sharing or scooter sharing system:

- The profit model - private owner provides all resources for equipment and management, limited contracts with public entities are possible, they are usually not incentivized by the state;
- Non-profit model - the objective is to cover operational costs and to expand the service; these kind of organizations are usually beneficiaries of some types of incentives (e.g. grants for the financing of initial investment or

operating costs, sponsorship or soft loans, etc.), such incentives are usually offered locally;

- Partnership model - public-private partnership where the owner can be a government agency or a local community responsible for the financing and administration of the system, while the management is outsourced to a private economic subject; subsidies from state or local funds are possible;

The main difference between these models is in their source of capital and financing. Profit organizations seek to expand their services to other markets, unlike non-profit organizations and partnerships. On the other hand, non-profit organizations and partnerships provide a better model for achieving local and national objectives, such as reducing traffic congestions in big cities or reducing harmful gas emissions and achieving environmental objectives, one of which is the increase of the share of renewable energy in the transport sector, that is, the use of alternative fuels.

6. THE MAIN POINTS OF ECONOMIC AND FINANCIAL ASPECTS OF ELE.C.TRA MODEL

In order to compare and evaluate individual business scenarios, certain indicators were selected and are described below.

NPV - Net present value

Net present value is the basic criteria in making financial decisions which can be defined as a difference between the sum of the discounted net cash flows in the entire effectuating period (economic earning/ maturation - generation of economic flows) of the project and the amount of investment costs. Expression “net value” generally indicates some kind of difference between positive or negative effects which are the results of some activity, while “present” indicates that all effects must be reduced to present value in order to be able to compare the value of investment with the value of expected returns generated through future cash flows.

If NPV> 0, in theory, project should be accepted. When choosing between two or more projects, one with the higher NPV should be selected.
If NPV <0, the project should be rejected.

If NPV = 0, then the decision should be based on other indicators.

PBP - Payback period

Payback period is the most simple criteria in making financial decisions on real investments and it entails a number of periods, usually years, when payback of the money invested in a particular project can be expected. Money invested in a project (investment costs) is returned through the inflow of net cash flows of the business through the entire effectuating period of the project. The period, that is, the year when the net cash flows from business operation reach the amount of the investment is the year when the payback period of the project is achieved.

IRR - Internal rate of return

Internal rate of return is the discount rate at which the net present value equals zero. To elaborate, it is the discount rate that reduces net cash flows of the project throughout the entire effectuating period to the value of investment costs. The internal rate of return of projects with multiple liquid net cash flows is calculated by trial and error. The procedure is repeated until the repeated calculation of the net present value yields the exact discount rate at which NPV is zero.

ROE - Return on equity

Return on equity is the ratio between the net profit from business operations in a given year and the equity in the same period. It is a measure of the profitability of company's investment and it shows the profitability of the sharholders equity.

Net income is income after taxes, while the average equity is calculated as the sum of the equity at the beginning and at the end of the year divided by 2. Net income is an integral part of the profit and loss account, and equity is an integral part of the

balance sheet. ROE is an important measure of company's profitability. Generally, the higher the ROE, the higher the company's ability to generate more revenue from new investments. This means that if two companies invest the same amount of capital, company that has higher ROE will generate more revenue. ROE is a good indicator of the growth rate of the company as it is considered that total revenues cannot grow at a rate higher than the current amount of ROE, unless the company takes a bank loan.

DSCR - Debt Service Coverage Ratio

Debt service coverage ratio represents the ratio between CFADS and the amount of debt (principal + interest). This coefficient is calculated on annual basis for each business year separately. Naturally, the higher the ratio, the easier it is to repay the debt.

If DSCR is greater than 1, it indicates that the project generates enough revenue to cover its debts, and if it is less than 1, it demonstrates that the project has negative cash flows. For example, if DSCR is 1.2, this means that the project generated 20% more revenue than it is required to cover the debts, and if DSCR is 0.95 this means that cash flows of the project cover only 95% of the debts.

6.1. Scooter sharing system

An important conditions for the survival and expansion of e-scooter sharing system is its economic sustainability. Regardless of the chosen business model and the ownership structure, prior to the implementation of the system it is important to evaluate the demand for that type of transport and to conduct an economic and financial analysis of potential scenarios of introducing e-scooter sharing system in the City of Zagreb.

Based on the survey of citizens conducted as part of the Ele.C.Tra project, the fleet structure in the City of Zagreb and analyses conducted as par of other projects that examined mobility in the City of Zagreb, there are three scenarios that have been subjected to economic and financial analyses. In a dynamic approach applied to assess the economic contribution of this project, two methods were used and those are investment payback period method and discounted cash flows method which includes the analysis of the internal rate of return (IRR) and the analysis of net present value (NPV).

All three scenarios assume project will start with 80 e-scooters deployed at 14 locations in the City of Zagreb. Locations would include places where it would be convenient for citizens and tourists to use this type of transport and those would include campuses, railway station and tourist sites such as museums, squares, etc. Number of e-scooters and locations for their parking would increase over the years. It is estimated that after 15 years of implementation the number of vehicles would increase to 125 and the number parking locations to 21. The main difference between scenarios is in the battery charging for e-scooters.

The first scenario (SC-1) anticipates the construction of charging station at locations where vehicles are parked. The advantage of this type of battery charging is that the

batteries are charged the entire time the vehicles are parked, and the likelihood that the battery will be empty at the moment when somebody needs to use the vehicle is relatively small. The disadvantage is that the construction of charging stations requires significant investments.

The second scenario (SC2) anticipates that all batteries (which are discharged to a certain level) be replaced with fully charged batteries at a single location. It involves the procurement of vans for the transport of batteries to the charging station and back to the parking location and the employment of few extra employees (in comparison to the first scenario) that would be responsible for changing and charging batteries 24 hours a day. The advantage of this method is that it doesn't require such big investment as the first scenario because the construction of charging stations at parking locations would not be required, although it would be necessary to invest in a spare batteries, procurement of vans and employment of additional employees who would change the batteries.

The third scenario (SC-3) anticipates that vehicles will be available for renting only from 06:00 am to 11:00 pm, while the period from 11:00 pm and and 06:00 am would be used for charging batteries at some central location. This scenario doesn't require investment in spare batteries or the construction of charging stations at parking locations. The advantage of this scenario is that it requires low investment in the system in comparison to other two scenarios, while the main disadvantage is the reduced operability of the system.

Active participation of the City of Zagreb is required for the implement any of the three above mentioned scenarios of introducing e-scooter sharing system. Participation of the City of Zagreb is required for the definition of the business model to be applied, drafting of feasibility study, coordination of preparatory activities and the like. In addition to that, every scenarios anticipates that the City of Zagreb will provide (subsidize) the parking area required for locations where e-scooters will be parked.

Assumptions that are common to all three predicted scenarios are the following:

- The first 80 vehicles would be procured in the inital phase by taking a bank loan while the other 45 vehicles would be procured gradually over a period of 15 years from the generated revenue.
- The share of long-term loans in total investment amounts to 70%.
- The loan repayment period is 14 years.
- Interest on long-term loan is 5.5%.
- Assumed average number of trips per day per vehicle is 4.5
- Assumed average length of a trip is 6 km.
- Assumed average time for the use of one e-scooter is 30 min.

Revenue generation is planned through charging three types of fees:

1. **Membership fee** in the amount of 80.00 HRK (one-time)
2. **The cost of vehicles per hour of use** is planned in the amount of 10 HRK
3. **Price per kilometre** in the amount of 1.2 HRK/km.

The total investment consists of the costs for the production of documentation and obtaining necessary permits, equipping operating centre, establishing a platform for business activities (website, mobile phone application), procuring equipment for vehicles, costs of insurance for vehicles during the first year of the project and the costs of marketing in the first year of the project, which are important because of the introduction of a completely new product in the city traffic.

6.1.1. SC-1 scenario of introducing e-scooter sharing services

SC-1 scenario anticipates the establishment of e-scooter sharing service with 80 vehicles deployed at 14 locations in the City of Zagreb. It predicts the construction of e-scooter charging station for 6 vehicles at each location. The system would function through the registration of users via mobile applications. Users would be required to connect the vehicle to the its charging station after they use it.

Over the years, the number of vehicles would increase as follows:

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Number of vehicles	80	82	84	87	90	93	96	99
Year	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Number of vehicles	102	105	108	111	114	117	121	125

Displayed below are the main parameters used in the economic and financial analysis of the scenario SC-1.

Parameters	**2017** - 2032
Number of vehicles	80 – 125
Number of employees	3 – 4
Number of members	1 200– 4 014
Number of charging stations locations	14 – 21
Number of plug-in sites	112 – 168

Number of employees during the first year includes managers and two employees responsible for the maintenance of vehicles during the first year (one employee per 40 vehicles). Number of employees would increase with the increase in the number of vehicles and as of 2025 three of them would be employed.

Investment costs

Investment costs include the costs required for the initiation of the project. Cost for the procurement of vehicles and the construction of charging stations make the largest share in total investment costs. In addition to those, investment costs also include the cost of equipping the operation centre, the cost of developing an interactive website and those for developing interactive application for smart phones, the cost of equipping vehicles, marketing costs during the first year, the cost of obtaining necessary permits, the cost of preparing project documentation and engaging expert services in the process of project development. Anticipated grant for

the purchase of electric vehicles in the amount of 7,500.00 HRK/vehicle is subtracted from total investment costs.

Investments	
The procurement of 80 e-scooters	2.432.000 HRK
Obtaining necessary permits	20.000 HRK
Project documentation	500.000 HRK
Expert services in the process of project development	400.000 HRK
The cost of equipping the operation centre	400.000 HRK
The cost of developing interactive website	100.000 HRK
The cost of developing interactive application for smart phones	150.000 HRK
The cost of equipping vehicles	224.000 HRK
Marketing costs during the first year	400.000 HRK
The construction of charging stations in the first year	1.276.800 HRK
The costs of insurance during the first year	112.000 HRK
Subsidies for e-vehicles	-600.000 HRK

Operating costs

In addition to salaries for employees, operating costs include the costs of the operation centre, costs for the maintenance of control and management equipment, management costs (accounting, tax consulting, etc.), the cost of vehicle registration and insurance and the cost of equipping new vehicles, the cost of electricity required to power the vehicles, the cost of constructing new charging facilities, the costs for the procurement of used batteries and marketing costs. In the second year marketing costs would amount to 100,000 HRK, in the third and fourth year they would amount to 50,000 HRK, and in subsequent years it was estimated that they would amount to 40,000 HRK per year.

Operating costs	
Gross cost of salaries for employees	336.000 HRK in the first year
Operation centre utilities	72.000 HRK per year
Costs of management	24.000 HRK per year
Costs of maintenance for vehicles and equipment	96.000 HRK in the first year
Costs of maintenance for control and management equipment	12.000 HRK per year
Cost of equipping new vehicles	2.800 HRK per vehicle
Marketing costs	100.000 HRK in the second year; 50.000 HRK/year (3rd and 4th year); 40.000 HRK/year (5th and 15th year)
Costs of constructing new charging stations	91.200 HRK per charging station
Vehicle registration and insurance	1.400 HRK per vehicle per year
Cost of power for vehicles	0.02 HRK/km
Cost of procurement of used batteries	12,000 HRK per battery

Displayed in the table below are the results of the economic and financial analysis which was conducted with the application of the above mentioned criteria in accordance with the SC-1.

Bank Perspective: debt service coverage ratio (DSCR)	1,69	**o.k.**
Investor's Perspective: ROE	34%	**o.k.**
IRR	17%	**o.k.**
Payback Period (year): PBP	7	**o.k.**
NPV	2.531.861	**o.k.**

According to the obtained results we can conclude that all main indicators would point to the success of the project in case all preconditions for the system are met.

Debt coverage ratio (DSCR) is much larger than 1 which indicates that project generates enough income to cover its debts, whereby the payback period for the return on investment is 7 years.

Figures below display diagrams showing the cash flow of the project (***Figure 0.16***.), profit and loss account (***Figure 0.17***.), return on equity (***Figure 0.18***.), and the debt coverage ratio (***Figure 0.19***.).

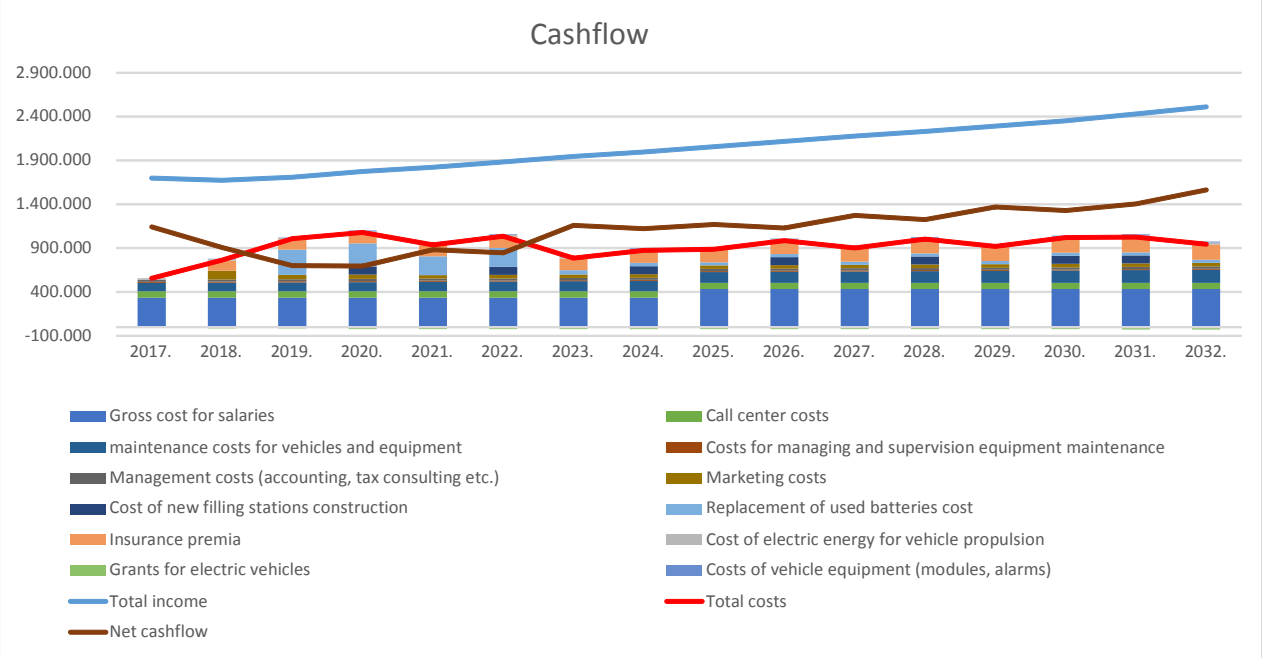


Figure 0.16. Cash flow of the project according to SC1 scenario

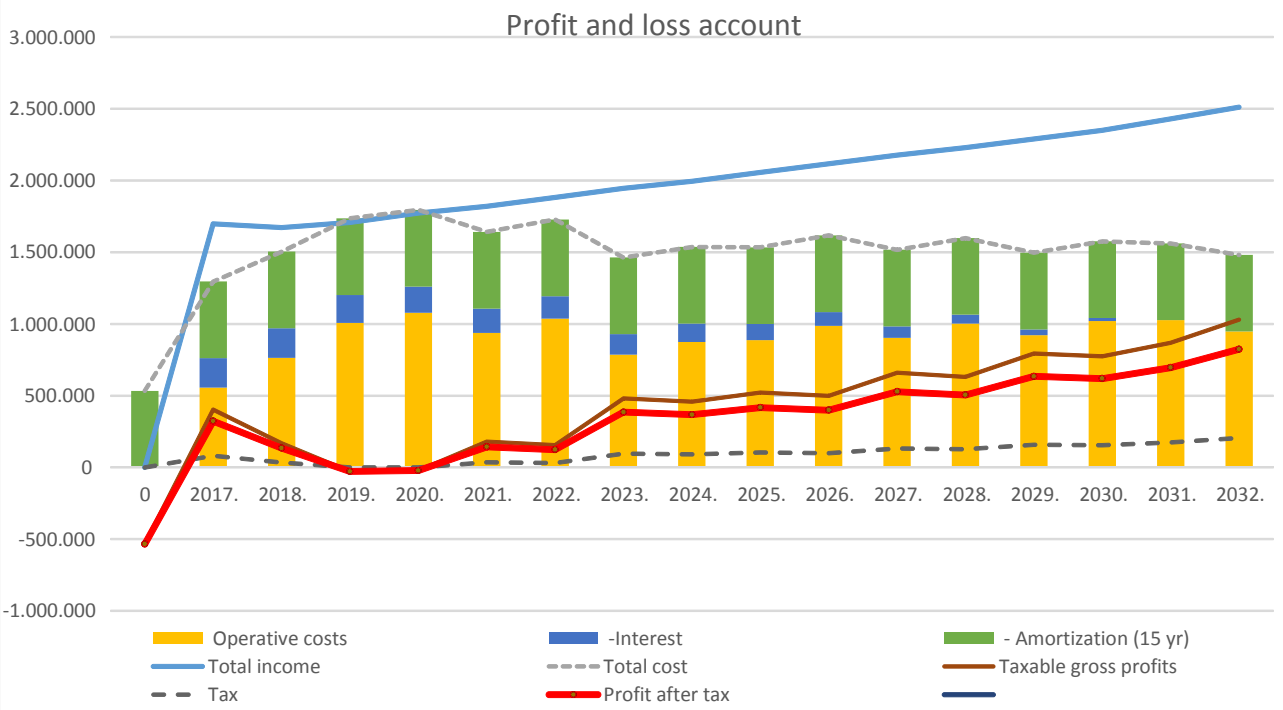


Figure 0.17. Profit and loss account according to SC1 scenario

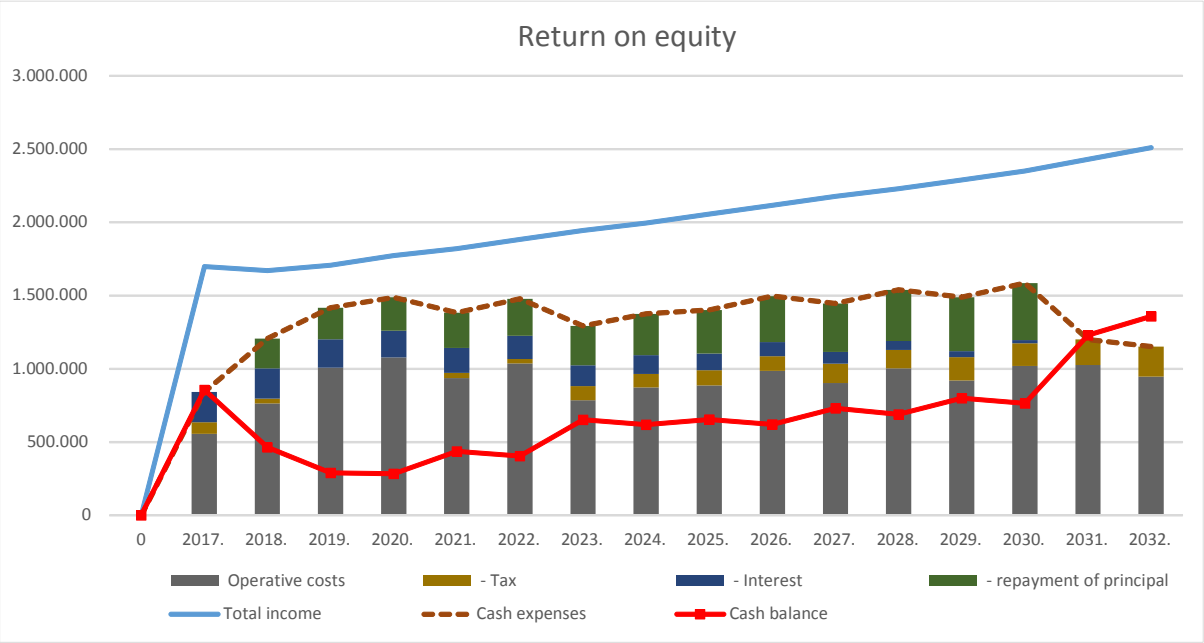


Figure 0.18. Return on equity according to SC1 scenario

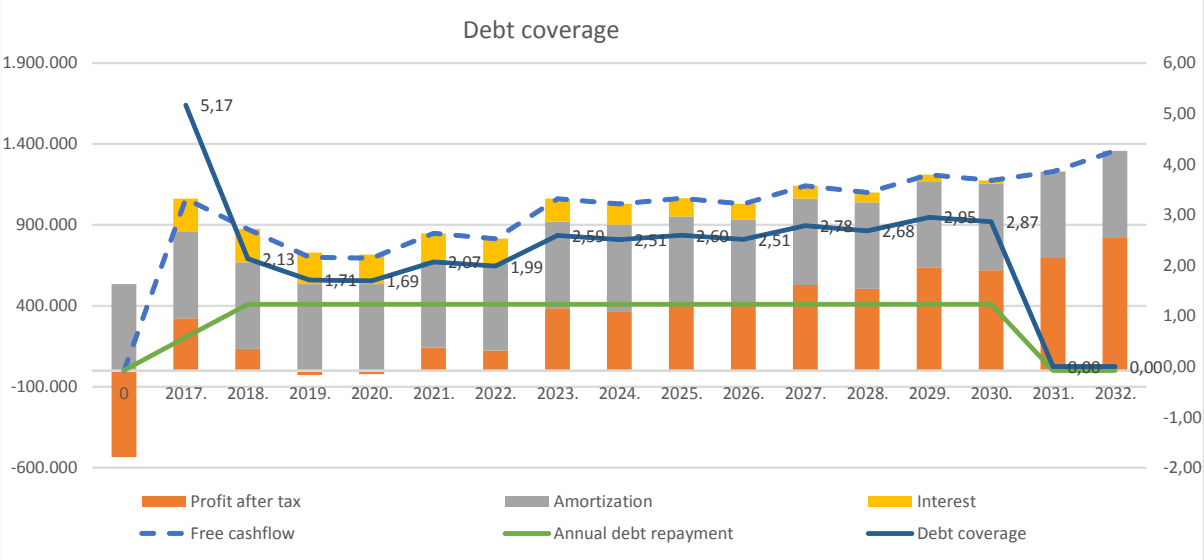


Figure 0.19. Debt coverage ratio according to SC1 scenario

6.1.2. SC-2 scenario of establishing e-scooter sharing service

The SC-2 scenario presumes establishing the *e-scooter sharing* service with 80 vehicles distributed in 14 locations in the city. Compared to the previous scenario, this scenario does not presume the construction of charging stations on the locations for *e-scooter* parking, but it presumes that all the batteries (discharged to a certain level) are replaced with charged batteries, and that empty batteries are charged in one location.

The dynamics of the increase in the number of vehicles over the project life is planned as follows:

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Number of vehicles	80	82	84	87	90	93	96	99
Year	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Number of vehicles	102	105	108	111	114	117	121	125

The main parameters used in the economic and financial analysis in the SC-2 scenario are provided below.

Parameters	**2017 – 2032**
Number of vehicles	80 – 125
Number of employees	5 – 7
Number of members	1 200– 4 014

The number of employees in the first year includes a manager and 4 service workers in charge of maintaining the vehicles (one service worker per 20 vehicles). The number of employed service workers would be increased with the increase in the number of vehicles, so from 2021 there would be 5 workers, and from 2028, six would be needed. The greater number of service workers compared to the first scenario is required due to the need to replace the discharged batteries and their charging 24/7.

Investment costs

Investment costs include the costs required to start the project. Of the total investment cost, the largest share relates to the purchase of vehicles, equipment of the operations centre for battery charging and the purchase of spare batteries. In addition, investment costs include the costs of developing an interactive website and an interactive application for smart phones, the costs of equipping vehicles, marketing expenses in the first year, obtaining necessary permits, preparation of project documentation and professional services in the project development process. Total investment costs are net of anticipated grants for the purchase of electric vehicles in the amount of HRK 7,500.00/vehicle.

Investments	
Purchase of 80 *e-scooters*	HRK 2,432,000
Obtaining necessary permits	HRK 20,000
Project documentation	HRK 120,000
Professional services in project development process	HRK 300,000
Costs of equipping the operations centre	HRK 1,000,000
Costs of developing interactive website	HRK 100,000
Costs of developing interactive application for smart phones	HRK 150,000
Costs of equipping vehicles (HRK 2,800.00 per vehicle)	HRK 224,000
Marketing expenses in the 1st year of the project	HRK 400,000
Spare batteries in the 1st year of the project	HRK 960,000
Costs of vehicle insurance in the 1st year of the project	HRK 112,000
Purchase of vans	HRK 228,000
Subsidies for e-vehicles	HRK -600,000

Operating expenses

In addition to employee salaries, operating expenses include the costs of the operations centre, maintenance costs for monitoring and control equipment, management costs (accounting, tax consulting, etc.), costs of registration and insurance and equipping of new vehicles, costs of electricity to power the vehicles, costs of purchasing batteries and marketing expenses. Marketing expenses in the second year amount to HRK 100,000, in the third and fourth year to HRK 50,000, and in later years, they are planned at HRK 40,000 annually.

Operating expenses	
Gross employee salaries	HRK 528,000 in the 1st year
Utility expenses of operations centre	HRK 72,000 annually
Management costs	HRK 24,000 annually
Maintenance of vehicles and equipment	HRK 96,000 in the 1st year
Maintenance of monitoring and control equipment	HRK 12,000 annually
Equipping of new vehicles	HRK 2,800 per vehicle
Marketing expenses	HRK 100,000 in the 2nd year; HRK 50,000 annually (3rd-4th year); HRK 40,000 annually (5th-15th year)
Registration and insurance of vehicles	HRK 1,400 per vehicle annually
Fuel to power the vehicles	HRK 0.02 per km
Purchasing batteries	HRK 12,000 per battery

Summary results of the economic and financial analysis carried out using the above criteria according to scenario SC-2 are presented in the table below.

Bank Perspective: debt service coverage ratio (DSCR)	0,96	**Too low**
Investor's Perspective: ROE	18%	**o.k.**
IRR	11%	**o.k.**
Payback Period: PBP	9	**o.k.**
NPV	276.179	**o.k.**

Of the observed indicators analysed in the economic and financial analysis according to the SC-2 scenario, the debt service coverage ratio (DSCR) is less than 1 which indicates that the project in all the years does not generate sufficient revenue to repay its debts. The period of return of investment funds is 2 years longer than in the SC-1 scenario. Other analysed indicators are also positive.

The figures below show diagrams presenting the project's cash flow (Figure 0.20.), the income statement (Figure 0.21.), the calculation of yield on own capital (Figure 0.22.), and the calculation of debt service coverage (Figure 0.23.).

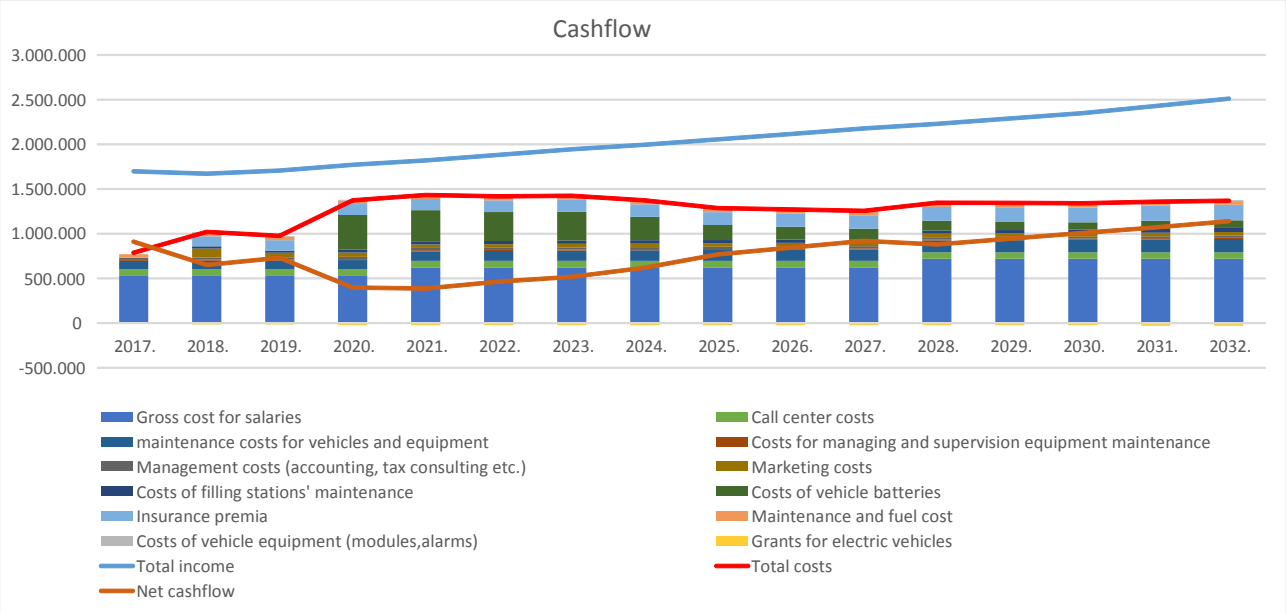


Figure 0.20. Project's cash flow for scenario SC-2

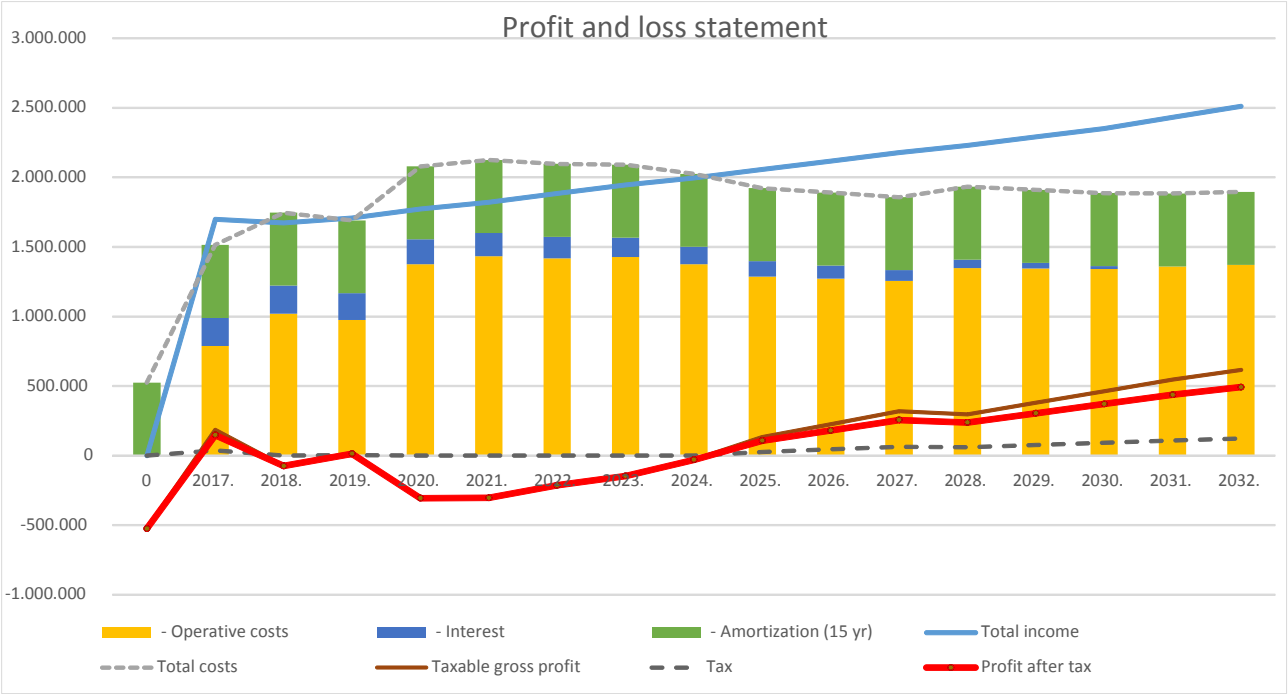


Figure 0.21. Profit and loss statement for scenario SC-2

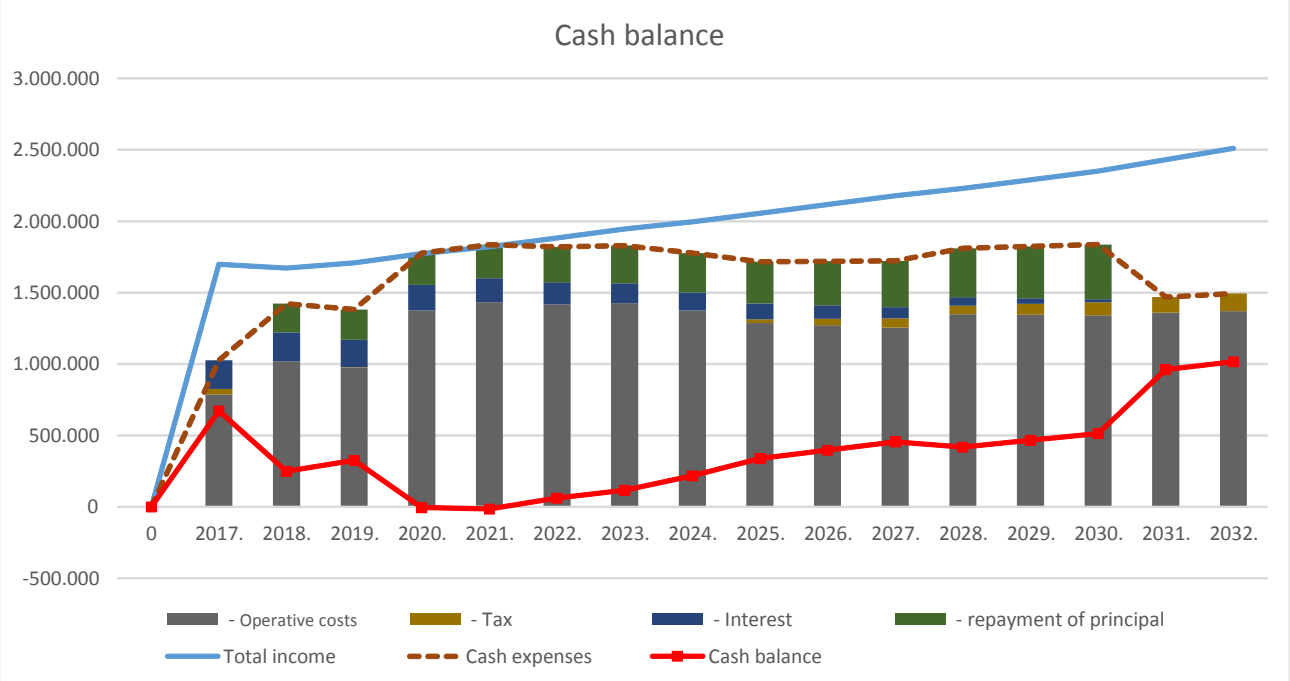


Figure 0.22. Calculation of yield on own capital for scenario SC-2

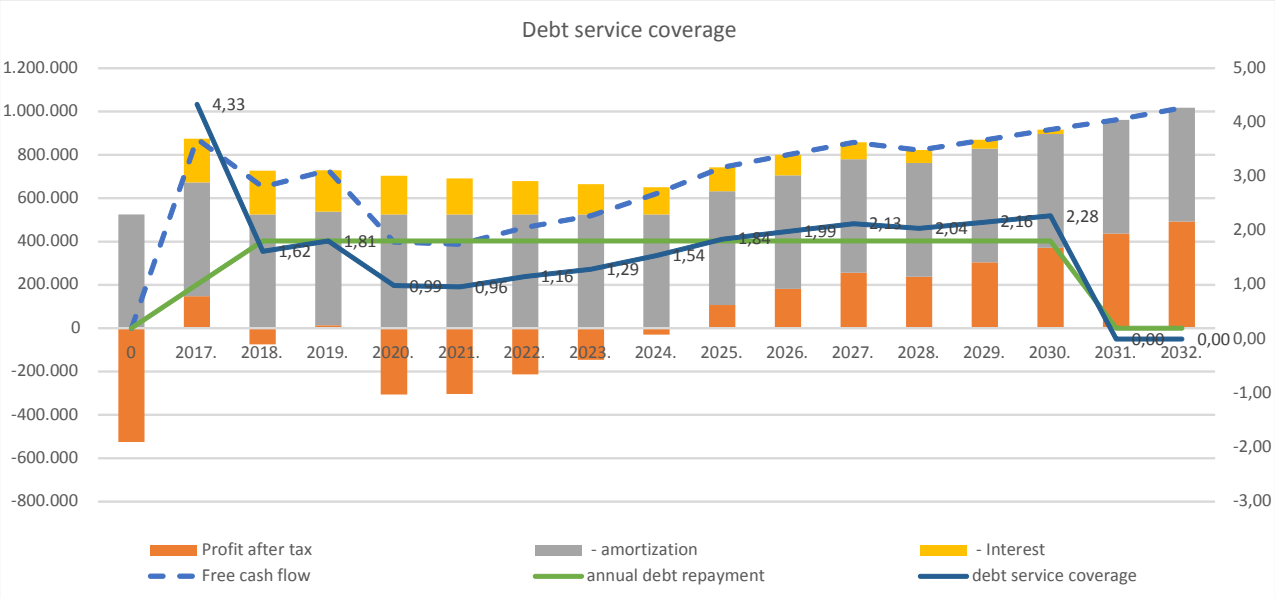


Figure 0.23. Calculation of debt service coverage for scenario SC-2

6.1.3. SC-3 scenario of establishing e-scooter sharing service

The SC-3 scenario presumes establishing the *e-scooter sharing* service with 80 vehicles distributed in 14 locations in the city. Compared to the previous scenario (SC-2), the replacement of discharged batteries that would be performed 24/7 is not presumed, but it presumes that all the batteries (discharged to a certain level) are collected after 11 p.m., charged in the central location and returned on *e-scooters* until 6 a.m.

This scenario does not presume investment in spare batteries or charging stations in *e-scooter* parking locations.

The dynamics of the increase in the number of vehicles over the project life is planned as follows:

Year	2017	2018	2019	2020	2021	2022	2023	2024
Number of vehicles	80	82	84	87	90	93	96	99
Year	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Number of vehicles	102	105	108	111	114	117	121	125

The main parameters used in the economic and financial analysis in the SC-3 scenario are provided below.

Parameters	2017 – 2032
Number of vehicles	80 – 125
Number of employees	4 – 5
Number of members	1 200– 4 014

The number of employees in the first year includes a manager and 3 service workers in charge of maintaining the vehicles and charging the batteries (one service worker per 25 vehicles). The number of employed service workers would be increased with the increase in the number of vehicles, so from 2021 there would be 4 workers, and from 2029, five would be needed. The greater number of service workers compared to the first scenario is required due to the need to replace the discharged batteries and their overnight charging.

Investment costs

Investment costs include the costs required to start the project. Of the total investment cost, the largest share relates to the purchase of vehicles and the equipment of the operations centre for battery charging. In addition, investment costs include the costs of developing an interactive website and an interactive application for smart phones, the costs of equipping vehicles, marketing expenses in the first year, obtaining necessary permits, preparation of project documentation and professional services in the project development process. Total investment costs are net of anticipated grants for the purchase of electric vehicles in the amount of HRK 7,500.00/vehicle.

Investments	
Purchase of 80 *e-scooters*	HRK 2,432,000
Obtaining necessary permits	HRK 20,000
Project documentation	HRK 120,000
Professional services in project development process	HRK 300,000
Costs of equipping the operations centre	HRK 1,000,000
Costs of developing interactive website	HRK 100,000
Costs of developing interactive application for smart phones	HRK 150,000
Costs of equipping vehicles (HRK 2,800.00 per vehicle)	HRK 224,000
Marketing expenses in the 1st year of the project	HRK 400,000
Costs of vehicle insurance in the 1st year of the project	HRK 112,000
Purchase of vans	HRK 228,000
Subsidies for e-vehicles	HRK -600,000

Operating expenses

In addition to employee salaries, operating expenses include the costs of the operations centre, maintenance costs for monitoring and control equipment, management costs (accounting, tax consulting, etc.), costs of registration and insurance and equipping of new

vehicles, costs of electricity to power the vehicles, costs of purchasing batteries and marketing expenses. Marketing expenses in the second year amount to HRK 100,000, in the third and fourth year to HRK 50,000, and in later years, they are planned at HRK 40,000 annually.

Operating expenses	
Gross employee salaries	HRK 432,000 in the 1st year
Utility expenses of operations centre	HRK 72,000 annually
Management costs	HRK 24,000 annually
Maintenance of vehicles and equipment	HRK 96,000 in the 1st year
Maintenance of monitoring and control equipment	HRK 12,000 annually
Equipping of new vehicles	HRK 2,800 per vehicle
Marketing expenses	HRK 100,000 in the 2nd year; HRK 50,000 annually (3rd-4th year); HRK 40,000 annually (5th-15th year)
Registration and insurance of vehicles	HRK 1,400 per vehicle annually
Fuel to power the vehicles	HRK 0.02 per km
Purchasing batteries	HRK 12,000 per battery

Summary results of the economic and financial analysis carried out using the above criteria according to scenario SC-3 are presented in the table below.

Bank Perspective: debt service coverage ratio (DSCR)	1,61	**o.k.**
Investor's Perspective: ROE	39%	**o.k.**
IRR	19%	**o.k.**
Payback Period: PBP	6	**o.k.**
NPV	2.553.477	**o.k.**

According to the results obtained, we can conclude that, in case all the system presumptions were realised, all the major project performance indicators would be positive. The debt service coverage ratio (DSCR) is significantly higher than 1 which indicates that the project generates sufficient revenue to repay its debts, with the period of return of investment funds of 6 years.

The figures below show diagrams presenting the project's cash flow (Figure 0.24.), the income statement (Figure 0.25.), the calculation of yield on own capital (Figure 0.26.), and the calculation of debt service coverage (Figure 0.27.).

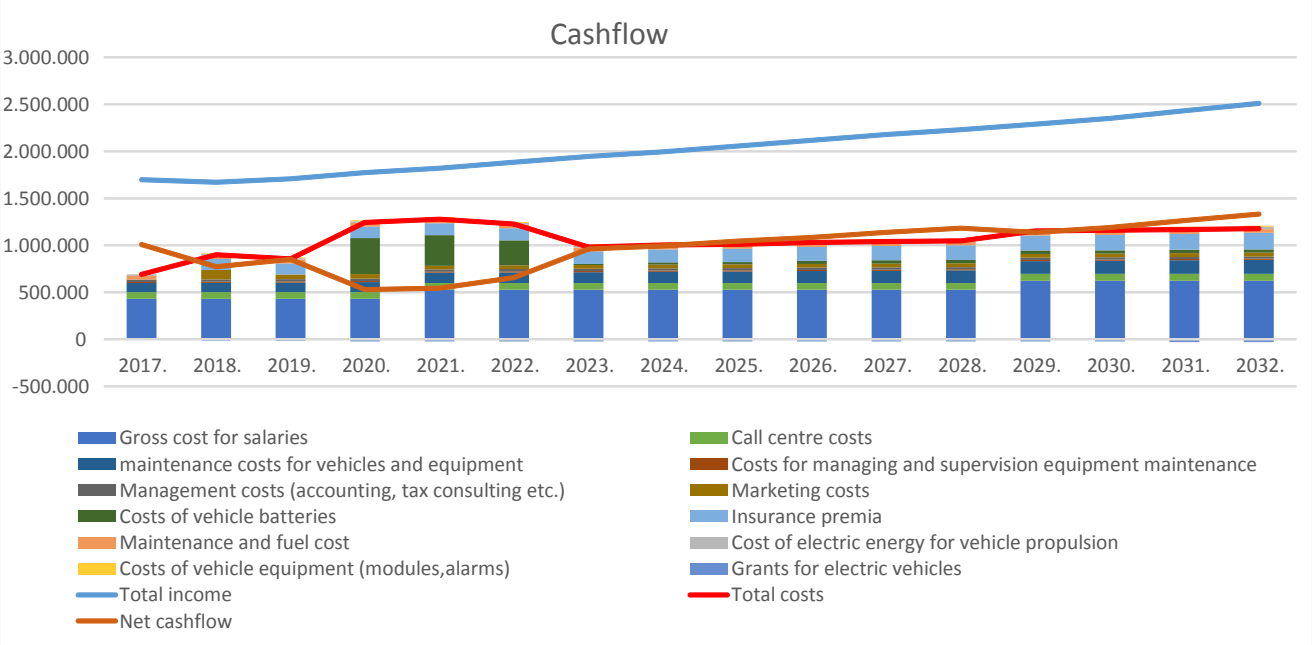


Figure 0.24. Project's cash flow for scenario SC-3

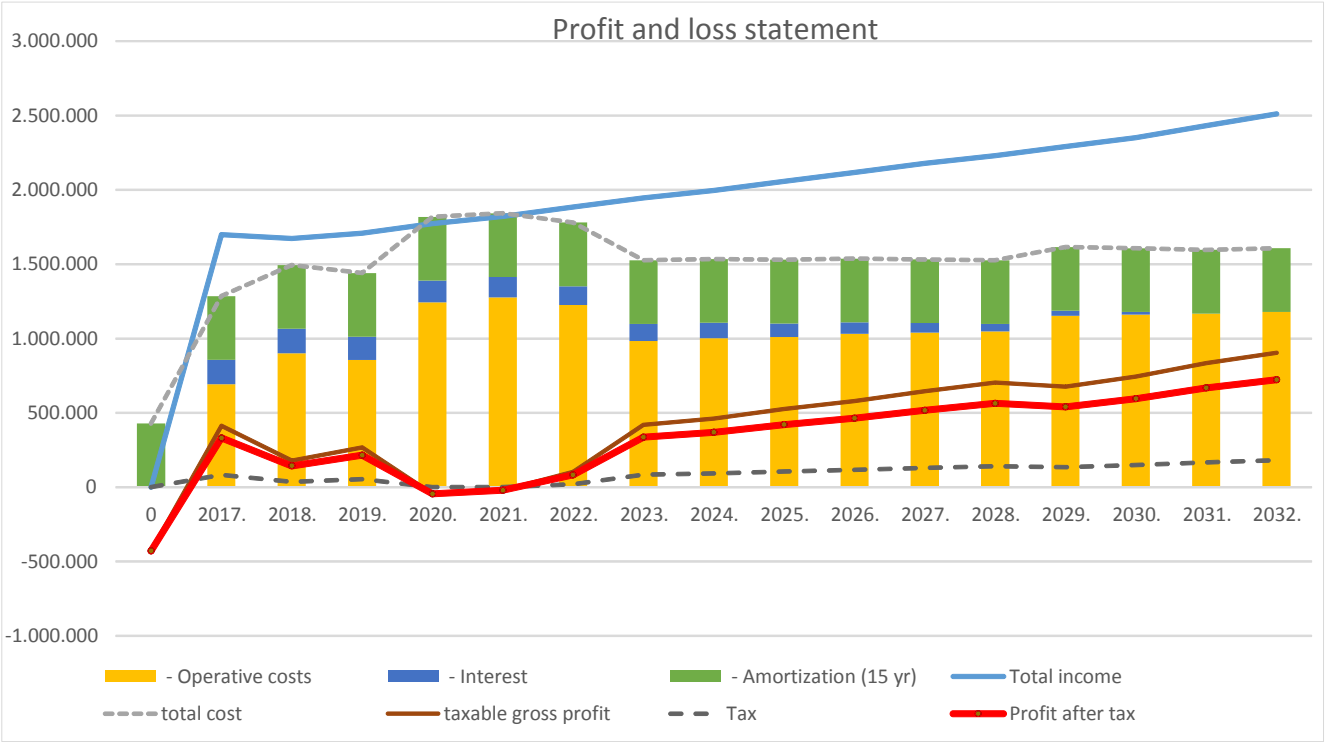


Figure 0.25. Profit and loss statement for scenario SC-3

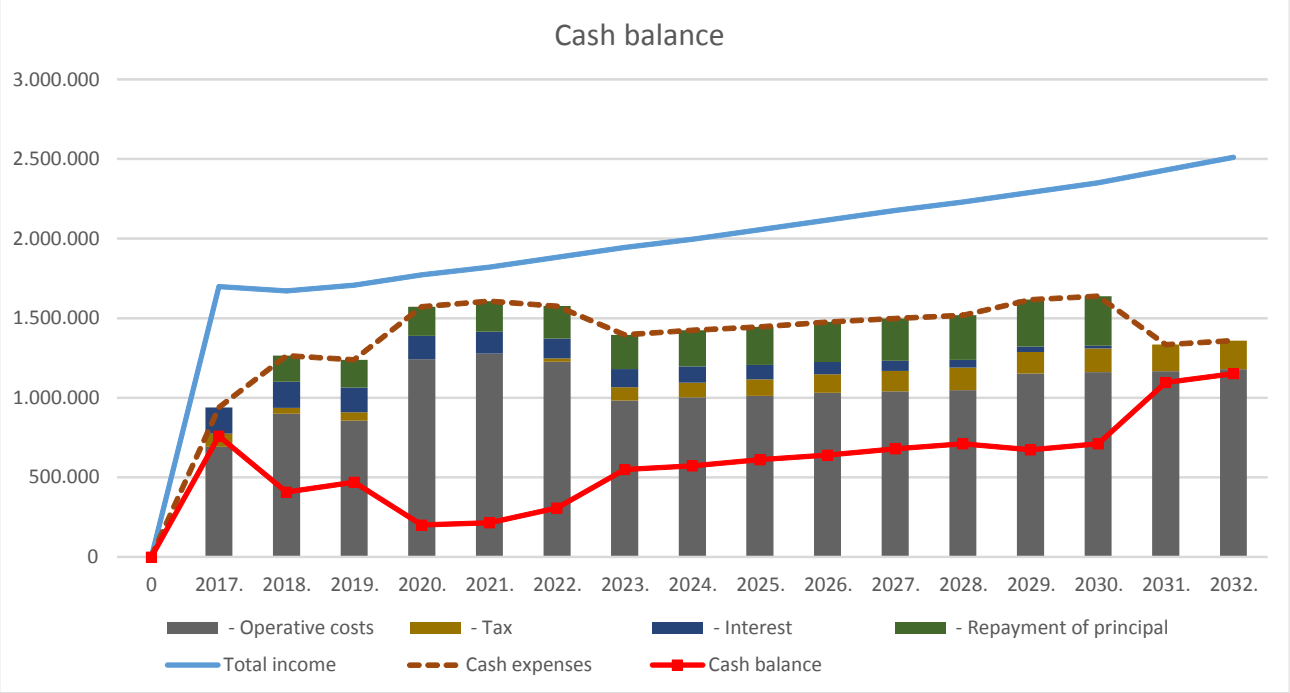


Figure 0.26. Calculation of yield on own capital for scenario SC-3

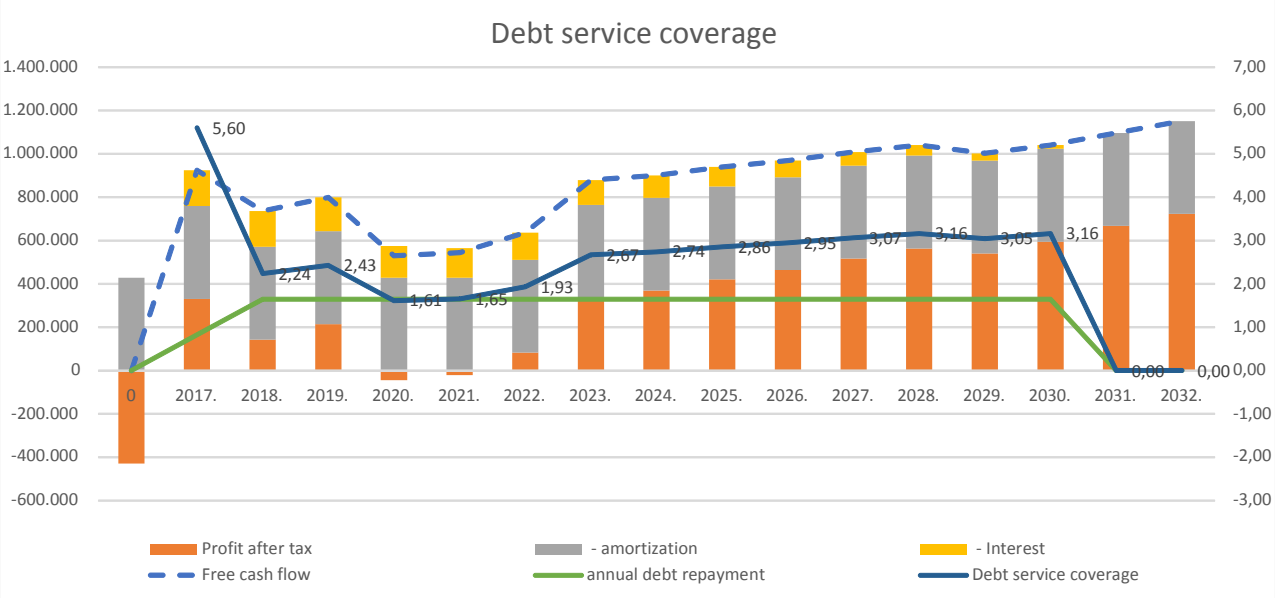


Figure 0.27. Calculation of debt service coverage for scenario SC-3

6.2. Private owners of electric vehicles

The share of electric vehicles in the structure of the City of Zagreb's (and Croatia's) vehicle fleet is very small, mainly due to the high purchase cost of electric vehicles compared to conventional vehicles. In order to increase the number of electric vehicles, in 2014 in Croatia the "**Let's drive economically**" project was launched and through it grants are awarded to citizens and companies for purchasing electric and hybrid cars and electric *scooters*, motorcycles and quadricycles. Below is the comparison of the total cost, from the investment to purchase the vehicles to operating expenses for an electric *scooter* and a petrol engine

scooter. The analysis includes *scooters* that can develop the speed of up to 50 km/h, with the following presumptions:

Table 0.3. Comparison of purchase costs and operating expenses of an electric and petrol scooter

	e-scooter	petrol
Investment (HRK)	30 400	17 000
Subsidy (HRK)	7 500	-
Battery (HRK)	12 000	-
Maintenance (HRK/year)	200	800
Energy consumption (HRK/km)	0.02	0.315

The analysis was made in a way that a comparison of all the costs, from the purchase of vehicles, maintenance and fuel consumption for a petrol and electric *scooter* was made for the life of 15 years. The analysis covered different annual mileages of vehicles, of 2000 km, 4 000, 6 000 and 10 000 km.

With the annual mileage of 2 000 km, the total costs of using an electric *scooter* are significantly higher than for a *scooter* with petrol engine. The analysis foresaw the replacement (purchase) of a new battery for the electric vehicle every 5 years of use. The battery cost is the major cost that in this economic profitability analysis gives advantage to the *scooter* with petrol engine.

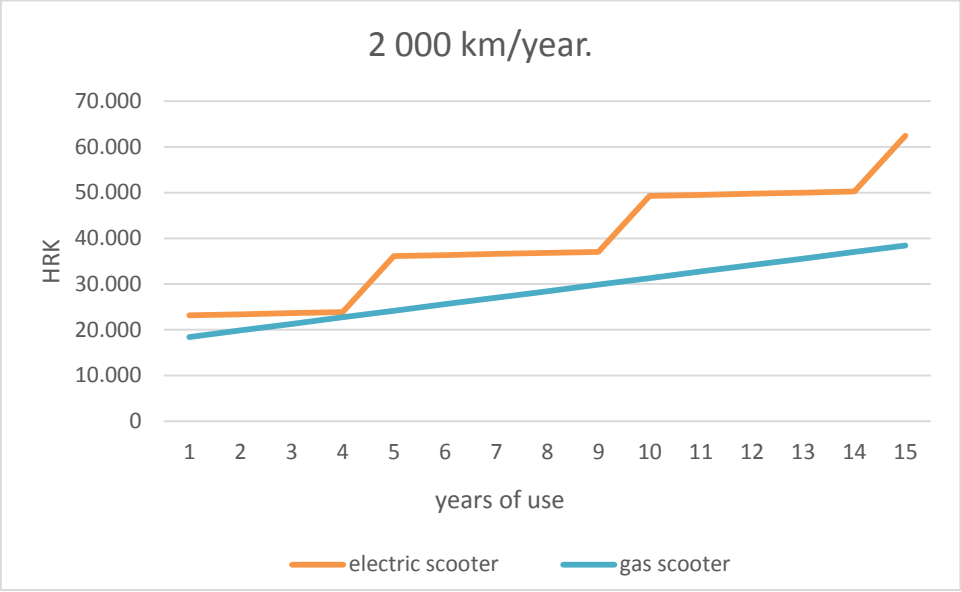


Figure 0.28. Comparison of a petrol and electric scooter with the annual mileage of 2 000 km

If the use of the *scooter* increases to 4 000 km/year, the total costs of the electric *scooter* are similar to the costs of a petrol *scooter*, but they are still higher.

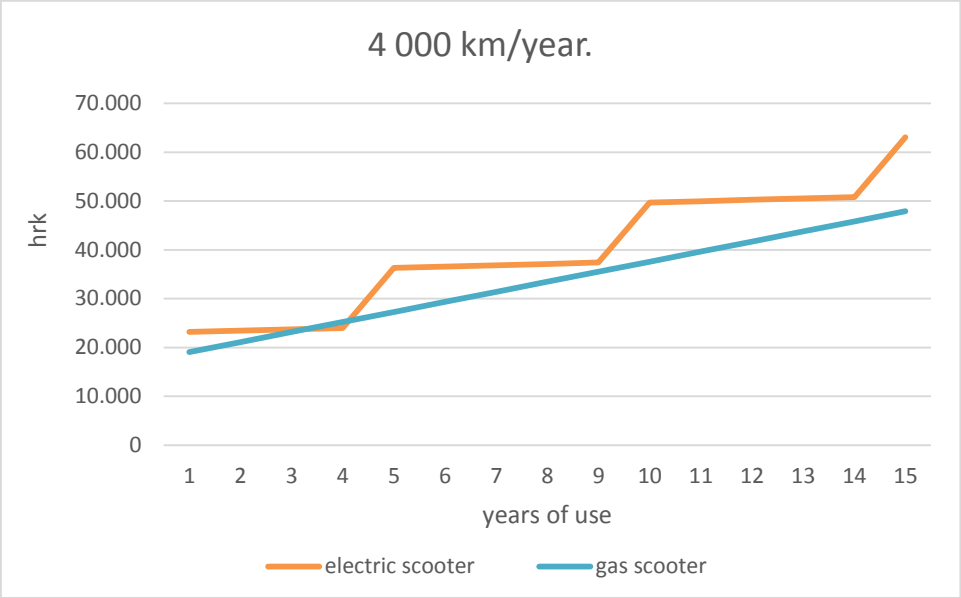


Figure 0.29. Comparison of a petrol and electric scooter with the annual mileage of 4 000 km

By a further increase in the annual mileage to 6 000 kilometres, costs of using an electric and petrol *scooters* are roughly equal. The costs of using a petrol scooter compared to an electric one significantly increase by increasing the mileage due to significantly higher prices of the power energy.

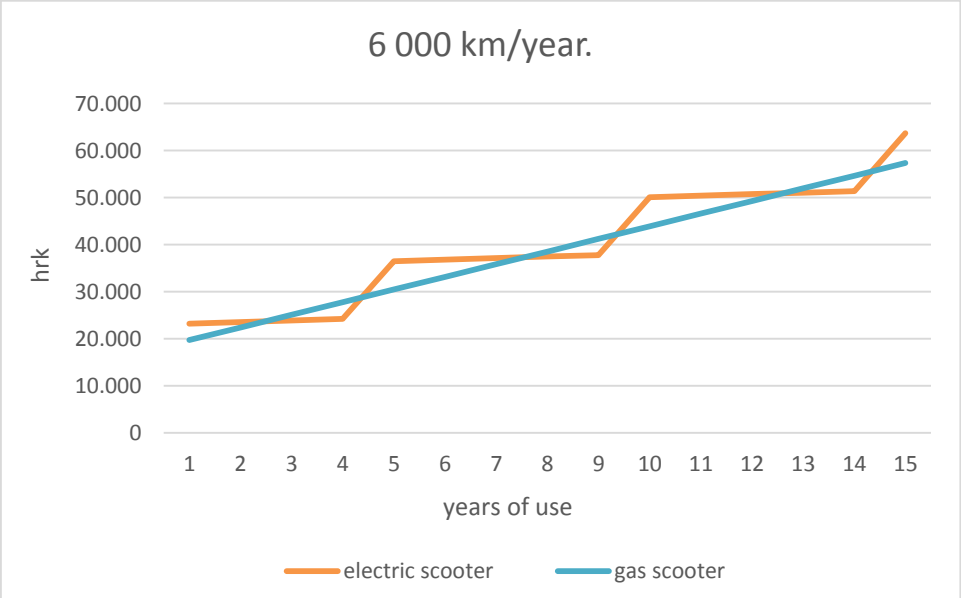


Figure 0.30. Comparison of a petrol and electric scooter with the annual mileage of 6 000 km

With the annual mileage of 10 000 km, the total costs of an electric *scooter* are lower than for the petrol one already after the second year of use.

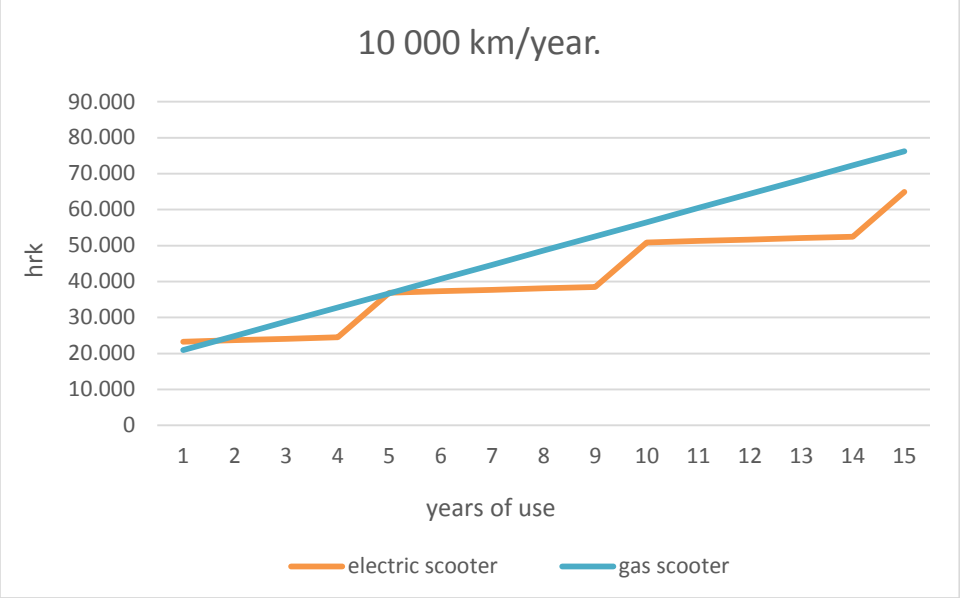


Figure 0.31. Comparison of a petrol and electric scooter with the annual mileage of 10 000 km

From the above economic analysis we can conclude that the purchase price of an electric vehicle and the price of a battery for the electric vehicle are crucial if we compare the electric vehicle with a petrol vehicle of similar characteristics. Given that the average mileage of motorcycles in Croatia is significantly less than 6 000 km (limit of economic profitability) it is not to be expected that the share of electric *scooters* will significantly increase without further subsidising purchases of these vehicles. Only with a reduction in the difference between the price of electric vehicles (and related batteries) and petrol vehicles, a greater expansion of electric vehicles on the market can be expected.

6.3. Business owners of electric vehicles

Potential business users of electric *scooters* are primarily companies engaged in postal activities or the delivery of packages. Besides them, potential users are also restaurants whose activities include the delivery of food and all other companies engaged in the distribution of goods in the city. Except for such companies, potential business users are also companies that have a higher number of employees. Such firms usually have the need of internal communication by vehicles if the company has several different locations in the city or has a need for carrying out the work at different locations in the city. Some proportion of demand for transport in such major companies would certainly be optimally performed by using an electric *scooter*. The city of Zagreb has around 1 600 legal entities with more than 100 employees. According to some experiences, in most such companies there is a need for at least one vehicle of this kind.

Since vehicles of business entities usually cross significantly more kilometres per year than private vehicles, the economic calculation goes in favour of at least one electric *scooter* in fleets of business entities. The above shows that in the business entities in the City of Zagreb in a relatively short period of time around 1 800 *e-scooters* could be used. In order to achieve this, it is extremely important to reach out to these potential users by promotional activities and education in order for them to decide to purchase and use electric vehicles.

7. IDENTIFICATION OF APPROPRIATE TECHNOLOGY AND IMPLEMENTATION OF INFRASTRUCTURE

7.1. Electric scooters

On the market there are many types of electric scooters, which in principle at first glance seem rather similar. The main difference is in the type and capacity of the battery. The main types are the batteries with silicone gel, lead or lithium. Of course, there are many other important components such as the engine and the structure, which cannot be ignored, but there are no great differences among them that affect the end user. All these differences lead to the wide range of prices of electric *scooters* that range from EUR 2 000 to 5 500.

The simplest comparison is in the range, so the cheaper ones using silicone gel or lead in the battery relatively quickly lose capacity, so after the initial 50 km per charge, after less than a year of use they fall to about 30 km. On the other hand, for *scooters* in the top price range we can count on 100 km per charge even after a long period of use. Therefore, in cases of higher loads and longer daily routes, and if used for business purposes, the only option are good quality *scooters* with a lithium battery, range of 100 km and price over EUR 5000.

Figure 0.32. Examples of electric scooters

In case of private owners and short daily routes (up to 25 km), the use of a *scooter* with lower capacity batteries and lower engine power is justified.

Another important difference among *e-scooters* is the way of installing the battery, i.e. whether it can be removed from the structure or not. This is very important and is closely linked to the possibility of charging the battery. If there is a charging station or external power socket to which the *scooter* can be easily connected by a cable, then the fitted fixed battery is not a problem. Given that the City of Zagreb has a very small number of charging stations, the use of such *scooters* is possible only in case external sockets are available (usually in a private or a company's garage). Also, the route planning for this type of *scooters* has to be very precise because of the small number of charging locations.

For other types of *scooters* with a removable battery, the use and charging options are much more flexible and easier, but usually these batteries have a smaller capacity. These *scooters* also have a lighter structure, so they are not suitable for larger loads.

Therefore, in case of a *scooter sharing* system and its application, taking into account the infrastructure of Zagreb and experiences of other cities, the option of *scooters* with removable batteries is much more promising for the realisation.



Figure 0.33. Examples of electric scooters with a removable battery

Some manufacturers also offer electric vehicles that do not exceed the speed of 25 km/h and a maximum engine power of 250 W, but in terms of structure they look like *scooters* and are called scooters. In fact, they belong to the category of electric bikes and such "scooters" are not required to be registered, a helmet is not obligatory for them and the traffic rules for e-bikes are applicable to them, i.e. they are allowed to ride on bicycle paths.

Figure 0.34. Example of electric scooter up to 250 W

7.2. Electric quadricycles

This type of light vehicles is very significant because it can greatly contribute to the spread of electric vehicles in urban traffic due to its characteristics. These are vehicles on four wheels driven by engines of up to 4 kW and a maximum speed of up to 45 km/h so they are registered under the same conditions as scooters of this power and speed. The range of such vehicles also varies depending on the quality of the battery, but the average data indicate 30 to 60 km with a single charge. There are also models with more powerful engines and higher speed, but such vehicles fall in the higher transport and financial category. An additional advantage of this vehicle is the roof, so the driver is protected from external weather conditions, which significantly extends the use of vehicles on an annual basis. Such vehicles have two seats so this is also an important advantage because it is considerably easier to transport two people than on scooters. Also, there are various examples of structures of such vehicles and installed batteries, so the prices vary from EUR 6,000 to EUR 13,000. Such a high price is in fact the most common reason why the use of these vehicles has not become significant yet.


Figure 0.35. Examples of electric quadricycles

In this type of vehicle, even more often than in scooters, the battery is fixed and the availability of charging infrastructure is even more important, which also influences the decision to use this type of vehicle. There are examples of vehicle structures where the battery can be removed, but such options further increase the cost of vehicle.

Figure 0.36. Examples of electric quadricycles with removable battery

8. ENVIRONMENTAL IMPACTS OF THE PROPOSED SCENARIOS

Carbon dioxide (CO_2) is the most significant anthropogenic greenhouse gas. The increase in anthropogenic emissions of CO_2 causes an increase in its concentration in the atmosphere and consequently leads to global warming and climate change.

Analysing the experiences of cities in which *scooter sharing* pilot schemes have been established, it is evident that it is possible to achieve significant fuel savings and reduce CO_2 emissions already in the first year of operations. In Barcelona, the so-called *Motit e-scooter sharing* has been established, whose business is currently based on 70 electric *scooters*. In the first year of operations, they achieved an average of about 264 user rides per day (220 citizens and 44 tourists) which corresponds to about three and a half rides a day per one electric scooter. In accordance with the mileage made, it is estimated that they saved around 10,685 litres of fuel per year, or that they reduced annual emissions by about 20.2 tons.

For the City of Zagreb, three possible scenarios, or *scooter sharing* scheme development models, are proposed. All three scenarios presume that the project starts with 80 electric scooters. The number of electric *scooters*, according to the model, would increase from year to year, and over 15 years of implementation it would rise to 125.

Taking into account the basic assumptions of the model (4.5 rides per vehicle per day with an average length of 6 kilometres), the conclusion is the possibility to reduce CO_2 emissions by about 62,805 kilograms already in the first year of operations (compared to a petrol *scooter* of a similar category). Cumulatively, for all 15 years of operation, according to the model assumptions, it is possible to achieve savings of around 1,267,089 kg of CO_2.

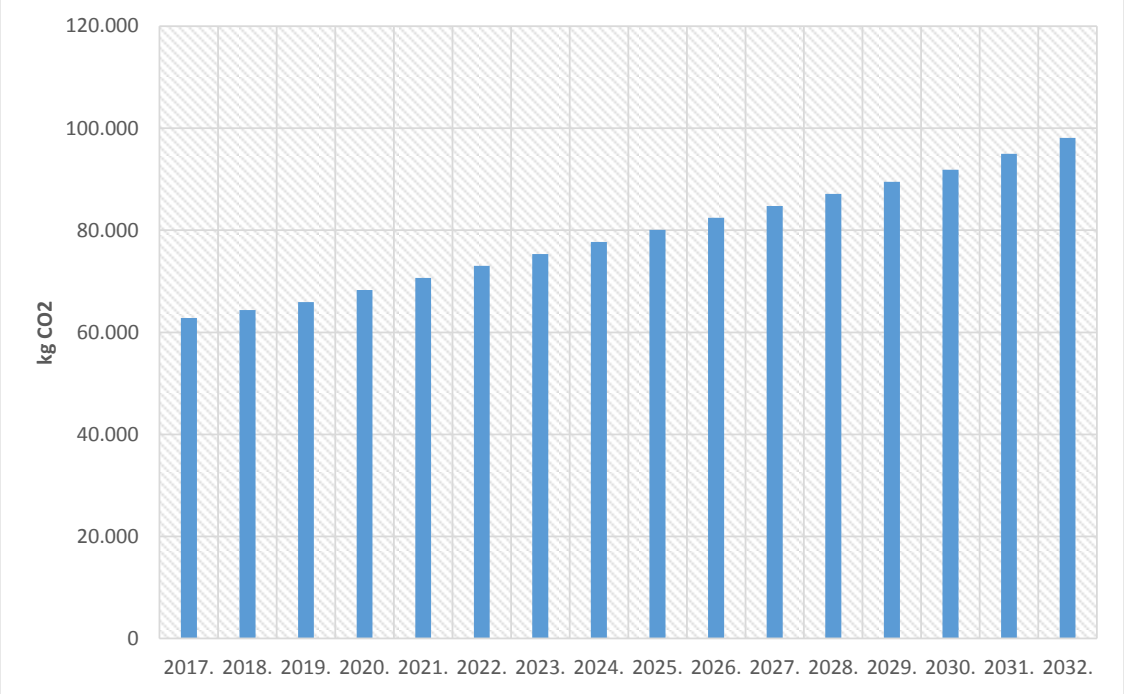


Figure 0.37. Projection of possible CO_2 emission reductions by establishing scooter sharing in the City of Zagreb

In addition to the *scooter sharing* scheme, a number of L category electric vehicles owned by natural and legal persons (larger companies) is expected. Taking into account the expected number of such vehicles (described in section 9.1), and assuming that individuals will make

approximately 6 000 kilometres per year (the marginal economic profitability shown in section 6.2.), and legal entities approximately 12 000 kilometres per year, the cumulative reduction in CO_2 emissions in the 10-year period of 6,378 tonnes of CO_2 is foreseen (calculated in relation to L category petrol vehicles).

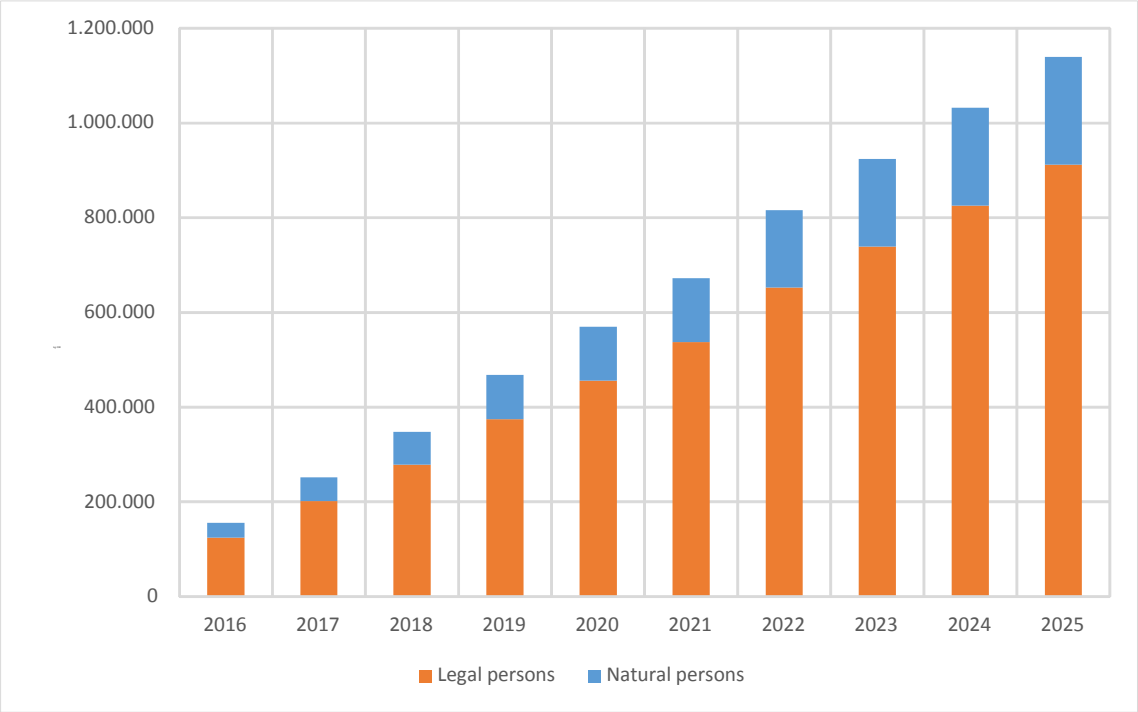


Figure 0.38. Expected CO_2 emission reduction taking into account the increase in L category electric vehicles

Awareness of the importance of air quality in urban areas and its impact on human health is increasingly important, and the city traffic is a significant source of pollution. While on the global level the carbon dioxide (CO_2) emission level is an important indicator, on the local level the reduction in emissions of other harmful gases is particularly important: carbon monoxide (CO), nitrogen oxides (NO_x), and (potentially carcinogenic) solid particles. By the increase in the number of electric vehicles in the City of Zagreb, significant reductions in emissions of these gases and pollutants are also expected.

9. ACTIVITY PLAN FOR INTRODUCING THE E-SCOOTER SHARING SYSTEM IN ZAGREB

9.1. Activities that can be implemented and the number of planned light electric vehicles

In early 2015, the Environmental Protection and Energy Efficiency Fund co-financed on the national level a total of 91 L category electric vehicles. Using the Fund's resources, natural persons purchased a total of 27 electric vehicles (16 of L1 category, 1 of L3 category and 10 of L7 category), while legal entities purchased a total of 64 electric vehicles (42 of L1 category, 3 of L2 category and 19 of L3 category). Due to a successful campaign and great public interest, the Fund will allocate further HRK 7.5 million for co-financing of electric vehicles in 2015.

Under the assumption that the Fund will continue the program of co-financing of electric vehicles, and given the current trend of purchasing these vehicles through the existing programme, the number of purchases of new L category electric vehicles in the coming period in the City of Zagreb can be projected.

Taking into account the fact that the City of Zagreb is the administrative and political centre of the Republic of Croatia it is expected that of the total number of purchased vehicles of L category in Croatia (using the Fund's resources) nearly 50 percent will be registered in the City of Zagreb. Thus, the approximate purchase of 75 electric vehicles of L category annually in the City through the Fund's system of co-financing is foreseen. With additional assumptions of the increase in purchases of such vehicles without using the Fund's financial resources (30 percent in the first three-year period, 35 percent in the second three-year period and 40 percent after 2021), the approximate number of 1,425 electric vehicles of L category in 2025 is expected (950 legal entities, 475 natural persons). These projections do not include vehicles that are part of the *scooter sharing* scenario.

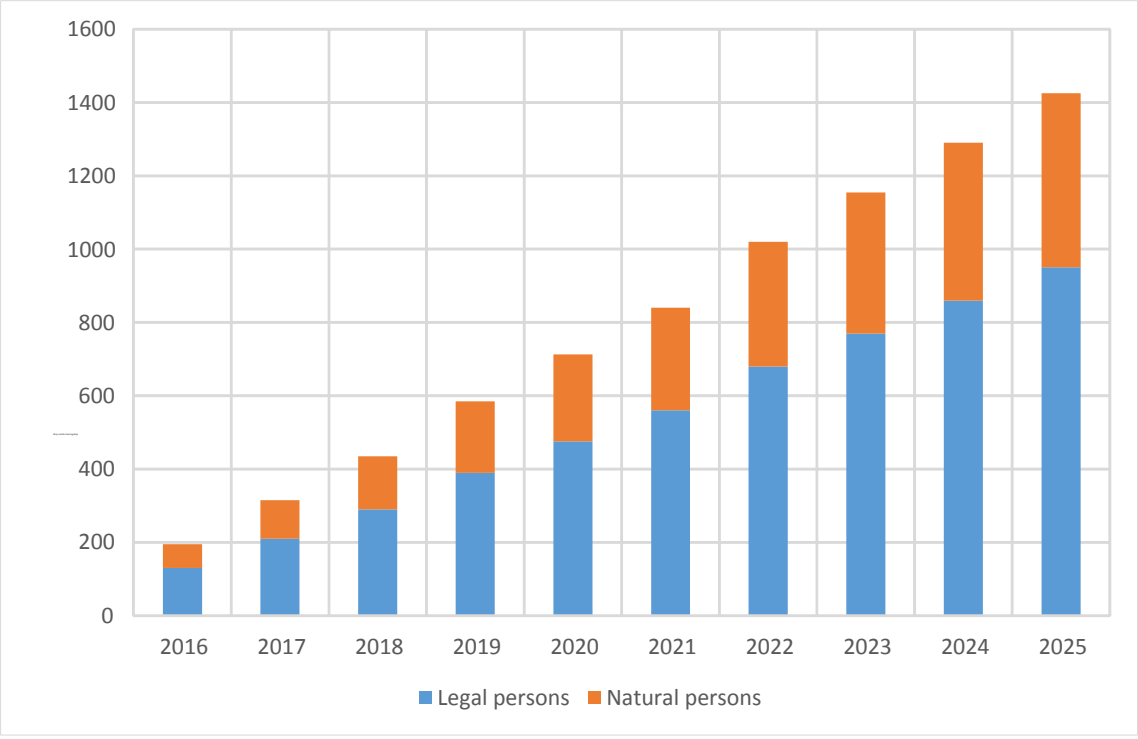


Figure 0.39. Projection of the number of L category electric vehicles in the City of Zagreb

It is definitely recommended to the City of Zagreb to consider making the decision on a partial replacement of the existing vehicle fleet with electric vehicles in one of the upcoming procurement procedures. For the local government, popularisation of cleaner technologies in traffic is a mechanism of public relations that can achieve maximum effects of acceptance by citizens for a relatively small investment. The city authorities can properly communicate with the general public by their own example, sending a clear message about the trends of development and implementation of the city's thoughtful sustainable development policy.

9.2. Key participants in the preparation and implementation of the EV sharing system

The project of implementing the *scooter sharing* system in the transport system of the City of Zagreb, including the activities of promotion of light electric vehicles and *scooters*, requires a comprehensive, integrated and interdisciplinary approach. In order to implement the project as successfully as possible, it is essential to categorise stakeholders and define their roles in each phase of the project implementation. The most important stakeholders can be categorised into three groups:

- business stakeholders (suppliers and distributors of electric vehicles, infrastructure and technology, equipment service, system operators, electricity suppliers, etc.)
- demand stakeholders (large companies, schools, university facilities, tourist offices, hotels, shopping centres, etc.)
- institutional stakeholders (local authorities, public bodies, associations, research institutes. etc.)

The interest of individual categories of stakeholders to participate in the programme of implementing the electric *scooters sharing* system is wide and can be systematised with respect to each category;

- The interest of business stakeholders
  - ✓ promotion of products and services in a broad range of end users (efficient marketing)
  - ✓ penetrating new markets (geographically and in terms of new users)
  - ✓ easier placement of products and services on the market due to incentives that are expected in the programme
  - ✓ opportunity for innovative products and services taking into account user feedback
  - ✓ achieving financial profit
  - ✓ cooperation with local authorities and the possibility for new projects

- The interest of demand stakeholders
  - ✓ raising awareness of sustainable mobility and innovative means of transport
  - ✓ own promotion and promotion of services (hotels, shopping centres, ...)
  - ✓ improving accessibility and acquiring new customers and influx of tourists
  - ✓ possibility of combining and integrating own services (e.g. discounts in shopping centres)
  - ✓ strong promotion with regard to participation in an innovative mobility model
  - ✓ cooperation with local authorities and the possibility for new projects

- The interest of institutional stakeholders
  - ✓ increasing social responsibility
  - ✓ reduction in energy consumption and pollutant gas and substances emissions
  - ✓ increasing the quality of life of citizens
  - ✓ raising awareness of the problem of sustainable mobility development
  - ✓ improving the quality of offer for the influx of tourists
  - ✓ promotion of sustainable mobility and alternative technologies

Although all the above stakeholders are not equally represented in all phases of the project implementation, their harmonic interaction is required in order for the resources to be properly used and the results to be optimal.

For the implementation of the *scooter sharing* project it is necessary to identify the **operational manager** who will be responsible for monitoring, managing, directing and supporting the project in all its phases. The operational manager is obliged to be familiar with all the project phases and all possible issues for the overall coordination of the project in order to optimise the use of time and all other resources of each stakeholder.

The **City Office for Energy, Environmental Protection and Sustainable Development** in cooperation with the **City Office for Physical Planning, Construction of the City, Utility Services and Transport** are proposed as the operational manager.

The City Office for Energy, Environmental Protection and Sustainable Development carries out activities related to energy and energy development planning, the efficient use of energy in direct consumption, sustainable development, renewable energy sources and environmentally friendly energy sources, environmental protection, air protection, noise protection. The Office's activities are based on initiating, promoting and creating appropriate programmes, plans, decisions and guidelines for the rational use of energy in direct consumption, preserving and improving the environment, while supporting the economic and industrial development, improvement in the standard of living, and thus the sustainable development of the City of Zagreb.

The City Office for Physical Planning, Construction of the City, Utility Services and Transport carries out activities related to the development and adoption of physical planning documents, traffic management, public land use, roads and road transport, traffic.

For the purpose of an easier and more efficient implementation, the operational manager should pay special attention to the presentation of the overall project to the general public, identify potential investors or the operators of the future implemented system, partners and stakeholders.

The **carrier of the investment** is a legal entity and the main actor in the project implementation. Its domain is primarily the construction of infrastructure and operational management of the overall programme. The basic idea of the programme for introducing the electric *scooter sharing* is self-sustainability, and certain financial profitability. In close cooperation with the Operational manager, the carrier of the investment will define the business model, sign agreements with stakeholders and develop a detailed investment study.

In the initial phase of the project there is a possibility of financial support from the **Environmental Protection and Energy Efficiency Fund**, whose activities relate to financing the preparation, implementation and development of programmes, projects and similar activities in the field of preservation, sustainable use, protection and improvement of the environment and in the area of energy efficiency and the use of renewable energy sources. Within this project, the most important functions of the Fund are prescribed by the Act on the Environmental Protection and Energy Efficiency Fund. These include the financing of the preparation, implementation and development of various projects and programmes aimed at preserving the environment, i.e. promoting new and environmentally friendly technologies that lead to a reduction in the environmental burden.

Within the Ele.C.Tra project, the City of Zagreb set the goal to promote the electric *scooter* transport model. One of the activities is the inclusion of as many stakeholders as possible in the creation of the common vision. In order to achieve synergies in the promotion of e-

mobility with the citizens and tourists, the City of Zagreb endeavours to cooperate with institutions and organisations in the city. So far, cooperation agreements have been signed with the **Zagreb Tourist Board**, **Zagrebparking** and **Energy Institute Hrvoje Požar**.

9.3. Promotional activities and education

The promotion represents the communication of a business entity (system operator of the *scooter sharing*) with their existing and potential markets. It is a process of communication between companies and users in order to create a positive attitude about the services and which should lead users to prefer their implemented concept.

Promotional activities at the beginning of the project are carried out with the aim of informing the citizens about the existence of new services and introducing them to its basic characteristics so that the potential clients develop a positive attitude to the service, while in later project phases they are aimed at improving sales.

In promotion, as well as in any other manufacturing process, good management is essential. The process of promotion management takes place in six basic steps that include the selection of the target market, setting the promotion objectives, budgeting, selection of the promotion media, selection of the promotional mix and, finally, evaluation of the promotion.

Selection of the target market

Setting of the promotion objectives is preceded by determining or identifying the target market in order to achieve effective communication with potential customers and consumers. The target market is determined on the basis of characteristics, of which the most significant are demographic characteristics, lifestyle, geographic micro-location and a number of other specific features that cause similar behaviour of a certain group. These include the so-called archetypal psychographic segmentations, based on lifestyles, attitudes, interests, opinions of people as individuals and as members of social groups.

The target market consists of potential users, existing users (if the system has already been implemented), but also those that affect purchase decisions. In this step, it is very important to determine the initial views and beliefs that a particular target group has toward the service or the organisation itself.

Accordingly, the market research in the City of Zagreb must be carried out in segments, taking into account the respondent's age, sex, professional qualifications, whether the respondent is employed, whether he/she owns a private car or other vehicle, whether he/she is a user of public transport or taxi service, etc.

Before the research it is necessary to determine the sample size on which to perform the research and to determine the research methods (in person, by telephone, via the Internet), and to create a short questionnaire which will give an answer to the main question; is there a demand for the service of electric *scooter sharing* and what is its real scope.

Setting the promotion objectives

The promotion is always linked with reaching a certain objective. The long-term setting of promotion objectives implies creating an identity of a business entity which achieves a positive public image. Short-term and medium-term promotion plans are mainly oriented on sales targets. The promotion objectives must be set in such a way, that over time, a synergy effect of promotional activities is achieved, and to achieve an adequate level of presence in

the media, that is, to achieve the presence which brings the preconditions for reaching the defined marketing goals on the short and long-term basis.

Budgeting

Cost-effective and efficient promotion implies the planning of promotional budget and planning of promotional activities.

Within the activities of setting the promotion objectives and budget, it is necessary to create a visual identity which would communicate with the market and the overall public. The visual identity refers to the company name, logo and trademark, company slogan, messages of the company, etc. It reflects the values, aspirations and the characteristics of the company, helps to create the reputation, creates a sense of community, indicates the mission of the project, etc. In the process of determining the content of the message, the most important thing is to determine what that message should say to the target market. An important role in creating the message is played by the image which is transferred by the message, positioning of the company as well as the selection of appeals (emotional, rational, moral). In this case, particular emphasis should be placed on benefits of reducing air pollution. Colour is one of the important factors of the visual identity since it triggers emotions and associations and expresses the brand's personality. Furthermore, an appropriate selection of colours in catalogues, publications and printed ads can determine how and what will people see first. Wrong choice of colours can make products unattractive. Warm colours attract attention and stimulate activity, but can also be disturbing and even uncomfortable, while cool colours do not attract attention but have a relaxing effect. Since the visual identity creates the first impression about the product, the impression must be positive and must reflect the company's views.

Selecting promotion media

Selection of the media refers to the decision on the scope, frequency, and the expected effect of the promotion, because each medium has its own specific characteristics, that is, advantages and limitations. The mass media are divided into the press (newspapers and magazines), and audio-visual and digital media such as radio and television and the Internet as comprehensive media.

The public medium with the most powerful authority is television which is best at demonstrating visual and applicable characteristics of services. It has great authority in shaping public opinion and, in general, publicity. In choosing the television as a promotion medium it is necessary to determine the timing of broadcasting the message and the reach that we want to ensure. Television, however, like all other mass media, has its advantages and disadvantages. The advantages of television as a medium are that it uses all communication elements (human voice, colours), wide potential of reach, selectivity and flexibility (by selecting the channel and timing, the audience is also selected), comfortable environment while receiving the message, using the authority, etc. The disadvantages of television as a medium are the shortness of the message (if the recipient is not paying attention, he/she had not heard or seen the message, the message is lost), the reduction of the target audience (the number of TV channels is increasing), high costs, overcrowding of programmes and other.

The print media include magazines and daily newspapers. Magazines have a high degree of selectivity, credibility, authority and prestige. They are specialised, and the area of specialisation may be: technology, fashion, family, health, business, etc. Each area of specialisation represents a particular targeted market segment whose demographic and psychological characteristics can be identified. Daily newspapers, as opposed to magazines, provide high flexibility in the use of space for promotional purposes, but on the other hand,

daily newspapers are crammed with promotional messages. They have a wide readership but no selectivity like magazines.

The newspapers are increasingly transferred to the virtual environment of the Internet. In addition to newspapers, the Internet also links the on-line magazines, allows viewing of television programmes, while simultaneously supporting individual, business, institutional and other entities in creating their own contents, opinions, views, debates, that is, the search and the comparison of certain information and data.

Advertising on the radio allows greater flexibility and easier identification of the targeted segment in terms of geographical area with significantly lower costs than television. Although the main disadvantage of radio advertising is that it transmits only the sound, radio is often listened to while some other task is being performed. However, a large number of radio stations require broadcasting of shows on different radio stations, which increases costs despite the initial low price. On the other hand, the inclusion in thematic programmes is possible, as well as organising prize competitions to make it interesting to a larger number of potential users.

Outdoor advertising enables a relatively good visibility provided that the ad is catchy and simple, and posters in many places allow coverage of the entire targeted geographic area of the City of Zagreb. However, it is often difficult to present the basic idea properly because the exposure to the ad is usually rather short. However, an attractive poster will certainly attract the attention of potential customers, raise the awareness of the existence of the service, and stimulate curiosity for acquiring further information about it.

Direct methods of advertising, by delivering ads to home addresses or e-mail addresses, has its advantages and disadvantages. The advantage of direct mailing is in the personalisation of the message and the possibility to present detailed information, good coverage area and relatively low cost. The main disadvantage of direct mailing is the fact that its effectiveness depends on the address list of existing and potential clients. Also, if the recipient is overloaded with various promotional messages, he/she will start to consider them worthless and disturbing, and he/she will delete them without reading. With respect to placing advertising material in mailboxes, on one hand the disadvantage is that it is considered worthless and cheap, but on the other, it allows potential users to familiarise themselves with the service when it suits them and when they have enough time.

The selection of the promotional mix

The activities for achieving and maintaining positive perceptions in the public can be directed to the company’s relationships with government institutions, financial institutions, intermediaries, opinion leaders and potential or existing clients.

As with the introduction of any new product or service in the market, it is necessary to conduct a full marketing campaign, which should systematically emphasise the social, environmental and economic factors which are brought by this type of mobility.

The promotional mix consists of: advertising, sales promotion, the Internet and other forms of direct marketing communication, personal sales and public relations and publicity.

Today, public relations are extremely important for the activities of public interest, especially for those that seek to achieve some objective, and include promotional activities aimed at properly examining and accepting the company’s efforts to achieve and maintain a company’s positive image as an entity that cares for the public and acts in public interest.

In the *scooter sharing* promotional activities, it is necessary to promote the idea of sustainable and clean transportation as a desirable social behaviour and to highlight the flexibility of the service. The important role in these activities could be given to the brochures and the website, as well as to reports in specialised magazines and TV and radio shows where the entire *scooter sharing* concept would be presented in detail and explained to the target group of users, based on the results obtained from the market research in the first phase, but also to other interested citizens. The website would provide the possibility to book electric *scooters*, information on available vehicles, price lists, service packages, etc.

As part of the promotional activities, it is necessary to emphasise the main reasons for selecting this model of mobility in the City of Zagreb and to highlight the real environmental (air quality improvement, noise reduction, traffic congestion reduction), social (interest in new technologies, individual contribution to environmental protection) and economic (high price of oil products, costs associated with owning a car) aspects of the *scooter sharing* model.

In the process of introducing the *scooter sharing*, the personal sale is also important, which includes sales activity where the salesman and the potential user are present at the same time in the same place. It is recommended to implement this type of sale as part of various events in public spaces or meetings where potential customers would, on request, personally be introduced to the process of inclusion in membership of the *scooter sharing* service, the registration into membership, testing of vehicles and the use of membership cards would be enabled on the spot, and they would get detailed explanations of the service use. Personal sale is the most expensive form of sale and at the same time it is a promotional activity. Management of this process is challenging, but can have a very positive impact on sales results.

In a later phase of the project, promotional activities must focus on sales promotion which includes all activities aimed at increasing the purchase of products and that are directly related to the product or its purchase. Sales promotion activities aimed at final customers are designed to encourage immediate purchases of the product, whether it is the initial, repeated or increased purchase. The main activities that traditionally fall in the sales promotion category are free minutes of using the service, discounts on a variety of service packages, prize contests, etc. These activities are considered to be an integral activity of the customer “attracting” strategy.

User education is also an integral part of the marketing campaign. It is necessary to carry out a certain type of education for using electric vehicles, having in mind their extremely poor representation in the market, to prevent avoiding the use by a certain part of the population due to the fear of the use of new technologies. On the other hand, a part of the target group could out of curiosity and interest in new technologies become important in creating the group of future users.

Education could be implemented as part of thematic fairs, but also as part of events related to environmental protection, energy efficiency, renewable energy sources, promotion of new technologies and other meetings related to urban infrastructure and transport. Also, favourable platforms for education and promotion of this type of mobility could be projects such as e-mobility, in case of electric vehicles use.

Promotion evaluation

By evaluating the promotion it is possible to determine which elements of the promotion process are successful and which are not. In this way it is possible to avoid costly mistakes. In case of a large number of possible promotional investment strategies, it is necessary to explore all alternative strategies and determine which one is the most effective.

9.4. SCHEDULE FOR ESTABLISHING THE EVs SHARING SYSTEM

The scooter sharing system implementation into the City of Zagreb's traffic system requires the identification and inclusion of groups interested in the project and its implementation, and the analysis of their roles, interests, significance and capacity for participating in the implementation.

The project stakeholders are individuals, groups, organizations or companies which have or may have a significant interest in the success or failure of the project, whether included in the project as active participants, advisors, external interest groups or some other role. The basic postulate of the stakeholder analysis is that different groups have different interests, capacities and problems. They should be analysed individually in the project preparation process, and the project itself should be directed at adequate problem and target identification and at the selection of the operation strategy.

The objective of stakeholder inclusion is to contribute to the maximization of social, economic and institutional benefits of the project for target groups and end-users, and to minimize the potential negative effects as well as the potential conflicts among stakeholders.

By means of stakeholder analysis and coordination, project funds will be appropriately divided to achieve the objectives and meet the needs of target groups, and organize project management so as to include stakeholders and ensure their participation in the best possible way. In addition, it is necessary to enable high-quality recognition of individual interests which will be adequately addressed in drafting the project and its implementation.

For the activity of stakeholder inclusion (key stakeholder identification, sending letters of interest, face-to-face meetings and mutual coordination), the time period suggested is six months. This phase of implementation includes the recognition of a potential investor, i.e. the system operator.

The project implementation is largely conditioned with financial cost effectiveness. If the project does not prove to be financially cost effective and sustainable over a long term, there is no reason for its further implementation. The decision on project implementation will be made based on a detailed cost-benefit analysis, which will be based on real costs of the potential operator and investor in the system. It is necessary to give a funding costs overview based on which propositions can be made on funding source and model possibilities. At that, national models and mechanisms should be considered.

A positive assessment of the cost-benefit analysis provides a basis for devising and enacting the operational plan of project implementation, i.e. defining the consensus and management model among key stakeholders. In this phase, the signing of a cooperation agreement between the City of Zagreb and the infrastructure investor (it is expected that the investor will take the role of the operator, i.e. service provider) is anticipated. Also, the signing of a cooperation agreement between the operator and the key stakeholders in the project is expected. The predicted phase duration is also six months.

The next phase of implementation includes the definition of market model focused on the relationship between the service provider and the users. The objective is to select the best possible model taking into account users' needs, available facilities, infrastructural limitations and other factors which could affect the system. In this phase, it is necessary to identify the final locations for the infrastructural implementation. As a result of the model, defining tariff rates for end users is expected. It is also necessary to timely verify the financial justifiability of the project by means of analyzing costs and benefits regarding the establishment of the defined model. The phase duration is estimated at three months.

Parallel to defining the model, it is necessary to initiate activities necessary for physical implementation of infrastructure. The implementation phase duration is estimated at three months. In addition, it is suggested that the project digitalization phase does not last longer than three months. It includes the designing of an interactive website with a related real time application which will be available on mobile devices of potential users. For the application production, it is necessary to collect and coordinate data on the traffic system of the City of Zagreb (activity duration estimated at five months).

The realized system of electric scooter sharing demands a periodic surveillance and monitoring system. Aside the technical and economic indicators of the project's success, monitoring the realized savings in the context of the reduction in emissions of polluting gases and substances is required, as well as the overall influence onto the traffic system of the City of Zagreb.

The graphic display of the anticipated activities is set out below.

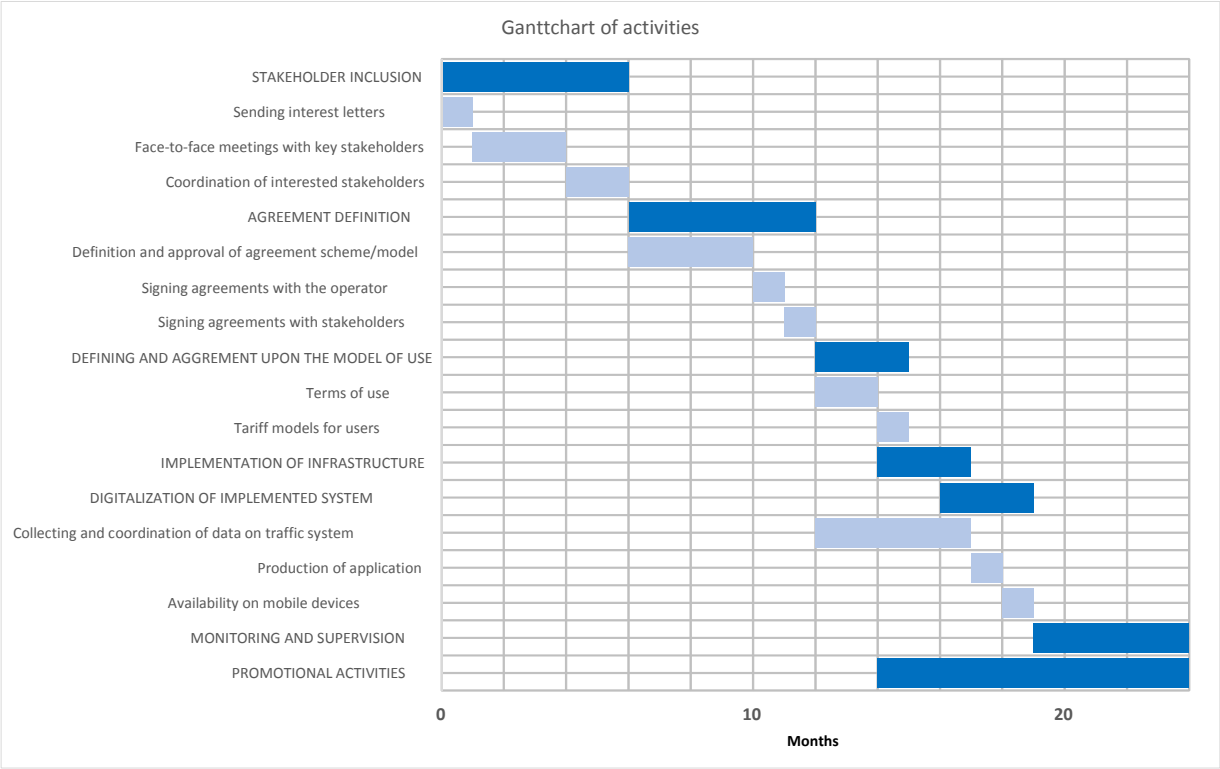


Figure 0.40. Ganttchart of anticipated activities

10. CONCLUSION

The basic objective of the Ele.C.Tra project is the reduction of CO_2 emissions in passenger transport by promoting a new, sustainable transportation model using electric scooters in urban areas. The task of this study is to adapt the Operative Plan of Sustainable Mobility Model Application to Specific Features of the City of Zagreb taking into consideration experiences gained during the pilot implementation of project in Genoa, Barcelona and Florence.

The study includes a review of the current state of traffic infrastructure in the City of Zagreb, a SWOT analysis has been made and starting determinants for the introduction of Ele.C.Tra model for electric vehicles in the City of Zagreb have been defined, a synthesis of needs of potential users has been made as well as a review of potential business models for project implementation. Economic and financial aspects of the Ele.C.Tra model have been analysed through three different scenarios and for each of the scenarios an environmental impact assessment has been made. On the basis of all the stated analyses, a plan of activities for the introduction of scooter sharing system in the City of Zagreb has been made.

On the basis of analysis of scooter sharing models implemented in Barcelona, Genoa and Florence as well as of the results of opinion poll conducted in the City of Zagreb, target groups for the use of e-scooter sharing system were defined. Those are mainly young people aged 16-35, students and employed persons, primarily those making short daily trips (around 30 minutes per trip). On the basis of the identified users' needs, three scenarios of implementation of scooter sharing system in the City of Zagreb were defined.

Under all three scenarios the project would start with 80 *e-scooters* which would be positioned on 14 locations in the City of Zagreb. The locations would include the places of interest for the citizens and tourists for this kind of transportation, including student dormitories, railway station, tourist attractions like museums, squares and similar. The number of *e-scooters* and their parking locations would be increased each year, in that over 15 years of implementation their number would increase to 125 vehicles and 21 parking locations. The basic difference between the analysed locations is in the manner of charging *e-scooter* batteries.

First scenario (SC-1) foresees the construction of charging stations on parking locations. The advantage of such manner of charging is that the batteries are charged during the whole time when the vehicle is not rented and the possibility of battery being discharged when someone needs the vehicle is relatively small. The disadvantage is that the construction of charging stations requires substantial investments. The basic indicators of efficiency of this scenario are positive. Debt service coverage ratio (DSCR) is considerably higher than 1 which implies that the project generates enough revenue to repay its debts, in that the payback period is 7 years.

Second scenario (SC-2) foresees that all batteries (discharged up to a certain level) should be replaced by charged batteries and that the discharged batteries should be charged in one place. The advantage of such manner of battery charging is low investment since charging stations on parking locations would not be constructed, but on the other hand, there is a need for investment into spare batteries, purchase of a van and more employees to replace the batteries. Under scenario SC-2, debt service coverage ratio (DSCR) is lower than 1 which implies that the the project does not generate enough revenue to repay its debts in all the years of project implementation. Payback period is two years more than under scenario SC-1.

Third scenario (SC-3) foresees that vehicles may only be rented in the period from 6 a.m. and 11 p.m., and the period between 11 p.m. and 6 a.m. is used to charge the batteries at

the central location. This scenario does not foresee investment into spare batteries or charging stations on parking locations of *e-scooters*. As under scenario SC-1, all main indicators of efficiency are positive. Debt service coverage ratio (DSCR) is considerably higher than 1 which implies that the project generates enough revenue to repay its debts, in that the payback period is 6 years. The advantage of this scenario is lower investment into the system whereas the main disadvantage is reduced system operability.

In addition to the *scooter sharing* system analysis, a comparison of costs (investment plus operative expenses) of *e-scooters* and petrol *scooters* has been made both when owned by private and legal persons. The analysis showed that the costs of using electric and petrol *scooters* are equal at annual mileage of 6 000 km. By increasing the annual mileage over 6 000 km, total costs of electric *scooters* are lower compared to petrol scooters mainly due to lower price of the propellent. At annual mileage under 6 000, the price of battery is the most significant cost and when it comes to economic analysis petrol *scooters* are given advantage.

Taking into consideration the basic assumptions of defined scenarios, the implementation of *scooter sharing* system in the City of Zagreb would result in the reduction of CO_2 emissions by around 62 805 kg in the first year of implementation. Over 15 years of implementation, the potential savings amount to 1 267 kt of CO_2.

In addition to the *scooter sharing* scheme, a particular number of L category electric vehicles owned by private and legal persons is expected. Taking into consideration the foreseen number of such vehicles, a cumulative reduction of CO_2 emissions of 6.378 tons of CO_2 is expected over a 10 year period (calculated compared to L category petrol vehicles).

The project of implementation of *scooter sharing* system in the traffic system of the City of Zagreb requires a comprehensive, integral and interdisciplinary approach. In order for the project implementation to be as successful as possible, stakeholders have been defined as well as their roles in each of the phases of project implementation. The most important stakeholders are classified into three groups as follows:

- business stakeholders (suppliers and distributors of electric vehicles, infrastructure and technology, equipment service, system operators, electricity suppliers, etc.)
- demand stakeholders (large companies, schools, university facilities, tourist offices, hotels, shopping centres, etc.)
- institutional stakeholders (local authorities, public bodies, associations, research institutes. etc.)

It has been estimated that it would take around 20 months to conduct all the activities in implementing the *e-scooter sharing* system in the City of Zagreb.

11. TABLES

12. FIGURES