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BUSINESS PLAN AND MARKET ANALYSIS FOR ELECTRIC VEHICLE INFRASTRUCTURE IN GREECE

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2 Executive Summary

Decarbonization, renewable energy, sustainability, and net zero are among the main themes that are seen recently gaining significant importance in the corporate world and personal lives. Mobility electrification is seen as a catalyst in achieving climate benefits in an already mature industry which is also heavily carbonized. Electrifying the fleet of existing vehicles wouldn't be enough on its own unless the complementary assets to support such electrification were in place.

This thesis presents a business plan for a Greek company that develops an electric vehicle charging infrastructure. Charging infrastructure is necessary for the adoption and expansion of mobility electrification. The business plan comprises market analysis, key hardware and software technologies that drive growth, and business and economic analyses and decisions for faster growth.

As with every start-up the business plan needs to be robust in its elements and fluid enough to adapt to the ever-changing market conditions and miscalculations that are often inevitable. Competitors and potential market penetration avenues are explored and proposed as guidance for developing this venture.

A key conclusion is the feasibility of such a venture and the economic viability for investors that can support such a necessary undertaking to achieve mobility electrification.

3 Introduction

AcroVolt is a Greek company with its mission being building and investing in *Electric Vehicles* ("EVs") charging infrastructure across Greece. Recent studies have shown that 79% of current EV drivers would purchase an EV again(Simpson, n.d.). Considering the rise of the EV industry, AcroVolt has decided it would be helpful to design an optimized charging network depending on different factors. Charging stations include much more than just EV chargers. AcroVolt provides everything needed, to location providers along with infrastructure.

AcroVolt along with an optimised network wants to ensure that the project itself is profitable. For a conclusion to be made, corresponding information must be gathered and the economic model of the company must be created. In this study, along with the business description, there is an extended market analysis containing information regarding the technology of EVs, the software, the competitors, and the market itself. Firstly is examined whether EVs are on the rise. A study shows that two out of three Greeks believe that EVs are the future of the automotive industry. In all 22 countries examined, Greece seems to be the most economical country when it comes to using a passenger car, including EVs, with an average monthly cost of €743(Nikolopoulou, 2022). After contacting Access to Motor Vehicle Information Regulation (AMVIR), data were collected regarding the number of EVs registrations in Greece. The largest EV fleet is in Athens and Thessaloniki, but an ongoing increase is displayed throughout different constituencies. The European investment bank conducted a study that states that 67% of Europeans and specifically, 81% of Greeks would choose to buy a hybrid or an electrical vehicle. Particularly, 41% of Greeks would buy a hybrid and 40% would buy an electric car. European drivers are expected to wait for several minutes¸ almost half an hour or more, as they charge their electric vehicles.

Once the automotive industry is examined, the company develops a strategy for establishing a charging network. Using various data from EUROSTAT and ELSTAT regarding the annual income, population growth, education attainment, and employment rate AcroVolt can study the constituencies in depth. To rank the constituencies by ordering the data values in descending order, *Multi-Criteria Decision Analysis* (''MCDA'') is used. An optimised charging network is possible now more than ever, as AcroVolt has formed a relationship with ANEDHK (ΚΡΗΤΙΚΟΣ), one of the largest Supermarket chains in Greece, guaranteeing the company has access to locations across Greece.

Lastly, the economic model makes it clear that the company can balance the fourth year of operating and be sold the tenth year with at least double the value of its EBITDA. It could even be sold five times the value of its EBITDA, making AcroVolt worth € 17.634.844.

4 Methodology

Fleet data has been scarce and with no option to gather it from Governmental resources. AMVIR disclosed all the registrations of EVs in different areas in Greece for 2020 and 2021. For information regarding the European and global EV market, there are included a few helpful parts of research Deloitte and BloombergNEF did.

To gather all data needed for the EVs, their categories, and their characteristics there was a sampling process from the EV database of GOCAR. All vehicles were viewed from the first 10 pages and were compared to find the maximum and minimum value of each element.

To examine the Manufacturers, Software providers, and Competitors most of the information presented is extracted from their websites and articles to ensure that they are dynamic and accurate.

Forecasting demand in Greece is achieved by collecting the data needed from ELSTAT and EUROSTAT. Due to Covid-19, many datasets were not as thorough as the years before. The year 2022 has not been completed, therefore there are no data included.

Tables that do not have a source are created for this research and therefore their methodology is discussed separately in the chapters.

It should be stated that AcroVolt and especially V. Karavas are disclosing information about the market and the technology behind EVs that could not be found elsewhere.

5 Business Description

5.1 Introduction

AcroVolt IKE is an Athens-based company focusing on infrastructure investments in the renewable energy sector. The company aims to create a nationwide network of chargers for electric vehicles to participate in Greece's mobility electrification and decarbonization effort. AcroVolt understands that drivers need more sustainable vehicles without worrying about whether they will be able to locate chargers and tries to remove the stress they might be under while on trips.

5.2 Mission

“Be one of the leaders in mobility electrification with a green network of charging stations”

AcroVolt’s mission is to be one of the leading companies in developing the charging infrastructure in Greece while aiming for a net zero approach across its stations.

5.3 Vision

“Our vision is for Greece to transition smoothly and quickly to a greener mobility sector with our contribution to its infrastructure needs.”

AcroVolt’s vision is based on its core values, being sustainable and creating choices that help the environment. The mission behind that statement is to create a network, helpful to drivers of electric vehicles and serviceable in the sense that chargers are easy to locate and in locations where people can wait while busy. The company has entered an emerging and growing market and its commitment is long-term in a market that is evolving, and future-oriented.

5.4 Scope of Business

Electrification and Climate Change initiatives are strongly supported by the EU and therefore by all the countries-members. Greece has lagged in the changes the environmental crisis and the market imposed, but the government has recently introduced legislation and incentives to aggressively promote EVs and further climate change initiatives. The company has an opportunity to participate early in a growing sector that ensures many advantages in the future.

AcroVolt is developing diverse relationships to ensure that the business is supported by experienced professionals and academics that can contribute to research initiatives. On the research side, AcroVolt has a relationship with academics at the University of Aegean, the London School of Economics, and the Mediterranean University in Crete. The company, to be sustainable, plans to develop projects to match Green Energy production (e.g. solar energy) with the energy needed for EVs. There are also efforts made in developing innovative algorithms for maximizing EV charging network Utilization.

6 Market Analysis

6.1 Introduction

The electric vehicle market has been increasing noticeably each year, since 2015. For a company to invest in the automotive industry and specifically in the electric one, all the necessary information needs to be gathered. Most importantly the market analysis must be thorough and inclusive of several different aspects. The market analysis will be conducted from a perspective of a company that focuses on developing the infrastructure network necessary for *Electric Vehicles* ("EVs"), projects to match Green Energy production with the energy needed for EVs, and developing innovative algorithms for maximizing EV charging network Utilization.

The information gathered refers to the adoption of electric vehicles in Greece, where the company has the biggest interest and data on the number of EVs are presented per state since 2019. Moreover, data are collected for the situation that prevails in Europe and globally since 2015. In market analysis, key technologies must be mentioned in the electric vehicle industry. Particularly, the types of electric vehicles and the technologies behind them are explained. The EV chargers are also analysed based on the types available, the connectors, and the manufacturers. Lastly, the software is a very important part of managing a network of chargers and could not be missing from this chapter.

6.2 Current EV adoption

In the past decades, most countries have been unstable financially. Greece is one of them and has been trying to recover. Remarkable is that while financially there is uncertainty the industry of electric vehicles displays an ongoing increase. For conclusions to be stated, the presence of EVs in Greece, Europe, and globally is of the utmost importance.

6.2.1 Presence of EVs in Greece

The global financial crisis in 2007 deeply influenced Greece and while the country was trying to recover, the pandemic of coronavirus disease spread. The Greek economy seemed to recover in 2019 but the preventative measures for Covid-19, taken by the government, were

a setback. Since the relaxation of the measures, the recovery of the economy has been visible but is not yet completed. Therefore, the reduction in the vehicle market by 5.5% does not come as a surprise. The reductions are not imprinted in the electric vehicle market which has the 2.3% of the market share(TEAM, 2022).

According to the 'Profiles' study by Focus Bari, two out of three Greeks believe that EVs are the future of the automotive industry. The Car Cost Index indicator published by LeasePlan demonstrates that EVs are the cheapest way to transport in most European countries. Additionally, in all 22 countries examined, Greece seems to be the most economical country when it comes to using a passenger car, including EVs, With an average monthly cost of €743(Nikolopoulou, 2022).

Greece lacks fleet data, the information is not available due to non-communication of the individual bases and systems of the Ministries. However, a fleet of purely electric vehicles is considered all the registrations that have been made in recent years. In 2013, 3 passenger *Battery Electric Vehicles* ("BEVs") were registered for the first time. In 2020 there were 679 registrations of electric vehicles. In 2021, 2,176 vehicles have been registered. Up to 2021 3,338 EVs have been registered and considering that everything is still circulating on Greek roads, it is safe to assume that the fleet reaches 4,000 units (some are imported from abroad).

Table 1: Registrations of EVs

State	2020	2021	State	2020	2021
Achaea	5	5	**Kavala**	4	5
Argolis	2	6	**Kozani**	7	11
Arcadia	5	8	**Laconia**	2	3
Athens	538	1900	**Larissa**	7	16
Cephalonia	0	1	**Lasithi**	2	2
Chania	7	17	**Lefkada**	0	1
Chios	0	2	**Magnesia**	1	4
Corfu	0	4	**Messenia**	1	2
Corinthia	0	2	**Pella**	2	1
Cyclades	2	5	**Pieria**	2	2
Dodecanese	21	55	**Arta, Preveza**	1	0
Drama	2	0	**Rethymno**	5	12
Aetolia-Acarnania	4	3	**Rhodope**	3	3
Euboea	1	3	**Thessaloniki**	20	46
Evros	3	3	**Serres**	2	6
Florina	0	1	**Thesprotia**	1	0
Phthiotis	5	4	**Trikala**	3	4
Imathia	1	2	**Boeotia**	1	1
Ioannina	9	13	**Xanthi**	0	2
Heraklion	7	15	**Zakynthos**	1	1
Karditsa, Trikala	2	5	**TOTAL**	679	2176

Several EV registrations in Greece by State. Source: www.seaa.gr

In 2022, from January to April, there were 734 sales with only 46 being electric vehicles.

The largest EV fleet is in Athens and Thessaloniki displaying an ongoing increase in the number of registrations.

Table 2: The development of the fleets per state

State	% of increase	State	% of increase
Achaea	0	**Kavala**	125
Argolis	300	**Kozani**	157.14
Arcadia	160	**Laconia**	150
Athens	353.16	**Larissa**	228.57
Cephalonia	100	**Lasithi**	0
Chania	242.86	**Lefkada**	100
Chios	200	**Magnesia**	400
Corfu	400	**Messenia**	200
Corinthia	0	**Pella**	-200
Cyclades	500	**Pieria**	0
Dodecanese	261.9	**Arta, Preveza**	-100
Drama	-200	**Rethymno**	240
Aetolia, Acarnania	75	**Rhodope**	0
Euboea	300	**Thessaloniki**	230
Evros	0	**Serres**	300
Florina	100	**Thesprotia**	-100
Phthiotis	-80	**Trikala**	133.33
Imathia	200	**Boeotia**	0
Ioannina	144.44	**Xanthi**	-200
Heraklion	214.29	**Zakynthos**	0
Karditsa, Trikala	250		

In some areas, there is a clear reduction in electric vehicles. It is assumed that this is happening due to the unstable financial situation and the lack of charging stations available to the public.

6.2.2 Presence of EVs in Europe and Worldwide

According to the Europe Environment Agency, the registrations of electric vehicles increased by 11% in 2020, from 550.000 to 1.325.000 units. Moreover, electric vans increased by 1.4% in 2020. There are a plethora of reasons behind the electric market's growth. Firstly, due to many years of research, companies have accomplished manufacturing quality batteries and vehicles. Furthermore, governments all over the world establish policies which promote electric vehicles and invest in them and their equipment technology(European Environment Agency, 2021).

6.2.2.1 Europe

The greatest contributor to greenhouse gas emissions in the EU is the transportation sector. To achieve the EU's climate neutrality goals, transportation emissions must be reduced. The current legislation aims to eliminate the emissions of CO_2 for cars and vans by 55% by 2030(European Environment Agency, 2021).

From 2010 until 2019, the new registrations of *Battery Electric Vehicles* and *Plug-in Hybrid Electric Vehicles* ("PHEVs") increased by 3.5%. Nearly 30,000 electric vans were sold in 2020, accounting for 2.2% of the market, an increase of around 0.8% points from the previous year. BEVs made up the vast bulk of electric van sales. *Non-Plug-in Hybrid Electric Vehicles* represented 12% of new registrations in 2020.

The graph below depicts the newly registered EV cars by country, blue color is applied for BEVs and green for PHEVs. Norway (75%) is dominating the electric vehicle market in Europe, followed by Iceland (46%), Sweden (33%) and the Netherlands (28%).

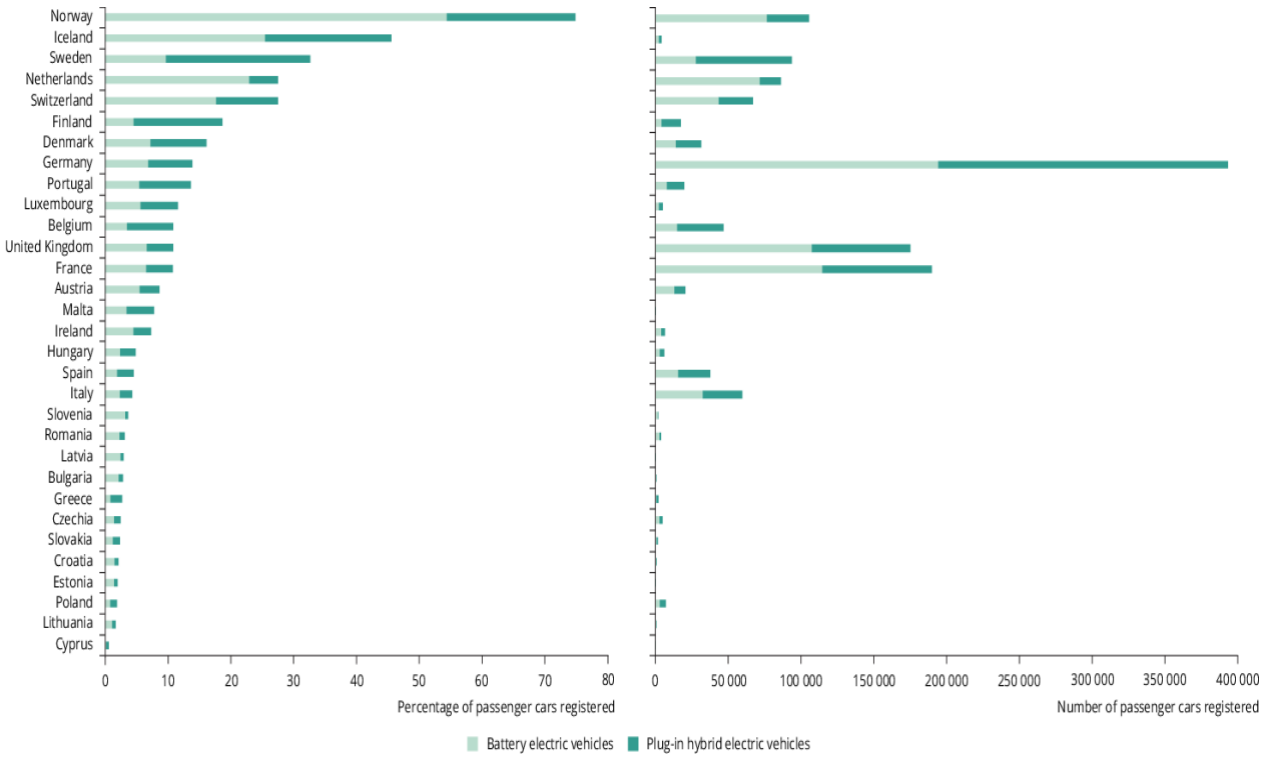


Figure 1: Newly registered EV cars, Source: European Environment Agency

Research Deloitte did show that people mostly prefer the purchase of an EV as it eliminates the emissions of CO_2 and has lower operating costs and better tax incentives. Some also prefer EVs to keep up with technology while having a specific preference for a vehicle brand.

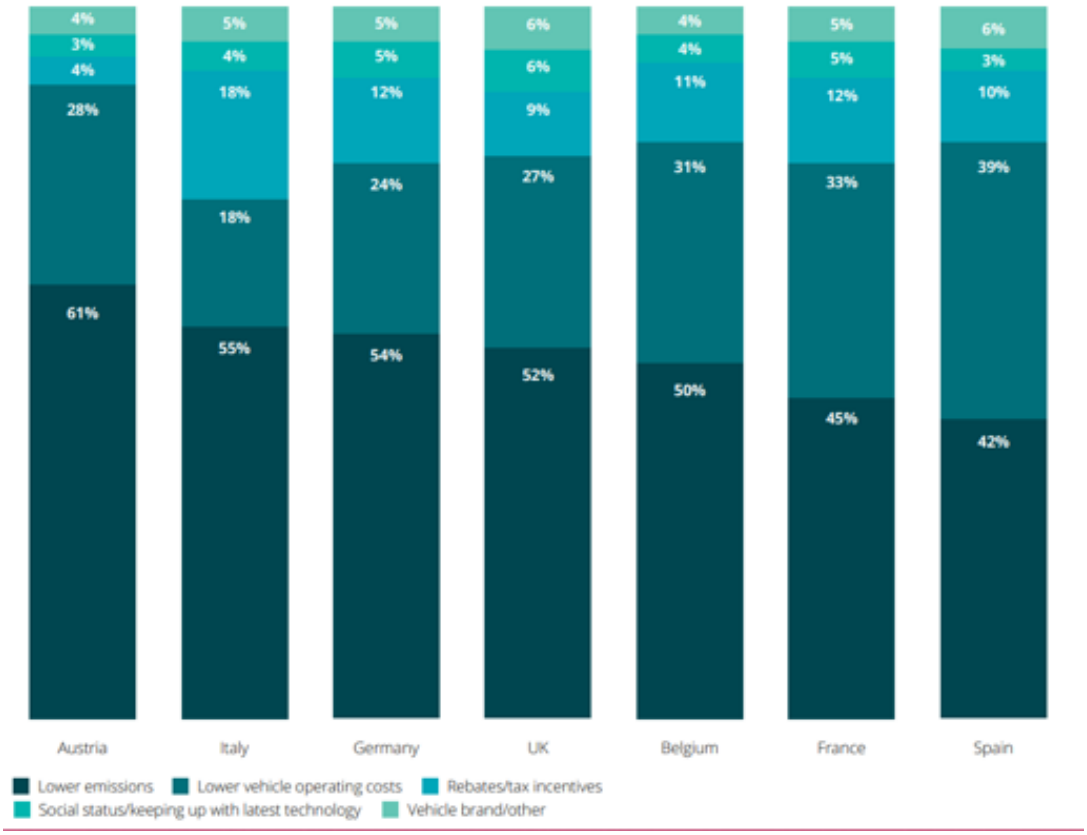


Figure 2: Reasons why consumers consider hybrids or BEVs, source: Deloitte

In the European countries examined most people would not consider giving more money for an electric vehicle than they would for an ICE car. People willing to spend extra money would give up to €2.500.

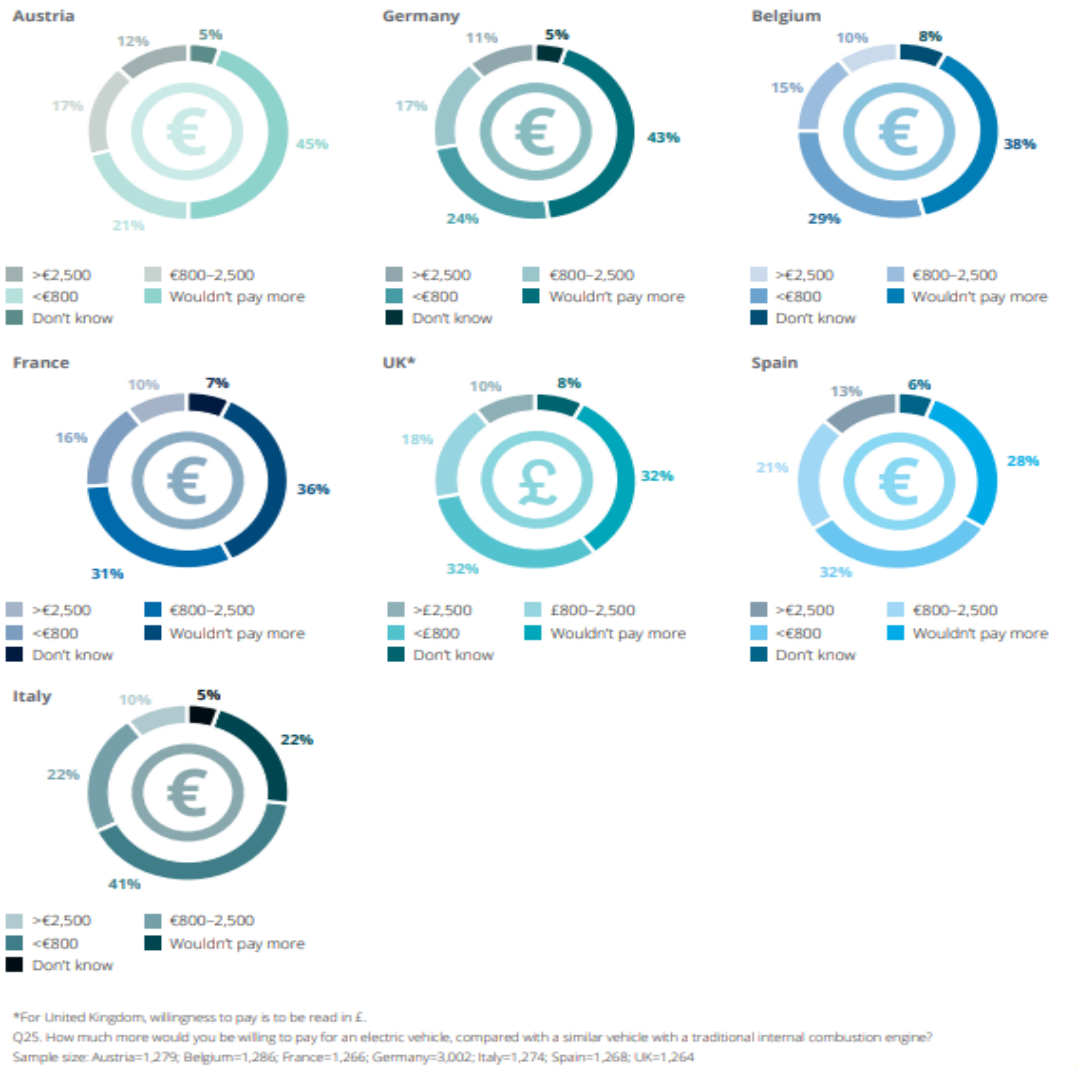


Figure 3: Money Europeans consider spending on EVs, source: Deloitte

It is important to understand whom consumers consider responsible for manufacturing publicly accessible EV charging stations, as it emphasises the potential trust they will show to different parties. From the study shown below, indisputably in Europe, people believe that firstly the government and then private companies with electric utilities should ensure there are chargers with public access.

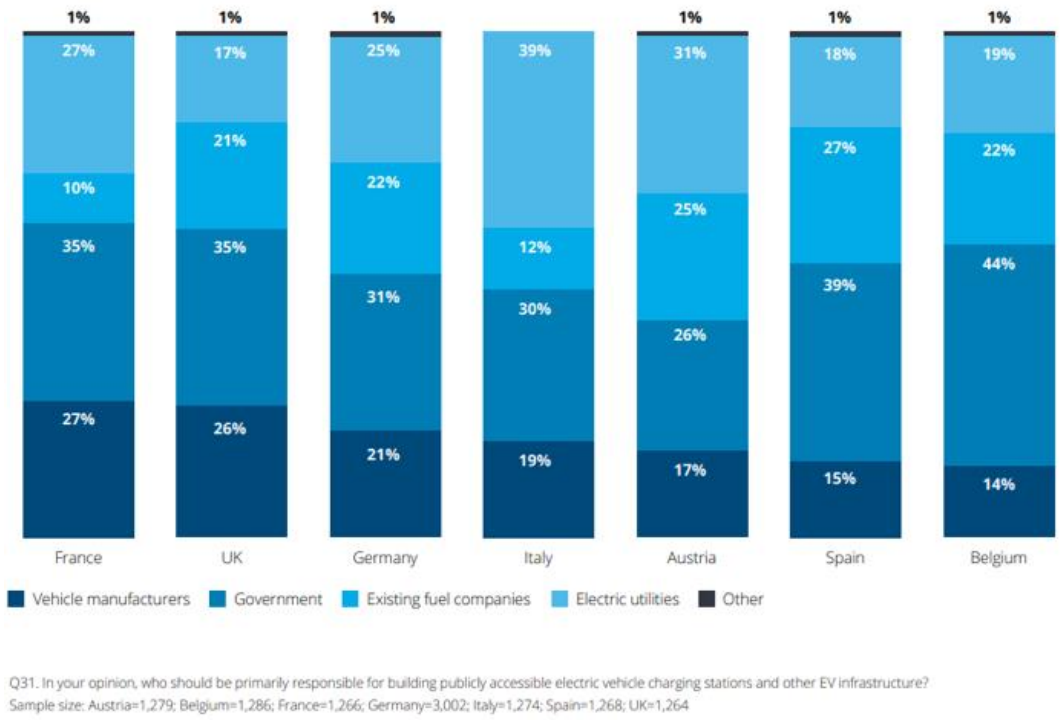


Figure 4: Carrier responsible for manufacturing publicly accessible EV charging stations, source: Deloitte

Drivers will need to wait for several minutes as they charge their electric vehicles. They will most likely combine that time with chores and other obligations. As seen below most drivers are willing to wait almost half an hour and some, even more.

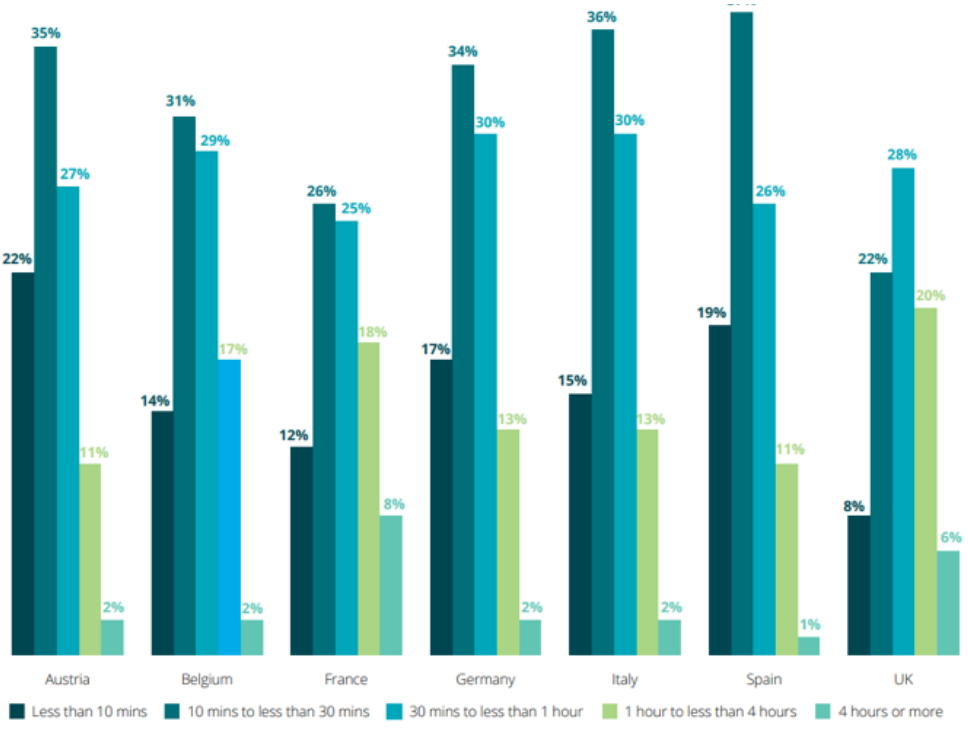


Figure 5: Amount of time consumers are willing to wait to fully recharge a BEV, source: Deloitte

6.2.2.2 Global

For the global EV presence to be understood, the leading countries/ continents need to be mentioned. China and Europe seem to be the ones in the lead since 2015.

Buses, 2 and 3-wheeled EVs have acquired most of the market share which compliments the need most cities have to eliminate environmental pollution. Vans and trucks are hard to be traded for electric ones, as there are not yet EV chargers infrastructure in most countries to support longer distances.

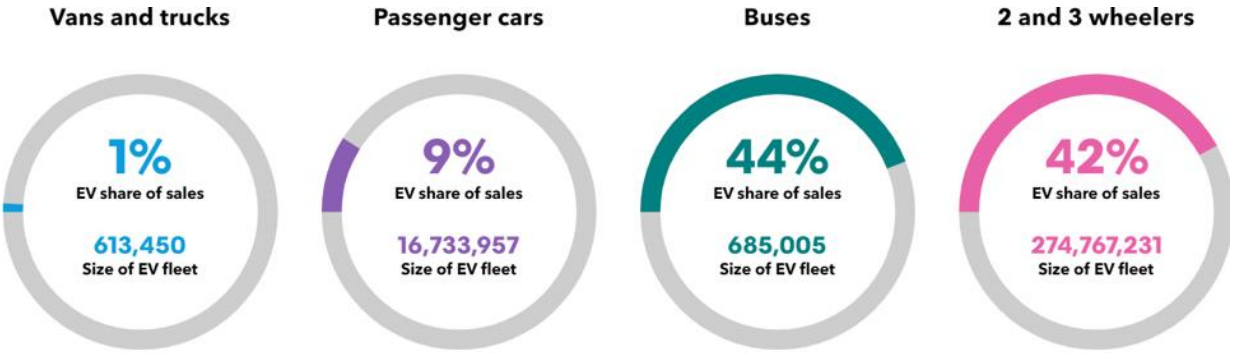


Figure 6: Share of sales, source: BloombergNEF

Examining the graph below it is clear that China dominates the electric vehicle market since 2016, except for the years 2015 and 2020 when Europe dominated it, with the U.S. being well behind.

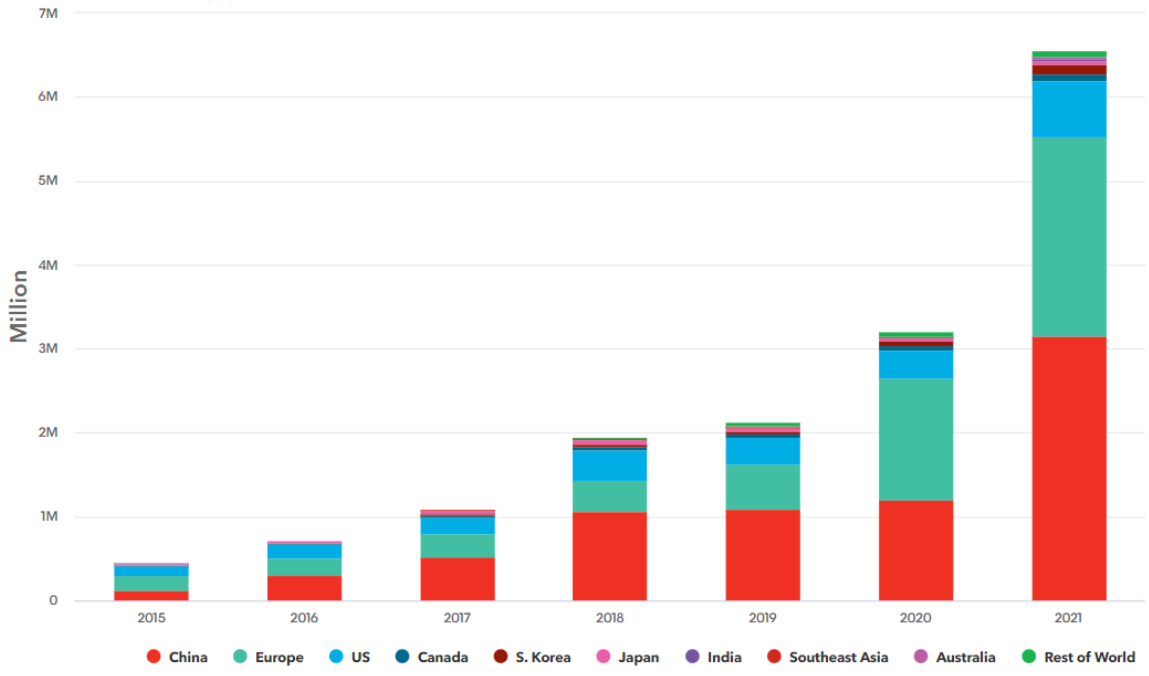


Figure 7: Global passenger EV sales, source: BloombergNEF

In the graph below it is also clear that the dominating drivetrain is BEV since 2016.

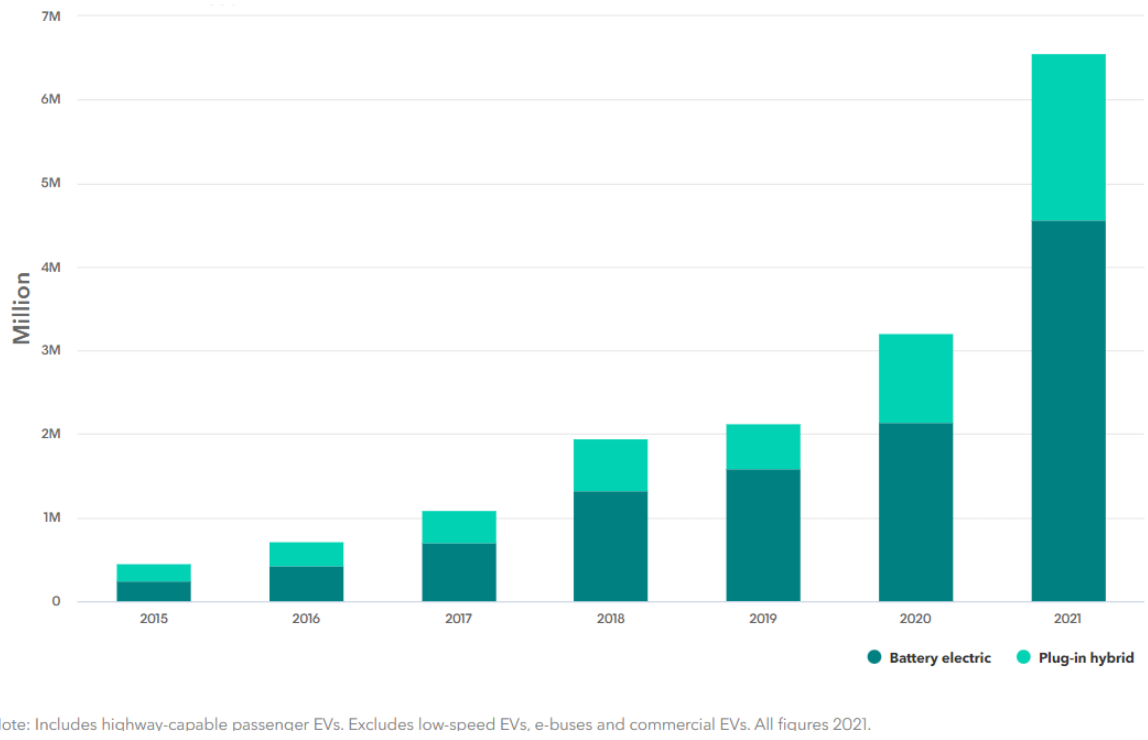
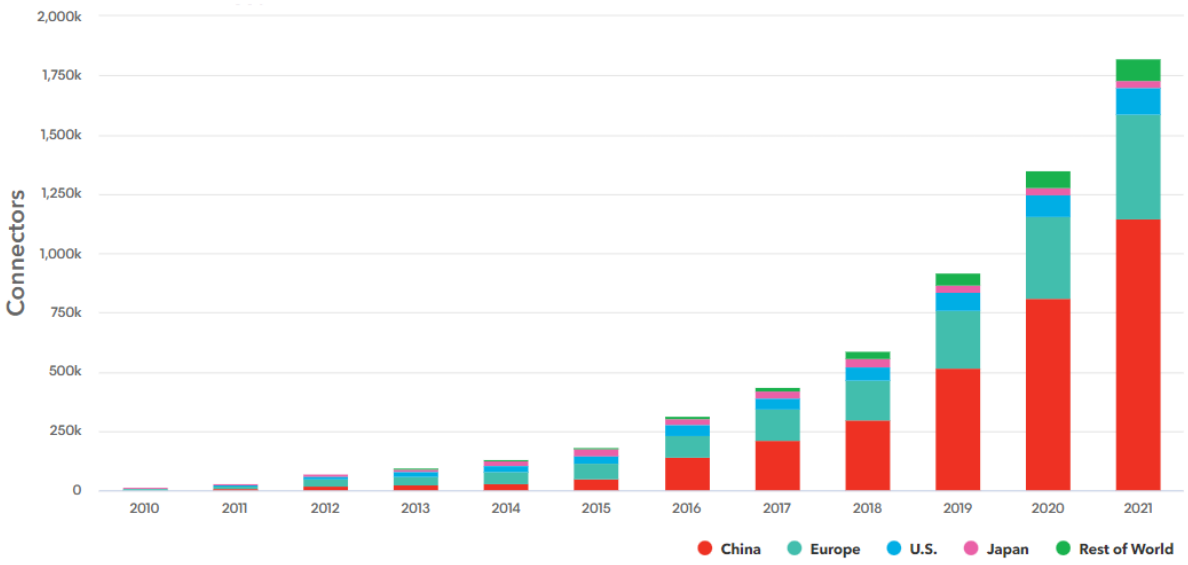


Figure 8: Global passenger EV sales by drivetrain, source: BloombergNEF

Many countries are making an effort to provide the corresponding support to companies to create a network of chargers. Governments create legislation for companies and drivers making the purchase of electric vehicles and the infrastructure of charging networks more appealing. Since 2010 *Charge Point Operators* ("CPOs") have been establishing charging points worldwide. Europe was leading up until 2015 when China began developing the country's charging infrastructure.



Source: BNEF, China Electric Vehicle Infrastructure Promotion Alliance (EVCIPA), U.S. alternative fuels data centre, Tesla, Chargehub, a range of public and private sources. All figures 2021.

Figure 9: Cumulative global public charging connectors, source: BloombergNEF

It is estimated that EVs are currently replacing 1.5M barrels of oil per day or around 3% of the demand for gasoline on all roads as shown below.

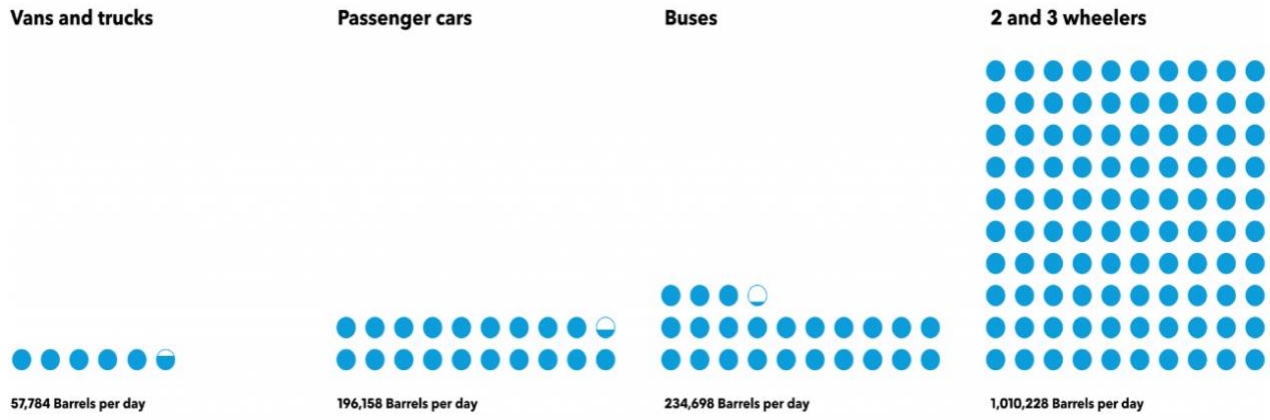


Figure 10: Oil displacement by vehicle segment, source: BloombergNEF

As the demand for electric vehicles rises, so does the demand for lithium, cobalt and nickel. In 2011, the industry was being shaped, and the demand for those materials came mainly from purchasing electronics. In 2012 so did the demand for E-buses and later on passenger electric vehicles. In 2021, the demand was allocated between all types of electric vehicles with passenger ones being in the lead.

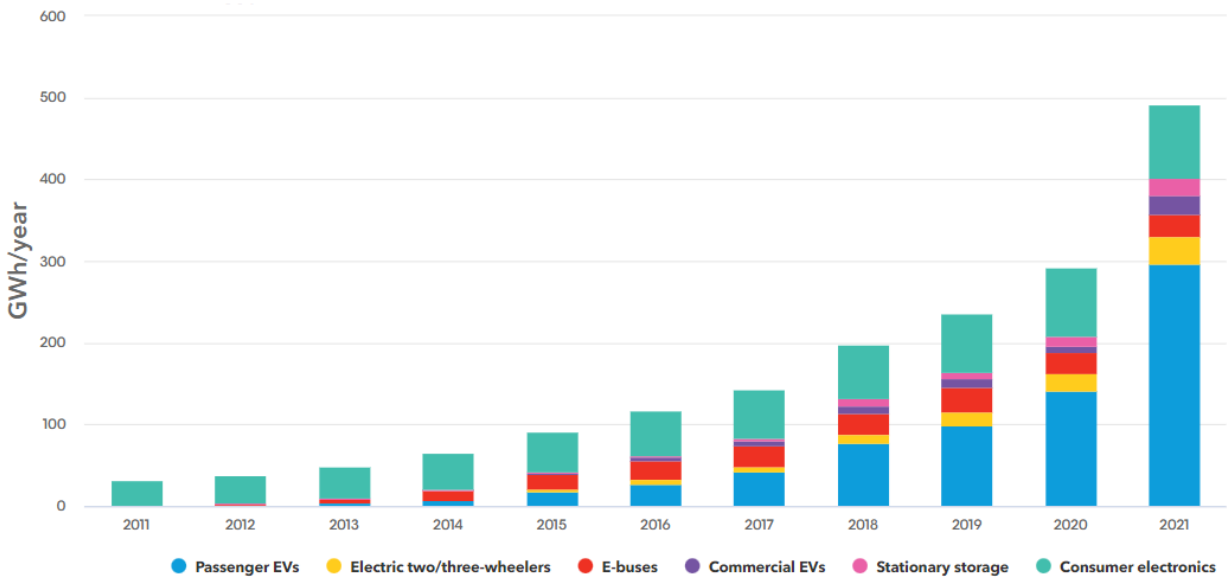


Figure 11: Annual lithium-ion battery demand by application, source: BloombergNEF

Quite importantly, BloombergNEF asserts that 2027 is the year that the road transport oil demand will peak. Between 2021 and 2050 the size of the electric vehicle market opportunity is estimated at $53 trillion (McKerracher et al., n.d.).

6.3 Electric Vehicles Market Analysis

6.3.1 Introduction

The electric vehicle industry is aiming to become more popular amongst potential buyers. The way electric cars became very popular in the past years makes the public doubt whether it's because of marketing and selling techniques or because it makes sense for them and the environment. Many studies are dedicated to explaining what someone can gain out of converting to electrical vehicles. As time passes, not only individual organisms and scientists conduct these studies, but countries care for the EVs' efficiency and profits too. Each country has its way of making the purchase of electric cars beneficial for the people, mostly by granting money. A study in 2019 showed that "Electric cars, which accounted for 2.6% of

global car sales and about 1% of global car stock in 2019, registered a 40% year-on-year increase" (IEA, n.d.).

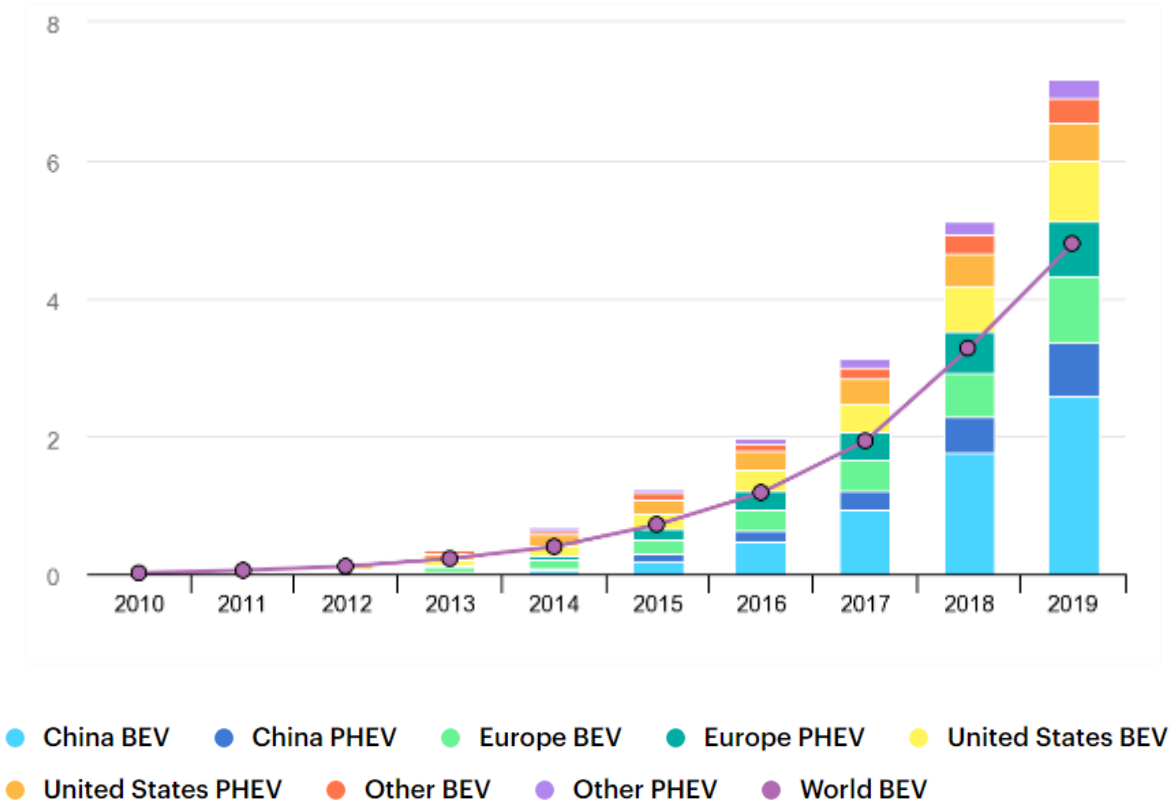


Figure 12: Global car stock, source: IEA

The European investment bank conducted a study that states that 67% of Europeans and specifically, 81% of Greeks would choose to buy a hybrid or an electrical vehicle. Particularly, 41% of Greeks would buy a hybrid and 40% would buy an electric car.

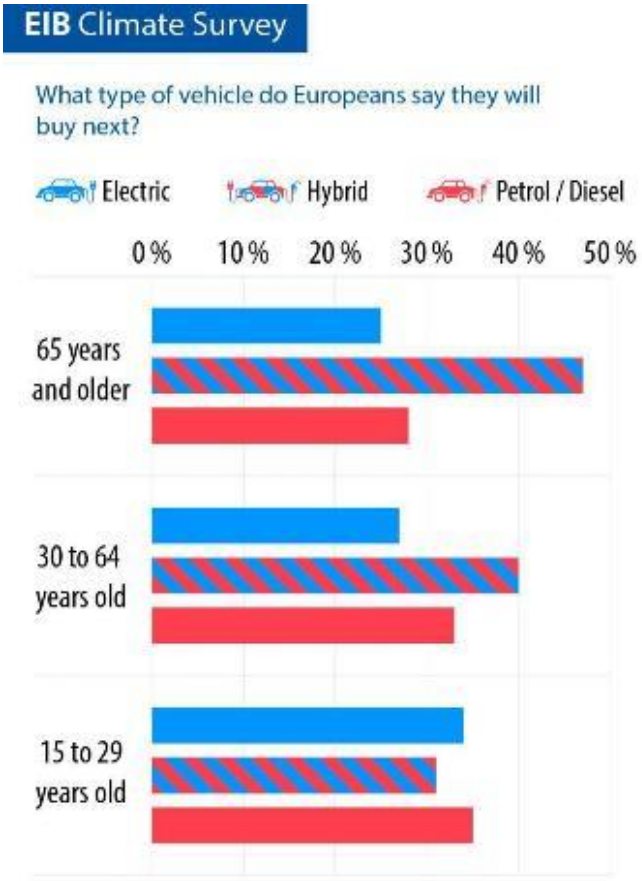


Figure 13: The type of vehicle Europeans say they will buy next, source: IEA

It's essential for potential buyers and players in the automotive industry to understand the reasons behind the popularity of electric vehicles. In an effort for these reasons to be more apparent, this section explains the characteristics of EVs and compares EVs and *Internal Combustion Engines* ("ICE").

6.3.2 Categories of Electric Vehicles

Electric cars fall into six different categories and below all will be stated (RAC, 2022).

6.3.2.1 Battery Electric Vehicle (BEV)

Powered exclusively by battery, battery electric vehicles are fully electric and part of the future. Their batteries are recharged at charging stations placed in homes and in public. Initially, the upfront cost is higher than that of an ICE vehicle, but their operating costs are significantly lower due to fewer mechanical parts and lower running costs per km.

Governmental grants and tax benefits help buyers of BEVs to minimize the burden of the higher upfront cost.

6.3.2.2 Plug-in Hybrid Vehicle (PHEV)

Plug-in hybrids can run on electric power and diesel fuel or petrol. They are considered to be carefree for road trips and travelling as they can distance approximately 65 km on electric power and use the ICE thereafter. Plug-in hybrids are still more expensive than ICE cars but their emissions of CO_2 are lower, and they provide a middle-ground solution.

6.3.2.3 Hybrid Vehicle (HEV)

Hybrids do produce less CO_2 and they run on electricity and diesel fuel or petrol. Their main power source is the ICE and they charge through its regenerative braking - their batteries are quite small. They also tend to be priced lower than purely electric vehicles.

6.3.2.4 Mild Hybrid Electric Vehicle (MHEV)

Most people and some manufacturers don't consider *Mild Hybrid Electric Vehicle* ("MHEV") to be a different category. This type of electric vehicle is not so much electric. What differentiates it from the above is that there is a small battery with an integrated starter-generator. Meaning, that MHEV is a subcategory of EVs because they offer a boost in acceleration. Therefore, they produce more emissions of CO_2 relative to the rest of the types of EVs.

6.3.2.5 Range-Extended Electric Vehicle (RE-EV)

The way RE-EV extends its range is simple, yet efficient and convenient, especially for long distances. It contains a small petrol or diesel engine which is used for charging the battery if need be. It is to be made clear that the car never runs on the engine.

6.3.2.6 Hydrogen Vehicle (FCEV)

Fuel Cell Electric Vehicles ("FCEV") are being explored in recent years by some manufacturers such as Toyota. It is very close to hybrid technology, but the key difference is the way they charge. In hydrogen vehicles, hydrogen is mixed with oxygen to produce electricity. The polymer electrolyte membrane (PEM) fuel cell is the most popular form of fuel cell used in vehicles. An electrolyte membrane is placed in between a positive electrode (cathode) and a negative electrode in a PEM fuel cell (anode). The anode receives hydrogen, while the cathode receives oxygen (from the air). An electrochemical process in the fuel cell catalyst splits hydrogen molecules into electrons and protons, which then go to the cathode via the membrane.

The electrons are pushed to go through an external route to produce work (powering the electric car), then they are rejoined with the protons on the cathode, and they form water(AFDC, n.d.).

They offer a driving range of over 480 km and they get refuelled in less than 4 minutes. FCEVs don't produce any emissions and they are qualified for tax benefits.

This is a technology that rivals fully electric vehicles and is likely to co-exist with BEVs in the near future, depending of course on Governmental support and adoption by the public.

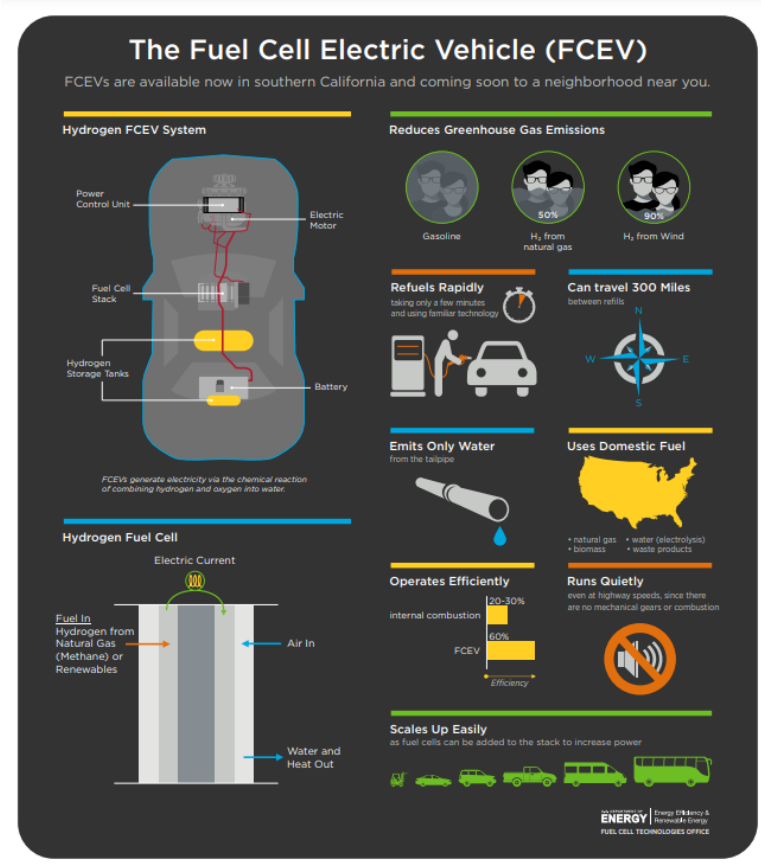


Figure 14: FCEV, source: afdc.energy.gov

6.4 Technology behind electric Vehicles

6.4.1 Inverters

Inverters serve the same purpose in EVs and PHEVs. In Battery electric vehicles built-in inverters, invert the AC power they receive from the grid to DC power the battery needs. They can be restricting given the fact that most cars have an inverter of 11kW and when charging on AC power they can provide fast charging. Sometimes buyers may only need to order their vehicles with larger inverters if that is offered by the manufacturer(Christine& Scott Gable, 2021).

6.4.2 Converters

Voltage converters are needed to convert the voltage of an electrical source. There are two types: the step-up converters that increase the initial voltage and the step-down converters that decrease it.

6.4.3 Battery

Electric vehicles depend on their batteries for the energy needed to move. Batteries are still very costly. For many years they had been unreliable due to their short lives, small range, and lack of recycling options. Now they are manufactured more efficiently. The battery pack consists of battery modules and cells. There are three types of cells (cylindrical, prismatic, and pouch) that can be used separately and for a battery to be built, hundreds are required. Cylindrical cells have the highest value for money, prismatic cells are the easiest to cool while they are quite cheap and pouch ones are the most flexible when they come to design.

A cooling unit, a temperature monitor, and, in most cases, a voltage monitor are all included in the battery modules, and they all give data to the *Battery Management System (BMS)*, which then takes care of maintaining the appropriate environment. The modules also include relays and other components that assure proper electrical and voltage distribution. It is feasible to ensure that all cells are charged and drained evenly as a result of this, which has a significant positive impact on the electric car's battery life.

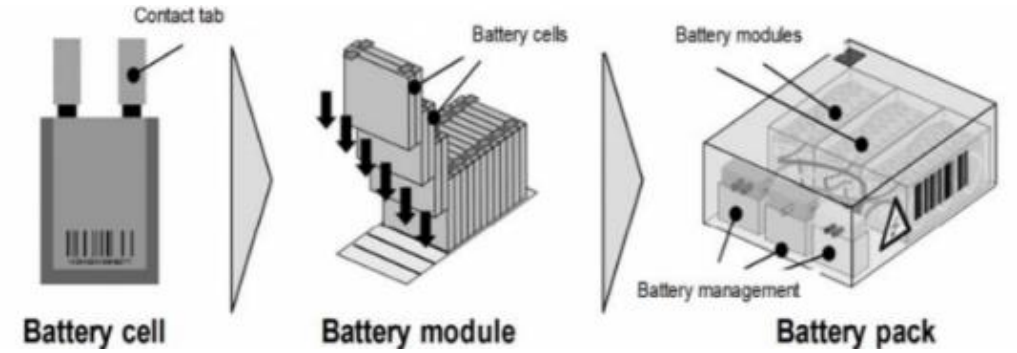


Figure 15: From battery cells to the battery pack, source: EVexpert

There are many parameters to be considered when it comes to the battery range. Usually, lead batteries can travel up to 80 km, nickel batteries have a range of up to 200 km, and lithium batteries can cover a distance of 320 to 480 km. Regenerative braking can increase range by 10-15% when the road is smooth and up to 50% in extreme conditions. It can also depend on the weather as EVs need to warm up using their battery (Jewell, n.d.).

The most important, when it comes to charging, is that the plethora of batteries should not be discharged below 20%. Most electric cars have a usable battery between 57kW and 85kW, there are also a few electric vehicles that have batteries of 37Kw up to 52kW and 91kW up to 108kW, and a small amount has 28kW up to 30kW.

6.4.4 Autonomy range

Each electric vehicle's range is estimated by the autonomy it has in the city, on the highway, and combined when the weather is cold and mild. Most EVs have a range between 250 km – and 600 km, and fewer have an autonomy range between 160 km - and 460 or between 390 km – and 890 km.

6.4.5 Price range

Electric Vehicles have a higher upfront cost than ICEs but they save money in the long run. The subsidies by the Greek Government help bridge the upfront cost gap between ICEs and BEVs. In Greece, prices of electric vehicles start from €9.500 (Citroen AMI) up to €160.000 (Porsche Taycan)(GOCAR, n.d.).

6.5 Electric Vehicles Chargers Market Analysis

6.5.1 Introduction

Although in recent years, there is a plethora of drivers who want to convert from ICEs to BEVs, there are many uncertainties that come along with this decision. The biggest of them all is the difficulty to find a sufficient number of EV chargers. *A charging station (EV charger) is a piece of equipment that supplies electrical power to plug-in Electric Vehicles*("Charging station," 2022). Electric Vehicles must keep their battery charged, the same way any chargeable device or electronic needs to.

The EV charging stations include, not only the EV charger, but the power grid, facility meter, energy controller, and extra equipment that might be needed. The power storage of a charger consists of the battery which usually is lithium-ion batteries with cells, packs, and *Battery Management System ("BMS")*. It also includes a power conversion system with the inverter, its enclosure, and *thermal management ("HVAC")* which means batteries can maintain a specific temperature. For the charger to be optimised the software platform is also needed. It aids CPOs and e-mobility service providers with the management of EV charging stations(Sustainable Energy Authority Of Ireland, n.d.).

There are three types of charging stations for EVs- rapid/ ultra-rapid, fast, and slow depending on their charging speed. There are also different electric car plug types, EV connectors, and charging cables. Next, the types of charging stations and the difference between direct current (DC) and alternating current (AC) are explored.

6.5.2 AC/DC Chargers

The power that is supplied from the grid is always *Alternating Current* ("AC"), but batteries can only store power in the *Direct Current* ("DC") voltage range. It is highly unlikely that

batteries store power in an AC format, as batteries are two-terminal devices that store static electricity. A DC circuit can carry current in one direction, while an AC circuit changes its polarity periodically. The batteries convert the chemical energy into electrical energy. The power stored in the battery is static because it is a DC. At the same time, we can't store AC in batteries because of the AC supply's frequency of 50Hz or 60Hz (50 to 60 times per second) (Ayothi, n.d.).

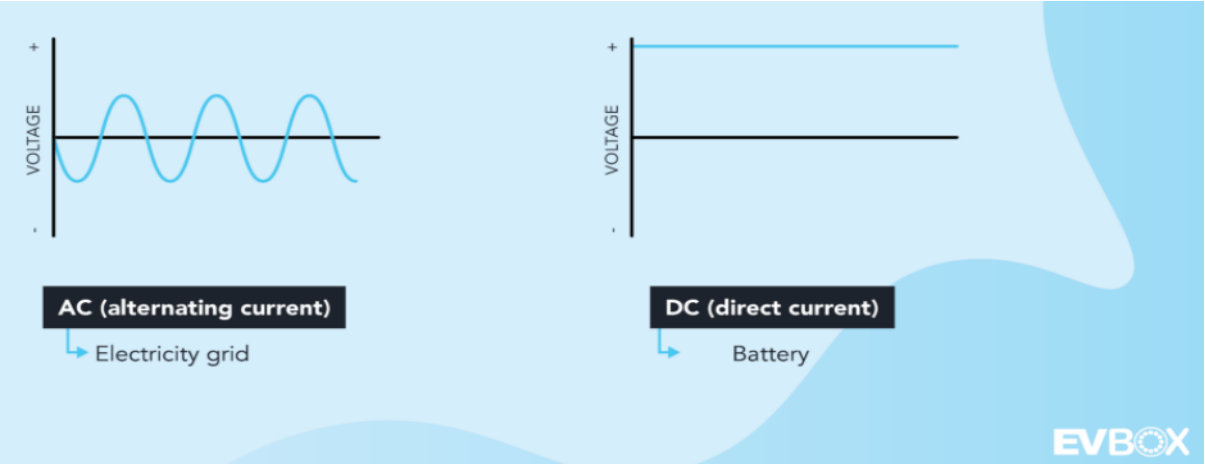


Figure 16: AC/DC, source: EVBOX

Therefore, when charging an electric car on AC power, it converts it internally to DC for it to charge. The difference between AC and DC is where the power gets converted. DC chargers convert the power inside the charger itself. This is a key difference, as the power AC flowing to an EV represents a flat line whilst DC represents a curve(Sullivan, n.d.).

Conclusively, DC chargers have access to more power and are constantly converting it. AC power doesn’t charge the vehicles as fast because the vehicle itself can receive only a certain amount, usually 7kW or 11kW, to convert internally at the time(Wallbox, n.d.).

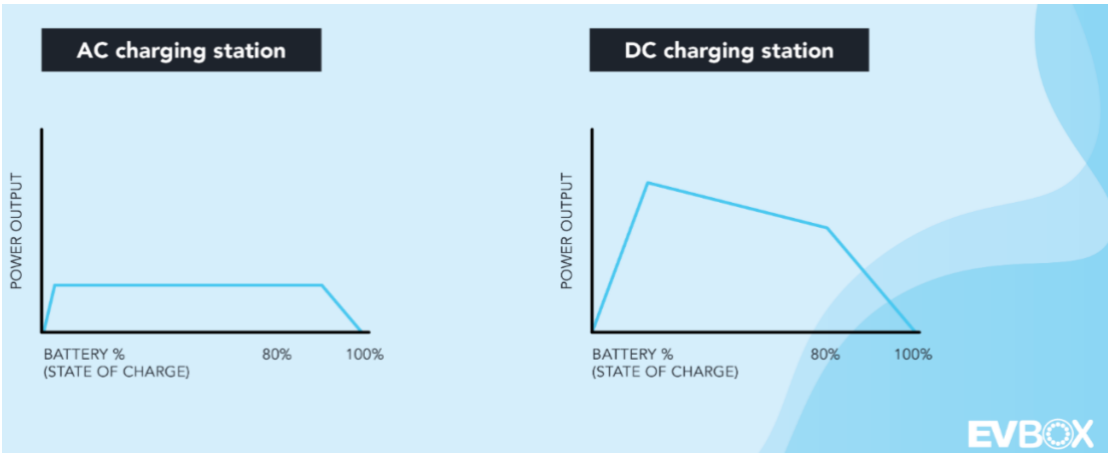


Figure 17: AC/DC charging curves, source: EVBOX

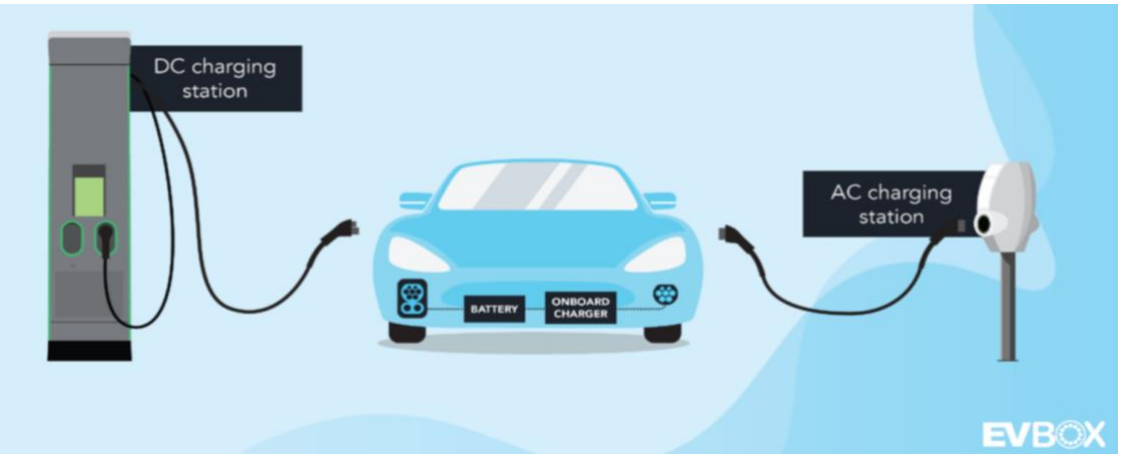


Figure 18: AC/DC charging, source: EVBOX

6.5.3 Types of Chargers

There are 3 types of chargers; level 1, level 2, and level 3. Each level represents the charging speed with level 1 being the slowest mode and level 3 being the fastest. Lastly, Tesla superchargers belong to level 3, but they will be mentioned separately as they aren't compatible with other cars (RAC, n.d.)

6.5.3.1 Level 3 (Rapid/ Ultra-Rapid)

One of the fastest ways to charge an electric car is by using DC rapid chargers, rated at 50kW to 350kW, or by using AC charges, rated at 43kW which is highly unusual (Lilly, n.d.). They supply high power direct or alternating current, to recharge the cars. Each unit has a listed power, representing the maximum available charging speed. Practically, that means that the car could be refilled up to 80% in less than an hour, after that it would take more time to reach 100% to protect the battery. Typically, ultra-rapid chargers rated at 100kW, 150kW, or 350kw can speed the process up to 20-40 minutes. Every rapid/ ultra-rapid charger has a cable, many have two.

6.5.3.2 Level 2 (Fast chargers)

Fast chargers are the most common when it comes to home charging points. Typically, they are rated at 7kW or 22kW and most of them provide AC charging. Some of them are rated at

25kW which provides DC charging. Depending on the EV's battery, charging time can vary between 5 to 7 hours at 7kW and 2 to 3 hours at 22 kW, as not many can receive more than 11kW or more when using AC power. Nissan Leaf, for instance, with a 3.3kW onboard charger can only draw as much, even if the charging point is more kW. Most fast chargers are 7kW and untethered, although if a cable should be attached to the device only compatible models can use it. This level is the most complicated one, as it can get very confusing to figure out how long charging can take. Hypothetically when charging for an hour at 7.4 kW a vehicle can gain autonomy up to 40 km, when charging for an hour at 11 kW a vehicle can gain autonomy up to 60 km, and when charging for an hour at 22 kW a vehicle can gain autonomy up to 120 km on AC power.

6.5.3.3 Level 1 (Slow chargers)

Slow charging Electric Vehicles can be similar to slow charging most devices. It is mostly rated between 2.3kW to 6kW. Charging times vary but usually, it takes 6 to 12 hours.

6.5.3.4 Tesla Superchargers

Tesla vehicles have a network of chargers with 2.500 stations worldwide. The charges are rated at 150kW and they can reach 80% capacity in around 30 minutes. It should be mentioned that Tesla's Model 3, Model S, and Model X can only use the Supercharger network. For the owners of these cars, it is possible to use adaptors to take advantage of general public points.

6.5.4 Connectors

There is more than one connector for Electric Vehicles and they vary depending on the region and the preferences of the car manufacturers.

Combined Charging System (CCS)

The most popular form of rapid charging is the connection *Combined Charging System* ("CCS") which combines AC (43kW) and DC (50-350kW) ports. The CCS Combo connectors are not the same in Europe, US, and Japan. In Europe, CCS type 2 connectors are compatible with Mennekes, and in the US and Japan, CCS type 1 is compatible with J1772 (Type 1). Some of the EVs that use CCS are BMW i3, Jaguar I-Pace, Kia e-Niro, and Volkswagen ID.3

CHAdeMO

Many Japanese and Korean in the electronic vehicle industry prefer this connector. It is designed for powerful DC charging stations and can charge up the battery to 80% in 30 minutes (at a power of 50 kW). Known brands that use it are Mitsubishi Outlander PHEV and Nissan Leaf.

ChaoJi

It's a third-generation connector, an evolution of CHAdeMO. It can charge supported cars with DC of 600A and power of up to 500 kW. Connector support previous standards of CHAdeMO, GB/T, or even CCS with an adapter.

Type 2 (Mennekes)

The most communal socket amongst EVs, even though not all of them can use AC rapid charging, is Mennekes. It can power up to 43 kW AC. The 7-pin charging connector plug is mainly used for electric vehicles made for Europe as well as several Chinese cars that have been adapted. Almost all EVs can charge on type 2 units using the correct cable. Type 2 has a version capable of charging on AC power at 7-22kW and a slower version rated at 3kW to 6kW on AC power.

Type 1 (SAE J1772 or J-plug)

The 5-pin standard electric-mobile connector is common to most American and Asian electric vehicles. It is a connector that charges with a power limit of 7.4kW. The slower version of type 1 is rated at 3kW to 6kW and runs on AC power.

'Commando' CEE plug

The Commando charger consists of a socket and a cable. It can match the speed of a home charging point. It's a 3-pin plug that can charge with AC power on 7-22kW(Maxwell, 2021).

UK three-pin or schuko plug

These plugs that can be found in buildings are rated at 3kW and 2.6kW each. Charging an EV fully could take up to 10 hours.

Tesla CCS

Tesla CCS is used for the Model 3 and is rated at 150kW on power DC.

Tesla Type 2 (Mennekes)

This connector is used for the Model S, and Model X and is rated at 150kW on power DC.

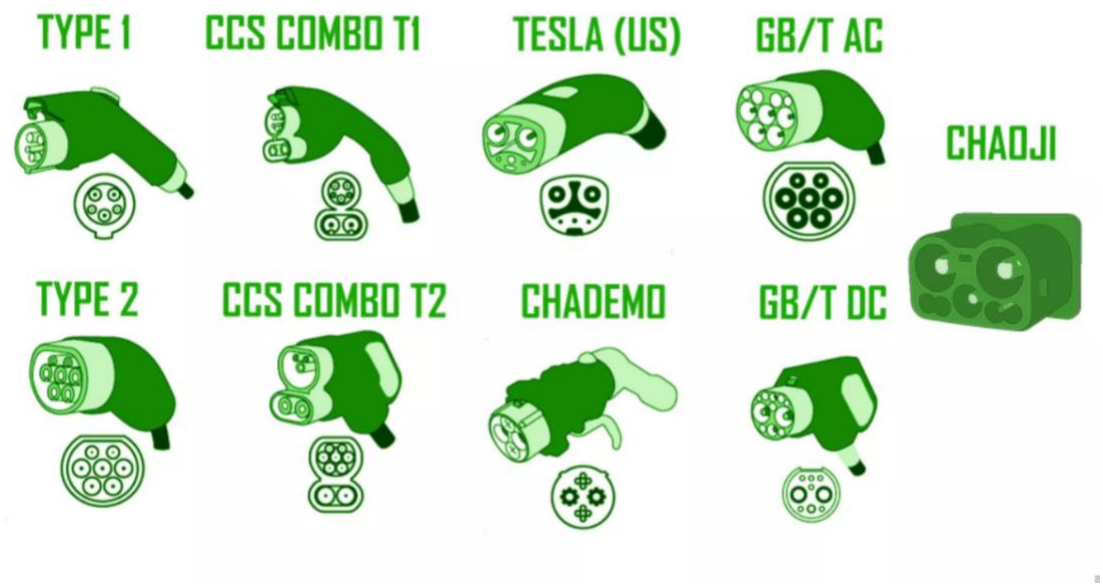


Figure 19: Types of connectors, source: https://www.midaevse.com

Table 3: List of most common EV cars and their supported ports and chargers

EV name	Type 1 / 2	CCS combo	CHAdeMO	Tesla Supercharger	Rapid Charging
Tesla Model S, 3, X, Y	Yes	Yes	Yes	Yes	Yes
Hyundai Ioniq Electric	Yes	Yes	No	No	Yes
Hyundai Kona Electric	Yes	Yes	No	No	Yes
Chevrolet Bolt EV (Opel Ampera-E)	Yes	Yes	No	No	Yes
Chevrolet Spark EV	Yes	Yes	No	No	Yes
Fiat 500e	Yes	No	No	No	No
Jaguar I-Pace	Yes	Yes	No	No	Yes
Kia Soul EV	Yes	No	Yes	No	Yes
Mercedes-Benz B-Class Electric	Yes	No	No	No	No
Mitsubishi i-MiEV	Yes	No	Yes	No	Yes
Renault Zoe	Yes	No	No	No	No
Renault Kangoo Z.E.	Yes	No	No	No	No
Nissan Leaf	Yes	Yes	Opt.	No	Yes
Nissan e-NV200	Yes	No	Opt.	No	Yes
Volkswagen e-Golf	Yes	Yes	No	No	Yes

Source: midaevse

6.5.5 Electric vehicles chargers manufacturers

As the public's priorities shifted, so did the companies'. Many realized the future lies in sustainability and began to explore ways to help the EV industry flourish. Now there are already major chargers manufacturers that have been globally established.

ABB

ABB is a global leading technology company focusing on four areas including electrification, process automation, motion, and robotics. The company's market cap is €57 billion. ABB has a wide range of products for electrification, including EV infrastructure. The company states that about 24% of CO_2 emissions are due to transportation and over 65% of those are due to passenger cars. For the emissions and noise to be reduced they produce AC and DC chargers for single-home residential charging, hotels, commercial fleets, industrial fleets, public commercial parking, fast charging roadside stations, heavy-duty truck charging, and bus charging. Additionally, the company distributes medium to low-energy power to charging stations and has battery storage systems available(ABB, n.d.).

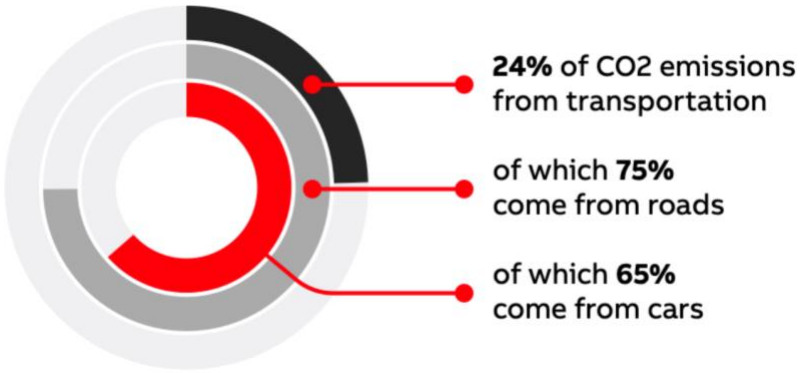


Figure 20: CO_2 emissions, source: ABB

Siemens

Another company that has been very active in eMobility is Siemens, a subsidiary of Siemens AG with products and solutions for electromobility. Siemens' portfolio includes AC charging stations, AC wallboxes, DC charging stations for fleets, and DC fast-charging stations, and its market cap is valued at €95.88 billion. The company has also created an innovative system ELFA which offers a wide range of power, making it compatible with all vehicle classes. ELFA makes it possible for *Original Equipment Manufacturers* ("OEM") to design their needed drivetrain configuration(companiesmarketcap, n.d.).

Ensto

Ensto was founded in 1958 by Ensio Miettinen and it is still a family business building systems. It is a manufacturing company of enclosures, EV charging, heating systems, EstoNet, lighting, modular wiring, and industrial components. There are 6 Ensto Building Systems Plants in Estonia, Spain, France, Finland, and Russia with a personnel of more than 300. In 2010 Ensto launched an excellence program EOX so continuous improvement would be achieved. Ensto

provides solutions for home, work, and public charging, and has created Ensto One, a versatile charging platform that can charge up to 22kW. (Ensto, n.d.)

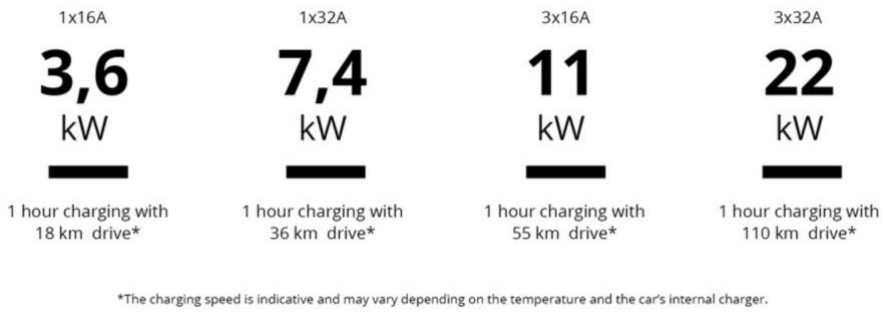


Figure 21: Ensto One, source: Ensto

Alfen

Alfen is a French company, engaged with the electricity grid; smart grids, EV charging, and energy storage. Alfen can offer a total solution in the field of medium and high voltage grids. The company also offers chargers for charging at home, at work, and in public. The Alfen Smart Charging Network operates in a way that chargers align their speed, functioning as a group while remaining individually controllable. The company has a market cap of €1.89 billion (companiesmarketcap, n.d.).

Schneider

A worth quoting manufacturer of equipment relative to eMobilty is Schneider. Schneider Electric is on a mission to a more sustainable future. Their manufacturing facilities are in Seneca, South Carolina. They offer miscellaneous products, controls, software, and services for homes, buildings, data centres, infrastructure, and industries. The company produces EV chargers, distributes energy, and sells products for solar and energy store, and industrial and building automation. Schneider's market cap is estimated at €80.07 billion(companiesmarketcap, n.d.).

Wallbox

This company was launched in 2015 by former Tesla employees outside Barcelona with its first charger, the commander. Since then, they have also produced level 2 AC chargers, pulsar range, copper SB, and commander 2. Another product, Quasar, allows the customers to use the power from the EV's battery to power their preferred building or the grid. Wallbox offers a portfolio of EV charging and energy management solutions for homes, businesses, and

public use (Wallbox, n.d.). The company was purchased by Kensington Capital Acquisition Corp., the combined new company is valued at €1.41 billion(Gardner, n.d.).

EVBox

The company was founded in 2010 and is backed by ENGIE. EVBox is a manufacturer with 10 facilities in Europe and North America, engaged with EV charging stations. Over the last decade, EVBox has delivered more than 350.000 charging ports and has more than 20.000 business customers in over 70 countries(EVbox, n.d.).

Sinexcel

Sinexcel was founded in 2007 and its headquarters are in Shenzhen, with a stock value of €3.87 billion. The company has over 155 patents and software works, more than 800 employees, covers more than 50 countries and has 3 manufacturing facilities. Sinexcel produces EV chargers and aims to lead in the electric energy field(Sinexcel, n.d.).

6.5.6 Price range

There are many factors determining whether one should purchase an electric vehicle, besides its cost and the supply of chargers. It's crucial that potential buyers understand the cost of owning the apposite charger(DiNello, 2021).

6.5.7 Infrastructure

Infrastructure can be extremely costly since the electric upgrade the circuit might need, can cost up to €14.000, along with the associated expenses. An electric circuit is a path for transmitting electric current. An electrical update conveys related costs, including electrical boards, meters to monitor electricity use or even an extra transformer. It may likewise include tedious, digging, and concrete work for electrical cables.

Figure 22: Infrastructure, source: Future Energy

6.5.8 Equipment

6.5.8.1 AC chargers

Expenditures while charging on level 1, can fluctuate as customers can charge on electrical outlets from the grid or on charging stations. Level 1 is mainly considered when the charger is for residential use. An electrical outlet of 16A can cost anywhere between €50 to €150 and a single-phase circuit charging station can cost between €650 to €2.500.

On level 2, single-phase chargers exist as much as three-phase ones. They need a 240V outlet and can be used for residential use and professional one, such as in offices. Single-phase AC chargers begin from €800 to €3.000, while three-phase ones cost anywhere between €900 to €6.000-9.000 (kafkas, n.d.).

6.5.8.2 DC chargers

DC circuit is always three-phase and is utilized mainly for public and professional use. This type of charger costs from €5.000 up to €100.000.

All of the above depend on whether charges are in their basic form or the companies have added value to them. They are more expensive supposing that the chargers have a built-in MID meter, a device that allows recording the energy consumption, or support *Open Charge Point Protocol* (“OCPP”), a protocol that allows communications from charging stations to a central management system. Chargers with screens on them, Wifi, Bluetooth, LAN, *Radio Frequency Identification Card* (“RFID”), and wireless charging cost more.

Figure 23: Chargers, source: Future Energy

6.5.9 Soft costs

Soft costs include anything around protective bollards for the chargers, custom striping, signage, and parking blocks as shown in the picture below. The cost of these differs.

Figure 24: Soft costs, source: Future Energy

6.5.10 Software

For a company or an individual to collect and analyse data, there must be software installed. According to Future Energy, the cost to host information in the cloud is around €26 per month, per port.

6.6 Software for Electric Vehicle

6.6.1 Introduction

A set of instructions, data, or programmes used to control computers and perform certain activities is referred to as software. There are many types including application software, system software, driver software, middleware, and programming software("What is Software?" n.d.). Each year the market share of electric vehicles grows and the more EVs are being purchased, the more industries invest in EV software. Hence, companies have started operating exclusively to provide end-to-end solutions for drivers. The benefit of using software rather than mechanical systems is that updating a vehicle only takes a software update rather than a physical change to the internal mechanisms.

6.6.2 Electric Vehicle Software

Four types of software are used in EVs. Initially, car design software manages the operation of the car and allows it to function effectively. The battery, brakes, lights, as well as any inside entertainment system and heated seats, will be managed and controlled by it. Because the vehicle is controlled by software, maintenance-specific and predictive software can be utilised to inform the driver when maintenance is required, specifically the battery and management system. Monitoring software will constantly monitor the car for problems and assist in their detection. It will also be able to alert the driver if any specific parts need to be examined or if a software update is required. Navigation software essentially helps identify journey routes, and charge station locations. It can also calculate the remaining km depending on the current battery charge, reducing the 'range anxiety' many EV drivers have, particularly on lengthy trips.

Taking into consideration all of the above, it becomes obvious that the software is developed to help drivers in as many ways as possible. It improves the drivers' experience but also it improves their safety and the environmental impact. It also makes it possible for the chargers to operate wirelessly, maintain the vehicle and identify remotely any issues that may emerge(eFaraday, 2021).

6.6.3 Charging Station Software

The software is equally important to the charging operations and e-mobility service providers so they can increase the charger's uptime and provide a superior EV charging experience to drivers. The companies aim to provide solutions for every issue that might be met. The operations component of EV charging software help in the majority of issues relevant to the charging network. It is capable of automatically diagnosing faults and remotely rectifying problems. It also has a mechanism that gathers, visualises, and analyses operational data for ongoing optimization.

6.6.4 Billing

EV charging billing is a sector that most companies focus on. Every software must have a complete billing and invoicing system that can handle a variety of payment methods, including prepaid and pay-per-use, as well as credit card payment gateways. It should include flexible pricing depending on criteria such as time of day, KWh, per minute, and charging speed. It should facilitate settlement between numerous parties, such as business partners and electric vehicle roaming suppliers. To manage settlements, many EV charging stations will need to interface with roaming systems such as Hubject, Gireve, and e-clearing.net. Multinational companies will require multi-currency capability as well as flexible tax administration. A major problem the market is facing at the moment is the lack of OCPI roaming.

6.6.5 Grid considerations

When considering the requirements needed by the electric grid to provide the additional energy necessary for EV charging, local infrastructure may be insufficient. Only a small number of vehicles can currently be supported by the Grid to charge at full power in an uncontrolled EV charging ecosystem. Energy management for EV charging spreads out the strain on the local grid, allowing utilities to avoid costly infrastructure changes while guaranteeing that all cars get the electricity they require on time at a charging point. Operators can monitor, control, and regulate energy use with smart energy management software for EV charging. In addition, energy from nearby storage or renewable energy sources may be absorbed into the charging facility's power supply, saving money and decreasing grid strain.

Drivers of EVs need easy-to-use self-service technologies to help them identify chargers, make reservations, roam beyond their networks, and make payments, in addition to reliable and accessible chargers. These solutions are often mobile applications that are powered by EV charging management software, which should also provide insights into client behaviour so that they may be better realized and supported.

EV fleet software manages one location that may be required to support several dozen or more electric cars, buses, vans, or any other vehicle, the majority of which will need to charge overnight in preparation for the next day's operation.

Charger manufacturers, service providers, software developers and suppliers, EV charging operators and e-mobility service providers, roaming platform operators, industry standards, and more are all part of the EV charging environment. The EV charging software solution should be open protocols like OCPP and *Open Charge Point Interface* ("OCPI") as they develop. Roaming platforms should be embraced to make it easier to locate all charge points available in an area. For a more flexible programme, API-based external development should be used allowing customers to use extra software-based features and functionalities from third-party developers ("What is EV Charging Software?" 2022).

6.6.6 OCPP (Open Charge Point Protocol)

Many infrastructure companies have partnered and created the *Open Charge Alliance* ("OCA") aiming to promote open standards through OCPP. OCPP launched in 2018 and since it is being optimised.

The purpose of OCPP is to provide a standardised communication route between charge points and central systems. This protocol allows any central system to communicate with any charge station(Open Charge Alliance, n.d.).

Table 4: Current functionalities (OCPP 2.0.1)

N	Current functionalities (OCPP 2.0.1)	Clarification
1	**Device Management**	It is a feature that CPOs who handle complicated multi-vendor (DC fast) charging stations need.
2	**Improved Transaction handling**	This is helpful for large numbers of transactions.
3	**Added Security**	Secure firmware upgrades, security logging and event reporting, and authentication security profiles have
4	**Added Smart Charging functionalities**	An Energy Management System (EMS) and Charging Station Management System.
5	**Support for ISO 15118**	Yes
6	**Display and messaging support**	Providing the EV driver with information.

Source: https://www.openchargealliance.org/downloads/ (Open Charge Alliance, n.d.)

6.6.7 OCPI (Open Charge Point Interface)

The *Open Charge Point Interface Protocol* ("OCPI") facilitates communication between eMobility Service Providers and CPOs. This protocol is open source and independent. Everyone is welcome to contribute to the development of OCPI. It is meant to be user-friendly, stable, simple, and standardized. OCPI is used by numerous companies and in many countries.

OCPI, as claimed by the EVRoaming Foundation, aims to *accelerate the market for EV drivers and improve mobility services*(EVRoaming Foundation, n.d.).

Table 5: Current functionalities (OCPI V2.2)

N	Current functionalities (OCPI V2.2)	Clarification
1	Roaming via hub	Data exchange between eMSPs and CPOs via hubs.
2	Roaming peer-to-peer	Separate interfaces are designed for eMSPs and CPOs.
3	Roaming with mixed roles	A mixture of the above.
4	Authorization	The OCPI provides CPOs with access to any eMSP token information. It can be executed in real-time or via a whitelist.
5	Reservation	It allows it to make and cancel a reservation.
6	Tariff information	The protocol facilitates the communication of crucial
7	Billing	Supports invoices and sends Charge Detail Records (CDRs).
8	Static charge point information	It includes IDs, CPOs, charge point site, host, charge point name, charge point location details (name, address, geocode, type, image, platform level, directions), nearby facilities, link to a website, time zone, opening times, current availability status, scheduled availability status, accessibility, tariffs, authorization modes, payment methods, terms and conditions, charge mode, connector type, maximum power, voltage, amperage, energy mix, remote start/stop, reservation, smart charging support, and the last update mark.
9	Real-time charge point status	Statistics: available, blocked, charging, inoperative, out of order, planned, removed, and reserved.
10	Session information	It includes sessions ID, start time, end time, energy consumed, CDR ID, authorization method, location, charge point ID, meter ID, currency, charging periods, total cost, sessions status, and last update.
11	Call Detail Record (CDR) information	CDR IDs, time, duration, finish status, and more.
12	Remote start/stop	Any charging session may be started and stopped remotely using the eMSP app.
13	Smart charging support	OCPI supports a variety of charging profiles. The user's choices can be saved for each session.
14	Calibration law	Exchange of signed metre data that can be used to comply with German calibration regulations (Eichrecht).

Source: https://solidstudio.io/blog/ev-roaming-with-open-standards-ocpi-ochp (Majcher, 2021)

6.6.8 Types of Software for Drivers and Charging Stations

More and more companies are established and offer end-to-end solutions for the drivers and electric vehicle charging companies. The software supports the charging sessions and is the means of communication between the vehicle, the charger, and the driver. Such software can be proprietary or open-source. An additional type of software support for the drivers is the network mapping software. All three are discussed next alongside the corresponding companies that offer them.

6.6.9 Charging Station Software

6.6.9.1 Proprietary Software

The majority of software is proprietary, created by a third-party provider. Commercial software that may be purchased, leased, or licenced from its publisher/vendor/developer is known as proprietary software. Proprietary software rarely allows access to its source code, to end-users or subscribers. Proprietary software can not be relicensed, distributed, and copied. The end-user licencing agreement, terms of service agreement, or other relevant usage agreements detail the limits or requirements placed by the vendor/developer. Before installing or using the programme, the user/organization/company must acknowledge the agreement. For breaking the agreements above, legal actions can take place(“What is Proprietary Software?” n.d.).

6.6.9.2 Network Mapping Software

Mapping software transforms the location data into maps. To find linked devices, network mapping software uses techniques such as trace routing. It collects data from routers, switches them, and sends them back to the mapping system, such as IP addresses, ports, and connection protocols. This helps *Network Administrators* (“NA”) in identifying network inefficiencies, as well as doing root cause analysis on network issues(“What is Network Mapping Software?” n.d.).

6.6.9.3 Open-Source Software for CPOs

Any CPO may examine, alter, and share the code in open-source software. Peer review and community production are used to build open-source software in a decentralised and

collaborative manner. Open-source software is produced by communities, specifically by CPOs, rather than a single publisher, developer or organisation. It is frequently less expensive, more flexible, and has a longer lifespan than proprietary software("What is open source?" n.d.).

6.6.9.4 Closed Software

Closed software means the source code is not available for others, except for the developers, to make changes. If someone is to make changes is necessary to have a corresponding license. Closed software for 3rd parties refers to software that does not allow CPOs to make any changes to the way the app works. Some providers offer chargers with the possibility to reinstall a different, preferred software.

Table 6: Software Availability & Characteristics

	CP Interface (Billing & Reservations)	**Open to 3rd Parties**	**Mapping of 3rd Party CPs**	**Roaming**
EVLoader	Yes	Yes	No	No
Google Maps	No	N/A	Yes	N/A
Hubject	No	Yes	Yes	Yes
AMPECO	Yes	No	No	Yes
Carge	N/A	No	Yes	No
Chargespot	Yes	No	No	No
PlugShare	Yes	Yes	Yes	Yes
GO-TO-U	Yes	Yes	Yes	N/A
Everon	Yes	Yes	Yes	Yes
Chargemap	Yes	No	Yes	Yes
ChargeLab	Yes	Yes	Yes	No
GreenFlux	Yes	Yes	Yes	Yes
ChargePoint	Yes	No	Yes	Yes
Ubitricity	Yes	No	Yes	Yes
ZAP-map	Yes	Yes	Yes	Yes
Driivz	Yes	No	No	Yes
eVplus	Yes	Yes	Yes	N/A

EVloader

The company launched in 2020 in Greece and currently has 40 charging stations on its map. EVloader aims to be flexible and operates B2B and B2B2C. The company endorses visibility, monitoring, transactions, and technical support. It is offered to CPOs with a free app that helps perform charging sessions and make reservations(Elevate Greece, n.d.).

Hubject

Hubject has been operating since 2012 and has provided the EV industry with the largest roaming network there is. There are over 1000 companies connected to the platform with almost 400.000 charging stations, which has reached over 10 million drivers across the globe. The company has 81 employees in its 3 offices(Hubject, n.d.).

AMPECO

AMPECO is a leader in the EV charging management market. The company offers solutions with a '*white-label and hardware agnostic EV charging management platform'*(AMPECO, 2021). White-label describe products that seem as if they are manufactured by the party who buys them. The company was founded in 2018, has more than 80 customers and has a presence on 5 continents.

The features that emerge from the purchase of the software are seen in the picture below.

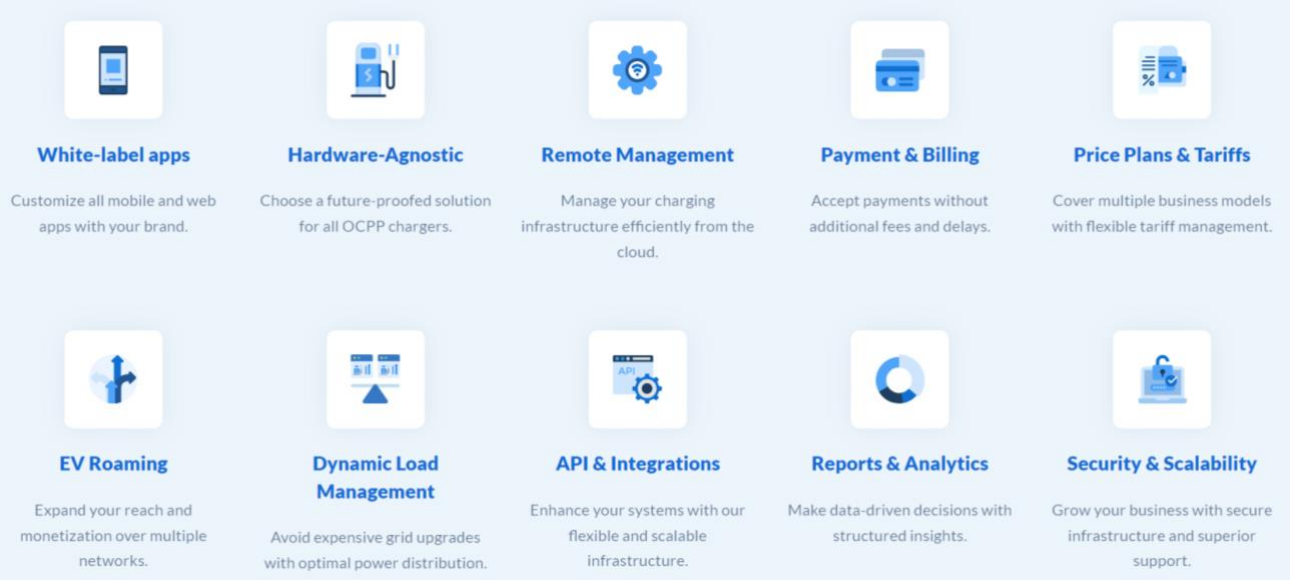


Figure 25: Features of software, source: AMPECO

Carge

The company was founded in 2020 in Athens, Greece and is the first e-Mobility Service Provider that uses smart grid balancing algorithms to assist EV drivers in finding, booking, plugging in, and paying at all charging stations across Europe (Crunchbase Inc, n.d.). On the map, there are shown more than 130.000 charge points in at least 15 countries("Charge," n.d.).

Chargespot

Chargespot is powered by Watt and Volt, it has 338 charge points, 150 points that will be established shortly and the app has been downloaded more than 15.000 times(Chargespot, n.d.). Chargespot gives access to one of the largest networks in Greece.

PlugShare

PlugShare was founded back in 2009, based in California and is fully oriented toward EVs. The app is one of the most popular amongst EV drivers, it uses API which can customise the app itself(PlugShare, n.d.). Plugshare Research was established in 2013 aiming to amplify anyone's voice in the plug-in vehicle industry. Almost 100.000 drivers are in the survey of PlugInsights (PlugShare, n.d.).

By using the app more than 500.000 charge points can be found and more than 750.000 trips have been planned by nearly 2.000.000 users(PlugShare, n.d.)

AmpUp

The company was founded in 2018 and has since been developing its network. Via the app CPOs can share their charge points publicly. AmpUP aims in reducing the anxiety drivers have when on road trips or the anxiety that emerges from the lack of home charging(AmpUp, n.d.). The app serves multiple workplaces, retail shops, campuses, hospitality facilities, and municipalities. Via AmpUp customers can view real-time data, get back reports, facilitate many user groups, optimise the characteristics of each charge point, track sustainability metrics, and set up direct deposits(AmpUp, n.d.).

Everon

Everon is a company that offers white-label software to CPOs with hardware agnostic and is developed by EVBox and engie. It allows CPOs to manage their EV charging network without the vendor lock-in. Also, Everon makes it easier to manage the station remotely, create

schedules to regulate energy consumption, get data from the employees' cards, manage roaming partners via OCPI, and connects its billing API to the COPs' *Enterprise Resource Planning* ("ERP") system(Everon, n.d.).

Chargemap

The company has been operating since 2017 in France and has the largest community of 1.184.952 members(Chargemap, n.d.). Chargemap has over 450.000 ports across Europe, some filters narrow the search of a station nearby depending on the fee that a station requires, the score, nearby services, specific connectors etc. The app allows drivers to plan their trips and the community has made sure that the data are reliable. The company has also issued a pass that shows the payment required in advance and holds a history of them(Chargemap, n.d.).

Google Maps

Some EVs like the Polestar 2 and Volvo XC40 Recharge, will include an improved navigation system from Google Maps to assist schedule recharge stops they require. The app will calculate each time the most efficient route including when recharge will be due and how much time the driver will spend at the charging station depending on the type of charger. Google maps also combine displaying the location of EV charging stations and displaying other stores/shops where drivers can spend their time waiting(Lekach, 2021).

ChargeLab

ChargeLab was founded in 2016 with a mission to make it easier for CPOs to deploy their chargers and for drivers to use them(ChargeLab, n.d.). The company's customers can be houses, workplaces, public spots, fleets, stadiums, hospitality facilities, parking lots, and others(ChargeLab, n.d.).

The software is an open, white-label and hardware agnostic system that offers connection with any OCPP compliant charger, gives access to data, displays a schedule to view availability, tacks costs and profits, manages users and permissions, customises reports, and collects money(ChargeLab, n.d.).

ChargePoint

ChargePoint is a leading company in the electric vehicle industry and has created an app with the largest EV charging network. There is hardware at the stations that helps the accuracy of

the locations, a possibility for different fees over time from CPOs, when it comes to fleets, the software can prioritise the vehicles in need of charging(ChargePoint, n.d.).

There are many more features that make this app so popular, the price can be set depending on many factors, there is advanced access control that grants access to drivers, more than 35 reports are available for CPOs, and there is a graphical dashboard that makes it possible to manage charge ports remotely. For fleets and individual drivers, there is a specific setting that notifies them when a charging station is available and the time left for a car to be fully charged(ChargePoint, n.d.).

ChargePoint has acquired has-to-be, the developer of be.ENERGISED, in late 2021. Has-to-be and ViriCiti made it possible for the company to have the most complete solutions in the EV industry in Europe and North America with over 150.000 charging ports in total available(ChargePoint, 2021).

GreenFlux

The company was founded in 2011 in the Netherlands and is independent with investors from multiple industries(GreenFlux, n.d.). GreenFlux is active in more than 21 countries and provides management solutions for charging networks to help in the adoption of Electric Vehicles. The company offers access to 232.000 charging points via roaming, has powered 2.2 billion km, and has offered 23 million charging sessions. The white-label software the company delivers can be managed by the buyer or can be outsourced back to GreenFlux, it optimises the way the grid is managed, delivers data of the transactions for invoicing or reimbursement, it also provides access to roaming hubs, such as Hubject, Gireve, OCPI, and peer-to-peer connections(GreenFlux, n.d.).

GO TO-U

GO-TO-U was founded in 2017 with its major investor being ABB and provides an app that includes 300.000 chargers in over 47 countries. The app demonstrates which charge points are unoccupied, occupied, have no online connection but have a virtual reservation, and are under maintenance. It also displays the kW of each charging station(GO-TO-U, n.d.).

Ubitricity

The company was founded in 2008 as a member of the Shell Group. Ubitricity is a provider and operator of EV charge points and has the largest public charging network in the UK. According to the company, 40% to 60% of owners of electric vehicles in cities don’t have access to chargers of their own and so it’s Ubitricity’s mission to offer easier access to them.

Ubitricity also offers end-to-end solutions including consultation, installation, utilisation, statics, and customer service(ubitricity, 2020).

ZAP-map

ZAP-map has been operating and has mapped over 95% of public charge points with most of them showing when they are available. The company's community is sharing information for the chargers and can share the chargers some might own as a part of the peer-to-peer ZAP-Home. ZAP-map also includes a variety of services for CPOs(S, n.d.).

Driivz

The company has been operating since 2013 and has counted many achievements. Their platform is used in 24 countries and is in partnership with many leading companies like EVgo and Volvo Group. By early 2022 Driivz was bought by Vontier, an international industrial technology corporation(Driivz, n.d.).

Driivz offers end-to-end services aiming to aid CPOs to fix remotely most operational issues, manage billing transactions, offer self-serving tools, decrease costs, and establish smart energy management. The company is also OCPP certified(Driivz, n.d.)

eVplus

eVplus has been operating since 2021 in the field of e-mobility and offers end-to-end solutions from the supply, and installation, to managing charging stations(eVplus, n.d.). The company's software is for CPOs and eMSPs offering to make adjustments remotely in real-time via OCPP, organise locations and charging ports, reservation of ports, print reports, and operation on the Amazon Web Server. Transactions via eVhander+ are also supported by integrating with all the payment gateways. Each CPO can determine the fee depending on usage time, unit of time, per kWh, or a combination of those. It is also possible to manage the energy as it is being transferred in real-time and supports the Static Load Management, Dynamic Load Management, and Vehicle to Grid (V2G)(eVplus, n.d.).

6.7 OEM

EVBox

EVBox has been operating since 2010 in the EV industry. The company manufactures charges and offers end-to-end solutions with its software. The company has helped to put approximately 350.000 charges worldwide and has 10 offices, manufacturing and lab facilities (EVBox, n.d.).

The company offers software to make management easier for the customers. So far, there are 74.000 charging ports in the system, 219.000.000 kWh charged, and 2.000.000 transactions have happened. The software is served to homes, workplaces, parking lots, retail shops, hospitality facilities, car fleets, and transport.

The software allows CPOs to control charge ports distantly, optimise electric power through charging profiles, commence charging remotely, set the desired fee, print invoices and reimbursements, make charge points accessible via the map, real-time information, export that information, manage remotely the entire network (EVBox, n.d.).

Blink

Blink is using its software for its network via the company's cloud. It's a user-friendly app that shows information about the charger including statistics, real-time status, locations, and prices. It makes it easy for the chargers to be monitored and to be paid remotely. Blink is also part of Hubject(Blink Charging Hellas, n.d.).

DEI blue

DEI blue is a leading company in the e-mobility field and had custom-made its software. Recently the company bought Garge, a start-up that develops software and is mainly designing platforms that give the possibility to have chargers mapped out and the fastest route to get there. Purchasing the start-up was necessary as the company's plan is to expand its network to 10.000 public chargers by 2025. DEI blue provides now complete services(newmoney, 2022).

NRG

NRG is one of the leading companies in Greece and has chosen to partner with the Driivz platform to develop the incharge platform. The choice was based mainly on the reliability the platform promises and the fact that can solve up to 80% of the problems emerging remotely(Driver, n.d.).

Protergia

In 2021 Protergia chose to manage its electric vehicle charging network with be.ENERGISED software. In Greece, there are currently 518 chargers and with the formed partnership between ChargePoint and Protergia, ChargePoint get to penetrate in Greek electric vehicle market. be.ENERGISED was chosen due to its flexibility, optimised operations, and billing services(ChargePoint, n.d.).

Elpedison

HELLENIC PETROLEUM is the company behind Elpedison and ElpeFuture making the services they provide complete. ElpeFuture is a subsidiary of HELLENIC PETROLEUM and operates as a CPO, eMSP, and as transaction manager. Some EKO and BP stations will have installed EV chargers, creating a powerful network.

ElpeFuture provides fast charging, strategic points to charge, and payment via APP or RFID. When paying with the ElpeFuture card, there is a 0.05€ discount(Elpedison, n.d.).

7 Strategy

7.1 Introduction

There is a process followed to estimate the future demand of EV drivers for electric vehicles and their equipment so AcroVolt can better set its revenue expectations. As Greece is just emerging from a very long financial instability there are a few indicators that will determine the demand. Statistics and findings are gathered from Greece. Many different are analysed, such as income, population, and demographic. The past few years have been crucial, as the pandemic has shifted the dynamics in the market and thus there are decisions made by AcroVolt about which years should be examined. All this information aims in identifying regions of interest and help AcroVolt create a successful and profitable network.

7.2 Forecasting demand for EVs in Greece

To forecast demand in Greece, statistical data by region are provided to identify potential buyers of electric vehicles and corresponding equipment.

In the figure, a presentation of Greek demographic data by Eurostat is shown(EUROSTAT, n.d.). The information applies to the entire country. Compared to the European Union, Greece's GDP per capita is less than €10.240. This is an indication that Greek people have less disposable income that could be directed to vehicle purchases.

	European Union	Greece
Population on 1 January (absolute number)	**447 207 489** (2021)	**10 678 632** (2021)
Youth population (15 - 29 years) (as % of the total population)	**16.3%** (2021)	**15.6%** (2021)
Minimum wage (Euro per month)	N/A	**773.5€** (2022-S1)
People at risk of poverty or social exclusion (as % of the population)	**21.5%** (2020)	**27.4%** (2020)
Unemployment rate (as % of the active population aged 15 - 74 years)	**7.2%** (2020)	**17.6%** (2020)
GDP per capita (Euro per inhabitant)	**27 830€** (2021)	**17 590€** (2021)
Greenhouse gas emissions (Tonnes per capita)	**8.4** (2019)	**8.4** (2019)
Electricity prices (Euro per MWh, incl. taxes)	**220.3€** (2021-S1)	**168.0€** (2021-S1)

Figure26: Greek demographic data, source: Eurostat

7.2.1 Annual Income

The three tables below hold information about GPD in different regions. Table 7 includes the Administrative regions of Greece containing data for GDP, Disposable income per household, Employment rate, Employment rate (males), Employment rate (females), and Unemployment rate in 2020. Table 8 includes the same information for the year 2019. Table 9 includes all the constituencies with the corresponding GDP (PPS per inhabitant) and GDP in 2019, as that information is not available for 2020. These data are used to understand the financial situation in Greece and where it might be more profitable to implement chargers.

All the tables are ranked from the highest to lowest GDP. In 2019 the regions' GDPs were higher in comparison to 2020, which is justified as in 2020 the country was under special measures against Covid-19. Most regions are ranking in the same place both years with a difference of a few thousand euros. The only differences noticed in the ranking are that Ionian islands are below Central Greece and Peloponnese below Crete in 2020. Table 9 contains Greece's constituencies displaying all regions of Attica having the highest GDP and Phthiotis with the lowest. It should be mentioned that Boeotia is very high along with the Cyclades.

The regions with the highest disposable income are the Ionian islands, the South of Aegean, and the Attica regions for both 2019 and 2020. These regions are considered to be of interest because GDP is also expected to continue to rank high in the following years.

In all regions more than half of the population is employed. Peloponnese has the highest employment rate, followed by North Aegean and Attica in 2020, whilst in 2019 the employment rates are way higher with Peloponnese, Crete, and South Aegean being at the top of the list.

Table 7: Administrative regions, 2020

Administrative region	GDP (PPS per inhabitant)	Disposable income per household	Employment rate	Employment rate, males	Employment rate, females
Attica	25 200.0	13 500.0	63.3 %	71.3 %	55.7 %
South Aegean	18 900.0	14 800.0	58.7 %	68.1 %	49.4 %
Central Greece	18 200.0	10 400.0	59.8 %	73.2 %	45.5 %
Ionian islands	16 700.0	15 100.0	60.1 %	70.8 %	49.8 %
Peloponnese	16 200.0	11 000.0	68.3 %	80.1 %	56.8 %
Crete	15 500.0	11 400.0	61.9 %	71.3 %	52.6 %
Western Macedonia	15 200.0	12 000.0	56.4 %	66.7 %	45.9 %
Central Makedonia	14 700.0	11 300.0	58.9 %	69.4 %	48.6 %
Thessaly	14 700.0	10 800.0	60.4 %	69.0 %	51.8 %
Western Greece	13 800.0	10 200.0	55.3 %	66.2 %	43.8 %
Epirus	13 500.0	11 400.0	58.0 %	68.3 %	47.7 %
Eastern Macedonia	13 100.0	10 500.0	59.4 %	69.0 %	49.4 %
North Aegean	12 200.0	10 500.0	65.2 %	74.9 %	54.8 %

Source: Eurostat

Table 8: Administrative regions, 2019

Administrative region	GDP (PPS per inhabitant)	Disposable income per household	Employment rate	Employment rate, males	Employment rate, females
Attica	28 200.0	13 500.0	61.9 %	71.0 %	53.2 %
South Aegean	22 300.0	14 800.0	66.0 %	76.9 %	55.0 %
Ionian islands	19 600.0	15 100.0	64.7 %	75.0 %	54.3 %
Central Greece	18 700.0	10 400.0	61.2 %	76.1 %	45.3 %
Crete	17 600.0	11 400.0	67.0 %	75.6 %	58.4 %
Peloponnese	17 500.0	11 000.0	67.0 %	78.8 %	55.5 %
Western Macedonia	17 200.0	12 000.0	56.0 %	68.0 %	43.9 %
Central Macedonia	16 200.0	11 300.0	58.4 %	68.6 %	48.6 %
Thessaly	15 800.0	10 800.0	59.7 %	70.6 %	49.0 %
West Greece	15 000.0	10 200.0	53.2 %	63.9 %	41.9 %
Epirus	14 600.0	11 400.0	60.8 %	69.0 %	52.4 %
Eastern Macedonia, Thrace	14 100.0	10 500.0	62.1 %	72.6 %	51.4 %
North Aegean	13 700.0	10 500.0	65.1 %	75.3 %	54.2 %

Source: Eurostat

Table 9: Constituencies, 2019

Constituency	GDP (PPS per inhabitant)	GDP	Constituency	GDP (PPS per inhabitant)	GDP
Athens A	40 500.0	33 500.0	**Achaea**	16 200.0	13 400.0
North Athens	33 700.0	27 900.0	**Lefkada**	16 000.0	13 200.0
West Athens	28 200.0	23 400.0	**Magnesia**	15 900.0	13 100.0
Boeotia	27 800.0	23 000.0	**Laconia, Messenia**	15 600.0	12 900.0
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	27 500.0	22 700.0	**Thesprotia**	15 400.0	12 700.0
Peiraeus, islands	24 300.0	20 100.0	**Evros**	14 900.0	12 400.0
South Athens	24 200.0	20 000.0	**Pella**	14 900.0	12 400.0
Zakynthos	23 100.0	19 100.0	**Arta, Preveza**	14 500.0	12 000.0
East Attica	21 800.0	18 000.0	**Ioannina**	14 500.0	12 000.0
Argolis, Arcadia	20 400.0	16 900.0	**West Athens**	14 400.0	11 900.0
Lasithi	20 000.0	16 600.0	**Aetolia-Acarnania**	14 300.0	11 800.0
Florina	19 600.0	16 200.0	**Kilkis**	14 000.0	11 600.0
Kalymnos, Karpathos, Kassos, Kos, Rodos	19 300.0	16 000.0	**Imathia**	13 800.0	11 400.0

Constituency	GDP (PPS per inhabitant)	GDP	Constituency	GDP (PPS per inhabitant)	GDP
Corfu	19 200.0	15 900.0	**Pieria**	13 800.0	11 400.0
Ithaki, Cephalonia	19 100.0	15 800.0	**Ilia**	13 800.0	11 400.0
Chania	18 100.0	15 000.0	**Lesbos, Limnos**	13 700.0	11 300.0
Grevena, Kozani	17 700.0	14 700.0	**Ikaria, Samos**	13 700.0	11 300.0
Thessaloniki	17 600.0	14 600.0	**Karditsa, Trikala**	13 700.0	11 300.0
Larissa	17 600.0	14 600.0	**Chios**	13 500.0	11 200.0
Thasos, Kavala	17 100.0	14 100.0	**Phocis**	13 400.0	11 100.0
Corinthia	17 100.0	14 100.0	**Kastoria**	13 000.0	10 800.0
Rethymno	17 000.0	14 000.0	**Serres**	12 900.0	10 700.0
Heraklion	16 900.0	14 000.0	**Rhodope**	12 800.0	10 600.0
Chalkidiki	16 900.0	14 000.0	**Drama**	12 700.0	10 500.0
Euboea	16 600.0	13 700.0	**Evrytania**	12 500.0	10 400.0
Phthiotis	16 500.0	13 700.0	**Xanthi**	11 800.0	9 800.0

Source: Eurostat

In 2020 the total expenditure per household was predicted to be €65,145,489 thousand, displaying a 9.95 decrease since 2019. In general, a decrease has been displayed but it is assumed it is due to the pandemic. It can be expected for the change to increase within the next years, as the economy stabilises.

Total annual expenditure, mean expenditure and variation rate on current and constant terms (2019): HBS 2020

	Current prices 2020		Constant prices 2019	
	Expenditure	Change	Expenditure	Change
Total annual expenditure of households*	65,145,489	-9.95	70,643,010	-7.78
Mean annual expenditure per household	15,981.96	-9.90	17,339,28	-7.82
Mean annual expenditure per person	6,255.60	-9.90	6,796.33	-7.96

**in thousands euro*

Figure 26: source ELSTAT

The graph below represents the allocation of expenditures on services and products. Transport is the third category with the largest share of expenditure (12.3%). Moreover, in 2020 67.2% of total households have a private car, showing a 1% increase in comparison to 2019.

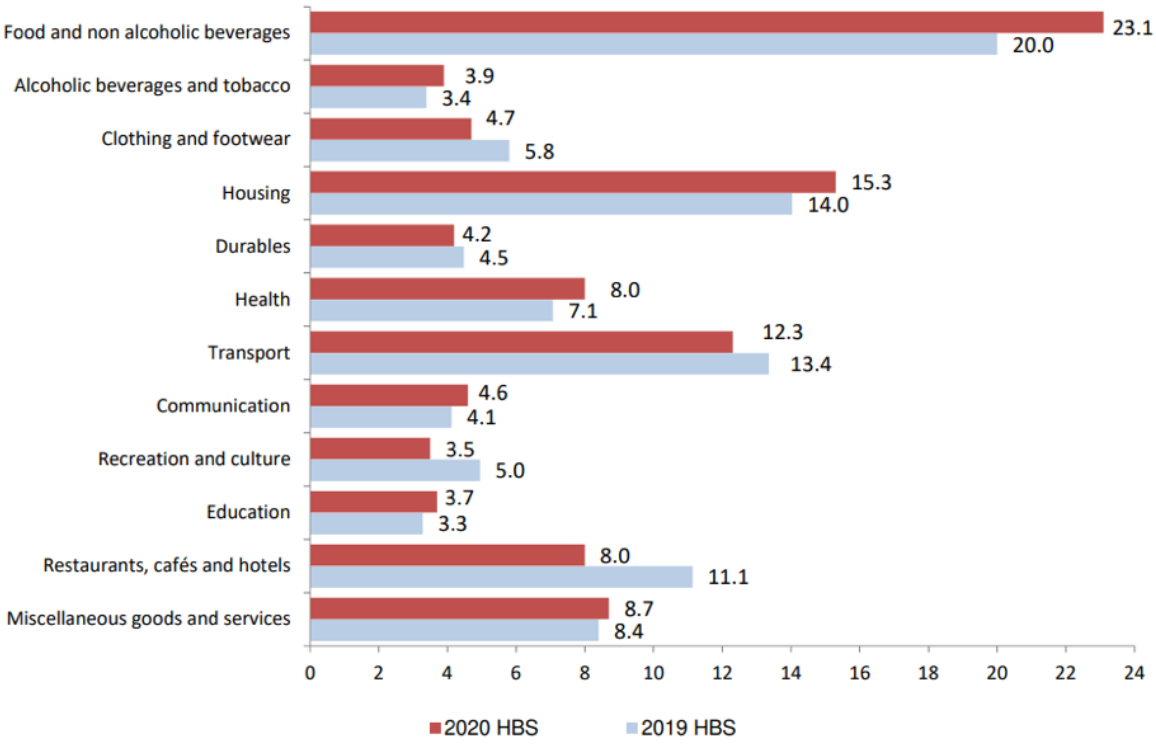


Figure 27: The allocation of expenditures on services and products, source: ELSTAT

7.2.2 Population Growth

Greece's population growth in 2020 is displayed in Table 10 Eurostat's data are lacking elaborate information about ages 15-24 years (early working age), 25-54 years (prime working age), and 55-64 years (mature working age). Data are found that dictate the number of people falling within those ages. People between 15-24 years are 10.34% (male 577.134/female 519.819), 25-54 years are 39.6% (male 2.080.443/female 2.119.995), and 55-64 years are 13.1% (male 656.404/female 732.936) of the population(indexmundi, n.d.). People between 15-64 years old hold 63.04%, therefore 15-24 years hold 16.4%, 25-54 years hold 62.8 %, and 55-64 years hold 20.8% of the population 15-64 years old. With those information Table 11 is created.

The way population is allocated in different constituencies helps in spotting the cities that hold most of the potential customers.

Central Macedonia and Attica hold most of the population of approximately 5 million people. Constituencies following the rank with over 200.000 thousand people are Magnesia, Euboea, Lefkada, Karditsa and Trikala, Laconia and Messenia, Larissa, Achaea, Heraklion and the islands Kalymnos, Karpathos, Kassos, Kos, Rodos collectively. Most people who are between 25-54 and 55-64 years old live in Thessaloniki, Attica, Magnesia, Euboea, Lefkada, Karditsa

and Trikala, Laconia and Messenia, Larissa, Achaea, Heraklion and the islands Kalymnos, Karpathos, Kassos, Kos, Rodos collectively.

In addition, it is important to take into consideration the population change of each region, as a positive change indicates that there will be more people in the future and therefore more potential customers. Positive change is displayed in Chania, West Attica, in the islands Kalymnos, Karpathos, Kassos, Kos, Rodos, Heraklion, West Athens, East Attica, and Rethymno.

Table 10: Greece's population data, 2020

Constituency	Total population	Population less than 15 years	Population 15-64 years old	Population over 65 years old	Population change (migration)	Population change (total)	Population change (natural change)
Thessaloniki	1 104 023.0	158 751.0	717 532.0	227 740.0	-3	-6.7	-3.7
Corfu	101 161.0	14 484.0	62 494.0	24 183.0	0.7	-5.2	-5.9
Rhodope	110 162.0	13 763.0	71 618.0	24 781.0	0.5	-6.5	-7
Chalkidiki	110 589.0	15 454.0	68 595.0	26 540.0	2.9	-2.9	-5.8
Xanthi	111 385.0	17 977.0	73 649.0	19 759.0	-1.6	-4.7	-3
Lesbos, Limnos	120 114.0	20 721.0	74 612.0	24 781.0	-0.7	-1.4	-0.7
Arta, Preveza	120 146.0	16 139.0	67 854.0	36 153.0	-1.2	-9.7	-8.5
Boeotia	122 969.0	17 570.0	80 993.0	24 406.0	1.9	-2.4	-4.3
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	126 829.0	20 739.0	79 952.0	26 138.0	-0.7	-0.6	0.1
Pieria	132 139.0	19 017.0	82 601.0	30 521.0	2.7	-5.4	-8.1
Thasos, Kavala	133 050.0	17 929.0	81 203.0	33 918.0	-0.3	-8.9	-8.6
Pella	136 549.0	17 894.0	84 777.0	33 878.0	1.8	-8.4	-10.2
Imathia	141 789.0	20 755.0	87 033.0	34 001.0	1	-6.7	-7.7
Evros	147 091.0	18 888.0	91 457.0	36 746.0	3.4	-3.5	-6.9
Corinthia	147 290.0	21 160.0	91 310.0	34 820.0	1.2	-4	-5.2
Elis	155 200.0	19 322.0	98 165.0	37 713.0	1.1	-5.7	-6.8
Phthiotis	158 926.0	22 229.0	97 430.0	39 267.0	0.2	-7.2	-7.5
Chania	159 893.0	25 733.0	102 513.0	31 647.0	1.3	0.8	-0.5
Serres	166 583.0	19 503.0	97 927.0	49 153.0	1.5	-12.3	-13.8
Ioannina	168 087.0	21 010.0	104 881.0	42 196.0	-1.8	-5.8	-3.9
Grevena, Kozani	169 446.0	21 871.0	105 487.0	42 088.0	-2.6	-10.1	-7.5
Argolis, Arcadia	177 072.0	24 008.0	108 215.0	44 849.0	-0.7	-7.9	-7.1
Evrytania	18 579.0	1 964.0	9 671.0	6 944.0	-3.2	-11.9	-8.6
West Attica	181 518.0	30 767.0	123 952.0	26 799.0	41.3	42.2	1
Aetolia-Acarnania	198 920.0	27 736.0	122 101.0	49 083.0	-2.6	-8.5	-5.9
Magnesia	202 401.0	27 117.0	128 559.0	46 725.0	0.3	-5.9	-6.2

Constituency	Total population	Population less than 15 years	Population 15-64 years old	Population over 65 years old	Population change (migration)	Population change (total)	Population change (natural change)
Euboea	213 190.0	29 761.0	135 384.0	48 045.0	-0.2	-4.5	-4.3
Kalymnos, Karpathos, Kassos, Kos, Rodos	220 683.0	36 088.0	146 045.0	38 550.0	-0.1	1.9	2
Lefkada	23 800.0	3 482.0	14 594.0	5 724.0	3.2	-2.9	-6
Karditsa, Trikala	232 430.0	29 017.0	136 836.0	66 577.0	-0.8	-10.1	-9.3
Laconia, Messenia	247 789.0	31 899.0	152 089.0	63 801.0	2.8	-3.4	-6.2
Larissa	280 284.0	41 602.0	174 083.0	64 599.0	-2.2	-6.4	-4.2
Achaea	296 945.0	43 662.0	192 354.0	60 929.0	-3.5	-6.2	-2.7
Heraklion	315 162.0	52 448.0	203 373.0	59 341.0	0.6	0.7	0.1
Ithaki, Cephalonia	38 567.0	5 406.0	23 785.0	9 376.0	0.9	-3.4	-4.4
Zakynthos	39 621.0	6 167.0	25 371.0	8 083.0	-0.7	-1.4	-0.7
Phocis	42 338.0	4 240.0	25 565.0	12 533.0	4.2	-3.3	-7.5
Thesprotia	45 032.0	5 510.0	26 839.0	12 683.0	3.9	-3.4	-7.4
Kastoria	46 071.0	5 772.0	28 667.0	11 632.0	-3.8	-12.1	-8.3
West Athens	484 973.0	73 567.0	321 956.0	89 450.0	8.3	5.8	-2.5
Florina	49 153.0	6 784.0	31 255.0	11 114.0	-0.3	-7.5	-7.1
Ikaria, Samos	49 961.0	8 471.0	31 164.0	10 326.0	-2.4	-2.3	0.1
Peiraeus, islands	490 685.0	68 601.0	315 928.0	106 156.0	-6.7	-11.5	-4.9
South Athens	518 720.0	72 056.0	330 917.0	115 747.0	-5.3	-8.6	-3.3
East Attica	570 125.0	85 879.0	377 812.0	106 434.0	14.4	13.6	-0.8
North Athens	572 267.0	81 402.0	356 848.0	134 017.0	-6.4	-8.8	-2.4
Chios	59 441.0	9 491.0	37 812.0	12 138.0	-0.6	-1.2	-0.6
Lasithi	73 758.0	10 364.0	45 883.0	17 511.0	0.2	-3.2	-3.4
Kilkis	80 430.0	11 181.0	48 923.0	20 326.0	0.2	-10.4	-10.6
Rethymno	87 691.0	14 323.0	57 423.0	15 945.0	0.1	1.6	1.4
Athens A	920 613.0	125 190.0	590 091.0	205 332.0	-1.2	-6	-4.8
Drama	96 925.0	12 655.0	59 268.0	25 002.0	4.2	-8.2	-12.4

Source: Eurostat

Table 11: Greece's analytical population (15-64 years old) data, 2020

Constituency	Population 15-64 years old	Population 15-24 years old (16.4% of column	Population 25-54 years old (62.8% of column	Population 55-64 years old (20.8% of column
Thessaloniki	717 532.0	117 692	450 734	149 107
Corfu	62 494.0	10 251	39 257	12 987
Rhodope	71 618.0	11 747	44 989	14 883
Chalkidiki	68 595.0	11 252	43 090	14 255
Xanthi	73 649.0	12 081	46 265	15 305
Lesbos, Limnos	74 612.0	12 239	46 870	15 505
Arta, Preveza	67 854.0	11 130	42 624	14 101
Boeotia	80 993.0	13 285	50 878	16 831
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	79 952.0	13 114	50 224	16 615
Pieria	82 601.0	13 549	51 888	17 165
Thasos, Kavala	81 203.0	13 320	51 010	16 875
Pella	84 777.0	13 906	53 255	17 617
Imathia	87 033.0	14 276	54 672	18 086
Evros	91 457.0	15 001	57 451	19 006
Corinthia	91 310.0	14 977	57 359	18 975
Elis	98 165.0	16 102	61 665	20 400
Phthiotis	97 430.0	15 981	61 203	20 247
Chania	102 513.0	16 815	64 396	21 303
Serres	97 927.0	16 063	61 516	20 350
Ioannina	104 881.0	17 203	65 884	21 795
Grevena, Kozani	105 487.0	17 303	66 264	21 921
Argolis, Arcadia	108 215.0	17 750	67 978	22 488
Evrytania	9 671.0	1 587	6 076	2 010
West Attica	123 952.0	20 331	77 864	25 758

Constituency	Population 15-64 years old (column A)	Population 15-24 years old (16.4% of column A)	Population 25-54 years old (62.8% of column A)	Population 55-64 years old (20.8% of column A)
Aetolia-Acarnania	122 101.0	20 028	76 701	25 374
Magnesia	128 559.0	21 087	80 758	26 716
Euboea	135 384.0	22 207	85 045	28 134
Kalymnos, Karpathos, Kassos, Kos, Rodos	146 045.0	23 955	91 742	30 349
Lefkada	14 594.0	2 394	9 168	3 033
Karditsa, Trikala	136 836.0	22 445	85 957	28 436
Laconia, Messenia	152 089.0	24 947	95 539	31 605
Larissa	174 083.0	28 554	109 355	36 176
Achaea	192 354.0	31 551	120 832	39 972
Heraklion	203 373.0	33 358	127 754	42 269
Ithaki, Cephalonia	23 785.0	3 902	14 942	4 943
Zakynthos	25 371.0	4 162	15 938	5 273
Phocis	25 565.0	4 194	16 060	5 313
Thesprotia	26 839.0	4 403	16 860	5 578
Kastoria	28 667.0	4 702	18 008	5 958
West Athens	321 956.0	52 809	202 244	66 904
Florina	31 255.0	5 127	19 634	6 495
Ikaria, Samos	31 164.0	5 117	19 577	6 476
Peiraeus, islands	315 928.0	51 820	198 458	65 652
South Athens	330 917.0	54 278	207 873	68 767
East Attica	377 812.0	61 970	237 332	78 512
North Athens	356 848.0	58 532	224 162	74 155
Chios	37 812.0	6 202	23 753	7 858
Lasithi	45 883.0	7 526	28 823	9 535
Kilkis	48 923.0	8 025	30 733	10 167
Rethymno	57 423.0	9 419	36 072	11 933
Athens A	590 091.0	96 789	370 680	122 627
Drama	59 268.0	9 722	37 231	12 317

Source: Eurostat

7.2.3 Education

Table 12 and 13 display the percentage of people who have graduated tertiary education based on gender, age, and employment rate after graduation. Attica, Central Macedonia, and Thessaly are the administrative regions with the highest percentage of total tertiary educational attainment of people between the age of 25-64. Attica, Western Macedonia, Epirus, Central Macedonia, Ionian islands, and Central Greece are the administrative regions with the highest percentage of total tertiary educational attainment of people between the age of 30-34. Lastly, it is important to mention the highest employment rate of recent graduates is in Attica, South Aegean, and Crete with over 60%.

Table 12: Greece's educational data, 2020

Administrative regions	Young people neither in employment nor in education and training (% of population aged 15-24)	Tertiary educational attainment, Females (% of population aged 25-64)	Tertiary educational attainment, Males (% of population aged 25-64)	Tertiary educational attainment, Total (% of population aged 25-64)
Attica	10.1 %	40.8 %	39.5 %	40.2 %
North Aegean	25.7 %	28.0 %	25.9 %	26.9 %
South Aegean	16.1 %	21.0 %	23.4 %	22.2 %
Crete	13.1 %	28.5 %	24.2 %	26.3 %
Eastern Macedonia and Thrace	15.6 %	25.3 %	22.3 %	23.8 %
Central Macedonia	10.4 %	34.0 %	28.7 %	31.4 %
Western Macedonia	16.3 %	29.9 %	24.3 %	27.1 %
Epirus	11.7 %	34.5 %	29.2 %	31.8 %
Thessaly	15.4 %	35.1 %	28.5 %	31.8 %
Ionian islands	15.4 %	25.8 %	23.4 %	24.6 %
Western Greece	11.8 %	23.7 %	17.6 %	20.6 %
Central Greece	22.1 %	24.6 %	21.9 %	23.2 %
Peloponnese	11.0 %	24.5 %	23.0 %	23.8 %

Source: Eurostat

Table 13: Greece's educational data, 2020

Administrative regions	Tertiary educational attainment, Females (% of population aged 30-34)	Tertiary educational attainment, Males (% of population aged 30-34)	Tertiary educational attainment, Total (% of population aged 30-34)	Employment rate of recent graduates (% of population aged 20-34)
Attica	57.3 %	47.3 %	52.2 %	70.4 %
North Aegean	48.7 %	27.0 %	35.7 %	45.4 %
South Aegean	30.5 %	25.9 %	28.1 %	63.7 %
Crete	36.5 %	30.2 %	33.7 %	60.6 %
Eastern Macedonia and Thrace	37.9 %	29.3 %	33.3 %	52.7 %
Central Macedonia	50.8 %	33.1 %	42.2 %	53.5 %
Western Macedonia	58.2 %	33.0 %	47.7 %	36.2 %
Epirus	62.0 %	28.8 %	46.7 %	35.6 %
Thessaly	47.5 %	32.0 %	39.8 %	51.1 %
Ionian islands	41.0 %	44.8 %	42.5 %	-
Western Greece	46.0 %	21.5 %	32.8 %	54.4 %
Central Greece	45.9 %	40.0 %	43.2 %	44.2 %
Peloponnese	39.3 %	30.5 %	35.1 %	56.7 %

Source: Eurostat

Collecting the above data provides information that can be used in the design of a successful network with charging stations.

7.3 Regions of interest

To find the areas more suitable for infrastructure, MCDA was applied to the collected data. MCDA is a tool used to solve complex problems. It helps define the important parameters and which are the distinctive parts of the problem(Natural Resources Leadership Institute, n.d.). The criteria used to rank the constituencies are the GDP (PPS per inhabitant), Population change (total), Population 25-54 years old, Competition, Relationships, Distance, and Easy to Travel. The way they are measured is displayed in the table below.

Table 14: Criteria

Distance from Athens (1-10)	**Competition (1-10) charging points**
1-10	1-10
1: 0-100 km	1: 0-10
2: 101-200	2: 11-20
3: 201-300	3: 21-30
4: 301-400	4: 31-40
5: 401-500	5: 41-50
6: 501-600	6: 51-100
7: 601-700	7:101-150
8: 701-800	8: 151-200
9: 801-900	9: 201-300
10: 901+	10: 300+
Relationships (1-3)	**Easy to Travel (1-3)**
1: there are no relationships	1: places that combine all transportation (aeroplane, ferry, vehicle, train) or are less than 100 km away
2: there are relationships	2: places that combine two ways of transportation
3: there are close relationships	3: places that combine one way of transportation

Table 15: The constituencies and their criteria

Constituency	GDP (PPS per inhabitant)	Population change (total)	Population 25-54 years old	Competition	Relationships	Distance	Easy to Travel
Thessaloniki	17600	-6.7	450734	7	2	5	1
Corfu	19200	-5.2	39257	3	1	7	2
Rhodope	12800	-6.5	44989	3	1	8	2
Chalkidiki	16900	-2.9	43090	7	1	6	3
Xanthi	11800	-4.7	46265	3	2	8	3
Lesbos, Limnos	13700	-1.4	46870	1	2	5	2
Arta, Preveza	14500	-9.7	42624	3	2	5	3
Boeotia	27800	-2.4	50878	7	1	2	1
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	27500	-0.6	50224	6	2	4	2
Pieria	13800	-5.4	51888	7	1	5	3
Thasos, Kavala	17100	-8.9	51010	3	1	7	2
Pella	14900	-8.4	53255	7	1	6	3
Imathia	13800	-6.7	54672	7	1	5	3
Evros	14900	-3.5	57451	3	1	9	3
Corinthia	17100	-4	57359	6	2	2	2
Elis	13800	-5.7	61665	5	1	3	2
Phthiotis	16500	-7.2	61203	5	1	3	2
Chania	18100	0.8	64396	6	3	4	2
Serres	12900	-12.3	61516	7	1	6	3
Ioannina	14500	-5.8	65884	3	2	5	2
Grevena, Kozani	17700	-10.1	66264	2	1	5	2
Argolis, Arcadia	20400	-7.9	67978	6	1	2	3
Evrytania	12500	-11.9	6076	5	1	4	3
West Attica	28200	42.2	77864	10	3	1	1
Aetolia-Acarnania	14300	-8.5	76701	5	1	4	3
Magnesia	15900	-5.9	80758	3	2	5	1

Constituency	GDP (PPS per inhabitant)	Population change (total)	Population 25-54 years old	Competition	Relationships	Distance	Easy to Travel
Euboea	16600	-4.5	85045	5	3	2	1
Kalymnos, Karpathos, Kassos, Kos, Rodos	19300	1.9	91742	6	3	6	2
Lefkada	16000	-2.9	9168	3	2	4	1
Karditsa, Trikala	13700	-10.1	85957	3	3	3	1
Laconia, Messenia	15600	-3.4	95539	6	1	3	3
Larissa	17600	-6.4	109355	3	2	3	2
Achaea	16200	-6.2	120832	5	2	3	1
Heraklion	16900	0.7	127754	6	2	4	2
Ithaki, Cephalonia	19100	-3.4	14942	3	1	4	2
Zakynthos	23100	-1.4	15938	3	1	4	2
Phocis	13400	-3.3	16060	5	1	3	3
Thesprotia	15400	-3.4	16860	3	1	5	3
Kastoria	13000	-12.1	18008	2	1	5	3
West Athens	14400	5.8	202244	10	3	1	1
Florina	19600	-7.5	19634	2	1	6	3
Ikaria, Samos	13700	-2.3	19577	1	2	3	2
Peiraeus, islands	24300	-11.5	198458	10	3	1	1
South Athens	24200	-8.6	207873	10	3	1	1
East Attica	21800	13.6	237332	10	3	1	1
North Athens	33700	-8.8	224162	10	3	1	1
Chios	13500	-1.2	23753	1	3	3	2
Lasithi	20000	-3.2	28823	6	1	5	2
Kilkis	14000	-10.4	30733	7	1	5	3
Rethymno	17000	1.6	36072	6	2	4	2
Athens A	40500	-6	370680	10	3	1	1
Drama	12700	-8.2	37231	3	1	7	3

Once the criteria have been determined, the ‘‘beneficial’’ and ‘‘non-beneficial’’ ones are chosen. A criterion is beneficial when its maximum value is wanted and non-beneficial when its minimum value is wanted. For the columns to be comparable, the numbers are normalised. For beneficial columns, the mathematical formula used is value/MAX(value), whilst for non-beneficial columns is MIN(value)/value. After the application of these formulas, a scale of 0-1 is created, with 1 dictating the best decision. Lastly, each row is summarised providing every constituency with a comparable number. The analysis can end here, but it is preferable to add weights to the criteria.

The weights of the criteria are shown in the table below. The summary of weights equals 1; each weight does not need to be different. GDP and Relationships are the most important criteria and therefore have the highest weights. Values from each column are multiplied by the corresponding weight. Finally, each row is summarised. The highest value in the column ‘‘SUM’’ represents the constituency that ranks at the top.

Table 16: MCDA

criterion weight	0.26	0.096	0.096	0.096	0.26	0.096	0.096	1
	beneficial	beneficial	beneficial	on beneficial	beneficial	beneficial	non beneficial	
Constituency	GDP (PPS per inhabitant)	Population change (total)	Population 25-54 years old	Competition	Relationships	Distance	Easy to Travel	SUM
Thessaloniki	0.113	-0.015	0.096	0.014	0.173	0.019	0.032	0.432
Corfu	0.123	-0.012	0.008	0.032	0.087	0.014	0.064	0.316
Rhodope	0.082	-0.015	0.010	0.032	0.087	0.012	0.064	0.272
Chalkidiki	0.108	-0.007	0.009	0.014	0.087	0.016	0.096	0.323
Xanthi	0.076	-0.011	0.010	0.032	0.173	0.012	0.096	0.388
Lesbos, Limnos	0.088	-0.003	0.010	0.096	0.173	0.019	0.064	0.447
Arta, Preveza	0.093	-0.022	0.009	0.032	0.173	0.019	0.096	0.401
Boeotia	0.178	-0.005	0.011	0.014	0.087	0.048	0.032	0.364
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	0.177	-0.001	0.011	0.016	0.173	0.024	0.064	0.463
Pieria	0.089	-0.012	0.011	0.014	0.087	0.019	0.096	0.303
Thasos, Kavala	0.110	-0.020	0.011	0.032	0.087	0.014	0.064	0.297
Pella	0.096	-0.019	0.011	0.014	0.087	0.016	0.096	0.300
Imathia	0.089	-0.015	0.012	0.014	0.087	0.019	0.096	0.301
Evros	0.096	-0.008	0.012	0.032	0.087	0.011	0.096	0.325
Corinthia	0.110	-0.009	0.012	0.016	0.173	0.048	0.064	0.414
Elis	0.089	-0.013	0.013	0.019	0.087	0.032	0.064	0.291
Phthiotis	0.106	-0.016	0.013	0.019	0.087	0.032	0.064	0.304
Chania	0.116	0.002	0.014	0.016	0.260	0.024	0.064	0.496
Serres	0.083	-0.028	0.013	0.014	0.087	0.016	0.096	0.280
Ioannina	0.093	-0.013	0.014	0.032	0.173	0.019	0.064	0.382
Grevena, Kozani	0.114	-0.023	0.014	0.048	0.087	0.019	0.064	0.323
Argolis, Arcadia	0.131	-0.018	0.014	0.016	0.087	0.048	0.096	0.374
Evrytania	0.080	-0.027	0.001	0.019	0.087	0.024	0.096	0.280
West Attica	0.181	0.096	0.017	0.010	0.260	0.096	0.032	0.691
Aetolia-Acarnania	0.092	-0.019	0.016	0.019	0.087	0.024	0.096	0.315
Magnesia	0.102	-0.013	0.017	0.032	0.173	0.019	0.032	0.362

criterion weight	0.26	0.096	0.096	0.096	0.26	0.096	0.096	1
	beneficial	beneficial	beneficial	on beneficial	beneficial	beneficial	non beneficial	
Constituency	GDP (PPS per inhabitant)	Population change (total)	Population 25-54 years old	Competition	Relationships	Distance	Easy to Travel	SUM
Euboea	0.107	-0.010	0.018	0.019	0.260	0.048	0.032	0.474
Kalymnos, Karpathos, Kassos, Kos, Rodos	0.124	0.004	0.020	0.016	0.260	0.016	0.064	0.504
Lefkada	0.103	-0.007	0.002	0.032	0.173	0.024	0.032	0.359
Karditsa, Trikala	0.088	-0.023	0.018	0.032	0.260	0.032	0.032	0.439
Laconia, Messenia	0.100	-0.008	0.020	0.016	0.087	0.032	0.096	0.343
Larissa	0.113	-0.015	0.023	0.032	0.173	0.032	0.064	0.423
Achaea	0.104	-0.014	0.026	0.019	0.173	0.032	0.032	0.372
Heraklion	0.108	0.002	0.027	0.016	0.173	0.024	0.064	0.415
Ithaki, Cephalonia	0.123	-0.008	0.003	0.032	0.087	0.024	0.064	0.325
Zakynthos	0.148	-0.003	0.003	0.032	0.087	0.024	0.064	0.355
Phocis	0.086	-0.008	0.003	0.019	0.087	0.032	0.096	0.316
Thesprotia	0.099	-0.008	0.004	0.032	0.087	0.019	0.096	0.329
Kastoria	0.083	-0.028	0.004	0.048	0.087	0.019	0.096	0.310
West Athens	0.092	0.013	0.043	0.010	0.260	0.096	0.032	0.546
Florina	0.126	-0.017	0.004	0.048	0.087	0.016	0.096	0.360
Ikaria, Samos	0.088	-0.005	0.004	0.096	0.173	0.032	0.064	0.452
Peiraeus, islands	0.156	-0.026	0.042	0.010	0.260	0.096	0.032	0.570
South Athens	0.155	-0.020	0.044	0.010	0.260	0.096	0.032	0.578
East Attica	0.140	0.031	0.051	0.010	0.260	0.096	0.032	0.619
North Athens	0.216	-0.020	0.048	0.010	0.260	0.096	0.032	0.642
Chios	0.087	-0.003	0.005	0.096	0.260	0.032	0.064	0.541
Lasithi	0.128	-0.007	0.006	0.016	0.087	0.019	0.064	0.313
Kilkis	0.090	-0.024	0.007	0.014	0.087	0.019	0.096	0.288
Rethymno	0.109	0.004	0.008	0.016	0.173	0.024	0.064	0.398
Athens A	0.260	-0.014	0.079	0.010	0.260	0.096	0.032	0.723
Drama	0.082	-0.019	0.008	0.032	0.087	0.014	0.096	0.299

The analysis provides us with a ranking of the 20 constituencies.

Table 17: The constituencies ranked

Constituency	Ranking
Athens A	0.723
West Attica	0.691
North Athens	0.642
East Attica	0.619
South Athens	0.578
Peiraeus, islands	0.57
West Athens	0.546
Chios	0.541
Kalymnos, Karpathos, Kassos, Kos, Rodos	0.504
Chania	0.496
Euboea	0.474
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	0.463
Ikaria, Samos	0.452
Lesbos, Limnos	0.447
Karditsa	0.439
Thessaloniki	0.432
Larissa	0.423
Heraklion	0.415
Corinthia	0.414
Xanthi	0.388

7.3.1 Sensitivity Analysis

Sensitivity analysis is a financial model that determines how to target variables are affected based on changes in other variables known as input variables (Kenton, 2022). In Table 16 the weights between GDP and Relationships are equally divided with them being 0.26 as they are extremely determinant at this stage in the market. The rest of the variables are also equally divided with them being 0.096.

To evaluate better the ranked constituencies, the weights of the criteria are changed. In this analysis, the variables have more or less similar significance. A version where variables can not be determinants is needed, so a more normalised ranking is portrayed. GDP has been reduced to 0.18, Relationships to 0.17, and the rest have been increased to 0.13.

Table 18: Sensitivity Analysis

criterion weight	0.18	0.13	0.13	0.13	0.17	0.13	0.13	1
	beneficial	beneficial	beneficial	non beneficial	beneficial	beneficial	non beneficial	
Constituency	GDP (PPS per inhabitant)	Population change (total)	Population 25-54 years old	Competition	Relationships	Distance	Easy to Travel	SUM

Table 19: Constituencies ranked, Sensitivity analysis

Constituency	Ranking
West Attica	0.634
Athens A	0.625
East Attica	0.564
North Athens	0.544
South Athens	0.497
West Athens	0.497
Chios	0.493
Peiraeus, islands	0.486
Ikaria, Samos	0.433
Lesbos, Limnos	0.426
Kalymnos, Karpathos, Kassos, Kos, Rodos	0.418
Chania	0.412
Euboea	0.389
Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	0.389
Thessaloniki	0.389
Larissa	0.377
Heraklion	0.368
Corinthia	0.367
Arta, Preveza	0.360
Argolis, Arcadia	0.359

Most of the constituencies remain on the list, which is encouraging meaning that even if the value of the variables changes those areas are safe to invest in. Arta, Preveza and Argolis, Arcadia appear only when the variables change, which means they could possibly be considered when creating a bigger ranking table.

7.4 EV charging Greek incentives for infrastructure

Europe aims to accelerate the adoption of electric vehicles and thus, has pushed the countries that constitute it to install residential and commercial charging stations and offer incentives and subsidies to citizens and businesses. The Greek government has recently announced extensive measures to reach its goal. By 2030 Greece aims for every third car to be electric and for charging infrastructure to be established. A €100M plan has been announced to help with the purchase of vehicles and chargers. Vehicles are subsidized with 15% of the total cost, while for taxis the subsidy is 25%, for e-scooters 20%, and for e-bikes 40%. If buyers choose to scrap their old vehicle in sight of purchasing a new electric car they get an additional €1000. The government has also offered tax benefits, making a full exemption for electric vehicles in registration, luxury commodity, ownership taxes, and VAT. Moreover, there are local EV incentives such as free parking and restrictions regarding air pollution-related traffic circulation. These incentives aim to make electric vehicles equally attractive, if not more attractive than ICE vehicles. There are also incentives for EV chargers in the form of a grant of €500 towards a home charger. Most importantly, the government has announced the installation of EV charging stations on all the main roads by the end of 2021 and municipalities will be required to have charging points installed in their regions (wallbox, 2021).

7.5 Partnerships

Companies should rely on strong partnerships with companies that have presence in multiple locations. Therefore, It is useful for AcroVolt to seal a deal with one person and simultaneously ensure the presence of charge points in many locations across Greece.

The company plans to develop relationships with location providers who meet the criteria for fast charging infrastructure and implementation. Mostly these locations include hotels, restaurants, and parking lots. There has been open communication with many such places in Athens, Crete, Chios, and Aegina.

AcroVolt also puts effort into shaping partnerships with location providers who qualify for rapid charging. These locations include supermarkets and gas stations. Investing in rapid charging is more expensive, therefore the choices made need to be strategic as analysed in this chapter. Below there is a list of stores that haven't partnered up with CPOs yet and can offer a nationwide presence for the company. This is a good target list for AcroVolt to create an alliance.

Table 20: Chains that have not created a partnership with a CPO

Supermarkets	5ae Galaxias Supermarket Family Super Market 16 stores Masoutis 334 stores MarketIn 188 stores
Toy Stores	Moustakas 228 stores Zaharias 47 stores
Home appliances Stores	Neoset 21 stores Notos Galleries 80 stores Hondos Center 100 stores
Electronics	Public & Mediamarkt 70 stores

8 Business Model

8.1 Business Model Canvas

Companies use the *Business Model Canvas* ("BMC") to identify the key elements for developing a successful business model for the EV charging station infrastructure project. The layout of the BMC is shown next alongside the goal of each of the elements that comprise it.

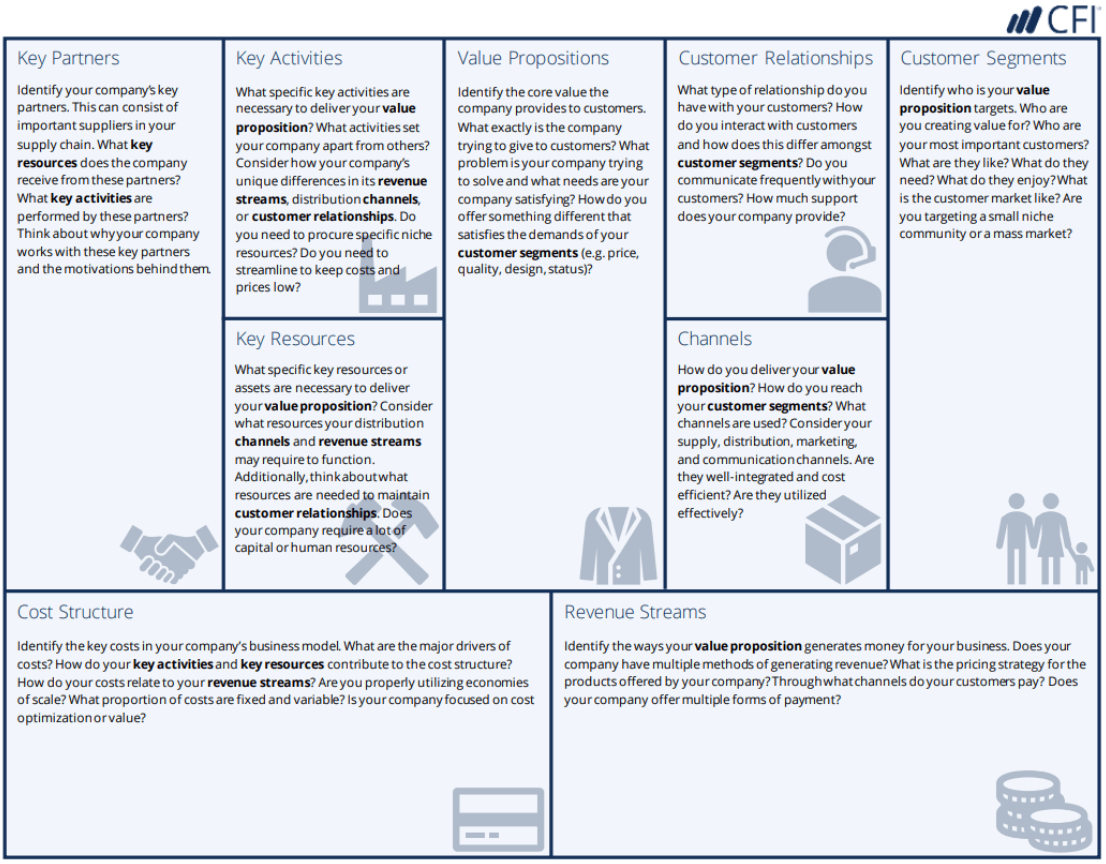
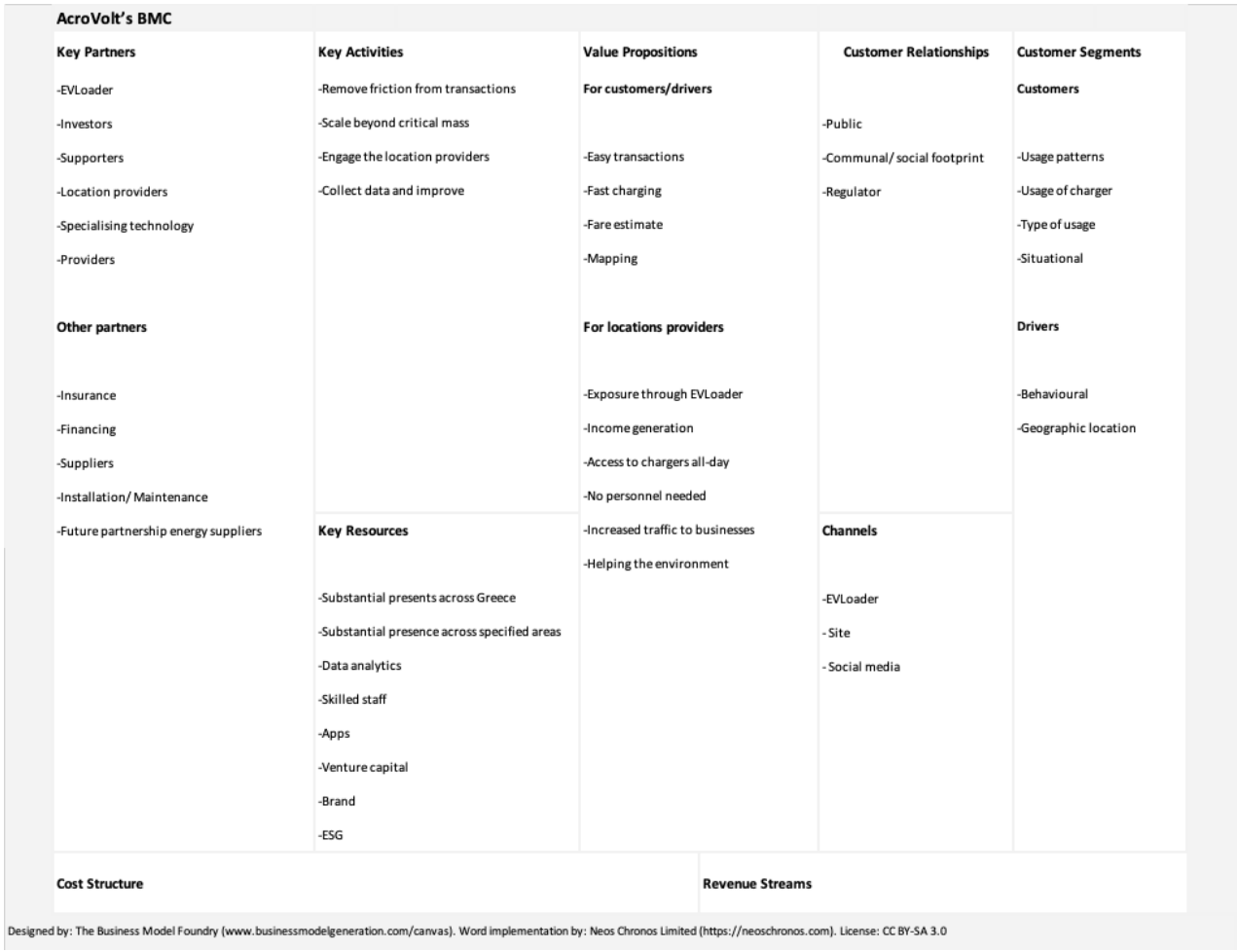


Figure 28: Template of BMC, source: CFI

The BMC allows identifying the value proposition, the products/ services to be offered, the partnerships to be formed, the customers and the ways that add value to all parties. Next, the key elements are presented of the BMC as they fit the business.



AcroVolt's BMC

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
-EVLoader	-Remove friction from transactions	**For customers/drivers**		**Customers**
-Investors	-Scale beyond critical mass		-Public	
-Supporters	-Engage the location providers	-Easy transactions	-Communal/ social footprint	-Usage patterns
-Location providers	-Collect data and improve	-Fast charging	-Regulator	-Usage of charger
-Specialising technology		-Fare estimate		-Type of usage
-Providers		-Mapping		-Situational
Other partners		**For locations providers**		**Drivers**
-Insurance		-Exposure through EVLoader		-Behavioural
-Financing		-Income generation		-Geographic location
-Suppliers		-Access to chargers all-day		
-Installation/ Maintenance		-No personnel needed		
-Future partnership energy suppliers	**Key Resources**	-Increased traffic to businesses	**Channels**	
		-Helping the environment		
	-Substantial presents across Greece		-EVLoader	
	-Substantial presence across specified areas		- Site	
	-Data analytics		- Social media	
	-Skilled staff			
	-Apps			
	-Venture capital			
	-Brand			
	-ESG			

Cost Structure	Revenue Streams

Designed by: The Business Model Foundry (www.businessmodelgeneration.com/canvas). Word implementation by: Neos Chronos Limited (https://neoschronos.com). License: CC BY-SA 3.0

8.1.1 Key Partners

- EVLoader
- Investors
- Supporters
- Location providers
- Specialising technology
- Providers

8.1.2 Other partners

- Insurance
- Financing
- Suppliers
- Electrical suppliers
- Future partnership energy suppliers

EVLoader is the app maker that makes it easier for the customers to find the chargers and complete the transaction.

Investors are the way the company gets funds and can bring its vision to life. Supporters can be anyone who acts in favour of the company, for instance, the government has made significant changes to the legislation and the tax regulations so electric vehicles become more popular.

Location providers provide a space for the charger to be placed. Depending on the location customers can spend a certain time, for instance in a supermarket they can charge as they shop.

Specialised technology providers make it possible to forecast utilisation to change the flow of usage. Aside from the key partners, many partners who are not as crucial help in the operation of the company.

Insurance offers financial protection whilst the financing associates always try to make figures add up. It also offers peace of mind to stakeholders regarding the liability from accidental damages.

Suppliers provide the necessary equipment as well as a warranty on the charging equipment. A strong supplier reflects positively on the company that manages them (CPOs).

Electrical suppliers: To strengthen the local economy, the company is cooperating with local electrical suppliers to support the installation and maintenance of the equipment.

8.1.3 Key activities

- Remove friction from transactions
- Scale beyond critical mass
- Engage the location providers
- Collect data and improve

The key activities, essentially describe how the company plans to operate and how it intends to be perceived.

Remove friction from transactions: EVloader removes the friction from transactions. It is possible to pay via the application without employees being required to be physically near the charger allowing it to be used at any time during the day. The downside to the existing companies' apps is the lack of OCPI roaming.

Scale beyond critical mass: The company needs to scale beyond critical mass and be self-sustaining, so it does not need additional investment to remain viable.

Engaging with location providers: The company is constantly in communication with the location providers, to strengthen the relationships between them, and to ensure that both parties are content in their collaboration. As a result, both strive to improve customer service.

Collect data and improve: The company needs to optimise the services and the products provided every time there are new data available.

8.1.4 Key resources

- Substantial presence across Greece
- Substantial presence across select areas
- Data analytics
- Skilled staff
- Apps
- Venture capital
- Brand
- ESG

Substantial presence across Greece: There is planned to be a substantial presence across Greece, so customers can plan their trips knowing they can rely on the company's chargers.

Substantial presence across specified areas: There is planned to be a substantial presence across specified areas, for example, tourist areas.

Resources can be brought by

- **venture capital financing,**
- **applications like EVLoader,**
- **branding and**
- **skilled staff.**

ESG: There will be a further analysis of ESG (environment, social, governance) to make sure that a company is operating ethically.

8.1.5 Value Propositions

8.1.5.1 For customers/ drivers

- Easy transactions
- Fast charging
- Fare estimate
- Mapping

8.1.5.2 For locations providers

- Exposure through EVLoader
- Income generation
- Access to chargers all-day
- No personnel needed
- Increased traffic to businesses
- Helping the environment

Easy transactions: Customers may effortlessly pay to charge their vehicles due to the app's easy transactions.

Fast charging will be possible in most charging stations depending on how long customers can wait at the location.

Fare estimate: A specific fare estimate covers the implementation and infrastructure. A percentage is for the location provider and the rest for the company.

Mapping is essential so drivers can find all the available chargers and plan their trips accordingly.

Exposure through EVLoader: The location providers can get exposure through EVLoader, as customers can choose them for both their services/products and the chargers that are installed.

Income generation: The company will also generate income for those location providers via the installation of the chargers.

Access to chargers all-day: There will be access to chargers all-day and the income will be generated irrelevantly during working hours.

Personnel needed: There is no personnel needed for the charging stations, as everything is automated.

Increased traffic to those businesses is guaranteed, as mentioned above, customers may choose the businesses for both their services/products and the chargers that are installed.

Helping the environment: There is an active act of kindness from the location providers to the environment when they choose to implement a charger for electric vehicles.

8.1.6 Customer Relationships

- Regulator

Regulator: The regulator controls the compliance with the rules, the taxations, and the transparency.

8.1.7 Channels

- EVLoader
- Site
- Social media

EVLoader: The EVLoader is the main channel of the company. It demonstrates all the charging stations and providers while offering the customers an easier way to pay.

Site: The company's site provides information for everyone, making the company more accessible.

Social media: Through social media, the company can get exposure.

8.1.8 Customer Segments

8.1.8.1 Customers

- Usage patterns
- Usage of charger
- Type of usage
- Situational

8.1.8.2 Location providers

- Behavioural
- Geographic location

Usage patterns: There are a few ways to separate the drivers into categories and understand the patterns they create. The drivers can spend more or less time on the chargers which reveal data. Depending on their use and the size of their batteries, some vehicles need a certain amount of charging.

Usage of chargers shows which chargers are used and for how long.

Situational refers to the reason customers choose a specific charger. Some of the chargers are placed in locations where someone can combine charging and chores, like supermarkets.

8.2 SWOT analysis

SWOT analysis is a planning process which includes the strengths, weaknesses, opportunities, and threats. The tool is helpful for businesses as it improves their decision-making. AcroVolt operates in Greece therefore the Greek market is being considered for the SWOT analysis.

Strengths	**Weaknesses**
Aware of the climate crisis	Charging is time-consuming
New technology	Expensive infrastructure and equipment
Early in the market	Lack of experts in the field
Strategic partnerships- ANEDHK	Small business
Strategic Partnership with Software by EVLoader	Small network
Relationships with various regions to begin with strong expansion	Limited financing
Fully focused on electric cars	Implementation barriers e.g. distance, lack of personnel in distant areas
Personnel and consultants who are experts in their field	
Option for Advertising – unique proposition	

Opportunities	Threats
Incentives by the Greek government for CPOs and EV drivers	Competition from CPOs with a strategic presence
European funding programs	Energy failure
Increasing fuel costs will support EVs	Expensive electric vehicles
Lack of infrastructure from other CPOs	Lack of energy infrastructure
Possible expansion to International markets	Continuous innovation in competition
3rd party investment in EVs and CPOs	Small EV market
Regulations by the Greek government for parking lots and businesses	Competition with other technologies e.g. fuel cell
Rise of social media and its promotion through them	Home charging

Table 21: SWOT analysis

8.3 PESTEL analysis

PESTEL analysis evaluates the business environment by studying the Political, Economic, Social, Technological, Environmental and Legal factors.

8.3.1 Political

- Electrification and Climate Change initiatives are strongly supported by the EU
- The political factors have favoured AcroVolt's growth and they have ensured a future for the company
- The Greek government's incentives aim by 2030 for every third car to be electric
- Incentive by the Greek government toward purchasing an EV

8.3.2 Economic

- Each year the sales of electric vehicles and the demand for their chargers have boosted the Greek economy

- AcroVolt has access to high-quality investment opportunities in the Mobility Electrification
- The current inflationary environment affects negatively installation capital expenditure costs. These, however, can be offset by the rising costs on the revenue side, albeit with some delay to implement increases.
- AcroVolt's business model incorporates innovative revenue sources to complement Charging revenues

8.3.3 Social

- The environment-friendly attitude people have shaped over the years, pushes them in making more conscious choices.
- Advanced technology and connectivity can make Greece more sustainable than ever and society is embracing that.
- Companies such as AcroVolt are innovative and contribute to climate change initiatives

8.3.4 Technological

- EVs and their chargers are a new technology, therefore they are expected to bring new technological features and new ideas to other sectors, for example, expansion of charging from vehicle to grid or homes
- AcroVolt is developing innovative algorithms for maximizing EV charging network Utilization
- Along with the development of the company, software companies also develop to make the drivers' charging experience easier.

8.3.5 Environmental

- AcroVolt's goal is to be Net Zero by offsetting electricity consumption via its network with renewable energy production, e.g. via solar
- Zero emissions from electric cars and supercharging stations, have raised the standards of environmental protection for all other tech and automotive industries.

8.3.6 Legal factors considerations

- Current legislation (N.4710/2020) dictates one EV charging station for every 20 parking spots in a single location – Implementation through 31/12/2022. It also provides detailed guidelines for the charger specification and their respective installation procedures.

9 Marketing Plan

Online presence is a means of communication and interaction between the company and the customers. Creating a strong online profile in social media, AcroVolt can increase revenue and customer adoption via online networks, developing the brand, selling and promoting products and services, attracting customers, getting their feedback, and hiring skilled staff through specific platforms. The company needs to be present on Facebook, Twitter, LinkedIn, and Google business profile. Those platforms are among the 11 most popular platforms used by businesses. 70% of B2C businesses have acquired customers through Facebook, and 71% of consumers who have had a positive experience with a brand on social media are likely to recommend the brand to their friends and family(Brandi, 2022).

AcroVolt's relationship with companies such as ANEDHK and EVLoader, increases its market presence and exposure to the overall EV market. Any cross references will bring more visibility to AcroVolt. It is imperative that such relationships are managed carefully as the impact to the company comes from both positive and negative posts. Creative content and frequent posts about relative topics to the field such as environment, technology and market will increase people's engagement with AcroVolt's pages. At a later stage, it is recommended that the company creates a LinkedIn profit to introduce major achievements and attract interested personnel.

People working with AcroVolt are suggested to attend and participate in roundtables and give speeches at conferences. Conferences bring participants information and much-needed acquaintances. At the same time, the company can arrange presentations with professional bodies to educate them on charging stations, EVs etc. Such bodies can be Hotel Professional Associations and others. To maintain the above and identify new ways of promoting our services AcroVolt considers hiring a Marketing professional in the near future.

10 Competitors

10.1 Introduction

The demand for electric vehicles has risen sharply and the supply of EV chargers had been relatively unresponsive. Over the past few years companies and manufacturers in the automotive industry, have understood the market, and have changed the narrative. Some companies have only been in the industry supplying electric cars and spare parts of them, whilst other companies have joined them as the public's priorities have changed. Therefore, companies have shifted the balance and some have become major players.

As the companies increase and invest in EV charging, they have to consider competition and municipalities' actions. Already, many municipalities have designed a network of chargers and they are creating competition for companies to take over their installation. All the companies offer a live map displaying where each charger is located. They will be examined depending on the locations they are operating.

10.2 Electric vehicle charging companies

Table 22: Chargers in Greece

Companies	Total charging stations (approximately)
Blink	163
DEI Blue	142
NRG	45
Fortisis	59
Chargespot	278
Protergia	122
AcroVolt	7

Blink

Blink is globally known and is operating since May 2019 in Greece with a few charging stations. Blink allows drivers to follow four steps, so they can easily charge their vehicles. Firstly, the charging cables should be connected to the vehicle and a yellow LED light will turn on, then

when RFID gets close to the cable the light will turn blue and the car starts to be charged, eventually, the RFID will get close to the cable to turn the light yellow again and disconnect the cable. (Blink Charging Hellas, n.d.)
Blink's key partners:

1. Thanopoulos Supermarket
2. Praktiker

DEI Blue

DEI has been operating since 1950 and has been in the Athenian stock market since 2001. The company is the biggest supplier of electric power in Greece and offers approximately 10.4 GW using Renewable Energy Sources. (DEI, n.d.)
DEI has a subsidiary, DEI Blue, which is establishing e-Mobility throughout Greece and holds a major competitive advantage as it supplies electric power. The main goals of the company are the infrastructure and maintenance of charging points in public parking lots, malls, national roads and more, but they also provide solutions for companies and individuals. (DEI Blue, n.d.)
DEI Blue's key partners:

1. AB Supermarket
2. IKEA
3. Kotsovolos
4. The mall
5. Halkiadakis Supermarket

NRG

Member of the Motor Oil family, NRG was founded in 2012 and offers energy solutions to domestic, commercial and industrial customers. They estimate that by 2030 there will be a 30% drop in the oil demand in Europe and 28% of all the vehicles globally will be electric. NRG claims that in December of 2021, 2.144 EVs were sold. In 2019 NRG entered into a partnership with BMW GROUP, aiming to join forces and get a bigger market share.(NRG, n.d.)
NRG's partners:

1. METRO AEBE
2. Sklavenitis Supermarket
3. Shell gas stations
4. Avin gas stations
5. Motorist Service Stations
6. Smartpark

Watt & Volt

The company was established in 2011 with a license for electricity supply and trading, since then they have over 60 stores in Greece. In 2020 Watt & Volt launched Chargespot, an app for charging stations. Chargespot has established 292 charging stations and more than 15.000

downloads on its app and holds a major competitive advantage as Watt & Volt supplies electric power. With the applications, customers have access to the location of more than 250.000 charging stations.(WATT+VOLT, n.d.)
Chargespot's partners:

1. Kaoil – Sira Oil gas stations
2. IKTEO
3. YAVA Gym
4. Flamingo Retail Park mall
5. Grecotel,
6. Istikbal
7. Gialino music theater
8. Biologiko Xorio
9. Parex
10. Kalavrita Ski resort

Fortisis

In 2011 Fortisis was founded and it has been operating in Greece, Cyprus, and Malta. The company provides solutions to companies, individuals and counselling for charging electric vehicles. (Fortisis, n.d.)
Fortisis' partners:

1. Polispark

Protergia

Protergia is operating since 2001 as a part of the MYTILINEOS group, producing and trading electric power. In 2021, the company was able to cover 11% of the market's demand(Protergia Charge, 2016). ProtergiaCharge was created specifically for charging electric cars and holds a major competitive advantage as is a subsidiary to Protergia, which supplies electric power. The company guarantees that the electric power from which vehicles charge is 100% produced from renewable energy sources (Protergia Charge, n.d.).
Protergias' partners:

1. ASTIR
2. Marina Zea
3. Olympia Group
4. Aegean Oil
5. City of Athens
6. There are also privileges for the owners of electric vehicles of the groups Kosmocar, KIA/HYUNDAI, Jaguar Land Rover

Heron

Heron was established in 2001 as a subsidiary of GEK TERNA and has just entered the e-mobility market so there is not much information about the company's vision, the company

mainly produces energy, supplies and trades electricity, which gives the company a major competitive advantage. (Heron, n.d.)
Heron's partners:

1. Volvo Hellas
2. Leroy merlin

10.2.1 Europe

Blink

In March 2019 Blink Charging and the Eunice Energy Group formed a joint venture to target the European Electric Vehicle (EV) Charging Market, beginning in Greece. EEG group is, for now, the only company based in Greece that produces energy from RES.

ChargeUp

ChargeUp Europe is an EV charging infrastructure industry organisation that many stakeholders in the field joined, to collaborate and deploy infrastructure across Europe. Some members are globally known: **BP**, **ABB**, **SHELL**, **EVBox**, **ChargePoint**, **Schneider Electric**, **BorgWarner**, **Efacec**, and **Ekoenergetyka**.

TotalEnergies is active in over 130 countries with 150000 charging points. Also, **EDP** from Lisbon is operating in 19 countries throughout the world with 66% of the electricity they use coming from RES.

Some members are well known only in Europe: **Fast**, **evway**, **Compleo**, **Last Mile Solutions**, **ABL**, and **Power Dot**.

Allego is operating since 2013 and has developed over 26000 charging stations, in 12 countries, using exclusively RES. There are smart charging options for electric automobiles, motorcycles, buses, and trucks available.

GreenWay was founded in Slovakia in 2011. The company works for infrastructure and as a CPO.

Has to be, is a company founded in 2013, dedicated to e-mobility development and based in Austria with over 25000 charging stations all over European Union. (ChargeUp, n.d.)

10.2.2Global

ChargePoint

The largest and most open charging stations are claimed to be ChargePoint's. Since 2007, ChargePoint has built a fully integrated portfolio of hardware, cloud services, and support regarding EV charging as the company is only focusing on that and holds a competitive advantage as it has access to funds. ChargePoint claims that every two minutes someone plugs into their network. There are more than 30.000 charges located on independently-owned businesses by 175 partners. The company claims that drivers have avoided 462K tonnes of greenhouse gas emissions as drivers have avoided more than 549 million litres of petrol (ChargePoint, n.d.).

Shell

Another major player is a well-known company, Shell which is a global energy business with competence in oil and gas exploration, production, refining, and marketing, as well as chemical manufacturing and marketing. Currently, it operates 90.000 charge points, with a target to operate over 500.000 by 2025 and has access to power networks giving it a competitive advantage. Shell's 'Accelerate to Zero' program enables corporate fleets to set a target when they drive with Zero and Net-Zero emissions across various markets. (Shell plc, n.d.)

BP

BP engages in exploration, extraction, refining, distribution, marketing, power generating, and trading. It has one of the largest networks globally and the largest in the UK with over 8.000 charging points. BP has access to power networks giving it a competitive advantage. (Chargemaster, n.d.)

Blink

In 2007 the company was founded in Ohio and since it has been one of the major players globally and more so in USA and Canada. The company is a leading owner, operator, and provider of electric vehicle charging equipment and networked EV charging services and holds a competitive advantage as it has access to funds. Blink's market cap is €0.63 billion and has three subsidiaries BlinkSwag, BlinkSigns, and BlinkGlobal. (BlinkGlobal, n.d.)

Volta

Volta was founded in 2010 and holds a competitive advantage as it has access to funds. The company has charged vehicles that would need over 3.9 million gallons of gas and produce over 60 million of CO_2. The company has a market cap of €0.34 billion and it designs, installs, and maintains a network of electric vehicle charging stations funded by sponsor brands (Volta Charging, n.d.).

10.3 Competitive advantage

A company's ability to produce goods or services faster, cheaper, or more efficiently than its competitors is known as a competitive advantage. Competitive advantage aims to create margins and make more sales, it is based on cost structure, branding, the quality of the products, the distribution system, intellectual property, and customer service. To create competitive advantages rivals must not be able to duplicate or mimic the factors that make that possible("What Is a Competitive Advantage?" n.d.).

AcroVolt is a new innovative start-up company with many competitive advantages. The company operates since 2021. It is one of the first in the market giving it an advantage in acquiring the know-how and in the future being helpful for the newer players. The reason AcroVolt can be successful lies in the way the company interacts with its partners. Most CPOs are also electricity suppliers in Greece and therefore when installing a charger they require the location provider to use their electricity network whilst AcroVolt is flexible and does not expect such changes. In addition, AcroVolt also provides the fund for every investment made with the location providers and does not require any funding from the providers themselves. Another advantage is given by the choice the company made in purchasing chargers that contain big screens making it possible to advertise services and goods. Lastly, the close relationship between AcroVolt and EVLoader makes software management for EV charging stations easier and ensures that the location providers are promoted as their logos are displayed on it. Another relationship AcroVolt has entered is the one with ANEDHK (ΚΡΗΤΙΚΟΣ), one of the largest Supermarket chains in Greece, guaranteeing the company has access to locations across Greece.

11 Management & Organization[1]

11.1 Company management

The project leader is Person-1, an experienced professional in the financial industry, investments, and the development of new products. Such expertise renders him useful as the leader of AcroVolt.

His relationships in the investment banking and asset management world, have been invaluable for bringing relationships and engaging with private capital providers for financing the project and for engaging with advisors whenever necessary.

11.2 Company Advisors

Person-2 is a seasoned Advertising and Marketing executive with 25 years of experience working for and with multi-national companies. His background is in Marketing and Marketing Management. He is experienced in relationship building, business development and marketing. He currently takes on the company's business development while he has expanded the in-house creative and design team with experienced professionals.

Person-3 is an academic with a deep network in the Smart City world and the trends that define the cities of the next generation. He has worked in city planning and new idea development making him a great asset to the company.

Person-4 works closely with AcroVolt being himself the project lead for EVLoader. This is a deep relationship that brings complementary synergies to both companies to grow in this new environment.

[1] Names have been redacted from the final draft to be submitted to the University

11.3 Company Analyst

Person-5 has been training as an Engineer and has experience with NGOs in Greece. She is managing the business plan development and implementation while engaging with the company's external relationships.

As the company grows, it adds more personnel and has a spec plan to increase the headcount in both managerial and operational sectors.

12 Products & services description

12.1 Charging

AcroVolt is a CPO and its main concern is the infrastructure and implementation of a nationwide network to assist the drivers of EVs. Apart from charge stations, AcroVolt provides an app, in partnership with EVLoader, to facilitate customers in finding the locations and overseeing each charging session that is performed by EVs. The company costs the charging stations by following the market pricing with no intention to deviate. Particularly, AcroVolt charges €0.40+VAT/kWh. This can be converted to a €-charge/min when information exists related to the power in which the driver is charging the vehicle. AcroVolt offers both fast and rapid chargers.

Short-Term Charging (<1 hr)

Short-term charging refers to locations that can offer a shorter time for drivers to charge their vehicles. Such chargers can be found in supermarkets and allow drivers to combine charging sessions with shopping. Another example is gas stations that help decrease range anxiety by providing chargers as most of them are located on high roads.

Long-term Charging (longer than 1 hrs)

Long-term charging refers to locations that can offer a longer time for drivers to charge their vehicles. Such chargers can assist residents that live close to supermarkets, people who stay in Hotels, and drivers who rent spots in parking lots.

12.1.1 Sales Approach

The company is building and developing relationships with owners/lessors of multiple of the above locations. This effort aims in providing drivers with the appropriate charger at the appropriate place.

12.2 Sponsorship

Sponsorship is expected to be a revenue at a later stage when AcroVolt provides a wider network of stations (value is when the network is expanded and with multiple points). By

covering the charger with AcroVolt's or a sponsor's message or logo, companies can increase their exposure and revenues.

Figure 29: Charger with UPIQ's logo, source: AcroVolt

12.2.1 Sales Approach

AcroVolt aims in having as few sponsors as possible, and if feasible only one. Proper incentives for companies can achieve that. That may translate to climate change initiatives or advertising with messages related to the charger location. Sponsorships are not part of the economic model currently.

12.3 Advertising

Advertising is considered a competitive advantage and AcroVolt has chargers from media, providing a screen, which makes it possible to advertise goods, services, and companies. Advertising can also attract sponsors e.g. Supermarket suppliers may find it attractive to pass a message to incoming clients right before they enter the store.

Figure 30: Media charger, source: AcroVolt

12.3.1 Sales Approach

AcroVolt is still a small business and thus it is more convenient to outsource advertising relationships or partner with an advertising company and receive revenues net of all commissions. At a later stage, it may be decided to manage this directly with hired personnel.

13 Economic Model

An economic model can help possible investors understand the profit margin of the company. It also gives a clear idea of the company and its needs. Firstly, the *Selling General, and Administrative* (''SG&A'') expenses are shown as they have to be included in the economic model. Table 21 includes the total employee expenses, which involve 10 employees. Table 22 presents office expenses, including rent, and utilities. Lastly, Table 23 other expenses are included such as travel, marketing, and insurance expenses.

Table 23: SG&A Employee Expenses

Employees	Title	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Employment	Total	€ 91,000	€ 173,320	€ 232,786	€ 254,942	€ 260,041	€ 265,242	€ 270,547	€ 275,958	€ 281,477	€ 287,106

Table 24: SG&A Office expenses

Office	Cost/month	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total	€ 1,100	€ 15,600	€ 19,440	€ 23,285	€ 24,734	€ 24,989	€ 25,249	€ 25,514	€ 25,784	€ 26,060	€ 26,341

Table 25: SG&A Other expenses

Other	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total	€ 22,500	€ 22,570	€ 22,641	€ 22,714	€ 22,789	€ 22,864	€ 22,942	€ 23,020	€ 23,101	€ 23,183

Capital expenditures are funds that help the company acquire chargers, equipment, property and other assets. AcroVolt has decided to install 3 different types of chargers Simple Dual AC, Media Dual AC, and Rapid Charger DC 50kW. Table 24 contains the costs of those chargers, the revenue each charger makes per kWh, the revenue made by Media Dual AC which has a screen for advertising, the kW of each charger and the total revenue.

Table 26: CAPEX

CAPEX	Costs	REV €/kWh	REV media	kW	REV	REV+
Simple Dual AC	15,000.00 €	0.05		22	€ 1,445.40	€ 1,445.40
Media Dual AC	20,000.00 €	0.05	€ 6,000.00	22	€ 1,445.40	€ 7,445.40
Rapid Charger DC 50 kW	30,000.00 €	0.06		50	€ 3,942.00	€ 3,942.00

Table 27: Total Number of chargers per year

Charger	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Simple Dual AC	5	25	60	110	175	175	175	175	175	175
Media Dual AC	5	25	60	110	175	175	175	175	175	175
Rapid Charger DC 50 kW	5	25	60	110	175	175	175	175	175	175

The summary of the annual CAPEX of each charger is the Total Annual CAPEX. The annual CAPEX of each charger results from multiplying the cost of purchasing each charger by the number of each charger.

Table 28: CAPEX per year

CAPEX	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Simple Dual AC	€ 75,000	€ 300,000	€ 525,000	€ 750,000	€ 975,000	€ -	€ -	€ -	€ -	€ -
Media Dual AC	€ 100,000	€ 400,000	€ 700,000	€ 1,000,000	€ 1,300,000	€ -	€ -	€ -	€ -	€ -
Rapid Charger DC 50kW	€ 150,000	€ 600,000	€ 1,050,000	€ 1,500,000	€ 1,950,000	€ -	€ -	€ -	€ -	€ -
Total	**€ 325,000**	**€ 1,300,000**	**€ 2,275,000**	**€ 3,250,000**	**€ 4,225,000**	**€ -**	**€ -**	**€ -**	**€ -**	**€ -**

Each year the utilisation rate presents 15% growth, as its displayed in Table 29. The annual kWh consumed by chargers taking into consideration the utilisation rate is the Total kWh Consumed multiplied by the utilization rate.

Table 29: kWh consumed by charger based on the annual utilization rate

100% Utilization	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total kWh consumed	4,117,200	20,586,000	49,406,400	90,578,400	144,102,000	144,102,000	144,102,000	144,102,000	144,102,000	144,102,000
KWh by Charger	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Total	**617,580**	**3,551,085**	**9,800,995**	**20,663,764**	**37,805,295**	**43,476,089**	**49,997,502**	**57,497,128**	**66,121,697**	**76,039,951**

Table 30: Annual Revenue, €

Revenue	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total	**34,164**	**196,443**	**542,183**	**1,143,102**	**2,091,357**	**2,405,060**	**2,765,819**	**3,180,692**	**3,657,796**	**4,206,465**

The Annual Revenue results from multiplying the REV/kWh from Table 24 by the kWh consumed per charger in Table 28.

The main economic model includes all the data from the above tables. It displays the revenues from charging (Revenue Electric) and from advertising (Revenue Media). Revenue electric is the summary of all rows in Table's 28 columns. Revenue Media is the annual revenue media for one charger multiplied by the total number of chargers. Revenue is the summary of those two.

It also includes SG&A, *Cost of Goods Sold* (''COGS'') which AcroVolt claims is 25% of its revenue electric, and *Operating Expenses* (''OpEx'') which is considered to be 3% of the total number of chargers multiplied by the cost of purchasing each charger.

Earnings before interest, taxes, depreciation, and amortization (''EBITDA'') is the Revenue without SG&A, COGS, and OpEx. The depreciation is 10% of the total CAPEX up to every year. EBIT is EBITDA without considering depreciation. There is no interest involved in the economic model as the company does not plan on getting a loan, therefore the taxable income is the same as EBIT. Tax results from multiplying the taxable income by 24%. Finally, Profit After Tax results from removing the Tax from the taxable income. Once the numbers are calculated, AcroVolt can work out the cash flow forecast.

Year		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Utilization rate		15.0%	17.3%	19.8%	22.8%	26.2%	30.2%	34.7%	39.9%	45.9%	52.8%
Revenue Electric		€ 34,164	€ 196,443	€ 542,183	€ 1,143,102	€ 2,091,357	€ 2,405,060	€ 2,765,819	€ 3,180,692	€ 3,657,796	€ 4,206,465
Revenue Media		€ 30,000	€ 150,000	€ 360,000	€ 660,000	€ 1,050,000	€ 1,050,000	€ 1,050,000	€ 1,050,000	€ 1,050,000	€ 1,050,000
Revenue (€)		**€ 64,164**	**€ 346,443**	**€ 902,183**	**€ 1,803,102**	**€ 3,141,357**	**€ 3,455,060**	**€ 3,815,819**	**€ 4,230,692**	**€ 4,707,796**	**€ 5,256,465**
Sales General & Admin		€ 129,100	€ 215,330	€ 278,713	€ 302,391	€ 307,819	€ 313,355	€ 319,002	€ 324,762	€ 330,637	€ 336,630
Cost Of Good Sold	25%	€ 8,541	€ 49,111	€ 135,546	€ 285,775	€ 522,839	€ 601,265	€ 691,455	€ 795,173	€ 914,449	€ 1,051,616
Operating Expenses	3%	€ 9,750	€ 48,750	€ 117,000	€ 214,500	€ 341,250	€ 341,250	€ 341,250	€ 341,250	€ 341,250	€ 341,250
EBITDA		**€ (83,227)**	**€ 33,252**	**€ 370,924**	**€ 1,000,436**	**€ 1,969,449**	**€ 2,199,190**	**€ 2,464,112**	**€ 2,769,507**	**€ 3,121,460**	**€ 3,526,969**
Depreciation (€)		€ 32,500	€ 162,500	€ 390,000	€ 715,000	€ 1,137,500	€ 1,137,500	€ 1,137,500	€ 1,137,500	€ 1,137,500	€ 1,137,500
Taxable Income		€ (115,727)	€ (129,248)	€ (19,076)	€ 285,436	€ 831,949	€ 1,061,690	€ 1,326,612	€ 1,632,007	€ 1,983,960	€ 2,389,469
Tax (€)		€ -	€ -	€ -	€ 68,505	€ 199,668	€ 254,806	€ 318,387	€ 391,682	€ 476,150	€ 573,473
Profit After Tax		€ (115,727)	€ (129,248)	€ (19,076)	€ 216,931	€ 632,281	€ 806,885	€ 1,008,225	€ 1,240,325	€ 1,507,809	€ 1,815,996
Summary Cash Flows											
Cash flow (€) incl CapEx		**€ (408,227)**	**€ (1,266,748)**	**€ (1,904,076)**	**€ (2,318,069)**	**€ (2,455,219)**	**€ 1,944,385**	**€ 2,145,725**	**€ 2,377,825**	**€ 2,645,309**	**€ 2,953,496**
investment Cash Flow	**€ (5,000,000)**	**€ (83,227)**	**€ 33,252**	**€ 370,924**	**€ 931,931**	**€ 1,769,781**	**€ 1,944,385**	**€ 2,145,725**	**€ 2,377,825**	**€ 2,645,309**	**€ 2,953,496**
Cumulative Cash Flow	**€ (5,000,000)**	**€ (5,083,227)**	**€ (5,049,975)**	**€ (4,679,050)**	**€ (3,747,119)**	**€ (1,977,338)**	**€ (32,954)**	**€ 2,112,772**	**€ 4,490,597**	**€ 7,135,906**	**€ 10,089,403**

Table 31: Main economic model

From the economic model, it is visible that the company becomes profitable in the fourth year and the payback on the initial investment of €5M is achieved in the seventh year. Small companies with growth potential are estimated to be valued at 5x EBITDA, bringing the company to €17.6M after the tenth year. *Internal rate of return* ("IRR") *is a metric used in financial analysis to estimate the profitability of potential investments. IRR is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis*(Fernando, 2022). With an IRR of 16.6% the investment can be recommended for a period of ten years with an additional "estimated" terminal value of € 17.634.844.

Table 32: IRR, Terminal Value

IRR	Terminal Value	Multiple
16.6%	€ 17,634,844	5

13.1 Sensitivity analysis

While the automotive industry seems to be fully supported and promoted, a sensitivity analysis is still very important, in case Greece does not present the growth that is expected. Even if the utilization rate is half what is expected, the investment is still profitable. The company will be profitable from the fifth year and the payback year for the initial investment of €5M is the eighth year. The IRR is 8.7% making the investment good. We should also include the terminal value of € 9.747.722 assuming that the company can be sold at 5x EBITDA in the tenth year.

Table 33: IRR, Terminal value, Sensitivity Analysis

IRR	Terminal Value	Multiple
8.7%	€ 9,747,722	5

Year		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Utilization rate		7.5%	8.6%	9.9%	11.4%	13.1%	15.1%	17.3%	20.0%	22.9%	26.4%
Revenue Electric		€ 17,082	€ 98,222	€ 271,091	€ 571,551	€ 1,045,678	€ 1,202,530	€ 1,382,910	€ 1,590,346	€ 1,828,898	€ 2,103,233
Revenue Media		€ 30,000	€ 150,000	€ 360,000	€ 660,000	€ 1,050,000	€ 1,050,000	€ 1,050,000	€ 1,050,000	€ 1,050,000	€ 1,050,000
Revenue (€)		**€ 47,082**	**€ 248,222**	**€ 631,091**	**€ 1,231,551**	**€ 2,095,678**	**€ 2,252,530**	**€ 2,432,910**	**€ 2,640,346**	**€ 2,878,898**	**€ 3,153,233**
Sales General & Admin		€ 129,100	€ 215,330	€ 278,713	€ 302,391	€ 307,819	€ 313,355	€ 319,002	€ 324,762	€ 330,637	€ 336,630
Cost Of Good Sold	25%	€ 4,271	€ 24,555	€ 67,773	€ 142,888	€ 261,420	€ 300,633	€ 345,727	€ 397,587	€ 457,224	€ 525,808
Operating Expenses	3%	€ 9,750	€ 48,750	€ 117,000	€ 214,500	€ 341,250	€ 341,250	€ 341,250	€ 341,250	€ 341,250	€ 341,250
EBITDA		**€ (96,039)**	**€ (40,414)**	**€ 167,606**	**€ 571,772**	**€ 1,185,190**	**€ 1,297,293**	**€ 1,426,930**	**€ 1,576,747**	**€ 1,749,786**	**€ 1,949,544**
Depreciation (€)		€ 32,500	€ 162,500	€ 390,000	€ 715,000	€ 1,137,500	€ 1,137,500	€ 1,137,500	€ 1,137,500	€ 1,137,500	€ 1,137,500
Taxable Income		€ (128,539)	€ (202,914)	€ (222,394)	€ (143,228)	€ 47,690	€ 159,793	€ 289,430	€ 439,247	€ 612,286	€ 812,044
Tax (€)		€ -	€ -	€ -	€ -	€ 11,446	€ 38,350	€ 69,463	€ 105,419	€ 146,949	€ 194,891
Profit After Tax		€ (128,539)	€ (202,914)	€ (222,394)	€ (143,228)	€ 36,244	€ 121,442	€ 219,967	€ 333,828	€ 465,337	€ 617,154
Summary Cash Flows											
Cash flow (€) incl CapEx		**€ (421,039)**	**€ (1,340,414)**	**€ (2,107,394)**	**€ (2,678,228)**	**€ (3,051,256)**	**€ 1,258,942**	**€ 1,357,467**	**€ 1,471,328**	**€ 1,602,837**	**€ 1,754,654**
investment Cash Flow	**€ (5,000,000)**	**€ (96,039)**	**€ (40,414)**	**€ 167,606**	**€ 571,772**	**€ 1,173,744**	**€ 1,258,942**	**€ 1,357,467**	**€ 1,471,328**	**€ 1,602,837**	**€ 1,754,654**
Cumulative Cash Flow	**€ (5,000,000)**	**€ (5,096,039)**	**€ (5,136,452)**	**€ (4,968,846)**	**€ (4,397,074)**	**€ (3,223,330)**	**€ (1,964,387)**	**€ (606,920)**	**€ 864,408**	**€ 2,467,245**	**€ 4,221,899**

Table 34: Main economic model, Sensitivity analysis

14 Environmental, Social, and (Corporate) Governance (ESG)

14.1 Introduction

ESG is an acronym for *Environmental, Social, and (Corporate) Governance* ("ESG"). ESG report displays values that are not necessarily shown in financial analysis. Many criteria are met in the report aiming to eliminate potential investors' possible doubts. ESG investing is expanding by the year as millennial investors tend to pursue businesses that portray their values. *Morgan Stanley Bank (NYSE: MS) found that nearly 90% of millennial investors were interested in pursuing investments that mainly reflect the values they hold* (Peterdy, 2022). By 2019, 17.1 trillion dollars were invested in a responsible investing strategy(The investopedia team, 2022).

As the worth of ESG investments is increasing, more companies include the reports in their statements or publish them separately. It is a chance to convince the stakeholders that they are trying to proceed with their projects sustainably long term. The three pillars of ESG are transparency, credibility, and materiality ("ESG | The Report How to Write a Sustainability Report," n.d.).

Many institutions such as Sustainability Accounting Standards Board (SASB), the Global Reporting Initiative (GRI), and the Task Force on Climate-related Financial Disclosures (TCFD) work towards creating standards and helping include ESG actively in reports.

AcroVolt stands by ESG investing and while the evaluation of a stock should be about the financial profits, it should also be about the profits of ethical entrepreneurship. Ethics pertain to morals or principles, therefore ethics are subjective. Considering the above three criteria – environment, social, and governance- the company's ESG report follows including all that AcroVolt wants to portray.

14.2 Environmental

Environmental criteria include any action taken to protect the environment. Companies can incorporate many, along with energy consumption, waste, testing on animals, climate policies, renewable energy sources, fair trade suppliers and more. Every company ought to comply with environmental regulations, however, the existing regulations do not offer complete protection for the planet. Companies need to make an effort, as most forms of climate disruption are influenced by human activity. In environmental reports, both beneficial

and detrimental information should be stated, emphasizing the actions taken to eliminate environmental footprints.

AcroVolt's objective and business model rely on the promotion and implementation of environmental initiatives related to mobility. Its mission is to develop EV charging infrastructure as a means of promoting mobility electrification to reduce the carbon footprint from the use of vehicles. At the same time, the development of an algorithm for optimizing charge point utilization improves the environmental footprint of the infrastructure.

AcroVolt goes beyond the promotion of Electric Vehicles by making sure the energy used for charging the vehicles can be offset with green energy production. AcroVolt is developing renewable energy projects to match the use of electricity by its infrastructure leaving a carbon-neutral footprint.

14.3 Social

Social criteria are expressed in many aspects including the community, the suppliers, and the employees. The recruitment of individuals of underrepresented nationalities, genders, and communities is impactful. The company ought to pay fairly its employees, regarding only on their expertise, provide perks, and have a workplace policy that prevents any kind of discrimination based on age, gender, weight, ethnicity, religion, politics, race, gender, nationality, social status, sexual orientation, or religious affiliation. Another aspect of being socially conscious is manifested through acts of kindness toward society. The administration of the company can donate money to local communities and urge the employees to volunteer their time to good causes. Moreover, it is important to be ethical towards the customers, be truthful about products and services, being kind, respectful and courteous to them.

AcroVolt believes in a world of opportunities offered to all. The company is actively recruiting in a manner that is balanced across genders and does not discriminate based on age, gender, weight, ethnicity, religion, politics, race, gender, nationality, social status, sexual orientation, or religious affiliation.

The company's principal has been actively volunteering this time to engage young professionals and entrepreneurs with businesses. He devotes a significant amount of his time to giving back to various groups of people via knowledge transfer.

The company partners with universities to offer internships to students, allowing them to get trained and acquire skills that can be useful to begin their professional careers.

AcroVolt's policy is to offer at minimum market-rate salaries and reward performance and a workplace policy regarding diversity, inclusion and prevention of sexual harassment.

14.4 Governance

The corporate governance of the company lies in its executive offices and management. Transparent financial and accounting methods and reports are of importance. The executive management and the board of directors should be composed of honourable members selected diversely and inclusively. The company should always attend to the interest of the stakeholders, employees, suppliers, and customers. The members of executive management and the board of directors should not use political contributions to obtain preferential treatment or engage in illegal conduct. Lastly, some companies prefer to not distribute big bonuses to executive members especially when employees are not being salaried largely.

AcroVolt is a company that is very transparent in its dealings and financial relationships. The company works with large organizations and ensures that all financial matters will never inhibit current and future relationships with such organizations. Additionally, there are no political affiliations with AcroVolt's principles.

AcroVolt is a limited liability company that is not required to have a board of directions. However, AcroVolt has a board of advisors that supports its efforts. This board is carefully selected and comprised of distinguished people in the professional and academic world.

15 Conclusion

This study has presented a business model for creating a robust EV charging infrastructure in Greece. The support electromobility has received globally and especially in Europe can verify the importance of investing in EV technologies and their equipment. Most European countries are offering favourable conditions, aiming to persuade the drivers to purchase EVs instead of ICEs. In Greece, there are legislations made to ensure that a charging network across Greece is created, ready to provide stress range free trips. There is free parking provided for EV drivers, along with no tax policy and government funding. That information can only lead to the need that exists for corresponding infrastructure.

Changes in behaviour are crucial for the shift to e-mobility. The user may perceive electrification as being 100% sustainable, yet depending on the totality of individual behaviours, the changes may have desired or undesirable effects. Simply said, EVs are more effective than ICEs, which means that more of the energy stored in the battery is utilised to power the vehicle. EVs use less energy, particularly when commuting in urban areas. Additionally, tailpipe emissions of air pollutants like nitrogen oxides and particulates are practically non-existent. Therefore it is feasible that EVs help create a more sustainable reality with a cleaner environment.

Even though Greece lacks fleet data, due to internal organisation matters in the Ministry of Infrastructure and Transport, data were found from many reliable sources as the future of the automotive industry is something that concerns many. In 2020 there were 679 registrations of electric vehicles. In 2021 there were 2,176 registrations of electric vehicles. That is an indication of the growth that is expected to be seen in the number of units. Drivers can find the type of EV that meets their needs as EVs fall into 6 categories with different ranges, prices, and overall characteristics.

EVs are more expensive than ICEs and that's one of the main reasons drivers hesitate when purchasing new vehicles. Batteries are still very costly and there are no assumptions made that their price will be reduced. For many years they had been unreliable due to their short lives, small range, and lack of recycling options. Now they are manufactured more efficiently. There are also plenty of studies that examine the possibility of FCEVs being explored in recent years. From the chapter on Market Analysis can be gathered that these two technologies will most likely co-exist, instead of competing.

AcroVolt aims in creating an optimised network of charging stations and that includes making strategic decisions about everything involved. The company can safely invest in Greece because even though the country has not been in a great financial state, it is still one of the most economical countries to own an EV. To ensure an adequate supply of power at all times, early participation of energy providers in the planning and development of charging infrastructure is essential. The company has to choose where AC and DC chargers should be

placed, depending on where clients are more likely to need rapid or fast charging. AcroVolt has decided to put fast chargers mostly in locations where clients can combine chores or entertainment along with charging e.g. supermarkets, whereas it's been decided to put rapid chargers in locations where clients need to leave as soon as possible e.g. gas stations. Moreover, this study aims in ensuring that the decisions made can be profitable and optimised and it provides a strategic plan for the areas the company should invest in based on influencing factors.

There are data in this study that have not been used as much as they could. However, they have not been excluded as they can help the reader to create an image of the market. They can also lead to more conclusions if they are of more importance in the future.

Although there are competitors in the field, EVs are on the rise and AcroVolt has an early start. That can translate to the company being a significant player in a few years when other companies might only be in the beginning. There are also many other reasons why the company can succeed. The close relationship between AcroVolt and EVLoader makes software management for EV charging stations easier and ensures that the location providers are promoted as their logos are displayed on it. Another relationship AcroVolt has entered is the one with ΑΝΕΔΗΚ (ΚΡΗΤΙΚΟΣ), one of the largest Supermarket chains in Greece, guaranteeing the company has access to locations across Greece. There are also a few very competent people consulting the company along.

Lastly, the economic model makes it clear that the company can balance the fourth year of operating and be sold in the tenth year with at least double the value of its EBITDA. It could even be sold five times the value of its EBITDA, making AcroVolt worth € 17.634.844.

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