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DEPARTMENT OF BANKS AND FINANCIAL INTERMEDIARIES

SUBJECT: M&A AND INVESTMENT BANKING

ELECTRIC CAR MARKET: INVESMENT OPPORTUNITIES

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CANDIDATE: LUCA D'AVANZO MATR. 673061 To my mother, my father, my brother. You are the people I want to make most proud of me

"We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too."

> John F. Kennedy Moon Speech- Rice Stadium Sept. 12, 1962

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CHAPTER 1 OVERVIEW ON ELECTRIC CAR MARKET

1.1 HISTORY

Electric car is not a brand-new product of modern time as, today, we are used to think about it. Was in the 19th century much more popular than it is now, indeed in the USA it had a third of market share that is astonish number, compared with the 2% of these days.

The very first vehicle moved by an electric motor was built around 1832 but only in the 1870s it became practical; in the 1900s Electric Vehicles (EV) became popular, they are quiet, don't smell, and don't emit pollutants, for that reasons they became very common, especially for the women. At the time, the gasoline-powered cars required more physical effort because of the changing gears and hand crank needed to start the car.

By 1912, in US there were 38,843 electric the 38% of all the cars on the road, 40% were powered by steam and only 22% by gasoline.

Among believer of EVs potential were Ferdinand Porsche, one of the best name in the industry, especially for sport cars, devoted himself to the construction of an electric car, the P1 released in 1898 and he also invented the first Hybrid Car, the Lohner-Porsche Mixte, that was powered form two motors, one alimented by gas and the other by batteries.

Thomas Edison, very well-known inventor recognize the potential of EV and considered it as the finest way of transportation, so worked to build better battery and together to his friend Henry Ford, committed to create a low-cost electric car. In an article of New York times of January 11,1914¹, it is possible to read that Ford was planning to build an affordable new car with 100 miles range and cost of \$600. Ford invested \$1.5 million in the project, the problem was in the unstable nickel-iron batteries used by Edison, incapable of work in many situations, instead of the heavier lead-acid batteries asked by Ford. Therefore, the project never saw the light.

Actually, Henry Ford set the decline of EV in 1908 when he produced the Model T, the first car of

¹ https://timesmachine.nytimes.com/timesmachine/1914/01/11/100080624.pdf

the revolutionary assembly line, that makes the cars affordable and produced on large scale, combined with the low price of the oil, the gas-powered cars became 3 times cheaper than the electric version and hence very popular. The electric options were pricier and common for the upper class, but destined to disappear in the following years. In addition, more gas stations appeared inside and outside the cities so that longer travel became possible. To give an idea of the price gap: "By 1912, gasoline car cost only \$650, while an electric roadster sold for \$1,750. The same year, Charles Kettering introduced the electric starter, eliminating the need for the hand crank and giving rise to more gasoline-powered vehicle sales"².

RISE OF EV

After a long dark period for electric cars, with only few humble attempts to bring the technology back, the very first turning point happened when Toyota released the Prius, in the 1997, a family vehicle that became the first mass produced hybrid car of the history³, and the bestselling one. But maybe the major breakthrough was given by Tesla motors in 2008 that launched the Tesla Roadster, the first battery powered vehicle with a great range per charge, that was of 320 km⁴. This generated a plenty of media attention and was a great signal for the market of EVs because starts to overcome what is a strong issue for the purchase of a battery-powered vehicle, that is range anxiety, more to come on that later.

Since then, other players understand the necessity to enter in this market and now, there are 23 models of full electric vehicles available on the market and 24 other upcoming models that will be available by 2020⁵.

It's now the time to clarify the concept of Electric Vehicle and the major variants...

² https://www.energy.gov/articles/history-electric-car

³ https://blog.toyota.co.uk/history-toyota-prius

⁴ https://en.wikipedia.org/wiki/Tesla,_Inc.

⁵ https://evrater.com/evs#ev-future

1.2 WHAT EV MEANS?

EV is a general term, used to indicate any kind of vehicle moved by an electric motor. In order to be more specific and distinguish the different option available for the electrification of the transportation we can define:

Battery Electric Vehicle: is the most sophisticated and can be considered the pure version of EV, it has an electric motor and can rely only on electric power stored in the batteries (lithium-ion technologies usually). The batteries represent almost the 50% of the cost of the car; so, the companies are focus on reducing the cost of batteries, in order to make marketable the production of the EVs. In 2017, they represented the 69% of all EVs sales.

Hybrids: combine the power of the gasoline engine and the gasoline powered one, depend on the grade of hybridization we can distingue

Mild-Hybrid: the electric motor is a light support for the internal combustion engine, mostly used to help the start and to reduce the consumption of fuel; the energy of this vehicle is produced from the regenerative braking, stored in the batteries and used in the useful moment. They have a small battery and that cannot be charged from an external source, so they are not considered in the statistics of electric vehicles sales.

Plug-in Hybrids: very close to the Hybrid, the difference is that with the plug-in, is possible to charge the battery from an external source of energy; the range of a plug-in hybrid is greater than normal Hybrid. In 2017, they represented the 31% of all EVs sales.

Fuel-cell Vehicles: use hydrogen to produce electric power, the only emission of this kind of car is water. They are not so competitive in terms of costs with other EVs and has a market share on total EV that is less than 1%.

1.3. COUNTRIES REGULATION

The strongest push to the renew of the electric technology was given by the governments that stimulated by the concern about climate change and global warming linked to CO2 emissions, encourage the diffusion of clean vehicles through incentives and limit on emissions.

PARIS AGREEMENT is the agreement within the United Nations to make a global effort against the climate change, adapt to its effect and to give support to developing nations to do so. The final goal is to limit the average increase in global warming below 2° Celsius above the pre-industrial level.⁶

Electric Vehicles have shown their power to reduce the carbon emissions. Make a precision estimation of reduction of pollution through can be tricky, because it will depend from how the energy is generated. What data shows is that even if the electricity is generated by using coal EV carbon emission are still 17% lower compared to an average gasoline-powered car. In a state like California were energy is generated mainly through green source, the reduction of carbon emissions is 80%.

In order to commit themselves to reach the target of the agreement:

FRENCH planned to ban the petrol and diesel car by 2040, furthermore, it want to stop to use coal to produce electricity by 2022 and aim to pursue this goal with up to 4 billion investments in order to increase energy efficiency.

NORWAY and NETHERLAND have even a more ambitious program to ban petrol and diesel cars respectively within 2025 and 2030 Norway is leading the adaptation to electric, in 2018 the sales growth by 40%. The battery electric vehicles were 31.2% of all vehicles sold (147,929 units) and 17.9% were hybrid⁷. The expectations for 2019 are much higher, the Norway are showing the world how fast it's

⁶ https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement

⁷ https://electrek.co/2019/01/02/electric-car-sales-norway-2018/

possible to adapt to alternative fuel vehicles. Some survey report that costumers are waiting for new electric options available.

ITALY

Financial plan of 2019 approved in December 30, 2018; establish an eco-bonus and an eco-tax for the car registered starting from March 1, 2019 until December 21,2021. This for the aim of push the demand low emission vehicles. The tax hit the luxury vehicles and suv, considered more polluting, and exclude the cars with small engine size.

It was designated a fund of 300 millions of euros to give incentives according to the following parameters in the table

CO2 g/km	Subsidy (euros)
0-20	6,000
20- 70	2,500
70-90	1,500

The parameters for the eco-tax are:

CO2 g/km	tax (euros)
110-120	150
120-130	300
130-140	400
140-150	500
150-160	1,000
160-175	1,500
175-190	2,000
190-250	2,500
>250	3,000

Source: Art. 79-bis, Proposta emendativa 49.069. in V Commissione in sede referente riferita al C. 13348

EUROPEAN TARGET - RESTRICTIONS ON CO2 EMISSIONS

In Europe, cars caused about 12% of total CO2 in the environment. The European Union answer to the Paris Agreements is a mandatory emission reduction targets for new cars sold: The target established in 2015 was about 130 CO2 g/km, a limit well respected indeed, in the 2017 the average level of emission of new cars sold was 118.5 CO2 g/km, so much below the limit imposed.

The new target for 2021 is 95 CO2 g/km

European EVs market share is now of 1.5% on about 15 million cars sold every year. The new target fixed for 2030, that is 37.5% reduction of CO2, compared with the 2021 limit means that by that date one third of cars sold in Europe needs to be electric.⁹

INDIA, the air pollution is a big issue, according to Greenpeace report (Airpocalypse) 2.3 millions of death annually, are caused by air pollution; the 3% of GDP is been destitute for the health care and remediation cost to the smog¹⁰. They want to reach the goal of not selling petrol or diesel car by 2030, that's what the energy minister has declared¹¹.

CHINA

China is the country that are leading the electric revolution both from a supply and demand

⁸ http://documenti.camera.it/apps/emendamenti/getTestoAtto.aspx?atto=1334&legislatura=18

⁹ https://www.bloomberg.com/news/articles/2018-12-17/carmakers-get-road-map-for-tougher-eu-limits-on-carbon-dioxide

¹⁰ https://secured-static.greenpeace.org/india/Global/india/Airpoclypse--Not-just-Delhi--Air-in-most-Indian-citieshazardous--Greenpeace-report.pdf

¹¹ https://www.independent.co.uk/news/world/asia/india-electric-cars-2030-fossil-fuel-air-pollution-piyush-goyalclimate-change-a7711381.html

standpoint. As the biggest global car market, China is making a big effort to reduce its dependence from oil and to clean the air.

The electric cars in china are only 3% of total car sales, so it's still high potential market and from 2019 has introduced a complicated rule system that will punish the carmakers that won't have a some determined quotas of zero or low emissions vehicles in their fleet. The rule establishes that automakers with production of over 30,000 vehicles must earn a 10% New Energy Vehicles (NEV) credit for 2019 and 12% in 2020. How the credits are calculated will depend also from the characteristics of vehicles, such as distance that can travel without charging up, speed etc.¹². According to Bloomberg estimates this will translate in a 4-5% of real car sales. Carmakers that will not reach the quotas, can buy credits from more virtuous carmakers if they cannot buy credit from rivals they have to pay a fee or in the worst case they will see shut down the production of the line. That's probably the most aggressive policy of EVs legislation in the world.

Sales for 2018 was about 1 million, and according to Bloomberg forecasts will account for 11.5m for 2030 (39% of global estimate global sales).



Source: Bloomberg New Energy Finance (forecasts from 2018)

Most prepared car makers to meet the China rules are BYD, BAIC AND BMW.

USA

¹² For more details on calculation credit see https://www.bloomberg.com/news/articles/2018-11-14/china-is-about-to-shake-up-the-world-of-electric-cars-quicktake

United states hit the great number of 1 million electric vehicles sales in 2018. The biggest credit to this result is to attribute to the incentives. ZEV (Zero Emission Vehicles) program is policy adopted first by California and then by other nine states (Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island and Vermont) designed to make the state achieving a good quota of electric vehicles.

ZEV program works in credit, it assigns each car maker a percentage of non-electric sales to be covered by ZEV credit. The credit target for the 2018 was 4.5% (2.5% of the sales to be zero emissions) and will be about 22% (8% of the sales to be zero emissions) in 2025¹³.

Another big incentive was established in 2008 and consist of tax credit from \$2,500 to \$7,500 for new EV, considering their characteristics about range and size of the vehicle, available for 200,000 EVs per carmaker.

Furthermore, great contribute was given by part of the program Electrify America. An investment program of \$2 billion (\$800 million in California) in infrastructure for EVs in 10 years period, until 2027¹⁴. The program was a part of Volkswagen's agreement after the scandal on emission of diesel engine in 2015.

Threaten form Trump government to fight the policies and program on electric vehicles, could represent a shock for the trend.

Here a summary chart, comparing the current government proposal to ban Internal combustion vehicle sales, that will force the carmakers selling in such countries to quickly adapt in order to not lose market share over the prepared competitors

¹³ More precise data on vehicle credit formula https://www.ucsusa.org/clean-vehicles/california-and-westernstates/what-is-zev#.XE3efS2h2gA

¹⁴ https://www.electrifyamerica.com/our-plan

Country	Current government proposals to ban ICE only vehicle sales
*` China	Actively considering and studying a ban
France	2040
Germany	2030
India	2030
Ireland	2030
🗢 Israel	2030
Netherlands	2030
Norway	2025
Scotland	2032
UK	2040

source: Thomson Reuters GFMS team, Thomson Reuters Eikon, and Reuters News. Data current as of March 20, 2018

1.4.NEXT 10 YEARS

The car industry is coming through radical transformation, everything will look different in 10 years: the companies that make cars are setting themselves to the new standard, other companies will rise, others will need to adapt or die. A new grid of charging stations will be needed to allow the diffusion of the EVs in the countries.

The estimations, from a J.P Morgan report (October 10, 2018), tell that EV will account for a 30% of all vehicle sales by 2025 and double in the next five years. That's means an astonishing rise for the next 10 years.

	GLOBAL ELECTRIC VEHICLE FORECAST
2015	9 ^{1%}
2020e	₽ ^{3% 1%} ^{7%} 88%
2025e	₱% 3% 20% 68% 000
2030e	D 18% 2% 39% 41%
BEVs	PHEVs Full + Mid Hybrids Pure ICE
Source: J.P. Mo	rgan estimates

That numbers will be consequences of a series of financial and non-financial factors, as explained in the next chapter.

CHAPTER 2

2. FINANCIAL AND NON-FINANCIAL FACTORS

In this chapter are analyzed the factors that influence the purchase of an EV model over ICEVs. The factors implied in the choice concern financial and non-financial factors. In order to look at this topic with analytical eyes, after a first explanation of what the factors are, it will be used a Multiple Linear Regression analysis with the aim to investigate which are the variables that most influence the adoption of the EVs and understanding the correlation through the observation of the coefficients.

When an individual considering buying an EV model he looks up some characteristics such as price, range, design, performances, but also the availability of charging stations that in the case of EVs models has a main relevance, because it's directly linked with the ease of use of the vehicle.

2.1. RANGE

The range is for sure, one of the major obstacles to the large-scale adoption of EVs and along with price it is almost the only real difference in the comparison with the classic gasoline cars. It is directly linked with the battery size, hence with the weight of vehicle. Compared with the gasoline, battery has lower energy density, that made the first a better carrier of energy in order to cover long distances.

With the progress made with new Lithium-ion batteries, that have 10 times more energy than lead-acid batteries (industry developed also thanks to the diffusion of smartphone), it is now possible to have a car with autonomy of 500 km per charge, that is available on Tesla model S, and represent the longest range of an EV on one charge, this of course came with a premium price. The new Tesla Roadster that will come in 2020 is supposed to have an autonomy of 1,000 km on one charge and is supposed to be the fastest car in the world, with an acceleration of 1,9

seconds from 0 to 100km/h.

Furthermore, companies are already developing new technologies such as solid-state batteries that will replace with ceramic material the electrolyte liquid in the lithium-ion batteries. The advantages will be: less risk of fire, extended life of batteries, faster charging, more energy density and then less weight.

All things being equal, the solid-state batteries are expected to carry 25% more energy than actual batteries that are now offering 0.8 kWh per liter. That is translated in more autonomy and more performance also.

Volkswagen is very optimistic and forecast to have solid-state batteries on their models by 2025¹⁵. Other companies too are investing and developing such technology, but it's maybe to soon in order to make it marketable. As every innovation, before to became cost-efficient, will needs scale-economies.

2.2.CHARGIN STATIONS

Charging up is far different experience than filling up the tank. It can require longer time and presumably be needed more often, depending on the size of the battery and the range available. The availability of charging stations in many countries don't allow to travel on a long range and that is a major barrier for the purchase of a battery powered vehicle.

According to European Automobile Manufacturers Association, in Europe there are about 100,000 charging stations, the target to allow a good electrical mobility and reduce CO2 emissions should be 2 million charging stations by 2025, twenty times more.

The major obstacle is represented by the psychological feeling associated with the shorter range available compared with gasoline powered cars, the so called "range anxiety", that is the fear of run out of fuel.

The psychological aspect of that factors is easily demonstrable by the fact that researches show that the actual mean range of 160 km of model in production, can meet the needs of 95% of the users.

On the other hand, this is a feeling that disappear after a period of adjustment. Some users

¹⁵ https://www.greencarreports.com/news/1119182_vw-confirms-its-planning-for-solid-state-batteries-by-2025

interviewed after a period of time of using an electric car declared that was even more enjoyable to get up every morning aware to have a 100% autonomy of their cars always available, considering that took only few second to plug in.



Image source: Smart, Powell & Schey , 2013, Extended Range Electric Vehicle Driving and Charging Behavior Observed Early in the EV Project, SAE World Congress 2013.

The graph shows from an experiment, that most user charge one or two times a day in place like home and at work. Charging more than 3 times a day is a rarity even if we are considering cars with small range.

2.3.PRICE

EVs are characterized by higher purchase cost between 30% to 80% but the sticker price is not the only cost of owning a car. Indeed, to make a fair comparison it is necessary to compare the

total cost of ownership over a car lifetime.

The half percent of the cost of an electric car is represented by the cost of the battery as the graph shows



the average cost of battery pack expressed in \$/kWh, so depending by the size, are falling and it will decrease as the number of EVs increase.



Average battery pack price

It is believed that a target price near \$100/kWh it is what it takes to make the price-parity between EVs and ICEVs.

Analyzing the average cost of the gasoline compared with cost of kWh; an Electric car can run on an average of half price of fuel compared with gasoline options.

	GASOLINE	ELECTRIC
PRICE	\$1.50	\$0.20
EFFICIENCY	20 km/l	5 km/kWh
PRICE/KM	\$0.075/km	\$0.04/km

a simple calculation like that can allow anyone, multiplying price/km times the average of km done in a year how much is possible to save in fuel costs.

Maintenance costs should also be much less, because of less moving part of EVs 30 vs 2,000, and regenerative breaking put less efforts on tires and brakes. At the time, it is not easy to do a precise computation of all that costs, because of scarcity of data available and too few repair shops are specialized on working on EVs.

2.4.PERFORMANCE

When considering buying a car, performance is a special matter, especially if we are talking about luxury car. A car should be also fun to drive. Well, electric cars didn't let down on this point, because of mode of operation of electric motors they can benefit of instant torque available, that means totally different driving style. Having instant maximum power always available, EVs came with better acceleration on 0-100 km/h; the disadvantage is that they have less efficiency at high speed, the high amount of energy required limit the range of the car. From a study of Plug-in Hybrid & Electric Vehicle Research Center of the Institute Transportation Studies, emerged that from a sample of 39 Tesla Model S adopters, the main reason of the purchase was the performance and reward of driving; the people's previous

vehicles included sport cars like Ferrari, BMW M series, Lotus and Dodge Viper GTS¹⁶.

One disadvantage would have been represented by the higher weight of batteries, as energy carrier, than gasoline. But car-makers smartly put this extra weight on the bottom of the vehicles so they have lower center of gravity and more stability.

2.5. REGRESSION

In order to investigate with an analytical approach what variables influence the EV adoption, hence the EV sales, it was done a Multiple Linear Regression analysis, on the most significant variables. The aim was to understand what are the correlations between variables.

 $y_i = B_0 + B_1 x_{i1} + B_2 x_{i2} + ... + B_p x_{ip} + E$ where i = 1, 2, ..., n

It was chosen to conduct the analysis on Norwegian market, because it has the highest market share of EVs on total vehicle sales. Therefore, understanding what make this market the most successful one, will give an insight on which one could be the next with high market share, what are the variables that bring to success and where it is better to focus the investments to achieve greater EVs adoption, take for granted that governments want so.

The period of time chosen was from 2011 to 2017 because of is the most significant in terms of new electric car sales in Norway.

INCENTIVES

Public incentives were left out from the regression analysis, the idea came from the reading of another master thesis (Simon Gazdowicz, 2005, Department of Informatics, Oslo) where

¹⁶ https://its.ucdavis.edu/blog-post/high-performance-fun-to-drive-electric-vehicles-uc-davis-study-reveals-surprising-consumer-motives/

through the observation of variance of EVs adoptions within municipalities of Norway, was shown that public incentives weren't a main driver.

It is also simply observable that the growth of EVs sales happened since 2010 even if the major incentives was spread much earlier:

The zero emissions incentives include:

- No purchase/import taxes (1990-)
- Exemption from 25% VAT on purchase (2001-)
- No annual road tax (1996-)
- No charges on toll roads or ferries (1997-2017).
- Charges were introduced on ferries with upper limit of maximum 50% of full price (2018-)
- Charges on toll roads were introduced with upper limit of maximum 50% of full price (2019)
- Free municipal parking (1999-2017)
- Parking fee for EVs was introduced locally with an upper limit of maximum 50% of full price (2018-)
- Access to bus lanes (2005-).
- New rules allow local authorities to limit the access to only include EVs that carry one or more passengers (2016)
- 50 % reduced company car tax (2000-2018).
- Company car tax reduction was lowered to 40% (2018-)
- Exemption from 25% VAT on leasing (2015)
- Fiscal compensation for scrapping of fossil vans when converting to a zero emission van (2018)
- Allowing holders of driver licence class B to drive electric vans class C1 (light lorrries) up to 2450 kg (2019)

source: https://elbil.no/english/norwegian-ev-policy/



New car sales in Norway



Figure 1- Yearly registrations of PEV's in Norway. Source: Norwegian road federation

Only battery vehicles were considered because, in Norway the quota of Hybrid vehicles is only a 6% of total sales of EVs

2.6. DIPENDENT VARIABLE

As best proxy of EVs sales, it was chosen the number of EVs registration in Norway. It is believed that every car sold is registered in same place. Using registrations instead of the data on direct sales, will carry an unimportant error of estimate that is possible to overlook. In that way, was easier to collect data. The source where data was gained, is Statistics Norway, the national statistical institute of Norway and the main producer of official statistics about Norwegian Society since 1876.

2.7. INDIPENDENT VARIABLES

NUMBER OF CHARGIN STATIONS

The data on charging stations was collected from the website Statista. This variable is the one responsible of mental obstacles to the EV adoption. It limits the ease of use of the battery powered cars if not enough to allow long travel, and make the electric options comparable with petrol cars, on a psychological way.

BATTERY PRICE

Was expressed in terms of dollar per kWh and the data was observed from a McKinsey estimation. Battery price is the major variable cost of a battery powered vehicle, as already mentioned, it accounts for 50% of the cost of an entire car. A target price of \$100/kWh is indicated as the way to have cost-parity with petrol cars. Hence, it could be a driver of EV adoption.

GASOLINE PRICE

Oil price, like for the battery price, is a cost component that has a rule in the perception of the electric options, the crude oil price was expressed as dollars per barrel. I didn't find data on average price for liters each year, but is believed that it is directly correlated with the crude oil price.

2.8. RESULTS

From the regression the following output:

	А	В	С	D	E	F	G	Н	I	
1	SUMMARY OUTPUT	Г								
2										
3	Regression St	atistics								
4	Multiple R	0.99184585								
5	R Square	0.9837582								
6	Adjusted R Square	0.96751639								
7	Standard Error	8996.59773								
8	Observations	7								
9										
10	ANOVA									
11		df	SS	MS	F	Significance F				
12	Regression	3	14707267440	4902422480	60.56951988	0.003496815				
13	Residual	3	242816312.1	80938770.69						
14	Total	6	14950083752							
15										
16		Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	
17	Intercept	-161846.444	64857.32245	-2.495422836	0.088061444	-368251.3897	44558.5027	-368251.3897	44558.5027	
18	CS	32.248166	6.558250757	4.91719014	0.016112421	11.37688507	53.11944685	11.37688507	53.11944685	
19	\$/kWh	174.752437	84.31080704	2.072716925	0.129903982	-93.56217964	443.0670531	-93.56217964	443.0670531	
20	oil price	-768.895364	422.2776096	-1.82082911	0.166183007	-2112.771183	574.9804546	-2112.771183	574.9804546	
21										
22										

The regression results show that R square is very high, the 98% of the variation of quantity of

EVs registrations are explained by the independent variables choose. Closer to one is R-

squared, better is the regression line fits the data.

Significance under 1% make the data statistically significant.

Here the only significant variable is CS (Charging stations) with p.value <0.05. The other two regressors are not statistical significant with p.value > 0.10.

A problem is represented by the negative intercept and because of it not would make a sense to have all regressors equal to zero, the intercept should be eliminated.

The regression became:

```
Coefficients:
Estimate
               Std. Error t value Pr(>|t|)
CS
      16.248
                  2.093
                          7.765
                                   0.00148 **
kWh
      12.337
                 81.398
                          0.152
                                   0.88686
oil -649.482
                637.228 -1.019
                                   0.36572
___
Signif. codes:
                0 `***' 0.001 `**' 0.01 `*' 0.05 `.' 0.1 `' 1
```

Residual standard error: 13660 on 4 degrees of freedom Multiple R-squared: 0.9781, Adjusted R-squared: 0.9617 F-statistic: 59.56 on 3 and 4 DF, p-value: 0.0008922

Where again the only significant variable is only CS, now with a p-value close to zero. R-squared is again very high, a little decrease in the value of F-statistic of about 10 points shows a little decrease of significance of the overall regression. The model is still significant, and in that case with numbers corrected for the heteroscedasticity.

What the data shows is that the number of Charging stations is the main driver for boosting the adoption of electric cars. That is in line with the reduction of range anxiety for the users, and with a well-structured ecosystem that makes the EVs usability comparable with the petrol cars that can count on an enormous grid of gas stations.

There are some limitations of not include incentives in the regression, part of success of EVs adoption in Norway is due with strongest incentives, so the same model applied on other country could have a lowered effect.

CHAPTER 3

3. INVESTMENT OPPORTUNITIES

Investing in Electric cars, is very challenging, because of: high technological aspect of the industry, high capital intense sector and a demand strictly linked with the infrastructures still insufficient in most nations. The boom in sales of electric vehicles will not happen overnight and as explained in the previous chapters it will depend from different variables.

That said, the phenomenon of EV adoption it will happen, it is not a matter of "if, it is a matter of "when", "where" and "who".

Global EV sales are expected to increase from 1.1 million of 2017 to 30 million by the 2030¹⁷. That is a huge expected growth that might be gained by the better players on the market. The entire automotive sector worth about 2 trillion dollars and in a few decades part of that value will be redistributed on EV.



Annual global light duty vehicle sales

Source: Bloomberg New Energy Finance

I've have identified few different attractive options to get an exposure from the rise of EV market that carry with them different risk profile:

- investing in companies involved in producing cars and or batteries
- investing in materials which the cars, batteries and components are composed
- investing in ETF, in order to cover all the market

3.1 COMPANIES

TESLA

Tesla is definitely the first company that come in mind thinking about investing in electric cars. It has been the first good player in the market, gained the best brand recognition, and made products of highest quality. It has a proprietary system for charging the cars, with its own charging stations that Tesla is installing in all over the world. As seen by the regression analysis on the previous chapter, the number of available charging stations is highly correlated with the EVs sales.

The stock remains highly volatile. Lots of bigger competitors have stepped in the market, ready to over perform Tesla in terms of technology and investments.

Tesla partnered with Panasonic to build a new factory in China, the Gigafacotory3, where will be built batteries, the latest and most affordable model of the company that is Tesla Model 3 and a new expected Model Y. The reasons of building the factory in China are that: as mentioned, China is the biggest market for EVs and is the only way to take advantage from the Chinese incentives that keeps out foreign automakers. Right now, Tesla's vehicles are too expensive for the Chinese market, the Model 3 starting price is \$72,000 much more high-priced than the \$44,000 necessary to buy the same car in US, part of that is caused by the additional tariffs on US products. Chinese government has been helpful with the company, allowing it to be by now the only manufacturer in China without local partner. Tesla's goal is to increase the production of 50% and to build their own batteries in order to keep a control on every production step and be able to sell the Model 3 at the competitive price of \$35,000. The

production capacity of the new Gigafactory 3, will be 500,000 cars annually; half of that number available for the first phase, while the maximum potential will be reached over time, first car is expected to be delivered by 2020¹⁸.

Issues with tesla was about the negative income generated for years. Through observation of the balance sheet it is clear that was caused by the high operating cost. Valuating Tesla only by the conventional ways like Discounting Cash Flow or comparables approach, it's not enough to catch the real value or in better words, to understand the "story" of the company. Even the operating sector of Tesla is not so clear, because the company is involved in: automotive, energy and technology.

It's not possible considering the company, without think about his CEO and founder, Tesla investor, surely has invested in Elon Musk and his vision other than in the company. The vision is probably the reason of its stock price on the market, considered overvalued by most analysts but with still lot of potential according to others. Tesla is probably right now the company where the analysts disagree more about.

The driver of its value on the market is represented by the revenues growth during the years, 73% in 2016, 68% in 2017, but the operating costs grew proportionally and continued to generate negative income.

That happened until the third quarter of 2018, with revenues grown of 183% compared with the same quarter of 2017, where Tesla generate positive net income of 312M, thanks to "labor hours for Model 3 decreased by more than 30% from Q2 to Q3...in Q4, we will focus even further on cost improvements while continuing to increase our production rate."¹⁹ Tesla can count of a reliable costumers base and a great brand loyalty, it can allow itself to announce a new Model and make the costumers pay before they can even see the product. That happened with Model 3 announcement, where 400,000 people put their names on the waiting list willing to deposit money to get that car.

¹⁸ Bloomberg

¹⁹ Tesla filings, Third Quarter 2018 Update

Company Name	Country	Enterprise Value	Market Cap (in US \$)	Revenues	EV/Sales
Volkswagen Aktiengesellschaft	Germany	\$278,738.14	\$88,540.90	\$286,698.30	0.97
Toyota Motor Corporation	Japan	\$359,588.70	\$199,925.40	\$276,630.20	1.30
Daimler AG	Germany	\$222,284.67	\$74,886.10	\$203,933.70	1.09
Ford Motor Company	United States	\$197,755.18	\$47,381.10	\$159,589.00	1.24
Honda Motor Co., Ltd	Japan	\$97,833.80	\$55,062.50	\$144,636.80	0.68
General Motors Company	United States	\$150,481.24	\$59,563.00	\$144,421.00	1.04
SAIC Motor Corporation Limited	China	\$58,738.24	\$64,865.00	\$143,679.50	0.41
Fiat Chrysler Automobiles N.V.	United Kingdom	\$39,113.11	\$31,680.30	\$135,633.90	0.29
Bayerische Motoren Werke Aktiengesellschaft	Germany	\$173,148.07	\$63,385.00	\$120,051.70	1.44
Nissan Motor Co., Ltd.	Japan	\$100,563.30	\$38,386.30	\$112,529.30	0.89
Hyundai Motor Company	South Korea	\$82,479.20	\$24,185.80	\$89,915.90	0.92
Peugeot S.A.	France	\$18,532.66	\$21,686.00	\$78,302.10	0.24
AUDI AG	Germany	\$26,607.63	\$38,837.40	\$72,199.80	0.37
Renault SA	France	\$69,542.53	\$25,133.00	\$70,569.20	0.99
Kia Motors Corporation	South Korea	\$16,874.60	\$11,370.00	\$50,168.10	0.34
Tata Motors Limited	India	\$20,977.10	\$14,310.90	\$45,215.90	0.46
Suzuki Motor Corporation	Japan	\$25,112.10	\$25,328.10	\$35,377.00	0.71
Mazda Motor Corporation	Japan	\$8,872.60	\$7,911.90	\$32,710.60	0.27
Subaru Corporation	Japan	\$16,866.90	\$23,262.00	\$32,062.70	0.53
BAIC Motor Corporation Limited	China	\$5,675.83	\$8,222.50	\$21,925.60	0.26
Tesla, Inc. (2018)	United States	\$70,781.58	\$59,860.80	\$12,471.20	5.68

source: Aswath Damodaran

High EV/Sales can be a signal of how revenues of Tesla are expected to grow from investors perspective.

Tesla bring high volatility, so high risk and possible high profit.

China is becoming the first player in demand, production and sales of EVs that also caused by the fact that reducing the pollution of the automotive sectors is an important commitment of the government. In 2017 Chinese automakers sold 770,000 new energy vehicles, 53% increase over 2016 (507,000 vehicle sold), and it's expected to reach 2,000,000 EV by 2020.²⁰

²⁰ Cina Association of Automobile Manufacturers

BYD

Is the biggest electric vehicle company, considered the Chinese version of Tesla, and one of its bigger competitor. BYD is backed by the investor Warren Buffett, well known for his value investing style. He entered in the company with an investment of \$232 million for 10% of the stocks, at the price of 8HKD equals about 1.02 USD.

In February 15, 2019, BYD close price was 50.35HKD. That is a return of 530% over 10 years. The company produce not only battery vehicle, but also plug-in hybrid models and that allows to reach costumers not ready for the full electric models; it is also active in battery production, it's actually the second biggest producer of automobile batteries in the world and is working on a plan to build new vehicle-battery factories in both Europe and U.S. A threat for BYD growth could be represented by the new Tesla Gigafactory3, above mentioned, that could be ready for the summer 2019 and start delivery vehicles for 2020. The Tesla factory where will be built batteries, Model3 and Model Y. Considering the 2018 market share of 18% in PEVs, Tesla new production plans could be an over 1 billion dollars threaten in revenues for BYD, starting from 2020.

A common index to look in the automotive sector is the Price to sales ratio, that is given by market capitalization on total revenues over the past 12 months. Making a comparison with TSLA that has a P/S of 2.4506, BYD appears more attractive with a lower P/S of 0.9960²¹.

CATL (Contemporary Amperex Technology)

is a Chinese company, listed in Shezen Stock Exchange from Jun. 2018, leader in China for production of electric buses for the production of automobile lithium batteries: CATL (12GWH), Panasonic (10GWh), BYD (7.2GWh)²².

The company reached, in 2018, the capacity of 17 GWh in battery production and is ready to open one more factory by 2020 in order to have additional 24 GWh of battery production annual that could make CATL the biggest world battery producer. The celerity in hitting the

²¹ Bloomberg data

²² https://www.marklines.com/en/top500/s500_551

target will be very critical for its future value.

Panasonic, General Motors, Toyota, Volkswagen and Volvo also are players well placed to get benefits form increasing sales of EVs.

3.2. MATERIALS

Lithium-ion batteries, besides the cars, are the base of many technologies like: smartphone, laptops, camera and always more devices rely on their performances.

Lithium batteries are more often used as energy storage, in particular as support for the renewable source of energy like wind and solar another growing field that according to forecasts is expected to have a 97% annualized grow rate until 2020²³.

By the rise of forecasted EVs sales, the demand for the batteries and its elements is expected to grow of about 10 times.

²³ Citi Research 2015. "Lithium: The Future is Electric



That conduct to talk about lithium as an investment. Very advised in the early stage of EVs and very dependent from it.

Lithium cannot be traded directly on the market, therefore in order to get an exposition from its raise is necessary to invest in companies involved in his production cycle. The most common way to invest in lithium is through ETF, that is a marketable security that allow to invest in a basket of assets, the value of the ETF will depend from its own underlying assets, they can replicate an index, or collect securities representative of a sector. The advantage came from diversification, this kind of investment allow to reduce the risk by spreading net assets through many companies.²⁴

In the specific case, I'm talking about Lithium & Battery Tech ETF, one of the largest ETF regarding lithium implied in EV sector, it allows to invest in companies from the mining of lithium to the production of batteries. It tracks the Solactive Global Lithium Index, an index with the aim to "tracks the performance of the largest and most liquid listed companies active in exploration and/or mining of Lithium or the production of Lithium batteries"²⁵ Below the top 10 companies of the ETF:

²⁴ https://www.globalxfunds.com/funds/lit/

²⁵ Solactive German Index Engineering

IOP IU HOLDINGS	TOP	10	HOI		NGS
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NET ASSETS % NAME FMC CORP 18.63 ALBEMARLE CORP 15.67 QUIMICA Y MINERA CHIL-SP 9.19 5.78 LG CHEM LTD 5.61 **TESLA INC** 4.99 **BYD CO LTD-H** SAMSUNG SDI CO LTD 4.73 4.52 **GS YUASA CORP** 4.47 ENERSYS PANASONIC CORP 4.20

As of 2/13/19

Holdings are subject to change.

Looking at the historical performance over 5 years, with a return of 4.73% and calculating the historical volatility on the daily variation returns of the same period that was 20.21%²⁶, I don't think that this ETF could still be a good investment for the next years, based on the actual conditions.





The thing is that according to Bloomberg forecast, Lithium will not be a risk factor to EV adoption, the actual supply capacity should be sufficient for the expected demand for the next

²⁶ my calculation

5-7 years.



Other metals and materials are required from lithium-ion battery pack in passenger EVs

Cobalt, essential for the stability of the battery, otherwise, is one of the biggest potential risk for the sector, it could suffer a shortage in the next years and the price could consequentially going up; the uncertainty is due to the fact that the major quantity of Cobalt is concentrated in Democratic Republic of Congo where there is a political instability and children are used to mining the metal. However, for such reasons, the companies are committing to reduce the dependence from Cobalt by developing new technology.

COPPER

Electric Vehicles use a considerable quantity of Copper in their motors and in the batteries, according to International Copper Association an Electric car can contain up to 6 km of copper cables, depending if we are talking about hybrid, plug-in hybrid or battery powered vehicle. Even charging infrastructure require copper to work.

Copper Usage



As the graph shows, Internal Combustion Engine vehicles contain 23 kg of copper while the Battery powered need up to 83 kg of copper, that means 260% increase.

By 2027 the demand of copper linked to the EV adoption is expected to be 1.79 million tonnes, that is 9 times the demand of 2017 $(185,000 \text{ tonnes})^{27}$.

Try to hit which player will win or, in other words, will gain more benefits from the trend in question, cannot be predicted with absolute certainty and maybe would require technical understanding of technologies behind the cars and battery.

Competition is very high, traditional carmakers are preparing to make a step in the coming electric vehicle market with new models and the condition of the market could rapidly change by the beginning of new technology.

²⁷ https://www.reuters.com/article/us-copper-demand-electric-vehicles/copper-demand-for-electric-cars-to-rise-nine-fold-by-2027-ica-idUSKBN1940PC

CONCLUSION

The world is changing and moving forward clean energy and renewable resource. Oil is a limited resource, destined to finish that's why governments are committing to reduce their dependence from it. If we want to safeguard the planet for the next generations, more efforts from the governments will be needed in such direction. Switch from petrol cars to Electric Vehicles is a must, and it will have to happen in the next decades.

The aim of the works was to give an explanation of what the Electric Market is, studying the variables that are moving it and give an insight on how to make a profit from its developing. The electric mobility and transportation will be the first option, with no doubts in most countries in 20 or 30 years, and maybe in 100 years we could find petrol cars only in the museums. All the forecasts agree with the fact that by 2050 half of car sales will be represented by an electric option. In order to achieve this result, as explained is unavoidable the diffusion of a structured grid of charging stations in all the states. The goal is to increase the sales of battery powered vehicles and reduce the quantity of harmful emissions.

Regarding the last point, how the energy is generated is very important: it is possible to reduce carbon emissions from 17%, if the energy is produced by coal, to 100%, if the energy is produced by clean source such as sun, water or wind.

Another goal, was to identify, what are the variables that better allow the diffusion of EVs. Public incentives are useful for making the cars price competitive in that early stage, but through a literature review was seen that they don't make such an impact compared with other variables. By regression analysis on the most successful and advanced case of EV adoption, Norway case, it was seen that charging stations are the most important variables in explanation of the EV sales. The variables about costs, such battery price or gasoline price were not statistical significant in the analysis.

That doesn't mean they do not make an impact at all, but that the major obstacles, to EV adoption, are linked to the psychological fear of running out of fuel, so called range anxiety; only a spread grid of charging stations is able to eliminate such fear.

The global electric car market might value a trillion dollar, by the 2050.

It is possible to get exposure from the rise of EV by many ways, the most profitable, surely, is taking a position in companies committed in production of cars or batteries or both. However, no profit came without risks. Assessing that risk, understanding the right time to enter in the market, deducting products' trend from macro-trend are the characteristics that identify the great investors. Warren Buffett, for instance, has entered in the market 10 years ago, and already gained his part of profits, through his investment in BYD. It is not too late for profiting from electric cars, there are many opportunities in the market, new players are birthing, new technologies are developing like wireless charging or solid-state batteries. Most of the risks are linked to such technological aspects of the field. It would be impossible to predict with certainty which player will win the race for EV diffusion or will come up with the better technology in the next years. During the work was discussed some of the companies better prepared, but thing can change quickly and investing in electric cars could still be challenging.

AKNOWLGEMENT

Allow me to express from the bottom of my heart, the immense gratitude to the Professor Marshall Langer. I can honestly say he is the better professor I have ever had; he helped me, during my work, he was always available, but above all, he has given to me, during his classes and our personal conversations some of the most important lessons of all my life. I will always remember that with gratitude and appreciation. Thank you.

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ABSTRACT

The thesis is about the electric car market. I have divided the work into three main parts, the first is about an overview of the history of the Electric vehicles (EV), in the second I analyze the main factors that driving the EV adoption and in the last part I look into investment opportunities in order to get an exposure from the rising of the EVs.

OVERVIEW ON ELECTRIC CAR MARKET

Electric car is not a brand-new product of modern time as, today, we are used to think about it. Was in the 19th century much more popular than it is now, indeed in the USA it had a third of market share that is astonish number, compared with the 2% of these days.

They were considered a superior product, very popular because they didn't require physical effort to changing gears and start the engine they didn't have vibrations and had overall better performance. Among their believers were brilliant people like Ferdinand Porsche, who also invented the first hybrid car, Thomas Edison and Henry Ford, that in 1914 together were planning to build an affordable car with 100 miles range and cost of \$600. This last project, never saw the light and the electric cars went out of the market many years later.

Henry Ford set the decline of EV, years before, in 1908, when he produced the Model T, the first car of the revolutionary assembly line, that makes the cars affordable and produced on large scale, combined with the low price of the oil. The gas-powered cars became 3 times cheaper than the electric version.

RISE OF EV

After a long dark period for electric cars, with only few humble attempts to bring the technology back, the very first turning point happened when Toyota released the Prius, in the 1997, a family vehicle that became the first mass produced hybrid car of the history, and the bestselling one. But the major breakthrough was given by Tesla motors in 2008 that launched the Tesla Roadster, the first battery powered vehicle with a great range per charge, that was of 320 km. This generated a plenty of media attention and was a great signal for the market of EVs also because starts to overcome what is a strong issue for the purchase of a battery-powered vehicle, that is range anxiety.

Since then, other players understand the necessity to enter in this market and now, there are 23 models of full electric vehicles available on the market and 24 other upcoming models that will be available by 2020.

TYPE OF EV

Electric vehicle is a general term, used to indicate any kind of vehicle moved by an electric motor but we can distinguish: Battery-powered vehicles that can rely only on electric power stored in the batteries, Hybrids that combine the power of the gasoline engine and the gasoline powered one, fuelcell vehicle that use hydrogen to produce electric power, the only emission of this kind of car is water.

REGULATION

The strongest push to the renew of the electric technology was given by the governments that stimulated by the concern about climate change and global warming linked to CO2 emissions, encourage the diffusion of clean vehicles through incentives and limit on emissions. Paris agreement is the agreement within the United Nations to make a global effort against the climate change, adapt to its effect and to give support to developing nations to do so. The final goal is to limit the average increase in global warming below 2° Celsius above the pre-industrial level. In order to reach the target of the agreement the nations are committing to incentive EVs or in same case to ban the sales of petrol cars.

• FINANCIA AND NON-FINANCIAL FACTORS

When an individual considering buying an EV model he looks up some characteristics such as price, range, design, performances, but also the availability of charging stations that in the case of EVs models has a main relevance, because it's directly linked with the ease of use of the vehicle.

The RANGE is for sure, one of the major obstacles to the large-scale adoption of EVs and along with price it is almost the only real difference in the comparison with the classic gasoline cars. It is directly linked with the battery size, hence with the weight of vehicle. Compared with the gasoline, battery has lower energy density, that made the first a better carrier of energy in order to cover long distances.

Furthermore, companies are already developing new technologies such as solid-state batteries that will replace with ceramic material the electrolyte liquid in the lithium-ion batteries. The advantages will be: less risk of fire, extended life of batteries, faster charging, more energy density and then less weight. All things being equal, the solid-state batteries are expected to carry 25% more energy than actual batteries that are now offering 0.8 kWh per liter. That is translated in more autonomy and more performance also.

Charging up is far different experience than filling up the tank. It can require longer time and presumably be needed more often, depending on the size of the battery and the range available. The availability of CHARGING STATIONS in many countries don't allow to travel on a long range and that is a major barrier for the purchase of a battery powered vehicle.

According to European Automobile Manufacturers Association, in Europe there are about 100,000 charging stations, the target to allow a good electrical mobility and reduce CO2 emissions should be 2 million charging stations by 2025, twenty times more.

The major obstacle is represented by the psychological feeling associated with the shorter range available compared with gasoline powered cars, the so called "range anxiety", that is the fear of run out of fuel. In many case, as said, it is only a psychological aspect, because researches show that the actual mean range of 160 km of model in production, can meet the needs of 95% of the users. On the other hand, this is a feeling that disappear after a period of adjustment.

EVs are characterized by higher purchase cost between 30% to 80% but the sticker PRICE is not the only cost of owning a car. Indeed, to make a fair comparison it is necessary to compare the total cost of ownership over a car lifetime.

The half percent of the cost of an electric car is represented by the cost of the battery.

The average cost of battery pack expressed in \$/kWh, so depending by the size, are falling and it will decrease as the number of EVs increase.

It is believed that a target price near \$100/kWh it is what it takes to make the price-parity between EVs and ICEVs.

There are other costs during the lifetime of cars, such as fuel cost, an Electric car can run on an average of half price of fuel compared with gasoline options; maintenance costs should also be much less, because of less moving part of EVs 30 vs 2,000, and regenerative breaking put less efforts on tires and brakes. At the time, it is not easy to do a precise computation of all that costs, because of scarcity of data available and too few repair shops are specialized on working on EVs.

PERFOMANCE in another matter for who buy cars. Well, electric cars didn't let down on this point, because of mode of operation of electric motors they can benefit of instant torque available, that means totally different driving style. Having instant maximum power always available, EVs came with better acceleration on 0-100 km/h. They are breaking many speed records even if the technology is very younger compared with gasoline-powered motors developer for years.

In order to investigate with an analytical approach what variables influence the EV adoption, hence the EV sales, it was done a Multiple Linear Regression analysis, on the most significant variables. The aim was to understand what are the correlations between variables. That was done in Norway, the most successful market in the world, to try to understand the main variables of this success.

What came up is that the number of Charging stations is the main driver for boosting the adoption of electric cars. That is in line with the reduction of range anxiety for the users, and with a well-structured ecosystem that makes the EVs usability comparable with the petrol cars that can count on an enormous grid of gas stations.

• INVESMENT OPPORTUNITIES

Global EV sales are expected to increase from 1.1 million of 2017 to 30 million by the 2030. That is a huge expected growth that might be gained by the better players on the market. The entire automotive sector worth about 2 trillion dollars and in a few decades part of that value will be redistributed on EV. I've have identified few different attractive options to get an exposure from the rise of EV market that carry with them different risk profile:

- investing in companies involved in producing cars and or batteries
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CONCLUSION

The world is changing and moving forward clean energy and renewable resource. Oil is a limited resource, destined to finish that's why governments are committing to reduce their dependence from it. If we want to safeguard the planet for the next generations, more efforts from the governments will be needed in such direction. Switch from petrol cars to Electric Vehicles is a must, and it will have to happen in the next decades.

The aim of the works was to give an explanation of what the Electric Market is, studying the variables that are moving it and give an insight on how to make a profit from its developing. The electric mobility and transportation will be the first option, with no doubts in most countries in 20 or 30 years, and maybe in 100 years we could find petrol cars only in the museums. All the forecasts agree with the fact that by 2050 half of car sales will be represented by an electric option. In order to achieve this result, as explained is unavoidable the diffusion of a structured grid of charging stations in

all the states. The goal is to increase the sales of battery powered vehicles and reduce the quantity of harmful emissions.

Regarding the last point, how the energy is generated is very important: it is possible to reduce carbon emissions from 17%, if the energy is produced by coal, to 100%, if the energy is produced by clean source such as sun, water or wind.

Another goal, was to identify, what are the variables that better allow the diffusion of EVs. Public incentives are useful for making the cars price competitive in that early stage, but through a literature review was seen that they don't make such an impact compared with other variables. By regression analysis on the most successful and advanced case of EV adoption, Norway case, it was seen that charging stations are the most important variables in explanation of the EV sales. The variables about costs, such battery price or gasoline price were not statistical significant in the analysis.

That doesn't mean they do not make an impact at all, but that the major obstacles, to EV adoption, are linked to the psychological fear of running out of fuel, so called range anxiety; only a spread grid of charging stations is able to eliminate such fear.

The global electric car market might value a trillion dollar, by the 2050.

It is possible to get exposure from the rise of EV by many ways, the most profitable, surely, is taking a position in companies committed in production of cars or batteries or both. However, no profit came without risks. Assessing that risk, understanding the right time to enter in the market, deducting products' trend from macro-trend are the characteristics that identify the great investors. Warren Buffett, for instance, has entered in the market 10 years ago, and already gained his part of profits, through his investment in BYD. It is not too late for profiting from electric cars, there are many opportunities in the market, new players are birthing, new technologies are developing like wireless charging or solid-state batteries. Most of the risks are linked to such technological aspects of the field. It would be impossible to predict with certainty which player will win the race for EV diffusion or will come up with the better technology in the next years. During the work was discussed some of the companies better prepared, but thing can change quickly and investing in electric cars is could be challenging.