

ELECTRIC VEHICLE MARKET IN
UKRAINE

by

Nazarii Hrechanyk

A thesis submitted in partial fulfillment of
the requirements for the degree of

MA in Business and Financial Economics

Kyiv School of Economics

2019

Thesis Supervisor: Professor Besedina

Approved by _____

Head of the KSE Defense Committee, Professor [Type surname, name]

Date _____

TABLE OF CONTENTS

LIST OF FIGURES.....	iii
LIST OF TABLES	iv
LIST OF ABBREVIATIONS	v
Chapter 1. EXECUTIVE SUMMARY	6
Chapter 2. INDUSTRY ANALYSIS AND RESULTS.....	9
2.1. Industry overview	9
2.2. Global and Ukrainian Electric Vehicle markets	11
2.3. Competition Analysis.....	14
2.4. SWOT analysis.....	17
2.5. Demand side of the market.....	19
2.6. Supply side of the market.....	30
Chapter 3. CONCLUSIONS AND RECOMMENDATIONS.....	36
REFERENCES.....	41
APPENDICES.....	44

LIST OF FIGURES

<i>Number</i>	<i>Page</i>
Figure 1. Production Statistics of cars by type in 2018, %.....	9
Figure 2. Global electric-vehicle sales, 2010-17.....	12
Figure 3. TOP 3 markets by total EV sales in 2018.....	13
Figure 4. EV sales as % of total vehicle sales by country.....	14
Figure 5. EVs as % of total vehicle sales in Ukraine.....	14
Figure 6. Average ICE and EV prices in US during 2-10-2016, USD th.....	20
Figure 7. EVs power stations map.....	31
Figure 8. The poll results based on the preferred type of engine in the next owned car.....	44
Figure 9. Global electric-vehicle sales, 2010-17 thousands.....	44
Figure 10. Number of charging points across Europe.....	45
Figure 11. Incentives for EV across Europe.....	46

LIST OF TABLES

<i>Number</i>	<i>Page</i>
Table 1. Total EV sales in Ukraine, 2017-18.....	13
Table 2. Best-selling Electric-vehicle models worldwide.....	15
Table 3. Best-selling Electric-vehicle models and their shares in Ukraine.....	16
Table 4. SWOT analysis.....	19
Table 5. Cost analysis of cars ownership by type based on current state.....	21
Table 6. Cost analysis of cars ownership by type based on sensitivity analysis.....	28
Table 7. Target audience analysis in Ukraine.....	29
Table 8. Announced country targets and objectives for EV deployment, 2020-30.....	34
Table 9. Publicly accessible chargers (slow and fast) by country, 2007, 14-17.....	47

LIST OF ABBREVIATIONS

EV Electric Vehicles

ICE Internal Combustion Engine

PHEV Plug-in hybrids

BEV Battery electric vehicles

NRKEUU National Regulatory Commission of Energy and Utilities of Ukraine

CIS The Commonwealth of Independent States

TAM Total addressable market

CapEx Capital expenditure

CHAPTER 1. EXECUTIVE SUMMARY

The Ministry of Infrastructure of Ukraine announced that they would like to achieve 75% of electric transportation inbound by 2030 according to national transport strategy of Ukraine. Taking into account the fact that about 20 Ukrainians replace their traditional car with electric one, it might be a good idea for electric car producers to sell their products in Ukraine. Therefore, I have decided to analyze this market and give my recommendation on whether it is truly a decent opportunity. In order to fulfill the goal of this thesis, I have conducted the following:

1. Overview of the automotive industry;
2. Research about Global and Ukrainian Electric Vehicle markets;
3. Comparison of key market players;
4. SWOT analysis;
5. Exploration of the demand side of the market and its sensitivity;
6. Investigation of the market supply.

First of all, automotive industry consists of three segments - passenger cars; light commercial vehicles; heavy trucks, buses and coaches and is driven by three key trends - connectivity & digitalization, regional shifts, mobility & logistics. It is predicted that in the future we will no longer differentiate between the transportation of humans and goods. I consider that electric vehicles are inevitable part of this future because EV are expected to account for 59% of total car sales by 2030.

Nowadays, China, US, and Norway are the global leaders of EV sales. 1 487 mln EVs were sold in that countries in 2018. Speaking about Ukrainian market sales volume, only 5 623 units were sold in Ukraine in 2018. Nevertheless, Ukraine has one of the highest growth rate – 93% (y-o-y). However, it should be mentioned that the majority of EVs are bought on the secondary market (~89% of total). The reason why Ukrainians prefer to buy used EVs are the following:

1. EVs have significant cost of purchase and are overpriced relatively to ICE cars. New EV models cost: Renault Zoe – 23 000 USD; Nissan Leaf – 30 000 USD; Tesla 3 – 35 000 USD; BMW i3 – 38 000 USD; Jaguar I-Pace – 74 000 USD. ICE cars cost at least 12% lower within the same segment.

2. Lack of official supply in Ukraine. As for June, 2019 you can officially buy only BMW i3, Renault Zoe, Jaguar I-Pace, Nissan Leaf and Hyundai Ioniq and make an order of Tesla through their site.

The EV market could be perceived as market with perfect competition due to every year the number of EV producers and their offers increases and a price of the cars slowly decreases. The main EV producers are Tesla and Nissan. Tesla provides customers with 3 differentiated models: Model 3, Model S, and Model X. Tesla Model 3 was the market leader model with 145 846 units sold in 2018. Nissan produces well-known and lovely EV – Nissan Leaf. In Ukraine, Nissan Leaf is currently the market leader across EVs (~67% of total in 2019).

SWOT analysis demonstrates that Strengths and Opportunities prevail Weaknesses and Threats of EV. In my opinion, main strength is eco-friendly aspect of the car; opportunity – immense total addressable market (~2 bln vehicles on roads by 2035); weakness – cost of purchase; threat - failure of EV producers to beat existing myths such as unbelief in:

1. Great performance;
2. Fact that EVs run on solar power solely;
3. Suitability for all types of weather condition.

EV producers could expect rising consumer demand in Ukraine due to the net financial position after 5-year ownership of EV car is better than that of ICE and Hybrid cars. After modelling procedure, it turns out that of EV car is more economically efficient relative to Hybrid (+16.8%) and ICE (+6.2%) based on the current market condition. I can explain that by significant savings on fuel and maintenance. In addition to initial estimation, I ran sensitivity analysis to account for change in variables included in the model such as electricity cost, gasoline cost and fuel requirements for 100 km. Sensitivity

model corresponds to results obtained earlier in the sense that EV's net financial position is +18.1% and +9% relative to Hybrids and ICE respectively after 5 years of ownership.

I would recognize 2 types of potential buyers of EVs as Type A (25-35 years old Petro who is unmarried IT specialist or connected with some creative job) and Type B (35-45 years old Ivan who is married department manager or take any other high position). They have different values and needs which should be taken into account.

Investigation of the market supply in Ukraine demonstrates the following:

1. Current number of vehicles per power station is about 7 units;
2. Tax-free regime which allows import of EVs without any charge;
3. The majority of power stations in Ukraine (above 90%) are slow and it takes 3 – 4 hours to charge the car by them;
4. Overall density of Ukrainian EV power stations are far from density of our neighbors – Poland, Hungary, Romania.

I suggested the following ways of improving supply side of the market:

1. Private investments in fast charging point infrastructure (approximate CapEx per 1 station is UAH 1,2 mln);
2. Tax benefits for imported electric charging equipment;
3. Implementation of the best practices of global EVs infrastructure development by taking China as a benchmark.

As a result of my analysis, it is recommended that it is not right time for the EV car producers to enter Ukrainian market. From the one hand, it is likely to predict the growing demand for EVs due to they are more economically efficient which makes them in favor during the decision-making process relative to ICE cars. On the other hand, the following aspects of the market: undeveloped market infrastructure; tax free regime; high cost of purchase and predominance of used EVs (89% of total sales) prevent recommendation from being positive. Thus, I expect that if EV producers decide to enter the Ukrainian market, it is very likely that they will not achieve the acceptable level of return due to Ukrainians will continue importing used EV cars because of favorable taxation policies and lack of funds for new EV for the majority of society.

CHAPTER 2. INDUSTRY ANALYSIS AND RESULTS

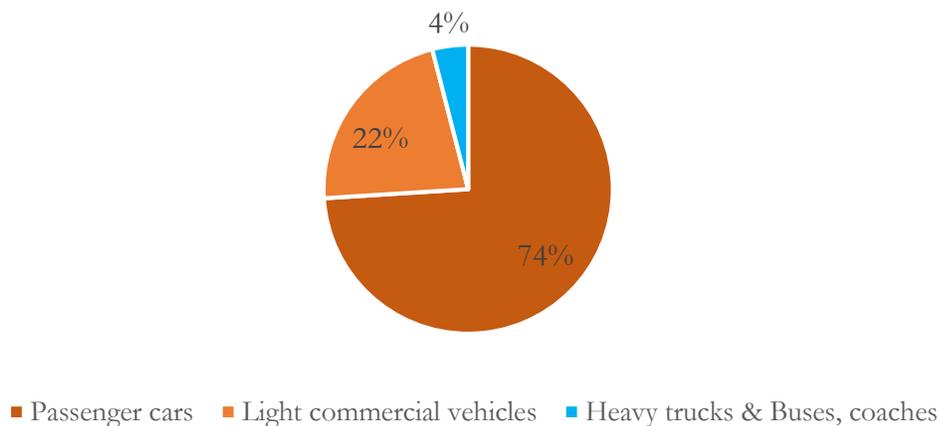
2.1. Industry overview

The automotive industry is a well-known economic sector which designs, develops, manufactures, markets and sells motor vehicles. Global automotive industry consists of 4 sectors:

1. Passenger cars;
2. Light commercial vehicles;
3. Heavy trucks;
4. Buses, coaches and minibuses.

According to the International Organization of Motor Vehicle Manufacturers, the global motor vehicle production in 2018 accounted for 95.7 mln cars (-1.1% Y-o-Y). With regards to the type of car, the biggest share had the passenger cars - 73.4%, the lowest - buses, coaches and minibuses - 0.29% (Figure 1).

Figure 1. Production Statistics of cars by type in 2018, %



* Source: International Organization of Motor Vehicle Manufacturer

The Automotive industry is heading into a restructuring phase (KPMG's Global Automotive Executive Survey 2019, 6) due to changing global environment and is affected by 3 key trends:

1. Connectivity & digitalization;
2. Regional shifts;
3. Mobility & logistics.

They will lead to that main car production will be shift from Europe to Asia. It is expected that less than 5% of cars will originate from Western Europe by 2030 (~15% in 2018) and that in future we will no longer differentiate between the transportation of humans and goods.

Also, if I have a look at the goods purchasing process, I will notice that buying of a car has its own peculiarities. In general, people spend about 10 hours searching online before buying a car. Although, they perceive online methods just as a source of information because the majority (above 70%) of population buy cars offline (E&Y's Consumers on Board 2014, 18). Furthermore, 4 out 5 buyers prefer to buy from the 1st person contacted meaning if a person comes to some dealership, there is high probability that he/she will buy from you.

Due to the fact that passenger cars technology were developed significantly in the recent years, It allowed to a new type of passenger cars - electric vehicle appeared. It is also worth mentioning that people are more inclined to purchase either partly (Hybrids) or fully (BEV) electric vehicles relative to traditional (ICE) cars (Appendix, Figure 8).

Therefore, we could expect that more EVs would be sold in the upcoming years, thus, making attractive for us to analyze EV market from the producer point of view. In the next section of the paper work, I am going to analyze Ukrainian EV market with respect to the global EV market.

2.2. Global and Ukrainian Electric Vehicle markets

I have chosen the Ukrainian market due to the following reasons:

1. Large country by population (~42 mln) with around 10 mln registered cars in the market;
2. Ukraine becomes more influenced by Western trends every year, including eco trends;
3. Shift in consumer preferences towards EV has taken place in the recent years because Ukrainians are more likely to buy electric car than 3-5 years ago.

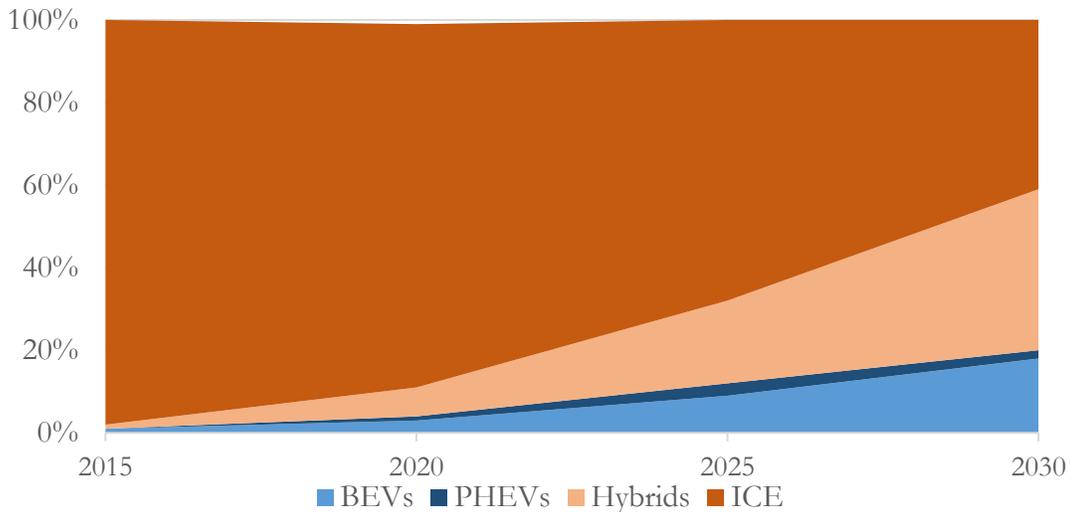
The reasons falling behind the optimistic EV market expectations are coming from the features of EV:

1. Rely on electricity rather than diesel;
2. Boost energy efficiency;
3. Provide better air quality and less noise;
4. Reduce greenhouse gas emissions.

Electric Vehicles market are generally represented by Hybrids, Plug-in hybrids (PHEV), Battery electric vehicles (BEV) and Fuel Cell Electric Vehicles (FCEV). I would dive into Hybrids and BEV analysis due to PHEV and FCEV are not very popular in Ukraine and are not expected to become so in the following years.

To begin with, we need to understand the technological difference between Hybrids and BEV. Hybrids are those EV which combine both a gasoline engine with an electric motor, while BEV run exclusively on electricity via on-board batteries. The market for Hybrids and BEV is very promising. If I take a look at a Global electric-vehicle forecast (Figure 2), I will find out that EV are expected to have 59% share of total car sales by 2030 (JPMorgan - Driving into 2025: The Future of Electric Vehicles 2018, par.3)

Figure 2. Global electric-vehicle forecast share



* Source: J.P. Morgan - Driving into 2025: The Future of Electric Vehicles

In addition, it worth mentioning that global electric-vehicle sales surpassed 1 million units in 2017. The growth rate of sales accounted for 57% in 2017 (Appendix, Figure 9). Such growth is driven by the following factors:

1. Policy environment – the key examples: public procurement programs, financial incentives to facilitate the acquisition of EVs and cut their usage cost (e.g. free parking), regulatory measures (fuel-economy standards and restrictions on the circulation of vehicles);
2. Technology advancement: the modern EV could drive up 482 km for 1 charge;
3. Energy costs are always lower than cost of diesel;
4. Increasing number of power stations worldwide (Appendix, Figure 10);
5. Simple construction of the EV allows for much easier maintenance.

Speaking about countries absolute and relative dimension, EVs sales in Ukraine is far from TOP markets by both the volume and the share of total vehicle sales, however evolving rapidly.

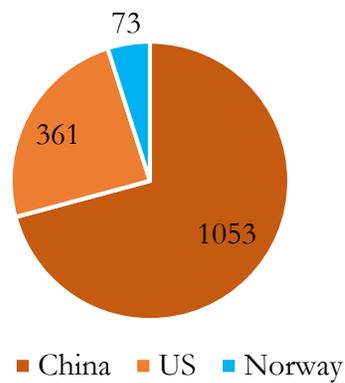
Starting from sales volume, 5 623 EVs were bought in Ukraine in 2018 while - 1 053 000 units in China (Table 1, Figure 3).

Table 1. Total EV sales in Ukraine, 2017-18

	2017	2018	Growth, (y-o-y, %)
Used	2549	5006	96%
New	368	617	68%
Total	2917	5623	93%

* Source: AUTO-Consulting

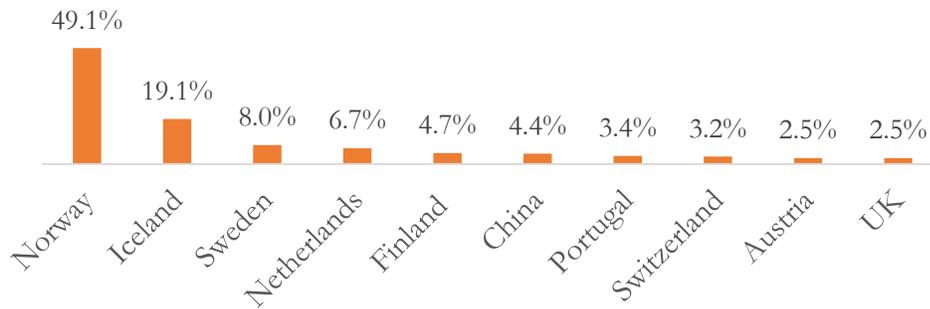
Figure 3. TOP 3 markets by total EV sales in 2018, th



* Source: Carsalesbase

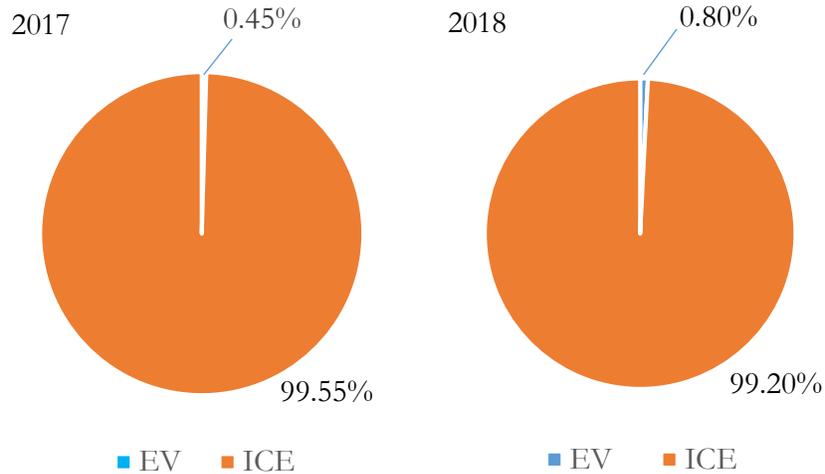
If I compare a relative measure - EV sales as % of total cars sales, I can state that Ukrainian share - 0.8% is much lower than the share of the leading country – Norway with 49.1% (Figure 4) but EV sales as % of total cars sales in Ukraine almost doubled in 2018 (Figure 5), thus, implying a positive tendency.

Figure 4. EV as % of total vehicle sales



* Source: <https://autonews.ua/stalo-izvestno-v-kakoj-strane-bolshe-vsego-pokupayut-ekstromobilej/>

Figure 5. EVs as % of total vehicle sales in Ukraine



* Source: AUTO-Consulting

2.3. Competition Analysis

According to carsalesbase, 1.26 mln units of EV were sold in 2018. Speaking about the market type, I would state that market will approach perfect competition due to every year the number of EV producers and their offers increases and a price of the cars slowly decreases.

Currently, Tesla is the market leader and its share of new EV sold was accounted for 18.6% worldwide in 2018. In addition, Tesla is the only one top producer which solely focuses on EVs production, while others large manufacturers such as BMW, Nissan, Chevrolet, Ford, Volkswagen, Kia perceive their EVs sales as an additional source of revenue. As a result, Tesla provides customers with 3 differentiated models: Model 3, Model S, and Model X while others have just one model to offer. Of course, it worth mentioning that even within one model line, they could differentiate it by offering slightly distinctive model specifications, i.e. BMW i3 and BMW i3s yet Tesla has a superior position regarding diversity of cars provided. Taking into account the fact, that on the one hand, every year models are improved by design and/or mileage, price, and on the other hand, overall models lines expand, I would say that EVs as products are not standardized and will become more and more differentiated in the future.

Having analyzed 15 best-selling Electric-vehicle models worldwide during 2017-2018, I can conclude that 9 out 15 (60%) are Chinese brands which are being sold only in the closed Chinese market (Table 2).

Table 2. Best-selling Electric-vehicle models worldwide, th

Rank	Model	2018	2017	Change
1	Tesla Model 3	145.846	0	New
2	BAIC EC180	90.637	78.079	16,1%
3	Nissan Leaf	87.149	47.195	84,7%
4	JAC iEV	55.570	28.262	96,6%
5	Tesla Model S	50.045	54.715	-8,5%
6	Tesla Model X	49.349	46.535	6,0%
7	Chery eQ EV	46.967	25.784	82,2%
8	BYD e5	46.251	23.632	95,7%
9	Renault Zoe	40.508	31.916	26,9%

Table 2. Best-selling Electric-vehicle models worldwide, th - Continued

Rank	Model	2018	2017	Change
10	JMC E200	39.883	16.247	145,5%
11	BAIC EU-Series	37.343	13.158	183,8%
12	BYD Yuan EV	35.699	0	New
13	BAIC EX-Series	32.810	4.212	679,0%
14	Geely Emgrand EV	31.853	19.899	60,1%
15	Hawtai EV160	29.938	11.823	153,2%

* Source: <http://carsalesbase.com/global-electric-car-sales-analysis-2018/>

If I compare two parts (BEV and Hybrids) of EV market in Ukraine, I will conclude that BEV market is fully dominated by Nissan Leaf, 67% of total EV sales in 2018 while Hybrid market is more competitive due to the leading model - Toyota Rav4 accounted just for 27% in 2018 and other models were much closer to Toyota (Table 3).

Table 3. Best-selling Electric-vehicle models and their shares in Ukraine

Model	BEV		Model	Hybrids	
	2018	2019		2018	2019
Nissan Leaf	76%	67%	Toyota Rav4	26%	27%
BMW i3	3%	4%	Toyota Prius	17%	15%
Tesla Model S	3%	4%	Chevrolet Volt	9%	10%
Renault Kangoo	2%	4%	Lexus NX 300H	8%	6%
Renault Zoe	N/A	2%	Mitsubishi Outlander	7%	6%

* Source: IRS Group

2.4. SWOT analysis

In order to receive more thorough understanding of EV market from EVs producers' point of view, it is very useful to conduct SWOT analysis.

I would like to begin SWOT analysis from the negative aspect affecting market - myths. People still believe in many things regarding electric vehicles which are no longer true. Ford Company commissioned a survey¹ recently of 3,000 people in the U.S., Europe and China. According to the survey, I would like to reveal the following statistics:

1. More than 90 percent of Americans and Europeans don't believe quick acceleration is a great benefit of electric vehicles. It means people think that EVs are still underperformed relative to ICE cars. However, if I take a look at recent Tesla models specifications, as well as the Jaguar I-Pace, I can say that they are able to beat plenty of gas-powered vehicles in a race. For example, Tesla model X can accelerate from 0 to 100 km/h for 3.1 sec and drive as fast as 250 km/h.

2. Forty-two percent of Americans think electric vehicles still require gas to run. This misconception comes from producers' promotion of hybrid cars. Thus, they confused consumers by themselves and as for me, they need to spend money and time on education of their consumers.

3. Close to 80 percent of Americans would not pick an electric vehicle for extreme weather, while nearly 65 percent would not choose one for all-wheel drive. This comes as surprise as well because:

- a. The top market for electric vehicles in Europe last year was cold and mountainous Norway, with over 35,000 sales in the first half of this year.

¹Ted Cannis. "Education is a Critical Missing Piece to the Electric Vehicle Puzzle; Here's How Ford is Going to Help Solve It.", September 5, 2019. <https://medium.com/live-electric/education-is-a-critical-missing-piece-to-the-electric-vehicle-puzzle-heres-how-ford-is-going-to-3bfd9c95bd28>

b. Among the top U.S. markets for electric vehicles are hot Southern California and mile-high, snowy Denver.

4. "Over two-thirds of Americans (67 percent) and Europeans (68 percent) don't believe that electric vehicles are capable enough in terms of towing and hauling." One of the ways to deal with myths like this could be in a better marketing campaign which can use video when F-150 prototype by Ford Company hauls over 1 million pounds.

Talking about weaknesses, I would say that the main one is always higher price of EV compared to ICE car with the same features. However, many researches state that EVs will reach cost parity in the near future. I will go a little bit more in detail in the next part.

As for strengths, I have already mentioned significant growth of the market during last years. Also, there are plenty of government policies which encourage market development. I will write about them in the supply side of the market.

According to the automotive trade journal Ward's Auto, it is expected that total amount of vehicles on the roads will reach 2 bln units by 2035 from 1.2 bln units in 2014. Taking into account the strengths and the fact that EVs sales accounted only for 1.4% of total car sales in 2018², it seems that market has significant opportunities to grow.

Summing up, according to the SWOT analysis presented in Table 4 the Strengths and Opportunities prevail Weaknesses and Threats.

² Bekker Henk. "2018 (Full Year) International: Worldwide Car Sales and Global Market Analysis.", February 23, 2019. <https://www.best-selling-cars.com/global/2018-full-year-international-worldwide-car-sales-and-global-market-analysis/>

Table 4. SWOT analysis

Strength	Weaknesses
Relevance to eco trends and public policies	Higher price of EV with the same features as ICE
Financial and others incentives	Uncommon feelings during drive
Cost saving on fuel and maintenance	Lower power capacity of engine
Safety up to 95% for adults	Lack of power stations infrastructure
Technology advancement	Limited production capacity of batteries
Opportunities	Threats
Immense TAM (~2 bln vehicles on roads by 2035)	Failure of EV producers to beat existing myths
EVs sales accounted only for 1.4% of total car sales in 2018	Unbelief of society in key strengths of EV
Positive growth dynamic of EVs sales	Inability to decrease the price of battery by 10% yearly
Growing demand for innovative/economical things	Unsolved problem of km reduction per 1 charge during the cold seasons
Technology advancement	

2.5. Demand side of the market

Every car producer, who is willing to sell its products in Ukraine, is ought to understand whether the sufficient demand exists in the market. In Ukraine as in any other country, there are three factors which can not be neglected when analyzing a demand for EV. These are:

1. Initial price of a car;
2. Cost of car ownership;
3. Target Audience.

I would like to start from initial price of a car as a factor. Since ICE and EV cars could be treated as close substitutes, I have collected their average prices in US during 2010-2016 (Figure 6). The main conclusion I can draw from the figure is that EVs were at least 50% more expensive during the mentioned period. Taking into account that average EV car costs more than USD 40 000 and average salary in Ukraine is about USD 410, I will state that for a typical person in Ukraine is difficult to afford EV car.

However, there are many forecasts predicting that EV cars will become more affordable and even could cost less than combustion-engine cars by 2022³. The reason is a steady reduction in the price and size of batteries. Couple of years ago, battery made up around half the price of a car, today - about 33 percent of the total cost, and that's due to drop to about 20 percent by 2025. All in all, reaching the cost parity of EV to ICE cars could lead to a higher demand for EV in the future in Ukraine.

Figure 6. Average ICE and EV car prices in US during 2010-2016, USD th



* Sources: US Department of Energy, International Energy Agency

Another important factor to be discussed is cost of car ownership. The majority of car producers proclaim that EV is the most economically efficient car type in the long run, thus I would like to verify that by conducting the cost analysis. The purpose of analysis is

³ Bullard Nathaniel. "Electric Car Price Tag Shrinks Along With Battery Cost.", April 12, 2019. <https://www.bloomberg.com/opinion/articles/2019-04-12/electric-vehicle-battery-shrinks-and-so-does-the-total-cost?>

to state whether owning EV is more economically attractive relative to cars with other type of engine or not.

I have picked up the brand-new Renault Z. O. E Life 2019, which already takes the 2% share in Ukraine even though it passed only several months since a release date. In order to meet demand peculiarities, I have decided to compare Renault Z. O. E Life 2019 not with other EV but with other types of cars, which could be interesting for Ukrainian audience. In order to make this comparison more accurate, I compare Renault Z. O. E Life 2019 to Toyota RAV4 Active and Toyota RAV4 2.5 Active - ICE and Hybrid respectively as they are more or less within the same class of automotive.

As an output, I computed the total financial expenses of EV/ICE/Hybrids ownership during 5 years period and found that indeed EV car is more economically efficient relative to Hybrid (+16.8%) and ICE (+6.2%) ownership based on the current market condition (Table 5). Thus, as for me, EVs producers could attract Ukrainian audience from the cost point of view meaning significant growing opportunities for producers.

Table 5. Cost analysis of cars ownership by type based on current market condition

Inputs	ICE	Hybrid	EV
Price, UAH	771,980	894,000	868,600
Fuel requirements	6.8	4.7	16
Price of fuel per 100 km	28.76	28.76	1.7
Spending on fuel, UAH/year	29,335	20,275	4,133
Maintenance cost, UAH/year	4,760	4,600	1,210
Operating costs for 5 years, UAH	170,476	124,379	26,715
Price of ownership for 5 years. UAH	942,456	1,018,379	895,315
Wearing-off yearly	7-9%	10%	10-12%

Table 5. Cost analysis of cars ownership by type based on current market condition -
Continued

Inputs	ICE	Hybrid	EV
Potential sale price after 5 years, UAH	508,798	527,898	485,031
Total financial expenses during 5 years, UAH	437,381	493,054	410,284

* Source: Own calculations based on <https://toyota.com.ua/ru/rav4/>;
<https://www.renault.ua/vehicles/electric/zoe.html>

Methodology of Cost analysis

One of the main inputs of the cost analysis is spending on fuel. All cars analyzed have different fuel consumption, therefore, it is crucial to understand the difference between them.

First of all, let's consider BEV - Renault Z. O. E Life 2019. For all EV cars, the fuel expense is calculated by the potential mileage per one charge divided by the volume of the battery. In a case of Renault Z. O. E Life 2019, the average expected mileage is 250 km. I found customers reviews on forums saying that EV loses about 30% of mileage during winter season, therefore, if producer gives 300 km, I expect the mileage of 200 km during winter. The battery capacity is 41 kWh. As result, Renault Z.O. E. will consume about 16.4 kWh per 100 km. As of September, 2019 cost of electricity for 1 kWh = 1,68 UAH, thus, approximate fuel spending will be around 4133 UAH.

Since the power station infrastructure is not well developed in Ukraine so far, I assumed people will charge their cars at home through the traditional 220W socket. As notification, price of charging up the car using different types of charge speed fluctuates from 3 to 6 UAH for 1 kWh.

Secondly, both Toyota RAV4 Active and Hybrid use A-95 gasoline. According to Toyota official brochures, Active version consumes 6,8 L/100 km; while Hybrid – 4,7 L/100 km. Given the fact that car producers state that on average owners drive about

15 000 km yearly and current average price of gasoline of 28.76 UAH/L as of 20.09.2019 provided by enkor.com.ua, thus, I calculated the approximate fuel spending by multiplying price of gasoline, average mileage and fuel requirement of analyzed cars.

Maintenance costs were calculated based on the previous models: Toyota RAV4 V2.2 Diesel - ICE, Toyota RAV4 Hybrid 2017- hybrid, Renault Z. O. E 2018. - EV based on Toyota service center in Lviv and publication on finance.ua.

The huge difference in maintenance costs is explained by higher complexity of ICE car body because motor oil, filters and the different types of liquids are quite often need to be change/replaced in ICE cars. In comparison, EVs simply do not have those things. In general, the first 10-20 thousand km for an electric car cost 200-300 UAH. The only expense is on the replacement of brake pads.

The battery life (usually gel batteries) is also significant, from 1000 to 3000 charges / discharges. Taking it into account, battery will serve no less than 100 thousand km, or at least 6-7 years. The battery cost takes the considerable share of all EV (10-25%) depending on the model and battery capacity. I do not include in my analysis cost of battery replacement due to the following reasons:

1. The automotive industry is rapidly changing right now and I think the models of cars presented in the analysis will lose interest of production beyond 5 year span due to consumers simply choosing more innovative cars at that moment;

2. I assume the tendency of the price of EV to go down will continue in the future due to the increasing supply and more innovative battery production leading to the situation when it would be more wise for customer to buy a brand-new EV rather than replace the battery.

Operational costs were calculated as the sum of spending on fuel and maintenance costs per 1 year multiplied by 5 years.

Price of ownership was computed by adding the price of acquiring the car to operational costs. The amount demonstrates the real expenses carrying by customer.

Since any car could be interpreted as a fixed asset, I estimated the possible annual depreciation due to the fact that every car loses part of initial economic value over time.

Having consulted with Roland Berger expert Volodymyr Dontsov, I set the highest depreciation of 11% for EV relative to 10% for Hybrid and 8% for ICE. The higher wearing off level for EV is explained by the fact that battery lose part of the capacity yearly, thus, making customers to value EV less with every year of possession.

Total financial expenses show the net financial position of customer in the end of year 5. The value was derived by subtracting price of sales from the price of ownership. If we compare the results, we would be able to say whether it has potential to sell EV in Ukraine for producers assuming all the consumers are rational. As a result, I find that EV (e.g. Renault Z. O. E Life 2019) has the best net financial position (+19.5% to Hybrids and +6% to ICE).

Sensitivity Analysis

In the cost analysis, I assumed all the inputs would be constant throughout the predicted period. However, it is very unlikely that all the inputs are going to remain the same. Therefore, I have decided to conduct the sensitivity analysis. Since the main difference between ICE and EV is the type of fuel they use, I consider it is relevant to predict how the main inputs of cost analysis (gasoline and electricity costs) might change in the future and what impact it will bring in terms of consumption behavior, thus, affecting the perspectives of producers to sell their cars in Ukraine.

1. Electricity Cost

The current price of electricity is set at 1,68 UAH/kWh. Although, in fulfillment of Ukraine's obligations under the Third Energy Package of the EU parliamentarians adopted the law about the Electricity Market. According to which, starting from July 1, 2019 a new electricity market was launched which involved determination of the electricity cost under the market conditions. In order to understand what impact it will cause, I would like to make an overview of the current market situation.

According to expert Oleksandr Prytyka⁴, the production of electricity market in Ukraine could be characterized as oligopolistic due to the fact that the biggest 5 companies control more than 90% of market:

- a. Energoatom – 56%;
- b. DTEK – 30%;
- c. Ukrhydroenergo – 7%;
- d. Centrenergo – 4%;
- e. Donbasenergoholdings – <2%

In addition, as a consumer, you can not choose from which producer to buy from, that is why the government regulator – NRKEUU exists. In Ukraine, electricity prices for the population make up no more than 30% of its cost of production in 2019, thus the subsidy amounted to about 60 billion USD is expected.

After a new electricity market has been launched, the NRKEUU's powers to regulate prices terminated and it is quite probable that tariffs on electricity will increase as a result.

The Prime Minister of Ukraine, Oleksii Honcharuk predicts two possible scenarios: optimistic and pessimistic⁵.

Optimistic scenario - prices will grow by 30% from the current level caused by changing of the approaches to pricing.

Pessimistic – prices will grow by 250%, given oligopolistic market structure, low elasticity of demand and the experience of implementing a similar market model in post-socialist countries.

Taking into account above mentioned notification, the price of electricity could be 2.184 UAH/kWh in optimistic scenario, while– 4.2 UAH/kWh in pessimistic one. In order to conduct sensitivity analysis I will take the pessimistic one since this price corresponds to

⁴ Prytyka Oleksandr. "Instead of "Rotterdam +": several properties about the upcoming "reform" in electricity.", May 2, 2019. <https://www.epravda.com.ua/columns/2019/05/2/647433/>

⁵ Honcharuk Oleksii. "Ukrainian blackout, or how much will electricity cost after 1st of July?", May 15, 2019. <https://www.epravda.com.ua/columns/2019/05/15/647781/>

average charge imposed by public providers as of 21/09/2019. Thus, we will relax the condition that that majority would still prefer to charge EV at home.

2. Gasoline cost

The first thing to mention is that I will focus on gasoline cost solely due to the following reasons:

a. The cars presented in the cost analysis use either gasoline or electricity as a source of energy.

b. The production of cars on diesel decreases every year. In addition, there are a lot of countries which are going to set/ already set the limitation on the car production with diesel engine. So, I do not think it will be a lot of cars with diesel engine meaning the majority of cars would use either electricity or gasoline.

In order to analyze the potential cost fluctuation of a gasoline, the two following remarks should be notified:

a. There are thoughts that if Russia imposes export restriction on petroleum products for Ukrainian market, then price of gasoline will go up. I would like to confirm or refute that.

b. Price of gasoline in Ukraine are tightly connected with the international market prices and FX rate of UAH/USD.

So, let's consider both of them in detail. Starting with possible of Russian export limitation to Ukrainian market. Russia is an important trade partner of petroleum products for Ukraine. According to the State Fiscal Service of Ukraine, Ukraine's import of petroleum products stood for 5.54 billion dollars in 2018. Russian share accounted for 37.3% or 2.07 billion dollars.

Although, when I dived in details, It became clear that Russian trade policy will not affect Ukrainian gasoline price because the share of gasoline imported from Russia takes only 0.4% of the total gasoline imported by Ukraine. Also, it is important that Ukraine

produced 50% of the total gasoline independently, other 50% were distributed between Belarus (30%) and Lithuania (20%) according to expert Mykola Topalov⁶.

To sum up, the only affect Russian intervention could have is the increase of diesel cost by 1-1.5 UAH/l leading to even more consumer desire to drive EV or Hybrids/ICE on gasoline.

Now, I would like to consider the effect of the international market prices and FX rate of UAH.

As of September, 21, 2019, the average crude oil price was 64,28 \$/bb taken from <https://www.oil-price.net/>. According to World Bank Commodities Price Forecast, It is expected that the average crude oil price will increase by CAGR of 1% to 70 \$/bbl by 2030. As a result, it could lead to a deviation of +9% from base scenario cost of gasoline.

Speaking about FX rate of UAH, there are many institutions giving prediction of the FX rate. The main similar output is that UAH will devaluate in the consecutive periods. As of June, 24, 2019, Ministry of Finance of Ukraine gave a new forecast regarding UAH/USD rate about 27,4 by the end of 2019. In order to find possible deviation from the current FX rate, I have picked up the following forecasts from Ministry of Finance of Ukraine, IMF, S&P. According to them, the average FX rate will devaluate by CAGR of 4,6% to 30 UAH/USD. As a result, it could lead to deviation of cost of gasoline +9% from base scenario.

If we sum up both effects, we will receive the possible deviation of +18% from base scenario cost of gasoline. Therefore, if the current price of gasoline is 29.49 UAH/l, it might be that the price will increase to 34 UAH/l in the worst case scenario.

In order to finish sensitivity analysis, I would like to adjust one more input: fuel requirements for 100 km by increasing them by 15% and 10% to 7.8 L and 18 kWt for ICE and EV respectively (Table 6).

⁶Topalov Mykola. "Russia's "oil" sanctions: whether there will be a fuel shortage in Ukraine.", April 18, 2019. <https://www.epravda.com.ua/publications/2019/04/18/647169/>

Table 6. Cost analysis of cars ownership by type based on sensitivity analysis

Type	ICE	Hybrid	EV
Price, UAH	771,980	894,000	868,600
Fuel requirements	7.8	5.4	18
Price of fuel per 100 km	34	34	4.2
Spending on fuel, UAH/year	39,938	27,604	11,365
Maintenance cost, UAH/year	4,760	4,600	1,210
Operating costs for 5 years, UAH	223,493	161,023	62,876
Price of ownership for 5 years. UAH	995,473	1,055,023	931,476
Wearing-off yearly	7-9%	10%	10-12%
Potential sale price after 5 years, UAH	508,798	527,898	485,031
Total financial expenses during 5 years, UAH	486,675	527,125	446,445

* Source: Own calculations based on <https://toyota.com.ua/ru/rav4/>;
<https://www.renault.ua/vehicles/electric/zoe.html>

In the cost analysis, I assumed that fuel requirements for 100 km given by producers are fully precise with the actual ones. However, it is quite often that producers deliberately underestimate this indicator or the fuel requirements are simply going up due to either age of a car or driving mode. Therefore, I think it is a good assumption to increase the fuel requirements by at least 15%. As for EV, I would like to increase the same indicator by 10% due to every year the mileage coverage per 1 charge rises.

To sum up, sensitivity analysis shows that even if all the negative events occur, EV will be still chosen by the rational consumer (the net financial position is +18.1% and +9% relative to Hybrids and ICE respectively), thus, EVs producers could expect rising consumer demand under any scenario.

Target Audience Analysis

Electric Vehicles market have their peculiar audience who might be interested in buying EVs. I distinguish 2 types of potential buyers as Type A (25-35 years old Petro who is unmarried IT specialist or connected with some creative job as project manager) and Type B (35-45 years old Ivan who is married department manager or take any other high position). They have different needs, values and features which should be taken into account by every EVs producer (Table 7).

Table 7. Target audience analysis in Ukraine

	Type A	Type B
Needs	Independence, personality, to be in a trend, to make it everywhere	Comfort, security, quality, stability, keep everything under control, certainty (defined schedule)
Values	Flexibility, efficiency, innovation, informative, visualization, quality, personalization, novelty, image, emotional comfort, freedom of action	Well-being of the family, stable income, a common pastime
Insight	Looking for a balance between career growth and social life, having hobbies, having pets. Make their own content, comments, posts	Aspires to provide and develop family, like to visit cultural events. Read different types of content
Motivation	The desire to stand out and be in the trend	The image of an ideal family, the future success of children
Goals	To have a healthy lifestyle, to be realized in life, to build a work-life balance	Confidence in the future, to be good parents

Table 7. Target audience analysis in Ukraine - Continued

	Type A	Type B
Worry about	Increase in price of life, career stagnation, routine	Increase in price of life, career stagnation, routine
Ways of approaching	Instagram, Facebook, LinkedIn	Web-search, YouTube, E-mail

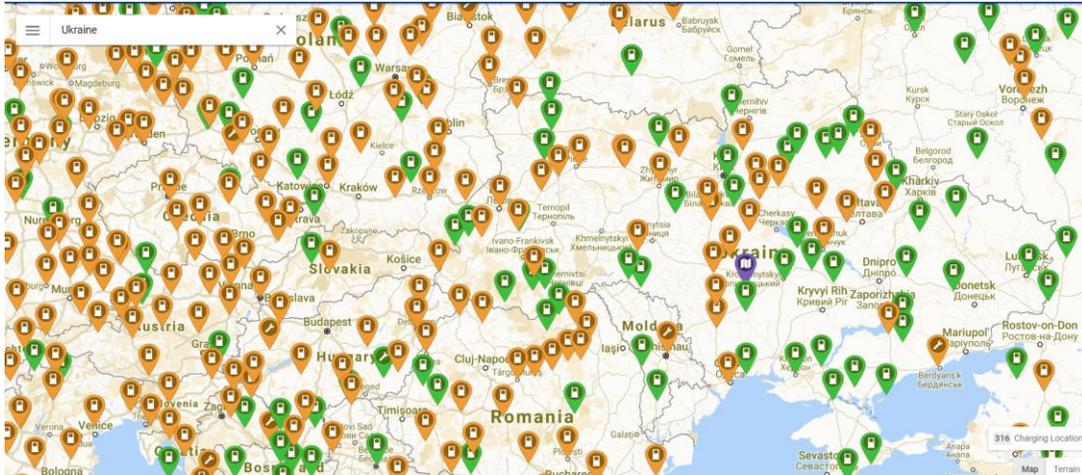
* Source: Own analysis based on Millennials and Gen X reviews

2.6. Supply side of the market

Every businessman thinks about various factors when deciding whether enter or not any specific market. The existing demand is necessary but not sufficient condition. It is very often that business goes where different parts of market ecosystem are favorable. Since I am analyzing electric vehicles market, I will refer to the level of infrastructure development and existing public policies in Ukraine as parts of market ecosystem.

To begin with infrastructure, I need to state that by infrastructure I mean the amount of public power stations. Public power stations are available to everyone and could be provided by both private sector and government. As for 20/09/2019, there are about 2300 power stations in Ukraine. The number of power stations increased 80 times since 2014 based on ElectroCars. Talking about the current number of vehicles per power station, it is slightly more than 7 relative to 10 in 2018, meaning that power station infrastructure is evolving. According to mentioned indicator, Ukraine has similar situation with Denmark and Portugal (Appendix, Figure 10). However, I should notice that the majority of power stations in Ukraine (above 90%) are slow and it takes 3 – 4 hours to charge the car by them. In addition, power stations are distributed mainly in the big cities: Kyiv, Kharkiv, Lviv, and Odessa, making usage of EV inconvenient in other cities or regions. In order to have a better insight about Ukrainian infrastructure, let's take a look at EV power station map (Figure 7). Besides, I provide the amount of publicly accessible chargers (slow and fast) by the leading countries (Appendix, Table 9).

Figure 7. EVs power stations map



* Source: <https://www.plugshare.com/>

There two main points from Figure 8 provided by plugshare.com:

1. Overall density of Ukrainian EV power stations are far from density of our neighbors;
2. The majority of power stations in Ukraine are traditional pictured in green while our neighbors have faster power stations pictured in yellow.

Therefore, power station infrastructure in Ukraine rather limits the development of EV market than stimulates it. It is very likely that market will reach full potential in those big cities, afterwards growth of EV sales will slow down if market infrastructure remain the same. Thus, I believe that infrastructure should be changed towards fast chargers build-ups and more spread power station network.

One way how it can be done through private investment by business. As a good example, DTEK with Strum project could be served. They have already set 19 fast power stations and their current aim is to connect Kyiv, Lviv, Odessa, and Dnipro through Poltava. They believe if drivers could charge their electric vehicles up to 80% for 20-40 minutes on the highway, electric vehicles will stop be perceived as only car for driving inside a big city.

If any other company wants to build infrastructure of fast charging point they should take into account:

1. Considerable capital expenditure. Taking Strum project as a benchmark, any potential businessman should spend about UAH 1,2 mln on equipment per 1 fast power station⁷.

2. Hardships with connection to the electricity supply in Ukraine. If you want to connect your own power station to electricity distributor, you need to wait from 120 to 350 days depending on a power capacity based on NRKEUU resolution. In addition, it could cost several times more than spending on equipment. However, there is another option to think about: join the existing electricity mains. As an example, Strum mains. It definitely will save time and reduce significant capital expenditure in the beginning, but in this case, they will ask to pay 15% as royalty out of your revenue from electricity supply.

Speaking about the second part of EV market ecosystem – financial incentives to producers, I would stress that Electric Vehicles is relatively new market, which is not widely spread due to people are used to drive ICE cars and it takes efforts for people to change their behavior. However, the producers of EVs could have the strong ally – government. The government could help producers, on the one hand, by giving them subsidies and, on the other hand, by giving financial incentives to customers which help to sell EVs both directly and indirectly.

Therefore, I do think that understanding of possible government policies relating EVs production/purchase is crucial prerequisite before saying whether or not EV market will develop in the future since those policies might strongly facilitate/discourage EVs production and sales. So, I would like to research different policies and find some best practices which could be useful for Ukraine due to Ukrainian officials are currently discussing the possible strategies for EV market development.

⁷ Kovalev Ihor. “STRUM expands the boundaries for electric vehicles.”, July 17, 2019. https://www.segodnya.ua/economics/comp_news/strum-rasshryaet-granicy-dlya-elektromobilistov-1302298.html

To begin with, a range of policy instruments related to the promotion of EVs have been adopted in major global markets. The People's Republic of China ("China"), Europe, Japan, United States and recently India have spurred EV consumer demand through a combination of instruments including:

1. Public procurement and investment plans;
2. Subsidies and other financial incentives addressing both EV purchase prices and refueling/charging infrastructure;
3. Fuel-economy standards;
4. Other measures, in particular including zero-emission vehicle (ZEV) mandates.

I would like to pay attention to public policies from China and take them as a benchmark due to China is the global leader in terms of EV sales. According to the Global EV Outlook 2018, there are two main policies regarding EV market during last couple of years:

- a. New energy vehicle (NEV) credit mandate;
- b. The National Electric Vehicle Subsidy Program.

The main purpose of NEV is to set an annual mandatory minimum requirements of EV production for car manufacturers. The mechanism is the following: they implied different credits for car produced based on a type and a minimum electric range (higher distance range and lower emission lead to higher credits given). If someone can not earn enough credits during the year, they may use a credit trading mechanism and purchase of NEV credits from other manufacturers who have excess credits.

The main purpose of the national Electric Vehicle Subsidy Program is to stimulate manufacturers to produce electric cars with ranges that are closer to those of ICE cars with higher energy densities in batteries. The mechanism is: they allocate subsidies for the purchase of electric cars based on the following criteria:

1. The vehicle range in kilometers (km);
2. Energy efficiency in kilowatt-hour per 100 km (kwh/100 km);
3. Battery pack energy density in watt-hour per kilogram (wh/kg).

As result, the size of grant could vary in China. The country, which set the standard grant for buyers, is Canada. The peculiarity of their public policy is that they will provide 5000 Canadian dollars to anyone who is going to buy EV under 45 000 during 2019-2021⁸. The total budget is 300 mln USD. In addition, they will grant car manufacturers with 5 mln USD in the upcoming 5 years in order to have different models of EV in the market.

Also, many countries provide increasingly clear signals to manufacturers and build confidence on the future policy framework and enable the mobilization of investment (Table 7).

Table 7. Announced country targets and objectives for EV deployment, 2020-30

Country or region	2020-30 EV target or objective
European Union	15% EV sales by 2025 and 30% by 2030
Netherlands	10% electric car market share by 2020. 100% EV sales in PLDVs by 2030. 100% electric public bus sales by 2025
Ireland	500 000 EVs and 100% EV sales by 2030.
India	30% electric car sales by 2030. 100% BEV sales for urban buses by 2030.
Japan	20-30% electric car sales by 2030.
United States (selected states)	3 300 000 EVs in eight states combined by 2025. 22% ZEV credit sales in passenger cars and light-duty trucks by 2025.7 California: 1.5 million ZEVs and 15% of effective sales by 2025, and 5 million ZEVs by 2030.
Other European Union	450 000 to 760 000 electric cars by 2020. 5.42 million to 6.27 million electric cars by 2030

* Source: The Electric Vehicles Initiative by International Energy Agency

⁸ Maksymiv Vitalii. "The government will compensate USD 5,000 for the purchase of an electric vehicle", March 23, 2019. <https://autonews.ua/pravitelstvo-budet-kompensirovat-5-000-dollarov-za-pokupku-elektromobilya/>

Speaking about Ukrainian government public policies, I should mention that as of 21.09.2019 the import of cars with electric engines is not subjected to any taxes at all. As AUTO-Consulting has already reported, since January 1, 2018, a special tax-free regime has been established to import new and used electric vehicles to Ukraine. Electric cars began to be brought to us from abroad without paying excise tax and value added tax. Tax-free regime was prolonged recently till the end of 2022.

Also, Verhovna Rada passed the electro mobile bill # 10405 in July, 2019 according to which:

1. New road signs "for electric vehicles", "other than electric vehicles", "places for charging electric vehicles" will appear in Ukraine;
2. Owners of ICE-cars are forbidden to occupy the places of ecological transport, otherwise the violation will be punished by a fine of 20 to 30 tax-free income of citizens (340-510 UAH);
3. Eco-friendly cars will be issued special license plates with green letters.

Amendments to Law # 10405 will be formally effective since January 1, 2020. This law along with tax-free regime makes EV ecosystem much favorable, however a lot more can be done if we take a look at European countries initiatives (Appendix, Figure 11). In my opinion, the further public policies that could further stimulate market development are tax benefits of imported electric charging equipment and decrease of the price of EV operation for legal entities. Although, these initiatives would be costly and need to be thoroughly calculated.

To sum up, if Ukraine pays attention to power stations infrastructure and best practice policies, EVs producers will definitely increase their interest in our market.

CHAPTER 3. CONCLUSIONS AND RECOMMENDATIONS

In this section, I am going to present my recommendations and conclusions based on the analysis of the EV market in Ukraine. Given the state of the Ukrainian market, it is recommended that it is not right time for the EV car producers to enter Ukrainian market. A better strategy will be to wait and observe how market will evolve in the next couple of years. My advice is based, on the one hand, on the fact this market looks attractive, but on the other hand, there are a lot of restrictions which prevail over positive aspects at that moment. In order to explain reasons for my judgement, I would like to structure my conclusion and recommendation as follows:

1. The positive aspects of a market;
2. The unfavorable aspects of a market;
3. Potential market system signs which can discount the unfavorable aspects of a market;
4. My forecast regarding how market would be evolving in the next couple of years.

So, I would like to start from the positive aspects of EV market in Ukraine.

First of all, Ukraine has one of the highest growth rate of EVs sales worldwide (93% in 2018 y-o-y) and is definitely the leader by this indicator in the CIS region. It is projected that the growth rate will continue remain about 90% in 2019. It is expected that the number of EV will increase to 37 100 by the end of 2019. As for 01/07/2019 there were 26 410 electric vehicles in Ukraine and growth rate was 97% in May 2019 relative to May 2018.

Secondly, the great market potential could be proved by recent official enter into the market of Renault and Jaguar which started to sell their Renault Zoe and Jaguar I-Pace respectively. It is definitely a positive sign of producer's confidence in the market.

Thirdly, the current infrastructure is evolving. The number of power stations increased 80 times since 2014. Talking about the current number of vehicles per power

station, it is slightly more than 7 relative to 10 in 2018. Also, Tesla announced that they will set 2 supercharges in Ukraine by the end of 2019.

Fourthly, tax-free regime which was extended recently till the end of 2022. In addition, Law # 10405 will be formally effective since January 1, 2020 which will imply the following:

1. New road signs "for electric vehicles", "other than electric vehicles", "places for charging electric vehicles" will appear in Ukraine;
2. Owners of ICE-cars are forbidden to occupy the places of ecological transport, otherwise the violation will be punished by a fine of 20 to 30 tax-free income of citizens (340-510 UAH);
3. Eco-friendly cars will be issued special license plates with green letters.

Fifthly, favorable trends. Since Ukrainians become more influenced by western trends, they are becoming more prompt to think about EV as their next car. Taking into account the results of cost analysis, I could state that EV is more economically efficient, due to net financial position is +18.1% and +9% relative to Hybrids and ICE respectively. The results are mainly driven by low electricity cost in Ukraine and much lower maintenance cost of EV relative to Hybrids and ICE cars.

Now, let's discuss the unfavorable aspects of a market.

First of all, Ukrainians prefer to buy used EVs which account for 89,1% of total EVs sales. The most popular model across them are as % of total EVs sales:

- a. Nissan Leaf – 64%;
- b. BMW i3 - 5%;
- c. Tesla Model S – 4%;
- d. Renault Kangoo – 4 %;
- e. Fiat 500e – 2%.

The dominance of Nissan Leaf could be explained by the fact this model was the first one available for much lower price relative to others EVs. In addition, Nissan launched this model a couple of years ago, thus, this model has a lot of reviews affecting customer decisions.

The reason why Ukrainians prefer to buy used EVs are the following:

1. EVs have significant cost of purchase. New models cost: Renault Zoe – 23 000 USD; Nissan Leaf – 30 000 USD; Tesla 3 – 35 000 USD; BMW i3 – 38 000 USD; Jaguar I-Pace – 74 000 USD.

2. EVs are overpriced relatively to ICE cars. The gap could vary significantly depending on the class and models compared but in general, EVs are priced at least 12% higher.

3. Lack of official supply in Ukraine. As for June, 2019 you can officially buy only BMW i3, Renault Zoe, Jaguar I-Pace, Nissan Leaf and Hyundai Ioniq and make an order of Tesla through their site.

Secondly, the share of new EV to total new car sales is tiny in Ukraine. For example, there were sold 227 pieces of new EVs in 5 months of 2019. At that time, more than 32,000 units were sold for new ICE cars.

Thirdly, the majority of power stations in Ukraine (above 90%) are slow and it takes 3 – 4 hours to charge the car by them. In addition, power stations are distributed mainly in the big cities: Kyiv, Kharkiv, Lviv, and Odessa, making usage of EV inconvenient in other cities or regions.

Fourthly, hardships with connection to the electricity supply in Ukraine. If you want to connect your power station to electricity distributor, it will take from 120 to 350 days depending on a power capacity. In addition, it could cost you several times more than your spending on equipment.

Fifthly, a lot of countries have already spurred a lot of policies, which make their market more interesting for producers and investors. These policies include:

1. Public procurement and investment plans;
2. Subsidies and other financial incentives addressing both EV purchase prices and refueling/charging infrastructure;
3. Fuel-economy standards;
4. Other measures, in particular including zero-emission vehicle (ZEV) mandates.

As a result, it is clear that for every positive indicator of EV market in Ukraine, there is a strong argument against. Therefore, I think that those counterarguments prevail as for now.

However, it does not mean that this will remain constant. In my opinion, there are circumstances under which producers should enter the market. So, the further public policies could stimulate EV market attractiveness in Ukraine:

1. Improvement of access to electricity supply. It will significantly improve easiness of doing business in Ukraine and will allow producers to reduce the launching time.

2. Tax benefits for imported electric charging equipment. This can ease the development of power stations infrastructure. In this case, there are two scenarios:

- a. Producers could set their own power stations and gain additional revenue
- b. Other market players, i.e. energy companies such as DTEK, could develop infrastructure.

Under both scenarios, the EV producers will be in the favorable situation due to development of power stations infrastructure which will incentivize consumers to buy EVs.

3. Increase in the demand for EVs from legal entities.

4. GDP growth. As for now, the majority of Ukrainians can not afford a new EV, Economic growth coupled with constantly decreasing prices for the EVs could ensure higher sales for producers.

Taking into account all the mentioned analysis, I would predict that more customers will be willing to purchase EV in Ukraine due to:

a. People will become more aware that their net financial position is much better after possessing EV relative to that of ICE meaning it is cheaper to own EV;

b. More affordable prices of EVs in the future driven by increasing supply and the decrease of battery costs;

c. Global and local market trends towards self-awareness of climate changes and understanding of the harmful effect of CO2 emission.

However, the following aspects of the market: undeveloped market infrastructure; tax free regime; high cost of purchase and predominance of used EVs (89% of total sales)

leave Ukrainian market without competitive edge. Thus, I expect that if EV producers decide to enter the Ukrainian market, it is very likely that they will not achieve the higher level of return in Ukraine due to:

1. More mature market in Europe along with stimulating public policies which will foster EV sales.
2. Ukrainians will continue importing used EV cars because of favorable taxation policies and lack of funds for new EV for the majority of society.

In conclusion, the potential sales volume of 246 000 EV units by 2024 in Ukraine will be reached mainly by increasing number of the used EV cars imported from Europe leaving little room for the producers of the new cars.

REFERENCES

1. Autoconsulting. 2019. *Autoconsulting*.
<http://www.autoconsulting.com.ua/index.php>
2. Autonews. 2019. *Autonews*. <https://autonews.ua/category/elektromobili/>
3. Bekker Henk. 2018. "2018 (Full Year) International: Worldwide Car Sales and Global Market Analysis." February 23, 2019. <https://www.best-selling-cars.com/global/2018-full-year-international-worldwide-car-sales-and-global-market-analysis/>
4. Bullard Nathaniel. 2019. "Electric Car Price Tag Shrinks Along With Battery Cost", April 12, 2019. <https://www.bloomberg.com/opinion/articles/2019-04-12/electric-vehicle-battery-shrinks-and-so-does-the-total-cost?>
5. Deloitte. 2019. *Global Automotive Consumer Study*,
<https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-global-automotive-consumer-study-2019.pdf>
6. E&Y. 2014. *Consumers on Board*.
[https://www.ey.com/Publication/vwLUAssets/EY-consumers-on-board/\\$FILE/EY-consumers-on-board.pdf](https://www.ey.com/Publication/vwLUAssets/EY-consumers-on-board/$FILE/EY-consumers-on-board.pdf)
7. Encorr. 2019. *Encorr*. <https://enkorr.com.ua/charts#ukraine>
8. Finance. 2018. *Finance Ukraine*. <https://finance.ua/ua/saving/beregis-elektromobilya>
9. Honcharuk Oleksii. 2019. "Ukrainian blackout, or how much will electricity cost after 1st of July?", May 15, 2019.
<https://www.epravda.com.ua/columns/2019/05/15/647781/>
10. International Energy Agency. 2018. *Global EV Outlook 2018*.
<https://www.connaissancedesenergies.org/sites/default/files/pdf-actualites/globalevoutlook2018.pdf>

11. International Organization of Motor Vehicle Manufacturers. 2018. *Production Statistics*. <http://www.oica.net/category/production-statistics/2018-statistics/>
12. JPMorgan. 2018. *Driving into 2025: The Future of Electric Vehicles*. <https://www.jpmorgan.com/global/research/electric-vehicles>
13. Kovalev Ihor. 2019. "STRUM expands the boundaries for electric vehicles." July 17, 2019. https://www.segodnya.ua/economics/comp_news/strum-rasshiryact-granicy-dlya-elektromobilistov-1302298.html
14. KPMG. 2019. *Global Automotive Executive Survey*. <https://home.kpmg/content/dam/kpmg/uk/pdf/2019/01/global-automotive-executive-survey-2019.pdf>
15. Maksymiv Vitalii. 2019. "The government will compensate USD 5,000 for the purchase of an electric vehicle", March 23, 2019. <https://autonews.ua/pravitelstvo-budet-kompensirovat-5-000-dollarov-za-pokupku-elektromobilya/>
16. Marketing agency IRS Group. 2019. *IRS Group*. <http://irsgroup.com.ua/ua/>
17. McKinsey. 2018. *Electric Vehicle Index*. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-global-electric-vehicle-market-is-amped-up-and-on-the-rise>
18. Oil price. 2019. *Oil price*. <https://www.oil-price.net/>
19. Plugshare. 2019. *Plugshare*. <https://www.plugshare.com/>
20. Prytyka Oleksandr. 2019. "Instead of "Rotterdam +": several properties about the upcoming "reform" in electricity." May 2, 2019. <https://www.epravda.com.ua/columns/2019/05/2/647433/>
21. Renault. 2019. *Renault Ukraine*. <https://www.renault.ua/vehicles/electric/zoe.html>
22. State Statistics Service of Ukraine. 2019. *State Statistics Service of Ukraine*. <http://www.ukrstat.gov.ua>
23. Ted Cannis. 2019. "Education is a Critical Missing Piece to the Electric Vehicle Puzzle; Here's How Ford is Going to Help Solve It.", September 5, 2019.

<https://medium.com/live-electric/education-is-a-critical-missing-piece-to-the-electric-vehicle-puzzle-heres-how-ford-is-going-to-3bfd9c95bd28>

24. Topalov Mykola. 2019. "Russia's "oil" sanctions: whether there will be a fuel shortage in Ukraine." April 18, 2019. <https://www.epravda.com.ua/publications/2019/04/18/647169/>

25. Toyota. 2019. *Toyota Lviv*, <https://toyota.lviv.ua/services-and-more/service-and-accessories/tech-service-prices.html>

26. Toyota. 2019. *Toyota Ukraine*. <https://toyota.com.ua/ru/rav4/>

27. TSN. 2019. TSN. <https://tsn.ua/auto/news/ukrayina/zaryadki-tesla-v-ukrayini-kompaniya-onovila-kartu-stanciy-supercharger-1382937.html>

28. Volodymyr Dontsov. 2019. Industry expert from Roland Berger. <https://www.facebook.com/vladimir.dontsov.37>

29. World Bank Commodities Price Forecast. 2018. *World Bank*. <http://pubdocs.worldbank.org/en/823461540394173663/CMO-October-2018-Forecasts.pdf>

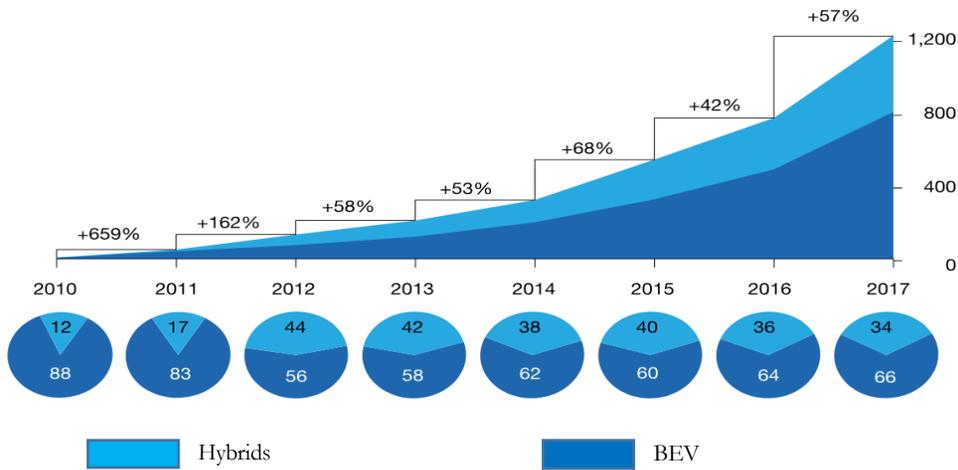
APPENDICES
 APPENDIX A
 SURVEYS

Figure 8. The poll results based on the preferred type of engine in the next owned car



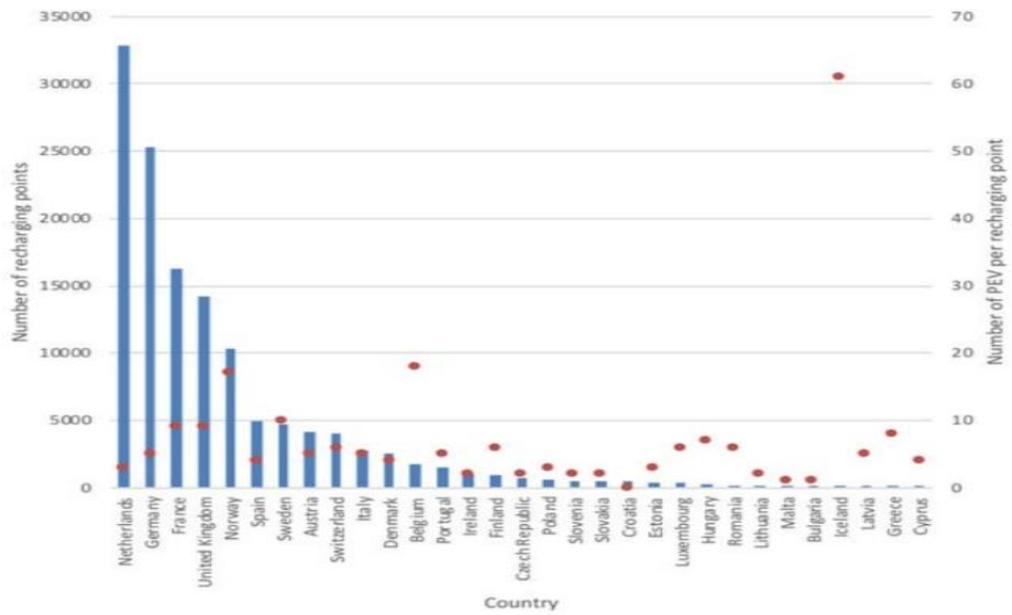
* Source: 2018 Deloitte Global Automotive Consumer Study

Figure 9. Global electric-vehicle sales, 2010-17 th



* Source: EV-volumes.com, McKinsey's Electric Vehicle Index

Figure 10. Number of charging points across Europe



* Source: <https://hevcars.com.ua/reviews/evropeyskiy-ryinok-elektromobiley-blizok-k-masshtabnoy-kommertsializatsii/>

Figure 11. Incentives for EV across Europe

Country	Purchase Subsidies	Registration Tax Benefits	Ownership Tax Benefits	Company Tax	VAT Benefits	Other Financial	Local Incentives	Infrastructure Incentives
Austria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Belgium	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bulgaria								
Croatia		Yes	Yes					
Cyprus		Yes	Yes					
Czech Republic		Yes	Yes					
Denmark	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Estonia	Yes							Yes
Finland		Yes	Yes					
France	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Germany	Yes		Yes	Yes		Yes	Yes	Yes
Greece		Yes	Yes			Yes		
Hungary	Способы поддержки продвижения электромобилей в разных странах Ев							
Iceland		Yes	Yes		Yes		Yes	Yes
Ireland	Yes	Yes	Yes	Yes			Yes	Yes
Italy			Yes					Yes
Latvia		Yes	Yes				Yes	
Lithuania		Yes	Yes				Yes	
Luxembourg	Yes		Yes	Yes				
Malta	Yes	Yes	Yes	Yes			Yes	Yes
Netherlands		Yes	Yes					
Norway		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Poland								
Portugal	Yes	Yes	Yes	Yes			Yes	Yes
Romania	Yes	Yes	Yes					Yes
Slovakia	Yes	Yes	Yes				Yes	
Slovenia	Yes	Yes	Yes					
Spain	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Sweden	Yes		Yes	Yes				
Switzerland			Yes			Yes		
United Kingdom	Yes	Yes	Yes	Yes			Yes	Yes

* Source: <https://hevcars.com.ua/reviews/evropeyskiy-ryinok-elektromobiley-blizok-k-masshtabnoy-kommertsializatsii/>

APPENDIX B

DATA TABLE

Table 9. Publicly accessible chargers (slow and fast) by country, 2007, 14-17

Country	2007	2014	2015	2016	2017	CAGR
Canada		2321	3508	4215	5841	52%
China		30000	58758	141254	213903	92%
Germany		2846	5328	17509	24289	74%
Japan		11517	22110	24372	28834	91%
Netherlands		11981	18044	26448	33431	88%
Norway		5385	5703	7758	9530	19%
United Kingdom		7742	9377	11208	13534	44%
United States	374	22633	31674	40473	45868	62%
Others	0	13215	29296	40330	54921	68%
Total	374	107640	183798	313567	430151	102%

* Source: Global EV Outlook 2018