Czech University of Life Sciences Prague

Faculty of Economics and Management

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Diploma Thesis

Strategic opportunities for a given industry

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DIPLOMA THESIS ASSIGNMENT

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Thesis title

Strategic opportunities for a given industry

Objectives of thesis

The main objective of this master thesis is recommendation of appropriate industrial strategy for state bodies and distributors of energy via charging points for the electric vehicles in the Czech Republic with a purpose to utilize the strategic opportunities.

Methodology

The thesis consists of two parts. First part deals with elementary theoretical overview. It deals with theory of industrial strategies, strategic partnership. The theoretical part of the thesis is based on critical review of information gained from study and comparison of relevant sources.

The fundamental, empiric part is focused on industry development due to the industrial strategy and partnership of main stakeholders to set the long term direction needed for growth.

Data for the empiric part are mainly secondary and should be gained from reliable sources. Based on the research, the relevant conclusions of the thesis are drawn.

Recommended structure of the diploma thesis:

1. Introduction – an explanation of the importance of the topic

2. Thesis objectives and methodology – main objective of the thesis will be divided in the partial objectives based on knowledge gained from the study of the theory. Appropriate methods of data collection and analysis will be explained in the methodology of the thesis.

3. Literature review – critical review of current knowledge in field of strategic management and vertical and horizontal cooperation within industry.

4. Specification of the selected industry – profile of main stakeholders and key determinants of the industry.

5. Practical part – analysis of data gained from own research according to the methodology.

6. Evaluation of results and recommendation – formulation of own proposal of improvements and changes in stakeholders roles and actions.

7. Conclusion – review of main results and evaluation of the contribution of the diploma theses.

8. References

9. Appendices

The proposed extent of the thesis

60 – 80 pages

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Strategic opportunities, strategic partnership, industrial strategy, electric vehicle, charging point,

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DAVID, F R. *Strategic management : concepts and cases.* Harlow: Pearson Education, 2011. ISBN 978-0-273-75599-9.

FISCHER, T B. *The theory and practice of strategic environmental assessment : towards a more systematic approach.* London: Earthscan, 2007. ISBN 978-1-84407-452-5.

ROBINSON, R B. – PEARCE, J A. *Formulation and implementation of competitive strategy.* Homewood, IL: Irwin, 1988. ISBN 0-256-06251-.

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Declaration

I declare that I have worked on my diploma thesis titled "Strategic opportunities for a given industry" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 31.3.2017 _____

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Strategic opportunities for a given industry

Abstract

The main objective of this master thesis is recommendation of appropriate industrial strategy for state bodies and distributors of energy via charging points for the electric vehicles in the Czech Republic with a purpose to utilize the strategic opportunities. The thesis consists of two parts. First part deals with elementary theoretical overview, with theory of strategic management, industrial strategies and useful strategic tools. The theoretical part of the thesis is based on critical review of information gained from study and comparison of relevant sources. In the empirical part, PESTLE analysis will be conducted, describing political, economic, social, technological, legal and ecological aspects relevant to the industry within the Czech Republic. Secondly, particular characteristics of the industry will be depicted together with evaluation of a current state of the industry in terms of the industry life cycle. Porter five forces supplemented by the role of complements follow as the analysis of the micro environment of the industry. Actual status of the industry will be assessed by SWOT analysis that will serve for further formulation of recommendation.

Keywords: Strategic opportunities, strategic partnership, industrial strategy, driving range, range anxiety, electric vehicle, charging point

Strategické příležitosti pro zvolené odvětví

Abstrakt

Hlavním cílem této diplomové práce je doporučení vhodné strategie odvětví státních orgánů a distributory energie prostřednictvím dobíjecích stanic pro elektrická vozidla v České republice s cílem využít strategické příležitosti. Práce se skládá ze dvou částí. První část se zabývá základním teoretickým přehledem, s teorií strategického řízení, odvětvové strategie a užitečných strategických nástrojů. Teoretická část práce je založena na kritické přezkoumání informací získaných ze studií a srovnání relevantních zdrojů. V empirické části je zpracována PESTLE analýza popisující politické, ekonomické, sociální, technické, právní a ekologické aspekty makro okolí, které jsou relevantní pro odvětví v rámci České republiky. Dále popisuje zvláštní charakteristiky odvětví spolu s hodnocením v současného stavu fáze životního cyklu odvětví. Porterův model pěti sil doplněn o část komplementů následuje jako analýza mikro prostředí odvětví.

Aktuální stav odvětví bude hodnocen pomocí SWOT analýzy, která bude sloužit pro další formulaci doporučení.

Klíčová slova: Strategické příležitosti, strategická partnerství, odvětvové strategie, elektrické vozidlá, nabíjecí stanice

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List of abbreviations

BEV: Battery electric vehicle

CEF: Connection Europe Facility

CNB: Czech National Bank

CNG: compressed natural gas

CO2: Carbon dioxide

CSR: Corporate Social Responsibility

DC: Direct Current fast charging

EC: European Commission

ERRC: Grid: eliminate-reduce-raise-create grid

EV: Electric vehicle

FCEV: Fuel cell electric vehicles

HEV: Hybrid electric vehicle

ICE: Internal combustion engine

Inc.: Incorporation (business)

Km/h: Kilometers per hour

Km: Kilometers

kWh: Kilowatt-hour

Li-on: Lithium-ion battery

LPG: liquefied petroleum gas

Ltd.: Public Limited Company

NAP CM: National Action Plan for Clean Mobility

PHEV: Plug-in hybrid electric vehicles

PPS: Purchasing Power Standards

PREDIT: Program of research, experimentation and innovation in land transport

REEV: Range-extended electric vehicles

SWOT: Strengths, weaknesses, opportunities, threats

The EU: the European Union

The US: the United States

Introduction

The transportation industry has been dominated by conventional vehicles for decades. Nevertheless, electric mobility has become a trend in the automotive industry, and automotive manufacturers have been investing their funds into the research to be developing vehicles driving on an electric motor, with a promise of becoming zero-emission. The reason behind is the ever growing concern of environment, climate changes, and seeking ways to substitute fuel engines with alternatives. Many countries around the world has been supporting the importance of electric vehicle development by implementing regulations to support the industry. Increasing number of population living modern urban lives in cities has been answering accordingly, shifting their attention to a more sustainable mobility.

¼ of air pollution in the Czech Republic comes from transport, the road transport accounting for around 61%. However, the number of conventional cars is essentially growing, and without the support of the state, the alternative ways of driving are unable to compete. The focus of the thesis is, however, on electricity-powered vehicles, which can potentially exhaust few emissions, and emit zero greenhouse gases and air pollutants, depending on the source of electricity. System based on electricity-powered vehicles is referred to as electromobility and consists of electric vehicles, charging infrastructure, technology, and suitable legislation. The development of electric vehicles is determined by the availability of charging stations and providing access to charging. They cannot exist without one another. Electromobility has high potential, and is worth focusing on, and discussing the possible changes, and improvements for its future development.

1 Objectives and Methodology

1.1 Objectives

The main objective of this master thesis is recommendation of appropriate industrial strategy for state bodies and distributors of energy via charging points for the electric vehicles in the Czech Republic with a purpose to utilize the strategic opportunities.

1.2 Methodology

The thesis consists of two parts. The first part deals with elementary theoretical overview. Theoretical overview has been used from academic literature that refers to conveying strategies for companies and for industries. The thesis disputes what is understood by the term strategy in business environment, how strategic management differs from other types of management. Moreover, there are several strategies identified that aid to understand the differences when implementing a strategy that is suitable for certain industries. Apart from general known strategies, there is as well an alternative one disputed that has an aim to point out markets that are new, undiscovered, or not completely saturated, that are rather niche markets and have need of implementing strategies yet unimplemented.

In terms of theoretical-methodological part, the focus is on the entire market of the industry rather than a specific company. There are appropriate strategic management tools identified for the types of industry chosen in the thesis. Focus is on two main areas: micro and macro environment that influence the behavior of all businesses with the industry. Both environments serve as an overview to understand what features the industry has in the Czech Republic. The tools used for are a PESTEL analysis for the part of analyzing the macro environment of the industry and the five forces model to help determine the competition with the micro environment. Analysis of the micro environment puts an emphasis on different vehicles competing in the industry, distributors of the electricity, and the main providers of charging points. Special attention is shifted to potential consumers who play an important part in the development of the technology and building an infrastructure as their bargaining power helps to move the technology faster. On the other hand, macro analysis of the industry in a wider sense, giving an examples of other European countries, serves as an inspiration for the Czech Republic to implement similar

successful strategies as neighboring countries. These tools give a framework for further identification of SWOT analysis.

The theoretical-methodological part also deals with the description of different kinds of electric vehicles based on the means of the consumption and energy supply of the specific type of vehicle, as well as energetic efficiency. Simultaneously, the author introduces a reader to the topic of different charging options. The author's aim in this sense is give a better comprehension of what types of electric vehicle and means of recharging require further attention in the practical part, just as well the necessity of the development of the technologies in the Czech Republic. However, due to the limited scope of the master thesis the author cannot go much into technical details.

Data for the thesis has been collected from many sources, primarily from available reports of several European associations and agencies, the Energy Regulatory Office, reports of consulting groups, reports and statistics of bodies of the European Commission, and ministries. In the last part, recommendation based on the outcomes of SWOT analysis are introduced.

2 Literature Review

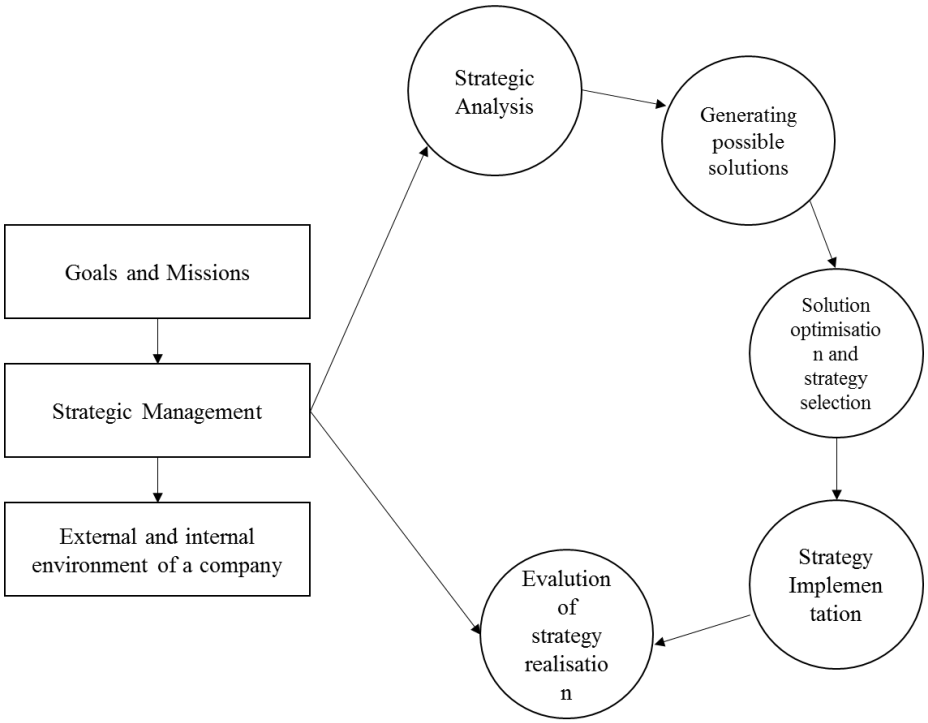
2.1 Strategic Management

The chapter aims to give a comprehensive account of strategic management, the term strategy theories related to strategy that are considered fundamental, and an alternative kinds as well.

Tactical, operational, and strategic management are all intertwined. However, strategic management is accompanied with *unrepeatable and unique phenomena and situations* when strategic decision-making. The occurrence of such situations is therefore hard to predict, and the situations are usually *poorly structured*, and their results are based on *intuition* and *informality*.[1]

Hence, strategic management should be understood as a never-ending process, with mutually linked steps, including defining mission, strategic goals, and vision as well. It is correct to say that the phases of strategic management can be interactive, and run simultaneously, separate, or in different order (see Figure 1).

Figure 1: Strategic management process



Source: KEŘKOVSKÝ, M., VYKYPĚL, O. *Strategické řízení. Teorie pro praxi. p.7.*

[1] KEŘKOVSKÝ, M., VYKYPĚL, O. *Strategické řízení. Teorie pro praxi. p.* 5.

Managers must seek answers to some questions. Which markets and part of the company should focus on? Which products and services should offer? How to improve existing products and services so that they are better than the competition? What is the potential success of the company and how wisely available resources should be spend. According to the criteria which will be useful to measure progress in implementing the strategy adopted? For better understanding, explanation of several terms related to strategic management is essential:

Mission identifies an elemental function in a company, it is an essence of company's existence. It describes a linkage between basic stakeholders (owners, employees, customers and suppliers).

Vision is essentially long-term in nature, reflects the overall vision of the future of the company. So that a vision can be successfully fulfilled, it is necessary to set specific strategic targets that will be provided as basic pillars of corporate strategy. These strategic objectives are therefore required to further develop sub-targets that we are able to work better with, and to continuously monitor and evaluate. Thanks to this companies are able to achieve the fulfillment of strategic objectives. Targets are set with a help of method SMART where each letter of the abbreviation refers to a specific attribute of a target:

S – Specific, M – Measurable, A – Attainable, R – Relevant, T - Time-bound

Strategic objectives are the anticipated future results, their formulation is based on the mission and vision of the company. They should reflect the desired state, which the company is trying to achieve.

Strategy sets out ways to achieve the fulfillment of the mission, vision and objectives. The traditional concept sees the strategy as a document which describes the long-term objectives of the company, determined the course of operations and looking for sources for their performance.

Critics reject this notion, given the rapid environment of today and permanent change. Modern definitions understands the strategy as a necessary tool for the survival of the company and its main task is to prepare the company to situations that may arise in the future. Estimated future trends and creates a possible scenario how this development then respond.[23]

[2] SEDLÁČKOVÁ, H. *Strategická analýza*. p.2-3.
[3] DEDOUCHOVÁ, M. *Strategie podniku.* p.1-2.

2.2 Strategy

The term strategy comes from an ancient Greek word "strategos", which was created by combining two words – "stratos" translated as troops or military expedition and "agein" – to lead, was used as a title name for the army commander. Strategists played a vital role in ancient Greece, and together with their military power, they held a political power as well. Since the ancient times, however, the importance of strategy has continued to grow. The ever changing world has an impact on the uncertainty for companies to make decisions. Strategies therefore prepare companies for all the scenarios that may arise.

Strategy, in today's sense, is a tool of a company to achieve its goals and objectives. A company must, first of all, define its vision, by which it can identify an appropriate strategy. Vision describes what the company wants to be. It is therefore a particular source of inspiration for the future and there are certain clear criteria described herein for the creation of subsequent strategic goals.

Analysis of micro and macro environment of an industry is a stepping stone for a feasible strategic analysis, which will be described further in thesis. Outcomes of such analysis serve to provide implementations and overtures for the company to retain and develop its position in the market.

"If you have the same strategy as competitors, you do not have any.
If your strategy is different, but easy to imitate, you have a weak strategy.
If your strategy is unique, different and difficult to replicate,
you have a strong and sustained strategy."[4]

2.2.1 Generic Competitive Strategies

Michael E.Porter derived three generic competitive strategies which help companies find a favorable position in the market.[5] The advantage of this useful yet fundamental strategy is that it can be applied to a wide range of business situations a company might face. After a brief review of these traditional strategic approaches, alternative strategy will be discussed further in the chapter.

[4] SOUČEK, Zdeněk: *Firma 21. Století (Předstihněme nejlepší!!!)*, p. 194.
[5] ELDRING, J. *Porter's (1980) Generic Strategies, Performance and Risk*. 1985, p.6.

The three generic strategies are: *overall coast leadership, differentiation,* and *focus*. The goal of these strategies is to become above-average performing, being distinguished as the "successful" ones in the business, letting other companies lag behind. This concept, known as *a competitive advantage*[6], says that a firm must make a choice between one of the three generic strategies, seeking to keep a sustainable competitive advantage. Otherwise, it would under-perform and stay *stuck in the middle*[7].

2.2.1.1 Overall Cost Leadership

By implementing overall cost leadership, a firm strives to become a number one low-cost producer on the market. This strategy, which was popular in the seventies, yield the company an above-average returns and places a firm in a favorable position relative to its competitors. The factors that lead to a low-cost position in the market are for instance: the use of economies of scale, tight cost and overhead control, cost minimization in human resources, service, sales force, advertising, and so forth. Although the quality and service cannot be omitted, the cost leader company becomes the price setter within the industry.

2.2.1.2 Differentiation

Some industries, namely energy sector, has specific rules where the price of the commodity cannot be changed and it is strictly set by law.[8] In such cases, a company must be seeking other ways to become better performing than its competitors. The second generic strategy, differentiation, helps to achieve an above-average position in the industry by differentiating a product, applying unique features to a product or a service that no other company in the industry has and can compete against. This means as well that the features are so important that a buyer would choose the product over a competitive product, even when the price is higher. The attribute by which a company differentiates its products differs from industry to industry. It can be seen in design, technology, or the after-purchase service, delivery system, or many other forms.[9] However, the above-average performance

[6] PORTER, MICHAEL E. *Competitive advantage: creating and sustaining superior performance: with a new introduction.* 1998, p.11
[7] A term developed by Porter, a company that tries to achieve all of the three strategies but completely fails
[8] Companies in energy sector maintain monopol position in the industry
[9] PORTER, MICHAEL E. *Competitive advantage: creating and sustaining superior performance: with a new introduction.* 1998, p.14.

can be achieved only if the buyer sees the superior values in the product and is willing to pay the premium price for the product. The differentiator company is not likely to become the low-cost producer in the industry for its expensive costs related to developing the differentiation strategy, although it is worth the costs when eventually a loyalty between the company and a buyer is established.

2.2.1.3 Focus

The third and last generic strategy is focus. A firm, in this case, shifts its attention to a specific customer or a geographic location. With a narrow focus, the company is more likely going to meet customer demands of the segment, and ideally also at lower cost.

2.2.2 Blue Ocean Strategy

Creating competitive advantage, as discussed in the three generic competitive strategies, is somewhat traditional approach. However, an alternative approach to the traditional one, known as *Blue ocean strategy*, was formulated in the work of two authors, W. Chan Kim and Renée Mauborgne.[10] Blue ocean strategy takes over when there is no competition for a company in the market, because the company itself creates the demand within a new or an unknown market space. Each such company monopolizing the market space belongs to blue oceans until competitors penetrating the market come into business.[11] On the other hand, some blue oceans are created within red oceans, simply by expanding the business of an existing industry (the term read ocean will be explained further in the chapter). Especially in the globalized world we live in, when the same goods are becoming accessible globally, trade barriers practically do not exist, industries have to face the fact that it is becoming harder to create niche market.

In order to create a blue ocean strategy, three strategic plans of action need to be met. First of all, such value must be created that it would convince potential consumers to buy the product. The second one being such price setting that would generate immediate purchases

[10] KIM, W. *Blue ocean strategy: how to create uncontested market space and make the competition irrelevant.* Boston: Harvard Business School Press, c2005, xv, 240 p. ISBN 15-913-9619-0.
[11] SIEGEMUND, C. *Blue Ocean Strategy for small and mid-sized companies in Germany*. 2008, p. 27.

as well as assurance of return on investment. The third and the last action plan is to ensure that the employees are motivated and informed enough to pursue the apt strategy.[12]
The two authors of blue ocean strategy created several tools and frameworks companies can use in order to create an uncontested market space – visualizing strategy, strategy canvas, ERRC Grid, Four Actions framework, and many others.

2.2.2.1 Read Ocean Strategy

The term blue ocean has been already described. But what does it mean when a firm is situated within read ocean market space? It is all the other situations outside blue ocean market space – all other existing industries within strongly competitive market space. Imagine a market space as an ocean. Red part of the ocean is where all the kinds of fish are and have to compete with each other in order to survive. In the blue part of the ocean, there is a possibility of discovering new kind of fish that would not have any competition among the other ones.

2.2.2.2 Better Place

Not all the revolutionary businesses and their products achieve to find their blue oceans. It happens when a company entering the market with its new revolutionary products is not able to acquire sufficient number of customers that could protect the product from its competitors.
Such situations happen in particular with products that are not affordable for the majority in the market.
One good example for so called blue ocean failure is a project launched in Israel called Better Place. It is of no surprise that Israel seemed like a suitable place for launching a new product regarding EV industry. Its small size, and the majority of population situated in urbans areas of Tel Aviv and Jerusalem predetermined the project to be successful. Sillicon Valley entrepreneur Shai Aggasi launched his innovative technology of battery-switching stations and electric cars in 2007, with an aim to fight the dependency on oils in Israel. Moreover, the battery-switching technology was faster than regular charging points. More written about this technology is written in 3.4 chapter. With 37 battery-switching stations,

[12] KIM, Chan W. and Renee MAUBORGNE. *How Strategy Shapes Structure*. In: Harvard Business Review [online]. 2009 [Accessed 2016-11-12]. Available at: <https://hbr.org/2009/09/how-strategy-shapes-structure>

ability to reduce the price of the car, and upgrade the battery as the technology improves, the project seemed to be on a good track to become a success. The company was charging a monthly fee for battery and electricity, and some additional services such as non-stop customer-service, all based on how many miles they travel. 850 million dollars were collected from investors used to build a huge infrastructure. However, less than 1500 cars were sold, and the company went bankrupt two years after the launch. One of the reasons why it went downhill is that there was not sufficient demand from consumers, and the government of Israel did not support the business with any tax or purchase incentives.[13]After the bankrupt announcement and several unsuccessful trials to sell the company off, an energy start-up Gnrgy Ltd. bought Better Place for less than 450 000 American dollars.[14]

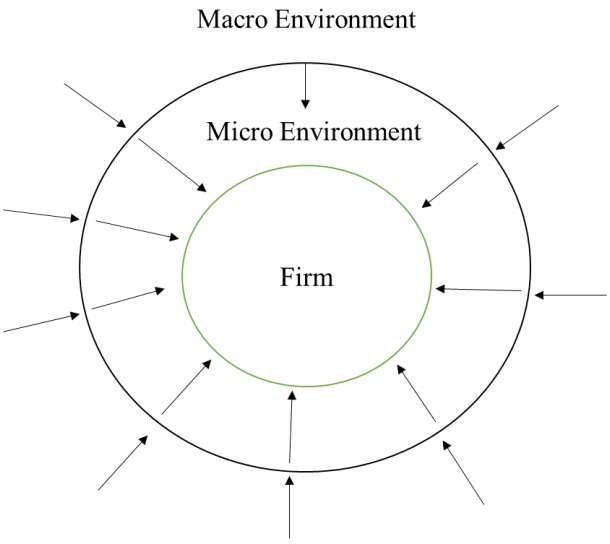
[13] *Better Place: what went wrong for the electric car startup?*. In: The Guardian [online]. 2013. [Accessed 2016-12-15]. Available at:<https://www.theguardian.com/environment/2013/mar/05/better-place-wrong-electric-car-startup>

[14] *Local energy startup buys remaining Better Place shares*. In: Times of Israel [online]. 2013. [Accessed 2016-12-15]. Available at: </http://www.timesofisrael.com/local-energy-startup-buys-remaining-better-place-shares/>

2.3 Analysis of Environment

This chapter provides an understanding of how the environment surrounding an industry may affect its strategy. Focus of strategic analysis is on two main areas: external environment of the company and analysis of internal resources. When analyzing the overall industry, the focus is on micro and macro environment that influence the behavior of all businesses with the industry. From the perspective of micro environment, the industry actively participates in making changes. The other perspective, investigating macro environment, must be closely examined so that the industry might promptly be able to adapt to its changes.

Figure 2: Environment surrounding a firm



Source: based on businesinfo.cz, 2017.

2.3.1 Industry vs. Firm

The word **industry** is used to refer to a *group of firms whose products are sufficiently close substitutes for each other that the member firms are drawn into competitive rivalry to serve the same needs of some or all the same types of buyers.* Therefore it can be assumed that the tools of a strategic analysis can be used for an industry as a whole.

2.3.2 Macro Environment

In the beginning of identifying any strategy, it is essential to determine in what environment, in terms of its dynamics, the industry is situated. There are two types[15]:

- static - it allows a simple estimate of future development based on historical data
- dynamic – for the estimate of future development, purely intuitive methods, so as highly sophisticated methods, can be used

From the two types of situations, it seems that the optimal situation an industry could be situated in, is static. It is, however, rather ideal and unrealistic situation, and in reality more complex matters are dealt with.

Basic method used for analysis macro environment of an industry is a PEST[16] analysis, a business measurement tool used to understand market growth or decline. It is an acronym for - political, economic, socio-cultural and technological factors, which are assessed in the analysis. Assessing two additional macroeconomic factors, comprises an extended version of PEST analysis – PESTEL analysis. This extended and enhanced version of the analysis includes examples of factors from environmental and legal perspective. Thanks to these factors, the environment's influences on companies are identified, which provide a complete picture for companies.

The aim of the PESTLE analysis is not analyzing all the existing factors rather than identifying those that are important for the particular industry. The main target of the PEST analysis is therefore presented as follows:

1. To identify areas of change that could have significant impact on the industry
2. To determine what changes may occur in these areas

2.3.3 Micro Environment

There are many methods of analysis industry micro environment. A very popular strategy in strategic management, developed by Michael E. Porter, is known as Five Forces Model.[17] Porter claims that these five forces are much stronger within a micro environment of an industry. The stronger these forces are, the less attractive industry or a company becomes. It is, in fact, a tool to observe company's competitive environment. The job of

[15] KOVÁŘ, F. *Strategický management*. 2008, p. 65.
[16] UNGSON, Gerardo R, YIM-YU, W. *Global strategic management*, p. 50 - 56.
[17] JEYARATHMM, M. *Strategic Management*. 2007, p.70.

managers is to identify these forces, and decide what strategy should be implemented to adapt to the threat of at least one of the forces in order to obtain competitive advantage.[18] The framework for the Five Forces Model consists of these competitive forces:

- Industry rivalry
- Threat of substitutes
- Bargaining power of buyers
- Bargaining power of suppliers
- Barriers to entry (threat of new entrants)

This model was expanded with one more force – complementary products, or complements – according to Grove's six forces model.[19] The five forces model in the thesis will include an analysis of complementary products as well.

[18] PORTER, Michael E. *Konkurenční výhoda: (jak vytvořit a udržet si nadprůměrný výkon)*. 1993, p. 30.
[19] DEDOUCHOVÁ, M. *Strategie podniku. 23.*

3 Methodology

3.1 Characteristics of an industry

Economic cycles affect specific industries differently. Cyclical industries are responding to the economic development very flexibly. During the expansion, economies show a high exchange rate rises, in the recession the decline. This includes industries producing superfluous goods whose consumption is required - the construction industry, automotive industry, tourism, electronics industries. Anti-cyclical sectors show satisfactory results even in recession period. Such companies produce cheaper substitutes of expensive products whose demand is growing during the economic downturn. These include cheap clothes, shoes and food to replace expensive products. On the other hand, neutral sector does not respond to the economic cycle, because companies in this sector produce goods that are necessary and often addictive. Food products, pharmaceutical and tobacco industries, or production of alcoholic beverages fall into this category.

The features of an industry, according to Sedláčková[20], are as following:

- The absolute size of the market or its specific market segment in terms of the volume of production and sales
- Relevant competition for the investigated market (local, regional, or even global area)
- Life cycle of the industry and the trend growth of the market - the emergence, growth, saturation and decline
- Characteristics of the branch in the number of competitors and their relative size to the total market. Here, a distinction is fragmented competition approaching by its nature a perfectly competitive market, monopolistic competition with one dominant player, whose steps are followed by smaller players, or oligopoly monopoly
- The number and relative share of customers on demand, purchasing power and ability to negotiate better terms to the detriment of suppliers
- Barriers to entry hindering access of new market players
- Output barriers do not allow market participants from it at no extra cost
- The pace of changes in technology and product innovation

[20] SEDLÁČKOVÁ, H. *Strategická analýza*. 32-33.

- The importance of market share in terms of achieving a production level guarantees, economies of scale and reduce costs through experiential effect

3.2 Industry Life Cycle

Each industry, according to Sedlackova[21], goes through 5 stages of development:

1) Embryonic Stage
2) Growth Stage
3) Shake-out Stage
4) Maturity Stage
5) Decline Stage

Life Cycle of Industry is an analogy to a model of Product Life Cycle. However, concerning Industry Life Cycle, it is hard to determine in what stage the industry is currently positioned in. Deriving from the situation in the market, Industry Life Cycle examines whether number of customers and demand is arising.

In the first Embryonic Stage, it is vital to secure the position in the market, and subsequently obtain high market share. In doing so, a company needs the resources to be able to recognize the niche and the potential in the industry, build strong competitive position by engaging in research, development, as well as require skills necessary for sales and services.

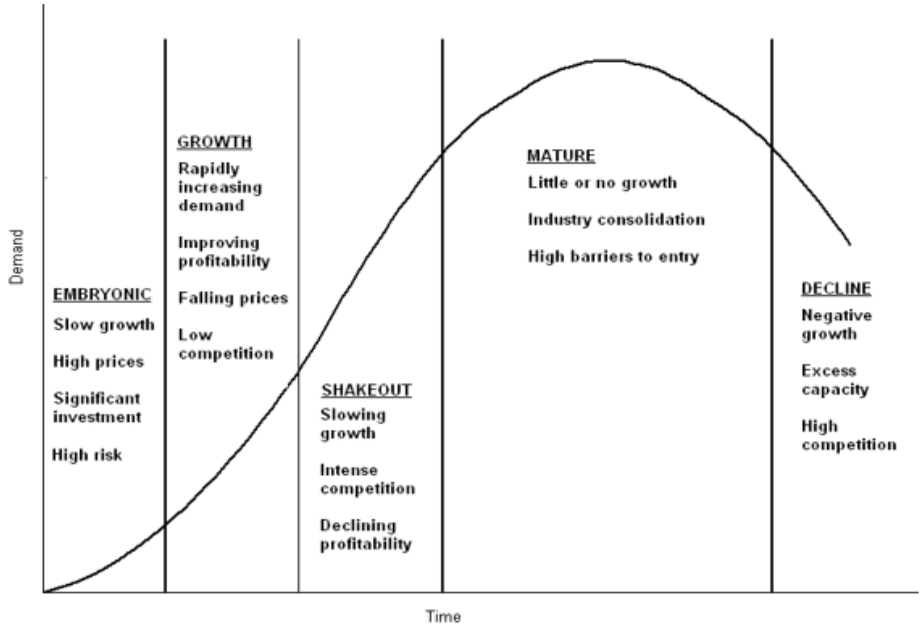
The second, Growth Stage, tells companies to secure their position in the market by improving their current market position. It is therefore mandatory to acquire new skills, to be innovative and resourceful, which would lead to the increase of market share, and in the best case scenario in an expansion of the business overseas, or to new segments.

In the Shake-out Stage, companies try to win customers over their competitors by differentiation and lowering the prices. When the demand is increasing with only very little steps, we can talk about the Maturity Stage, the company should only reinvest and maintain its position in the market. In the Decline Stage, however, the demands commences to decline, the companies must either implement new strategic decisions and strategies, or step out of the market. This happens for the weakest players, and those who

[21] DEDOUCHOVÁ, Marcela: *Strategie podniku*,

seek their ways to stay in the game, shall be able to recognize threats and opportunities, and address them in their strategies.

Figure 3: Industry Life Cycle



Source: Based on Dedouchová: *Strategie podniku*, p.25.

3.3 Political and Legal Factors

When we talk about the main political factor influencing industry, we talk about political stability versus political instability. With regard to legal factors, concerning respect for national law - standards and regulations that constitute the imaginary barriers limiting business activity and also determine the conditions for the exercise of this activity. Czech Republic as a member of the European Union faces restrictions with the fact that certain EU legislations must be followed. Furthermore, it is the determination of various restrictions and quotas to regulate the export and import. In extreme cases, it may be to impose an embargo on the export or import of certain product, which can totally paralyze certain sectors or in the worst case paralyze the entire national economy.

Some of the questions asked during identifying political and legal factors affecting firm's strategy are as following:

- What is the position of supervisors and regulators?
- What government policies can be expected?
- What is the outlook in terms of laws and regulations?
- What constraints are to be expected from future legislation?
- What opportunities does future legislation offer*?*

3.4 Economic Factors

Fundamental macroeconomic variables give a picture of the economic state that a country is situated in. These factors depend closely on each other and can have an impact on predicting future. [22]

- What are the economic trends in the industry and what is their impact on the company?
- What is the development, trend, and relative comparison with neighboring countries of basic macroeconomic factors? (such as gross national product, inflation rate, nominal interest rate, etc.)
- What is the purchasing power and investment capacity of target groups?
- What is the exchange rate?

[22] GRASSEOVÁ, M. DUBEC, R. ŘEHÁK, D. *Analýza v rukou manažera: 33 nejpoužívanějších metod strategického řízení*, p. 177 - 212.

- What are the prices of complementary commodities?

3.5 Socio-cultural Factors

Change in lifestyle, relative wealth growth of communities, switch of attention to the population in the urban areas, and the development of communication through a variety of tools has had an impact on the society. The aging population in the developed world, the atomization of families, an increase in the number of single-living people, bring different opportunities. The Czech Republic as being a trend follower rather than trend setter may learn from other better developed countries such as Japan, the USA, and Western European countries.[23] Some of the questions asked during identifying socio-cultural factors affecting firm's strategy, are as following:

- What is the composition of potential target groups, in terms of age, background, family, etc.?
- What is the buying behavior of current and potential customers?
- What are consumer's preferences?
- What changes in consumers' lifestyles can be perceived and what are the consequences for the company?

3.6 Technological Factors

In this fast paced world new technologies are developed sometimes even overnight. If a company wants to stay competitive in the market, it has to watch the newest trends, discoveries, and moreover, to be able to predict the future trends in order to secure a competitive advantage. Old technologies are more costly and does not provide the righteous treating of the environment. Some of the questions asked during identifying technological factors affecting firm's strategy, are as following:

- What are the important developments in technology and what are the consequences for the company?
- What technologies are likely to come into market in the next few years?

[23] GRASSEOVÁ, M. DUBEC, R. ŘEHÁK. D. *Analýza v rukou manažera: 33 nejpoužívanějších metod strategického řízení*. 2010, p. 177 - 212.

3.7 Ecological Factors

This factor has become more significant in recent years. Whether it is technology – the entire equipment being ecological, or the way a firm gets rid of the waste, each firm, no matter what it produces, should implement environmental policy to some extent. It is on one hand, however, a question of laws of how much environmentally involved a firm is. On the other hand, companies take their own initiatives to cater for their environment. This issue will be discussed further in the chapter as corporate social responsibility. Some of the questions asked during identifying ecological factors affecting firm's strategy are as following:

- What is the impact of the industry on the environment?
- Are there any externalities?
- What are the important developments in the field of ecology, such as nature preservation, carbon footprint minimization or emission reduction, and what are the consequences for the organization's activities?

3.7.1 Social Corporate Responsibility

> *"Open and transparent business practices that are based on ethical values and respect for employees, community and the natural environment."*

The main aim of each company is to make a profit whilst obeying laws, which are in force. However, if a company goes beyond what is required by law, it refers to a term called "corporate social responsibility"[24], often used in an abbreviated form "CSR". Acting responsibly towards the environment can bring a company many advantages, such as good reputation, and future success. Not only is it a question of acting responsibly due to the growing importance of taking care of the global issues, such as climate change, let alone companies that should address these issues in order to succeed in business as consumers are becoming more aware of the issues affecting the environment around them.

Areas of corporate social responsibility companies may engage in, are as follows:

- pollution control
- health and hygiene
- training self-help
- philanthropic activities

[24] JEYARATHM, M. *Strategic Management*. 2007, p.30-34.

- etc.

In addition, the abbreviation "CSR" may as well be referred to as "corporate citizenship"[25] "*that uses costs in short-run to generate positive social and environmental changes rather than providing immediate financial profit*." This description of "CSR", in addition, puts an emphasis on the expenses that are used for the good cause toward the environment rather than having the goal of creating a profit, which is what businesses are for in the first place. Despite this fact this aim is suppressed for certain time to create better environment for others.

[25] Terms: Corporate Social Responsibility. In: Investopedia [online]. n. d. [Accessed 2016-12-07]. Available at: <http://www.investopedia.com/terms/c/corp-social-responsibility.asp>

Figure 4: Three dimensional conceptual model of corporate performance

Source: JEYARATHM, M. *Strategic Management*. 2007, p.31

Archie Caroll in his 3 dimensional conceptual model of corporate performance believes that companies have 4 responsibilities: economic, legal, ethical, and discretionary responsibilities, last two of them being company's social responsibilities. They are listed in their order of priority. Carroll's view on economic responsibility is that a company must produce goods and services that are of value to society. Company's legal responsibility is the obedience of rules and regulations. Additionally, Carroll claims that a socially responsible company should follow generally held beliefs that are ethical, and may engage in voluntary activities, such as philanthropy.

Conversely, this point of view of Carroll's is quite the opposite of the one of Friedman's, who believes that a company's business is to *"make money as long as the law is not broken"*[26]. From the perspective of companies operating within energy sector, the possibilities of using technologies that are "greener", that is to say the trend toward more environmentally-free companies is so wide-spread, that pure money making would not be regarded as ethical from the viewpoint of consumers and society. Hence the first model of Caroll's is more suitable at the time being. Tesla Motors, Inc., the producer of electric vehicles, concentrates on sustainability and environmental friendliness of their products. Not only does it enhance corporate brand image but such efforts bring benefits to stakeholders as well.

[26] CHENEY, GEORGE M., STEVEN, K., ROPER, J. *Debate over Corporate Social Responsibility*. 2007, p.16.

3.8 Industry Rivalry

Rivalry and competition between firms are particularly influenced by *the number and size of competitors in a given market and their competitive strategies, market growth, product differentiation, capital requirements associated with entry to a given market (high fixed costs), exit barriers from industry, let alone by the globalization* that brings new competitors into the industry, mostly in the form of various multinational companies. The intensity of competition thus stems mainly from the structure of the microenvironment and competitive strategies of individual companies.

3.9 Threat of Substitutes

As a substitute product can be understood a product that is able to satisfy the needs and requirements of customers to such degree that they prefer the substitute to any other products available in the industry. It can also work the other way around. Substitutes come from similar or exactly same markets/industries. It comes with the occurrence of new technologies, however substitute products do not necessarily need to be the ones replacing the other products, but they definitely become a competitor in the market. The main factors in this competitive market forces are *the relative prices of substitutes, differentiation substitutes and the costs of change.*

3.10 Power of Suppliers

In addition to standard service providers, under the term suppliers can be understood as suppliers of energy, raw materials and semi-finished products also employees, especially in companies with brisk activities of trade unions. Suppliers like any other entity are trying to gain the maximum benefit for themselves. The negotiating position of suppliers and their ability to gain profits on your side is high, if it satisfies certain conditions:

- Low competition in the market that causes a small number of possibilities for suppliers. The position is even stronger when there cartel pricing and market sharing, or the supplier is in a position of monopoly.
- Purchases of an analyzed company (buyer) represent only a minor share of revenues for suppliers.
- There is no direct substitute, and if then its use requires additional investment costs and interference with the operation of the business.

- There are substantial costs associated with the transition from the existing supplier to another.
- Backward vertical integration, whether through acquisition, merger, or build supply capacity is not feasible. The need to achieve significantly higher production volumes than required by current production plant or legislative regulation of the industry can be hidden in high investment costs

3.11 Power of Customers

This power is shaped by customers and their efforts to get the best possible product at the most reasonable price. It often pushes the individual producers of goods and providers of services to mutual rivalry and the competitive struggles, reducing profit margins and a more favorable business conditions for the buyers. Power of customers grows when standardized products are taken into account, because customers can easily switch to other suppliers, and the importance of the product as an input for other economic activities decreases. The power of consumers also lies in the number of buyers and suppliers. A small number of buyers carrying large purchases have high bargaining power. Exactly the opposite will be the case of a large number of smaller suppliers. They thus lose their bargaining power at the expense of buyers.

3.12 Barriers to Entry

In every industry, there is threat of new players entering the market that could compete with the current ones, meet their objectives and possibly achieve profitability. On the other hand, there might be potential barriers to entry that would discourage or disable the potential entrant penetrate the market. It could be *for instance legislative obstacles, high initial capital costs, hard to achieve economies of scale*. Moreover, there could be already a high level of product differentiation existing and thus customer loyalty to existing customers is hard to break. In some cases, there are high barriers to exit from the industry due to high input investments. This also leads to an increase in the probability of aggressive reprisals from the existing players.

3.13 Complements

Complements can be divided into two groups. The first are the complements that improve functionality and value perceived by the user of the product. The second group are the complements that are completely necessary for the functioning of product analyzed.

3.14 SWOT Analysis

The aim of the two previous analyzes is to identify opportunities and threats in the environment of an industry, and to find its strengths and weaknesses. Given these results, in order to come up with conclusions and formulate recommendations, SWOT analysis tend to be used as a tool whose aim allows the results from two previous analyses to create a synthesis. By assessing the strengths and weaknesses, and the opportunities and threats, there is an opportunity to evaluate different strategic behaviors of the business toward future development.

SWOT analysis can be carried out for a company, product, place, industry, or person.

According to the nature of the industry and the combination of internal and external sides, various option of strategies that are based on four possible simplified approaches can be chosen:

Access S - O: exploit strengths and opportunities offered by the industry surroundings.

Access W - O: try to neutralize weaknesses opportunities for assistance from the environment.

Access S - T: use their strengths to eliminate threats.

Access W - T: trying to solve the unfavorable situation at the cost of disposal of the organization.[27]

Another part in SWOT analysis is the evaluation of the factors, that is to say to what extent each specific factor is relevant/irrelevant. A factor from each group is assigned a specific weight based on the relevance and importance to the company. The sum of the weights of the same group must always give 1, or 100%. The weights are assigned on a subjective basis. Subsequently, the factors are assigned a rating from 1 to 5, 1 considered the least important factor, to 5 – considered the most important factor for the company's future business development.

[27] KOVÁŘ, F. *Strategický management*, p. 165.

Despite the fact that the SWOT analysis occurs to show too much of simplicity for such complex analysis as strategic analysis is, it is a very useful tool for the further formulation of findings and recommendations.

4 Practical Part

4.1 Electromobility

This chapter gives an overview on the origins of electric vehicles, which was more than hundred years of disputes whether conventional or alternative fueled vehicle were to dominate the market. Further the chapter continues with explanation of the existence of different types of electric vehicles, as well as different ways of recharging them. Electromobility is a road transport system based on electricity-powered vehicles. This road transport system consists of electric vehicles, charging infrastructure, technology, and suitable legislation.

4.2 History of Electric Vehicles[28] [29]

This chapter provides a reader with a historical look at what caused internal combustion engine vehicles dominate and gain such an enormous success in the market space over battery electric vehicles. Regarding the inventions of electric-powered vehicles, there is no way to tell who, or in what country the electric vehicle was invented in. There will be mentioned several breakthroughs that can be considered as "the firsts".

In early part of the thirties, countries such as Hungary, the Netherlands, France, Germany, even the United States contributed with their inventors to create an electric-powered vehicle. Reason behind the inventions was simple. Horse-drawn carriages were no longer attractive and acceptable for people who were looking for alternative ways to commute around their areas. Steam-powered carriages were a better solution, they were quite inexpensive and fast, but unpractical for their long warm up times to get the carriage started. In 1833 Scotland, an inventor Robert Anderson builds a prototype of electric-powered carriage. In 1834, another breakthrough in developing electric motor was in the United States, done by Thomas Davenport, who installs first direct-current electric motor into a locomotive. All these vehicles, however, had non-rechargeable battery. The first rechargeable battery was developed in France, by Gaston Planté, almost forty years later. However, the development in the electric-powered cars took years until they became practical and comfortable to use. In Europe, it was around the second half of the nineteenth

[28] *The History of the Electric Car*. In: Energy.gov [online]. 2014. [Accessed 2016-12-07]. Available at: <https://www.energy.gov/articles/history-electric-car>

[29] ANDERSON, J. ANDERSON, CURTIS. *Electric and Hybrid Cars: A history. 2005, p.3-15.*

century, largely in France and Germany. They were safe, reliable, and easy to get started[30], silent, and clean, but only available for wealthy population due to their price. American company Baker Electric produced only so-called BVs for twenty years. In addition, the classis American car companies, Oldsmobile and Studebaker, were founded for the purpose of producing EVs exclusively. Moreover, both in London and New York, in 1987, EVs were used for commercial purposes, in cab service around cities. When the vehicles ran out of battery, they could be easily recharged at charging stations and put back shortly after to the streets to do business. The cars were convenient and safe for the wealthy clients, and effective in service for cab companies.

Nevertheless, the internal combustion vehicles that were dominating were still quite expensive to large population. Everything changed when a long highway from the west to the east of the US was build. EVs were not capable to run such long way due to their small range capabilities and lack of charging points along the highway. The only possibility were ICEs. Cheap petrol, invention of electric starter, and introduction of Henry Ford's Model T contributed to the fact that VHs became extinct. All by 1935.

However, after the so-called "oil price shocks" in 1973 and 1979, when the oil and gasoline prices went up, the governments of countries in the world had to commence with supporting the research and development in alternative fuel vehicles. In France 1976, it was supported by "PREDIT" program. In the United States, General Motors developed a prototype for an urban electric car, and so forth. However, all the cars produced in the seventies had lots of flaws in comparison with ICEs. Maximum speed of 45 miles per hour, and the capability range of the battery being only 40 miles before they had to be charged again.

Following the requirement of the state of California[31], General Motors introduced electric vehicle "EV1", the first model of the new wave of EVs - with a range of 80 miles and speed of 50 kilometers per hour. Even with such large step in development, the price of the vehicle had its impact on the vehicle never to be commercially available for sales.

Even though there was not much hassle about alternative fuel vehicles in the late nineties, the research and development was ongoing. In 1991, Toyota introduces Prius – the first commercial hybrid car. In the first year, 18 000 pieces were sold. In the beginning of the 21st century things started to change. There were several events that helped with the revival

[30] Used for marketing campaigns
[31] Zero-emission vehicle requirement

of electric cars. The launch of Toyota Prius, released worldwide in 2000, with new battery technology. Subsequently in Californian Silicon Valley, Tesla Motor began with a production of luxury sports car whose driving range was more than 320 kilometers thanks to a new Li-ion type of battery. During the same year, Mitsubishi introduced the model iMiEV, and Chevy Volt and the Nissan LEAF models were released the year after in the United States.

4.3 Types of vehicles

4.3.1 Internal Combustion Engine Vehicles (ICEs)

These conventional vehicles use petrol or diesel to provide vehicle power. They have been mass-produced and dominating the industry for years, providing convenient mean of transportation for the population of any social background. The advantage is, foremost, the price and the convenience provided with greatly developed infrastructure of gas stations. They, however, massively contribute to the increase of greenhouse gas and air pollution emissions. Also, they highly depend on the sources of fossil fuels. Furthermore, the energy from the fuel delivers only about up to 25% energy efficiency.

4.3.2 Battery electric vehicle (BEVs)

BEVs use energy wholly from electric energy stored in battery to power all the electrical systems in the car. Battery must be regularly recharged at recharging stations, house outlets, or non-grid sources. BEVs have several advantages, but also some disadvantages in terms of their technology. Their energy efficiency can be as of 75 %, whilst conventional vehicle delivers around 15%. As for maintaining the vehicle, it is time and cost demanding since the BEVs have significantly less components – no oil or fuel changing, no pump, alternator replacements, etc. BEVs exhaust few emissions, none if the electricity generation comes from renewable source of energy, and fewer if it comes from both renewable source and fossil fuel energy.

BEVs can potentially emit zero greenhouse gases and air pollutants; however, the type of electricity generation (solar, wind, coal, etc.) determines the well-to-wheel emission. Nevertheless, if the charging source is a coal-powered plant, the amount of CO 2 emitted from a BEV is about one-half to one-third less than what a gasoline-powered vehicle emits. Moreover, they produce no air pollution and their driving range being from 80-400 kilometers.

The best-selling BEV in 2015 in the European Union was the Renault Zoe, comprising around 1/3 of sales. This model of Zoes were equipped with 22 kWh lithium-ion battery pack with a driving range between 210 km and 240 km. In September 2016, it was announced that a new ion-battery of 41 kWh lithium-ion battery will increase the driving range up to 400 km. In addition, luxury model of Tesla Model S now being the third popular BEV in the EU, as well as the best-selling BEV in the world.[32][33]

In spite of all of their advantages, there are still some limitation concerning producers – their limited driving range, long time to recharge, expensive battery, and fewer recharging stations.

4.3.3 Hybrid electric vehicle (HEVs)

As oppose to BEV, hybrid electric vehicles provide the convenience of combining both an internal combustion engine and an electric motor. HEVs have no capacity to plug in because their driving energy comes from regenerative braking or the engine. Batteries for BEVs are more expensive than for BEVs in terms of price per kWh. The vehicles' driving range is ranging between 0 to 10 kilometers, which means that the electric motor can be used only for short distances, and the environmental impact is bigger as it exhaust emission while driving on ICE, it produces more noise pollution than HEVs, and is highly dependent of fossil fuels.

4.3.4 Plug-in hybrid electric vehicle

PHEVs combines both an electric motor and internal combustion engine that can work together or separately. As from the name of this type of vehicle, it is apparent that the battery can be recharged from the grid, which means that whilst recharging, the combustion engine supports the electric motor. As well as the HEV, batteries tend to be more expensive than the ones of BEVs. The driving range between 20 and 85 kilometers is smaller than the ones of BEVs, which places the PHEVs to be more suitable for urban driving. Almost 40% of sales in Europe in 2015 is linked to the Mitsubishi Outlander, a

[32] Private source
[33] 50,000 units were sold in 2015

plug-in hybrid using Li-on battery that can go up to 60 km, moreover, being the most popular plug-in worldwide with sales of 39,000 units.[34]

4.3.5 Range-extended electric vehicles (REEVs)

The REEVs' combustion engine serves only as an auxiliary feature to power the vehicle in case the battery is empty. It is not directly linked to the wheels. As for a PHEV, an REEV overcomes the problem of a restricted driving range associated with BEVs because it can be fueled at conventional filling stations. Indicative electric driving range: 70–145 km.

4.3.6 Full cell electric vehicles (FCEVs)

FCEV stands for fuel cell electric vehicle where the moussing oxygen from the air and compressed hydrogen. They provide longer driving range compared to BEV as well as faster refueling. Therefore, they are more suitable for longer distances. However, their infrastructure is limited, and the technology is still slowly developing.

4.4 Different charging options

In the previous chapter, it was described that different types of electric vehicles have different electric driving ranges. Not only do the driving range depend on the type of battery used, but the type of technology used in charging them as well. The charging time is a very crucial variable for consumers. And thus, as the BEVs and FCEVs are the only types that do not have an internal combustion engine, which means that in order to recharge their battery, they require special types of recharging infrastructure. Therefore, there is a constant demand from both the sellers and consumers to improve the technology that has been, in fact, slowly developing.

There are three fundamental ways to recharge the battery: plug-in charging, battery swapping, and "wireless" induction charging.

Battery swapping, already from the name apparent, uses swapping stations to completely exchange an empty battery for a new one. This way of recharging battery is not available in Europe most probably due to high developing costs and the Better Place bankruptcy of swapping station pilot project launched in Israel in 2007. However, Tesla launched a chain

[34] *Mitsubishi*. In: Cars Sales Base [online]. 2016. [Accessed 2016-11-15]: Available at:<http://carsalesbase.com/european-car-sales-data/mitsubishi/>

of swapping points at their current recharging stations in the United States.[35]Another way to recharge batteries is called wireless, or induction charging. Rather than physical connection between the charging point and the vehicle, the system uses an electromagnetic field instead. It is still however not commercially available, and there were only a few pilot projects launched for buses in Belgium, Germany, the Netherlands, and the United Kingdom, and in Sweden for EVs. Plug-in charging takes place at charging points using plugging a cable physically into a plug.

This type of charging is widely used, and can happen at different locations, which will be described in the next chapter. Table 1 summarizes all types of charging options of EVs, the times need to recharge the battery for different types of EVs with an example of a specific model of car suitable for it, and the level of availability in Europe.

All things considered from Table 1, BEVs and PHEVs are the only types of EVs that require specific infrastructure to be built in order to recharge their batteries[36] and as a result of analyzing all the types of recharging options, plug-in charging occurs to need to get more attention for its efficiency, and yet limited availability.

[35] BULLIS, Kevin. *Why Tesla Thinks It Can Make Battery Swapping Work*. In: MIT Technology Review [online]. 2013. [Accessed 2016-12-15]. Available at: <https://www.technologyreview.com/s/516276/why-tesla-thinks-it-can-make-battery-swapping-work>

[36] Other can be recharged at fuelling stations

Table 1: Types of charging infrastructure options

Energy Source	Gasoline/Diesel	Hydrogen	Battery	Battery	Battery
Description	Conventional gasoline or diesel refueling	Hydrogen refueling	"Wired" charging using a plug	Battery swapping	"Wireless" Induction charging
Time Needed	5 min	5 min	4-8 hrs or 20-30min	5 min	2-8 hrs
Suitable for which power-trains	ICE, HEV, PHEV, REEV (gasoline)	FCEV REEV	PHEV BEV	BEV	BEV
Example car	All ICEs	Hyundai ix35	Renault Zoe	Renault Florence	N/A[37]
Current availability in Europe	Widely available	Very limited	Limited Availability	Very limited	N/A[38]

Source: Amsterdam Roundtable Foundation and McKinsey & Company The Netherlands report. *Electric vehicles in Europe: gearing up for a new phase?*. 2014, p.29.

[37] Few pilot cars
[38] Few pilot projects in progress

5 Practical Part

5.1 Characteristics of an automotive industry

The following chapter gives a concise overview of automobile industry. Although the topic of the thesis concentrates on EVs and specifically on the charging points, it is necessary to describe the automotive industry as a whole with features of EV industry.

Several characteristics describing specific features of the industry were collected as follows:

- Table 2 shows the number of annual sales of all types of cars in chosen countries. The number of cars in the Czech Republic is growing gradually. The numbers are comparable to the overall sales statistics of cars in Europe. EVs however comprise only 0.7% of all the vehicles in the country.[39]

Table 2: Annual sales of cars given countries

Area	2011	2012	2013	2014	2015	2016
Europe	19,740,019	18,663,178	18,343,409	18,587,650	19,035,989	20,134,829
Czech Republic	194,945	193,795	185,939	215,594	260,070	291,008
The U.S.	13,040,613	14,785,936	15,883,443	16,843,464	17,845,624	17,865,773
China	18,505,114	19,306,435	21,984,079	23,499,001	24,661,602	28,028,175
Global Market	78,170,420	82,129,138	85,606,136	88,338,098	89,684,608	93,856,388

Source: Based on statistics at OICA[40]

- The industry is highly concentrated, which means that the market is dominated by a few major companies from 5 countries – China, Germany, Italy, Japan, and the USA. This phenomena is known as oligopoly. However, the existing players have a lot of opportunities to bring new innovation due to the wideness of the product range of the industry.

[39] *Global EV Outlook 2016*. In: International Energy Agency [online]. 2013. [Accessed 2016-12-15]. Available at: <https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf>
[40] *Sales Statistics.* In: OICA [online]. 2017. [Accessed 2017-03-15]. Available at: <http://www.oica.net/category/sales-statistics/>

- There are significant barriers to entry and exit. The costs required for the startup capital to enter the market are enormously high, and for such industry where the value of purchase is high, the well-known brand that represents safety is prevailing. Nevertheless, this does not completely apply to the EV market. Since the EVs contain only basic motors, and have relatively few parts, the barrier to entry are lower. Barriers to exit in this industry include high costs with closing the facilities and resale of them. On the other hand, barriers to going mainstream are high due to charging capacity, recharging time, and cost or lifespan of the EVs.
- As far as economies of scale when deploying EV charging infrastructure, fast charging stations provide the best result of economies of scale.
- There were over 180 000 electric vehicles (including both all electric vehicles and plug-in hybrids) sold in the EU in 2015, accounting for 1.4% of all passenger cars sales. The world sale of EVs was 500 000, which overall makes 70% increase over one year from 2014 to 2015.[41]

5.2 Evaluation of EV industry life cycle

The industry is still in its embryonic phase. It is so for several reasons. One of them is that the price of the EVs are significantly higher than those with ICEs. The market of EVs is not fully commercial yet, and the market has to rely on the early adopters who aid to raise the awareness to public of the EV benefits. Furthermore, the EV market in the Czech Republic still lag behind in comparison with Western countries, therefore the biggest players on the market are not attracted to introduce more EV models for different segments and the offer is thus highly limited, which prevents the industry to grow. The last issue is the lack of infrastructure for recharging EVs, the density is very low.

[41] *Global EV Outlook 2016*. In: International Energy Agency [online]. 2013. [Accessed 2016-12-15]. Available at: <https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf>

5.3 Political and legislative factors

These factors in this chapter are going to be bounded to the member states of the European Union as the Czech republic as the member state might learn from other member states on how to improve its legislation and policy to create higher demand for EVs. All the European countries that have adopted some form of support recorded significant step forward and become regional leaders in electric vehicles.

All the regulations that can be implemented in any of the member country has to be built upon directives of the EU. However, it is on each countries' decision then to what degree solutions for supporting sustainable mobility are implemented

5.3.1 Policy of the European Union

In 2009 was the first year when there were first CO_2 standards introduced for new passenger cars. At the end of 2013, the European Parliament and the Council of the European Union reached *an agreement regarding two regulatory proposals that will implement mandatory 2020 CO_2 emission targets for new passenger cars and light-commercial vehicles in the European Union. The passenger car standards are 95 g/km of CO_2, phasing in for 95% of vehicles in 2020 with 100% compliance in 2021*. However, the newest Clean Power for Transport Directive 14/94/EU on the deployment of alternative fuels infrastructure suggests an implementation of a national policy framework for market development of alternative fuels in the transport sector and infrastructure.

In the long run, the deployment of alternative fuels in the Czech Republic is a starting point for the EU Climate-energy 2030. The first objective is to reduce CO2 emissions by 40% by 2030 compared to 1990. The second objective is to increase the share of renewable energy sources, which will represent 27% of the total energy mix by 2030. The third commitment for 2030 is to increase energy efficiency to 27%.[42]

In 2015 the government of the Czech Republic introduced National Action Plan for Clean Mobility (NAP CM). The aim of the NAP CM is vital development of alternative transport in the Czech Republic. One of the objectives of the NAP CM is to ensure the

[42] 2030 climate & energy framework. In: EC.Europa. [online]. 2017. [Accessed 2017-03-07]. Available at:<https://ec.europa.eu/clima/policies/strategies/2030_en>

transposition of the Directive 2014/94 /EU into the Czech legislation, namely fulfill the requirement to ensure development of the market with alternative fuels, and building minimal infrastructure for them. Article 4 of the Directive demonstrate that all the following must be ensured[43]:

- all providers of publicly accessible charging stations are free to purchase electricity from any supplier of electricity in the EU
- all publicly accessible charging stations provide the possibility of charging on and ad hoc basis without a contract with the affected supplier or provider of electricity
- prices charged by public operators of publicly accessible charging stations must be easily and clearly comparable, transparent and non-discriminatory
- legal framework allow it to be a contract to supply electricity for recharging station can be closed with a vendor other than the contractor or home service where the charging station is located.

According to National Action Plan for Clean Mobility (NAP CM)[44], the costs associated with fast charging would be as following:

- Payments would be done to the operator of fast charging point for the access to the publicly accessible charging point.
- It consists of costs related to fast charging, without costs related to the electricity itself, which means that consumer pays for the ability to recharge the vehicle elsewhere, but home.
- It is expected that for BEV it would be 500 CZK/month, and for PHEV the fee is not expected as PHEVs are mostly recharged in households.

It is expected that the recharging infrastructure is going to be built in phases. The most important paths, commutes, and towns with more than 100 000 inhabitants, all the regional towns, and highway paths will be covered with charging infrastructure by 2020, which accounts for 27% of the population in the Czech Republic. All the towns exceeding 10 000 inhabitants will be covered with the charging infrastructure by 2025, accounting for 52%

[43] *DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the deployment of alternative fuels infrastructure*. In: EUR – Lex [online]. 2014. [Accessed 2017-03-03]. Available at:<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en>
[44] *National Action Plan for Clean Mobility*. [online]. 2016. [Accessed 2017-03-17]. Available (in Czech) at: <https://www.mzp.cz/C1257458002F0DC7/cz/cista_mobilita_seminar/$FILE/SOPSZP-NAP_CM-20160105.pdf>

of population. For instance, Norway built an infrastructure of charging points with double multi-standard fast charging stations every 50 km on all main roads, altogether covering 7 500 km.

5.3.2 EU member state incentives

Many European countries apply incentives for electric vehicles. We speak mainly of tax reductions and exemptions, or bonus payments and premiums for the buyers of electric vehicles. Table gives an overview of such purchase and tax incentives in several member countries of the European Union that are relevant toward the Czech Republic and can serve as an inspiration for further development of this technology on the Czech market. Whilst many of them offer a variety of incentives and support when purchasing an EV, some of them (such as Croatia, Estonia, Lithuania, Poland, Slovenia, etc.) have not deployed any yet. Without any support from the state, the EV industry is not able to create demand, market, and infrastructure for fuel-efficient vehicles.

In general, the most used forms of incentives are as following:

- purchase incentives (tax benefits)
- traffic regulations
- procurement
- emission and environmental obstacles
- pilot projects
- local incentives

5.3.2.1 Incentives in Norway

Norway is the top electric vehicle (EV) market in the world. The EV Norwegian market share was estimated at 22% in 2015. It is thanks to their vast package of incentives (see Table 3). The mission with the tax incentives was to encourage immediate purchases, and thus, they are valid until 2018, with further reconsideration for upcoming years. Furthermore, consumers pay no VAT, there is no import tax imposed. BEVs/FCEVs are exempted from purchase tax, with PHEVs having a reduction on purchase up to 10.000 EUR. Another example of the success of having no loss in revenues is a principle where high taxes are paid for high emission cars and lower taxes for low and zero emission cars.

Another advantage of users of EVs are the local incentives, such as the ability to drive in bus lines, park for free of charge.

Table 3: Purchase and tax incentives for electric vehicles in Norway

Incentive category	Description
Registration Tax Benefits	Purchase Tax exemption for BEV's/FCEV's, reduction for PHEV's (Up to 10.000€)
Ownership Tax Benefits	Tax reduction
Company Tax Benefits	Tax reduction
VAT Benefits	No VAT tax (BEV / FCEV)
Other Financial Benefits	No import Tax - Purchase tax/import tax is the same in Norway.
Local Incentives	- Urban toll exemption - Highway toll exemption - Free Parking - Bus lane use - Funding in some cities for normal charging stations in shared apartment buildings, shopping centers, parking garages etc.
Infrastructure Incentives	Public funding for fast charging stations every 50 km on main roads.

Source: EAFO, 2017.

5.3.2.2 Incentives in Germany

Although the tax exemption in Germany is not as high as in Norway, the Netherlands, or Denmark, Germany has found its own way of developing this technology in the country. Platform *Electromobility model regions2009-2011* supported applied research, studies of consumer behavior, and development of commercial services in electromobility with a sum of 130 mil. EUR. Other purchase and tax incentives of Germany are listed in Table 4 below.

Table 4: Purchase and tax incentives for electric vehicles in Germany

Incentive category	Description
Purchase Subsidies	- For pure electric cars, there is a grant of 4,000 euros. For hybrids, it is 3,000 euros. - Rewards are only for cars with a list price of a maximum of 60,000 euros (base model). - The promotion lasts for a maximum total of 400,000 cars. - The federal government contributes a total of 600 million euros. The cost should ever share federal and automakers half. Overall, the funding is therefore EUR 1.2 billion. - The promotion ends in 2020.
Ownership Tax Benefits	Exemption for the first 10 years for cars registered until Dec 31 2015, 5 years from then on to Dec 31, 2020
Company Tax Benefits	Tax deductions on company cars
Local Incentives	BEV benefits : - Free Parking - Reserved Parking spots - Bus lane use

Source: EAFO, 2017.

5.3.2.3 Incentives in the Czech Republic

Table 5 proves that there is lack of strategy for the development of EVs implemented in the Czech Republic. The only incentive, which is an exemption from the road tax, and that is only meant for cars used for business purposes, and compared to the other incentives mentioned above, it does not provide enough encouragement for purchase.

Table 5: Purchase and tax incentives for electric vehicles in the Czech Republic; source: EAFO, 2017.

Incentive category	Description
Registration Tax Benefits	No purchase tax
Ownership Tax Benefits	Electric, hybrid and other alternative fuel vehicles are exempt from the road tax (this tax applies to cars used for business purposes only).

5.4 Economic Factors

5.4.1 Sales of Vehicles

The number of registered vehicles has been oscillating around 300 thousand pieces, in 2015 and 2016 showing significant increase in comparison with the previous years (see Table 6). The reason is the end of financial crisis in the country, so the consumers were encouraged to purchase more. The number of registered cars hit the record of 259 693, which is 12. 94% more than the previous year.

Trends in sales of new cars can be estimated on the basis of GDP development and the relative comparison of the number of cars per capita GDP among countries with similar traffic patterns. The volume index of GDP per capita in Purchasing Power Standards is used for county comparisons among the EU 28. [45]. In 2016, GDP per capita of the Czech Republic expressed by PPS within the European Union was 87%.[46]

Table 6: Registered and discarded vehicles in the Czech Republic

	2011	2012	2013	2014	2015	2016
Registered Vehicles	**304 989**	**298 352**	**290 851**	**312 722**	**382 191**	**424 115**
- **New**	173 282	174 009	164 736	192 314	230 857	259 693
- **Used**	131 707	124 343	126 115	120 408	151 334	164 422

[45] If the index of a country is higher than 100, this country's level of GDP per head is higher than the EU average and vice versa

[46] *GDP per capita in PPS*. In: EUROSTAT. [online]. 2016. [Accessed 2017-01-25]. Available at:<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tec00114&plugin=1>

Discarded Vehicles	**172 724**	**172 449**	**164 751**	**164 580**	**195 468**	**201 672**
Total Increase	**132 265**	**125 903**	**126 100**	**148 142**	**186 723**	**222 443**

Source: Based on data from SDA website

Last year, in 2016, there was 271 EVs registered in the Czech Republic, and the newest statistics show that it has increased by further 68 the first months of 2017. Altogether, since there was 1067 EVs driven, most of them registered in 2015.
Table 6 shows the registration numbers of BEVs in the Czech Republic over years. The most sold electric vehicle is Nissan Leaf, counting for 173 vehicles in the country.

5.4.2 Exchange rates of the Czech crown toward EUR and USD

The exchange rate CZK/EUR plays a vital role for the price of power electricity and the vehicles imported from other European countries where the euro currency is used.
The figure X demonstrates the exchange rate between CZK and EUR. The depreciation in 2013 was caused by the Czech national bank's attempt to slow down the disinflationary trends. CNB then committed to keep the exchange rate around 27 CZK/EUR.

Figure 5: Exchange range of the Czech crown CZK/EUR

Source: Exchange rates of CSOB Bank

American dollar and the Czech crown has an impact on the price of the fuel, lithium and the vehicles imported from the United States. Figure 5 demonstrates the CZK/EUR exchange rate.

Figure 6: Exchange rate of the Czech crown CZK/USD

Source: exchange rates of CSOB Bank

Figure 6 depicts the average oil price development of crude oil, type Brent. Brent serves as one of the primary benchmarks of crude oil, and it is priced in U.S. dollars, therefore the consumption of oil is as well a subject of exchange rates.

Volatility of oil prices can be seen as opportunity or threat for electric vehicles. The average prices were rising until 2014, then dropped and the price was oscillating further until now, in CZK the average price for crude oil was 27.9 CZK/liter.

5.4.3 Crude Oil Prices

Figure 7 depicts the average oil price development of crude oil, type Brent. Brent serves as one of the primary benchmarks of crude oil, and it is priced in U.S. dollars, therefore the consumption of oil is as well a subject of exchange rates.

Volatility of oil prices can be seen as opportunity or threat for electric vehicles. The average prices were rising until 2014, then dropped and the price was oscillating further until now, in CZK the average price for crude oil was 27.9 CZK/liter.

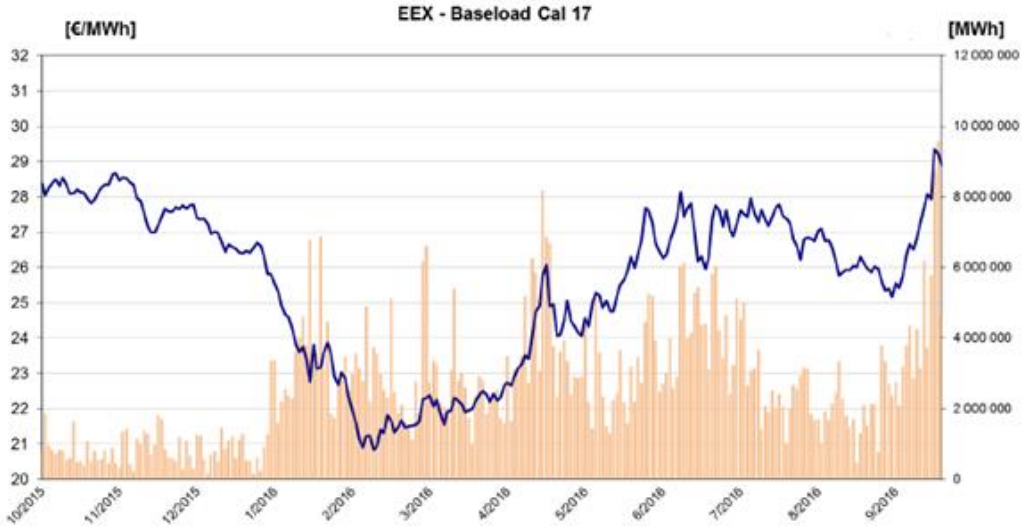
Figure 7: Development of crude oil price (type Brent)

Source: Nasdaq, 2017

5.4.4 Electricity Prices

Figure 8 depicts the electricity prices at the European Energy Exchange, leading energy exchange in Central Europe. It shows electricity prices quoted in EUR per MWh, including trading volumes. For the first half of the previous reporting period there was a decrease in prices of basic products, the period occurred contrary. The resulting average annual decrease at the price of electricity in euro is approximately 20.5%.

Figure 8: Electricity spot-price



Source: EEX, 2017.

5.5 Socio-cultural Factors

Electric vehicles are still not available to a wide range of inhabitants in the Czech Republic. When speaking of the target group, the age does not play any role, rather than the social class. It is mostly upper-middle class that is capable of inhering an electric vehicle. Moreover, the target group of EV brand Tesla Motors is a person beyond affluent, being both passionate about addressing environmental problems, and being tech savvy, with a strong sense for luxury.

As electric cars are still in their initial phase of deployment, so called early adopters play a vital role for the edification of society. They can be characterized as consumers that are generally environmentally conscious addressing global environmental issues, sustainable mobility, and such. They make buying decision based on benefiting broader society, with other consumer benefits that they can appreciate. The limited driving range made electric vehicles be used only within city commutes, but requirements and expectations of potential EV adopters are changing. Potential consumers place importance on range on a single charge, time needed to charge, and upfront cost (because of the large and expensive batteries in electric cars).

Overall, electric vehicles are commonly used for daily travel, especially to work, and the average electric vehicle drives about the same number of kilometers annually as an average conventional vehicle. Most owners do not change their travel patterns and most electric vehicles are bought to replace a conventional car. For a number of reasons, many consumers do not see electric vehicles as a credible transport option. These include cost, user requirements, limited information and technological uncertainty (in comparison with the more familiar conventional vehicle technologies), as well as certain country‑specific factors.

Trends concerning the industry puts an emphasis on single people who do not necessarily need to own a car on their own. Thus, car sharing service of EVs has been introduced by many companies. This trend might aid with a boost of EV adoption in near future. It is already showing steady growth in Europe. For example, third of German population in urban areas are happy users of such service, for example: Car2Go, DriveNow, Flinkster and Autolib' are some of the car-sharing services that are using EVs.

Another trend are smartphone apps that show drivers availability of charging points in the desired location. For instance, ChargeMap.com, a community-based lists all the charging points accessible worldwide. Both mobile and website version is available for users.

5.6 Technological Factors

Technological advances are going to be a key factor for development and deployment of electric mobility. It is necessary to increase the capacity of operation, durability, and extreme condition handle together with a decrease of price, which as it was already mentioned, is possible with commerciality of EVs. Another technological factor refers to charging points whose durability would exceed ten years, and the ability of the devices to process sufficient amount of electricity, and to be able to produce such amount of electricity that would satisfy demand. Threat of the technology of EVs is in the substitutes that might eliminate the demand for EVs. It could happen if the technology of the substitute would improve, namely if the effectivity of the combustion engine would increase, or if the prices of alternative fuels would decrease. Engines based on compressed natural gas might benefit if the price of natural gas decreases. This technology is already gaining popularity thanks to a combination of consumers having the chance to have an own pumping station, which is used widely in distributed natural gas, forklifts and compressed natural gas cars.

5.7 Ecological Factors

The fundamental concept of EVs introduction to the wide population is for environmental reasons as they are to exhaust no local emissions and no noise pollution in comparison with conventional vehicles. They generate so called “positive externalities” as for the environment and helping nations fight the dependency on oil imports. Nevertheless, in order to understand an environmental impact a production of EVs might have on the environment, one must look at the production of EVs from the perspective of the entire process of producing them. First of all, electric vehicles are more energy-intensive to produce than conventional ICEs. They need around 70 % more primary energy to make, especially for the production of electric motor and batteries. Batteries used in EVs can include several negative elements, such as lantganum, nickel, or cobalt that can cause harm to both environment and health. However, the technology is improving and previously an

important but toxic part of batteries – cadmium, is no longer used in modern lithium-ion batteries.

The overall environmental impact lies in the source of the electricity used during its operation. The development of electric vehicles and increased use of night stream could lead to higher efficiency and electricity generation when they generators with greater regularity will be used. As a result, the amount of capacity that is used only during the day or on a monthly basis will be limited.

5.8 Rivalry among current competitors

5.8.1 Conventional manufacturers vs Tesla

The two main groups competing with each other in the industry are vehicles with internal combustion engine and electric vehicles. Regarding EVs specifically, an approach of companies producing EVs vary. One group of producers of EVs produce traditional ICE vehicles, and thus, the production of EVs is not their main focus and many times results from the regulations of governments to meet certain quota of EV production, whilst the other group is solely focusing on production of EVs, its development of technology, etc.

5.8.2 Conventional car manufacturers producing electric vehicles

As it was already mentioned in the chapter of history of electric vehicles, the first conventional car producer introduced an electric model of car "EV1" in order to meet requirements of the state of California. However, nowadays it is not exclusively a result of legislation for conventional car manufacturers to launch their own EVs, rather a way of expanding their portfolio for the reason of following the trends and staying competitive as a brand.

Although the offer of EVs on the Czech market is not as wide as in the US, Scandinavia or other neighboring European countries, there are several models of EVs available for purchase. With an expansion of infrastructure, the offer of EVs on the Czech market will definitely expand.

5.9 Threat of substitutes

Substitutes of electric vehicles are those vehicles that use an alternative source to power the vehicle, as oppose to conventional ICE. It refers namely to hybrids, and in the last years vehicles running on compressed natural gas (CNG) and liquefied petroleum gas LPG. In the next part, some of the comparisons of electric vehicles with their substitutes are mentioned.

In terms of the comparison of the purchase prices, the least expensive cars are conventional ones. Vehicles on CNP and LPG are significantly higher, then even higher purchase price have hybrid type of vehicles, and the most expensive ones on the market are still electric vehicles. In terms of the operating costs on daily basis, electric vehicles have an advantage as they do not consist of many parts that would need much maintenance.

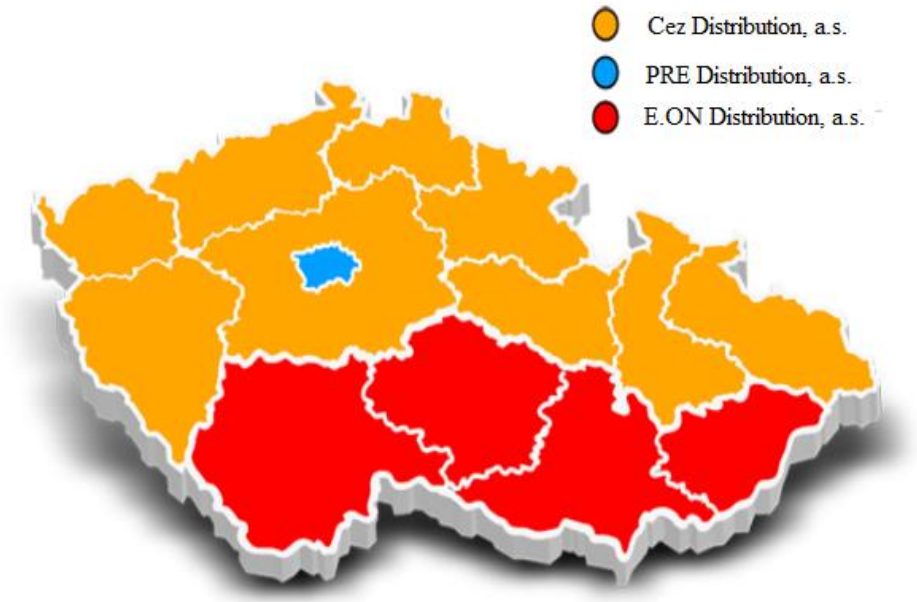
From the ecological point of view, naturally, the most harmful vehicles are conventional ones, and the most ecological are electric vehicles that can potentially exhaust zero emissions. Very promising technology that could compete with electricity-powered vehicles are fuel cell hydrogen vehicles, but the technology has not been implemented and is still developing.

5.10 Power of suppliers

There are three electricity distributors for recharging points on the Czech market: CEZ Distribution, E.ON Distribution and PRE Distribution. Each of them operate in different locations[47]:

- CEZ Distribution ensures distribution of electricity in Pilsen, Carlsbad, Central Bohemia, Usti over Labe, Liberec, Hradec Kralove, Pardubice, Olomouc and Moravia-Silesia region
- E.ON Distribution covers the area of southern Bohemia and southern Moravia
- PRE Distribution distributes electricity in Prague and in town Roztoky

Figure 9: Location of electricity distributors in the Czech Republic



[47] *Distributor or supplier? Who is who.*. In: Elektrina.cz [online]. 2014. [Accessed 2017-03-014]. Available (in Czech) at:<http://www.elektrina.cz/distribuce-elektriny>

Source: <elektrina.cz>, 2017.

The above mentioned shows that a supplier can be in certain area only one. However, it does not mean that the distributor have power over its customers because the actual distribution of electricity as well as its price is subject to regulation by the Energy Regulatory Office. The prices for distributing electricity are set each year, and are published in Energy Regulatory Journal Moreover with different prices for specific tariff. Moreover, ERO implemented convenient low tariff to recharge EVs overnight, tariff C27d for entrepreneurs and smaller companies, tariff D27d for households.[48] Household users of electricity can save up to 50% on each Kwh thanks to green recharging.

What could be an opportunity to improve the development of EVs and the infrastructure in the Czech Republic can be done through direct subsidies, or an American style of EV funding.

5.11 Power of customers

Power of customers is strong in this case because a purchase of EV is a significant investment. Thus, customers are willing to devote their time to map the market, compare their options of different EVs together with other alternatives. Moreover, consumers do not perceive EVs as a credible transport option. One of the reasons is that consumers have limited information compared to the conventional technologies, information about charging points, access and payment methods. This lack of comprehension of their capabilities result in having to expect more problems regarded the usage of EVs than the users actually face in reality.

The biggest obstacle, however, for consumer to make the purchase decision stays the price. A solution for this case is seen in so called "total cost of ownership". It is a measure tool used to offset the costs linked with the purchase and usage of EV so that it would get to the price level comparable with conventional vehicles. It usually includes monetary incentives such as tax exemptions, reduced electricity prices and proportionally smaller costs for charging infrastructure.

[48] *Energy Regulatory Journal*.. In: Elektrina.cz. In: Energy Regulatory Office [online]. 2014. [Accessed 2017-03-20]. Available at:<https://www.eru.cz/documents/10540/2041142/ERV_11_2016/7d55bec4-1526-4aec-858e-f01b2efe838e>

It was found out as well that consumers have a wrong perception of EVs being not suitable for everyday requirements, especially in terms of range and charging limitations. They are particularly concerned about battery life expectancy although it is very unlikely the battery would fade below 80 % capacity before 250 000 km.[49]

To sum it up, in order to become successful, EVs need to be perceived as reliable in the eyes of consumers. There is a need to inform the public that the driving range and the recharging time will not influence regular daily operation of the car. The driving range is therefore crucial when decision making to purchase an EV. Driving range under 100 km is unacceptable for consumers, especially in areas outside urban zones. Determining is well the need to decrease so called "range anxiety", which is defined as *the fear that a vehicle has insufficient range to reach its destination and would thus strand the vehicle's occupants.* A solution for this would be a development of infrastructure of fast charging vehicles on larger scale.

5.12 Potential of new entrants into the industry (Barriers to entry)

The threat of potential new entrants is low due to the strong position of already existing players in the market. They, however, face the obstacles as well when building an infrastructure for the EVs. There are several barriers listed further in this part that a provider of charging points might face when entering market with new charging points.

5.12.1 Availability of electrical power in the area

Building a charging point, especially fast charging one, requires certain level of electrical power. Building a new electrical power network of strengthening an existing one is cost and time consuming.

5.12.2 Contract with land owners

Land or a building for building a new charging point are in most cases owned by third parties (a parking lot, a shopping mall). The aim is to come into consensus for a cooperation in long term since the costs associated with building such charging point are significant, and a short-term cooperation would not bring enough effectiveness, but high

[49] *Electric Vehicles in Europe.* In: European Environment Agency [online]. 2016. [Accessed 2017-02-014]. Available at:<http://espas.eu/orbis/sites/default/files/generated/document/en/Electric-vehicles2016_THAL16019ENN.pdf>

risk. Moreover, building such charging point on an owner's land does not seems very motivational due to low or zero profitability in the first years, and therefore it is hard to motivate them with for instance attractive rent.

5.12.3 Construction administration

Land or a building for building a new charging point are in most cases owned by third parties (a parking lot, a shopping mall). The aim is to come into consensus for a cooperation in long term since the costs associated with building such charging point are significant, and a short-term cooperation would not bring enough effectiveness, but high risk. Moreover, building such charging point on an owner's land does not seems very motivational due to low or zero profitability in the first years, and therefore it is hard to motivate them with for instance attractive rent.

5.12.4 Regulations

There are still not enough regulations defined to protect users of electric vehicles, such as no strict rules and ban on usage of parking spots.

5.12.5 Technology

As the electric vehicles are associated with limited driving range. Sufficiently dense infrastructure can aid to eliminate the "range anxiety"[50], however, as the development of the technology for the charging points continues, it is necessary to be able to react to those changes, and provide a consumer with an up-to-date charging point technology.

5.13 Complements

In general, there are three way of recharging EVs at recharging points. Level 1 charging uses the same 120-volt outlets that can be found in standard households. By installing such outlet, any residents can charge in their garages with no need to add any electricity upgrades. Level 2 charges the battery faster than the one of level 1, using 240-volt outlet. This type of charging requires installation of additional electricity updates in order to

[50] *Range anxiety is scaring people away from electric cars — but the fear may be overblown.* In: Washington Post [online]. 2016. [Accessed 2017-02-08]. Available at: <https://www.washingtonpost.com/news/energy-environment/wp/2016/08/15/range-anxiety-scares-people-away-from-electric-cars-why-the-fear-could-be-overblown/?utm_term=.592b90447b1d>

handle higher voltage power, it is referred to as AC. On the other hand, Direct Current (DC) fast charging provides compatible vehicles with an 80 % charge in 20-30 minutes.

As far as fast-charging infrastructure, according to the EU Directive 14/94/EU, it is proposed to use CCS (Combo) charging connector, by following of this standard being adopted by Germany car makers. However, it is allowed during the transition period throughout 2091 to be installing CHAdeMO connectors. The solution for this proposition of the EU is an installation of multi-standard fast-charging stations, which allow the usage of both connectors.[51]

Figure 10 depicts a map of all the charging points in the Czech Republic. The newest statistics say that there are around 450 charging points in the country, which around 300 are simple AC charging points, and the rest are DC fast charging points.[52] The first charging points was built in 2014 by Cez Group. Since 2015 the number has been increasing and the main players on the market are planning on further expansion for this type of fast recharging.

Figure 10: Map of available charging points in the Czech Republic

Source: hybrid.cz, 2017.

[51] *DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the deployment of alternative fuels infrastructure.* In: EUR – Lex [online]. 2014. [Accessed 2017-03-03]. Available at: < http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en>

[52] *Czech Republic Summary* In: EAFO [online]. 2017. [Accessed 2017-03-24]. Available at: <http://www.eafo.eu/content/czech-republic>

5.13.1 CEZ

CEZ is the biggest player on the market. The map (Figure 11) indicates the location of the charging points. The company already built 71 charging points, from which 45 charging points are AC (green points in figure) and 26 DC fast chargers (orange points). The charging points are mostly located in the surroundings of cities, near shopping malls, which is logical, as the consumers can spend time at the shopping mall whilst the vehicle is recharging. The website where the map comes from is an interactive map, there one can find a specific address of a charging point with GPS position data, as well as the type of chargers available and its current state.

Figure 11: Charging points of CEZ Electromobility

Source: Website of CEZ - /E/Mobility, 2017

5.13.2 PRE

PRE introduced a number of projects in electromobility: PREmobility. The very first project was for charging points, called PRE "Charging". It was a network of charging points named ePoint in the capital city of Prague. As it indicates on the map (Figure 12), the vast majority of the charging points are located in the city of Prague, but there were also built charging points in Brno, Ostrava, Plzen, and Ceska Lipa.

Figure 12: Map of charging points of PRE

Source: <premobilita.cz>, 2017.

Till the end of 2013 all the charging points of PRE were for free. As of 2014, the use of charging stations is charged. The price list of PRE is as following: 3.03 CZK/kWh for the used electricity, and 0.2 CZK/min is the price for charging. The charging service of PRE however allows to have first 120 minutes of charging for free. As well as CEZ and E.ON, PRE offers different types of charging points, 30 AC charging, and only one DC fast charging point in Prague in a shopping mall Chodov.

5.13.3 E.ON

E.ON engages in the field of electromobility with a title "Electromobility Mobility Solutions". The project is called Mobility Smart or "smart mobility" and it involves building an infrastructure for CNG vehicles.

As the first ever in the Czech Republic was built charging stations in the parking area shopping center Vaňkova Gallery in Brno. Recharging for visitors free shopping center. Other stations are located at the following locations: Prague headquarters of Mercedes-Benz in Chodov, Prague locations of Charouz Těšnov and Černokostelecká facilities, airport Brno - Turany.

A new E.ON charging station are located in Humpolec along the E50, which is the main highway between Prague and Brno, has been split into two charging lanes: on one side you have a 6-stall Supercharger and on the other side you have a combination of several other charging standards. It features two DC fast-charging chargers; a CHAdeMO charger

capped at 50 kW and a CCS charger also capped at 50 kW. The station also has a few level 2 22kW Mennekes type 2 chargers.[53]

Not each types of charging point is suitable for any location. Normal charging points drivers especially in restaurants, offices and shopping centers. Most options have drivers in Prague, Brno and Ostrava. On the other hand, lack of charging points is seen in areas around Olomouc Bruntal, Jesenik, Marienbad, Jicin and Zdar.

[53] *Tesla's first Supercharger in Czech Republic is in an impressive charging station*. In: Electrec [online]. 2016. [Accessed 2017-03-17]. Available at: <https://electrek.co/2016/07/19/teslas-first-supercharger-czech-republic-eon/>

5.14 SWOT Analysis

The aim and the outcome of this SWOT analysis is to discover strengths and weaknesses of this technology that are determining its future development. On the other hand, focus on the influences of the macro environment may turn to opportunities and threats for the industry.

5.14.1 Strenghts

- Energy efficiency, dynamics, and safety
- Create positive externalities
- Well-functioning platform for the development among distributors
- Scarcity of fossil fuels whose price will increase significantly in the future

5.14.2 Weaknesses

- Purchase price of Evs is significantly higher than of the ICEs, especially due to the price of the battery (which costs around 10.000 US dollars and beyond)
- Low or no regulations to fasten the process of building an infrastructure, especially appearing as an inconsistency in the approach of contruction offices to give permissions
- Limited access to charging points due to the lack of built infrastructure
- Lagging behind the neighboring countries in terms of implementation of tax, purchase, or local incentives
- Limited information and technological uncertainty of potential consumers

5.14.3 Opportunities

- Reduction on the oil dependence
- Reduction of emissions and pollution in the areas with intense traffic in urban areas
- BEVs and PHEVs are the only types of EVs that require specific infrastructure to be built in order to recharge their batteries, creation of new innovative business models, and services related to their charging infrastructure
- Pressure from the legislation of the European Union to meet the targets set in the directives and other regulations

- Development of batteries in terms of their capacity that could have an impact of lowering the price per 1 kWh, and subsequent the overall decrease of EV prices. It occurs to be just a matter of time when the technology improves, and the technology would be commercially available, and not dependent on early adopters anymore
- EV charging can influence demand of kWh at certain times in certain areas. Therefore, the development of smart ICT systems, which would lead to smart charging, during off-peak times, otherwise it could result in either transformer or cable overloads
- Developing of awareness and of public about the perks of deploying the EVs
- Shift towards electromobility as a service in dense urban areas, where alternative ways of EVs, such as car-sharing services, can be implemented
- An increased use of night stream could lead to higher efficiency and electricity generation
- Cooperation of state bodies, ministries and offices to facilitate the bureaucratic processes linked to licensing, permissions with building infrastructure

5.14.4 Threats

- Incompatibility of charging points of different distributors both in the Czech Republic and in other European countries. Infrastructure of charging points for electric vehicles has no borders, EVs should be able to get recharged in any European country and consumers should not face any obstacles
- Increase in electricity prices due to increasing prices of power electricity, and charging the use of renewable resources
- Lack of motivation for the land owners where potential charging points could be built due to the initial inprofitability of providing a charging point in the first years of its operation

5.14.5 Summary of SWOT analysis

After assessing all the points in SWOT analysis, it is correct to say, that the current situation with the development of the technology is stagnating due to the lack of infromation of the public, lack of legislation and incentives, and the lack of infrastructure built. Thus, the recommendation for state bodies and distributors of energy via charging points will derive from these findings.

5.14.6 Forecast

It is expected that by 2020 the annual sales will reach the number of 7,000 EVs in the Czech Republic. This represents about 3% of the market and only a small lag behind Western European countries where this share is expected to be between 5 and 10%.[54] Building new infrastructure would be possible via European fund "The Connecting Europe Facility for Transport" which has total budget of €24.05 billion for the the period 2014-2020.[55] By this fund the European Commission supports connecting Europe by building charging stations along the main road of Trans-European Transport Networks.

According to a survey of the Ministry of Environment, 48% respondents would prefer an electric vehicle over any other type of an alternative fueled vehicle. Moreover, it is expected that there will be 6000 BEVs and 11 000 PHEVs registered in the Czech Republic by 2020. The growth rate is expected to be around 7%.

Figure 13: Prediction of EV sales

	Current State	Vision 2020
BEVs	Around 1000	6000
PHEVs	Around 250	11 000

[54] *Electromobility in the Czechia*: recession occurs after growth in sales In: Energie Portal [online]. 2017. [Accessed 2017-03-16]. Available (in Czech) at: <http://www.energie-portal.sk/Dokument/elektromobilita-v-cesku-po-recesii-nastava-narast-predaja-103652.aspx>

[55] *Connecting Europe Facility* In: EC [online]. 2017. [Accessed 2017-03-16]. Available at: <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport>

Source: Based on the presentation of the Ministry of Environment, 2016.

In terms of new models BEVs and PHEVs introduced on the Czech market, Skoda will introduce its first PHEV in 2019. Following the indtroduction of this hybrid, Skoda automaker has announced that another BEV will be announced some time after, and that by 2025, there will be introduced 4 or 5 new models of BEVs.

6 Results and Discussion

This part of the thesis comes from the obstacles mentioned in the current state of EVs and charging points in the Czech Republic, as well as weaknesses, but it also uses the strengths to eliminate threats and grip the necessary opportunities.

Electric vehicles are still sold only in dozen of pieces in the Czech market, except for the programs supported by the main players, they are still being commercially unavailable to the wide range of consumers, and being unable to compete with vehicles powered by internal combustion engine. One of the main reasons is seen in the lack of information of the public about the capabilities of this technology, as well as the high price, which is seen as the greatest obstacle to make the purchase. The situation with charging points for electric vehicles is however improving, and the main players on the market providing charging points keep building infrastructure, compared to other European countries such as Germany, Norway, or Estonia at rather slow pace. Electric vehicles and charging points cannot exist without one another, and development of one depend upon the other one. It is, thus, necessary to be developing technologies and strategies for both in order to see significant improvement in foreesable future. The fact that they create positive externalities should be highly considered by the state authorities whose power lies in providing incentives, and funds to support this technology on the Czech market.

The following recommendations are tailored for two groups involved in the industry. On one hand, state bodies whose support lies in the succes and improvement of the technology. On the other hand, the main players on the market providing electric vehicles without which the charging point infrastructure would not be able to continue to be built.

6.1 Recommendation for state bodies

6.1.1 EV awareness campaign

The perks, and capabilities of the usage of electric vehicles are not known to the public. There has been no platform created for that so far. This recommendation comes from the idea that the support and development of this technology shall be supported via progressive education. It could be done so in two areas:

- Public EV campaign: An information campaign on electromobility to inform the public about the long-term benefits of electromobility, to give awareness to the public about the sustainability of this type of road transport, to keep the public up-to-date with latest strategic targets, and plans, as well as the incentives related to the purchase decision-making.
- Public school education: Including information about electromobility into curriculum of public schools should not be omitted. The education could start as of high school level. Second of all, the teachers at all levels of education regarding technical schools at national level should expand their knowledge of this topic through seminars.

6.1.2 Simplification with administrative burden for building an infrastructure of charging points

Before the construction of a charging point can start, there are several bureocratic processes required. The bodies do not have any rules, or legislation linked with charging points. Therefore the creation of legislative methodology, defining a charging point as a small construction, would ease the process for stakeholders to obtain a permission faster and under certain set condition.

6.1.3 Extended parking priviliges

Blue zone in urban areas indicated by a blue stripe (vertical and horizontal markings) is intended to be used for “residential parking”. Only drivers with valid parking permission can park their vehicles in such zones who obtained it due to either having a residential card in the area, owning a propery, or running business there. Other drivers are allowed to park in the blue zone after paying a fee. The aim of this recommendation is to allow owners of electric vehicles, to park in such zones for free of charge for at least one year of owning an EV, with a promise of discounted parking spot after this period. The reason of this action is to encourage purchase of an electric vehicle over a conventional one. This action was already undertaken in Germany, in Stuttgart, as of 2014.

Public parking lots are also a good area of interest when it comes to local incentives. Paying for parking a vehicle is a factor that discourage people from driving, and therefore this incentive is a great way to priorize those with low emission electric vehicles. They could be used as another local incentive to allow drivers of electric vehicles park at parking

lots where there is a fee charged normally. As an inspiration, in Amsterdam the parking is completely free of charge for public parking lots, whereas in Rotterdam this perk is allowed for one year only.

The decision whether to implement this incentive is however on each municipality, and could be implemented at least in the largests cities in the Czech Republic. These type of indirect local incentive was already implemented in several European cities, such as Stuttgart, London, Paris, and Amsterdam.

6.2 Recommendation for providers of energy through charging points

6.2.1 Expanding fast-charging infrastructure

One of the greatest threats for potential consumers to purchase an electric vehicle is the "range anxiety", which describes a situation drivers fear from knowing that there would be not enough charging points along the way and that they would be unable to finish their journey. This negative phenomena can be overcomed by building a well-organized charging infrastructure of charging points. The lack of charging infrastructure is in the fast charging points, currently 156 are available throughout the country.

The total length of roads and highways is around 56,000 km in the Czech Republic. If we take into account building an infrastructure on the highway network, that would be to cover an area of approximately 2095 km. If the charging points were to be places each 50 kilometres, it would have to be built around 41 new charging points. Also, if an electric vehicle consumes 14 kWh/hour[56], the vehicle is able to drive beyong 110 km. It generally satisfies drivers who want to go on a longer journey and be able to recharge their vehicle in a relatively short time.

The Anex III.1.1.2 EU Directive on the alternative fuels infrastructure states that Direct Current (DC) charging points for EVs *shall be equipped, for interoperability purposes, at least with connectors type Combo,* that is to say that each newly built charging points should be multistandard, consisting of both Combo and CHAdeMO type of connector, which allows to recharge any type of electric vehicle. Charging of DC power 50 kW are much faster, allowing 80% of the charge capacity of the battery between 20 and 30

[56] Calculated for the standard model Renault Fluence

minutes. Figure 14 depicts connector 3 types of connectors that are used in multi standard charging points, where Mennekes is an AC normal charging connector.

Figure 14: Different types of charging connectors for charging points

Source: Website of CEZ - /E/Mobility, 2017.

Building new infrastructure would be possible via European fund "The Connecting Europe Facility for Transport" which has total budget of €24.05 billion for the the period 2014-2020. There has been no calculation done for the costs of the construction as it is not in the scope of the thesis, and this information might

Figure 15: An overview of the recommendation for expanding charging points in the Czech Republic

Location	Highway nodes
Density	Each 50 km
Type of a charging point	Multi-standard fast
Type of a journey	Long journey
Funding	CEF fund

Source: Author's work

Another question is, however, the location of the fast charging points. As it would be on the main highways, it can be assumed that regular gas stations would be a suitable location to place them on. However, to determine, what exact brand of gas stations would be the most apt one would require further analysis, which does not fit in the scope of the thesis. Another point for further strategies is the additional service that could be added to the time drivers spend whilst waiting for their electric vehicle to recharge. It is a great way to generate income, and create another business opportunities.

Conclusion

The main aim of this thesis was to come up with recommendation of appropriate industrial strategy for state bodies and distributors of energy via charging points for the electric vehicles in the Czech Republic with a purpose to utilize the strategic opportunities. This aim has been fulfilled and the author stated what strategic opportunities could be undertaken so that the market could develop.

Electric vehicles are still sold only in dozen of pieces in the Czech market, except for the programs supported by the main players. The vehicles are yet commercially unavailable to the wide range of consumers, and unable to compete with vehicles powered by internal combustion engine. One of the reasons is that the price of the EVs are significantly higher than of the conventional vehicles, the battery being the most expensive component of the vehicle. The market has to largely rely on the early adopters who are the greatest force for the market to keep going. As oppose to Western European countries, the biggest players on the market are not attracted to introduce more EV models since the market is growing at a rather slow pace, and the offer is thus highly limited, which prevents the industry to grow. Moreover, the market with electric vehicles cannot develop as well if there is not a sufficient infrastructure of charging points built for EVs. It is, thus, necessary to be developing technologies and strategies for both in order to see significant improvement in foreesable future. Providing incentives to support the development of the industry has been a succesful step in many European countries. However, Norway as a leading country in this technology in Europe has stated that the support from the state bodies is just temporary in order to build the infrastructure and bring awareness to encourage the purchases.

The outcome of the two strategic tools applies were as following. Without the support of the state bodies implementing more incentives to help with the development of the market, the technology is unable to grow, and become commercially available, therefore the need of incentives is requisite. A recommendation for extended parking priviliges was suggested as an indirect form of an incentive. Resulting from the findings of the current situation, it there were recommendation made for state bodies to simplificate the bureocratic obstacles the distributors of charging points face before starting a construction.

Another issue concerning the industry is the lack of information provided for the public. Recommendation for such purpose was introduced, such as creating EV campaigns for the public, as well as educating teachers and students about this technology.

Furthermore, the so called “range anxiety“ that potential consumers fear when taking on long journeys may be overcome by expanding the existing offer of publicly accessible charging points throughout the country along the main highway network, approximately each 50 kilometers with fast charging points with multi standard connectors. Building new infrastructure would be possible to fund via European fund “The Connecting Europe Facility for Transport” which has total budget of €24.05 billion for the the period 2014-2020.

The findings are general and their aim is to serve as recommendation for pursuing further strategies to develop the market in the Czech Republic.

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