Market analysis for electric vehicle supply equipment: The case of China

ANDREY BUSK
ARVID JOELSSON WARRENSTEIN

KTH Industrial Engineering and Management

Master of Science Thesis
Stockholm, Sweden 2014

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Analys av marknaden för laddnings-utrustning för elbilar: Fallet Kina

ANDREY BUSK
ARVID JOELSSON WARRENSTEIN

KTH Industriell teknik och management

Examensarbete
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Godkänt	Examinator	Handledare
2014-06-11	Pär Blomkvist	David Bauner
	Uppdragsgivare	Kontaktperson
	Hong Kong EV Power Ltd.	Martin Tsang

Sammanfattning

Personliga eldrivna fordon (EV) är ett nytt teknikområde som är på väg att uppnå stort momentum på flera av världens marknader. Eftersom branschen fortfarande ligger i sin linda finns det i nuläget inga tydliga strukturer, som gäller för alla marknader världen över, gällande relationerna mellan aktörer, vilket leder till osäkerheter när det kommer till att ta strategiska beslut. Uppdragsgivaren för denna studie är Hong Kong EV Power Ltd. (EV Power), en Hongkong-baserad leverantör av laddningsstationer för elbilar och relaterade tjänster, som har ambitionen att inträda marknaden på det kinesiska fastlandet inom den närmaste framtiden. Emellertid har EV Power ännu inte bestämt sig vilken stad de vill rikta in sig på i det första skedet.

Denna avhandling ämnar formulera en modell som kan användas för att utvärdera och jämföra geografiska marknader med avseende på lämpligheten för ett marknadsinträde av en leverantör av laddningsstationer för elbilar. Dessutom kommer modellen testas på tre städer på kinas fastland (Peking, Shanghai och Shenzhen), med syfte att komma fram till vilken stad som är mest attraktiv för EV Power, samt att utvärdera modellens funktionsduglighet. Sist kommer resultaten från utvärderingen av de tre städerna att tjäna som utgångspunkten för en analys som ämnar ta fram framgångsfaktorer för ett marknadsinträde på kinas fastland.

För att uppnå detta har fyra olika datainsamlingsmetoder använts: Först studerades teori, med syfte att få bakgrundskunskap likväl som att få förståelse för specifika faktorer som påverkar ett marknadsinträde som detta. För det andra observerades EV Powers nuvarande verksamhet i Hong Kong, i avsikt att förstå vad som har lett till den framgång som företaget upplevt på sin hemmamarknad. För det tredje intervjuades branschexperter för att få ett perspektiv på branschen som helhet. Sist samlades sekundär data kring de tre städerna in, för att kunna utvärdera de olika faktorerna som ingår i den framtagna modellen.

Den slutgiltiga modellen består av fem faktorer som påverkar en stads attraktivitet för ett marknadsinträde av en leverantör av laddningsstationer för elbilar. De identifierade faktorerna är: 'Marknadens tillgänglighet', 'Kortsiktig efterfrågan', 'Förväntad marknadsandel', 'Vinstmarginal' och 'Långsiktig produktpotential'. Dessa faktorer är i sin tur indelade i subfaktorer som har sina egna uppsättningar av drivare. Efter att ha använt modellen för att utvärdera de tre städerna konstaterades det att Shanghai är den lämpligaste staden för ett marknadsinträde av EV Power, främst på grund av stadens dominans på marknaden för privatanvända elbilar och ett gynnsamt regelverk. Slutligen hittades tre framgångsfaktorer för ett sådant inträde: 'Fokusera på tjänster', 'Bibehåll partner-relationer' och 'Inträd tidigt'.

Nyckelord: *Eldrivna fordon, elfordon, elbilar, elektriska fordon, e-mobilitet, laddning av elbilar, laddinfrastruktur, marknadsanalys, marknadsinträde, Kina, tillväxtmarknad, nya teknikområden, SMF, små och medelstora företag, uppstartsföretag*

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Andrey Busk
Arvid Joelsson Warrenstein

Approved	Examiner	Supervisor
2014-06-11	Pär Blomkvist	David Bauner
	Commissioner	Contact person
	Hong Kong EV Power Ltd.	Martin Tsang

Abstract

Personal electric vehicles (EV) is an emerging technology that has gained much momentum in several markets during the past decade, and China is currently one of the markets where the growth in EV sales is the highest. Since the industry is still in its infancy, there are currently no clear structures regarding the relationships between different actors that apply to all markets globally, leading to great uncertainty in strategic decisions. The commissioner of this study is Hong Kong EV Power Ltd. (EV Power), a producer of EV supply equipment (EVSE) and related services in Hong Kong, which aspires to enter the Chinese mainland in the near future. However, EV Power has yet to decide which city they want to target first.

This thesis aims to formulate a model that can be used to evaluate and compare geographic markets for a market entry by an EVSE company. Furthermore, the model is tested on three cities in Mainland China (Beijing, Shanghai and Shenzhen), in order to derive the most attractive city for EV Power and to evaluate the adequacy of the model. Lastly, with the results from the city evaluation, as a point of departure, success factors for an entry into Mainland China by the commissioning company will be summarized.

In order to achieve this objective, four distinct data collection methods have been used: First, theory was studied, in order to gain background knowledge as well as to understand specific factors that impact a market entry decision such as this. Second, EV Power’s current business in Hong Kong was observed, with a view to achieve an understanding of what has led the company to experience success in its home market. Third, Interviews with industry experts were conducted, so as to get a perspective on the industry as a whole. Fourth and last, secondary data for the different cities was collected, for the sake of evaluating them according to the developed model.

The final model consists of five main factors that encompass the elements that influence a cities level of attractiveness for entry by an EV charging station supplier. The identified factors are: ‘Market accessibility’, ‘Short-term demand’, ‘Expected market share’, ‘Profit margin’, and ‘Long-term product potential’. These factors are in turn divided into sub factors that have their own set of drivers. Using the model to evaluate the cities, it was found that Shanghai is the most suitable city for a market entry by EV Power, mainly due to its dominance in the market for private EVs and a favourable regulatory environment. Finally, three main success factors, for such a market entry, were found: ‘Focus on services’, ‘Maintain partner relationships’, and ‘Enter early’.

Keywords: *Electric vehicle, electric car, new energy vehicle, electric mobility, EV, PEV, Electric vehicle supply equipment, EVSE, electric vehicle charging, charging infrastructure, market analysis, market entry, market attractiveness, evaluation model, China, emerging markets, emerging technologies, small and medium-size enterprises, SME, start-up*

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Moreover, we would like to say thank you to all the people who contributed with their extensive knowledge through interviews. Without which, it would not have been possible to carry out this research. Last but not least, we want to thank Sida Minor Field Studies and ÅF Forskarstiftelse who have provided generous scholarships which made the necessary data gathering possible.

Andrey Busk & Arvid Joelsson Warrenstein
Stockholm, June 2014

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Glossary of terms

Term	Explanation
BEV	Battery Electric Vehicle. All-electric vehicle relying solely on electric motors for propulsion
BMWi	BMW sub-brand which designs and manufactures plug-in electric vehicles
BYD	Build Your Dreams. Popular Chinese OEM based in Shenzhen, China
CLP	CLP Group. Originally China Light & Power Company Syndicate. Hong Kong based electric utilities company
CSG	China Southern Power Grid Company. One of China's two grid operators
Electric car	Car that is propelled by one or more electric motors and is powered by batteries. Also called highway-capable EV
EV	Any electric drive vehicle (vehicles using electric motors for propulsion). Three main types exist; vehicles powered directly from an external power station (e.g. trams), vehicles powered by stored electricity originally from an external power source (PEVs) and those powered by an on-board electric generator such as an ICE (HEVs)
EV Power	Hong Kong EV Power Ltd., the study's commissioner
EVSE	Electric Vehicle Supply Equipment. Products used to charge the batteries of PEVs. Includes all equipment used to deliver energy from an external power source to an electric vehicle.
Fleet	A group of more than two vehicles owned or leased by an institution
GHG	Greenhouse gas
HEV	Hybrid Electric Vehicle. Combines an ICE with an electric propulsion system powered by internal processes (e.g. electric generators, regenerative braking) rather than by plugging into an external power source
ICE	Internal Combustion Engine (refers in this thesis to conventional vehicles which propel by means of ICEs)
LEV	Light EV. Often has two or three wheels and uses electric rechargeable battery. Typically reaches speeds of up to 45km/h.
LSEs	Large-scale enterprises
OEM	Original Equipment Manufacturer. The company that manufactures the final product available to end-users. In this thesis, it is used to refer to automobile manufacturers
Personal EV	An EV (see above) meant for use as personal (e.g. an electric car) rather than mass-transport (e.g. busses, trams)
PEV	Plug-in electric vehicle. Superset including PHEV and BEV and LEV In

	this thesis, it refers to PHEVs and BEVs only
PHEV	Plug-in Hybrid Electric Vehicle. Also; plug-in hybrid vehicle or plug-in hybrid. A hybrid vehicle (see HEV) that makes use of a rechargeable battery that that can be restored to full charge by plugging into an external electric power source
SGCC	State Grid Corporation of China. One of China's two grid operators
SME	Small and medium-sized enterprise
SOE	State Owned Enterprise
Wallbox	Semi-fast EV charger, not to be confused with Charging poles (slow chargers), DC fast chargers or Battery Swap stations

1 Introduction

This chapter begins with a general background to this study and an introduction to the commissioning company. Then, the purpose and the research questions of the study are defined, followed by introduction and overview of the electric vehicle technology, electric vehicle charging, history and development, and the current situation in China. After, the delimitations and the disposition of this thesis are outlined.

1.1 BACKGROUND

Electric vehicle (EV) technology went from being the dominant propulsion method, for almost 100 years ago, to becoming almost non-existent in the eighties and early nineties. In recent years, the technology has experienced a revival, and the momentum is only increasing, with sales growing by around 100% year-on-year in several markets (see Subsection 1.4.2 for a detailed overview of EV history). In fact many original equipment manufacturers (OEMs) have predicted 2014 to be the year of electric vehicles (Roberts, 2014) (Shahan, 2014) (Schaal, 2013). Governments and the public alike have been welcoming of this new development, as it is seen as a way of reducing reliance on fossil fuels, and consequentially, as a mean to reduce pollution and emissions of GHGs (among other benefits) (UK Government, 2012) (US Government, 2014) (Harvard Law, 2012). Nevertheless, the technology has its issues: The main one is the limited range of many of the models, leading to 'range anxiety' (the fear of not reaching the destination due to the vehicles insufficient range) among potential customers, and thus delaying diffusion of this technology (Eberle & von Helmolt, 2010) (Rahim, 2010). This is where charging infrastructure becomes a crucial part of the recipe for success in the diffusion of EVs across the world.

It has become clear that widespread adoption of electric vehicles is dependent not only on characteristics of the vehicles and the publics' perception of the technology itself, but also on the accessibility of charging infrastructure, or electric vehicle supply equipment (EVSE) (Knox, 2012) (IEA, 2013). A high availability of charging stations is in fact a necessity for electric vehicles to become a realistic alternative to conventional internal combustion engine (ICE) vehicles (Knox, 2012) (Hatton, et al., 2009) (IEA, 2013) (He, et al., 2013).

At the moment, there are several competing solutions for how to charge an EV, both in terms of location of the charging equipment and the technology used to charge. These technologies compete among each other for everything from government subsidies to gaining compatibility with the current EV models (see Subsection 1.4.1 for additional information on this). The result is that the resources of the actors that try to facilitate EV diffusion is thinned out over several incompatible infrastructures, instead of being focused on making one of these a viable option. This makes the infrastructure that is supposed to facilitate EV diffusion less effective, but it also makes it harder for individual EVSE companies (which, during the current era of renewed EV interest, often are start-ups or small-medium enterprises (SMEs), with little resources as it is) to grow and expand (Twomey, 2014) (Kuo, 2014).

Little research has been conducted on the business aspect of EVSE (Schroeder & Traber, 2012), and there is a need for investigations into how these smaller EVSE companies should conduct their expansions outside of their home markets. This thesis aims to do just that, which hopefully will facilitate the move towards EVSE as a viable business venture and by extension, increasing the diffusion of EVSE and EV technology.

1.1.1 An introduction to Hong Kong EV Power

The commissioning company for this research, Hong Kong EV Power Ltd. (henceforth EV Power) is a company in the EVSE sector with a vision of "improving people's lives by providing environmentally friendly energy". EV Power's business comprises of developing, manufacturing, installing and maintaining charging solutions for electric vehicles, and the company currently has over 100 charging stations in use in Hong Kong. EV Power wants to contribute to the overall sustainable development of the world and believes that by widening the market for its product, it will do so.

EV Power is a market leader in Hong Kong who now aims to expand in Asia and particularly on the Chinese mainland. The company has a desire to grow rapidly and hence they seeking assistance in selecting a suitable city to enter and a broad-strokes strategy for how to enter this city. EV Power has decided that, for this initial expansion, it is Beijing, Shanghai or Shenzhen they want to enter and their preliminary hypothesis was that Shanghai is the most suitable city.

1.2 PURPOSE

The first and foremost purpose of this study (and the primary contribution to knowledge) is to develop a model for analysing markets suitability for an entry by a small-medium sized EVSE provider. This model should be developed in a way that makes it useful for assessing all and any geographical markets globally, and it should be applicable for any SME that produces or/and services charging equipment for EVs. Additionally, the model development methodology should be applicable to any other similar context of market entry.

Furthermore, the second purpose of this study is to test the created model on three Chinese cities in order to help EV Power to make a decision regarding which city to enter. This process will also help with assessing the adequacy of the developed model. Lastly, the conclusion from this assessment is used in order to advise EV Power on key success factors to consider when making a market entry into the suggested city.

1.3 RESEARCH QUESTIONS

In order to fulfil the purpose of the study, the following research questions have been answered:

RQ1. What are the factors that need to be taken into account when analysing potential markets for a market entry by an EVSE SME producer?

RQ2. Considering these factors, which Chinese city (Beijing, Shanghai or Shenzhen) should EV Power enter?

RQ3. With the results from the previous questions in mind, what are the key success factors that EV Power should adhere to in order to make a successful entry?

1.4 ELECTRIC VEHICLE TECHNOLOGY, AN OVERVIEW

In its broadest sense, the term electric vehicle encompasses a mobile object that transfers passengers and/or cargo, and which uses one or more electric motors for part of the propulsion effort (Anderson & Anderson, 2010). By this definition, EVs can then be divided into personal and mass-transport electric vehicles (Pistoia, 2010). Henceforth, this paper will focus only on personal EVs. Personal

EVs can further be divided into categories based on the exact technology used for propulsion. Figure 1 is a diagram that illustrates the technologies included in the term personal EV.

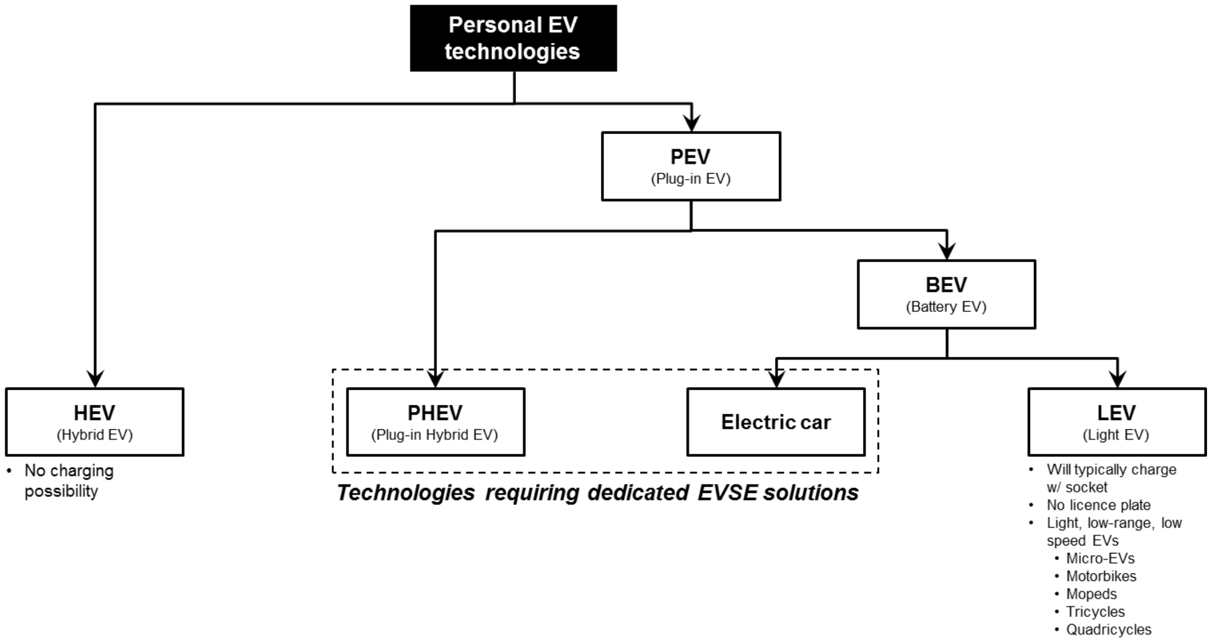

Figure 1: Personal EV technologies (Pistoia, 2010) (Anderson & Anderson, 2010)

For the purpose of this research, the only relevant technologies are plug-in hybrid EVs (PHEVs) and electric cars. Hybrid EVs (HEVs) are hybrids that use ICEs to charge the battery, and thus lack support for external charging. Light EVs (LEVs) have very low performance, and therefore come with a very small battery that can be charged to full by using a regular wall socket in little time. Due to this, contrary to what is shown in Figure 1, for the remainder of this thesis the abbreviations PEV and battery EV (BEV) will exclude LEVs, since that technology are out of scope of this study.

PHEVs make use of both an ICE and electric drive for propulsion. PHEVs can recharge their power storage unit (commonly a battery) by plugging into an external power source. With this technique, depending on daily mileage and chosen charging strategy, the electric drive may become the main power source, with the ICE being a backup (Pistoia, 2010) (Anderson & Anderson, 2010). The main advantages with PHEVs compared to ICEs or even HEVs are better fuel economy, better performance and smaller environmental impact (Electric Power Research Institute, 2007) (Argonne National Laboratory, 2009).

Electric cars, often called simply EVs or highway-capable EVs, are personal automobiles propelled solely by electric motors. This leads to electric cars being even more environmentally friendly, having even better fuel economy and even better performance. The drawbacks are that they are generally quite expensive and that the range is limited in comparison to ICEs and hybrids (e.g. Nissan Leaf has a range of 117 km) (Sperling & Gordon, 2009) (Sandalow, 2009) (Pistoia, 2010).

1.4.1 Electric vehicle charging infrastructure

As already touched upon, a prerequisite for the diffusion of electric vehicles is the ability to re-charge the battery and hence, a developed charging infrastructure is as important for electric vehicles as a network gasoline stations are for ICE vehicles (CPW, 2010). As also mentioned, there is currently several different takes on EV charging, that differs mainly in terms of technology used but also in which location (or setting) is believed to be best for charging an EV. In this subsection, these different takes on EV charging will be presented to the reader in brief. This is followed by a short discussion on charging as a product – how the technology is marketed and what governs it.

EV charging technologies

Today there are three main ways to recharge an EV battery: conductive/plug-in charging, battery swap and inductive/wireless charging, where conductive charging can be divided further (CLP, 2014). The following paragraphs contain descriptions of all of these charging technologies.

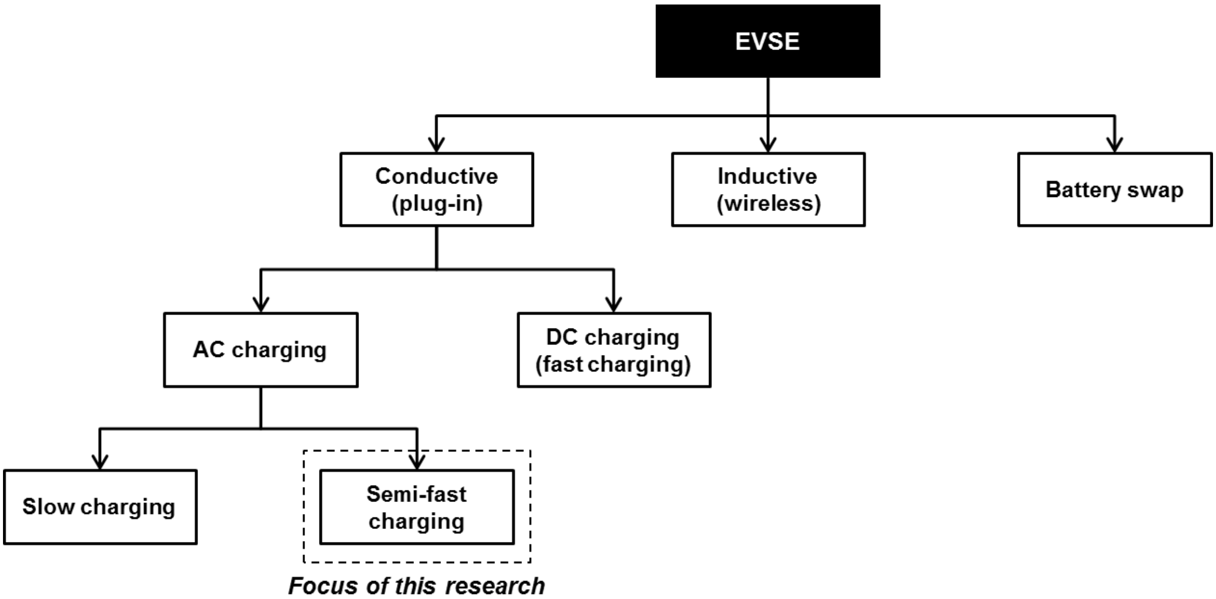

Figure 2: Interrelations between EVSE technologies (CLP, 2014)

Conductive charging

There are prevailing three types of conductive charging for PEVs: slow (AC), semi-fast (AC), and fast (DC) (the charging times for each of these are summarized in Table 1).

Battery size	Level 1		Level 2		Level 3
16kWh	10h	7h 16m	3h 38m	2h 5m	17m
26kWh	15h	10h 55m	5h 27m	3h 7m	26m
42kWh	26h 30m	19h 5m	9h 33m	5h 27m	46m

Table 1: Comparison of charging times for three levels of conductive charging (CPW, 2010)

Level 1, or slow charging, is an AC charging method, most commonly used for residential charging and roadside charging poles (CLP, 2014). This kind of charger requires a significant amount of time in order to fully charge a PEV, between 10 and 27 hours depending on the battery size. The level 1 charger is therefore common for LEVs and low capacity PEVs. Some countries, like USA, restrict level 1 charger due to grounding not being common practice for all domestic installations. This charger does often not require any complex installation than the socket and the price depends on the type of required cable, but is generally in the lower end. (CPW, 2010) (US Department of Energy, 2013a)

Level 2 , or semi-fast charging, is an AC charging method that is common for residential, workplace and public use and take between 4-8 hours to fully charge an EV, this charger is commonly called ‘wallbox’ (see Figure 3). The wallbox, as it sounds, is mounted on the wall in the parking garage or parking space (and as such, is unsuitable for most roadside parking spaces). Both BEV and PHEV use this kind of charger, which unlike level 1 charger is equipped with several safety measures. For example, the power supply is cut when the charger is not connected to the car. Level 2 chargers are more expensive and the installation costs, which vary depending on the power availability, distance to power supply and installation complexity is often substantial as well. (US Department of Energy, 2013a)

Figure 3: A BMWi wallbox setup (Photo: BMWi)

Level 3, or fast charging, is a DC charging method that charges an EV in 20-50 minutes, depending on the battery size. Both BEV and PHEV can recharge using this charging type. Level 3 chargers are often very expensive (upwards of 100,000 USD) and are therefore only used as an option for public charger. They are also very technically intricate, which limits their usage. (US Department of Energy, 2013a) (CPW, 2010) (Schroeder & Traber, 2012)

Besides charging method, there is also difference when it comes to the charging plugs that are used to connect the car to the charger. For AC (level 1 and 2) charging, there are currently three types available on the market. Type 1 (Yazaki) is the North American and Japanese charging standard. This standard does not support three-phase power grid and is limited to single-phase and lower power output and have a cable that is permanently fixed to the charging station (Bräunl, 2012). Type 2 (Mennekes) is the European standard, which supports both single- and three-phase charging and higher power output than type 1 (Bräunl, 2012). The third type is the Chinese standard, which is similar to the type 2 standard. However, while the type 2 standard has developed during the last few years, the Chinese standard has been frozen at an earlier version of a type 2 standard and is hence not compatible with the current type 2 cars anymore (Bräunl, 2012). There is currently no global standard, and hence, the possibility to connect an EV to a charging station depends on the type of both the EV and the EVSE. (Bauner, 2010) (US Department of Energy, 2013a)

When it comes to DC (level 3) charging, the Japanese CHAdeMO was the first available standard. CHAdeMO is a DC-only standard, which means that one requires separate connectors, and in some cases separate inlets in order to be able use both AC and DC charging stations with the car. This standard has however been challenged by the new Combo standard that supports both AC and DC charging. (Bräunl, 2012)

Battery swap

Battery swap is another technique of recharging electric vehicle battery. Instead of connecting the EV to the power outlet, the vehicle's empty battery is removed and a fully charged one is put in its place. This is an automated process performed in a battery swapping facility. In such a facility, empty batteries are recharged and stored until someone requests a swap. This option appeared as an alternative since it is the fastest way to fully recharge an EV (the process takes around 5 minutes) and is considered by some to be the only way for EVs to compete with the speed of refuelling of an ICE vehicle. However, the major drawback of battery swapping is the fact that this technique is incredibly expensive. A battery swapping facility equals to an investment of $500,000 USD and takes up a lot of space (similar to a car wash). Furthermore, this technology requires cars that are compatible with the method of extracting the battery, of which there currently only two examples; Renault Fluence ZE and Tesla Model S. (Galbraith, 2009) (Voelcker, 2014)

Battery swapping was made famous by Better Place, a company that set up battery swapping stations and managed its service. Better Place partnered with multiple OEMs who were to produce models that would be compatible with Better Place's technology. However, in 2013 the company went bankrupt due to what many believed was a combination bad timing and bad execution (Fehrenbacher, 2013). Today, battery swapping technology is lagging behind the other charging types in terms of diffusion. (Voelcker, 2014).

Inductive charging

Inductive, or wireless, charging is a method where the electricity, required to recharge the battery, is transferred to the vehicle via magnetic resonance coupling that generates AC power. The speed of charging is comparable to level 1 and level 2 conductive charging described earlier. The main advantage of inductive charging is convenience and improved safety. Although inductive charging has some clear advantages it also has many disadvantages (compared to conductive charging). First of all it is slower (there are no level 3 equivalent for inductive charging), due to lower efficiency it requires longer charging times, which will be problematic as battery technology advances. Secondly, the lower efficiency also contributes to additional cost to the user (in terms of energy loss, which could be up to 20% compared to conductive charging), resulting in a total 25% higher cost. (Hanzhou Wu, et al., 2011)

Charging infrastructure locations

EV charging locations are often described as belonging in one of two main categories: residential and public EVSE (CPW, 2010) (Hatton, et al., 2009). Residential EVSE can be divided into single attached/detached garage, carport, and multi-family dwelling. Residential charging is considered to be the dominant charging location, where the EVSE units could be bundled with the individual EV sales (Hatton, et al., 2009). For all types of residential charging, only conductive charging, level 1 and level 2, and inductive charging is applicable. Most experts believe the conductive level 2 charger to be preferable due to the charging efficiency, speed, and safety (CPW, 2010) (Hatton, et al., 2009)

The publicly available charging infrastructure is more complex than the residential one. Broadly speaking, this type of EVSE can be located on the roadside, in stand-alone parking lots or garages, in parking lots or garages connected to commercial buildings, and at gasoline stations. This type of charging location can be of any type, but level 2 charging is dominating in most markets. (CPW, 2010)

Charging as a product

EV charging as a product is a complex concept. In essence, it consists of three key offerings; the actual wallbox, the installation and maintenance of the wallbox, and the actual charging service. In addition, auxiliary products/services are offered by some companies (payment services, statistics collection, etc.). These can be offered to a range of customers, which is elaborated later on in this thesis.

Apart from this, the key concept to understand about the business aspect of EVSE is that the wallbox is not like any other product. Buying a wallbox is not like buying a fridge that will work standalone as long as you have an outlet. Instead, a wallbox is part of a larger system. Whether or not a charger will work as intended is dependent on a lot of other technologies and actors (e.g. the utilities (which will have to allow sale of energy[1] and connection to the grid), interest groups (which will decide on standards), governments (which will decide on subsidies and other incentives) and other actors in the value chain of EVs (e.g. OEMs, which will decide on how the car may interact with the charger). Furthermore, the impact of these system components will be varying depending on the intended use of the wallbox (see charging location); a private use charger may only need the charger to be compatible with one car, whereas a public charger needs to be compatible with most models. (Marquis, et al., 2013)

1.4.2 History and development of EV technology

Electric vehicle technology has been around for more than 100 years (Hoyer, 2008). In 1900 38% of all cars were EVs while only 22% were ICEs and the rest were steam powered (Encyclopaedia Britannica, 2013) (Anderson & Anderson, 2010) (Hoyer, 2008) (Midler & Beaume, 2010). However, after the development of Henry Ford's T-model Ford, the ICE, and petroleum as a fuel, became the dominant design (Midler & Beaume, 2010). There are several theories describing why this happened. Factors like fuel availability, consumer perceptions, endowment, quality of infrastructure, manufacturing costs, and technological development are considered some of the key factors behind the rise of the internal combustion engine (David, 1985) (Arthur, 1989) (Watson, 2010). Both (Foreman-Peck, 1996) and (Cowan & Hultén, 1996) conclude that both early electric vehicles and steam-powered vehicles failed to innovate as effectively as combustion driven vehicles.

[1] In many countries, the possibility to sell energy is limited to utility companies (Ackermann, et al., 2000). However, these regulations can often be circumvented, for example by charging the user by time unit instead of by energy unit (Tsang, 2014) (Shen, 2014).

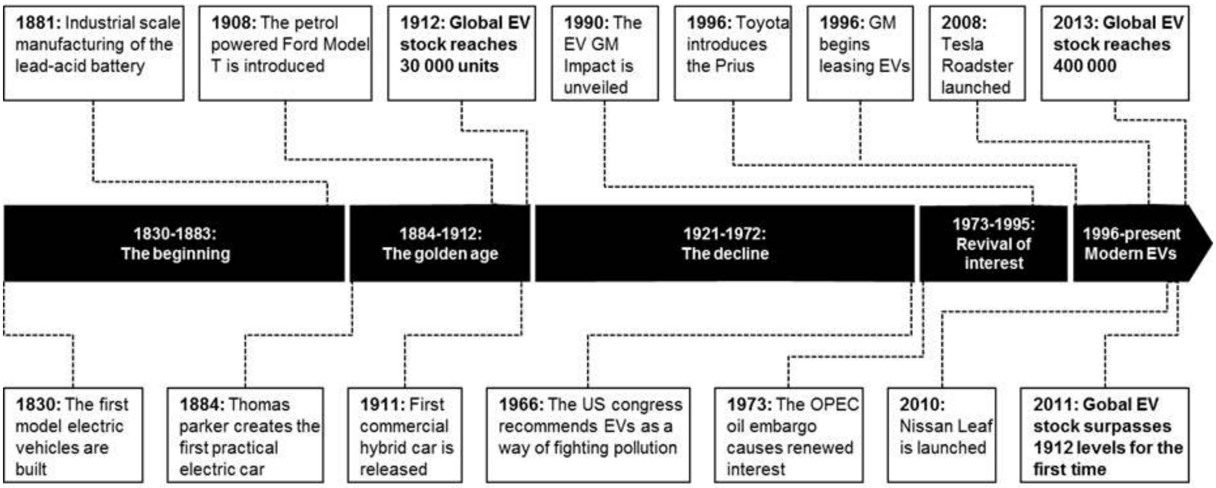

Figure 4: Personal EV timeline (Anderson & Anderson, 2010) (IEA, 2013)

ICEs dominated the market completely, and EVs where practically forgotten until critique against the existing vehicle industry began to arise in the 1960s, and with the oil crisis of the 1970s, consumer focus began to shift towards sustainability (Bauner, 2010) (Anderson & Anderson, 2010) (Hoyer, 2008) (Midler & Beaume, 2010). Nevertheless, this was a marginal development, and it would take until the beginning of the 1990s for the electric vehicle initiatives to take a hold for real among OEMs (Hoyer, 2008). In 1996, Toyota released Prius, the first mass produced hybrid vehicle, which sparked interest in EV technology among environmentally aware consumers. More recently, Tesla Roadster, which became commercially available in 2008, became the first EV to use a lithium-ion battery and has been cited as an inspiration for major OEMs' ventures into EVs (many of whom, before Tesla Roadster was released, thought that lithium-ion technology would not be ready for commercial use until 2020 or later)[2]. In 2010, Nissan released Leaf, the first BEV released by a major OEM and in 2012, the first time since 1910s, the global EV market has reached a new historical peak (in terms of global stock) and is currently growing by more than 100% annually (IEA, 2013).

In early 2014, the global EV stock was at 400 000 units (Nissan Leaf alone reached 100 000 in sales since its launch in 2010), and in some countries (like Norway and the Netherlands); PEV penetration is reaching 5-10% (Cobb, 2014). Furthermore, most of the large OEMs are currently developing EV models (Accenture, 2011) (Arthur D. Little, 2010). The current relative upswing in popularity for EV technology has been attributed to three main factors. First is the increased focus on environmental friendliness (use of EVs lead to significant decreases in local air pollutants, as well as decreases in GHG emissions) (Sperling & Gordon, 2009) (Sandalow, 2009). Second is the fact that several important advances have been made in the battery technology (Sperling & Gordon, 2009) (Sandalow, 2009). The third factor is the perceived need for national governments to decrease their reliance on foreign fossil fuels (mainly oil) (Sperling & Gordon, 2009) (Sandalow, 2009) (Mitchell, et al., 2010).

However, despite this upswing, the EVSE business is still very much in the early stages of development. During the last 10-20 years, various countries have tried several approaches to charging, some driven by private companies and other by government initiatives (everything from Better Place's experiments with battery swap in Denmark and Israel, French Autolib' and US's Zipcar electric car pools approaches, to the Chinese government's plans to install 10mm chargers before 2020) (The Economist, 2011a) (Loveday, 2011). No system has yet been successful enough to

[2] Tesla Roadster was also the first highway-capable all-electric vehicle in the US since many years and the first BEV with a range above 320 km on one charge (Webb, 2013).

dominate the market. To add to this, the market is heavily fragmented, with development being driven by small innovative companies, each with their own idea of how EV charging will be done in the near future. It is apparent that for EVs to become a real contender in the personal vehicle market there is a need for profitable way to develop charging infrastructure on a large scale and spread it globally.

1.4.3 EVs and EVSE in China

Today, China is considered by many to be the world's worst polluter (The Economist, 2013a) (Lee, 2013) (Wolfe, 2014). This massive pollution has led to two main problems: (i) the pollution of the local environment[3], which affects the Chinese population and its wildlife[4], and (ii) the massive amount of GHG emissions that China accounts for[5], which contributes heavily to global warming and thus affects the entire global population. The West and Japan have in many cases succeeded in cleaning up after their previous mistakes when it comes to pollution of the local environment, but carbon emissions are difficult to mitigate and no country has yet really solved this issue. This also applies to China, which has just begun working towards solving its environmental problems[6]. Whether China succeeds in solving these problems or not, will hence be crucial for the health prospects of the entire global population.

In 2009, China became world largest automotive market and in 2012, China was ranked as the world's largest producer of GHG emissions, which are spread mostly by personal cars, gasoline powered trucks and busses (Marquis, et al., 2013). In the fight to reduce pollution and become less dependent on oil, China wants to reduce the use of fossil fuels. Hence, since 2009, the Chinese government has launched various policies and incentives in order to promote the development of electric vehicle. The government aims to have 500,000 electric vehicles in circulation by 2015, a figure which, if all goes according to plan, will increase to 5 million by 2020 (The Economist, 2011a). A study by The Boston Consulting Group shows that electric vehicles could represent 7% of new car sales in China by 2020, making the country the world's largest market for electric vehicles (The Economist, 2011b).

Despite the ambitious targets large government incentives, the Chinese electric vehicle adoption is lagging behind. In 2013, only 17,600 electric vehicles were sold in China, just a fraction of 21.98mm ICE vehicles sold in the country during same year. Today, of the world's 400,000+ electric vehicles, ~45,000 (~12%) are Chinese, making the 5 million target quite unrealistic (Electric Vehicle News, 2014). Nonetheless, the Chinese market is growing rapidly and together with a positive regulatory outlook, the market seems fairly attractive at a first glance. Recently, the popular Chinese OEM BYD[7] got approval to sell its electric vehicles in Beijing and Shanghai, which is expected to give a boost in national EV sales in China (Larson, 2014). Many of the world's largest OEMs are seeking alliance in

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[3] Up to 10% of China's farmland is polluted by heavy metals, and studies have shown that the air quality in some parts of China is up to 40 times more polluted than the WHO acceptable level. (The Economist, 2013a)
[4] Studies have shown that, in northern China, air and farmland pollution has led to a decrease in the average life expectancy of 5.5 years. Meanwhile, the Chinese government has said that 40% of the country's mammals are threatened by these pollutants. (The Economist, 2013a)
[5] The combustion of coal and the 85 million cars in China now accounts for 30% of the world's total carbon-dioxide emissions (compared with 10% in 1990). While carbon dioxide emissions in Europe and the U.S. are on decline, they continue to rise in China. (The Economist, 2013b)
[6] Last year, China was the country that spent the most on renewable energy worldwide - one-fifth of total global spending on renewable energy. This year, China has earmarked USD 275bn to projects reducing pollution, which corresponds to twice the country's defence budget. (Perkowski, 2012) (The Economist, 2013b) (Nielsen & Ho, 2013)
[7] BYD is a Chinese conglomerate that is on the forefront of the Chinese EV development, leading the domestic sales of electric vehicles (China Auto Web, 2014).

China in order to pursue the diffusion of electric vehicles. Joint ventures such as BMW-Brilliance, Shanghai-VW, BYD Daimler, FAW-VW are just a few of those (KPMG, 2012) (Chotai, 2013).

China's next five year plan will be commencing in 2016, and it is still unclear of what path the government of PRC chooses with regards to electric vehicles, but the outlook is positive (Fulton, 2011).

1.5 DELIMITATIONS

In order for the study to be completed within a reasonable time-frame, some limitations have had to be made. The main delimitation of this study is that the focus is limited to charging of personal PEVs (i.e., we will not study the market for charging of mass-transportation vehicles such as buses, trains, etc.) and LEVs will also be excluded. This delimitation was made since larger vehicles use other technologies for charging and therefore require different evaluation approach whereas LEVs do not require a dedicated charger at all. It is also the opinion of the authors that this leads to a more coherent study, with more depth at the cost of width.

Another important delimitation is that we have focused on developing the model so that it will suit SMEs. Larger companies may find the results of this study less applicable. Lastly, as mentioned earlier, EV Power had already decided on the cities to be included in the evaluation.

1.6 DISPOSITION

Chapter 2 introduces the theoretical framework that has been the basis of our research. Specifically, seminal ideas within market entry strategy are presented, as well as theory related more specifically to the situation for a smaller actor in an emerging technology industry looking to enter an emerging market. Chapter 3 outlines the methodology used in this study. In Chapter 4, the reader is presented with a strategic mapping of the commissioning company, EV Power. Here, the key factors for EV Power's success are deduced and analysed. The chapter also serves as a reference for the reader to the specifics of the industry and EV Power's business. In Chapters 5, 6, and 7 the main analyses, which has helped answering our research questions is presented. Chapters 5, 6 and 7 correspond to research question 1, 2 and 3, respectively. Finally, in Chapter 8, the conclusions of the study are summarized and the chapter also contains a discussion of the results.

2 Theoretical framework

This chapter will introduce previous research on the topic of market entry strategy, which will serve as a theoretical background for this thesis. First, seminal theory on market entry strategies and market analysis for mature product and geographical markets will be presented. However, this thesis deals with market entry for an (i) SME in an (ii) emerging technology industry, within (iii) an emerging market. Therefore, the section on general market entry strategy will be followed with three sections outlining how these three specific conditions may affect this study.

2.1 ENTERING A MARKET

In general, market entry is quite an exhausted subject, with the key aspects of entering a new market being agreed upon by scholars (e.g. (Hollensten, 2007), (Peng, 2006), (Lasserre, 2007), (Douglas & Craig, 2010)). Organizations and their operations are getting more and more global, and thus, market entries are plentiful, making market entry strategies grow even more relevant (Hollensten, 2007), (Peng, 2006), (Lasserre, 2007), (Douglas & Craig, 2010). Due to the abundant research on the field, much theory has reached an almost factual status. There is a general consensus that devising a market entry strategy based on answering the following three questions (Hollensten, 2007), (Peng, 2006), (Lasserre, 2007), (Douglas & Craig, 2010) (Dawson, et al., 2006) (Zang & Wang, 2009):

- **Where:** Which market do we want to enter?
- **When:** At what point in time do we want to expand?
- **How:** Which entry mode should we use to enter this market?

For this thesis, the 'Where?' question is extremely relevant for all three of the previously stated research questions and the 'When?' question is only relevant to research question #3. The 'How?' question deals with entry modes[8], which is something that will not be treated in this thesis, and therefore there will be no presentation of theory on this topic.

2.1.1 Where?

A foreign expansion decision is not that different from a general business investment decision; the main decision factor is in most cases profitability. In essence, to evaluate a market for a potential entry entails analysing the market environment and how it plays to the organizations strengths and weaknesses. (Hollensten, 2007) (Peng, 2006) (Lasserre, 2007) (Douglas & Craig, 2010). These days, for companies operating in a mature industry, the process of selecting a market for entry follows a fairly rigid structure. Below, the existing knowledge on the process for evaluating a markets potential is summarized.

The step-by-step market selection process

The broad strokes of the market selection process are subject to a consensus within academia. At the highest level, the process can be divided into 5 steps (Hollensten, 2007), (Peng, 2006), (Lasserre, 2007), (Douglas & Craig, 2010)). Each step consists of an evaluation, but different factors are assessed in each step and the level of detail increases by each step. By evaluating the markets in a

[8] Examples of entry modes are mergers and acquisitions, joint venture, and starting from scratch (Hollensten, 2007) (Peng, 2006).

step-by-step fashion, one saves time by not doing an in depth analysis of markets that could be easily discarded.

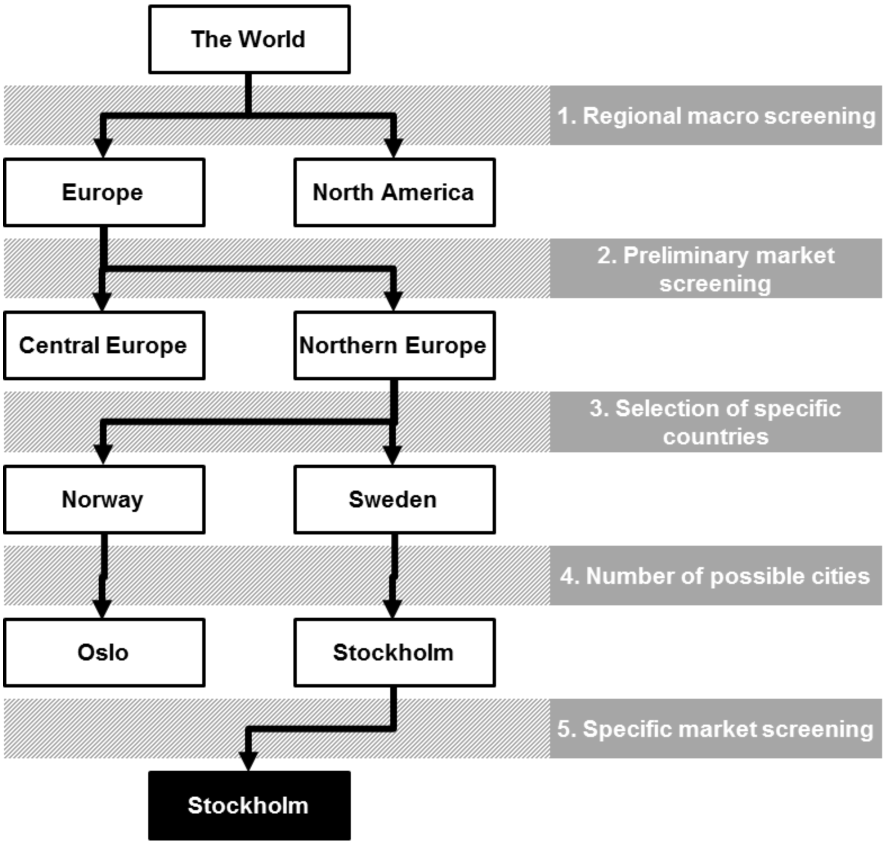

Figure 5: Example of the step-by-step market selection process (Adopted from Hollensten (2007))

The first step is a broad 'regional macro screening', where a region (often a continent) is selected. The second step can be called a 'preliminary market screening'. This step consists of segmenting the region and identifying appealing segments (where a segment is a cluster of markets with commonalities based on cultural, political, economic, social or technological factors). The third step 'selection of a specific country/countries' and step four consists of narrowing it down to a 'number of possible cities'. The fifth and last step is the 'market analysis' (in some works called 'specific market screening'); where the selected cities are evaluated in order to derive the most attractive city/cities for a market entry (Hollensten, 2007).

As described in Section 1.5, this study is delimited to three, already pre-selected, cities (Beijing, Shanghai and Shenzhen). Consequently, only the last step of the market selection process is applicable for this study, i.e. the 'market analysis'. In the following subsection, the market analysis step will be elaborated upon and important factors for such a screening will be presented.

Factors of importance in a market analysis

The market analysis, or specific market screening, is a process where the few selected markets (often cities) are thoroughly analysed in order to find out which of these markets is the most attractive one. In order to arrive at that answer, academics have agreed upon several factors that are important to consider. As described above, the market attractiveness needed to be put in relation to the organizational strengths and weaknesses. Therefore, academics divide these factors into external and internal, below both external and internal factors are elaborated.

External factors

While assessing markets attractiveness, there are several external factors that need to be assessed. According to several experts within the field (Hollensten, 2007) (Peng, 2010) (Lasserre, 2007) (Douglas & Craig, 2010) it is first important to assess the general market characteristics. More specifically, this consists of estimating the *market size* and *growth rate*, *market competitiveness* and *price potential*, *market accessibility*, and *cost of serving the market*.

The foremost factor that contributes to the attractiveness of a market, according to Hollensten (2007) and Lasserre (2007), is the *market size* and *market growth*. Generally, the larger the market size and growth, the more attractive is the market. However, in many cases a high growth rate is considered more desirable since then, the future demand will be higher and an already large market size might indicate a market that is reaching maturity and since might already have established competition (this dynamic is elaborated upon in Subsection 2.1.2) (Hollensten, 2007) (Lasserre, 2007).

The next important factor to analyse is *market competitiveness*. Markets with already strong and well-established competition or lots of entrants and leavers are considered less attractive due to the effects on pricing and the cost of establishing a company (a saturated market requires a lot of marketing, for example). Further, *price potential* aims to evaluate the profitability potential in the market. Markets where customers obtain high bargaining power due to prevalence of options to one's product will often see a reduction in prices and hence lower profit margins. *Market accessibility* aims to investigate factors that facilitate and/or hinder the establishment in the market. Such barriers might be formal (e.g. unfavourable regulations) or informal (e.g. informal ties between suppliers and distributors). Lastly, *cost of serving the market* is about the direct cost of distributing and controlling operation in the evaluated market, markets with higher operational costs are considered less attractive. This factor is mainly driven by geographic distance and the selection of entry mode. (Hollensten, 2007) (Peng, 2010) (Lasserre, 2007) (Douglas & Craig, 2010).

Internal factors

While some markets will clearly, by looking at external factors, seem more attractive than other, it is still important to relate the external factors to the organizational strengths and weaknesses. The internal factors themselves do not tell much about market attractiveness, but when put together with the external factors, the complete picture of market's attractiveness could be drawn. The experts, (Hollensten, 2007) (Peng, 2010) (Lasserre, 2007) (Douglas & Craig, 2010), suggest that it is important factors such as *competitive advantage, product adoption, resources*, *and skills*.

First it is important to understand the organizations competitive advantage and why it is going well in the company's home market (struggling companies are rarely focusing on international expansion). It is then important to evaluate and see if these advantages will apply to the new market or if the company will require changes in its business model in order to differentiate itself from the existing competitors found when looking at the external factors. Further on, it is necessary to see whether the company's service(s) and/or product(s) are *adoptable* to the new market. Some markets might have different regulations, technological standards or customer requirements that are necessary to take into consideration while considering the attractiveness of the external factors. Besides these two, it is certainly important that the company possesses enough *resources* required for the market entry and have access to the right *skills* (such as managerial, international marketing, and sales), essential in order to succeed with a market entry. (Hollensten, 2007) (Peng, 2010) (Lasserre, 2007) (Douglas & Craig, 2010)

2.1.2 When?

When deciding when to enter a market, one has to consider the respective benefits and drawbacks of entering first and entering later. Although an early entry has generally been associated with high performance and advantage for the entering firm, researchers in the field has reached a consensus that this is not always the case (Peng & Yadong, 2000) (Perez & Soete, 1988). Below, the main factors that the literature cites as influencing the timing of a market entry will be presented.

The factors that have an influence on the decision are often categorized as ‘first-’ and ‘late-mover advantages’ (Hollensten, 2007), (Peng, 2006), (Lasserre, 2007). Lasserre (2007) and Perez & Soete (1988) have related timing advantages to the traditional concept of the *product life cycle curve* (see Figure 6). The phase during which a market takes off, but the competition has yet not been well established is called ‘Window of opportunity’. During this phase, there is a lack of structure in the industry and a dominant design (see Section 2.4) has not yet emerged (Suarez, et al., 2014). In the introduction phase, the main focus is on the product itself, it has to be functional and break into the market. At this stage, investment required to establish oneself in the market is low, but there is also a high uncertainty with regards to the direction in which the market may be headed. Any investments made in this stage may be lost if the wrong bets are made (Perez & Soete, 1988). As the product moves along the life cycle trajectory the cost and complexity of a potential entry changes. Still moving in late, but within the ‘windows of opportunity’, have its advantages, such as the possibility to free ride on the first mover’s investments, resolution of technical and market uncertainty and first mover’s difficulty to adapt to market changes (Peng, 2010) (Lasserre, 2007).

When a few companies have taken their chances and entered during this ‘window of opportunity’, the market enters the ‘growth phase’. The product has now been relatively defined and the innovation processes now shifts focus to the processes of production, leading to reductions in costs and changes in price due to rise of competition. At this stage, an entry requires much more resources or a highly differentiated strategy. Next, the market moves towards the ‘maturity phase’. The competition is well established and the market size and growth are well known. At this point, the eventual winners in the market is an easier guess than it was earlier, and opportunities arise for actors that have the means to enter the market by acquiring smaller but successful companies. This may be a large investment, but carries less risk than fighting it out in the introduction and growth phases. (Lasserre, 2007) (Peng, 2010)

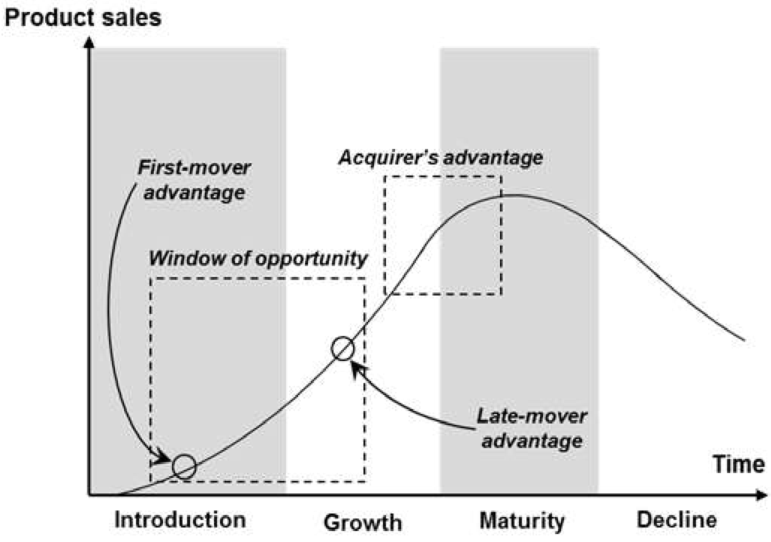

Figure 6: The ‘Window of opportunity’ concept and the product life-cycle (Lasserre, 2007)

As we can see, the decision of when to enter a market is influence by factors related to market characteristics (growth, competition) as well as factors related to the business of the potential entrant (mainly resources available, but also the competitive advantages).

2.2 MARKET ENTRY APPROACH WHEN ENTERING EMERGING MARKETS

When it comes to entering an emerging market, most scholars agree that this calls for some additional strategic considerations compared with market entries in mature geographical markets (Yusuf & Nabeshima, 2010) (Gaba, et al., 2002) (McHardy Reid & Walsh, 2003) (Peng, 2006). In this section, it will be discussed how choosing to enter an emerging market may add some aspects when deciding WHEN to enter, and HOW to do it. Of course, different emerging markets will lead to varying extra considerations (Ovcina, 2010).

There is also extensive previous research on entering an emerging market, and entering the Chinese market in particular (Yusuf & Nabeshima, 2010) (Tse, et al., 1997) (Tse, 2010) (Gaba, et al., 2002) (Niu, et al., 2012) (McHardy Reid & Walsh, 2003) (Peng, 2006) (United States of America Department of Commerce, 2013). Since the Chinese open-door policy took effect in 1978, China has been particularly interesting for businesses, since an entry into the country allows the company to tap into a market with more than a billion consumers. This particular market also offers some significant challenges, in part due to the fact that the regime has great influence over business in the country, but also due to cultural barriers. The race for dominance of the Chinese markets has led to many failed market entries, and because of this, much research has been done on the topic, to try to devise working strategies. (McHardy Reid & Walsh, 2003)

2.2.1 When?

When dealing with emerging markets, scholars are not certain if the first mover advantages are as dominant as they are when entering an already developed economy. Of course, a new entrant in an emerging market has to deal with a whole new set of difficulties. The uncertainties that were mentioned as a drawback associated with an early entry are even stronger, and it may be worth waiting for someone else to solve some these problems. Not only will a late entrant be able to learn from its predecessor's mistakes, he will also benefit from an environment more adapted to foreign players (governments and institutions will in time learn to collaborate more effectively with foreign organizations). On the other hand, it may be worth it for a company to solidify its position in the market early on, since competition will often become more intense in the emerging markets. (Peng & Yadong, 2000) (Peng, 2006)

For china and other countries with a regime with much direct influence on business, it is important to analyse the regimes interest and attitude towards the product and industry at the particular time, since this may have a strong influence on the potential success (Van Peteghem & Zhang, 2010).

2.3 MARKET ENTRY APPROACH FOR SMES

The above sections (2.1 & 2.2) have described traditional market entry strategies often employed by large companies in both mature and emerging markets. For SMEs however, the approach may differ. Such differences in the decisions of *where* and *when* to enter are outlined below.

2.3.1 Where?

When analysing a new market, it is important to point out that the new market selection process is different when it comes to SMEs (Hollensten, 2007) (Lasserre, 2007) (Peng, 2006). As described by (Hollensten, 2007), an internationalization strategy for an SME is often triggered by a reactive motive where it responds to an externally driven opportunity. Further, market expansions for SMEs are often driven by low psychological distance (i.e. similar culture, language, political system) and short geographical distance between the local and the new markets. Geographic proximity often reflects similarities in the psychological distance and thus, SMEs often expand into neighbouring countries first (Hollensten, 2007) (Peng, 2006). The fact that SMEs often have limited resources for upfront investment, and therefore want to make use of existing assets to as large degree as possible, makes focusing on neighbouring markets even more beneficial (Hollensten, 2007) (Peng, 2006).

Due to this, the market selection process for SMEs is often narrowed to choosing between a limited numbers of cities within the neighbouring countries. Hence, only the last of the five steps in the 'market selection process' need to be performed; 'market analysis' (Hollensten, 2007). In fact, this is exactly what happened when defining the scope of this study. For SMEs, a market entry selection process is hence, more a 'go' or 'no go' decision (Hollensten, 2007).

Conversely, LSEs often have existing operations in several markets and rather base their expansion decisions on possible synergies from existing operations (Hollensten, 2007). They care less about the CAPEX[9] costs and instead look at the opportunities for low OPEX[10]. In addition, LSEs often have better access to market data and are able to proactively conduct more thorough and systematic analyses of different market opportunities (Hollensten, 2007).

2.3.2 When?

As previously explained, there are three general phases in which one can move into a market; first mover, late mover and acquirer. Each come with their own distinct advantages, even though it is generally agreed that is preferable to be the first mover in most cases (Peng, 2009) (Lasserre, 2007). This is even truer for SMEs (Peng, 2009) (Lasserre, 2007). As already explained, to be able to enter the market as a late mover, a company will need to expend more resources in order to bully itself into the market. A company set on entering the market by acquisition will in turn need even more resources. Hence, in order for an SME to able to compete, it will generally need to enter the market at an early stage and work its way into the market rather than buy its way into it (Peng, 2009) (Lasserre, 2007).

2.4 MARKET ENTRY APPROACH FOR EMERGING TECHNOLOGIES

Above, market entry strategies for conventional products in both mature and emerging markets and market entry strategies for LSEs and SMEs have been discussed. However, EVs is an emerging technology, which has certain implications on considerations for market entries. Instead of dividing this section into *where* and *when*, the implications are discussed one by one, as their impact is less defined from studying theory alone.

2.4.1 Lack of proven business models

For emerging technologies, especially ones with a complicated value chain, there often is often little consensus regarding which business models might be best suited for the technology (Palo & Tähitnen, 2013). Often, new technologies results in new business models (Baden-Fuller & Haefliger, 2013). As a company in an emerging technology industry, one will want to consider how its business model fits into the market that you consider entering.

[9] Capital expenditures are expenditures creating future benefits.
[10] Operating expenses are ongoing costs for running the business.

A business model can view to consist of three separate elements (Lerch, et al., 2010) (Timmers, 1998) (Lehmann-Ortega & Schoettl, 2005):

1. Value proposition: the product and services offered to the customer
2. Value chain configuration: which part of the value chain should be grouped together in a business? (Example: for ICEs, the standard business model is that the OEM handles production, and sometimes sales of the vehicle, as well as maintenance. However, the OEM has nothing to do with the fuel-part of the value chain)
3. Revenue model: How and for what will the company charge the customer?

As already hinted at above, these elements are often standardized for mature industries, but their composition can often vary from company to company when it comes to emerging technologies (Lerch, et al., 2010). However, when the emerging technology has been around for a while, but there is still no business model consensus, there may be regional similarities in what business models have become standard, and therefore, it is important to take this fact into account when deciding which market to enter: One must consider how one's own business model fits in to the already established value chain of the market (Lerch, et al., 2010) (Palo & Tähitnen, 2013)

EVs is a technology with a complex value chain and no standardized business models (Bohnsack, et al., 2014). There is little consensus on which parts of value chain should be managed by which actor, and the revenue model for each potential part of the value chain is not standardized either (Gomez san Roman, et al., 2011). An example of how this could impact market entry decisions; An EVSE provider which installs public chargers and charges the customer per unit of electricity would not want to enter a market if the OEMs there have decided to provide free, widespread, public charging for their customers.

If possible, one wants to find a market where there is a niche market where the company's value offering fits. If this is not possible, there is always the option to adapt the business model to the new market. (Baden-Fuller & Haefliger, 2013)

2.4.2 Large technical systems

Some emerging technologies, Like EVs, may have problems gaining widespread adoption due to what has been called the 'chicken and egg problem' (Romm, 2006). The technology is part of a larger system in which the adoption of the parts are interdependent, where the public will not accept one part until the other is widely accepted, and vice versa, creating a paradox. (Grundmann, 1994)

These technologies can be viewed as so called 'Large Technical System' (LTS) (a type of phenomena, often a large production, or infrastructure, system), which implies that the development of the innovation, spread, and adoption of a technology or product cannot be explained by analysing a single actor (often a company or a product). Instead, one must take into account other elements such as political intervention, regulatory practices, social development and cooperation between actors in the market to fully explain why a technology develops in a particular way. This view of LTSs was first introduced by Thomas P. Hughes's book Networks of Power (1983): Electrification in Western Society 1880–1930. Hughes (1983) exemplified this view by looking at the electrical power network in the US and its development as a result of the interaction between actors in that particular market. In an industry that is not part of a LTS, market dynamics can be much simpler. Often, a single actors' success or failure in the market can be attributed largely to the decisions made within the company. As described above, this is not the case for companies within LTSs (one can argue that a company within a LTS must make decisions that comply with the overall system in order to succeed, and while this is true, it misses the point; that companies within an LTS are at mercy to a larger system and must be more vigilant to its environment). (Hughes, 1983) (Bauner, 2010)

From a market entry perspective, it is therefore essential to take into account where these interests from other actors exist/does not exist in order to make a proper ‘Where?’-decision.

This is indeed, very relevant for EVs, which clearly can be seen as a LTS; the system is mainly comprised of governments, OEMs, utilities, property developers, interest and lobbying groups as well as EVSE providers (Marquis, et al., 2013). It is essential to take all of these into account when assessing a market for the EVSE technology.

2.4.3 The emergence of dominant designs and standards in a new market

At some point in a technology's life cycle, it may reach a point where standardization happens with regards to one or several aspects of the technology. Standardization can happen due to industry agreements or government intervention, but de facto standards can also emerge due to the path-dependency of a dominant design. (Utterback & Abernathy, 1975) (Ehrhardt, 2004)

The concept dominant design was introduced by Utterback and Abernathy (1975). It describes how a technology becomes a de facto standard. By gaining allegiance with the market, a technology can become an industry standard without the help of cross-corporate agreements. A dominant design does not necessarily serve the customers’ needs better than the forsaken designs, instead a dominant design may emerge due to a plethora of reasons and pure coincidences. The effect of a dominant design is reinforced if the technology has strong network effects: Once the emerging technology has reached a certain penetration, the dependencies between the actors in the network will create a snowball effect, increasing the dominance of the technology. (Ehrhardt, 2004)

According to Beise (2001) and Klaus, et al. (2005), different dominant designs can emerge in different regions. Hence, when entering a new market, it is important to be aware of any dominant designs that exist. Similarly, if there is no clear dominant design yet, one should be vigilant and try to understand where the market is moving in terms of standardisation (Ehrhardt, 2004). For electric vehicles, it is important to understand which type of charging will become dominant in the market (slow, semi-fast, fast, battery swap, or inductive) and what the physical characteristics of the interface will be. For example; a company producing fast chargers would not want to enter a market where battery swap is moving towards becoming the dominant design. It would be hard enough to gain market penetration if the inclination towards battery swap was solely due to customer allegiance, but with the network effects of EVs involved it would be almost impossible.

2.4.4 Lack of information

Often times, emerging technologies are tougher to analyse since there is less data at hand due to the recent emergence. Additionally, there may be less academic discourse for the same reason. Even if there is data, it is often unreliable and divergent, as emerging technologies ‘suffer’ from extreme growth rates and rapid changes in technological development. This leads to the ‘Where’-analysis being harder to complete. (Sinha, 2005)

Regarding EVs, there is definitely no lack of academic discourse. This may be due to the fact that the technology has existed for a long time, and there have been attempts to achieve widespread adoption of EVs at several points during the past 100-years (as described in Subsection 1.4.2). However, it is true that the field suffers from a lack of data; this is mainly due to the high growth rate, which makes insights from past years become dated at a rapid rate. Another reason is that interest from businesses is not yet high enough to warrant a large amount of market research. Lastly, changes in government policy and regulations have a huge impact on the market for this technology, and such changes are naturally very difficult to forecast. (Christensen, et al., 2013)

For situations such as this, some researchers have suggested one should enter the market as early as possible, in order to gain information from this initial entry to base subsequent decisions on. This is sometimes called “emergent strategy”. (Christensen, et al., 2013) (McDermott & Colarelli O'Connor, 2002)

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3 Methodology

This chapter of the thesis has the goal of describing the methodology that has been used in order to answer the previously defined research questions. First, an overview of the scientific approach is presented. Thereafter follows a section which elaborates on the data collection methods and lastly, the quality of the chosen methodology is discussed.

3.1 SCIENTIFIC APPROACH

The nature of this study is defined as *exploratory*, since there are no previous researches that encompass the particular purpose and research questions of this study (i.e. a market entry strategy for an electric vehicle charging infrastructure producer). This study has been classified as *applied research* because of the fact that the findings of the study are applied to an existing problem, defined by the commissioning company (EV Power). The logic of the study is considered to be *inductive*, meaning that the theory is developed from the observations of empirical reality and going from observations to statements of general patterns. (Collis & Hussey, 2009)

Based on the study's research questions and its purpose, it has been concluded that this study is of an *interpretivist* nature. Interpretevism is, as defined by Collis & Hussey (2009), a research paradigm that focuses on exploring the complexity of social phenomena with a view to gaining interpretive understanding. The Interpretevism approach does not focus on quantitative methods and quantitative data but rather a qualitative approach where the research is conducted in close interaction with what is being researched. (Collis & Hussey, 2009)

When looking at the actual methodology of the research, *action science* was chosen as the main research strategy. Collis & Hussey (2009) describe action science as: *"a methodology used in applied research to find an effective way of bringing about a conscious change in a partly controlled environment"*. The primary purpose of this study, as described earlier, is to contribute to science by developing a EVSE city evaluation model, but it is also within the purpose to solve the problem for the commissioning company (recommend which of Beijing, Shanghai or Shenzhen is most suitable for market entry by EV Power), which is typical for action science. The research was conducted closely with the commissioning company (EV Power), at their headquarters in Hong Kong. The co-operation involved continuous information exchange and feedback, which facilitated the research process.

The practicality of the research has been conducted in the following way: First, it was necessary to build an understanding of the underlying phenomena of electric vehicle technology and theoretical background of market entry strategies as well as the corporate condition and business environment of the commissioning company, meaning that a literature review and observations of the commissioning company were conducted first. Further, factors that are important to consider while entering a new market, as an electric vehicle charging infrastructure producer, have been derived through a combination of the previously gathered knowledge together with insights gathered from interviews with industry experts. Combined, these factors have been logically grouped into a universal, mutually exclusive and collectively exhausting, EVSE city evaluation model (which answers research question #1). Furthermore, in order to solve the actual problem stated by the commissioning company, three Mainland Chinese cities have been evaluated using the EVSE city evaluation model (which answers research question #2). Finally, the knowledge gathered while answering research questions #1 and #2 were combined, in order to answer the third research questions and hence, provide a recommendation of how EV Power should successfully enter the selected city.

3.2 DATA COLLECTION METHODS

Both primary and secondary data has been gathered in order to fulfil the purpose of this research and answer the research questions. The primary data consisted of observations of EV Power and interviews with industry experts, while secondary data consisted of the theoretical framework and city specific data. All four types of the gathered data have been used in order to answer all three research question, where the relation between the four data types and each research question is presented through Figure 7.

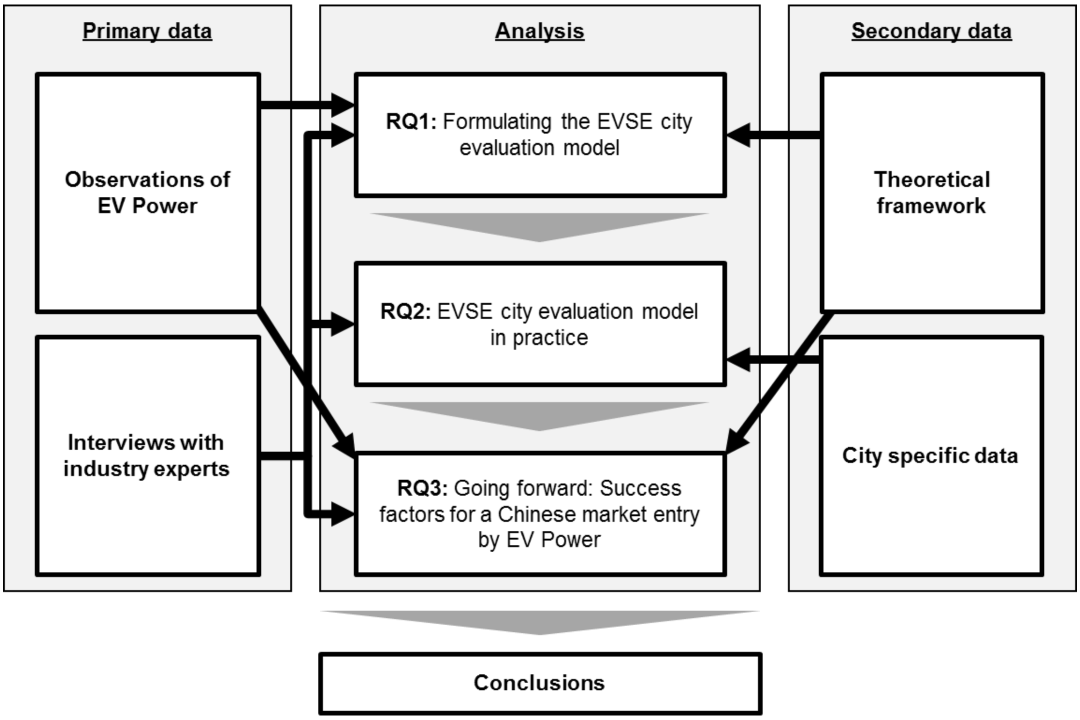

Figure 7: Overview of the research approach and different data types (Proprietary analysis)

3.2.1 Theoretical framework

Although this research is based on an inductive approach, meaning that the theory is developed through observations of the empirical reality, first, a theoretical framework had to be established. The theoretical framework (see Chapter 2) has the purpose r to build a knowledge foundation regarding the current science of market entry strategies and was completed through an extensive literature review of the current discourse (including books, scientific publications, dissertations, and online resources). The theoretical framework is providing secondary data for both research question #1 and #3.

3.2.2 City specific data

The second type of secondary data is city specific data, which has been gathered in order put the created EVSE city evolution model to practice, i.e. to decide which of the three pre-selected cities is most suitable for a market entry by EV Power (i.e. answer the research question #2). The city specific data was gathered through review of books, articles, reports, newspapers and other online resources.

The gathering of the city specific data was based on the developed EVSE city evaluation framework, meaning that there was no predefined method while searching for such data; it was collected when it was required, as a part of the evaluation process. The city specific data is only contributing to the second research question.

3.2.3 Observations of EV Power

Observations of EV Power were chosen as the first primary data type, aiming to gain experience and understanding of the current operations of a real-life EVSE producer. As mentioned, these observations were made at the company's headquarters in Hong Kong, closely to the company's home market. This was a *non-participant* type of observation, meaning that the authors were observing and recording actions without being involved. The main goal of these observations was to build an understanding of EV Power's business and why they have achieved success in their home market.

The observations were a necessary part of the study, since it is important to understand how the company works, in order to be able to provide a valid recommendation of which city to enter (research question #2) and how to enter successfully (research question #3). Hence, the data gathered through observations of EV Power contributes to both research question #1 and #3. These observations were a natural next step from the literature review of electric vehicle technology, i.e. observe how the theory was applied in practice. It is also important to point out that ethics, confidentiality and objectivity were considered during the observations. The results of the observations are presented next, in Chapter 4.

3.2.4 Interviews with industry experts

Interviews with industry experts were the second primary data type that has been gathered. A total of 14 semi-structured interviews were conducted with various academics, EV industry experts, and OEM and electric conglomerate representatives (complete interviewee list is presented in the Appendix). Majority of the interviews had a two-purpose approach: (i) understanding of success factors for an EVSE producing company and (ii) gathering information about the three evaluated cities. Hence, the interviews provided both insights about the EV and EVSE industry and its success factors as well as specific information about the situation in the three evaluated cities. These, semi-structured, interviews were conducted face-to-face in Hong Kong, through videoconference, or via email.

The chosen interviewees have mainly been selected either by recommendation from the founders of EV Power (Tsang and Chan) or by recommendations from other interviewees; so called *snowball sampling* (Collis & Hussey, 2009). Even if other sampling methods might have been more objective (i.e. having less bias), this was found necessary due to the cultural differences that were encountered in China (i.e. difficulties to find appropriate interviewees). The recommendations also allowed interviews with more senior employees of various organizations, which are assumed to be favourable for this research.

The reason for selecting the semi-structured interview approach was due to the open nature of such interviews and the possibility to go outside the pre-defined questions, resulting in broader understanding of the phenomenon (Collis & Hussey, 2009). Most of the interviews were conducted by both authors, majority of which in English (apart from one in Swedish and one in Chinese). In most cases, interviews were recorded and supplemented with notes taken during the interview. After each interview, the recording and notes have been analysed where the all the main findings were summarized. This was found to be the most efficient way of analysing the interviews, although complete transcribing would have been beneficial. The data gathered through the interviews with industry experts have been used in order to answer all three of the research questions.

3.3 RESEARCH APPROACH QUALITY

In the following section, the quality of the research approach is discussed in a critical manner. First, the reliability and validity of the methodology are discussed, followed by a presentation of limitations for this particular research approach.

3.3.1 Reliability & validity

Reliability is a measure of an extent to which the results of the study would differ if the research was repeated. Because of this study's interpretivist nature it is fair to assume that reliability of the study is not of the same importance than if the study has been positivistic. However, as discussed by, for an interpretivist study, it is important to establish authenticity of the findings. Unlike a quantitative study, a qualitative study like this has reduced reliability when it comes to replicability. Nonetheless, the research has been designed to achieve as high reliability as possible. (Collis & Hussey, 2009)

Considering primary sources, interviews have been conducted with many persons within different organizations, in order to avoid bias statements. Moreover, in order to achieve authenticity, all interviews have been recorded. When it comes to observations, although the observations can be repeated, there is a high possibility that the results might be different. This is due to the fact that electric vehicle technology being an emerging technology that is in a high-pace of change and growth. Regardless, the purpose of the study has been to capture the current state and hence, this is not considered an obstacle to the reliability of this study.

While looking at the reliability of secondary sources, it is fair to assume that those are reliable enough. Most of the secondary sources used in the theoretical framework are published articles, reports, and books, which have been chosen, based on their popularity and are publically available through libraries and the World Wide Web. The secondary data used for the city evaluation is however not as reliable as secondary sources used for the theoretical framework. This data is often been derived from newspaper articles, documents and reports, which are not reviewed in the same manner as academic articles or books. Having that in mind, each statement is most often confirmed by several sources, in order to reduce bias.

Validity is instead the extent to which the findings of the research reflect the phenomena under study (Collis & Hussey, 2009). Since the study is interpretivist, the goal of the study has been to capture the essence of the phenomena and the extracted data provides rich and detailed explanations. As defined by Collis & Hussey (2009), the validity of such study is often high. However, it is important to point out that although the goal has been to create as objective picture of the reality as possible, there might have been some bias in the responses of the interviewees and during the observations of EV Power. This is mainly due to the fact that majority of the interviewees and the observed company are based in Asia. Hence, although the findings of the study seem highly valid when it comes to Asian markets and especially Mainland China, this might not be the case for the rest of the world.

3.3.2 Limitations of the selected approach

The two main limitations for this thesis are the limited access to market data and the fact that only one EVSE supplier has been studied.

Several factors have influenced the access to secondary data for this study. First is the context of the study; as have been mentioned several times before, EVs and EVSE are emerging technologies, which means that few market studies have been made, and that those that have been made may not be very accurate. In some cases, the fact that the study concerns China has had an impact as well, since China can sometimes be a very opaque market. Second is the budget for the project; it was found that some data needed existed but could only be accessed by paying large amounts for market research report. Thirdly, the study was restrained by a relatively short time frame; if the thesis had a longer time frame there may have been time to gather all of the data needed for the second analysis ourselves.

Furthermore, only one EVSE supplier was studied when developing this model. While this study was of course commissioned by EV Power, the aim was to make the resulting model general enough to be used by most EVSE SMEs. If the opportunity existed to use more than one company for the basis of this study, it would have been helpful.

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4 Strategic mapping of EV Power

The purpose of this section is to get a better insight of how a successful EVSE company (EV Power) is operating and what some key factors for success are in this industry. The strategic mapping begins with an introduction to the commissioning company, EV Power, and is then followed by a review of their business model, a stakeholder mapping and finally an analysis of the competitive landscape. All data and stated facts in this chapter are derived from observations of EV Power and interviews with the company founders Martin Tsang & Laurence Chan.

4.1 Introduction to EV Power

EV Power is a Hong Kong based company focusing on electric vehicle charging solutions. The company was started in 2010 as a spinoff from AMOS Enterprises Ltd., which is an engineering solutions company with the explicit aim of providing innovative solutions to improve people's lives. EV Power has the following mission:

> *"We hope to turn the city into a greener environment by promoting the use of electric vehicles in Hong Kong and China; by providing a convenient, safe and cost effective charging solution for EV drivers and car park managers."*

The mission reflects their operations, in the sense that the company works with a multi-purpose approach and a so called double bottom line[11]: EV Power does not only focus on profitability but also on helping to reduce the environmental impact from conventional ICE use as well as ensuring safety when using electric vehicles and associated equipment. EV Power is also TÜV[12] certified.

4.2 Current business model

It has previously, in the theoretical framework (Subsection 2.4.1), been asserted that there is little consensus regarding which business model is appropriate for companies operating within the EV industry. EV Power has exploited this, and is currently providing multiple products and services, in order to be able to serve its customers in any way possible in the rapidly changing niches of the Hong Kong market. In the following paragraphs, the business model of EV Power is explained in detail.

EV Power is a full range EVSE provider, meaning that the company offers consultation, it manufactures, installs and maintains electric vehicle charging stations. EV Power provides all three types of chargers, i.e. slow charger, semi-fast charger and fast charger, but lately, they have primarily focused on the semi-fast wallbox charger, shown in Figure 8. EV Power's wallbox is compatible with all of the charging plug standards on the market (discussed in the Subsection 1.4.1) and is hence compatible with most of the electric vehicles currently present in all markets globally. However, the wallbox is only suitable for car parks and not roadside parking, since it requires a wall to be mounted on.

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[11] Double bottom line is a business concept describing an enterprise and/or investment, where a conventional bottom line (profit or loss) is combined with an additional bottom line in terms of positive social impact. (Illinois Facilities Fund, 2013)

[12] TÜV is a German organization working with validating the safety of products and protecting humans and the environment against hazards. (TUV, 2014)

Figure 8: EV Power's semi-fast wallbox (Photo: EV Power)

EV Power is vertically integrated, which means that they, apart from manufacturing the wallboxes, also providing a full-range service to their customers. Figure 9 illustrates EV Power's complete value offering and the revenue contribution of each part. For a typical customer, first, the company provides consultation and a site visit in order to evaluate if the customer will be able to install a wallbox and assesses the complexity of installation (which in turn decides the total cost of the installation). This service is free of charge as long as the customer decides to purchase a wallbox. The next step in the value offering is the 'sale of charger' price of which is dependent on the complexity of installation. If the customer decides on purchasing a charger, EV Power installs the charging station and provides complimentary user training. For public charging stations, EV Power also receives a revenue share from the charging service fee, charging station maintenance, and it also provides complimentary hotline support. The company also aim to, in the near future, be able to generate revenue from administration fee and sales of generated statistics and charging station data. For private charging stations, only maintenance and hotline support are relevant in terms of the last step of the value chain.

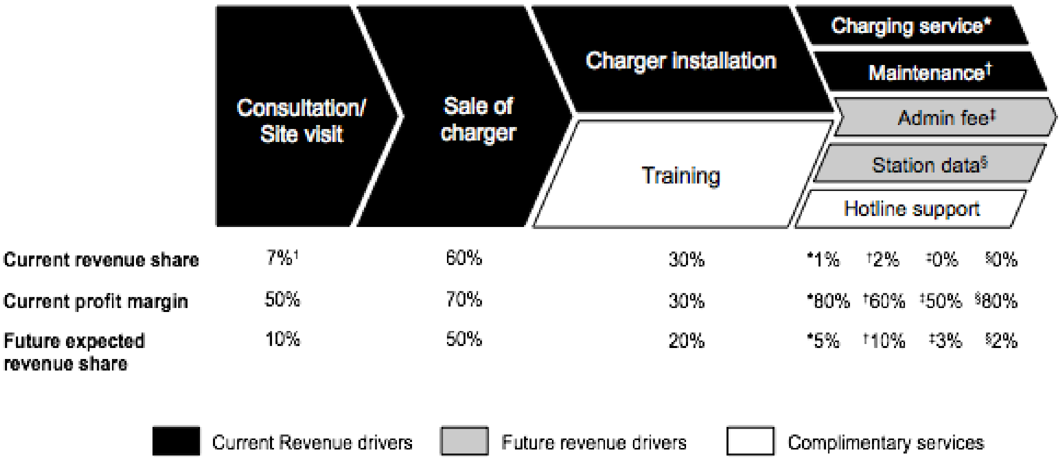

Figure 9: EV Power's current value offering (Proprietary analysis)

At the point of when this study was conducted, most of EV Power's revenues came from the actual sale of charging stations (60%), and charger installation (30%). Regarding the profitability, it has been observed that the company in general has pretty high margins on most of its value offering, where charger installation is the one service with the lowest profit margin due to it being a labour intensive service.

4.3 STAKEHOLDER MAPPING

In order to get a better understanding of EV Power's business and success in their home market, a stakeholder analysis has been conducted. Due to the fact that EVs are part of a LTS (as discussed in Section 2.4); an EVSE provider has various stakeholders with varying influence. This is no less true for EV Power, especially since the company has a full value offering. An interesting specific of the EVSE industry is that so many of the different stakeholders contribute directly to revenues. At this point in time, EVSE is purchased by almost all actors in the LTS to some extent.

The strategic mapping has identified that EV Power's current stakeholders are PEV owners, corporate fleets[13], utilities, government (parking and fleet), OEM partners, and property developers. Property developers are in turn divided into three categories: residential, office and retail buildings. In Figure 10, the identified stakeholders are mapped by their revenue contribution, i.e. 'sales', and their 'indirect influence'. All of the stakeholders except utilities are also direct customers of EV Power, as stated earlier.

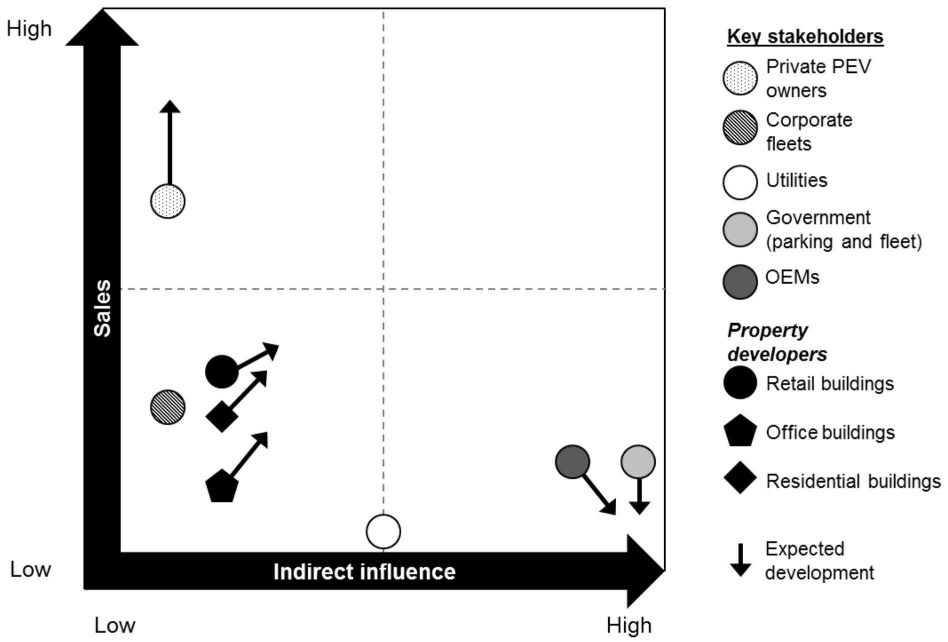

Figure 10: Stakeholder mapping (Proprietary analysis)

The stakeholder mapping (Figure 10) shows that currently, private PEV owners have the biggest revenue contribution (sales) while having relatively low indirect (non-monetary) influence. Further investigation and discussion with the company founders have revealed that although all private PEV should own a residential charger, this is not the case in Hong Kong. The reason for this, according to the company founders, is the large amount of public chargers present in Hong Kong (there are nearly double amount of public chargers compared to the number of PEVs). Nonetheless, the this is something that company founder believe will change when the number of private PEVs grows, since the publically available chargers would not be as vacant as they currently are and a residential charger will become a prerequisite when owning a PEV.

[13] A vehicle fleet is a group of vehicles that could be owned or leased by governments or corporations. (Morris, 2014)

On the opposite side, partners and government have relatively low revenue contribution. From discussions with company founders, it seems that this trend will be stronger in the future, where PEV owners will generate even more revenue while OEM partners and government will generate less revenue, but still remain highly influential. Currently, OEMs are buying EVSE for demonstration purposes only, a practice which will diminish with time. Part of the purchases from governments are public charging, an effort they make to encourage EV diffusion in the early stage of development. The purchases of chargers by private PEV owners, however, will only increase as EV diffusion continues.

Instead, the OEM partners and government have substantial indirect influence, and will continue to have so in the future. The government practices its influence by promoting use of electric vehicles and setting policies and regulations and the OEMs have a large indirect influence by choosing which EVSE provider to partner with. OEMs enter partnerships with EVSE providers whereby they refer each customer of their cars to the EVSE provider for installation, service and possible purchase of the charger itself. Due to this, partnerships with OEMs are seen, by EV Power, as the main source of connecting to private PEV owners. The company does not market themselves directly to the end user but rather to the OEMs, who in turn are referring the customers to EV Power. In fact, through both the analysis of EV Power's business model and the stakeholder mapping, it has been discovered that OEM partnerships are of great importance when it comes to success of EV Power.

Another important observation is that utilities have no actual revenue contribution but still a high indirect influence. This is due to the fact that it is important to have a good relationship with the utility companies in order to be able to install the wallboxes (e.g. connect the wallbox to the power distribution).

4.4 ANALYSIS OF THE COMPETITIVE LANDSCAPE

According to EV Power, there are three main types of competitors active in Hong Kong: (i) privately owned companies such as EV Power, (ii) utilities, and (iii) large electronics companies. When it comes to privately owned companies, there is only one competitor called Cableplus. Cableplus is an engineering company focusing only the product (wallbox), which they are selling at a lower price. At the time of the analysis, Cableplus only had two chargers installed in Hong Kong. Looking at utilities, there is CLP Engineering Ltd., which is a part of CLP Group; the largest vertically-integrated Hong Kong based electricity generation, transmission and distribution company. CLP Engineering Ltd. is, at the point of this analysis, the largest competitor with 200 installed chargers in 30 locations. The company uses its reputation from the CLP Group's operations in order to cross-sell electric vehicle charging infrastructure and, but is solely focusing on large-scale project (i.e. no residential charger sales and installation). The only large electric company operating in this market is Schneider Electric with their <10 installed chargers. Schneider Electric is also focusing on larger scale projects and cross-selling with their other business parts. Besides the defined types of competitors and above described companies there are also around 600-700 regular 13A sockets available, which are suitable for level 1 charging (slow charging). Table 2 is a summary of the competitor analysis, which is covering charger installed base, strategy, target customers, and vertical integration.

	Installed base	Strategy	Target customers	Vertical integration
Hong Kong EV Power Limited 香港電動能源有限公司	• 120 chargers	• Proprietary payment system • Partner referrals • Contact with PMOs	• Government/Corp. • Private EV owners • Property developers	• Design & manufacturing • Sales & Installation • After service • System for end user
CLP 中電	• 200 chargers in 30 locations	• Using reputation and cross-selling • Only large projects	• Government • A few large corporations	• Design & manufacturing • Sales & Installation • After service • Less functional system
Schneider Electric	• <10 chargers	• Cross-selling • Low price • Charger unsuitable for HK	• Any large institutions	• Design & manufacturing • Sales, no installation • Limited after service • No end user system
cableplus 科寶	• 2 chargers	• Selling chargers at low price	• Unknown	• Licensed design, own manufacturing • Sales, no installation • No after service or sys.
Other (13A sockets)	• 600-700 sockets currently installed	• N/A	• N/A	• N/A

Table 2: An overview of EV Power's current competitors and their business models (Proprietary analysis)

While most of EV Power's competitors design, manufacture, sell and in some cases install and after service electric vehicle charging infrastructure, EV Power differentiates themselves by focusing on a full-scale service, as previously described a full offering. Also, EV Power has its own proprietary payment system, a superior back-end system, and strong partnerships with OEMs, government, property developers, utilities, and good contact with residential property management offices (which is essential in order to install residential charging stations in multi-storey buildings) [14].

[14] In Hong Kong, residences are managed by small property management companies. When a private PEV user want to install a wallbox at his or hers parking space, he or she needs approval from the property management office, which EV Power helps him or her to attain.

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5 Formulating the EVSE city evaluation model

The analysis in this chapter aims to answer research question #1. The chapter begins with presenting the final EVSE city evaluation model, which is followed by detail descriptions and rationale for each factor of the model. After that, the relative importance of each factor is deduced. Lastly, the approach to be used when assessing and rating each factor is described.

5.1 THE MODEL

The city evaluation model serves as the answer to the first research question of this study as well as the first question of any market entering strategy: What market do we want to enter (‘Where’-analysis)?

In the model one can find concepts that are reoccurring in any market analysis, but with added detail that make them specific for, and more useful for, the EVSE industry (like the division of short-term demand into EVSE specific segments). It also contains some entirely new concepts, like the division of the commonplace market size factor into two exclusive factors (more on that later). The model aims to be exhaustive, as to contain all factors that need to be taken into account when analysing a market for entry by a small to medium-sized EVSE producer.

Figure 11 shows the first two (out of a total of three) levels of the final model, which includes five important factors to consider. Each of these factors will be elaborated on in this chapter. The model also has an inherent weighting of the factors, which will be presented in Section 5.3. If used correctly, an analysis made using this model will result in a numerical rating of a market, which may be used to compare it to a reference market or another potential new market.

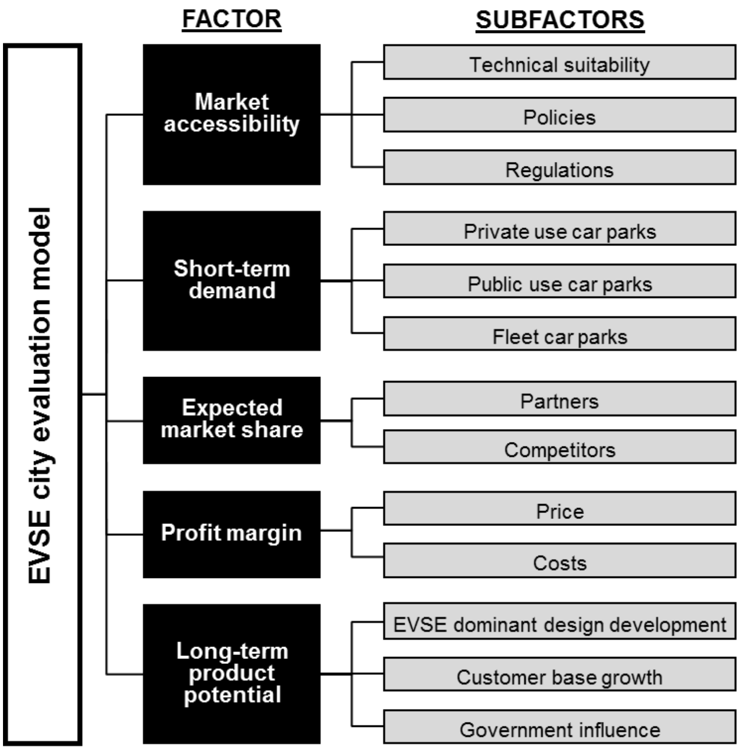

Figure 11: The EVSE city evaluation model (Proprietary analysis)

5.2 BREAKDOWN OF THE MODEL

In the following subsection, each part of the EVSE city evaluation model is broken down, discussed and motivated, in order to create an understanding of the rationale behind the composition of the model and its factors.

5.2.1 Market accessibility

The first part of the EVSE city evaluation model is *market accessibility*. *Market accessibility* has been acknowledged as a key factor to consider in any market entry (as described in Section 2.1). In the EVSE city evaluation model, this factor is even more central. This is due to the nature of the EV Technology: For EVs, being a LTS competing with another LTS (ICEs), barriers[15] to market accesses in the form of intervention (whether they act to support or limit the spread of the EV technology) from other actors (utilities, government), are especially important[16]. The factors included in *market accessibility* are so fundamentally important that the outcome of this analysis can in itself 'break' a market. If all other factors are great for a market but the market accessibility is not sufficient, entry may still be impossible.

The analysis has concluded that the three most important market accessibility factors to be assessed are *technical suitability*, *policies*, and *regulations* (presented in Figure 12).

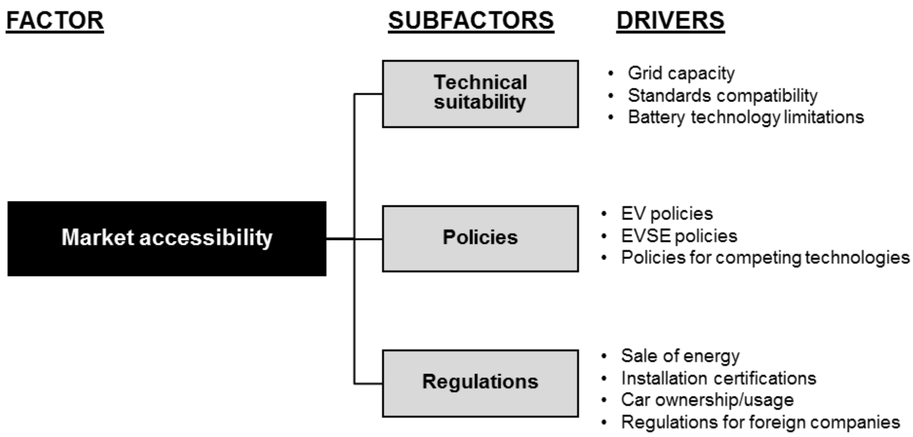

Figure 12: Market accessibility overview (Proprietary analysis)

Technical suitability

First of all, when analysing a new market, it is necessary to get an understanding whether the markets in question are technically capable to support a deployment of electric vehicle infrastructure. This a binary, 'go or no go', factor, meaning that if has city does not have the technical suitability for EVs, the rest of the analysis is will not matter, and the market will not be suitable for a market entry (Pfeiffer, 2014) (Hecker, 2014) (DeForest, et al., 2009) (Liu, 2012) (Streng, 2014). This is yet another

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[15] The *market accessibility* factor may be viewed as related to the 'barriers to entry' component of the Porter's five forces framework. However, while barriers to entry are positive if the company in question can overcome them, as they keep new entrants out of the market, this is not the case of the sub-factors of market accessibility. The sub-factors are such that if they exist, they cannot be overcome by investing more money, so they act to keep all actors out of the market. (Porter, 1980)

[16] EVs has historically had a hard time competing with ICEs (since the early 1900s at least), much due to the fact that both of these technologies (ICEs and EVs) can be considered Technology Systems (see Section 2.4) and hence requires intervention and collaboration from several actors in the market to solve the 'chicken and egg' problem and achieve significant adoption rates. ICEs have already reached this point, with developed networks of petrol stations and in some parts of the world the government subsidises fuel.

example of the dependency of the EVSE industry on other actors in the LTS, such as utilities, government bodies, industry associations, etc. Whether a market is technology capable to handle a large scale EV rollout is driven by the main drivers: batteries, grid capability and standards.

The batteries are constantly improving and today's technology is 'good enough' to facilitate the usage of EVs. However, as Streng (2014) points out, batteries of EVs are sensitive to the climate conditions where they operate. Streng (2014) compares the battery to a human being, saying that the battery 'feels' good in the same setting where humans feel good and that too cold, too hot, or too humid settings are not preferred. Therefore, one must assess whether or not the market's climate can support EV technology before deciding on a market to enter.

It is also important that the market in question has a power grid that is appropriate for deployment of EVs and large scale EVSE. The grid should be stable and not have too much downtime. It must be able to handle the large load that a high EV adoption rate will incur, especially during peak hours. (Streng, 2014) (Pfeiffer, 2014) (Hecker, 2014) (The Regulatory Assistance Project, 2013)

Lastly, standards capability is a key driver in determining whether or not the *technical suitability* of the market is sufficient. As mentioned in Subsection 1.4.1, standards in EV technology refer to both the standard for the physical shape of the plug and the standard for the charging protocol. It is important to investigate what standards are used in the market and if those are coherent with the standard used by the company in question (i.e. if the company wanting to enter the market produces chargers that are compatible with the cars existing in this market).

Policies

As it has been pointed out several times, by both industry experts Streng (2014), Heltner (2014), Shen (2014), Au (2014) and Hecker (2014), employees of EV Power Tsang (2014) and Chan (2014) and as well determined through the theoretical study of LTS-technology (see Section 2.4): Governmental policies are one of the main drivers of the widespread use of EVs, and hence also the diffusion of EVSE. Albrecht Pfeiffer (2014), Manager New Energy Vehicles at BMW Group China, (2014) explains that *"[The attractiveness of a market] entirely depends on the local government and what they will invest in. And whether they have the proper guidelines and policies in place to encourage people to buy EVs".*

Policies can both be obstructive to EV adoption (e.g. policies favouring other propulsion methods, such as subsidies on petrol)[17], or positive for this development (e.g. subsidies for PEV purchases) (Bauner, 2010) (Streng, 2014) (Pfeiffer, 2014). A complete lack of any policies might not be a critical barrier to diffusion of electric vehicles, but positive policies are certainly an important driver. A market with 'better' policies, towards the promotion of electric vehicle usage, is therefore more attractive for an electric vehicle charging infrastructure producer.

When it comes to the impact of policies as incentives, most of the interviewees (and as elaborated by Streng (2014) and Pfeiffer (2014), agree that mobility enhancing policies[18] are preferable compared to direct subsidies. This is due to the fact that these incentives historically tend to be more impactful. Streng (2014) and Pfeiffer (2014) have confirmed that the 'right' types of policies are essential

[17] Streng (2014) points out, even though USA has a large interest in the electric vehicle technology, the usage of oil and lobbying towards using oil as power of fuel are making the electric vehicle market space a challenging environment.

[18] e.g. policies that give EV users dedicated parking spots or traffic lanes, as opposed to monetary subsidies

component required in order for the EV industry to succeed. Both have exemplified this with the case of Norway, the country with the highest penetration of EVs in the world (Gronn bil, 2014), which has focused the majority of their efforts into policies for increased mobility (Figenbaum & Kolbenstvedt, 2013).

Regulations

Besides *policies*, it is also important to consider governmental regulations prevailing in analysed markets (see Section 2.1). Governmental regulations are an important part of the market accessibility analysis and it is necessary to investigate whether regulations could become a barrier to entry of the desired market. From what has been concluded in previous works on market entries, (Peng, 2006) (Hollensten, 2007) (Lasserre, 2007), when looking at regulations, it is first important to understand the market regulation towards foreign companies and whether there are required licence fees, initial investment, tariffs towards imported goods etc.

Further, interviews with experts within the field of electric vehicle technology as well as strategic mapping of EV Power have shown that it is important to understand the regulations regarding the sale of energy. If such regulations are in place, it will be necessary to adapt the business model accordingly in order to be able to gain revenue from sale of charging service in public charging stations. Apart from directly affecting revenues, such polices may have an impact on the success of EVs as a whole, as it creates problems for several important actors in the system. Additionally, some of the world's major cities have started to regulate the use of cars in order to combat traffic congestion. Since this would lead to fewer car sales overall, it is important to recognize (Bloomberg News, 2014) (Shen & Takada, 2013).

Next, the Strategic mapping of EV Power and interviews with Au (2014), Shen (2014) and Pfeiffer (2014) have shown that it is important to investigate whether private companies are allowed to install electric vehicle chargers and whether there are any requirements with regards to e.g. permits. A market with a complicated process with regards of charging installation certifications might not be a suitable market to enter.

It is also important to point out that, as with policies, all regulations do not necessarily affect the market negatively (Hecker, 2014). Therefore, it is equally important to investigate if any regulations are in favour of promoting the usage of electric vehicles. Such regulations may exist in the form of restrictions on ICE sales, tax and toll exemptions for EVs, as well as other, regionally specific regulations (Pfeiffer, 2014).

5.2.2 Short-term demand

According to research quoted in the Section 2.1, one of the most important factors to consider while evaluating a market's attractiveness is the current *market size* and *growth rate* of the analysed markets.

However, the long term growths of EV and EVSE markets, which are characterized by volatile growth rates, have been found hard to reliably estimate (Streng, 2014) (Heltner, 2014) (Wang, et al., 2012). As mentioned in the theory with regards to emerging technologies, the extremely high growth rates (for EVs, 100%+ in the last few years (IEA, 2013) (Environmental News Network, 2014)) of these technologies are subject to rapid increases or declines due to external factors that are hard to predict. The current consensus among business scholars on using current market size and estimated future growth rates as a main part of the market assessment may work for mature industries where reliable estimates exist, but this is not the case for EVs (Streng, 2014). In fact, EV Power founder Martin Tsang (2014) said the following regarding estimates of future EV markets:

> *"Up until now, everyone has been wrong. Every year estimates lag behind predictions. There is no reason to believe that the current estimate will be any more correct"*

, and Heltner (2014) agrees:

> *"Such volume estimates [for future EV market size] are prone to inaccuracies"*

Having that said, it is still necessary to have a guideline for the potential *market size* and *growth rate* when comparing several markets, even if the estimate might be uncertain. Therefore, we have divided the market size and growth factor into two separate parts of the model that will be estimated in different ways: *short-term demand* (elaborated further in the current subsection) and *long-term product potential* (see Subsection 5.2.5). *Short-term demand* will be a detailed estimate of the current markets (corresponding to the traditional *market size* factor), while *long-term product potential* will be a more qualitative analysis of the drivers that will have an impact on the future size of the market (corresponding to the traditional *growth rate* factor). By performing this division, numerical estimates can still be used in the short-term, where they are the most reliable.

This division is also very fitting for companies in the EVSE industry, as many of them are funded by venture and seed capital and are fully aware that profit and high revenues may not be achievable in the near term (Heltner, 2014) (Streng, 2014). They may be more interested in future developments, and therefore it is appropriate to do a separate and thorough analysis of the factors influencing a future market. The following paragraphs will detail how to estimate the s*hort-term demand*.

A market should be sized for each segment individually (Peng, 2009). Hence, the first thing to do is to segment the market appropriately. The first segmentation that may come to mind is segmentation by type of customer. The Strategic mapping of EV Power has shown that the customer segments that buy wallboxes are the following: private EV owners, property developers (retail, office, residential), corporate, governments, and OEM partners. However, it turns out that several of these customer types are interested in chargers for more than one application. For example; a private PEV owner may purchase a wallbox for either residential use, while the government may purchase a wallbox for use either in a state owned car parking space (public use) or for a government fleet (government fleet use). It is clear that there are several reasons for a specific customer type to purchase a wallbox, and therefore, each customer type contributes to more than one sub-market, and it is hence not fitting to try to estimate the market by customer type. However, the reasons for buying a charger turn out to correspond to where and by whom they are used. As pointed out by Heltner (2014), Anonymous interviewee (2014) and Tsang (2014) and the Strategic mapping of EV Power, a wallbox could be sold either associated with a PEV sale or independently. Independently sold wallboxes are exclusively used as public charging option in public use car parks[19], by governments or corporates (Chan, 2014). Wallbox sales associated to PEVs are of one of two categories: sales to private PEV owners for

[19] Public use car parks are defined as a car park that can be used by anyone (e.g. public parking lots, parking houses, and parking in retail malls). It does not relate to whether or not the car park is owned by a private institution.

installation in private use car parks[20] or sales to corporates/government fleets. By dividing the market in this way, a situation where each sub-factor is driven by different elements in the market is achieved, and the overlapping that would come from dividing the market by customer type is eliminated. Below (through Figure 13) the reader will find an illustration of the *short-term demand* part of the model.

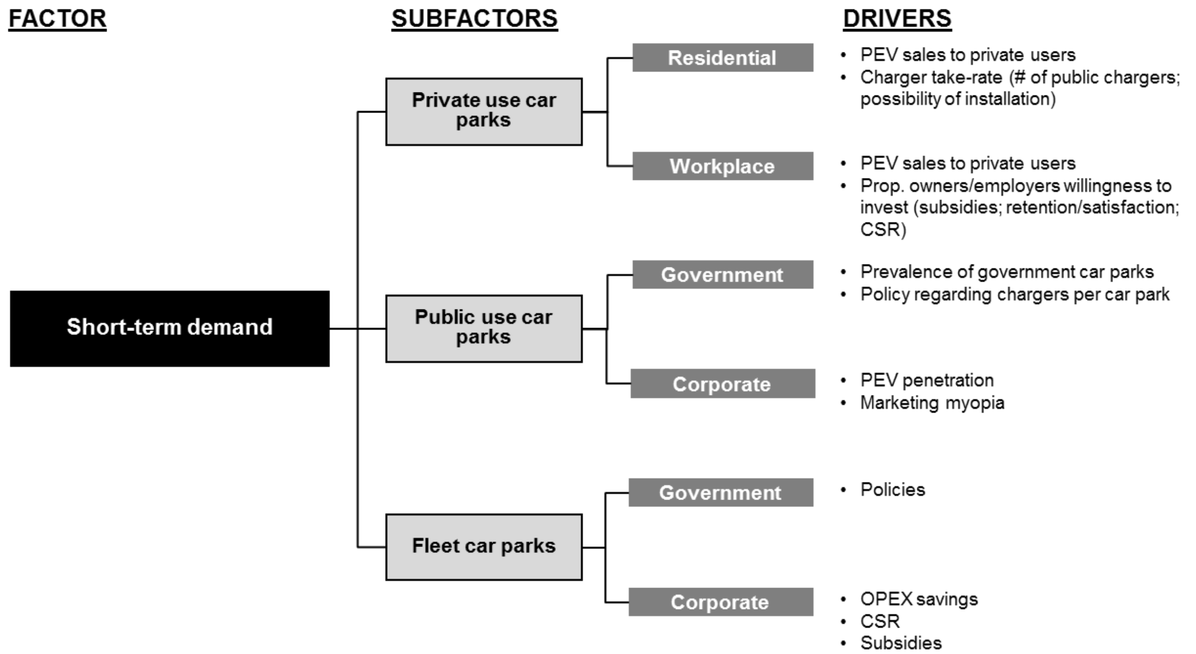

Figure 13: Short-term demand overview (Proprietary analysis)

Private use car parks

The private use car parks sub-market has two customer types: private EV owners (buying wallboxes for private use) and corporates (property owners and employers, buying wallboxes for workplace use, which is still private). Below, the drivers of this sub-market are described.

Residential

Based on interviews with Tsang (2014), Hecker (2014) and Pfeiffer (2014), it has been made clear that most industry experts believe that wall boxes for residential use will correspond the biggest share of any given market and is also the segment that will enjoy the greatest growth in the long-term. Through the Strategic mapping of EV Power (Chapter 4) and interviews with Tsang (2014) and Heltner (2014), it is concluded that the sales in the residential segment is primarily driven by the number of privately owned PEVs sold, which should be quite obvious. However, not every sale of a private PEV results in a wallbox sale, therefore a second driver is the take-rate of the wallbox (Tsang, 2014) (Heltner, 2014).

The wallbox take-rate[21] is the rate by which a wallbox is being purchased together with the car (Heltner, 2014). Take take-rate itself is driven by the number of publically available chargers and whether the condition of the buildings in the market generally allows for installation. From interviews

[20] Private use car parks are defined as a car park where use is restricted to specific people (e.g. residents for residential parking or employees for workplace parking). The exception is car parks for fleets, which has restricted use but still has its own category.

[21] The wallbox take-rate concept is based on the 'accessory take-rate' (ATR), a KPI related to mobile phone industry, which measures accessories sold together with mobile phones.

with Tsang (2014) and Heltner (2014) and the Strategic mapping of EV Power, it has been concluded that the number of chargers purchased together with the EV is dependent on the number of publically available chargers in the market. When the number of publically available chargers is greater than number of PEVs, naturally, PEV owners may rely on public charging and therefore forego buying a wallbox themselves. As the number of PEVs grow, and surpasses the number of publically available chargers, PEV owners will not have the same ability to always charge in public and hence, will have to purchase a residential charger (Hecker, 2014) (Pfeiffer, 2014) (Tsang, 2014) (He, 2014).

Apart from the number of public chargers, the possibility of installation has some impact on the take-rate. Naturally, if one does not have a possibility to install a wallbox (due to living in an old building or having no dedicated parking space, etc.), one will not purchase it. Tsang (2014) and Pfeiffer (2014) points out that a customer living in a private house (such as a villa) will in almost all cases be able to install a wallbox, while the possibility of installing a wallbox in the car park of an multi-storey apartment building will vary in from case to case. However, it is no secret that the current PEV customers typically have an income above average (Silke Carty, 2012). This has been confirmed by interviews with Tsang (2014), Streng (2014), Anonymous interviewee (2014) and Au (2014), who mentioned that since the targeted customers in any market are affluent people (at this time), they will live in apartment buildings where installation will be possible. Due to this, as long as PEVs are relatively expensive, the general condition of the buildings in the market will have a marginal impact on the take-rate

A potential take-rate driver that has not been included in this model is the difference in proportions between BEVs and PHEVs in different markets. Currently, opinions regarding weather PHEV users could do without home charging are differing, and therefore this driver has been left out. (Heltner, 2014) (Tsang, 2014)

Workplace

When it comes to workplace car parks, both interviews and secondary sources have showed that there are two main customers within this segment: (i) the property owners and (ii) the employers (Calstart, 2013) (US Department of Energy, 2013b) (Tsang, 2014) (Chan, 2014).

Similar to residential wallboxes, it has been found that the amount of workplace chargers is also driven by PEV sales to private users. The study of EV Power's business in Hong Kong showed that workplace wallboxes are generally not purchased by the actual EV owners, but by the employees or by the property developers managing the workplace building. As such, the purchase of a wallbox for use in a workplace setting is not directly associated with the purchase of a PEV. Nevertheless, it was also found that in almost all cases, employers and property developers would not equip their parking lots with wallboxes pre-emptively. Instead, they would offer it to employees/tenants with EVs. Hence, the relationship of the number of workplace wallboxes sold to the number of private PEVs sold still holds.

Naturally, and also similar to the residential segment, all PEV sales will not result in a wallbox sale for a workplace parking space. It can be assumed, however, that most employees who are offered a workplace wallbox by their employer/property developer would accept the offer. Therefore, the share of PEV purchases that will lead to a purchase of a workplace wallbox has been found to be driven by property owners or employers willingness to invest in a wallbox. This is confirmed by previous studies on the subject (Calstart, 2013) (US Department of Energy, 2013b), and by interviews (Au, 2014) (Chan, 2014).

Three main elements have been found to influence a property developer or employers interest in investing in workplace chargers: subsidies, tenant retention/employee satisfaction, and CSR (Calstart, 2013) (US Department of Energy, 2013b). Subsidies could come in the form of tax exemptions or direct price subsidies. Regarding the tenant retention/employee satisfaction element, both of these different actors may use EV wallboxes as a benefit, in order to keep their respective stakeholders (i.e. tenant and employees), leading to overall satisfaction and at the same time demonstrating the organizational leadership in supporting cutting edge technology (Calstart, 2013) (US Department of Energy, 2013b). Sanborn & Oehler (2013) explains that the prevalence of employee benefits as a means to increase employee satisfaction is something that differs a lot across markets. Thirdly there is CSR. Investing in workplace chargers may lead to a better public that may benefit the company in the long term (Mueller, et al., 2012) (Calstart, 2013) (US Department of Energy, 2013b).

Public use car parks

The next subfactor of the *short-term demand* is the *public use car parks*. This subfactor encompasses all the wallboxes that will be purchased and installed for public use and hence, are not associated with individual PEV purchases. Instead of further dividing this segment by location, it has been found that breakdown by wallbox ownership makes the most sense, since the different ownership categories have the same underlying drivers. As previously concluded, a public charging station, and in this case a public wallbox, can be owned by either government or corporates.

While it is a prevailing opinion that the public use car park market will be of little importance for EVSE providers in the long term, due to the perceived dominance of residential charging (Tsang, 2014; Edelstein, 2014; Wood, 2012; Gordon-Bloomfield, 2013), it is a significant part of EV Power's revenue share at this point in time (as described in Chapter 4, Section 4.3), and thus has a place in the *short-term demand* factor.

Government

The government ownership segment includes the car parks or parking spaces owned by the government. As mentioned in the introduction to EV technology, a government owned parking space could be roadside car parking, multi-storey car parks and stand-alone parking lots. The amount of wallboxes a government will purchase is first and foremost dependent on the type of government car parks existing in the given market (i.e. the amount of each parking type) (Tsang, 2014). As concluded, a wallbox is not suitable for roadside parking, which excludes this type of parking (Pfeiffer, 2014) (Tsang, 2014). Further, through discussions with Shen (2014), Pfeiffer (2014), Hecker (2014), He (2014) and Au (2014) it has been concluded that the chargers purchased by government owned car parks are solely driven by local policies existing in the given market. A government that is more focused on promoting the use of electric vehicles will be keener on purchasing public charging stations than a government that is not.

Corporate

The corporate owned public car parks are owned by organizations that either are in the car park business or own car parks as a side business complimentary to other operations such as property development or commercial space ownership.

The analysis has concluded that the corporate owned public car parks are driven by the PEV penetration in the given market. This is related to the business rationale behind owning a car park, where the goal is to obtain as high occupancy rate as possible, since empty car spaces do not generate any revenue and only incur costs (Heltner, 2014) (Streng, 2014). Thus, with a high PEV penetration, not having PEV charging infrastructure will deter those who own a PEV and are looking for a parking space (Heltner, 2014). As concluded previously, current purchasers of PEVs are affluent individuals, which owners of commercial space (e.g. shopping malls) want to attract. For property developers, offering EV charging in a property's parking space may increase the square meter price, if the PEV penetration is sufficient (Tsang, 2014) (Hecker, 2014). As one industry expert puts it:

> *"[Corporate] car parks, that is, throughout the world, is a very difficult pitch, because they compete on usage of square meter price, and as long as the penetration of EVs is not high enough, these spaces will not attract anyone, it is that simple. Car parks owners will only start to get into this business if the momentum and the penetration of EVs is high enough - it will take a while" -*
> (Streng, 2014)

However, since the current PEV penetration is relatively low in all markets, it is also important to assess the prevailing level of marketing myopia[22], which is also a key driver: At this point in time, there is not much profit to be made by the car park owners that invest in publicly available electric vehicle wallboxes. However, Heltner (2014) talks of the possibility of a 'snowball effect'[23], which means that when some car parks owners start investing in wallboxes or other charging alternatives, others will be forced to follow in order to stay competitive. According to Tsang (2014), this is what has happened in Hong Kong recently. Hence, if there is a low level of marketing myopia in the market investigated, one can expect public car park owners to have a greater interest in PEV charging earlier, in order to avoid being left behind and securing profits in the long term. As discussed in interviews with Heltner (2014) and Streng (2014), this depends on the general mind-set of the people in the given market; are they only looking for short-term profit or do they think of the long-term?

Fleet car parks

The third and last subfactor of *short-term demand* is *fleet car parks*. Fleets, as defined earlier, are two or more vehicles that are owned or leased by an institution, and can for example be used for taxis, car rental, goods transportation, etc. A fleet car park is a car park used by these fleet vehicles. Since the fleet vehicles are owned or leased by either a corporation or a government entity, the natural sub-categorization of fleet car parks is government and corporate.

Government

When it comes to *government fleet car parks*, discussions with Pfeiffer (2014), Chan (2014) and Hecker (2014) have identified that government policies is main contributing driver for the market of wallboxes to be used governments. Policy regarding EV use by government institutions will dictate the number of EVs used by the government, which in turn will drive the number of wallboxes.

Corporate

The market size for corporate fleet car parks is on other hand driven by a number of factors. First of all, it is driven by the monetary gains that a corporation might receive from acquiring an electric vehicle fleet, i.e. the reduction in variable costs of operating the fleet[24]. The variable costs of operating an electric vehicle fleet is substantially lower than the equivalent operation performed by ICE vehicles

22 Marketing myopia is a concept introduced by (Levitt, 1960) and describes a narrow minded approach where only short-range goals are considered when making business decisions, regardless of the total NPV of the venture.
23 Snowball effect is a term describing a process starting from a small and insignificant level and further builds up upon itself and becomes larger (Cambridge Dictionaries Online, 2014).
24 Cost savings was also expected to be a driver for government fleets, but according Xiaocheng (2014); this has not been the reason for government fleet EV orders in China.

(Streng, 2014) (National Renewable Energy Laboratory , 2012). These savings may differ in between markets (since fuel prices differ) and therefore, companies will be less inclined to use EVs in their fleets in markets with smaller cost savings. However, the initial investment will, in most cases, be higher than for an ICE fleet (Streng, 2014); therefore, subsidies to corporates which uses EV-fleets must be taken into account. Another gain to be made for corporates using EV fleets is CSR (Tao, 2013) (Mallia, 2014) (Epstein, 2014) (Gustavsson & Carlsson, 2013). Hence, a market where the public is aware of environmental problems and where companies engage themselves in CSR initiatives will likely have a higher number of corporates adopt PEV fleets.[25]

5.2.3 Expected market share

The prevailing theory of market entry strategies makes it clear that assessing the potential market share in a new market is important to any market entry strategy (Horn, et al., 2005) (Hollensten, 2007) (Peng, 2009) (Lasserre, 2007). While a market might seem attractive from a size and growth perspective, it is necessary to get an understanding of how big portion of the market may be captured, i.e. the *expected market share*. Analysing the *competition* is a key factor in establishing the possible market share (as described in Section 2.1), which is why this is one of two subfactors for *expected market share*. The other subfactor is *partners*; the importance of partners for the EVSE business is explained in the chapter Strategic mapping of EV Power4. An overview of *expected market share* factor is presented through Figure 14.

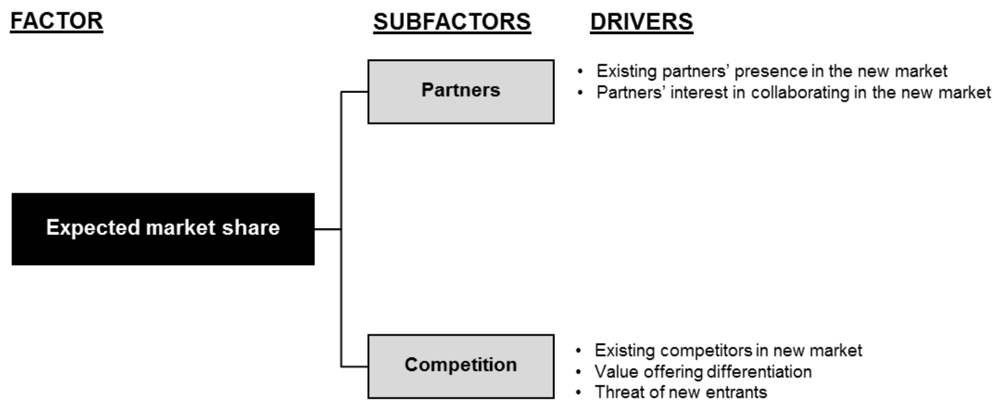

Figure 14: Expected market share overview (Proprietary analysis)

On a high level, the EVSE offering consists of two parts, the product (wallbox sales) and the service (installation, maintenance, etc.) (as explained in Chapter 4). It is paramount to understand that these two serve entirely different needs for the customer and hence, they might have different market shares in some regions where the vertical integration of the EVSE providers is different than in Hong Kong[26]. Therefore, a conclusion has to be made for each of these market shares.

[25] In addition to the drivers mentioned, take-rate was investigated as a potential driver for both fleet types. However, interview with Xiaocheng (2014) and sales history from EV Power has shown that fleets orders generally include one wallbox per vehicle.
[26] In Hong Kong, EV users tend to buy their chargers from a third party like EV Power, and have them install it. In other regions, this might not be the case and separate entities may handle sales of the product (wallbox) and service (installation maintenance, etcetera). (Tsang, 2014) (Streng, 2014) (Pfeiffer, 2014)

Partners
The first part of the *expected market share* analysis is looking into the possibility of establishing partnerships in the new market. This is a factor that is very specific to EVSE companies. In fact, partners are a key part of the EV LTS: While performing the literature review as well as the strategic mapping of EV Power and interviews with industry experts, it has been concluded that partners (e.g. OEMs and large electronic companies) play an essential role in the existence of the small-medium producers of electric vehicle charging infrastructure. Partnering up with OEMs has shown to be the main source of acquiring the private use customers (as found through the Strategic mapping of EV Power), which has been concluded to be the most important customer segment. Utilizing partnerships has been shown to be a possible key competitive advantage for EVSE companies (see Chapter 4). And competitive advantages is an internal factor that has been established as main factor affecting market entries (see Subsection 2.1.1).

The importance of partners for realizing a substantial market share when it comes to sales of wallboxes stems from the nature of the wallbox product: The typical EV customer at this point in time probably has some interest in the technology, and has done extensive research on the car he/she wants to buy. However, the customer typically has no knowledge of which charging alternatives are available, and will often go with whatever the OEM recommends. Partners are equally (possible even more) important for establishing a market share for an EVSE service offering: Other providers of wallboxes will often use a third party to install/service their product, and they will do so on a long term contract basis, why it is important to win these contracts with partners. Again, there is no defined business model for any of the actors in the EV industry, so OEMs have not yet decided what to keep in-house and what to outsource (some OEMs, like Tesla, even sees public charging as part of their offering). (Lee, 2014) (Anonymous interviewee, 2014) (Hecker, 2014)

The first driver for this subfactor is the presence of already acquired partners in the new market - it is important to analyse whether the existing partners from the home market exist in the new markets. Secondly, it is important to understand what offering these partners are interested in in the new market, and whether these partners already are having these needs met, or if they are open for partnerships.

Competition
From what has been gathered in the theoretical framework, it is clear that one needs to study the competition in to get an understanding of the potential market share. In order to get an idea of the competitive landscape that prevails in the market and further, to get a guideline on whether it will be possible to capture market share, it is important to map and analyse the competitors.

Of course, for an emerging technology like EVs, the first thing one wants to know is if there is any competition in the market at all. It may very well be that there are no current incumbents, and that there is a literal first-mover advantage available. It is however very unlikely that this will be the case. Therefore one needs to map the existing competitors and enquire about the fragmentation of the market and the size of the competing actors (for SMEs, it is essential to understand how one's resources compares to those of the competition. If the competition is comprised of a few large companies, they will have the means to bully a smaller entrant out of the market). (Porter, 1980)

The second thing that is important to map is what the value offerings of the current incumbents in the new market is. This is again related to the fact that there is no clearly defined business model for EVSE providers; one needs to understand which actors will be competing with the company and for which parts of the offering (e.g. some current incumbents may only offer installation, while the company in question offers both sales of the wallbox and installation). (Sinha, 2005) (Zang & Wang, 2009)

5.2.4 Profit margin

The fourth part of the city evaluation model is *profit margin*. The main purpose of this part is to analyse which of the potential markets is the most profitable market (see Section 2.1, for the rationale behind this statement). While the analysis will have already shown which market is most attractive when it comes to *short-term demand* (i.e. volume) and *expected market share*, it is now important to conclude which of these markets will have the highest profit margin in order to get the full picture of the expected profit contribution. To arrive at what market has the higher margin, naturally, *price* and *costs* have been chosen as subfactors (presented in Figure 15). It is important to point out, as mentioned in the Chapter 2, which at the early stage of a product lifecycle (where EV technology currently is); the actual profitability is of little importance. Instead, the focus lies on the revenue growth and innovation. This is something that has been underlined during the interviews with industry experts and strategic mapping of EV Power. In fact, none of the interviewees did worry about pricing of the product (wallbox) or costs at this stage. However, although profit margin might not be of such importance at this point, at the end of the day, a market entry has to be profitable and profit margin must still not be overlooked while evaluating possible markets. (Perez & Soete, 1988)

As with the breakdown of the *expected market share* factor, the *profit margin* factor is also applicable to the two parts of the offering: product and service. These two are entirely different when it comes to price and costs and therefore a conclusion has two be made for each of these offerings.

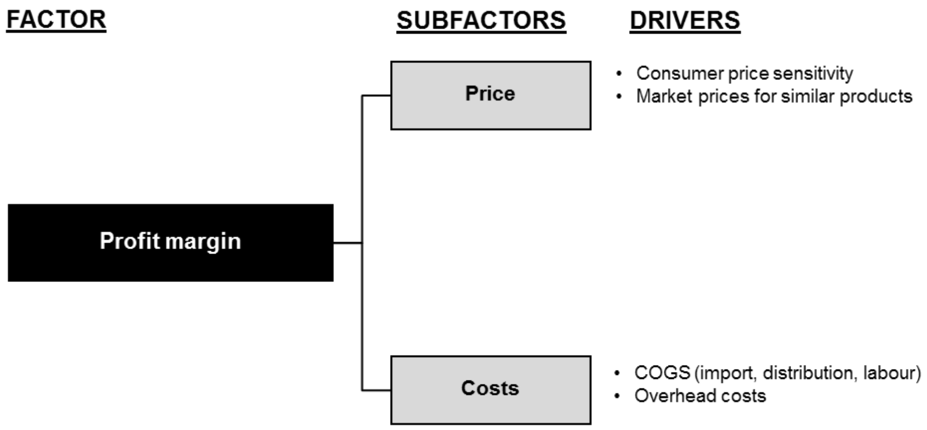

Figure 15: Profit margin overview (Proprietary analysis)

Price

The first part of the *profit margin* factor is *price*. This subfactor has the main goal of analysing what price level the product (wallbox) and service (installation, maintenance, etcetera) would be sold at in the analysed market. From interviews with Au (2014) and Tsang (2014) it has been concluded that both product and service should be analysed in the same manner. In order to decide on a price, one needs to come up with a, from the customers viewpoint, acceptable price range (Au, 2014) (Tsang, 2014)

The bottom of the range can be defined by comparing with the price of competitors with a similar offering (Chan, 2014). For the top of the acceptable price range, the customer price sensitivity needs to be assessed. The price sensitivity could be assessed by ways of a customer or survey, or by benchmarking with similar products or services (Kostova, 2010)

Costs

The second part of the *profit margin* factor is *costs*. The main cost items for an EVSE provider entering a new market are cost of goods sold (COGS) and overhead costs, according to Tsang (2014) and Chan (2014). COGS encompass all costs that are associated with product sales, such as material, manufacturing, labour, inventory, etc. The analysis of COGS may vary depending on the company being analysed. More specifically depending on if the company are planning on moving the production of the product to the new market, which would require a much more comprehensive analysis than if, they keep production in the home market. Overhead costs are indirect costs such as office rent, insurance, taxation, etc. Both of these cost buckets need to be analysed in order to arrive at which city is most attractive when it comes to costs.

It is important to point out that an important part of an EVSE business is having employees with the right expertise, due to the highly technical nature of the offering (Chan, 2014) (Shen, 2014). Therefore, it is important to find out the price of acquiring labour with appropriate expertise. This may be troublesome in emerging markets, and well-educated labour may even end up costing more than in developed economies, due to the scarcity of the resource (Perez & Soete, 1988) (Deloitte, 2007) (EY, 2011).

5.2.5 Long-term product potential

As mentioned in the *short-term demand* section, the EVSE market is of a nature that makes it hard to determine in absolute numbers in the long term. Having said that, an assessment can still be made to better understand in which direction a specific market might move, and how prevalent factors that will hamper and/or facilitate growth are in the market. In our model, we have grouped these factors into a bucket called *long-term product potential*, presented through Figure 16.

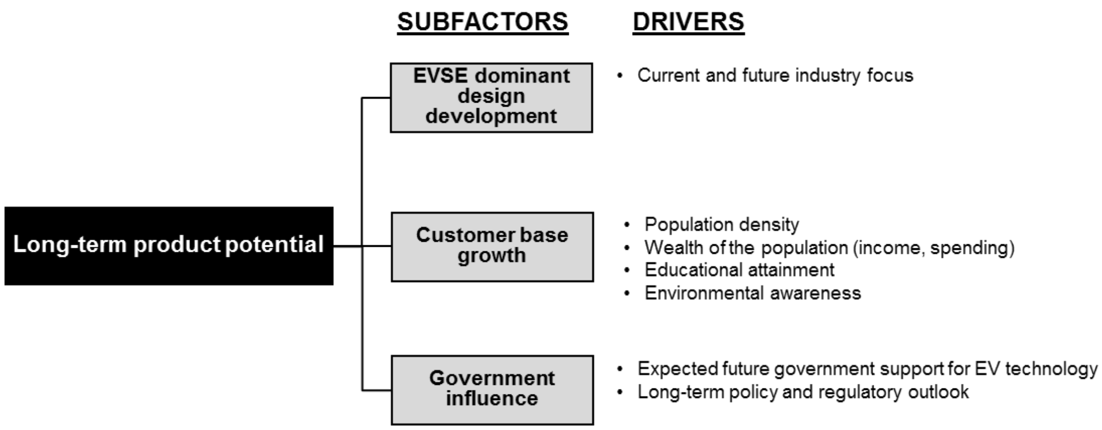

Figure 16: Long-term product potential overview (Proprietary analysis)

Fundamentally, the product potential of EVSE in a market is driven by the diffusion of PEVs, and the key to understanding the long-term potential for PEVs (and EVSE) is to realize that these technologies are part of a LTS (discussed in the Chapter 2, Section 2.4). What this means for EVSE products and services, and the companies producing them, is that the success (i.e. sales figures) in the long term will depend largely on decisions and dynamics that are external to the company. The identified key components in this system, from the viewpoint of the EVSE supplier, are the *EVSE dominant design development*, *customer base growth* and *government influence*.

EVSE dominant design development

From studying the theory (see Section 2.4) it has been found that, for companies acting in an emerging technology industry, it is essential to study the development of an eventual dominant design in the proposed markets. As mentioned before (again in Section 2.4), dominant designs may differ in between markets for emerging technologies. For the EVSE technology, there are currently several different charging technologies available (semi-fast, fast, etc.) that may end up experiencing different levels of success in different regions. To find out the potential of a company's product in a particular market, it is important to formulate and opinion regarding whether this product fits into the dominant design paradigm that may exist or may emerge in the market.

Since which technology becomes a dominant design is not necessarily related to its performance or suitability for the market (a great example of this is the QWERTY keyboard), one should refrain from relying on product performance measurements or customer preferences as indicators of whether a dominant design exists. Instead, James Utterback (Utterback, et al., 1998) (the founder of the dominant design theory) suggests that the main indicator is what technologies the different actors in the industry (in this case, the EV LTS) are focusing on. This 'industry focus' has been selected as the key driver for the *EVSE dominant design development*. Since this factor concerns long term development, it is essential to not only study the current situation, but any future developments as well (also, since dominant designs may not yet have emerged at the time of the analysis, only studying the current situation may result in a 'false negative' for this factor).

Customer base growth

As discussed in the Chapter 2, while evaluating potential markets attractiveness, it is important to look at *market size* and *growth rate*. Since *short-term demand* has already been established, it is important to evaluate the markets potential when it comes to *customer base growth*. Several secondary sources agree that PEV owners tend to live in densely populated cities, and be wealthy, educated, and environmentally aware (Bansal, et al., 2011); (Goldmark, 2013) (Rorke, 2009) (IEA, 2013); (Woodyard, 2012) (Wu, et al., 2013) (Electric Vehicle Information Exchange, 2012). This is something that also has been confirmed by interviews with industry experts (Streng, 2014) (Anonymous interviewee, 2014) (Lee, 2014).

EVs are a more interesting alternative in markets with a high population density due to the shorter ranges and lower average speeds (Organisation for Economic Cooperation and Development/IEA, 2012); (Wyland, 2012) (Tsang, 2014) (Heltner, 2014). However, at a glance it appears that EVs has done well in both markets with high and low population density, but at a closer look it turns out that in markets such as Norway (a notoriously large country for its populations size (World Population Review, 2014a), EVs are mainly popular in the larger cities (Figenbaum & Kolbenstvedt, 2013). Furthermore, (Scoltock, 2012) points out that any city with a high population density would be suitable to EV diffusion. It is also important to note that there might be a diminishing return when looking at population density, meaning that after density surpasses a given threshold, the additional population density will no longer add to the attractiveness of this city (Chen, et al., 2013). Cities such as Oslo and Rotterdam, the world's most successful cities with regards to EV adoption has a population density of 3,200 persons/km^2 and 2,700 persons/km^2 (quite low as far as capitals are concerned), which could be used as proxies for such threshold (Stone, 2014) (Organisation for Economic Cooperation and Development/IEA, 2012) (Demographia, 2014)

Regarding the wealth driver of this factor, although electric cars are getting less expensive by the year (as battery technology improves), it is still a product that cannot compete (in price) with lower-end

ICEs (Qualey, 2014) (Tuttle, 2013). Indeed, depending on which source you want to believe, it will take until 2020-2030 until BEVs are on par with ICEs in terms of lifetime costs (Crist, 2012) (Evans, 2011) (Weiss, et al., 2000). Some have even gone so far as to dismiss electric vehicles as "toys for the rich" (Young, 2014) (Payne, 2012) (Rao, 2013). Hence, having a wealthy population seems to be important in order to achieve a high EV diffusion.

Besides population density and population wealth development, it is important to understand the market's educational attainment. Secondary sources, as well as interviews with experts agree that the typical EV customer is not only wealthy, but also well educated. It is speculated that the part of the population with higher education are keener on adopting new technologies (Bansal, et al., 2011) (Rorke, 2009) (Woodyard, 2012) (Wu, et al., 2013) (Electric Vehicle Information Exchange, 2012) (Heltner, 2014) (Streng, 2014) (Au, 2014).

Lastly, in markets where EVs has been successful (like Norway and the Netherlands), interest has stemmed from a high environmental awareness, because of the fact that EVs is an environmentally friendly way of transportation. Hence, it is important to evaluate the environmental awareness outlook of the analysed cities. (Figenbaum & Kolbenstvedt, 2013) (IEA, 2013) (Rorke, 2009)

Government influence

Government influence, as stated several times before in this thesis, is an essential element in EV adoption and diffusion. In the *market accessibility* factor, current government policies and regulations are studied in order to assess the friendliness of the evaluated markets. In case of emerging technologies, governmental influence is more important in the beginning of the product development than later on in the product lifecycle (Porter, 1990). In an early role of product development, government play more direct role of supporting the technology by investing direct capital or subsidies or temporary protection, why it is important to study policies and regulations, included into *market accessibility* factor of the model.

As the industry progresses as (Porter, 1990), puts it, the industry and companies within the industry have to become the source of advancement and government influence will likely reduce. However, in the case of EV and EVSE, it is not yet clear when the industry could support itself and it is thus important to study the future outlook of government influence (Marquis, et al., 2013). It is not certain that the market which has the most favourable environment today in terms of government influence will keep that advantage tomorrow (Konrad, 2013), which is why the expected future government influence must be studied in addition to the subfactors of 'market accessibility'.

Assessing the future in this regard is of course very difficult, since government influence is subject to changes in representation and other unpredictable factors. Due to the differences in the governance of different markets, little can be said about how to perform this analysis without going into specifics about a particular market. However, one way to get an idea of future government influence is to study long-term EV and EVSE targets, which will give an indication of how the government sees the future of EV technology and how keen the government is on promoting EV diffusion (IEA, 2013).

5.3 THE RELATIVE IMPORTANCE OF THE MODEL'S FACTORS

Although of the above described factors are all considered important in order to arrive at the answer to the questions about which city to enter, some of the factors have been found to be more important than others, and hence, a precise method for describing this relative importance of the factors is required. In order to arrive at an acceptable method for this, secondary sources have been studied to find benchmarks for this type of 'factor weighing' in a business context. The method we settled on, quantifying qualitative information and using a combination of weighting and rating, was the only suitable option for this situation (David, et al., 2009). The weights are part of the model and as such, part of the answer to the first research question. The weights are meant to general (with one exception, see below), and this quantitative description of the relations in between the factors are meant to apply to all small to medium-sized EVSE providers.

For the weighing, a fraction-based weighting approach has been used, imparting that the weight of the whole model (i.e. all factors that affect a market entry) sums up to 1 (David, et al., 2009). The five factors in the model each make up different sized parts of this whole. The weighting of the model has been performed in two steps. First, the top level of factors has been weighted in relation to each other and secondly, the sub-factors within each top level factor have been treated in the same way. Below follows an illustration (Figure 17) of the finished weighing.

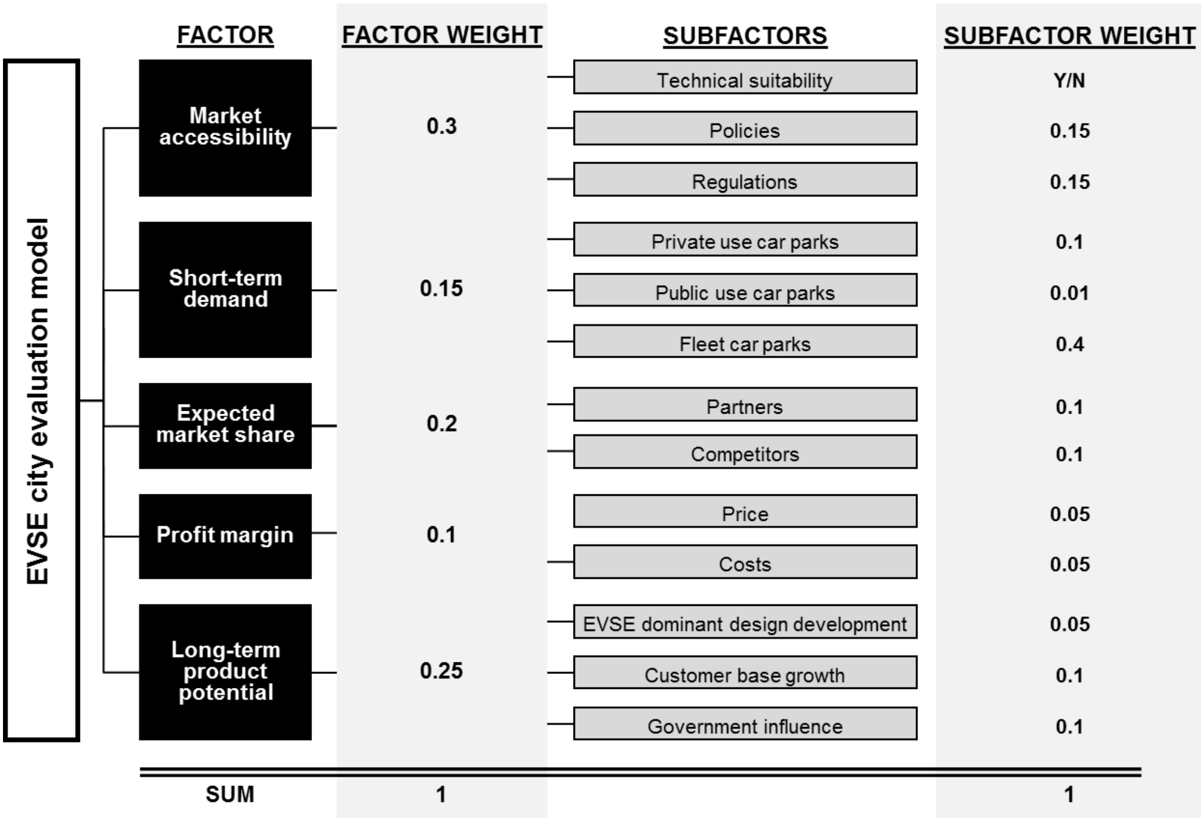

Figure 17: The EVSE city evaluation model with assigned weights (Proprietary analysis)

One of the factors, namely *short-term demand*, will have a weighing that may differ depending on the commissioning company's business model, as it takes into account the focus of the company's efforts (and is thus not a generalizable result of this study). Different EVSE companies may target different markets (i.e. private, public, or fleet) or all of the markets equally. Hence, the weighting within the *short-term demand* factor has to be aligned with the commissioning company's (in this case, EV Power's) business model.

For the top level of factors, weights have been distributed among *market accessibility* (0.3), *short-term demand* (0.15), *expected market share* (0.2), *Profit margin* (0.1), and *long-term product potential*

(0.25). An explanation of this weighting of the factors and an elaboration on the internal weighting of each of the subfactors follows below.

The interviews conducted for this study has revealed that *market accessibility* factor is of the greatest importance when it comes to analysing future markets for EVSE providers. Pfeiffer (2014), Streng (2014) and Hecker (2014) hold that the collection of drivers that make up the *market accessibility* factor are the most important factors of all for deciding on the type of market entry that this study concerns. *Technical suitability* has previously been defined as a 'go' or 'no go' factor, which means that it does not require weighting but is rather a 'yes' (Y) or 'no' (N) factor (i.e., a market that is not technically suitable for an EV deployment does not require any further analysis and can therefore be rejected instantly). Further, the interviewed experts as well as the Strategic mapping of EV Power has provided no reason to believe that either policy or regulations are more important than the other. Hence, the internal weighting of *market accessibility* (0.3) has been equally divided between *policies* (0.15) and *regulations* (0.15).

Short-term demand, *expected market share* and *profit margin* are interrelated in that sense that they together form the basis of the near-term profits in the given market. Looking back at theoretical framework, it is clear that profit is the main objective of any market entry. Thus, the extent to which each of these factors affect the profit for the company should serve as a good basis for this weight. It is widely known that profit can be calculated in the following way (Schurter, 2013):

$$Profit = Volume * Margin \text{ where } Volume = Total\ market\ size * Market\ share$$

From this expression it may be expected that each of the factors *short-term demand*, *expected market share* and *profit margin* all have equal impact on the profit. However, this does not account for strategy and synergy considerations. Due to EVs status as an emerging technology, the companies (who are often funded by venture capital firms which do not expect profit at an early stage) are often not focused on profit at this stage. Rather, they focus most of their efforts on achieving a high revenue and market share (see Subsections 5.2.2 and 5.2.4).

The current ambition of most EVSE provides is to capture a large customer base, hence, the *profit margin* (0.1) factor has been concluded to be less important than *short-term demand* (0.15) and *expected market share* (0.2), in fact it is, at this point in time, considered least important of all five factors in the model. For the same reasons, *market share* is considered more important than *short-term demand*. Looking back at the theoretical framework, it is clear that is essential to establish a *high market share* as early as possible, before the market gets saturated and the partners have already established relationships with other actors. *Market share* is something that should be established early and that is considered hard to recover. This is not the case for *short-term demand*; the immediate demand is not expected to be anywhere near the figures for later years (as assessed by the *long-term product potential* factor). Hence, a lower *short-term demand* but a high market share is preferable to the opposite.

For *short-term demand* (0.15), a fixed internal weighting has been found to be unsuitable. Instead, as mentioned earlier, this weighting should be company specific. In the case of EV Power *private use car parks* (0.1) is the primary target segment of EV Power. As concluded through the Strategic mapping of EV Power, the main future growth of customers is assumed to be within this segment (which is agreed upon by industry experts, see Subsection 4.34.3) and that this is the segment in which EV Power has their main competitive advantage. For EV Power, neither *public use car parks* nor *fleet car parks* are main target segments. Although some of current revenue has been generated from these segments, the co-founders Tsang (2014) and Chan (2014) believe that these segments will become less important when the PEV deployment takes off, and hence, EV Power has shifted its focus away from these segments. However, at the same time they still believe that corporate and government fleets are more important than *public use car parks.* Like many others, Tsang (2014) and Chan (2014) believe that public charging will not be the main method of charging for anyone in the future – every PEV will need a dedicated charger. Therefore, the public use car park market will stop growing in the near future. Hence, *fleet use car parks* (0.04) is weighted higher than *public use car parks* (0.01). However, a company with different business model (i.e. having different customer mix) will require another distribution of weights within *short-term demand*.

The factor *expected market share* (0.2) consists of the subfactors *partners* and *competition*. Favourable outcomes for both of these subfactors are absolutely essential to achieving a high market share and have previously (see Subsection 5.2.3) been considered equally important. Hence, *partners* (0.1) and *competition* (0.1) have been weighted equally.

For the similar reason, when it comes to *profit margin* (0.1), it is hard to establish which of *price* (0.05) and *costs* (0.05) is more important. This is mainly due to the previously discussed fact that EV and EVSE industries are still in an early stage of development and, as discussed in Subsection 2.1.2, neither price nor costs are main objective of the firms acting in this market space. Thus, both *price* and *costs* have been weighted equally important.

Long-term product potential (0.25) has been concluded to be second most important factor to consider. As touched upon many times previously in this report, most people who are active in the industry are well aware that EVs is a technology that has not come close to reaching its peak capabilities yet, and is dependent on the developments in the near future in order to reach this peak (see Subsection 5.2.5 and Section 2.4 for more detailed discussion regarding this topic). The technology is still in the 'introduction' stage of the product life-cycle. If the technology stays at its current market penetration, there will be little to gain for companies in the industry. Due to this, most EV-related businesses put much emphasis on, and are very interested in, what will happen in the future (especially since the EVSE product is part of an LTS; which leaves the individual actors at mercy of a larger system).

The subfactors of *long-term product potential* have been given the following weights to signify their interrelations: *EVSE dominant design development* (0.05), *customer base growth* (0.1), and *government influence* (0.1). *EVSE dominant design development* (0.05) was weighted lower than the other two factors. This is due to the fact that currently, no markets are expected to have reached a dominant design for either EVs or EVSE (see Subsection 2.4.3). It is still important to analyse this market in order to try to gauge in which direction the market is heading and how the commissioning company fit into that development. Previously, it was established that policies and regulations are the main drivers behind EV and EVSE diffusion. However, *government influence* is considered to be more important at an early stage of a 'product life-cycle' (Porter, 1990) (Ranawat & Tiwari, 2009). At that stage, government should act as a catalyst for the product growth. However, when the product growth takes off, it should be able to grow on its own, without governmental support (Ranawat & Tiwari, 2009) (Porter, 1990). Hence, long-term *governmental influence* (0.1) is weighted below the previously discussed *policies* (0.15) and *regulations* (0.15). Lastly, *customer base growth* (0.1) is considered equally important as *government influence*. This is based on the previous discussion about the interrelation between *short-term demand, expected market share,* and *profit margin* and the fact that as the importance of the government influence goes down, it goes up for *customer base growth* (Porter, 1990).

5.4 RATING MARKETS USING THE MODEL

In order to decide which city is the most attractive city to enter, the evaluated cities need to be rated for each of these factors. The rating of the evaluated cities is based on five scale rating approach, where 5 represent the highest score and 1 represents the lowest.

A relative scale where the new markets are evaluated against each other would not tell the investigator much about the absolute appropriateness of the prospective market entry. Even if one city comes out on top, this does not communicate if this market is attractive, only that it is better than the other markets in the assessment. Due to this, the rating scale needs a baseline, or an absolute reference. There are two ways to do this: One can define absolute measurements for each factor that corresponds to a valuation of the investment in entering a market. The other option is to compare the new markets to a market where the company already has established itself (the result of the evaluation can then be related to the businesses successes in the old market). For several reasons, this study will use the latter option; first and foremost, EV Power has no set investment goal to compare with, and secondly doing a financial valuation of the market would result in significant scope creep for this thesis. Hence, in this case, Hong Kong (EV Powers home market), will be used as a baseline. For all factors, the three cities will be compared to Hong Kong, which represents a rating of 3, in the middle of the scale, signifying that an evaluated city can be on par (3), more attractive (4), much more attractive (5), less attractive (2), much less attractive (1) than Hong Kong.

After having rated each subfactor, the weight of each subfactor is multiplied with the rating for each city, the product for all subfactors and their weights is then added together to form the final rating. This will produce a comparative ranking of the cities from most to least suitable for entry. Additionally, in accordance with the above paragraph, it will compare the investigated markets to the baseline market (in this case Hong Kong) and give an indication if the new markets are more or less appropriate than this baseline.

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6 EVSE city evaluation model in practice

In this section, the previously defined and discussed EVSE city evaluation model is put to practice. The model is used in to evaluate three specific markets within Mainland China. The three markets have been previously been decided on by the commissioning company. The chapter starts off with a short introduction to each of the cities. Next follows a complete market analysis using the EVSE city evaluation model as a basis. Lastly, the results of the evaluation, i.e. the complete model populated with ratings for each city and subfactor, are presented and the most attractive city is revealed.

6.1 INTRODUCTION TO THE EVALUATED CITIES

China, being the world's most populous country, hosts cities with vast differences in culture, governance (since China is such a large country, local governments often play a comparatively large role in the cities development), and wealth. The three cities evaluated in this report are all so called 'tier one'[27] cities (Barton, et al., 2013), implying a relatively high development, a large population and a well-developed consumer market. Below, a brief introduction to each of the cities involved in this evaluation is provided for the reader's reference.

6.1.1 Beijing

Beijing is the capital of China, located in north-eastern part of mainland China. Beijing, also called Peking, is with its 21 million inhabitants among the most populous cities in the world, and the second most populous in China (Beijing Statistics Bureau, 2012). The city is considered to be the Chinese political, cultural and educational centre. It is important to note that in Beijing, the local government of the city does not play as big of role in as in some of China's other major cities, due to the fact that Beijing is the capital and home of the Chinese national government (Marquis, et al., 2013). Furthermore, the city often serves as a pilot city for many of the national government's initiatives (Marquis, et al., 2013). Although Shanghai is often seen as the centre of Chinese business (United States of America Department of Commerce, 2013), Beijing, with its close ties to the central government, hosts the headquarters of the largest of the Chinese SOEs (notably, SGCC) (Yusuf & Nabeshima, 2010).

However, despite being the leading city when it comes to politics and business, Beijing has also been a leading city when it comes to air pollution (Hong, 2014). As noted in the introduction of this report, the average Beijing habitant loses five years of his/her life due to air pollution and recently, the Beijing smog was even referred to as a 'nuclear winter' (Beech, 2014)

6.1.2 Shanghai

Shanghai, located on China's eastern shore, is the most populous city in China hosting over 24 million inhabitants (Ni, 2014). Shanghai is considered to be the commercial and financial centre of china and a global transportation hub, hosting world's busiest container port (World Shipping Council , 2013). In 2013, Shanghai was made the first free-trade zone in mainland China, becoming a preferential

[27] The habit of categorizing Chinese cities into three tiers originally stems from a government classification system. It aims to segment the cities of China using objective indicators such as population and GDP, in order to facilitate discussion in a country where the cities with more than one million inhabitants number 171. Nowadays, economist, consultancies, and businesses all have their own idea on exactly which factors should be considered in this classification, and hence, the cities included in each tier may be dependent on who you ask. Nevertheless, there is a great deal of consensus, especially with regards to the first tier. (Gardner, 2013)

environment for foreign investment (China Breifing, 2014). Shanghai has long been one of the fastest developing cities in the world, experiencing double digit growth since 1992 (except during 2008-2009, as a result of the recent financial crisis) (Shanghai Government, 2011). Much as a result of the favourable business climate, Shanghai is the wealthiest city on the Chinese mainland, and the consumers there have the highest purchasing power in all of China (China Daily, 2014) (Rapoza, 2012). Indeed, Shanghai boasts the largest luxury goods consumption on the mainland (UBM Asia, 2009).

6.1.3 Shenzhen

Shenzhen is a city in southern China, situated just north of Hong Kong. Shenzhen was little more than a fishing village until 1979, when the national government proclaimed Shenzhen the first of Chinas so called Special Economic Zones (SEZ). As a SEZ, Shenzhen has special economic policies more oriented towards a free market approach and the national government's policies and regulations are more flexible for this type of city (The Economist, 2010). Thirty-five years after the announcement, Shenzhen is the most successful SEZ in China, and is currently among the fastest growing cities in the world (The Economist, 2010). It is regarded as southern China's major financial centre and is a hub for foreign investment into China (Pomfret, 2012). Shenzhen also hosts the headquarters of BYD (BYD, 2014), one of the most prominent EV OEMs in China. BYD is an important company to the region, and the local government and CSG has done a lot to support the company and EV adoption in general (Andersson, 2010).

6.2 CITY EVALUATION

In this section of this thesis, the EVSE city evaluation model formulated in the previous chapter is put to practice. Each factor of the model is analysed with help of primary (interviews with industry experts) and secondary (publications, newspapers, reports, websites) data, in order to arrive at an answer to which of the three cities is the most attractive for a market entry by EV Power.

6.2.1 Market accessibility

First factor of the EVSE city evaluation model is *market accessibility*, which, as previously defined, consists of the subfactors *technical suitability*, *policies*, and *regulations*. Analysis of each of these factors follows below.

Technical suitability

Researchers and businessmen alike agree that the grids in all of the so called 'tier one' cities will be able to handle a large scale EV rollout (Shen, 2014) (Pfeiffer, 2014) (Hecker, 2014). This has also been supported by previous research by (Liu, 2012). The grids may not be as reliable as the ones in the western world, but as one expert puts it:

> *"Even if there are problems with the grid in tier one cities, these problems will only occur in poor neighbourhoods, which are not where EV users live" –*
> (Streng, 2014)

Since all three of the evaluated cities are 'tier one' cities, the conclusion is that the grid is good enough to support an EV rollout in all of these cities.

As concluded in the analysis, in order for a market to be attractive, the existing cars in the market need to be compatible with the charging standard used by the EVSE producer in question. As explained in the Section 1.2, currently there is no worldwide consensus regarding the charging plug standard and there are currently three main charging plugs available. It was also explained that China has its own standard. However, the Strategic mapping of EV Power has shown that the company's charger is compatible with all three of the charging standards currently available. Lastly, looking at battery technology, China has similar climate to Hong Kong and hence, the conclusion is that all three cities are acceptable when it comes to *standard capability*.

Summary: Technical suitability

The analysis has concluded that Beijing, Shanghai and Shenzhen are all technically capable to support an EV rollout (considering grid capacity, standards capability and battery technology limitations). *Technical suitability* is to be rated 'yes'/'no', and in this case, all of the three cities will be rated 'yes'.

Policies

The review of secondary sources has found that there are three categories of policies used in China today: National EV subsidies, Local EV subsidies and EVSE subsidies. Below (Table 3) is a summary of their prevalence in the three evaluated cities and Hong Kong, for reference.

	National EV subsidies	Local EV subsidies	EVSE subsidies
Beijing	• Max. 60,000 CNY (depends on vehicle range)	• 30,000-40,000 CNY per car (PHEV/BEV)	• None
Shanghai		• 30,000-40,000 CNY per car (PHEV/BEV) • Indirect subsidy: Exempt from car plate auction: 65,000-70,000 CNY (avg. price)	• None
Shenzhen		• Max 60,000 CNY per car	• CSG offer 2 free of charge charging poles w/ installation • CSG offers off-peak discount for charging (0.3 CNY/kWh)
Hong Kong (reference)	• N/A	• Exemption from first registration tax (292,500 HKD[1] for a Nissan LEAF) • Corporate profit tax deduction	• EV charging in an apartment complex lets developers build more floors for parking

Table 3: Summary of policies (Hecker, 2014) (Pfeiffer, 2014) (Edelstein, 2014a) (Konrad, 2013) (Ren, 2011) (Bloomberg News, 2014) (Horwitz, 2014) (China Auto Web, 2014) (Harvard Law, 2012) (Bloomberg News, 2011) (Environmental Protection Department, 2014) (Webb, 2013)

The national EV subsidies consists of monetary remuneration from the government when purchasing a PEV and are applicable nationwide. The local EV subsidies are additional subsidies that apply together with national subsidies and are specific for each city. EV charging subsidies are subsidies which apply specifically to EVSE equipment. In China as well as in Hong Kong, all EV related subsidies are of monetary nature (as opposed to mobility policies, described in Subsection 5.2.1). In Shanghai and Beijing, none of the policies turn out to be barriers; in fact, they encourage the diffusion of EV technology. In Shenzhen, there is one policy that acts as a barrier; CSG offers two charging poles with each PEV purchase, including free of charge installation.

Summary: Policies

Shanghai and Beijing both have similar and exclusively favourable policies, but they are not as generous as the ones in Hong Kong. Shenzhen, on the other hand, has one policy which acts as a barrier. Hence, Shanghai (2) and Beijing (2) are rated just below Hong Kong (3) and Shenzhen is rated last (1).

Regulations

Four types of regulations, with regards to EVs and charging infrastructure, have been observed in China: National energy sales regulations, National regulations regarding installation, Local limits on car ownership, and Local limits on car usage. Their prevalence in the three cities (and Hong Kong) is summarized in the Table 4 below.

	National energy sales regulation	National regarding installation	Local limits on car ownership	Local limits on car usage
Beijing	• Non-utility companies cannot sell energy • But billing based on time units is possible	• State gird companies have monopoly on cabling from grid to distribution room	• Monthly license plate lottery • 240k ICEs/yr • 20k EVs/yr	• Driving limited to every other day when heavy pollution is forecasted
Shanghai			• Licence plate auction • 100k plates/yr • EVs are exempt	• None
Shenzhen			• None	• None
Hong Kong (reference)		• Registered electrical contractor may perform full installation	• None	• None

Table 4: Summary of regulations (Pfeiffer, 2014) (Hecker, 2014) (Morgan Stanley, 2014) (Loveday, 2014) (US Energy Information Administration, 2013) (Nengneng, 2014) (Hong Kong Environment Bureau, 2013)

Interviews with industry experts Shen (2014), Tsang (2014) and Hecker (2014) have revealed that the energy sales regulation is central to EVSE providers in all markets. Energy sales regulations generally state that non-utility companies are not allowed to sell electricity. This affects the EVSE market because owners of public charging stations (i.e. *public use car parks*) may not be allowed to sell electricity, in the same manner as for example gas stations sell gasoline. To get around this, many EVSE providers (like EV Power in Hong Kong) have taken to charging for parking per time unit instead of charging per electricity unit used. Such an energy sales regulation (with the same loopholes) is in effect throughout China and Hong Kong; hence all three cities are here equal to Hong Kong.

The second nationwide regulation concerns the installation of charging stations. In Hong Kong, EV Power or similar companies have the ability to perform the full installation of the wallbox and to perform all of the cabling (after being certified) (Hong Kong Environment Bureau, 2013), while in in China, part of the installation which is required in some buildings (the cabling from the grid to the energy distribution point) may only be performed by the two state grid companies (Pfeiffer, 2014). Due to this, it is essential to have good relationships with the state grid. While the state grid companies aim to help the EV technology spread as much as possible (SGCC , 2010), the fact that one has to coordinate the installation in this way makes the mainland markets slightly less attractive than Hong Kong.

Further, interviews and secondary data gathering has revealed that in China, several cities have local limits regarding car ownership, i.e. a cap on the total amount of cars sold or other regulations that reduce car sales. In Hong Kong and Shenzhen there no such regulations while in Beijing there is a cap equal to 240,000 ICE vehicles per year plus additional 20,000 EVs, where car plates are randomly drawn from a pool of applicants. In Shanghai, there is instead a yearly cap of 100,000 license plates, which are auctioned out to the highest bidders. However, in Shanghai, EVs are excluded from the auction, which results in an incentive that promotes EVs (the savings that this regulation results in has already been discussed in *policies*; the aspect that is important here is the limit on the number of cars per year). Hence, while Shenzhen is on par with Hong Kong, Beijing is considered less attractive and Shanghai is considered most attractive.

Lastly, it has also been discovered that in Beijing, there are local regulations regarding limits on car usage. In fact, in Beijing, driving is limited to every other day when pollution is heavy, which is decided based on the registration plate of the vehicle. This does not exist in Shanghai, Shenzhen or Hong Kong, making Beijing less attractive.

Summary: Regulations
In summary, the national regulation regarding installation, which requires close contact and dependency on state grid corporations, is found to be an obstacle in all three of the analysed cities. Since Shenzhen has no other distinguishing regulations, it rated below medium (2). Further, it has been found that Beijing has the most regulations that are negatively affecting the attractiveness of the market, resulting in the lowest rating (1). The fact that Shanghai has a cap on ICEs, which makes a substantial incentive for EVs in this market, makes this market more attractive and hence, it is rated higher than Hong Kong (4).

6.2.2 Short-term demand

For the second part of the EVSE city evaluation model, we have evaluated the *short-term demand* in the three main markets (private, public & fleet) for each of the cities (Beijing, Shanghai & Shenzhen) comparatively. Due to the previously introduced (see Section 2.4) complexities of the emerging technology markets and especially the EVSE market, there have been no attempts to reach an exact quantitative market size for each of the cities. Instead, we evaluated which city came out on top for each factor (how does the market size of the different cities compare to each other). For some factors, we have, nevertheless, used numerical estimates for the comparison. The reason for not including a definitive market size is, as discussed earlier (Section 2.4), the difficulty to find accurate estimates for such a new and fast growing technology. To add to this, it is hard to find data for emerging economies such as China (even more so on a city-level).

Private use car parks

The first and most important driver of the private use car park market is the total sales of PEVs. By using estimates from multiple secondary sources, we have arrived at the numbers shown in Figure 18. This clearly shows that the Beijing's market is larger than both Shanghai and Shenzhen (all three markets are substantially larger than Hong Kong). However, in this part of the evaluation, it is only interesting to study the number of private PEVs. Figure 18 shows that Shanghai has a major advantage in this sub-market, while Beijing and Shenzhen are projected to sell equal amount of private EVs. The expectation Shanghai will the larger market for private PEVs in the near future has also been confirmed by interviews with Heltner (2014), Shen (2014) and Lee (2014).

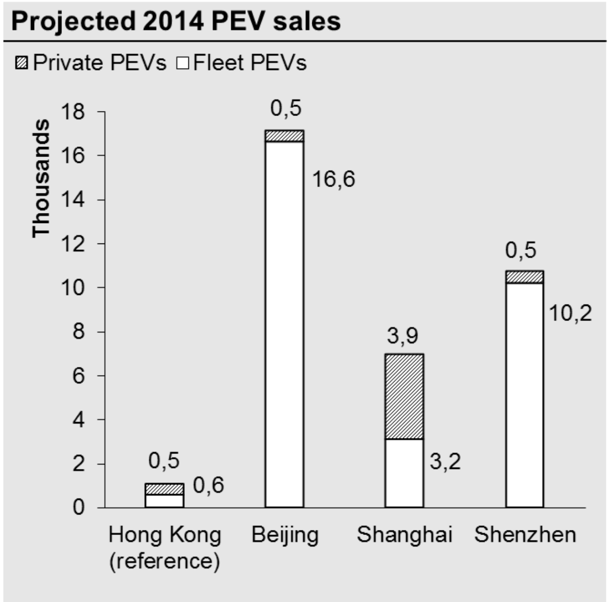

Figure 18: Projected personal PEV sales for 2014 (Proprietary analysis) (McKinsey & Company, 2010) (Undercoffler, 2014) (Boehler, 2014) (Bloomberg News, 2014) (Roland Berger Strategy Consultants, 2013) (Beijing Daily, 2014) (Environmental Protection Department, 2014)

The second key factor according to the city evaluation model is the 'take-rate'. One of the most important drivers here is whether or not the public charging infrastructure in the city is large enough to provide an opportunity for private EV owners to charge in public. The strategic mapping of EV Power showed a take-rate of about 40%, in the Hong Kong market, and the ratio of public chargers to PEVs in Hong Kong is 4 times higher than the ratio of Shanghai and 10 times higher than the ratio of Beijing (comparison presented through Figure 19). There is no information about the exact relation between this ratio and the take-rate (more than the fact that it is an inverse correlation (Heltner, 2014) (Tsang, 2014)), but it is assumed that due to the huge difference in the charger/PEV between the mainland cities and the reference market, almost all PEV purchases will have to include a charger, in all three cities. Indeed, industry experts have suggested that the-take rate will be close to 100% in all three of the evaluated cities, due to the lack of public charging. Heltner (2014) expresses it in the following way:

> *"In Hong Kong, the [public charging] coverage is very good, so some customers do not need to charge at home. In China, where there is almost no infrastructure [...] the take rate must be around 100%".*

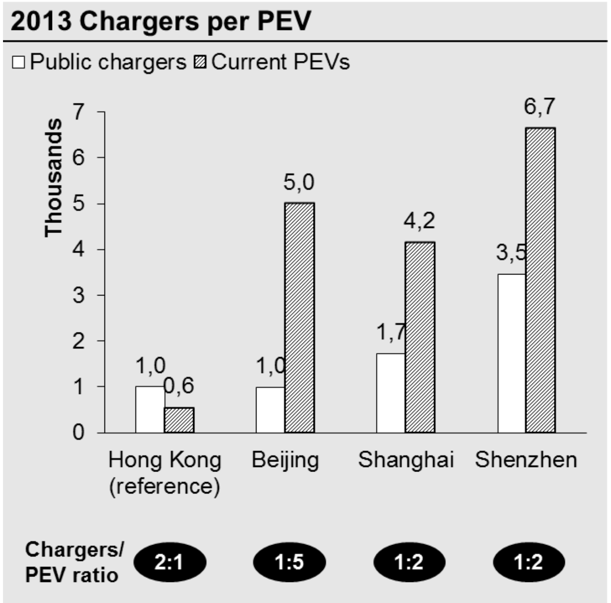

Figure 19: Public chargers, PEVs and chargers/PEV ratio (Proprietary analysis) (Roland Berger Strategy Consultants, 2013) (Hong Kong SAR Government, 2013) (Gong, et al., 2013)

The city evaluation model also points out that the 'feasibility of installation' is an important driver for take-rate. For this driver, interviews have suggested that, while some buildings in all three cities might not be suited for installation of a wallbox, most of the PEV users will live in high-end residences, thus this will not be an issue (Streng, 2014) (Hecker, 2014) (Heltner, 2014) (Shen, 2014) (Anonymous interviewee, 2014).

Looking at the workplace segment, it has been concluded that it is also driven by total sales of private PEVs and property developers or employers willingness to invest in a wallbox. The total sales of private PEVs have already been estimated and are presented through Figure 18 above. As concluded before, Shanghai has the largest market when it comes to private PEV sales, and Beijing and Shenzhen are estimated to be in par with Hong Kong.

Further, the elements that influence the willingness to invest in a workplace wallbox are subsidies, CSR and tenant retention/employee satisfaction. First off, neither Hong Kong nor the mainland cities have any subsidies for workplace charging. Regarding CSR, no studies have been found comparing CSR efforts in either of the cities. A survey of property developers and selected employers could have been performed to assess this, but due to the limited impact of this factor on the total assessment, it was decided that this would be out of scope for this thesis. For tenant retention/employee satisfaction, there are many studies comparing this factor on a country level and several more comparing different cities in more developed economies (Clark, 1998) (Ritter & Anker, 2002). However, for cities within China, nothing has been found. As mentioned in Section 2.4, when studying emerging markets one can expect to encounter lack of data on some topics, and this seems to be the case here. In the absence of the information mentioned above, Shanghai seems to come out on top for the workplace segment as well.

Summary: Private use car parks

All in all, the evaluation has shown that the take-rate will be close to 100% for all three cities, which is higher than current 40% take-rate in Hong Kong. With this in mind, the larger market for private PEVs in Shanghai makes it clear that Shanghai will be the best market for private use car park wallboxes. In fact, Shanghai seems to be a much larger market than Hong Kong in this regard. Hence, Shanghai receives the highest possible rating (5). Shanghai and Shenzhen are both on par with Hong Kong in terms of market size for private PEVs albeit, the higher take-rate results in a larger market for wallboxes compared to Hong Kong, this leads to the same rating of both Shanghai (4) and Shenzhen at (4).

Public use car parks

There are two sub-markets for public use car parks, characterized by the customer type of the buyer: government and corporate. Both of these factors' contribution to the assessment of the evaluated cities is discussed below.

The market for wallboxes for public use car parks managed by governments is very small, if not non-existent in China. According to Pfeiffer (2014):

> *"...the parking spots in the big cities are not [government managed] but privately managed."*

Also, Heltner (2014) explained:

> *"What public parking we have [in China] is connected to retail buildings".*

A couple of researchers in Chinese infrastructure reiterate this sentiment (He, 2014) (Wu, 2014). When it comes to roadside parking, the conclusion from the interviews and the strategic mapping of EV Power has shown that the product (wallbox) is not suitable for roadside installation, and is hence, not a part of the assessment. This goes for Hong Kong as well, according to Tsang (2014).

This leaves corporate public use car parks. In China, these are mostly car parks connected to retail buildings, since there are very few stand-alone parking houses (He, 2014) (Hecker, 2014) (Heltner, 2014). The main driver for corporate car parks has been concluded to be the PEV penetration in the city (see Subsection 5.2.2). Below, in Figure 20, the PEV penetration for each of the cities in question is shown. It turns out that Shanghai and Shenzhen have above double the penetration of Beijing.

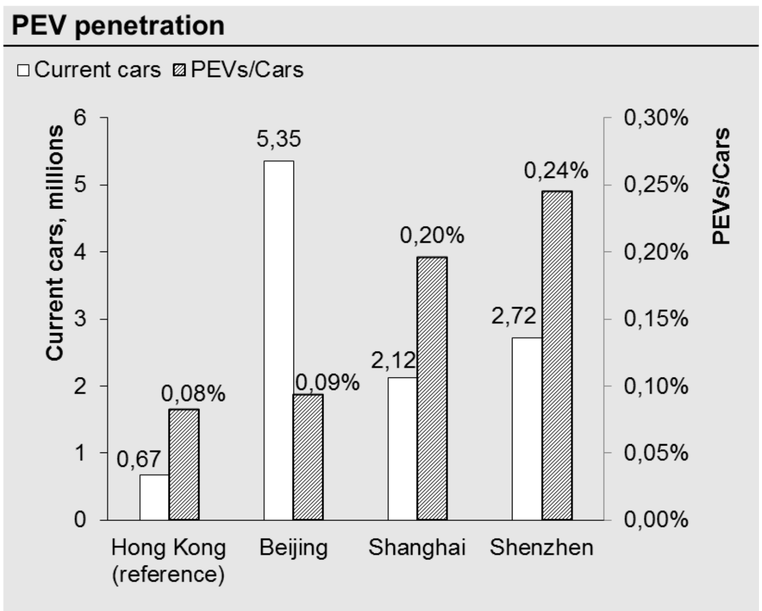

Figure 20: Number of cars and PEV penetration (Gong, et al., 2013) (Xinhua, S, 2013) (Wall Street Journal, 2013) (China Daily, 2014); (Shenzhen Daily, 2014) (Sasin, 2014) (Hong Kong SAR Government, 2013)

The second driver to take into account is the 'marketing myopia' (i.e. if any of the cities have a culture that promotes long-term thinking in business). The study has found that this does not differentiate the cities; in fact, there is a prevailing culture of prioritising short term savings before long term gains throughout the whole of mainland China, which makes EV chargers in any public car park a hard sell. (Heltner, 2014) (Pfeiffer, 2014) (Streng, 2014)

> *"In the west, you take a long term perspective [...]. The Chinese walk the other way around. They can see from the numbers that in five years' time, [EV charging] will be profitable. But if they had that money now, they would rather start a vacuum cleaner factory, or invest it into something that will give me profits tomorrow [...]. They are more short term oriented"* – (Streng, 2014)

The last driver, policies and regulations, has been found to not have any impact. According to Pfeiffer (2014), He (2014) and Hecker (2014) there are no policies for public use car parks anywhere in China.

Summary: Public use car parks

In summary, the government public use car park market has been found negligible. Further, when looking at corporate public use car parks, it has been concluded that the only decisive factors for the evaluated cities is the PEV penetration, since the marketing myopia is considered equal in all markets and policies and regulations are not applicable to these particular markets. Hence, since Shanghai and Shenzhen have the double PEV penetration than Beijing, they are considered the preferable option for public use car parks. Shenzhen comes out on top with the highest ranking (5), Shanghai is close runner-up with (4) and Beijing, being similar to Hong Kong in this regards, receives a medium rating (3).

Fleet car parks

Again, throughout the establishment of the city evaluation model, we have established that fleet car parks category is divided by customer type into the submarkets corporate and government, both discussed below.

Through the analysis, we have concluded that corporate fleets will not be a significant market in any of the three cities. In the words of Pfeiffer (2014):

> *"...corporations in China are not interested in PEVs at the moment, and it will not happen anytime soon"*

Indeed, this reluctance towards PEVs on the part of Chinese corporations seems to be stemming from the same shortsightedness, a common cultural factor in all of China, which was discussed in the previous section. Primary sources agree that Chinese corporations are typically not willing to pay high CAPEX upfront to save OPEX in the future (Au, 2014) (Streng, 2014). Hence, the corporate fleet market is considered non-existent at the moment.

Government fleets however, is a huge market in many of the Chinese cities. Figure 18, from the analysis of *short-term demand* (Subsection 6.2.2), shows that in both Beijing and Shenzhen, fleet orders will make up the majority of the sales in the short term (we consider all these fleet sales to be government sales, since we have seen no evidence of interest from corporates, according to what has been concluded above)[28]. Beijing's and Shenzhen's dominance in the fleet market is due to goals set by the local and national governments, (For Beijing, an important contributor is the and the fact that it

[28] The one exception may be rental companies, but this business model has just arrived to China, and does not make up a sizeable market for now (Economy, 2014) (Murphy, 2013) (Bloomberg News, 2014).

is the capital and home of the national government, and as such has a large concentration of government entities needing fleets) (Pfeiffer, 2014) (Hecker, 2014) (Shen, 2014).

Hong Kong differs from the mainland when it comes to the fleet market. Here, there is a market for corporate fleets, as evidenced by corporate fleets' share of total revenues for EV Power (see Figure 10). This is largely due to the tax deductions available for corporates (see Table 3). There is also a smaller market for government fleets (again, see Figure 10). However, as we can see in Figure 18 (private use car parks), the total fleet market in Hong Kong is small compared to that of the mainland cities.

Summary: Fleet use car parks
The *corporate fleet car parks* market will not be significant in China. This is because corporate fleets are not yet interested in PEVs. At the same time, it has been concluded that all three cities will have significantly larger government fleet markets than Hong Kong. Shenzhen and Beijing's markets are more than 20 times larger than Hong Kong's, and are therefore rated high (5). Shanghai's market, while being significantly larger than Hong Kong's, is not close to the ones of Shenzhen and Beijing, and therefore receives a (4).

6.2.3 Expected market share

In Chapter 5, it has been described how expected market share is a product of two factors: *partners* and *competitors*. It has also been concluded that the analysis need to be conducted for all three markets (*private use car parks*, *public use car parks* and *fleet car parks*) and for each of the offerings (full offering and service only offering). Thus, the analysis will be divided into each of the subfactors and analysed for each of the markets and offerings.

Partners

The first thing to investigate for this subfactor is whether or not the current partners (the ones EV Power is doing business with in Hong Kong) are present in the three cities. Next, it is important to understand what type of partnerships the existing partners are interested in.

It turns out that all of the current partners are present in Shanghai and Beijing, but only half of them have started doing business in Shenzhen (as shown in Table 5 below). After having discussions with the current partners of EV Power (BMW, BYD, Porsche and Tesla[29]), it has become clear that, in China, they are not interested in EV Power's full offering, as they plan to market their own wallboxes (produced by themselves or third party electronics companies), but most partners have a hard time finding suitable installers and thus, they are interested in partnering with EV Power for service. It has also been understood that these partners are only interested in referring business to EV power in one of the three markets: *private use car parks*. Naturally, OEMs have nothing to do with public car parks and it seems that the *fleet use car park* market is not yet seen attractive enough by these OEMs (except BYD), as confirmed by Anonymous interviewee (2014) and Lee (2014).

[29] Tesla does not use official partners, but they have a close relationship with EV Power in Hong Kong which includes referring Tesla customers to EV Power for charger purchase (Tsang, 2014)

	Current HK partnership	China strategy	Beijing	Shanghai	Shenzhen
BMW	• Partners with EV Power and Schneider • No EVs released yet	• Charger comes with car • Target private EV users • Interested in outsourcing installation	• No partner contracts signed	• No partner contracts signed	• No partner contracts signed
BYD	• Mainly taxis • Uses CLP, but also EV Power for installation and service for public taxi chargers	• Charger w car • Target all different users • USE CSG for partnership	• Dealership (s4) deals with installation • For fleet, customer deals with installation	• Dealership	• CSG
PORSCHE	• EV Power is official partner • CLP also partner • 0 sales • Prop charger is a socket	• Charger comes with car • Targets private EV users • Will use independent company for installation	• Has partner already, although open for discussion	• Has partner already, although open for discussion	• No presence yet, but this will change soon
TESLA	• Does not use official partners • Uses EV P's charger for now, but may change	• Charger comes with car • Target private customers • Outsources all installation to 'trusted electricians'	• Tender ongoing	• Tender ongoing	• Nothing yet

Table 5: Current partners, their China strategy and their current situation in each market (Proprietary analysis) (Tsang, 2014) (Chan, 2014) (Hecker, 2014) (Heltner, 2014) (Lee, 2014) (Pfeiffer, 2014) (Xiaocheng, 2014)

Additionally, it is worth noting that some actors that themselves aim to provide the full-offering (OEMs and large electronic manufacturers) have shown interest in outsourcing the installation and service part of their offering, but they have had a hard time finding suitable partners (Heltner, 2014) (Streng, 2014). This makes the case for service-only offering even stronger.

Summary: Partners

In terms of which partners are active in the market, the situation is the same in between Hong Kong, Shanghai and Beijing. Shenzhen lags behind, having only half the partner presence. However, the Mainland cities lose out to Hong Kong, since the partners have shown that they are not interested in the full offering on the Mainland. With this in mind, Shanghai and Beijing are rated slightly below medium (2), and Shenzhen is rated at low (1).

Competition

According to market entry theory, and backed up by opinions from experts Au (2014), Streng (2014), Shen (2014) and Hecker (2014), it will be hard for a small entrepreneurial company like EV Power to enter into a market with already established players. Especially if these players are much larger in size.

Below (Table 6) is a summary of the competitive landscape in all three markets, analysed for both full offering and service only.

		Beijing	Shanghai	Shenzhen
Private use car parks	**Product**	• OEMs • Large electronic manufacturers (in large scale partnerships with OEMs)		
	Service	• Large electronic manufacturers (in large scale partnerships with OEMs) • Local electricians with little expertise in EVs		
Public use car parks (corporate)	**Product**	• No one yet • Large electronic manufacturers may enter if they see value		
	Service	• No one yet • Large electronic manufacturers may enter if they see value		
Fleet use car parks (government)	**Product**	• SGCC • Grid subsidiaries • OEMs		• CSG • Grid subsidiaries • OEMs
	Service	• SGCC • Grid subsidiaries		• CSG • Grid subsidiaries

Table 6: Summary of competition in each segment and city (Proprietary analysis) (Hecker, 2014) (Heltner, 2014) (Streng, 2014)

First, when it comes to *private use car parks* market, the competition is equal in all three cities. Looking at the wallbox product, the interviews with Heltner (2014), Lee (2014), Anonymous interviewee (2014), Hecker (2014), Streng (2014), Tsang (2014) and Xiaocheng (2014) have established that in all three cities, the wallboxes are sold either by OEMs or large electronic manufacturers in large scale partnerships with OEMs (e.g. Schneider with BMW and ABB with Denza). Both OEMs and large electronic manufacturers are all well-established companies with much more resources than EV Power, making competing with them a futile matter. Additionally, (discovered through the same interviews as above) these wallboxes are often offered as complementary to the car, or at a reduced price. The conclusion is that when it comes to actual wallbox sales, the competition fierce in all three cities. Also, the competitive landscape is found to be tougher than in Hong Kong. This is mainly due to the fact that in Hong Kong, the OEMs have chosen not to market their own proprietary wallboxes (discussed in Subsection 4.4) and they instead use companies like EV Power or SOE subsidiaries. Only one of the large electronic manufactures (Schneider) has shown interest in Hong Kong, probably because the market is too small.

On the other hand, looking at service for private use car parks (installation, maintenance, etcetera), the interviews with Heltner (2014), Lee (2014) and Streng (2014) has shown that the service is provided either by large electronic manufacturers (only for their own chargers) or by local electricians with little experience in EVSE. This means that the OEMs have a hard time finding someone competent enough to install their proprietary wallboxes. In fact Heltner (2014), Lee (2014) and Streng (2014) agree that all three markets lack an expert player, like EV Power, to outsource services to. As expressed by Heltner (2014):

> *"... there are currently no such expert [as EV Power] in China, and if there were, [BMW] would turn to them when it comes to installation business"*

Hence, the conclusion is that, within service, there is a favourable competitive landscape. This competitive landscape is considered more favourable than the present one in Hong Kong; this is due to the fact that Hong Kong already has established players within this segment.

Similarly, when it comes to *public use car parks*, the competition has been found to be equal in all three cities. As concluded previously, the government owned public use car park market (for wallboxes) is very small if not non-existent in China, hence, the competition analysis for 'public use car parks' has focused on the corporate segment. For this segment, as mentioned by Heltner (2014), Pfeiffer (2014) and Shen (2014), there are currently no active actors within either the product (wallbox) or service (installation, maintenance, etcetera). This is mainly due to the previously concluded fact that the *public use car parks* segment is very small and have not yet taken off in China (mainly because of marketing myopia present in the mainland). However, as pointed out by Streng (2014), large electronic manufacturers might enter this segment when they see value in doing so. This is quite opposite to Hong Kong, where *private use car parks* owners have been already started investing in EVSE.

Lastly, looking at *fleet use car parks* market, the competition only differs for Shenzhen, while it is the same for Beijing and Shanghai (the difference is however marginal since it is only type of state grid company and its subsidiaries that differ). As previously established, the *fleet use car park* market is only applicable to government segment, since there is no interest from corporates. The government fleet market segment has been found to be substantial in all three cities. However, from interviews with Heltner (2014), Streng (2014), Tsang (2014), Pfeiffer (2014), Hecker (2014) and Shen (2014), it has also been found that this market is solely dominated by state-owned enterprises. When it comes to the product (wallboxes) those are most likely to be provided by the OEMs that are supplying the fleets, which experts assume to be of domestic origin. Such OEMs are either manufacturing the wallboxes themselves, or have a partnership with either state grid or state grid subsidiaries. In China there are the State Grid Corporation of China (CSGC), handling Beijing and Shanghai, and China Southern Grid Company (CSG), handling Shenzhen (each grid company also have subsidiaries in each city). The service (installation, maintenance, etc.) for the *fleet use car park* segment, is also dominated by state grid companies and grid subsidiaries, which often handle the large scale orders. From interviews with Heltner (2014), Streng (2014), Tsang (2014), Pfeiffer (2014), Hecker (2014) and Shen (2014) it has been established that a small, foreign, company like EV Power will have hard time grabbing market share within this segment. In China, governments will most likely turn to state-owned companies, both when it comes to the actual product (wallbox) and service (installation, maintenance, etcetera) of those. All in all, the competitive landscape for *fleet use car parks* in all three cities is considered worse than in Hong Kong, where government is openly turning to private actors.

Summary: Competition

All three cities have been found to have an equal competitive landscape. It has also been found that the competition in all three mainland cities is less intense when compared to Hong Kong (except in the *fleet car parks* segment). Further, it has been established that in general, competition is quite intense for wallbox sales while experts agree that all three cities lack a service expert, like EV Power. All in all, this leads to all three cities receiving a rating of (4).

6.2.4 Profit margin

The fourth part of the city evaluation model is *profit margin*. In this section, the differences in price and costs between the different markets will be discussed.

Price

In order to come up with *price* difference, first the price sensitivity of the customers' needs to be gauged (as previously defined in Subsection 5.2.4). As there is no data on this for the specific product of wallboxes, a proxy has been used: The price of specific car models from EV Powers' partners have been studied in the different cities – these cars will be sold to the same customers that may buy the wallboxes. It is assumed then, that the OEMs have made a sufficient assessment of eventual differences in price sensitivity in between the cities, and that the same price sensitivity is applicable for the service part of the offering. It turns out that these OEMs sell their cars at the same prices all over China (Wang, 2013) (Kuo, 2014). This sameness in price sensitivity is confirmed by Shen (2014) and Au (2014), who explains that due to the fact that EV customers are mostly affluent individuals, price sensitivity is less of an issue.

Secondly, according to the EVSE city evaluation model, one needs to study the price of comparable products on the market. It has been established when analysing the competition (Subsection 6.2.3) that this is similar all across mainland China. Since no further information on price levels was available, it is therefore assumed that comparable products will have the same price in the whole of the mainland as well.

In comparison to Hong Kong, prices are expected to be quite a bit lower, as it is common ‘industry practice’ to increase prices for the mainland (Jones, 2014) (Gnaticov, 2013). This may suggest that the OEMs consider mainland customers less price-sensitive. All the while, competition is somewhat tougher in Hong Kong (as established in Subsection 6.2.3), with more alternatives for the customers, which might drive lower prices.

Summary: Price

All three potential markets are equal for this factor, and it is considered likely that if there is a difference between pricing in Hong Kong and the Mainland China, it is that the EV Power will be able to charge higher prices on the mainland. Hence, all three cities receive a (3) rating.

Costs

As for *costs*, in creating the model, it was established that the essential costs to analyse are COGS and overhead costs.

In the case of EV Power, the actual wallbox will be produced in Hong Kong, regardless of the city that is chosen for entry. This means that for the most part, COGS will be similar. However, for the service part of the offering, labour is a large part of the costs. EV Power needs both skilled and unskilled labour in order to deliver their service, so these have been studied separately. In order to get a view on the labour costs of the cities, wages for university graduates as well as minimum wages have been compared (see Figure 21): The minimum wage in Beijing, is lower than those in Shanghai and Shenzhen, which in turn are much lower compared to that of Hong Kong (Beijing Daily, 2014) (China Breifing, 2013) (Office of Human Resources and Social Security, 2013) (CGA, 2013) (Nengneng, 2014). When looking at more skilled workforce, Beijing has the highest starting salary for graduates. However, all in all, the difference in salaries is marginal in between the three mainland cities.

Figure 21: Average university graduate starting annual salary and annual minimum wage (HR Service Providers Directory, 2013) (温蕭闫欣雨, 2014) (China Breifing, 2013) (Office of Human Resources and Social Security, 2013) (CGA, 2013) (Shanghai Daily, 2014)

For overhead costs, two of EV Powers' most significant operational costs have been studied: corporate tax and office space rent. China, has a national corporate tax of 25%, which is higher than the Hong Kong one (16.5%) (Deloitte, 2013) (The Government of the Hong Kong Special Administrative Region, 2014). Looking at office space rent, secondary data shows that Hong Kong is more expensive than all three of the mainland cities (presented in Figure 22). Hong Kong is often, by secondary sources, considered to be one of the world's most expensive office locations (Morris, 2014) (Li, 2014) (Money Beat, 2013). Shenzhen, on the other hand, comes out on top with the office rents, while Beijing and Shanghai are pretty equal, and in between Shenzhen and Hong Kong.

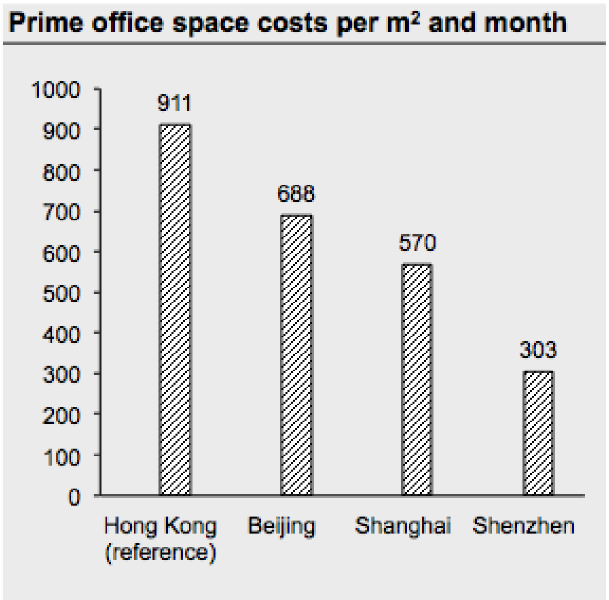

Figure 22: Prime office space costs per m² and month (Cushman & Wakefield, 2013)

Summary: Costs

In summary, looking at COGS, the analysis of wages showed that all three cities have similar costs and all three are cheaper than Hong Kong. Further, looking at overhead costs, although Hong Kong has lower corporate tax, the other cities have lower office rent. All in all, the cost in Mainland China are found to be lower than in Hong Kong, where Shenzhen has the lowest costs and thus receives a rating of (5) and Beijing and Shanghai, being quite similar, are rated (4).

6.2.5 Long-term product potential

The last part of the city evaluation model is *long-term product potential*. This part has the purpose of assessing which of the evaluated cities is the most attractive in a long-term perspective, and is, as described in the model, a compliment to short term demand. The three previously identified sub-factors (EVSE dominant design development, customer base growth, and government influence) are analysed in that order.

EVSE dominant design development

EV Power focuses on semi-fast AC chargers (wallboxes), and it is imperative that the market chosen for entry is not dominated by some of the other charging technologies, that are not compatible with AC charging.

The driver for this factor is the so called 'industry focus' described in Subsection 5.2.5. This factor needs to be assessed both in the near term (to establish if there is already a dominant EVSE alternative) and in the long term (to predict which alternatives will survive in the future). The industry focus in the near term will be established by looking at the products that are currently offered by EVSE suppliers in the market, and by looking at which EVSE alternatives will work with the current PEVs being offered in the market. For the long term industry focus, interviews have been conducted where industry experts give their view on this development.

To recap the introduction to EV charging given in Chapter 1, Subsection 1.2.1, the following are the competing technologies for EV charging currently:

- AC charging: slow (charging poles) or semi-fast (wallbox) charging,
- DC charging: fast charging,
- Battery swap,
- and inductive/wireless charging

Currently, different actors are working with different charging technologies in the Chinese market. Below (Table 7) is a summary of some of the main actors' focus to date:

		Charging technology used*					Cities active in†		
		CP	WB	DC	BS	IN	BJ	SH	SZ
OEMs	BYD		✓				✓	✓	✓
	BMW		✓				✓	✓	✓
	Tesla		✓	✓			✓	✓	
	Porsche		✓				✓	✓	
Large electronics manufacturers	ABB			✓			✓	✓	✓
	Schneider		✓	✓			✓	✓	✓
SOEs	SGCC	✓	✓	✓	✓		✓	✓	
	CSG	✓			✓				✓

*CP = *Charging pole*, WB = *Wallbox*, DC = *Fast charging*, BS = *Battery swap*, IN = *Inductive charging*
†BJ = *Beijing*, SH = *Shanghai*, SZ = *Shenzhen*

Table 7: The technological and geographical focus of different market actors (Xiaocheng, 2014) (Hecker, 2014) (Lee, 2014) (Streng, 2014) (Tesla, 2014) (Schneider Electric, 2014) (People's Daily Online, 2010) (Morris, 2014) (SGCC , 2010) (SGCC, 2013)

The first thing to notice is among these examples is that AC and DC charging dominates the supply. No actor is currently working with inductive charging and battery swap only exists due to efforts of the SOEs. The dominance of AC and DC charging is further proved by the fact that most OEMs with business in China today do not produce models that support either battery swap or inductive charging (Tsang, 2014) (Shen, 2014). As we can tell by Table 5 (Section 4.4), Hong Kong is in the same situation.

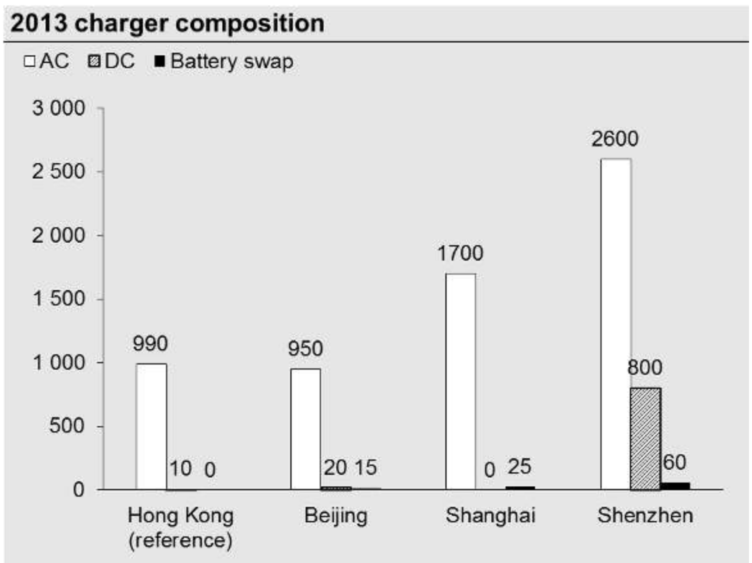

Figure 23: Charging technology composition (Roland Berger Strategy Consultants, 2013) (Electric Vehicle Association of Asia Pacific, 2013) (Webb, 2013)

Further, Figure 23 shows the prevalence of AC, DC and battery swap in the three cities and it is apparent that currently, the only city where AC charging is not clearly dominating is Shenzhen. Furthermore, according to Hecker (2014), the DC chargers that currently exist in China are not suitable for personal PEVs - instead they are made for busses and taxis, and often only used by demonstration projects.

Regarding the long term prospects for the different EV technologies, the majority (all but one) of the industry experts that we have interviewed believe that AC charging will dominate in the long term. Hecker (2014), researcher at BMW in Beijing, puts it this way:

> *"AC charging will definitely dominate the Chinese market in the future, mainly due to a lack of direction from the DC producers and the absence of technological compatibility between foreign cars and Chinese DC chargers. [...] The government is pushing DC charging, but only for multi-passenger vehicles"*

Furthermore, the industry experts all believe that the same technology (likely AC) will dominate the market in all three mainland cities as well as Hong Kong in the long term.

Summary: EVSE dominant design development
Everything points to that if a dominant design will emerge, it will be AC charging. This goes for all three cities. Hence, all cities are rated as equal to Hong Kong for this factor (3).

Customer base growth

In this part of the evaluation, the identified drivers: population density, wealth of the population, education attainment, and environmental awareness are analysed.

As described in Subsection 5.2.5, markets with higher population density are more likely to adapt to EVs and hence, are more promising in terms of future customer base growth development. In order to arrive at which of the analysed cities would have the best outlook with regards to population density, secondary sources have been studied (results presented in Figure 24). For reference, it has first been established that Hong Kong has one of the largest urban population densities in the world (Census and Statistics Department Hong Kong Special Administrative Region, 2012). Further, secondary sources shows that all three of the evaluated cities have an urban population density much smaller than Hong Kong, but still have highly densely populated urban areas (above world average of 4,300 persons/km2) (Demographia, 2014). With regards to possible diminishing return, also discussed in Subsection 5.2.5), all three cities are concluded more than double of the urban density for the suggested proxies (Oslo and Rotterdam). The outcome of this driver is therefore considered to be non-decisive for the overall conclusion of *customer base growth*.

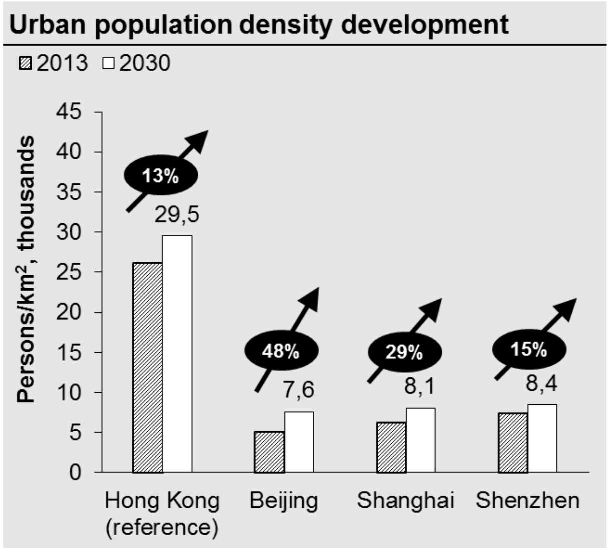

Figure 24: Urban population density (Proprietary analysis) (Demographia, 2014) (Census and Statistics Department Hong Kong Special Administrative Region, 2012)

The second driver of *long-term product potential* is wealth development, which is an imperative factor since EVs are mainly sold to the more affluent part of the population. To approximate wealth, this study has looked at how the population will develop in terms of income and spending. Below, Figure 25 shows the predictions high income households and Figure 26 shows predicted consumer markets for cars.

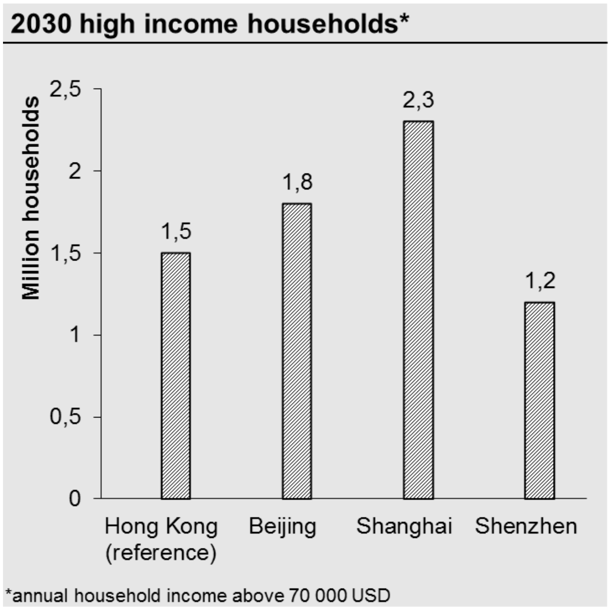

Figure 25: Projected number of high income households and size (Oxford Economics, 2014)

The analysis show that all three of the evaluated cities are ahead of Hong Kong. Shanghai comes out on top, and Beijing is second and Shenzhen third. In fact Shanghai will spend 2.5 times more than Hong Kong, while Beijing is twice as much as Hong Kong. Shanghai's spot as the wealthiest city in China is something that has also been corroborated by interviews with Heltner (2014), Hecker (2014) and Tsang (2014), who agree that this will facilitate EV deployment in the city in the future.

Figure 26: 2030 consumer markets for cars (Oxford Economics, 2014)

Thirdly, the EVSE city evaluation model suggests that educational attainment need to be assessed, since EV customers tend to highly educated. China in general is famous for its demanding educational system. Today, 60% of high-school graduates attend a university and China has more than 2,000 universities and colleges (Levin, 2010). In order to gauge the educational level of the analysed cities, current number of graduates per year has been studied. Unfortunately, no future projections have been found, hence the analysis is based on the current number, presented in Figure 27. Having said that, interviews with OEM representatives Heltner (2014), Lee (2014) and Anonymous interviewee (2014) point out that their target customers are often middle aged. This implies that current graduates may be an appropriate measure for assessing the market in the long term. All three cities have substantially larger amount of graduates each year compared to Hong Kong, but the difference in-between the cities is not as big. Beijing comes out on top, followed by Shanghai and Shenzhen.

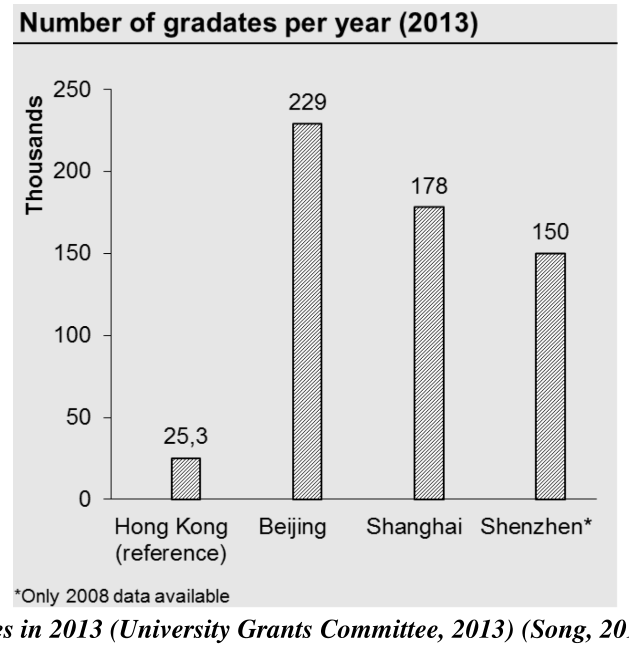

Figure 27: Graduates in 2013 (University Grants Committee, 2013) (Song, 2013) (McGeary, 2011)

The last driver of *customer base growth* is environmental awareness. An exhaustive method to measure environmental awareness in all three cities would have been a survey or questionnaire distributed to a carefully selected sample representing the population of each city. Due to the time limitation of this study, such a comprehensive analysis could not be performed, hence, secondary sources have been studies instead. There is not much information on the city level for this factor, however. In fact, no useful information was found on environmental awareness in Shenzhen at all. In an effort to make a qualified assumption for Shenzhen for this factor, data for Guangzhou, a close by and culturally similar city[30] has been used. Table 8 shows the results of a poll measuring environmental awareness in Shanghai, Beijing and Guangzhou.

Share of population who...	Beijing	Shanghai	Guangzhou
...are satisfied with air quality	46%	46%	49%
... are satisfied with water quality	60%	58%	61%
... believes that protection of the environment should be given priority	77%	75%	66%
... are satisfied with efforts to preserve the environment	69%	57%	59%

Table 8: Environmental awareness in mainland China (Gallup, 2012)

As the reader will note, the cities are largely similar in terms of environmental awareness. But how they compare to Hong Kong? Another study shows that the percentage of the population that claims to know about global warming is 93 % in Hong Kong and 62% in China (Gallup, 2009). While global warming is only one aspect of environmental awareness, it is used here as a proxy for environmental awareness in general, and indicates that overall, Hong Kong residents are more environmentally aware than those on the mainland[31].

Summary: Customer base growth

In summary, all four analysed drivers are put together in order to arrive at the rating for each of the cities. First of all, it has been concluded that all of the analysed cities are very densely populated and that the population density is a non-decisive driver (in this case). Further, when looking at population wealth development, the analysis shows that Shanghai comes out on top followed by Beijing. Shenzhen is found to be worse than Hong Kong. Thirdly, looking at education attainment, the

[30] Guangzhou is another tier one megacity in China. It is the fourth largest city in terms of population (Shenzhen is fifth) and third largest in terms of GDP (Shenzhen is fourth) (World Population Review, 2014b) (EconMatters, 2011). The city lies approximately 100 kilometres from Shenzhen, which is a small distance in China, which spans 5,500 kilometres from north to south. The cities also both belong to a region called the Pearl River delta, one of the most urbanized regions in the world. In fact, the cities in the Pearl River delta are expanding so rapidly that they have started sharing suburbs. Administrators in south china has started planning for a merge of all cities in the pearl river delta into a mega-city with more than 40 million inhabitants (The Economist, 2011c) (Moore & Foster, 2011). With this in mind, Guangzhou seems an acceptable proxy to China for this one factor. It is reasonable to believe that the geographical and cultural similarities in between the two cities make the outcome for this factor roughly the same.

[31] It can be argued that the environmental awareness in tier one cities should be higher than the country average. Unfortunately, no studies were found comparing Hong Kong to any of the three cities in terms of environmental awareness. Nevertheless, the difference between Hong Kong and China is so large in the survey quoted, that it can be seen as an appropriate indicator.

conclusion is that all three cities come out on top of Hong Kong, where Beijing is first, Shanghai is second and Shenzhen third. Lastly, with regard to environmental awareness, the analysis has shown that all three of the evaluated cities fall behind Hong Kong with little to no difference in between the cities.

Beijing comes out on top of all cities, followed by Shanghai. Shenzhen and Hong Kong are considered to be equal. With all this in mind, the final rating of the cities is Beijing (5), Shanghai (4), and Shenzhen (3).

Government influence

In order to compare the future government influence we will look at the two previously defined drivers: expected future government support for EV technology and Policy and regulatory outlook.

For the first driver, government targets have been compared in order to get an idea of the local government's ambition for its EV (vehicles) and EVSE (public chargers) adoption. It is assumed that the levels of these targets will indicate how interested the government is in furthering this technology. Below (Figure 28) is an illustration of the 2015[32] government targets for EV and EVSE adoption.

Figure 28: 2015 government targets for EV & EVSE adoption. Hong Kong is excluded due to lack of targets (Hensley, et al., 2011) (Yuyang & Wei, 2010) (Jerew, 2014) (Cheng-Yen, 2011) (Ng, 2014)

As we can see, Shanghai's government seem less ambitious than those of Beijing and Shenzhen (both regarding EV and EVSE adoption targets). This is in line with what has been explained in interviews with Hecker (2014) and Tsang (2014). Indeed, Marquis, et al. (2013) writes that Beijing's EV adoption is driven by a 'state leadership model' and that "The capital city is good at regulation and is experienced in cooperating with public and private sectors". About Shenzhen, Marquis et al. (2013) writes that "Local government is determined to develop an EV industry and has already taken substantial steps". Contrary to this Marquis et al. (2013) claims that EV adoption in Shanghai is driven by a 'platform-led business innovation model' and that "The ability to develop private [EV] business […] is strong". The Hong Kong SAR government has not set up any targets for either EV or EVSE adoption, which is why such a reference is not found in the chart.

For the driver policy and regulatory outlook, it would be appropriate to study expected future developments for the same policies and regulations that are discussed in the *market accessibility*

[32] Targets for further into the future is not specified yet for individual cities, as a new five year plan will adopted in 2016. However, it is assumed that these numbers give an indication of future ambitions as well.

factor (Subsection 6.2.1). Unfortunately, as already mentioned, it is often hard enough to predict politics even in the most developed countries. In China, this is all the more complicated, as the government tend to be rather erratic. For example, Streng (2014) says that a year ago, he would be reluctant to enter Shanghai or Beijing as an EVSE provider, due to SGCC's protectiveness of the industry. Historically, CSG has been easier to work with, but this changed rather swiftly recently:

> *"Lately, state grid revised their policy, and they now support private EV charging companies. This is a complete U-turn in the behaviour of state grid over the last couple of months [...]. We had noticed a change in state grid's attitude during the previous year but in Western Europe it would take a decade for something to actually happen. That is China for you"*

Additionally, a new five year plan is coming up in two years (2016), and its content with regards to environmental impact is of course not known (Fulton, 2011). Nonetheless, both policy and regulatory outlooks seems to be positive in both Hong Kong and the three Mainland cities. In Hong Kong, the first registration tax waive has been prolong until March 2017, instead of March 2014 (Environmental Protection Department, 2014) (Electric Vehicle Association of Asia Pacific, 2013). It is similar to mainland China, where the monetary electric vehicle subsidies (both national and regional) were extended in 2012 until 2015, and overall, Chinese government is very ambitions when it comes to electric vehicle adoption, having a 500,000 vehicle goal for 2015 and 5 million vehicle goal for 2020 (Standing, 2014).

Summary: Government influence
In summary, all three of the cities have ambitious targets set by government and positive policy and regulatory outlook, all three come on top of Hong Kong since they targets for EV adoption and EVSE deployment. Beijing has the most attractive outlook when it comes to government influence, hence rated highest (5). This is mainly due to the cities strong governmental connection and having a leading role in the country's EV adoption. Shenzhen and Shanghai are both pretty close and hence, both are rated 4.

6.3 CITY EVALUATION RESULT

Based on the analysis in the previous section, where Beijing, Shanghai and Shenzhen were analysed with help of the EVSE city evolution model formulated in Chapter 5, the most suitable city for market entry by EV Power is Shanghai. The summary of the analysis (presented through Figure 29) shows that Shanghai has received the highest final score, equal to 3.6 out of 5 possible. The analysis also shows that all three of the evaluated cities seem to be attractive markets, i.e. almost on par with Hong Kong (3.0) or higher. Beijing has received second highest score, 3.2 out of 5, and Shenzhen is last with 2.9 out of 5. For a thorough discussion about the city evaluation result, and recommendations to EV Power that are based on this, see Subsection 8.1.2 in the Conclusions Chapter.

EVSE city evaluation model

FACTOR	SUBFACTORS	WEIGHT	Hong Kong	Beijing	Shanghai	Shenzhen
Market accessibility	Technical suitability	Y/N	Y	Y	Y	Y
	Policies	0.15	3	2	2	1
	Regulations	0.15	3	1	4	2
Short-term demand	Private use car parks	0.1	3	4	5	4
	Public use car parks	0.01	3	3	4	5
	Fleet car parks	0.04	3	5	4	5
Expected market share	Partners	0.1	3	2	2	1
	Competitors	0.1	3	4	4	4
Profit margin	Price	0.05	3	4	4	4
	Costs	0.05	3	4	4	5
Long-term product potential	EVSE dominant design development	0.05	3	3	3	3
	Customer base growth	0.1	3	5	4	3
	Government influence	0.1	3	5	4	3
SUM		1	3	3.2	3.6	2.9

Figure 29: Summary of the city evaluation (Proprietary analysis)

7 Going forward: Success factors for a Chinese market entry by EV Power

This chapter is an analysis conducted in order to answer the third research question. The point of departure for this analysis is the evaluation of the three cities presented in Chapter 6, and then dynamics that were uncovered in that process. Three key success factors have been establish that EV Power should adhere to. These are presented below.

7.1 Focus on services: competition for that offering is weak

In Chapter 6, Subsection 6.2.3, it was shown that there exists fierce competition for sales of the actual product (wallbox), but very little competition for competent service from a company with experience in the EVSE industry. Furthermore, in same chapter it was revealed that many partners already sell their own wallbox in Mainland China, but they are in need of service and installation from a reliable third party.

If EV Power were to sell wallboxes to private PEV users or fleet customers in Mainland China, they would have to compete with free wallboxes from OEMs and cheaper wallboxes from large electronics manufacturers. For public use car parks, it is a bit easier, since there will be no competition from the OEMs. But as stated before, public use car parks is a small market that is believed to never reach the volumes for it to be a worthwhile effort. For service on the other hand, which is needed by all three customer segments, the only real competitor today is local electricians, which have little experience with EVSE (for larger fleet orders, there might be competition from SOEs).

In the theoretical framework (Chapter 2), it is explained how important it is for an actor in an emerging technology industry to consider how ones business model fits into the value chain configuration of the market. Further, the importance to find a niche market where ones value offering fits is stressed. An alternative to this is adapting ones business model to fit an identified niche market.

With this in mind, EV Power should consider focusing all of its efforts, in mainland China, on providing service and installation – a currently unpopulated niche. Having said that, EV Power should keep its wallbox-producing capabilities, as the width of EV Powers offering is what makes the company a good partner (see below) and keeps it from succumbing to the rapid changes in the EV industry.

7.2 Maintain partner relationships: look for new ones outside OEMs

It has been established that partner relationships, and their central role in the EV LTS, are essential to the EVSE business. For wallbox sales the customer usually has no preference, and will listen to the OEM when it comes to choice of wallbox (but as established above, wallbox sales should not be the focus in mainland China). For service, it is of course a direct transaction with the partner.

The current partners value the partnership with EV Power due to the company's adaptability and its broad offering (Heltner, 2014) (Anonymous interviewee, 2014) (Lee, 2014) (Shen, 2014). The service expertise for EVSE is also rare to come by, and a competitive advantage for EV Power (as shown in

Chapter 6, Subsection 6.2.3). Due to this, it should not be difficult for EV Power to establish additional partnerships. Interviews with industry experts Xiaocheng (2014), Heltner (2014), Au (2014), Streng (2014) and Hecker (2014) have revealed that in mainland China, there are opportunities to partner with, and gain business from, other types of businesses apart from OEMs:

- Partner with car dealerships: Some Chinese OEMs, like BYD, does not work with partners for installation; they leave that up to the dealerships. In China, there are several large chains of dealerships that EV Power should try to partner up with
- Partner with car rental companies: A new trend in China (and elsewhere) is rental EVs. This is a great opportunity for a partnership which will provide steady revenues from service and installation if the business grows
- Partner with Large electronics manufactures: While these companies manufacture their own wallboxes, they may not be interested in installing them
- Partner with property developers: This may give opportunities both in the public use car park market and in the private use car park markets (it is expected that luxury developments will have pre-installed wallboxes in the near future)

7.3 ENTER EARLY: SEIZE THE WINDOW OF OPPORTUNITY

The next thing EV Power has to decide is when to enter the new market. As it is stated in the theory, generally, SMEs should make use of first mover advantages and enter early. The analysis in Section 6.2, points to the fact that the 'window of opportunity', characterized by a lack of competition and stable business models, is still open in Shanghai. In Shanghai, there is little established competition with the same offering as EV Power. This means that EV Power will not have to spend excessive resources fight its way into the market, something that may change in the future. Currently, there is also an ongoing investigation by OEMs into partnerships with EVSE suppliers. EV Power should enter early in order to get the better of this.

The benefits of an early entry is even greater for emerging technologies, where it could mean more impact on the direction of the development of a technology in a market. Basically, in the Section 2.4, it is described that for emerging technologies there are some important characteristics that can develop in different directions for varying markets (business model standards, dominant designs and LTS configurations). Further, it is explained that you want to choose a market that is developing in a direction that suits your business. Looking at these facts, it is apparent that if one enters a market at an early state, it will be easier to affect this development and steer the market in the direction that is appropriate for the business in question. An early entrant can be part of defining the business model standard in a market, as well as the dominant design. It can also take a place as a large actor in the LTS that surrounds the business. It is revealed in the analysis that Shanghai is in the early state of these developments (there are few competitors, all with different business models and vertical integration. The LTS is just taking shape, with the government and utilities, for example, are just now establishing their role in EV development). Thus, the sooner EV Power enters, the greater impact it will have on the industry developments.

To add to this, in the theory, it is explained how SMEs often lack data in these types of market entry assessments, and how entering a market and trying out ones business model can actually be the preferable way to gain knowledge. This analysis has shown that the lack of data aspect is definitely a big factor when it comes to EVs. We believe that in order for EV Power to be successful in several Chinese markets, in a few years, they have to enter one to gain the knowledge that they need.

8 Conclusions and discussion

In this, the final chapter of the thesis, the conclusions for each of the three research questions are presented. Thereafter, certain aspects of these conclusions are discussed and put in a larger context. Lastly, suggestions for further research which may use this study as its point of departure are presented.

8.1 CONCLUSIONS

The main purpose of this study (and thus contribution to knowledge) has been the development of the EVSE city evaluation model, which, in its finished form, may be used to analyse markets attractiveness and its suitability for an entry by a small-medium sized EVSE producer. The second purpose of this study has been to put this model to the test by evaluated three Mainland Chinese cities, Beijing, Shanghai and Shenzhen, in order to help EV Power to make a decision regarding which city to enter. This evaluation had the dual purpose of providing a recommendation to the commissioning company but as well as serving as a test to assess the model's credibility. Finally, for the last part of the study, the conclusion from the city evaluation has been used in order to advise EV Power on key aspects that need to be taken into account when entering Shanghai. Below follow the full conclusions for each of the study's three research questions.

8.1.1 RQ1

What are the factors that need to be taken into account when analysing potential markets for a market entry by an EVSE SME producer?

These factors have been identified through the theoretical framework, strategic mapping of EV Power and interviews with industry experts. Further, the factors have been grouped in order to create a mutually exclusive and collectively exhausting model, suited for a market analysis for the EVSE industry. The final model is presented through Figure 11 on page 33.

Some of the main influences on the final model's composition was:

- The fact that the product and the services cater to several customer segments with different but overlapping needs and characteristics.
- The fact that the EVSE industry is part of an LTS that includes powerful actors such as governments, utilities and OEMs that all influence the market hugely and sometimes unpredictably.
- The fact that EVs are an emerging technology which, among other things, makes predictions for the future uncertain.

A discussion about the model's adequacy and generalizability is presented later in this chapter.

8.1.2 RQ2

Considering these factors, which Chinese city (Beijing, Shanghai or Shenzhen) should EV Power enter?

The purpose of the second research question is to put the created EVSE city evaluation model to practice by evaluating three possible markets (Beijing, Shanghai or Shenzhen) for a market entry by EV Power. The final evaluation of these cities has shown that Shanghai is the most attractive city based on the criteria set by the model. The model uses Hong Kong as the baseline for an absolute reference for whether the market is attractive or not, based on the fact that EV Power is successful in Hong Kong.

All in all, the results have shown that all three of the evaluated markets seem to be good markets for a market entry by EV Power. The analysis has shown that all three cities are almost on par with Hong Kong or better. China in general has been found keen on adopting EV technology, strongly supported by both national and local governments. Most of the world's major OEMs see large potential in the EV market in China and all of EV Powers' current partners are interested in the three evaluated cities.

Looking closely at the results of the evaluation, Shenzhen comes out last, rated (2.9). The results indicate that the Shenzhen market is almost on par with the Hong Kong, looking at total attractiveness. Shenzhen benefits from being the home of BYD; local governments show their support by ordering large fleets of EVs, which in turn result in a high penetration that counters market myopia. However, this government support has also led to policies and regulations that make the city less attractive to private actors. Furthermore, it seems the city is just not considered as 'important' a city as Shanghai and Beijing, despite sharing their 'tier 1' status. This results in the city losing out on partners (since these are not prioritizing Shenzhen compared to Shanghai or Beijing) and long term product potential (since cannot match the future development of the two other cities).

Beijing is rated second best (3.2). The main advantage of Beijing is its government presence. As mentioned earlier, Beijing is driven by 'state leadership model'. It is also the city with the worst pollution which is accompanied by a great desire to solve that issue. Beijing has been found to have the greatest total short-term demand and the best future customer growth potential. The main drawback of Beijing is, however, it regulations. Having a cap on annual vehicle sales and local limits on car usage are huge disadvantages. In fact, if Beijing's regulations had been rated equal or higher than those of Shanghai, it would have come out on top.

Finally, Shanghai is the most attractive city, at a rating of (3.6). The analysis has shown that Shanghai is equal or better than Hong Kong for 10 out of 12 analysed subfactors, and experts agree that, currently, Shanghai seems the most attractive city among the three analysed cities. Shanghai is a city of great wealth (which has been established as a main driver of EV adoption) and the city will remain China's wealthiest well into the future. Shanghai was also found to have the largest short-term demand for private EVs due to the conscious choice by the local government to rely on the private market. Furthermore, the influence that the government has chosen to exert has been the right one; as already mentioned, Shanghai has a great policy and regulatory environment that furthers EV technology in the area. The fact that EVs are excluded from Shanghai's notorious licence plate auctions and that there are no limits on EV sales or car usage in the city has contributed greatly to this favourable rating. Consequentially, it is our recommendation that EV Power should enter Shanghai before considering Beijing or Shenzhen.

It is important to point out that the results of the evaluation are reflecting the customer mix of EV Power. As discussed earlier, the internal weighting of the model's *short-term demand* factor is dependent on the commissioning company. For the case of EV Power, *private use car parks* was deemed the most important segment, while *fleet use car parks* place as a distant second and *public use* *car parks* is the least important. As other EVSE providers may target different customer segments (e.g. focusing more on public or fleet car parks or focusing equally on all), the final evaluation results will be different for them. For example, if this same analysis was conducted for a company focusing solely on government fleets, Beijing would have been found to be most attractive.

8.1.3 RQ3

With the results from the previous questions in mind, what are the key success factors that EV Power should adhere to in order to make a successful entry?

The conclusion for this research question forms three recommendations for EV Power to adhere to when entering the new market:

1. Focus on services: competition for that offering is weak
2. Maintain partner relationships: look for new ones outside OEMs
3. Enter early: seize the window of opportunity

The first conclusion concerns the focus of EV Powers' offering. The analysis has shown that in mainland China, EV Power should focus on providing service (installation and maintenance), since this is where they have their major competitive advantage. It is also the part of the offering that will face the most favourable competitive landscape in Shanghai. Secondly, it has been concluded that partnerships are a crucial part of the EV LTS, and as such, of great importance to companies such as EV Power. The recommendation is to both leverage partnerships from the home market when entering to as well as to search for new partners. In this search, it is recommended that EV Powers' explore possibilities outside of OEMs. Lastly, EV Power is advised to enter Shanghai at an early stage. An early entry is seen as highly advantageous. As it will require less resources, and give EV Power more impact on the future of the industry and its role in the LTS.

8.2 DISCUSSION

In this section, we will discuss the conclusions in a broader context. Common concepts such as the implication of the limitations, generalizability and the contribution of the research will be covered. First however a topic specific to this thesis will be discussed; the relation of the conclusions and what the conclusion from research question #2 means for the credibility of the conclusion for research question #1.

8.2.1 Adequacy of the model

It is important to reflect upon whether or not the model that was formulated as an answer to research question #1 in this study is appropriate for its purpose; to assess the attractiveness of a market. On an academic level, research question #2 mainly serves as a way of testing the model in a real-life situation. In this part, the process of answering, and the outcome of, research question #2 will be discussed as a proof for the functionality of the model.

When using the model to evaluate the cities, the authors did not encounter any important information about the EV market that was not already included in the models factors. Of course, this may be a slightly nonsensical statement, but among the articles on the development of EV technology in China that were read in this process, none attributed the eventual success to a factor that is not in some way included in this model. Using the model, Shanghai was deemed the most attractive market mainly due to a large market for private PEVs and its current regulatory environment. Is this an accurate description of reality? This is hard to judge without referencing a similar study (of which there are none). What can be said is that this study confirms the initial suspicions of the managers at EV Power. Furthermore, it is in line with what all of the interview experts say about the Chinese market; Shanghai will dominate the market for private EVs due to the wealth of the city. Referring to the interview subjects' opinions can again be seen as a circle argument since the model is partly based on information from the interviews. Having said that, the interviews are only one of the three bases for the model (the others being theory and the mapping of EV power), so it may still be an interesting point. All in all, it turns out that it is hard to judge the credibility without further studies, but looking at what is known at this point, the model seems appropriate for its purpose.

8.2.2 Generalizability

Of course, the conclusions relating to research question #2 and research question #3 are not generalizable, since they pertain specific cities. However, the conclusion for research question #1 aims to be generalizable. It was the purpose of this study to create a model that was general enough to be applicable for all geographical markets. In order to achieve this it has been made sure that both literary and interview sources share a broad background. Literature has been studied that originates from, and concerns, many parts of the world (although with a clear bias towards Europe, North America and Asia Pacific). The interviewees have backgrounds in the EV industry in the same three regions. In addition, every piece of information has been critically analysed to determine its applicability for other markets.

That said, the authors' commitment to the external partner for this study limited the choice of cities for the evaluation part of this study, which resulted in the model being used on three, in this context, quite similar markets. Presumably, the generalizability of this model would have been more thoroughly tested if the evaluation would have dealt with markets in different countries or even on different continents.

8.2.3 Impact of the methodological limitations

As elaborated on in Subsection 3.3.2, this research had two main limitations; limited access to market data and the fact that only one EVSE supplier was studied first hand. Below, the impact that these limitations may have had on the conclusions will be discussed.

It is not the belief of the authors that the lack of data has impacted the formulation of the model (and the answer to research question #1). While the model includes one short term market size and one factor concerning long term potential instead of the more traditional approach to study the markets quantitative growth over time, this is more due to the inherent characteristics of the subject technology (the unpredictable development of EV technology due to government intervention, for example) than due to the availability of the data. However, this limitation may have had some impact on the conclusions for research question #2. If more data was available, it may have been possible to triangulate a lot of the data that was used. Additionally, the factors that were not fully assessed in this study due to lack of data (environmental awareness, price and willingness to invest in workplace chargers), may have had a different impact on the results if data was readily available. Whether this would have had any major impact for any of the factors is impossible to say, but as already discussed in Subsection 8.2.1, the final result in terms of the city selected by the model seems reasonable.

If more than one EVSE supplier was studied, the drivers of success for this type of business may have been deemed different. Since the mapping of EV Power serves as part of the basis for the framework, this may have impacted the structure of the same. This becomes even more likely when considering how different EVSE companies' business models are at this stage of the industry's development. Nevertheless, the framework also builds on theoretical knowledge and interviews with experts with backgrounds in different parts of the EV industry. It is of course difficult to predict how such a major addition to the study would impact the conclusions, but considering again that the mapping of EV Power only served as one of several basis for the model, it is the authors' opinion that while such an addition may have changed the structure of sub factors (e.g. the division of the *short-term demand* factor), it would not change the factors that have been concluded to be important for EVSE development.

8.2.4 Contribution

A lot has already been written about EVs, both academically and otherwise. However, previous literature mostly deals with the technology or it tries to find the optimal infrastructure deployment from a societal perspective. Few have tried to investigate how the different actors in this industry should conduct their business and develop in the market in order to make a profit. This is an important question, since the future diffusion of EV technology cannot fully rely on government incentives; there must be a profitable business case.

This study contributes to this particular base of knowledge. No study has been conducted on market entries for EV companies yet, so that is a contribution in itself. Additionally, it is the authors' opinion that this study has helped in making clear what impact the different actors in the EV LTS has on the market. Earlier literature often focuses one or a few of the factors and its impact on EV diffusion. This study has been conducted with a view to investigate all of these factors simultaneously and relate their individual impacts to each other.

Lastly, since a definitive outcome was reached in terms of which city was most attractive for market entry, it is the belief of the authors that the results of this study will serve as a great help for EV Power when they now move to expand in Asia.

8.3 SUGGESTIONS FOR FUTURE RESEARCH

Since this study is quite comprehensive, it touches upon a few topics that are not exhausted by this study. These topics may serve as an interesting basis for future research in the field of EV technology. Below, a couple of suggestions of further studies with a basis in this thesis are listed.

- Examining the vertical integration within the EV industry and how business models for EVSE companies may look in the future
- Study the development of dominant designs for EVSE in different markets, globally

Additionally, as already stated in the 'Generalizability' part of this chapter, it would be interesting to try out the model suggested in this thesis on other markets around the world.

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10 Appendix

Interviewee	Title	Date
Mr Martin Tsang (on-going discussion)	CEO and co-founder, Hong Kong EV Power Ltd.	2014-02-03 - 2014-04-18
Mr Laurence Chan (on-going discussion)	Managing Director and co-founder, Hong Kong EV Power Ltd.	2014-02-03 - 2014-04-18
Professor Kevin Au (recorded)	Dept. of management, The Chinese University of Hong Kong	2014-02-19
Professor Sylvia He (recorded)	Dept. of Geography Resource Management, The Chinese University of Hong Kong	2014-03-11
Ms Dan Wu (recorded)	Dept. of Geography Resource Management, The Chinese University of Hong Kong	2014-03-11
Mr Andreas Hecker (recorded)	PhD student, BMW Brilliance, Beijing	2014-02-25
Mr Tim Heltner (recorded)	Product Rollout Manager, 360° Electric, BMWi China	2014-02-27
Mr Albrecht Pfeiffer (partially recorded)	Manager, New Energy Vehicles, BMW Group China	2014-02-26
Mr Gunther Quest (e-mail)	Head of E-Mobility and BMWi Region China	2014-03-09
Mr Ouyang Xiaocheng (e-mail)	BYD China	2014-04-13
Mr Newman Shen (recorded)	E-Mobility Business Development Manager, TUV China	2014-03-10
Mr Lawrence Lee (e-mail)	E-Mobility Project Leader, Porsche China	2014-04-03
Mr Hans Streng (recorded)	SrVP, EV Charging Infrastructure, ABB	2014-03-31
Anonymous interviewee (recorded)	Service Manager for Asia Pacific, EV OEM	2014-04-14