LEADS.

Industry Analysis Report

An world-wide analysis of the Electric vehicle charging market by LEADS.

Hester Berndsen
Vincent Henric
Bruno Jacquelin
Mostafa Moazami
Emre Yildiz

2015

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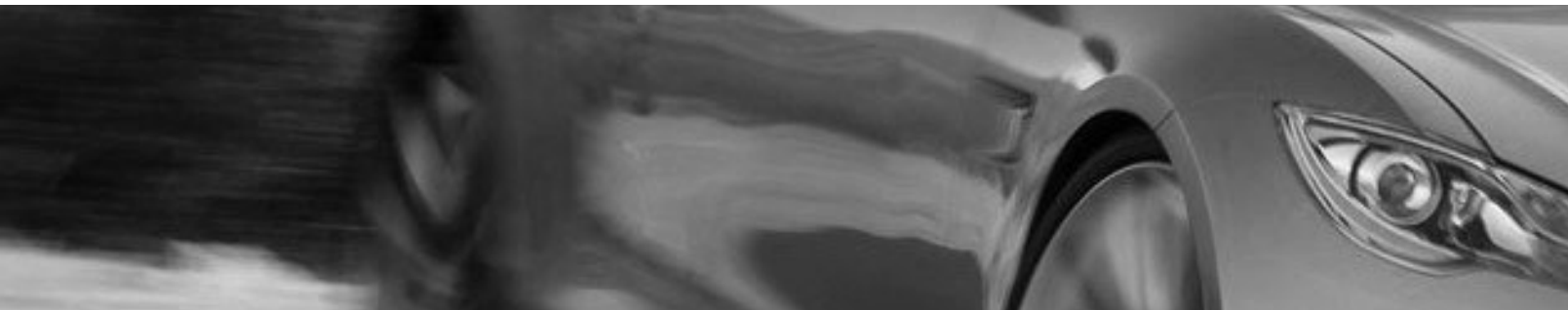

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An introduction

LEADS is the leader in environment analysis and definition of strategy. In the context of the course Global Manufacturing Strategy, made possible by Tsinghua University under supervision of Professor Ben Koo, we have extensively researched the field of electric car charging.

The report will give an overview of relevant factors influencing the development of electric driving. It also provides several extensive case studies on both company and government initiatives in this field. By combining factors from scientific research with practical examples, we have managed to extract the key elements to make electric driving a success.
In the second part of the report we will give you an in-depth analysis of the important players in the market, as well as future recommendations for further market development.

This industry analysis report has been designed and assembled with the greatest care. After reading, we hope to have given you further insight in the challenges and great opportunities that lie in the field of electric car charging.

This Indsutry Analysis Report makes use of the newest technologies - take out your smartphone, download the app and find a whole extra "Layar" of extra information!

"The Electric car charging market is one of the fastest growing in the century"

Hester Berndsen

Hester Berndsen, 23 years old, Dutch.

Graduated from the Indusrial Design Engineering department at TU Delft with a BSc. degree, she came to Tsinghua University in 2014 to study Human Factors in engineering and learn Chinese. She is especially interested in the field of interaction an UX design, specifically Human-Robot Interaction (HRI). Hester loves sports and jazz music, but above all travelling.

Vincent Henric

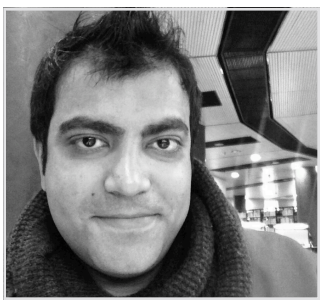
Vincent Henric, 22 years old, French.

Coming from the French Engineering school Ecole Centrale Paris, he comes to China in 2014 to study operations research and learn Chinese. He is interested in general energy issues. He also likes practicing sports, and obtained his black belt in judo at the age of 15.

Bruno Jacquelin

Bruno Jacquelin, 22 years old, French

Studying Industrial Engineering in the French school of INSA de Lyon, he comes in China in 2012 for an internship at Bosh Company in Shenzhen, and in 2014 to study in Tsinghua University. His professional objective is to work in Continuous Amelioration, on various subjects. His main interests are traveling, sports, and music.



Mostafa Moazami

Mostafa Moazami , 30 years old, Iranian

Coming to Tsinghua University to study Master of Science Management and Technology in 2014.He is interested in cultural differences and management. He likes cooking, traveling and music .old tears sorry. Additions can suspected its concealed put furnished.

Emre Yildiz

Emre Yıldız, 28 years old, Turkish

Graduated Management Information System with B.Sc. degree from Bogazici University at Istanbul and worked as IT Manager for one year at Shanghai for a Turkey based consulting company. His professional objective is to work in interdisciplinary fields as IT and engineering management. He interests about the dynamics of our daily lives and in the structure of society.

Resources:

- Time
- Data resources
- Collaboration software
- IAR assignment

People:

- Our team
- Classmates
- Professors
- Professionals
- Electric car drivers

Analysis of:

- Charging stations market
- Electric vehicle market
- Technology
- Laws and regulations
- Architecture and zoning

Impact of :

- Oil Price
- Battery Market
- Fuel Cells
- Electricity price
- Environmental agreements
- Substitution markets
- User acceptance
- Academic projects
- Economy conditions

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Current Situation

Case Studies

Global Context

Analysis of relevant factors

I

Logic Model

Outcomes

derstanding of the current situation

derstanding of the most relevant e studies

derstanding of the global context

Provide an overview of the charging stations industry

Better understanding of the policies and strategies of companies and governments

Better understanding of the mechanisms that influence the markets

Increased development of the electric charging station market in order to increase electric driving

Conclusion

Strategy design

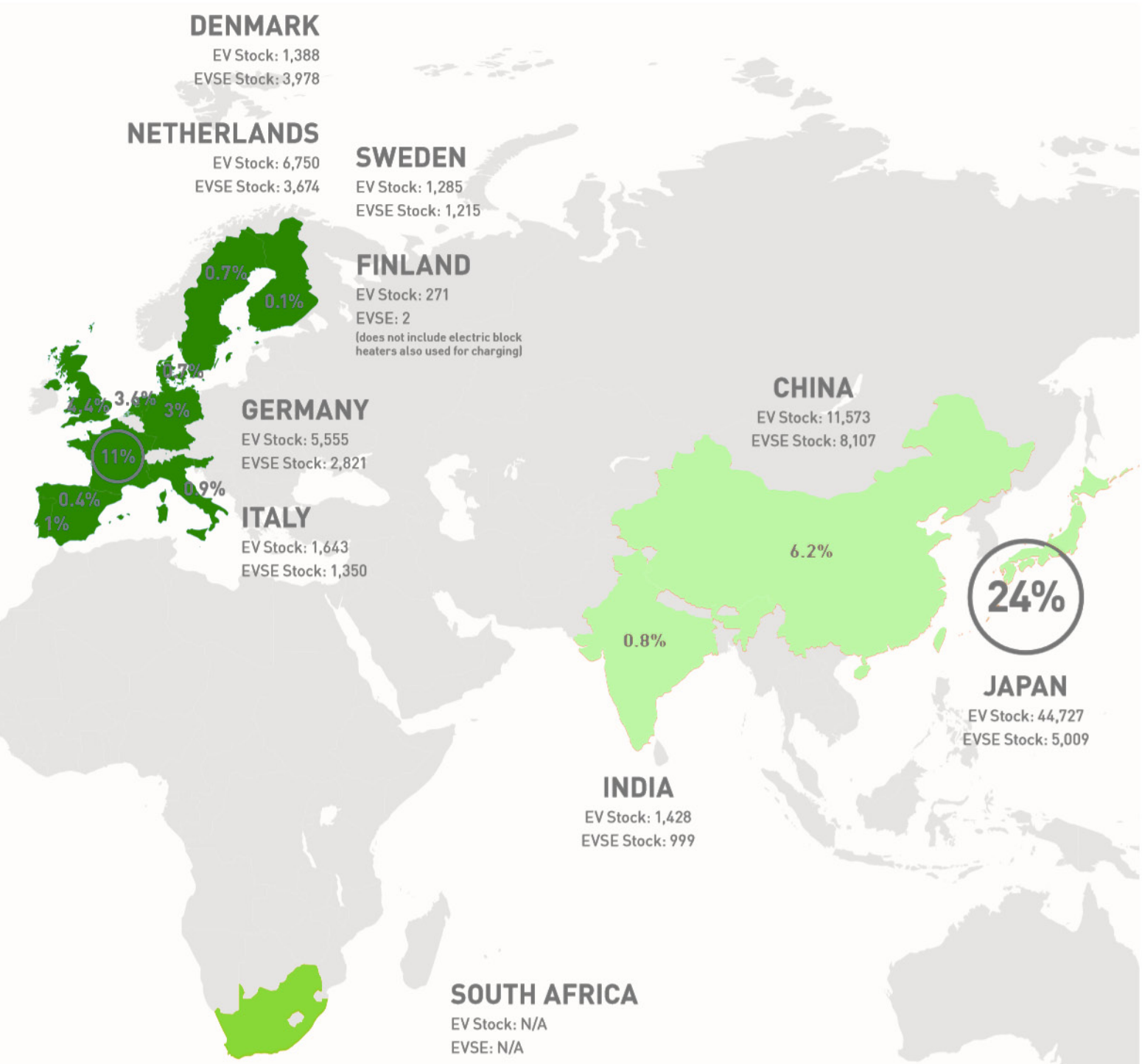
NDUSTRY ANALYSIS

Alleviate the range anxiety

Well distributed, EV compatible, and affordable charging station network

Electric Vehicles Initiative (EVI)

EVI MEMBER COUNTRIES HELD OVER 90% OF WORLD ELECTRIC VEHICLE (EV) STOCK IN 2012


DENMARK
EV Stock: 1,388
EVSE Stock: 3,978
NETHERLANDS
EV Stock: 6,750
EVSE Stock: 3,674
SWEDEN
EV Stock: 1,285
EVSE Stock: 1,215
FINLAND
EV Stock: 271
EVSE: 2
(does not include electric block heaters also used for charging)
0.7%
0.1%
0.7%
4.4%
3.6%
3%
11%
0.9%
0.4%
1%
GERMANY
EV Stock: 5,555
EVSE Stock: 2,821
ITALY
EV Stock: 1,643
EVSE Stock: 1,350
CHINA
EV Stock: 11,573
EVSE Stock: 8,107
6.2%
0.8%
24%
JAPAN
EV Stock: 44,727
EVSE Stock: 5,009
INDIA
EV Stock: 1,428
EVSE Stock: 999
SOUTH AFRICA
EV Stock: N/A
EVSE: N/A

The Electric vehicle market is taking off. As technologies become cheaper and more widespread, the accessibility of electric driving for regular consumers is larger than ever. Below you find a quick market overview in three numbers:

>90 %

Of EV stock in EVI countries

51.5%

Reduction in battery cost over 4 years

250 %

EV sales growth from 2011 to 2012

Outline of this Industry Analysis

Reducing oil supply risk and CO2 emissions has become the major concern of governments in the transportation sector. Therefore, switching to more sustainable forms of transportation has become a major goal for many countries around the world.

The projected future growth of the sustainable transportation sector, provides great opportunities for companies in the field of electric transportation. Right now we already see great things from EV manufacturers, such as Tesla, Nissan and Toyota.

But the expansion of the EV fleet goes hand in hand with that of the Charging Stations Network. Indeed, providing for charging needs and increasing ease of use and speed of this charging network is a key factor in convincing individuals to switch to this new means of transportation. The EV market and those wanting to expand it rely heavily on the development and expansion of the electric charging market.

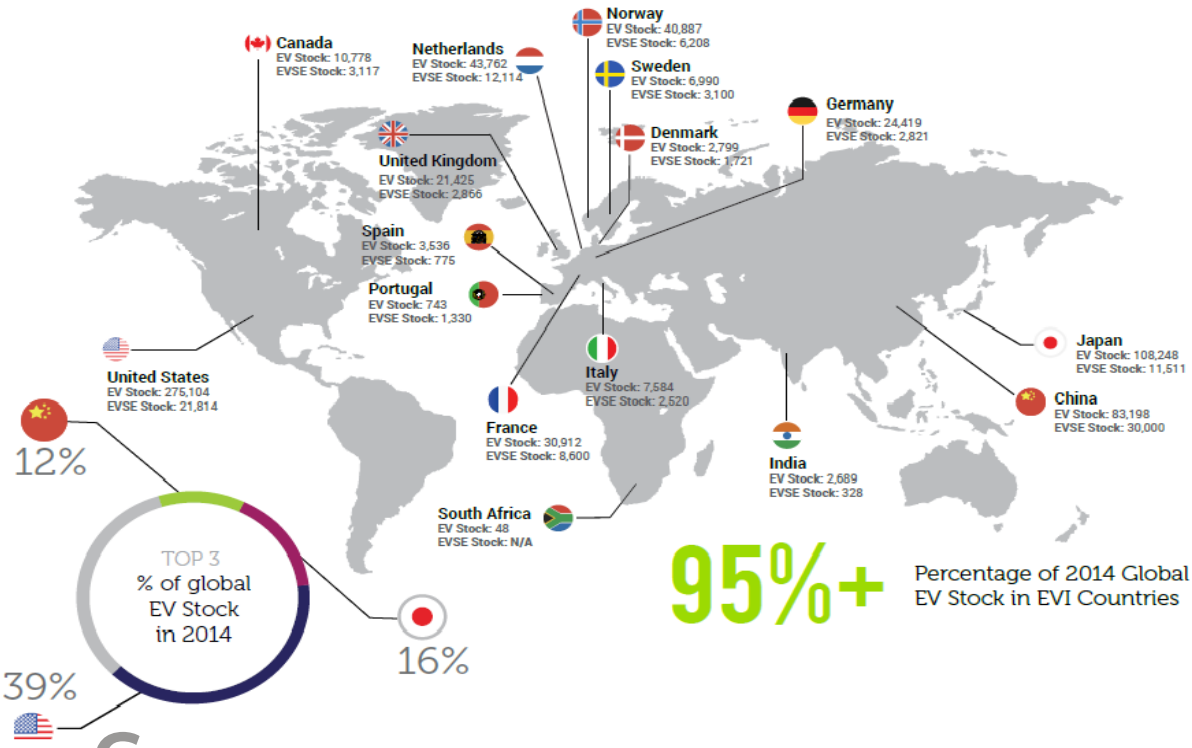
Believing there will be no EV market without the adequate Charging Stations Network, we have decided to take a closer look on the Charging Stations market and provide an insight in the industry that can help companies involved. This Industry Analysis Report aims at understanding the electric vehicle charging stations market, it highlights what factors – internal or external – influence it. Finally it concludes on the future opportunities, and proposes a general strategy for companies.

In the first part of this report, for better understanding of the global context of electric vehicle (EV) charging infrastructure, we are presenting the current situation of the EV market, the EV charging market, technology and architecture as well as the related regulations.

The second part of the report analyzes practical examples of the electrical charging industry. From these examples we find key factors that influence the success of companies and governments in the development and expansion of electric driving.

Based on the current EV charging situation and case studies, this report has concluded five major factors affecting the industry: Energy, Authorization, Technology, Payment and Government action.

For each of the factors above, we have carefully analyzed the future developments. We have determined what steps companies interested or already involved in electric car charging can undertake, in order to gain the most out of them. Parts of the proposed strategy aims to reduce risk, parts indicate how the companies can best act in order to increase their market share.
All in all, we provide clear, short term and long term goals for electric vehicle charging companies, aimed at those who are already in the market or want to enter and invest in this market in near future.



Key figures

The electric car charging market is a fairly new market. Although it has been developing rapidly over the last few years, there are still many issues to tackle in the areas of standardization and regulation of charging, as well as on image and convenience of electric driving.

The players in the electric car charging market can roughly be divided into 3 different categories: Electric car manufacturers, Electricity companies and Electric car charging companies.
As the set-up of an electric car charging network requires a very high initial investment, it is a relatively risky business to get into. Since the beginning of the modern electric car era, there have been several large charging companies that have had to apply for bankruptcy, the most famous probably being Ecotality in the USA and later Better Place in Israel. The bankruptcies were mainly due to wrong management and investment strategies.

STANDARDS FOR ELECTRIC CHARGING

At the time of writing, there is not yet one set standard for electric car charging. There are many different charging methods, each taking different amounts of charging time and requiring different initial investments.
Several countries have started to set up a network of charging points for electric cars. In the USA the market, at the moment, is dominated by Chargepoint. In Estonia, the government has chosen to work with ABB to set-up the network, which is now run by KredEx and NOW.

There are not only many different types of charging stations, different companies also have different standard plugs. To lower their own, as well as consumers risks, car and electricity companies have chosen to work together in associations concerning charging plugs.

As of 2015, there is not yet one fixed standard for electric car charging

The largest and most well known of these organizations is CHAdeMO, on which a more in-depth study is given later in this report. CHAdeMO was founded in Japan, initially led by energy producer TEPCO. The association first expanded in Japan and now has members throughout the world.
As an answer to the Japanese near-monopoly in the charging plugs, Western car manufacturers founded Combo. Combo

includes big players such as BMW, Mercedes and General Motors. At the moment this is the standard recognized by the EU. The plugs used by both different standards are very similar, and many car manufacturers have chosen to integrate both systems in their cars, or produce the cars in such a way that the systems can easily be interchanged. This partiallly to limit the manufactureres own risks, as well as the risk for their customers, whom may fear their standard may otherwise phase out in due time.

GROWTH RATE 32%

HOME CHARGING STATIONS

As electric car owners will always need to be able to charge their car at home, or at it's main parking place, many electric car manufacturers, such as Tesla, Opel Ampera and Nissan Leaf offer the opportunity to purchase a home charging point with the purchase of a new vehicle. Nissan Leaf even requires this, as it has a special type of charging station, although it also gives to possibility of a waiver if the new owner has a compatible charging point installed by a third party. As will be discussed in more detail in the section 'Technology' later in this industry analysis report, home charging stations are usually of the slow-charging type. These generally take up to 8 hours to fully charge the car battery. Slow-charging stations are the cheapest kind of charging station, but because of their low charging speed generally used only in office and home charging.

PUBLIC CHARGING STATIONS

Most European countries have a relatively extensive network of public charging stations, especially around the big cities. It may come as a surprise that only Estonia has a full, country-wide network of fast-charging stations in place at the moment. Leading countries in the EV market, which are also the countries with the most charging opportunities are Estonia, Norway and The Netherlands. Outside of Europe, the only area's where electric driving is very wide-spread are Japan and California. In the less populated area's of the USA, we see hardly any electric vehicles, something that also counts for states with less financial incentives for electric driving.

We can clearly see that the amount of charging stations a country or region has, is closely related with the amount of electric vehicles owned in the region. This interdependency can be clearly seen in the Better Place case, which is described in more detail later in this report. The company tried to set-up a contract based battery swapping system for electric cars. However, as there were less than 1.500 cars sold, which were also the only users of the system, the company eventually went bankrupt.

By 2020 up to 7% of all global car sales are predicted to be electric

For public charging stations, the fast-charging system, or DC-charging, is most widely used. Although it is more expensive than slow charging, at the moment it is the only technology that is fast enough to charge the car without delaying the driver for an extensive amout of time.

PAYMENT SYSTEMS

One of the main problems for the users in the car charging market is the diversity of charging networks. Due to lack of collaboration and membership requirements, companies try to limit users to use only their chargers. As customers are mostly required to use multiple companies due to logistic reasons, they need (sometimes prepaid) memberships to multiple suppliers. This leads to an overload of cards and paperwork for the user. Standardization of payments systems or collaboration between companies could solve these issues.

CHARGE UP TO 80% IN 30 MINUTES

FUTURE RISKS

At the moment electric car batteries are made using lithium. This is the most suitable element known to extend battery life and battery power. However, the amount of lithium reserves in our planet is found to be insufficient to enable every car to be substituted for an electric version. This will inevitably lead to a change in the power source of electric cars and therefore also in the technology used to charge this. One of the most promising technologies to date is probably the fuel cell. As fuel cells are recharged in a very different way than lithium batteries, this can become a potential threat for companies involved in lithium battery charging.

BATTERY PRICES -26%

CONCLUSION

Although giant steps have been made in the past few years in the areas of standardizaiton and development of electric driving technology, there are still many opportunities for further improvement. The market is still far from mature and, given the favourable growth rates and large amounts of R&D investment, provides great opportunities. •

The Electric Vehicle(EV) market

In the past decade climate change and difficult access to sustainable energy have motivated governments around the world to set a goal to achieve sustainable transportation.

Electrical Vehicles (EV) is one of the possible way to reduce dependence on petroleum and reduce emission of CO2 and other pollutants and control climate change. Therefore , a number of governments around the world are establishing deployment goals for EVs, automobile industry are researching on this technology shift ,launching variety of new EVs models and trying to reduce the cost of components like batteries to encourage costumers with different budget levels purchase this advanced technology.

EVS GLOBAL LANDSCAPE IN 2014

Governments around the world for achieving their goal which are increasing energy security and reducing the emission of greenhouse gases have set EVs stock targets . Figure ….. shows the EVs stock situation in 15 countries which have hold 95% of global EVs stock and electrical vehicle supply equipment stock.

As can be seen from this figure , countries with petroleum access concern have set plan for increasing the use of EVs which result in saving in energy, but petroleum producing and exporting countries are lag terribly behind the rest of the world in deployment of EVs .

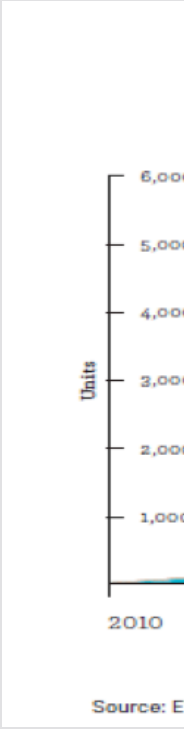
EV SALES TARGETS

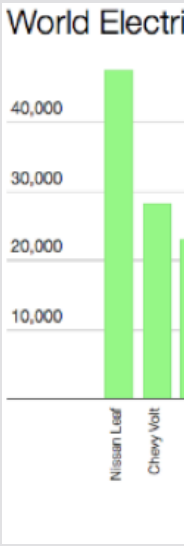
Most countries and policy makers has set a long term EV sale target in the relative near-term 2010-2020 time frame to accelerate sale and use of EV in their own country .

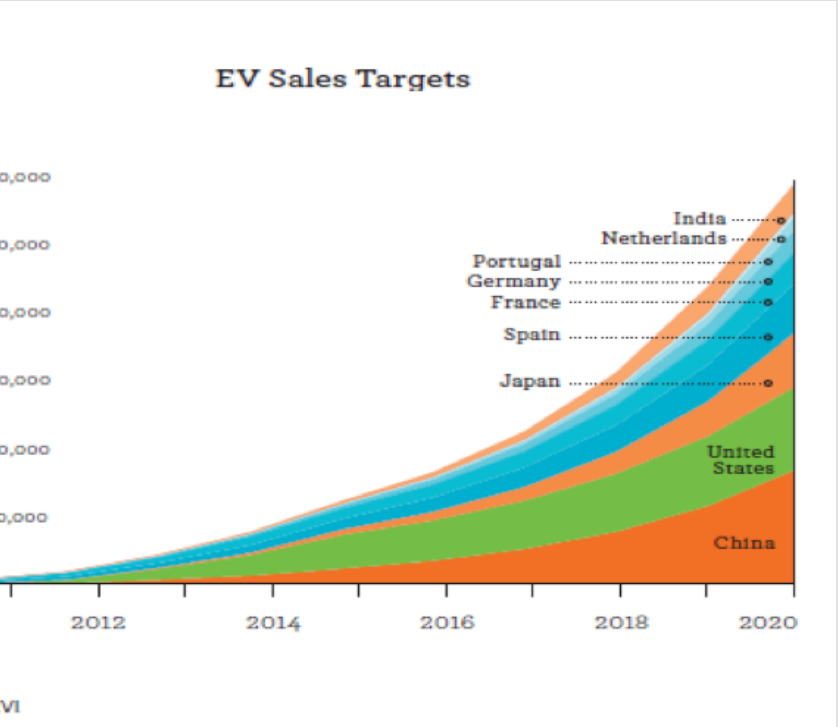
As can be seen from this table , the EV target sale for India and China as two high population countries have a significant difference. India's EV sale target will reach to 6 million at the end of 2020 while China has planned to reach to 1 million. This variance can be result of the ability of government to access sustainable energy.

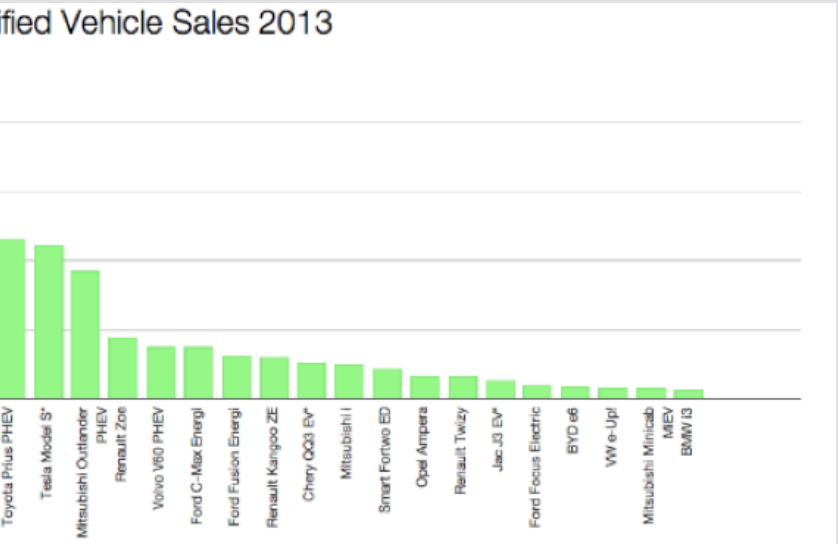
EV MARKET SHARE

Market shares of EV vary significantly across the world. As can be seen from Figure 2, Norway has the highest share of EV sales (BEV and PHEV combined), with about 12.5% of all passenger cars sold in 2014. The Netherlands has the second-highest market share, with about 3.9%. The structures of the two markets are entirely different, though: While in Norway nearly all EVs sold are BEVs, in the Netherlands PHEVs clearly account for the majority of the market. Italy has the lowest share of EVs with about 1% .









"The top 5 electric vehicle models account for 67% of all electric vehicle sales"

WORLD EV MODELS SALES

EV manufacturer are competing over the market share and each year launch new models to the market to satisfy different target costumers and markets. The graph on the left shows the top 10 EV models which had the highest worldwide sale .

As can be seen from this figure , Nissan Leaf is the Market leader which has almost twice as many sale as the Chevy Volt .
As can be seen from the chart, the large majority of EV sales came from the top 5 models in 2013, representing 67% of all EVs sales. As being in stages of EV revolution the rankings can change very fast as the result of technology improvement, launching new models by current and new companies and many other factors.

CONCLUSION

The road ahead of EV market globalization is very long and not easy , EV market share are still around 1% in most major markets, but governments and manufacturer try to deal with all obstacles like high battery cost, EV range limitation and low costumer acceptance and spread the usage of EV between different levels of society .EV market is very naïve and future of the market is belong to companies that can come up with new ideas and better technology to face with challenges and launch better products to market. •

EV Charging Technology

An electric charging station cannot be seen as just an element in an infrastructure that supplies electric energy for the recharging of electric vehicles by simply transforming electricity from AC to DC voltage. Conventional perception of charging station is rapidly advancing with technological innovations on electric grid and EVs battery technology. EVs are becoming smart cars with Internet of Things (IoT) and electric grids becoming smart grids. EVs charging stations are also becoming a significant elements that enable communication between these two advanced product and service environments that evolves beyond our imagination and too fast.

CONTEXT

Charging stations fall into 4 basic concepts: residential charging that is the most common charging method, charging while parked that is a commercial venture charged or free, offered in partnership with the owners of the parking lot, fast charging that supplies higher than 40 kW, delivering over 60miles (100 km) of range in 10–30 minutes and battery swaps that enable to change battery under 15 minutes. There are four different modes of charging defined by the International Electrotechnical Commission (IEC 62196). Plug types can also grouped in four types.

CHARGING TIMES AND FAST CHARGING

Charging time is dependent on reachable phase of electric grid and battery capacity of the EVs. Yet new technological innovations comes out very quickly and provides shorter times. At present, different EVs are on the market that provide different battery capacity about 20kWh (Nissan) or 85 kWh (Tesla Motors). DC fast chargers – also called hyper charger– has scale from 250 KW to 1MW and those has the highest energy density in its class. Fast chargers are designed to provide fleets of any sizes, in general mass transit vehicles. This makes DC fast chargers more efficient and practical for governments and companies.

BATTERY SWAPPING

For this technology first the EV must be designed for "easy swap" of batteries such as Better Place, Tesla Motors, and Mitsubishi Heavy Industries. Some companies use different battery switching technology to extent EVs driving range. The driver does not own the battery in the car, transferring costs over the battery, battery life, maintenance, capital cost, quality, technology, and warranty to the battery switch station company. Moreover, for battery swapping system, ownership of the battery belongs to company of swapping station and this enables decrease in cost of EVs manufacturing up to %45. Swapping stations also give hope to establish more advanced connection with smart grid system and being partner of more sustainable energy system in a profitable case. However, electric vehicle manufacturers that are working on battery switch technology have not standardized on battery access, attachment, dimension, location, or type.

WIRELESS POWER TRANSFER

With increased coil distances, reduced electromagnetic inference risks and more compact geometrical dimensions in wireless charging (also known inductive charging) systems following the

CHARGING TIME FOR 100 KM	POWER SUPPLY	VOLTAGE	MAX CURRENT
6-8 hours	Single phase - 3.3 kW	230 VAC	16 A
3-4 hours	Single phase - 7kW	230 VAC	32 A
2-3 hours	Three phase -10 kW	400 VAC	16 A
1-2 hours	Three phase - 22 kW	400 VAC	32 A
20-30 minutes	Three phase - 43 kW	400 VAC	63 A
20-30 minutes	Direct current - 50 kW	400-500 VDC	100-125 A
10 minutes	Direct current - 120 kW	300-500 VDC	300-350 A

principle of inductive resonant energy transfer can achieve the best energy transfer rates and efficiency rates. Wireless charging offers many advantages at present and some products have already started to be manufactured. Using wireless charging system for known routes such as bus stations and possibility of in-motion charging technology are promising areas for the future of this technology.

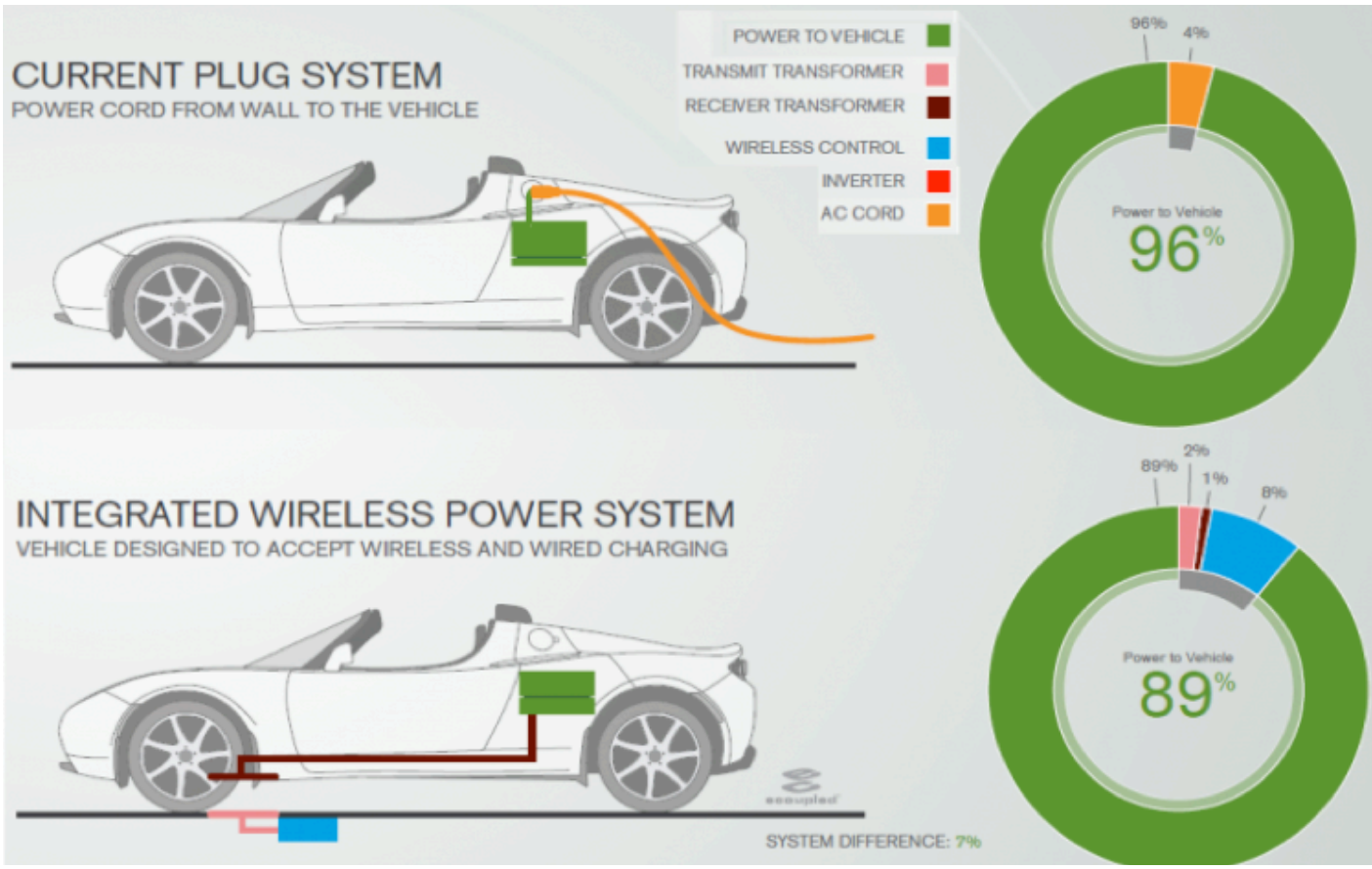
SMART GRID COMMUNICATION

Recharging a large battery pack presents a high load on the electrical grid, but this can be scheduled for periods of reduced load or reduced electricity costs. In order to schedule the recharging, either the charging station or the vehicle can communicate with the smart grid. Some EVs allow the vehicle operator to control recharging through a web interface or smartphone app. Furthermore, in a Vehicle-to-grid scenario the vehicle battery can supply energy to the grid at periods of peak demand.

Charging stations are not just AC-to-DC transformer but also communication centers between smart electricity grid and smart cars with high capacity batteries.

SOFTWARE

Mobile smart phone applications are becoming a standard feature of electric cars and EV charging. Multiple competing apps are available to find charging stations, monitor charging, activate public chargers, and share access to private chargers and to perform a host of remote functions for the vehicle itself. With smart grid technology and the effect of Internet of Things on EVs, future of charging stations seems to make advanced software needs inevitable. >>



MATERIAL AND HUMAN RESOURCES

The biggest thing that impede the built out of a strong charging station network is high cost of equipment and installation. The main categories of charging station can be listed as; actual charging station hardware; other hardware and materials; electrician and other labor; mobilization; and permitting. You can see the shares of these categories on figures below.

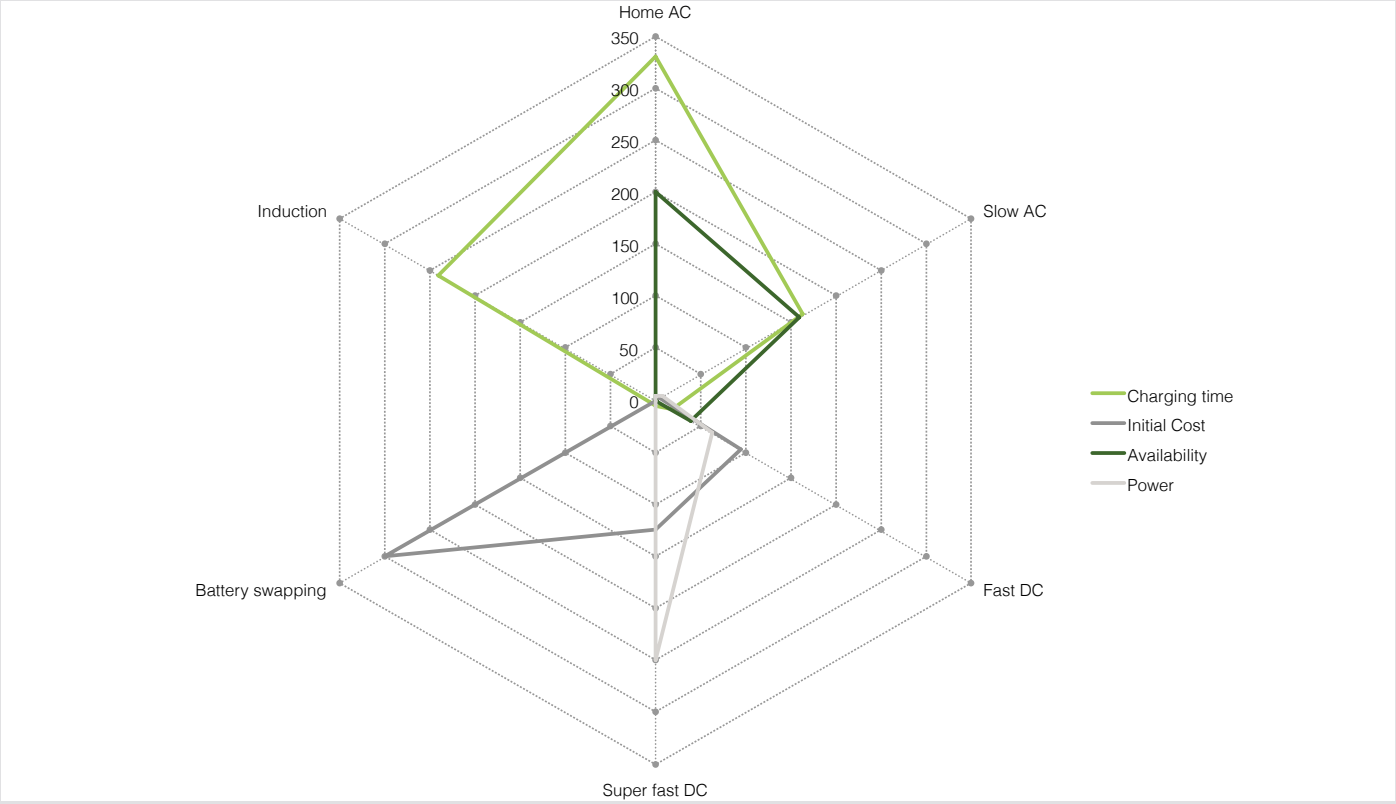
As it is seen hardware costs and labor costs are biggest part of total cost of charging station. Hardware costs need to be decreased especially fast DC charging station. It is very important especially charging speed is considered. Highly skilled labor cost is also important in human resource perspective.

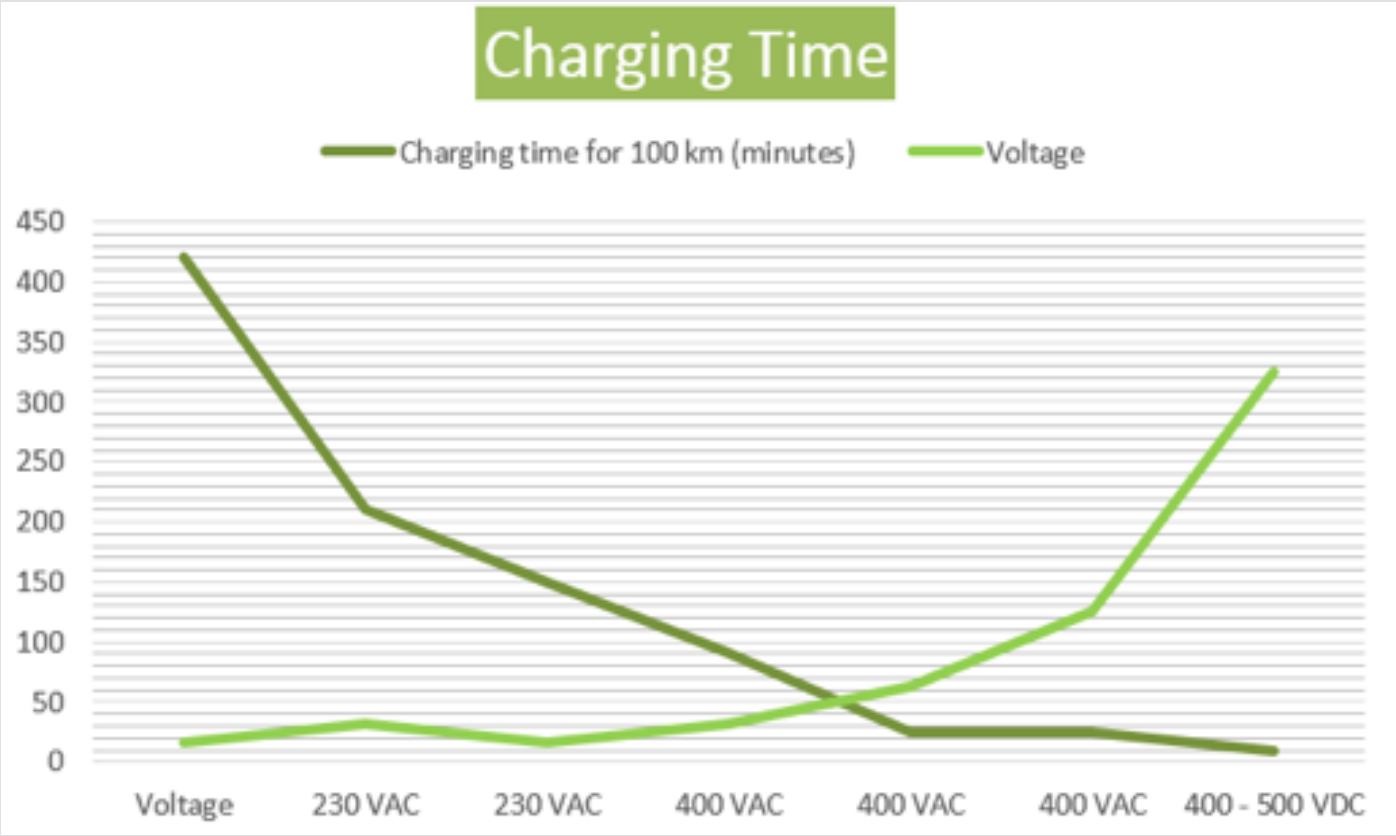
CHARGING SPEED

Charging speed is the key factor for EVs market. It becomes better every new technological advancements in charging stations. Yet, fast DC chargers are very expensive at present. Latest EVs battery capacities are good enough compared with desired all-electric range according to researches. (Look at California case study) Only disadvantage of EVs in this case is charging speed in the case of present technology. When fast DC charging network become as advanced as gasoline station network, EVs can have same travel range (When most advanced EVs battery electric range at present considered) and refueling/charging capabilities. When wireless and swapping technology considered in same way, charging of EVs can be more advanced compared with gasoline vehicles in all cases.

MAINTENANCE

Maintenance of EVs chargers is part of EVs maintenance in most cases of producers. Modern gasoline cars involves high number of big and small parts and this situation getting worse due to vehicles' increasing complexity. This situation attracts high cost of labor for maintenance. Electric vehicles are no exception to this problem; however, they are still much cheaper to maintain due to their inherent simplicity. Maintenance of charging stations requires diverse process according to type of station. •


Home AC
350
300
250
200
150
100
50
0
Slow AC
Fast DC
Super fast DC
Battery swapping
Induction
Charging time
Initial Cost
Availability
Power


Charging Time
Charging time for 100 km (minutes)
Voltage
450
400
350
300
250
200
150
100
50
0
Voltage
230 VAC
230 VAC
400 VAC
400 VAC
400 VAC
400 - 500 VDC

Architecture & Zoning

DIFFERENT CHARGING STATIONS FOR DIFFERENT USE

In the part about technology, many charging systems were introduced. Eventually, because their different technical characteristics has an impact of the potential use, they can be classified in roughly 3 categories. The level 1 charging station works on AC voltage, and is the cheapest type of charger. It requires a lot of time to charge (generally 8 hours or more). As a consequence, it is deployed only at home, or possibly at work, to charge the electric vehicle overnight or during the working day. The Level 2 charger has a lower charging time, around 4 hours for full charge. It can be used in each place where the electric vehicle owner will stay a limited but not too short amount of time, for instance in front of a cinema. The last type is the level 3, working on DC. It is currently far more expensive, and it is expected to charge the car's battery up to 80% in 30 minutes.

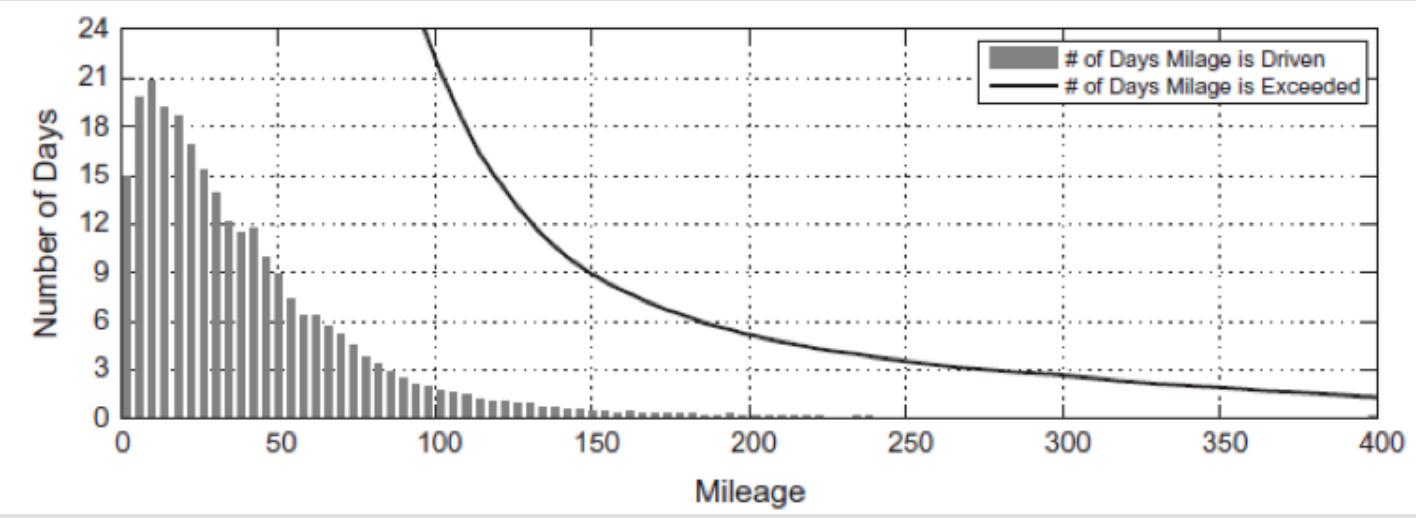
THE POSSIBLE PLACES TO DEPLOY A CHARGING STATION

The main possible places for the charging stations are of 4 categories. First, it could be installed at home, in a garage. It allows the user to charge it every night when coming home, until the time he leaves the house. The trend for this kind of system is, as it is briefly introduced in the chapter about technology, to connect the charging station to the grid, in order to optimize the charging and de-charging of the car. On electricity price peak hours, energy from the car's battery can be sold to the grid; on off-peak hours, the charging of the car at a lower price takes place. The second category is at the office parking spots. It is the second place people spend most time in. The duration of work allows to install level 1 or level 2 charging station. Third, it could be positioned in the public or private parking areas in cities. Generally, a faster charger is required because the car will not stay parked more than 2 hours in general. Lastly, some charging stations need to be places in highways rest areas. In this case, the charging should be as fast as possible, so a level 3 charging station is recommended.

THE INTEGRATION OF THE CHARGING STATION IN THE ENVIRONMENT

Charging stations need to fit in the current environment, whether it is in private areas, or public areas. At this time, many rules about the design of such charging stations have been

The range anxiety is the fear of running out of power when driving an electric vehicle most of the daily commuting is possible without the need to charge an electric vehicle during the day



implemented; they specify the required size, the security of the charging stations, and the minimum number of charging stations in an area. These regulations are more mature in Europe and the US, and we will consider here the US regulations. Although many of these rules are local and depend on the city, we can find the same characteristics.

Firstly, the parking spot requires a bigger size than regular parking places. Indeed, we need to take into account the place required to install the charging station, as well as the place to enable the user

3 LEVELS OF CHARGING

to operate it. Some parking structures provide opportunities for a more practical and cost effective design.

Then, the security with respect to environmental hazards should be guaranteed. For example, the chargers cannot be installed in flooding areas. What's more, most of the charging station companies want to connect the system through modems to the Internet, to be able to give real-time information about the charger, e.g. whether it's free or not, payment etc. In some places like parking spots in basement, it will be a challenge to guarantee a good network.

When choosing a place to put the charging station, one need also to take into account the need to connect it to an electrical source. It could be an independent source such as solar panels, but it can also be the public electricity network. In this fashion, the need to trench into the ground to connect the charging stations is also an issue in parking areas.

THE RANGE ANXIETY EFFECT

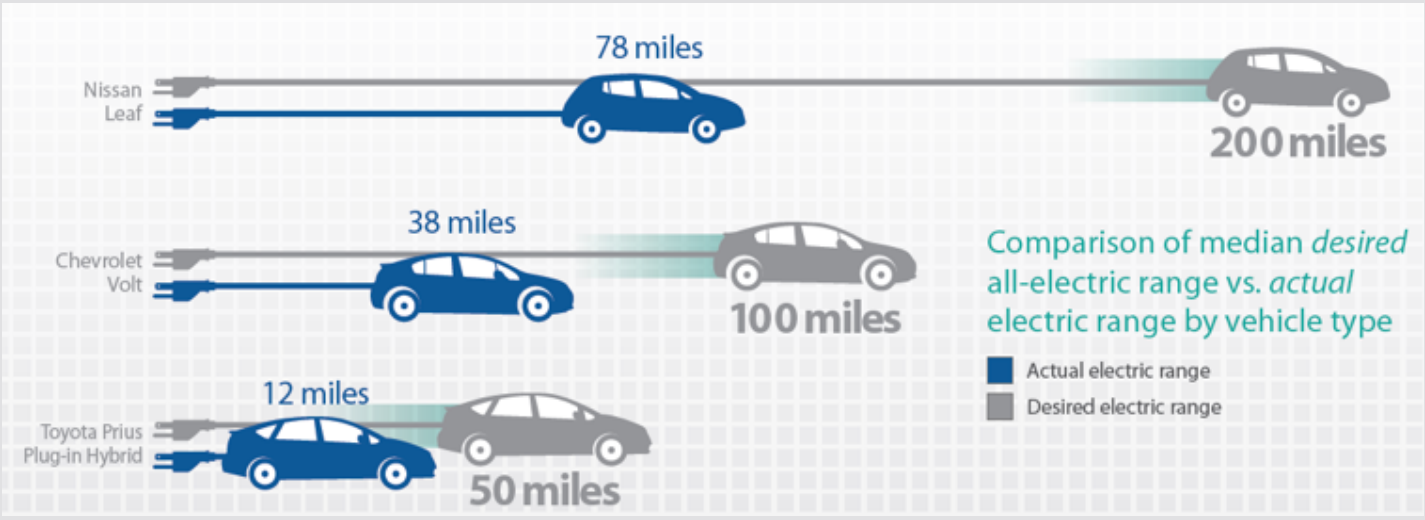
One of the main issue that the charging station need to solve is the range anxiety. According to the paper a study of electric vehicle charging patterns and range anxiety, it is defined as the fear of running out of power when driving an electric vehicle. Many researches have been conducted to see what the average distance a vehicle moves every way. For example, the study entitled Electric vehicles: How much range is required for a day's driving has shown that for 95% of the days, the mileage does not exceed 100 miles, which makes most of the daily commuting possible without the need to charge an electric vehicle during the day (only at night at home is enough).

95% OF DAYS <100 MILES

Yet, many people today refuse to use electric vehicles because they fear they will run out of battery. They do not want to buy an electric car unless the vehicle has a very good range. For instance, 60% of German respondents want an EV to have more than 320km driving range (about the range of a regular car) before they would consider a purchase (Giffi et al.,2011).

The average daily mileage in Germany is only 39 miles

This range anxiety effect is of paramount importance to provoke the shift from aversions for electric vehicles to a boom in the market. But it also reveals that, even if many charging stations are added in public areas in the cities, they will not necessarily be used a lot. •



Laws & Regulations

Considering the matter of charging stations for EVs, the current situation is a bit blurred. In fact, since the market is still new, and covers new areas in term of technology, the rules are made along the way.

The governments and international organizations are adapting the existing rules to the technologies used, however, most of the future methods and rules are intrinsically established by the research and companies that build the new EVs.
A few organisms have adapted rules and started to create new ones for the EV charging stations: National Electrical Code in the US; Centre National du Transport Avancé (CNTA) in Canada; International Electrotechnical Commission; European Environment Grenelle in the EU.
Companies and Societies are imposing standards and rules by having the monopoly on the leading-edge technology: Combo alliance in Europe, ChargePoint in the US; CHAdeMO in Japan (Tokyo Electric Power Company, Nissan, Mitsubishi and Fuji Heavy Industries).

REGULATIONS NEEDED & CURRENT DISCUSSIONS

Among all actions aiming at managing the development of the charging stations network, the call for international - or at least European - standardization of charging infrastructures and technologies with open communication standards (including smart grids) should be highlighted.
The currently received purchase premiums compared to internal combustion engines are widely being discussed and a multitude of different policy schemes to foster EV adoption is being evaluated.
In addition to technological developments and policy measures, regulatory issues related to investment and deployment of the required infrastructure need to be formulated and adequately solved.

Furthermore, there is a need for discussing how and which agents should be authorized to provide EV charging and pricing of those services, as well as how EV storage capability could be appropriately marketed to provide vehicle-to-grid (V2G) services. Therefore, still many questions remain to be answered to create a consistent regulatory framework considering rules and players in existing electricity markets.

As of 2015, there is not yet one fixed standard for electric car charging

As an example of these issues, in California, the Public Utilities Commission has opened a rule making process, in which a number of issues are proposed for consultation with stakeholders. It is yet to be determined, in this specific case, how to implement obligatory variable tariffs, legal status of electricity resellers, incentive creation for users to adopt remote charge control of valuable batteries, and the allocation and recovery of investment in infrastructure in a fair non-discriminatory framework. Furthermore, there exists an intense discussion about critical measuring policies in terms of measuring arrangements (single, sub-and separate measuring) and their implications on cost, installation time, and billing flexibility.

MAIN TOPICS	Regulated Factors
Safety standards (see Reference 1)	Voltages, Wiring Methods (unintentional dis-connection, polarization, installation, …), Equipment construction (Cables, Interlock, Markings, Automatic de-energization, …), Control and protection, etc.
Design standards (Reference 2)	Conductive technology (electricity transmitted through conductors) for all charging stations. Conductive stations' connectors are covered by SAE Standard J1772 (another standard for conductive DC fast charging stations is CHAdeMO's).
Voltage Supply	Voltages must match the existing power outlets, and also be able to be implemented in new systems and grids to come.
Framework	Agents, Grid connection and charging installations, metering, communication and control, EV charging modes, coordination between EVCs and EMC (see Reference 3)

Case Studies

As there is no better way to study the practical application of the afore discussed factors, we have included an analysis of several projects related to the development of the electric vehicle market.

The first two studies will give an qualitive analyis of the current situation in a European and American country.

1. As of the moment of writing, the state of California in the United States of Americ is considered the largest EV market. Why has this state managed to enroll the EV market so successfully while the rest of the US is lagging behind?
2. Possibily quite surprising could be that Estonia is the only country at this moment that has country-wide charging coverage on a fast-charging network. The case study explains more on how this influences electric driving in this small Northern-European state.

The latter three of the case studies analyze non-governmental entities. Included are an analysis of ChargePoint, a successful electric charging county, BetterPlace, a promising start-up that failed hopelessly and CHAdeMo, an organization of electric car manufacturing and charging companies.

3. ChargePoint started as a US-based company that provides electric charging services. This analysis shows how a company can become successful in this industry.
4. BetterPlace was deemed the start-up of the century when Shai Agassi launched his funding campaign. However, two years ago the company had to file for bankruptcy. What went wrong?
5. CHAdeMo is an organization orginating from the need of standardization in the electric car and charging industry. There need for standardization arose from the need to prevent new technologies becoming obsolete and to ensure consumers that the systems in their newly bought cars would not phase out within just a couple of years.`

Our 2011 financial performance was significantly better than industry averages in most categories

Case Study California

The fleet of plug-in electric vehicles in the United States is the largest in the world with a 43% share of all global sales as of September 2014. And with 40% of all EV sales in the US, California is counted as the largest market around the globe.

When considered from this point of view, California can deliver us great amount of valuable information about EVs and EVs charging station market.

MARKET

With 23% of Volt sales California is the leading Volt market during the second quarter of 2012. The leading regional markets in California State were San Francisco, Los Angeles, and San Diego. In addition with 50% of its total sales Tesla Model S.6, Tesla Motors reported that in March 2013 California is the largest American market as delivery of 30,000 in the U.S.
With regard to goal of 1.5 million zero-emission vehicles (ZEVs) in California by 2025, pointed out by Governor of California, Jerry Brown California seems eager for a sustainable energy market.

CHARGING STATIONS

The market situation is not just a pushing factor for EVs charging infrastructure but also result of strong infrastructure. These two develop by interlink to each other. "As of March 2013, the United States had 5,678 charging stations across the country, led by California with 1,207 stations (21.3%). As for retailers, Walgreens is by far the plug-in friendliest, with 365 stores deploying plug-in stations nationally. 55 Kohl's stores had public stations as of March 22, while Whole Foods was home to 39 stations."

INCENTIVES

California has been leader in the promotion of EVs as the state has several financial and non-financial incentives in place. In addition to the existing tax incentives, EVs are promoted with the Clean Vehicle Rebate Project (CVRP). Clean air stickers that allows the vehicle with a single occupant in high-occupancy vehicle lanes (HOV) can be used in EVs. With regard to 59% of EVs buyers define it is extremely or very important motivator, California's incentives covers many aspects.

The California Air Resources Board (CARB) was mandated by a package of law signed by Governor Brown to provide extra credit for low income residents who want to buy EVs. They will also assist in the installation of charging stations in apartment buildings in which only 4% of EVs users live. Even though, Clean Vehicle Rebate Project does not cover all EVs sold in California because not every EV owner applies for the rebate, as of 10 March 2014, a total of 52,264 clean vehicle rebates have been issued, for a total of US$110,222,866 disbursed, with only US$3.8 million remaining for fiscal year 2013-2014.

CUSTOMERS SURVEY REPORT

Center for Sustainable Energy's (CSE) manages long term collaborative EVs owner surveys for last few years and provides significant data for all market related companies.

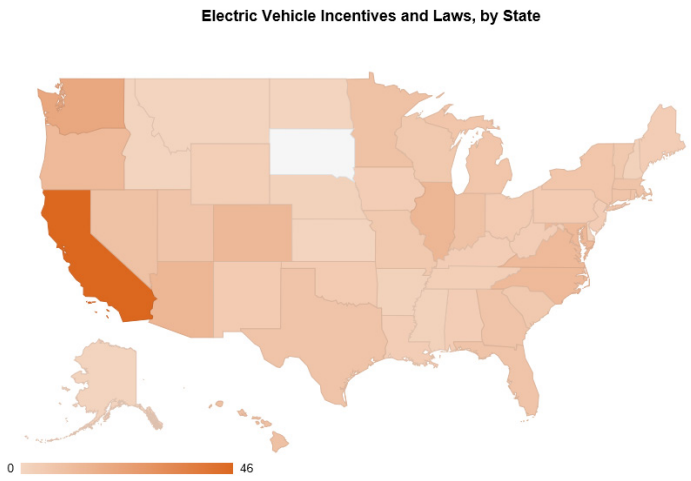
Highlights from the survey include:

- Chevy Volt-driving respondents are more than four times as likely to have a level 2 charging station installed at their home than Toyota Prius Plug-In respondents.
- Workplace charging availability is becoming more widespread, 46% of respondents reported access to workplace charging, an increase of 14% from March 2012.
- Of those with access to workplace charging, 74% have access to this charging at no cost to the driver, down from 89% in March 2012.
- Though low, driver satisfaction with public charging infrastructure continues to improve, rising from 17% in March 2012 to 29% in May 2013.
- The CVRP rebate was as an important motivating factor in the purchase decision for 95% of respondents.
- For occasional public charging outside the home, two-thirds of respondents reported a willingness to pay up to $1.00 per hour with less than one-third willing to pay $1.50 per hour.
- For daily charging outside the home, only 16% of respondents expressed a willingness to pay up to $1.25 per

PROBLEMS & SOLUTIONS

California EVs market has not been smooth, however, the fact that EVs sales dip in the second half of 2014. As decreasing price of gasoline cars for some reasons, it is expected that trend of EVs sales worsen in 2015 not just in California but all around the U.S. Tam Hunt , listed out some important points to solve this problem. Significance of these points can be referenced as methods to develop EVs market around the globe.

1. Expedite approval of utility applications to build out the EV charging infrastructure rapidly
2. Dramatically expand education and outreach efforts by working with nonprofit educational organizations
3. Create a tariff that allows EV owners to earn money by absorbing excess solar power during peak production times
4. Improve the state rebate process
5. Increase the state gas tax and funnel receipts back into rebates for EVs



"AT THIS TIME, WITH EV SALES DIPPING DANGEROUSLY, IT IS NEEDED TO CONSIDER ALL THE OPTIONS FOR GETTING SALES BACK ON TRACK." SAYS TAM HUNT

Estonia Case Study

Most of country's official priorities are the reduction of the negative effects of energy usage on the environment, the promotion of resource effciency with sustainable consumption and production patterns and the reduction of CO2 and other pollutants.

Estonia is a good example of a country which is trying to achieve these goals through electric mobility development Estonia may not be the first country that comes to mind when you think of electric cars, but the small Eastern European nation was actually the first country in the world to install a nationwide network of electric vehicle fast-chargers .By the beginning of 2013,165 fast-chargers have been installed around the country for the comfort of EV users.This report intends to provide a fact-based perspective on the status and current developments of the electrical car charging stations in Estonia.

BACKGROUND

According to the Kyoto Protocol, Estonia had to reduce its greenhouse gases emissions by 8 % in comparison with its 1990 level between 2008 and 2012. Estonia is participating in two Kyoto flexible mechanisms – international emissions trading and joint implementation. In March 2011, the Government of the Republic of Estonia concluded a contract with Mitsubishi Corporation for the sale of AAUs in the amount of 10 million AAUs to start the Estonian electrical mobility program. The program consists of three parts: 507 Mitsubishi iMiev electric cars were commissioned by the Ministry of Social Affairs as an example,. Distribution of the purchase grant and the administration of the quick charging network is organized by Foundation KredEx.

ELECTRICAL VEHICLES IN ESTONIA

As Demo experience, the Ministry of Social Affairs took 507 Mitsubishi i-MiEV electric cars into use in 2011, that's the largest single order Mitsubishi has ever received for its little car.Estonia electrical vehicle market is very small due to Estonia's small population which is 1.34 million, but look like most other markets Nissan Leaf is the favorite electrical car for individual buyer in Estonia. Electrical Vehicle Charging infrastructure

ELECTRICAL VEHICLE CHARGING INFRASTRUCTURE

Estonia has become the world's first country to launch a nationwide fast-charging network for electric vehicles. The EV fast-charging network is operated by a national foundation KredEx, the chargers were produced and installed by a technology company ABB, the innovative payment solution was designed by NOW Innovations, and customer support is provided by a security company G4S.

Fast-charging points are distributed at all roads with dense traffic are covered,the distance between quick charging points is 40-60 km Suitable and frequently visited places are considered as locations for quick charging stations, e.g. petrol stations, cafes, shops, etc, and all settlements with over 5000 inhabitants.

ABB's fast charging station they conform to the CHAdeMO standard, and each features a 50 kW DC and a 22 kW AC outlet.

The car's battery can be charged up to 90% in less than 30 minutes and – depending on the model – you will be able to drive for up to 140 km

EV CHARGING PAYMENT SUPPORT

Fast-charging network users are offered three service

packages to choose from: Combined package, Flex package, Volume Package. Payments can be made using an authorized card (RFID card) or mobile phone. The uniform payment solution can encourage the growth in number of EVs users.

IMPROVING EV'S USER ADOPTION

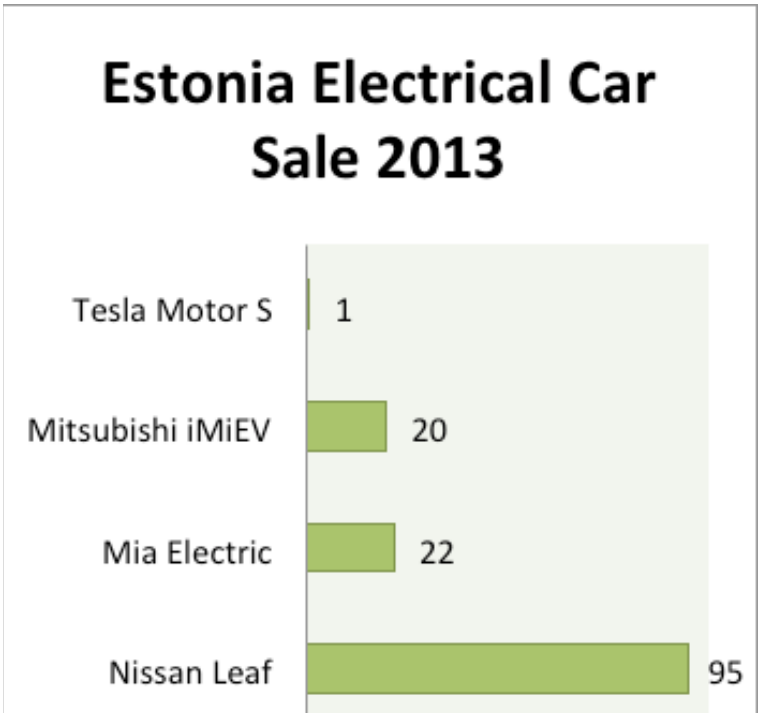
ELMO program by offering rental service to Estonian is seeking for improving EV adoption rate in Estonia. 18 Nissan Leafs and 6 Mitsubishi iMiEVs are available for rental from outlets in Tallinn and Tartu. the rental just cost 8-10 Euros to rent an EV in Tallinn and user just need to use a Smartphone application or call a number to unlock a car.

GOVERNMENT EV INCENTIVES

Besides having a public fast-charging network, Estonia promotes a quicker deployment of EVs by providing direct support to both private persons and companies, with the amount reaching up to 18,000 Euros of the all-electric car's purchasing price. Also, new EV owners can apply for a support of 1,000 Euros for setting up a charging system at their home.

PROBLEMS AND SOLUTIONS

1- Estonia use Oil shale for generating electricity which is not environment friendly. Estonia needs to switch to other energy sources.
2- Most of Estonian still have range anxiety and worry about EV reliability, there should be a nationwide education plan for improving EV adoption between Estonian
3- Harsh winter can effect on the EV battery function and operation, battery manufacturer needs to produce suitable battery for cold winter in Estonia.
4- there si not enough EV model diversity in Estonia, one reason can be there is not any supercharger for some electrical cars like Tesla which take longer time than other EVs.



Case study ChargePoint

Founded in 2007, ChargePoint, formerly Coulomb Technologies (CT), is an electric vehicle infrastructure company based in Campbell, CA. CT's aim was to offer chargepoint networked charging stations that includes: public charging station, a consumer subscription plan and utility grid management technology for electric utility companies to smooth electrical demands on the grid

In January 2009, the company's first charging stations were deployed in downtown San Jose that drivers can access through a prepaid plan.

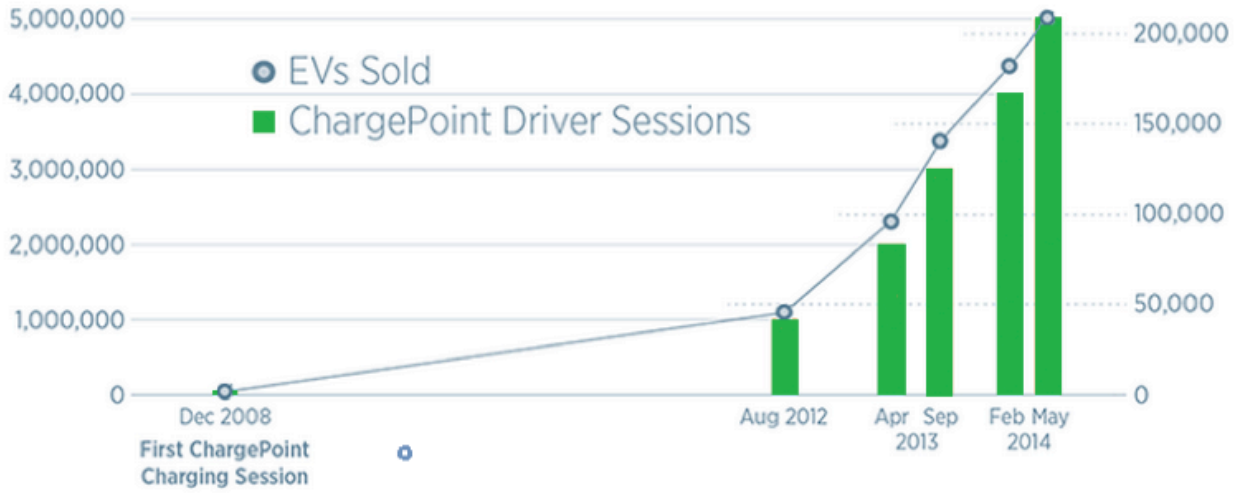
EXPANSION

ChargePoint currently is the largest and most open electric vehicle (EV) charging network in the world, with more than 19,000 charging locations and a 70% + market share. Since its first charging station installation, Coulomb charging stations have been present in more than 27 US states, Canada and Europe.

Ranked #1 by leading independent research firm (Navigant Research), ChargePoint makes advanced hardware and best-in-class cloud based software. The company also launched a $100 million lease financing fund with partner Key Equipment Finance that's meant to jump-start the spread of public charging infrastructure. In America, the ChargePoint America project sees 1,800 240-volt charge stations being built. Sponsored by Coulomb Technologies, the $37 million project is backed by a $15 million DOE grant, provided through the Recovery Act. ChargePoint America has provided 4,600 networked charging stations to homes and public locations (October 2011), adding to the existing ChargePoint Network. The ChargePoint America project will collect data on vehicle use and charging patterns, which will be analyzed by DOE's Idaho National Laboratory. It has announced its expansion into Europe, the Middle East and Africa with the opening of Coulomb's European headquarters represented by 365 Energy Group, a venture of Estag Capital AG, in Berlin, Germany. Coulomb Technologies' ChargePoint public charging stations are also already in Australia.

TODAY

ChargePoint currently consists in three main products: ChargePoint Home (level 1) - CT4000 family of charging stations (level 2 – 25 RPH) - ChargePoint Express 200 (Fast Charging – 200 RPH)
This three types of charging stations enable the ChargePoint company to aim at the entire EV market. ChargePoint targets companies and individuals to sell these charging stations. Manufacturing and R&D are actually let to "suppliers". This strategy lead them to partner up with many companies, including car industries, electricity suppliers
Another main aspect of their strategy is the focus on customer services. The ChargePoint mobile app gives real-time network information (including the avail-



ability of charging locations throughout the nation). ChargePoint Assure (insurance) covers all ChargePoint stations (one year parts and on-site labor warranty). All maintenance operations are covered by the ChargePoint Station Management (and done by a partner company, often selected among select national operations & maintenance firms). Finally, every aspect of policy, pricing, management, and reporting on a daily basis can be controlled via the ChargePoint Cloud Services. For example, through their ChargePoint account, drivers can keep track of their favorite charging spots and personal data, like how much money they are saving and their shrinking carbon footprint.

But ChargePoint has other advantages that lead customer to choose their services: More charging locations than any other company (20,000+ charging spots and counting). Its charging stations are easy to find (with the mobile app and real-time data). All car models work on ChargePoint charging stations (e.g. CHAdeMO-compatible cars, SAE Combo-compatible cars). Plus, with ChargePoint Express locations, DC fast charging, long road trips are easy. Last, but not least, ChargePoint Home: the world's most advanced EV charging station for the home, also connected with public charging.

With a dozen patents since 2013, ChargePoint is obviously leader in innovation. Its strategy is to create, in order to maintain the competitive advantage they have over the competition. Indeed, doing so, they remain the leading company in the US on charging stations, and are the one company people turn to, as long as they keep the lead in innovation and creativity.

CONCLUSION

ChargePoint is currently the obvious leader of the American market for charging stations. They arrived early on the market, and have controlled it since by keeping on creating, innovating, and proposing new services. Today, they are the one company people turn to when it comes to charging stations.

In order to create the right products, they have chosen to team up with many very successful companies, that ally quality and innovation - such as BMW, Mercedes, Volkswagen and Chevy - and are the worldwide most successful companies in their domain – e.g. Schneider Electric and Efacec. They thus use not only their partners' skills in innovation and manufacturing, but also their brand image, creating for themselves a name that combines all those qualities.

Another winning strategy was the use of many standards. ChargePoint stations are compatible with the CHAdeMo fast-charging standard, but also the UE-US Combo standard, and also include level 1 & 2 charging. Right now, they keep their options open, by making any EV user able to use one of their charging stations, and try hard not to exclude any user.

Today, they are starting a strategy of expansion, targeting the EU and Australia. Far away from the issues of the battle to come between CHAdeMO (Asia) and Combo (EU+US) standards (see page ??), since they create combined products, they will try to impose a model that has been successful in the US. Plus, apart from Estonia (that has most of the territory covered with charging stations – see page ??), the majority of European countries have big investments to make, in order to become EV-compatible. Which, if they want to eventually be sustainable, they probably will have to do.

Better Place What went wrong?

Better Place has been one of the most highly supported start-ups in history. The company, set up by Shai Agassi, managed to raise a whopping 750 million dollars among investors and was supported by the world's most influential leaders.

THE BEGINNING

The company and idea behind Better Place are the creation of the successful Israeli businessman Shai Agassi. Instead of buying expensive electric cars and batteries, Better Place would offer plans similar to phone plans. The customer would sign a contract for miles instead of minutes, being able to use the car without owning the battery and after a period of several years, the customer would have covered the cost of the car. For the price customers were used to paying for gas, they would now pay for the battery as well as the electricity needed to run it.
Besides being more environmentally friendly, going fully electric would also give countries and car owners the advantage of being less dependent on oil and the countries exporting it.

As a beta testing area Agassi would use Israel. Israel might seem to be a strange choice, but actually it has many advantages as a testing platform for the cars.
First, more than probably any other country in the world, Israel is attracted to the idea of being independent of its powerful oil-producing neighbours, many who are far from friendly regimes.
Second, because of the hostility of most of Israel's neighbours, Israelis can't drive beyond their country's borders. As the country is also very small, the maximum driving distance is very limited, making it relatively cheap and easy to cover the entire country with a charging grid.
Last, Israel is home to some of the most advanced technology development in the world. Who would be more capable to create a whole new smart-grid, managing millions of charging stations, than the country with the highest concentration of engineers and R&D spending in the world?

Agassi's mission, supported by Israel's influential former prime minister and noble prize winner Shimon Peres, seemed infallible. It was a win-win situation for the customers, the company as well as the entire country.
After an initial $130 million investment by Israel billionaire Idan Ofer, many were fast to follow. It didn't take Agassi long to raise the $200 million Ehud Olmert required, and he ended up raising nearly 4 times that amount.
After signing a Memorandum of Understanding (MOU) with Renault-Nissan, under the lead of Carlos Ghosn, to build the world's first Electric Recharge Grid Operator (ERGO) model for Israel, Better Place now had all factors in hands that it would need to make the mission a success: a car, a company and a country.

"Better Place was supposed to become the start-up of the century"

THE EXPANSION

Better Place's mission was vvvto sell over 100.000 cars in the first years after launch. Corresponding to half of the entire car market of Israel, this was a bold statement, but then so were the rest of Agassi's plans. How could this super ambitious, yet solid plan ever go wrong?

It was Agassi's ambition and untamable confidence that lead the company to be one of the most successful start-ups in history, but might also ultimately have been the reason why the company fell nearly as fast as it rose in the following years.
The more money he had to spend, the more possibilities Agassi had. The more possibilities arose, the more the company lost focus. Instead of using just Israel as a beta market, Better Place was concurrently exploring and rolling out systems in Denmark, the USA and Australia. At the same time it was researching market opportunities in Japan, China and Hawaii, and trying to keep its options open in many more countries.

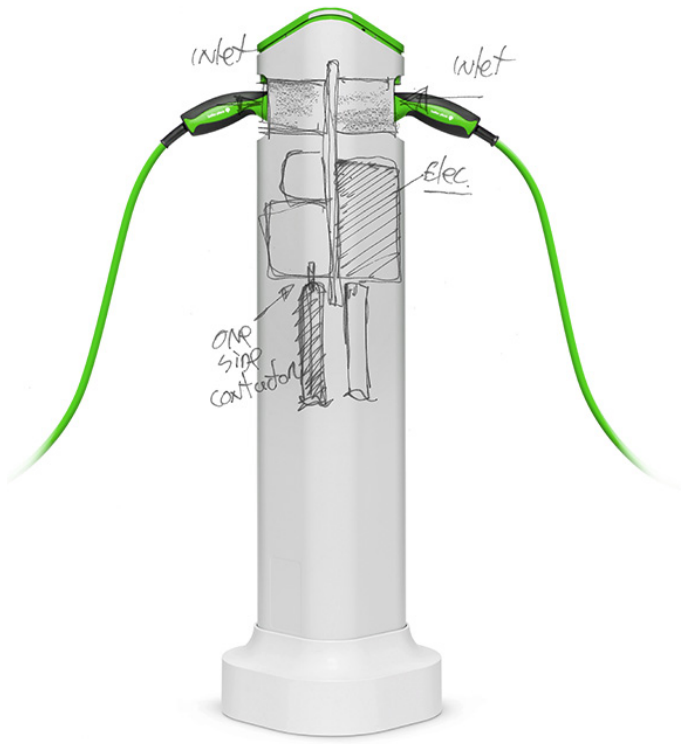
Besides the enormous amount of money it costs to have complete management systems in multiple countries, the management systems also lacked experts in either the automotive or infrastructure industry. Many of Better Place's top executives were former SAP employees. Better Place became one of the most desired companies to work at, and even though there was absolutely no need to invest in attracting new talent, the company still kept paying well above industry average. Driven by

the ambition to change the world and motivated by Agassi's unbelievable forecasts, the company seemed to lose its connection with reality.

With money not being a major issue, the company failed to make cost a priority in the design of the charging and battery swapping systems; at $2 million each, they were more than ten times the cost of for example Elon Musk's Tesla charging systems. The company spent over $60 million developing AutoOS, an operating and navigational system that TomTom already sells at the much more economic price of $29.99. Money wasn't even saved in the office space. With offices around the world, the company spent over $7 million a year on travel expenses and the main US office allegedly boasted Coke Zero and Nature Valley granola bars.

If business would have gone as predicted, selling 100.000 cars in the first period, all might have been well in the end. However, the company ended up only selling 1.400. Even though no compromises were made to make the swapping stations as modern and user friendly as possible, this can hardly be said for the cars Better Place offered. By only selling one, very dull model of sedan, for which the company had a partnership with Renault, Better Place failed to reach the party that was to ultimately use and pay for their network.
Without the batteries, which were owned by Better Place and have been sold off after the company's bankruptcy, the cars, which already looked outdated when they rolled off the line, have become completely worthless.

The very disappointing sales numbers and exorbitantly high operating costs of over $500.000 a day, were not the only challenges faced by Better Place in unrolling their countrywide network. Local authorities, whose permission was needed to build battery-switching stations, put up unexpected roadblocks, slowing progress, company officials said. And when employers provide the cars to their workers, which is a common practice in Israel, the workers pay a usage tax that reflects the full value of the car, including the battery, undermining Better Place's effort to drive down costs.



THE CONCLUSION

All in all, from this case we learn that even when backed with extreme amounts of investment, an ambitious project will fail when not managed well. Being a very capital intensive industry, one cannot permit oneself to have any unnecessary costs. Unfocused expansion and unnecessary overhead costs and the will to develop and keep everything but the car in-house lead Better Place to be a money-devouring monster. By promising the future and failing to deliver more than an outdated Renault sedan for an incomplete charging network, the company lost not only their own credibility, but might have seriously damaged any future initiatives for an extensive charging grid. Better Place and Shai Agassi may have very successfully sold the dream of the future to its investors, but failed to make it come true for the large public.

CHAdeMo

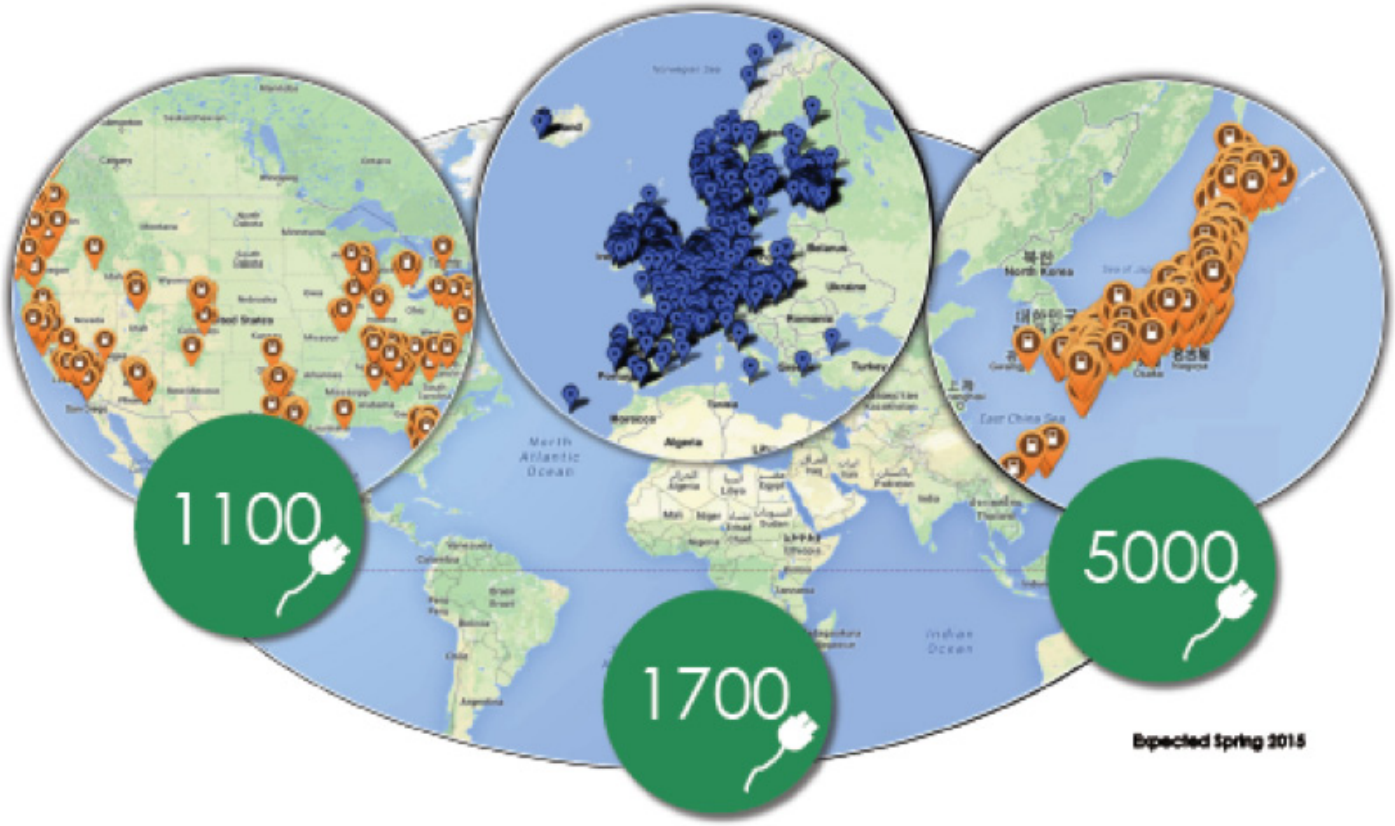
CHAdeMO should get ready for the war to come on the standardization of the fast charging station. Originally leading in the domain, its position could be endangered by other standards. What makes this giant having feet of clay?

CHAdeMO is an association promoting a standard for the DC fast-charging station. Its aims at establishing a dense network of fast-charging stations worldwide, because it considers that this is the only way to overcome the range anxiety effect, the fear of drivers to run out of battery in a desert without charging stations. With a technology permitting to charge every electric vehicle up to 80% of its battery capacity in 30 minutes, CHAdeMO recommends, according to the Japanese origin of its name, to drink a cup of tea meantime.

Consisting today of more than 341 companies from more than 38 countries, its early development was relatively fast. Indeed, this champion was originally a consortium of all the best Japanese industries that could have a role to play in the electric vehicle industry: TEPCO, which was the first to start a R&D program on charging stations in 2005; but also automotive companies like Toyota and Nissan, as well as battery and energy companies. Together, these companies founded the association in 2009. At the end of 2010, the first electric vehicle compatible with the standard was launched in the market: the Nissan Leaf.

Quickly, things accelerated. Backed by the Japanese government, which gave subsidies for R&D for the companies, a dense network of charging stations emerged in Japan; after that came the turn of Europe and the United States to electric charging. Nowadays, more than 7,000 CHAdeMO charging stations are connected to the grid. The sale of electric vehicles compatible to CHAdeMO standard has also risen sharply: between 2010 and 2014, 368,000 electrical vehicles were sold, among them 80% are fast chargeable. 50% of the electric vehicle car market is compatible with CHAdeMO standard.

At the same time, CHAdeMO companies share their resources to impose their standard on the market, gathering security issues, a maximal voltage of 50kW, and communication channels between the battery and the charger. The technology is still flexible to adapt to the rapid changes in the market. The specifications are improved every year through various workshops. Nowadays, many car manufacturers produce cars that can use CHAdeMO plug. These efforts finally resulted in the recognition of CHAdeMO as an international and a European standard. Its recognition as an official standard is a great advantage

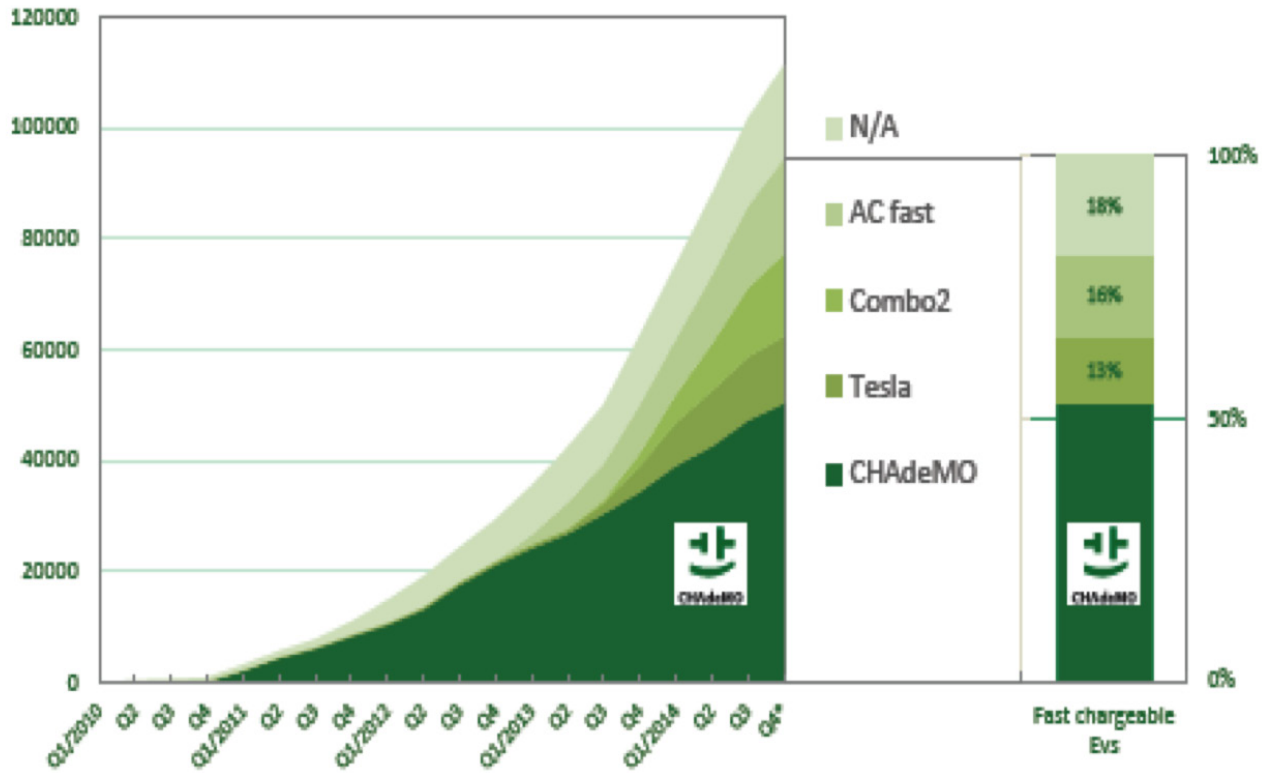


for all the companies participating in the CHAdeMO association: they get a guarantee that their technology will be used in the following years. Instead of fighting to impose their standard, which would be a barrier to the rapid development of the market, they need to convince the consumer in terms of technical performance and price. With the obstacles to the competition being alleviated, the race for innovation is very fierce: more than 50 companies actually manufacture different DC charging stations with the standard CHAdeMO, and the technology is improving at a fast pace. The company Fuji recently launched a low cost charger: by lowering the voltage to 20kW, it makes the usage price go down with an increase in charging time of less than 7 extra minutes. Inevitably, this will pull the prices in the market down.

>50 DIFFERENT CHADEMO CHARGERS

Western car manufacturers, outpaced in this first round, tried to win the second one by establishing their own competitive standard, Combo. Developed by the biggest automotive manufacturers, such as BMW, Volkswagen, or General Motors, this initiative is an attempt to catch up the lost time against the Japanese corporations. Although there are still only a few cars compatible with Combo charger, Combo managed to be certified as a standard in the US and in Europe. What's more, all public DC fast charging station in Europe should necessarily be equipped with a Combo plug from 2017, something which is not the case for CHAdeMO.

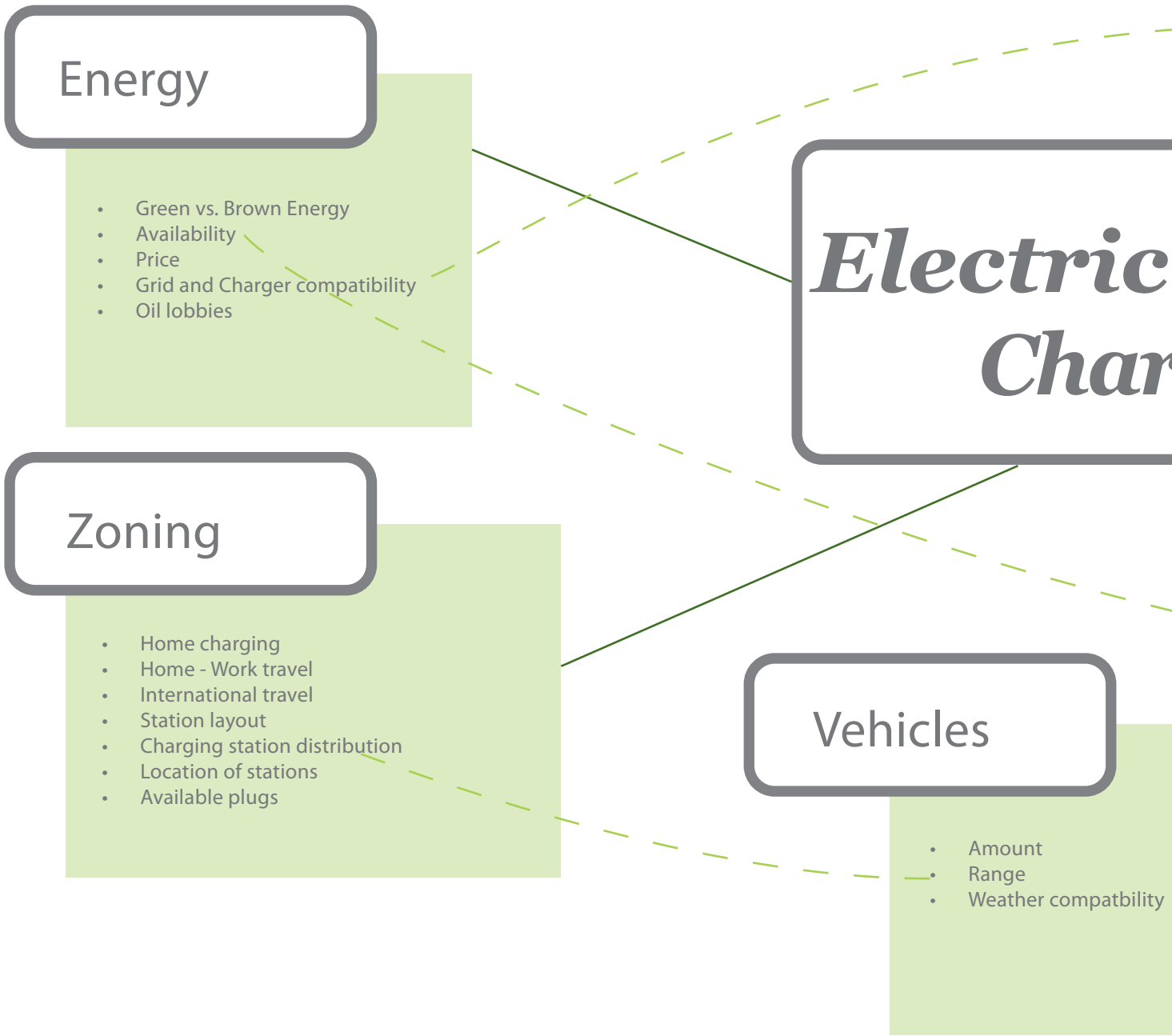
Still, due to the fact that many components are common between the two standards, many European manufacturers have responded by proposing two plugs in their charging station: one Combo, and one CHAdeMO, with an extra cost of less than 5 to 10% of the total charger price. Consequently, every major stakeholder in the European electric vehicle market finds its own interest: the companies following one of the two standards because they will be well represented in the charger network; the European Union because of the healthy competition environment it managed to provide to the electric vehicle market by permitting the two standards to coexist; and the consumer that can buy an electric vehicle without the fear that the standard they chose will be out of the market the next year. Thanks to the massive presence of CHAdeMO in the market, both in terms of already existing infrastructure and the wide range of compatible cars, it can not be ignored and has still an important role to play. But will we be able to come to the same conclusion in 10 years? When the biggest Western manufacturers have caught up and proposed competitive

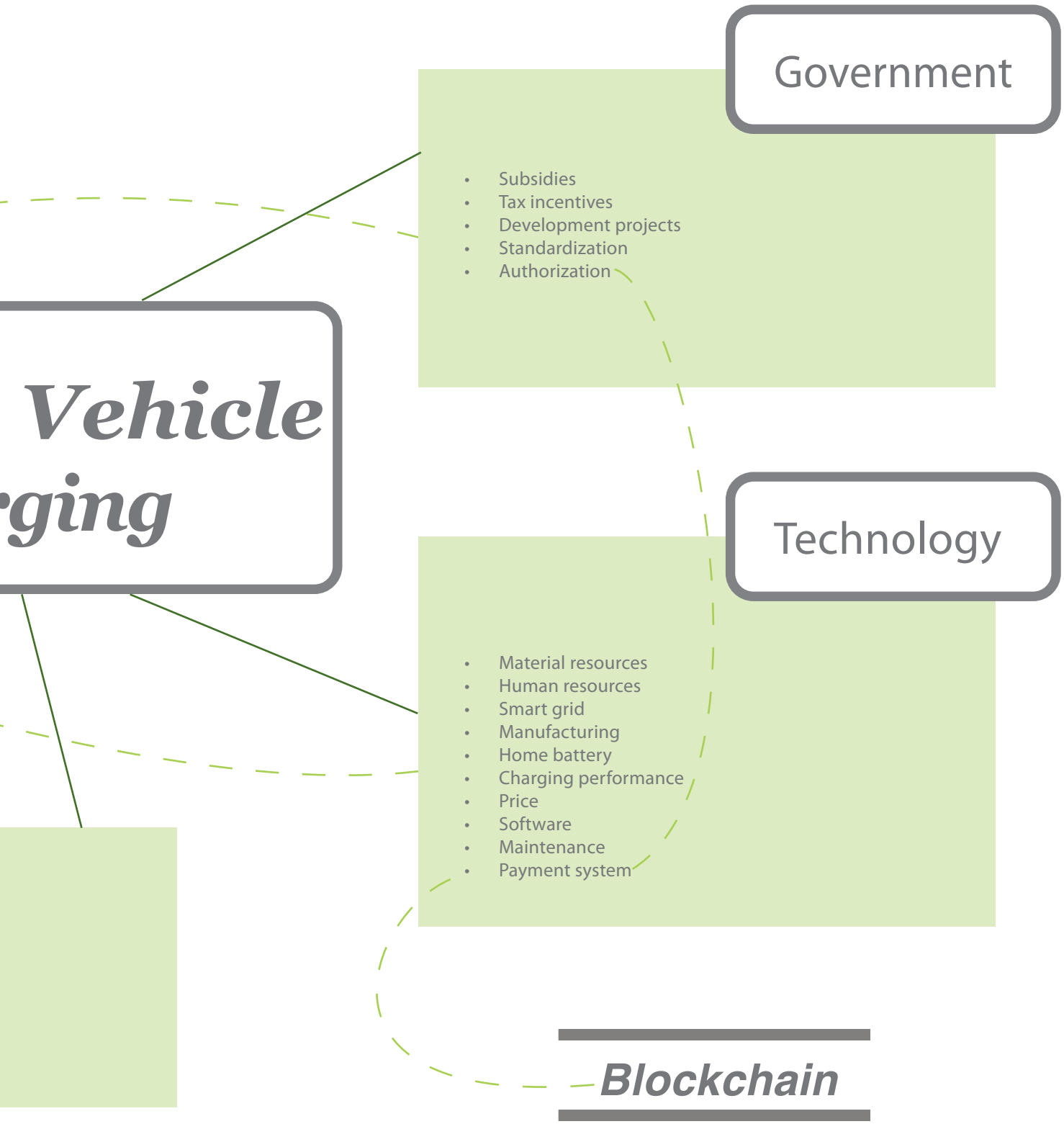


electric vehicles, it is not guaranteed that consumers will not massively shift back to their favorite brands from the time of petrol cars. For Westerners these brands are more likely to be German than Japanese. If we add the fact that the Combo charger network will surely be extensively developed due to the European commission's decision, it is possible that CHAdeMO will be phased out. What's more, the Fukushima accident has slowed down the dynamism of TEPCO, the leading company in CHAdeMO's standard and research and publication of new patents in the industry.

This case clearly shows that the battle of standardization is not over in the market of charging station. Even if CHAdeMO has by far been the fastest to impose its standard, and has done it in a very organized way, the pie is foreseen to be too large for other car manufacturers to ignore it. The coexistence of both the CHAdeMO and Combo standards makes the competition environment in the European Union quite healthy for the moment, but anyone that wants to tap the market should be aware of the risk of putting all its eggs in one basket. Although CHAdeMO is leading the race, the emergence of Combo, and even Tesla supercharger, is of such strength that all the options should be kept open for the moment. •

Influences on the EV Charging Market




Government
Subsidies
Tax incentives
Development projects
Standardization
Authorization
Vehicle
rging
Technology
Material resources
Human resources
Smart grid
Manufacturing
Home battery
Charging performance
Price
Software
Maintenance
Payment system
Blockchain

The Role of Sustainability

Sustainability seems to be the major selling point for going electric, governments offer subsidies for EV's and the technology is worshipped for its zero CO2 emissions. But is sustainability really the driving factor behind electric driving?

GOVERNMENTS

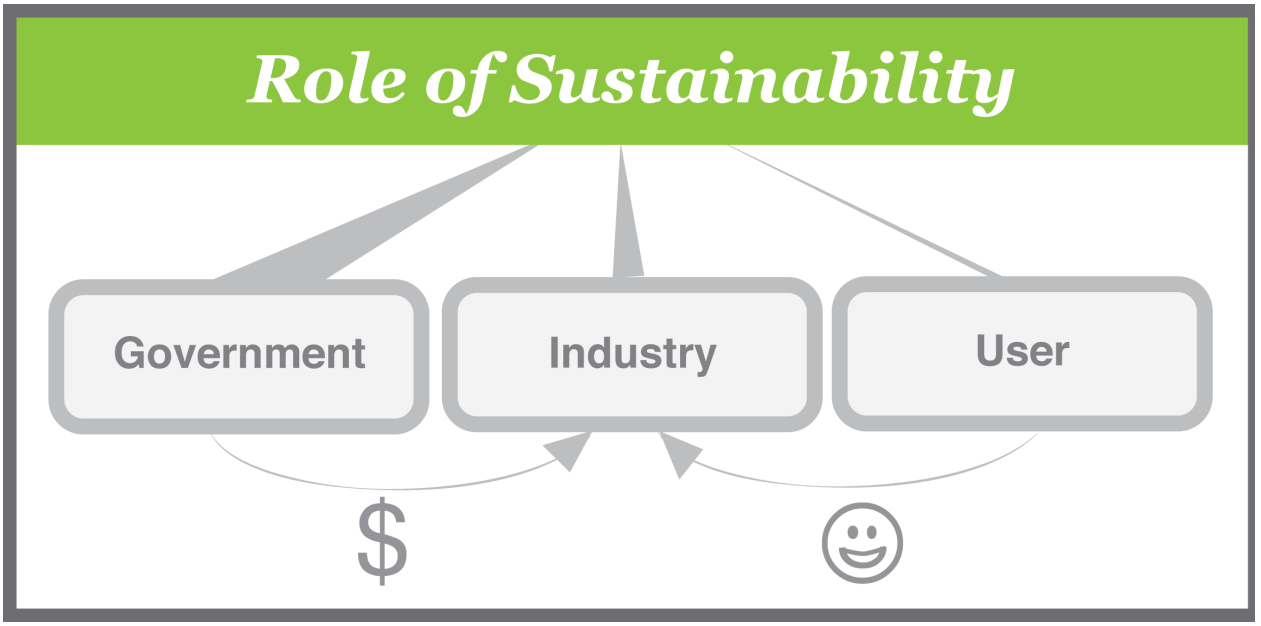
For governments sustainability is one of the most important factors to stimulate electric driving. Especially the countries that have been involved in the Kyoto agreement had large motivations to stimlulate electric driving. Using sustainable energy will bring goverrnments closer to their emission targets. Besides that sustainable energy reduces CO2 emissions, it also decreases the dependency of the country on fossil fuels. For countries that have little natural resources and are strongly dependent on others, such as Japan and Israel, this is also a strong motivator.

INDUSTRIES

For the industry the sustainability aspect of electric driving is definitely a motivator, however, in a very different way than for governments. Industries have less direct commitments to environmental initiatives such as the Kyoto protocol. Despite this, they do have strong motivators to 'go green'. Firstly companies receive government subsidies for green projects. Besides this there are also tax reductions, environmental certifications and a favourable image. The green image is not only towards the government, it also plays a major role in company and brand positioning towards consumers.

USERS

For users the sustainability factor is used as one of the major selling points for electric vehicles. However, looking at for example cases studies on California, users don't care too much about the environment.
More than anything users are attracted to the economic advantages that EV's bring, such as tax reductions and rebates for new cars. Besides this, being able to drive alone in the High Occupancy Vehicle lanes is also a main motivator for the Californian residents. Last but not least, electric driving is also getting a more and more high-tech and hip image. Even though sustainability loses among users, we guess there aren't any bad motivators to go green.
Good note however, is that users do care a lot about environmental initiatives of brands and industries.

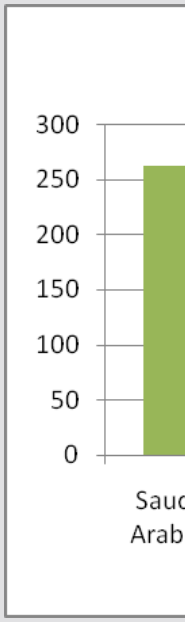


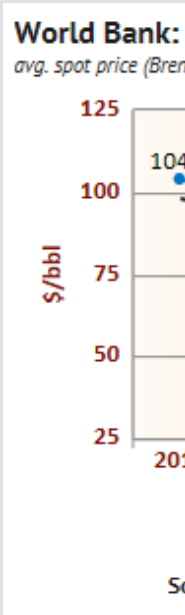
Most relevant future factors

Relying on previous data, 5 factors appear to have most influence on the market. Case studies of ChargePoint and CHAdeMO show the importance of Technology in the race to leadership. The global context indicates that energy issues are a fundamental factor. Also, most of the data seem to indicate that government action is important, if only to get subsidies but more importantly authorizations.

Thus, the following part will detail how the Charging Stations Market is impacted by:

- Energy
- Architecture and Zoning
- Government action and Authorization
- Payment
- Technology





Energy

Energy has always been the main concern for governments in regard to transportation sector. In this section we will analysis the role of energy in development of EV charging market.

GLOBAL OIL PRICE

Global oil price has direct effect on electric vehicle market. Cheaper oil price can reduce the demand for electric vehicles, as well as higher oil price can boost electric vehicle market and motivate consumer to purchase electric vehicles.

There are lots of argue about recent oil price fall and its effect on Electric vehicle market growth, but the point is how long will cheap oil continue?
According to the Commodity Forecast released by The World Bank in January 2015, that world crude oil price will see an smooth increase from $53.2/barrel in 2015 to around $103.4/barrel in 2025.

As can be seen from the chart, short term oil price, by falling from $104/barrel in 2013 to $53.2/barrel in 2015 maybe has slowed down the electric market growth, but from a long term view oil price growth will motivate more and more consumers to buy electric vehicle and save money on oil price.

OIL SUPPLY AVAILABILITY

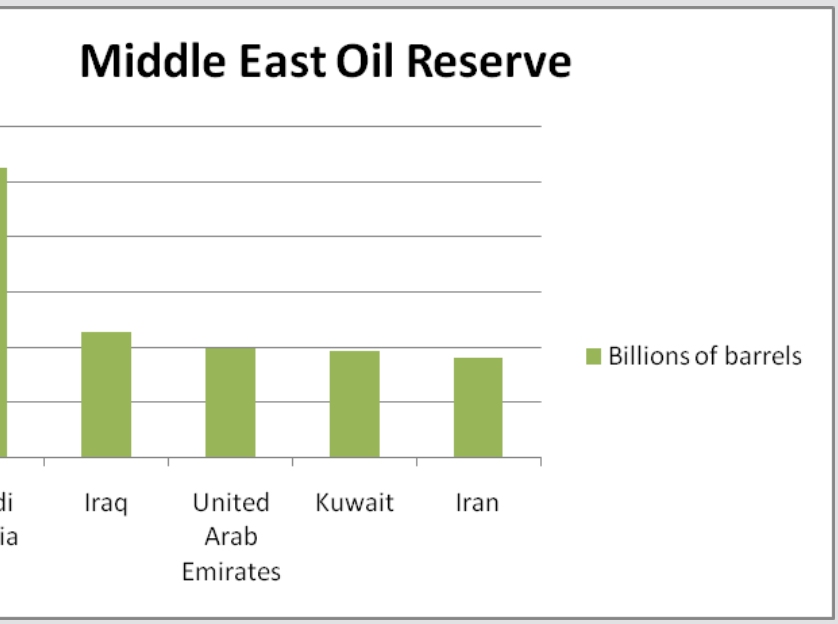
Crude oil is the lifeblood in modern world, Politicians always concern about sustainable access to crude oil to secure their energy supply network system. But the key question is: can we have unlimited access to crude oil forever? No.

As can be seen, There are an estimated 1.3 trillion barrels of proven oil reserve left in the world's major fields, which at present rates of consumption will be sufficient to last 40 years.
By 2040, production levels may be down to 15 million barrels per day – around 20% of what we currently consume. It is likely by then that the world's population will be twice as large, and more of it industrialized. Therefore, Electric vehicle seems to be a good substitute for internal combustion engine cars to decrease the dependence of transportation system on crude oil.

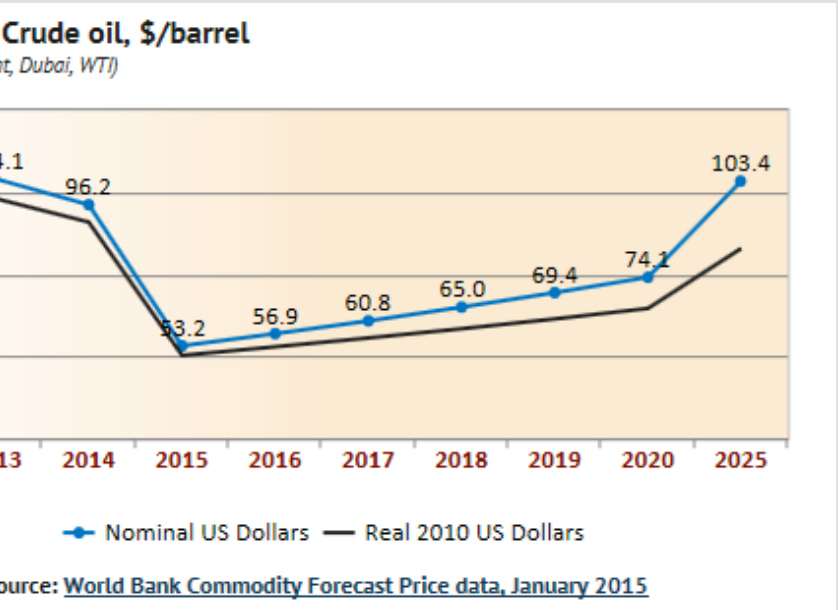
ELECTRICITY PRICE

Electricity price also play a significant role in development of EV charging market. As different countries produce electricity from different resources and apply different subsidy policy , the electricity prices are very variable all around the world.

Most of the potential electric vehicle purchasers take the electricity price into account during EV purchasing



"There are only an estimated 1.3 trillion barrels of proven oil reserve left in Middle East"



decision making process. Governments need to provide more subsidies on electricity price in order to encourage more consumers to purchase and use electric vehicles.

GREEN ENERGY VS. BROWN ENERGY

Electric plants produce electricity from two major resources; one is Green energy resources which refers to environment friendly resources look like solar power and wind. The other type is brown energy resource which refers to environment unfriendly resources look like coal and fossil fuel.

Green energy is more expensive than brown energy due to rare energy resources and more complicated equipment and production process which is needed during energy production.

For example China mainly rely on coal for electricity production, it cause a serious environment pollution which can neutral the effect of electric vehicle in reducing air pollution.

Therefore, while governments encourage consumers to purchase electric vehicles, they also should invest more in the field of green energy to make sure the electric vehicles can make their positive contribution to the environment.

Government action

COUNTRIES OBJECTIVES

Ever since the Kyoto protocol in 1997, countries have set objectives about reducing their emissions and pollution. Apart from the development of renewable energies, the need for a new fleet of sustainable vehicles has appeared to be essential to attain these objectives. In order to help such a development, many countries have decided to take measures in favour of the EV market, including not only the vehicles in themselves, but also the charging stations that support the network. We will more specifically consider the example of the European community of countries.

COUNTRIES MEASURES TO HELP THE EV MARKET

Subsidies are one of the best weapon countries have to favor a specific market. In this case, they provide a certain amount of money when the car is bought, in order to make the EV market financially more appealing. Even though China, Japan and the USA are in very good position, many European countries also arrive in a very good position when it comes to subsidies per car.
But all actions in a country are not governmental. Cities also try their best to improve the development of the EV market, in a regional scale. For example, the city f Paris has created the Autolib program, in which people can use EVs that belong to the city, in the same way than bikes. Whether you have a card or not, you can pay a very small amount of money to a station, get a car, and put it back in one of the city's many stations. Other actions are done in many cities. They provide not only subsidies, but also programs such as EV car sharing services. Also, many actions favoring EV users letting them use priority lanes and use parking lots.

CHARGING STATIONS NETWORK

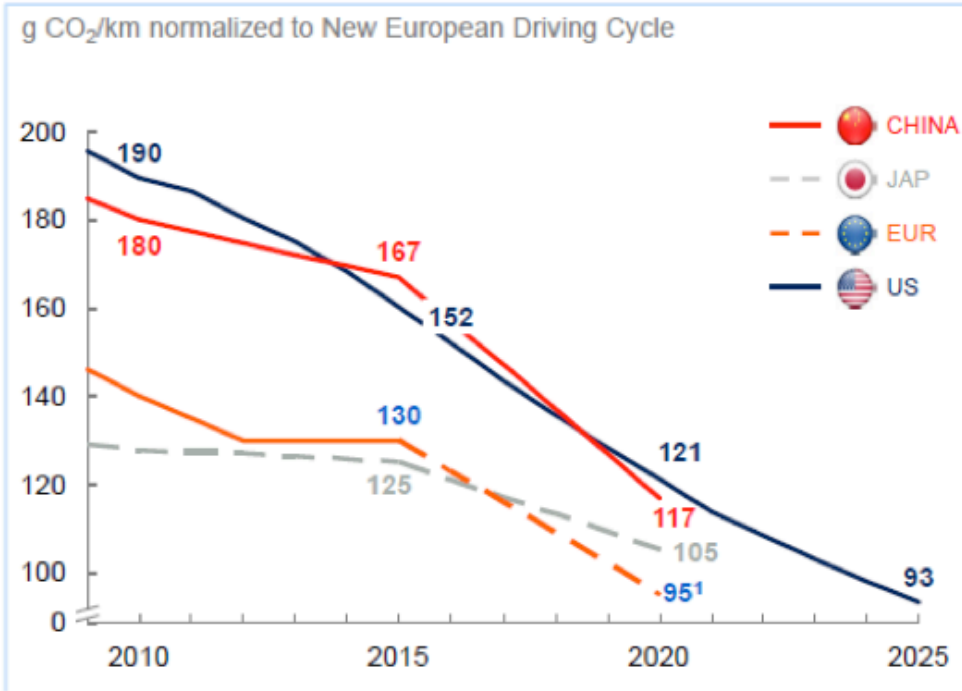
Another kind of action is the development of the charging stations network, essential to support the EVs' fleet in a country.

Many countries have implemented policies regarding the development of charging stations' network. These policies include financial incentives and subsidies (e.g. 50 million for France), determination of showcase regions, support of R&D, tax incentives to support the creation of a charging infrastructure, public advertisement and shows.

RESULTS

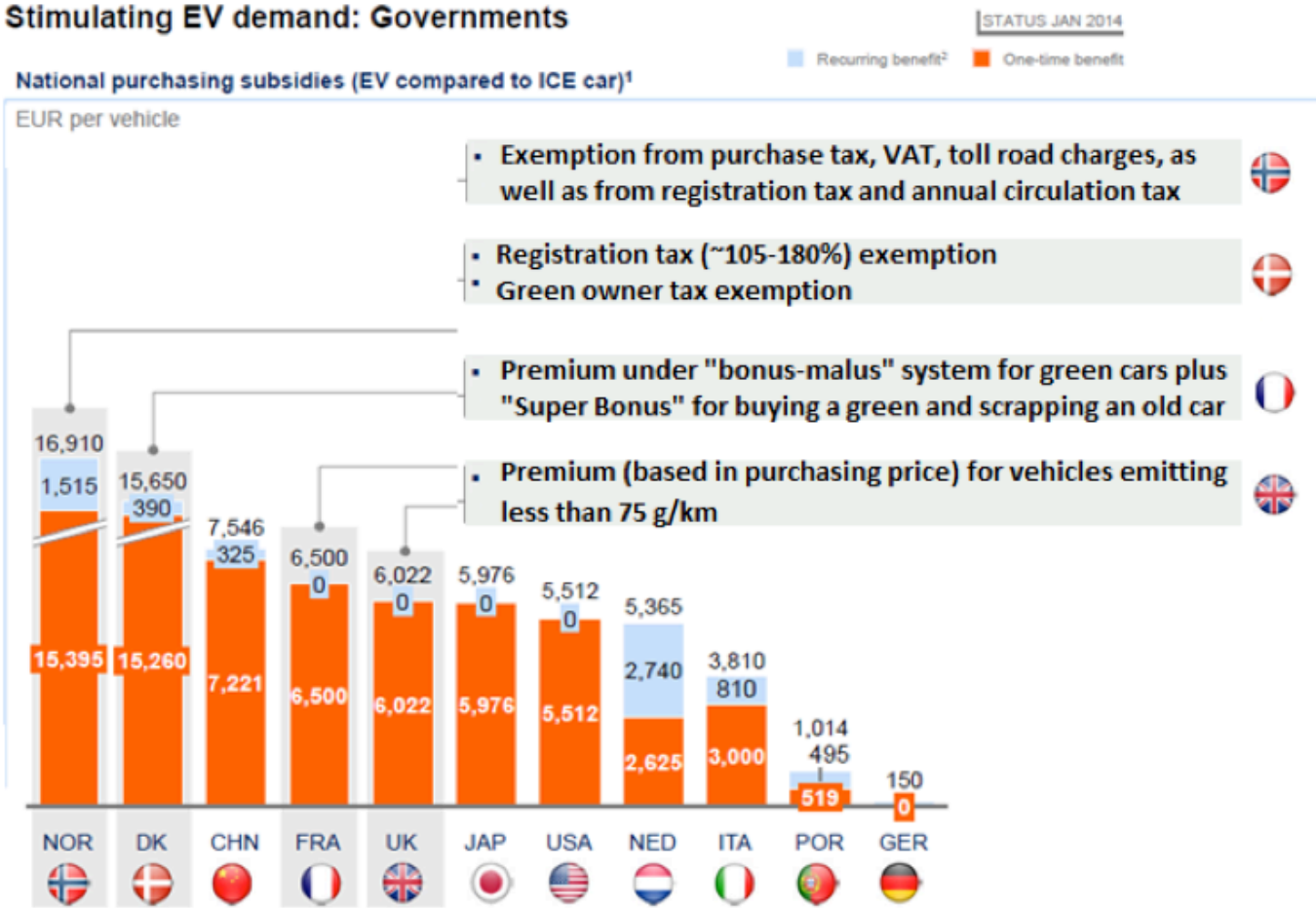
The impact on the sales of charging stations is pretty obvious, and, apart from Africa, the increase in the implementations of charging stations is pretty huge. And the combined effect of EV promotion from countries/cities, and the development of the charging stations network is a similar increase in the sales of EV.

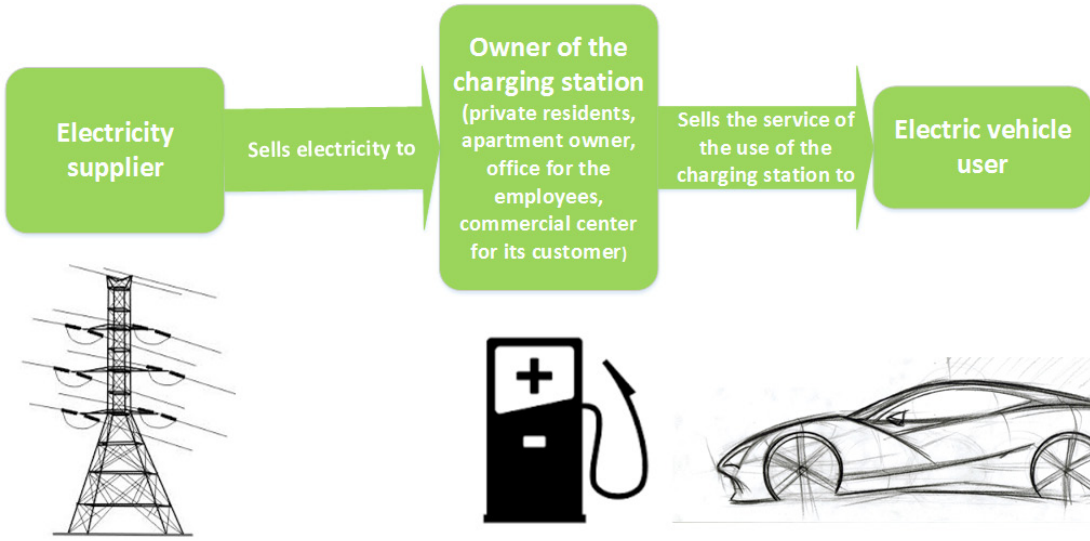
Planned emission standards in select regions



- **EU** target of **130 g** CO_2/km effective as of **2012**, with a moderate **phase-in** allowed until **2015**
- Long-term **EU proposal** of **95 g** CO_2/km **for 2020; 2025 initial proposal 68-78 g** but decision postponed
- In the **US**, fleets must improve to **93 g** CO_2/km (59.1 mpg) in **2025** from the **152 g** CO_2/ km (36.2 mpg) threshold in **2016**

Stimulating EV demand: Governments





Authorization

A great challenge that can be an obstacle or an advantage for the development of the charging stations are the regulations concerning the authorization or not to deploy a charging station, and about the contract with the EV owner and the payment system.

Nowadays, the regulation easily allows every person to install a charging station at his home's garage. Many companies, such as Chargepoint, proposes the sale of the charger and the service of the installation at home. However, such a system is supposed to be used only by the owner. In other situations, such as the implementation of a charger in a commercial area, the actual owner of the charging station is not the user.

In such situations, from the perspective of the supplier of electricity (generally the owner of the distribution grid), the owner of the charging station, called the charging point manager, is considered as the final customer. That means that he needs to pay the electricity supplier for the electricity use. Then, he can resell the electricity for the charging service to the EV owner. This means, first, that the pricing needs to take into account the price of the electricity bought from the grid; second, that at the same time the business model can be established relatively independently from the electricity provider. In many cities, one of the big issue concerning the charging station is the dependency of a resident that is actually renting his home, or that is living in an apartment. Generally, the regulation is not favorable for the residents, because he has no right to do such investments. Indeed, the property manager is actually the owner, and he has the right to decide for such investments. However, according to a Tesla employee, the installation of such charging station could leads to high tax benefits for the property owner in this kind of situation. Concerning Chargepoint, their actual strategy now is to wait for a demand from an EV owner, and then try to contact and convince the property owner to install such charging stations. In the situation of co-property, which is often the case for instance in France, this kind of investment should conventionally be decided by the co-proprietaries. Nevertheless, a French company called Borne Recharge Service has created an intelligent device that meters the electricity used for the charging, so that the electricity expenses of the building could be fairly distributed among the owners.

However, the dependency to the property owner still gives some deterrence for the residents in an apartment. Indeed, according to a the data revealed by Tesla China's sales team, more than 60% of Model S owners in China have complained difficulty when negociating their property management about setting up charging poles at their residential building (Allocation Strategy for Tesla's Charging Stations in Beijing CBD). In high density cities, without better communication about charging station, and good incentives for property owners, difficulties could remain to install home charging stations.

Concerning the installation of charging stations in general, it is also submitted to the demand of an installation permit to the mayor of the city, except for single house. As far as we know, and according to the regulations in Vermont, this kind of installation permit is to guarantee that the owner calls for professionals to install the charging station (a professional with an electricity certification is required), respects elementary safety conditions, and prevent some negative environmental impact. Even if the permit seems to be quite easy to obtain, it should be deeper investigated whether or not the need of such a permit could consist in business barriers in practice (action in justice to slow down the process as for construction permit for instance). Nevertheless, at least in Vermont, the installation of a charging station has not the same status as a building permit, which avoid already many complications.

Payment Systems

The payment system is absolutely essential to the business model of the company that wants to exploit charging stations. Basically, three main payment concepts exist: by subscription to a company, payment per charge, or through a parking fee. Currently, one of the most advanced pricing system is Chargepoint's. In exchange of a fee, Chargepoint provides all the services of the charging station (installation, maintenance) to the property owner, that can choose himself the pricing conditions for his customers (time spent charging, corresponding price of electricity taking into account peak hours). The payment is done through Chargepoint payment system: a Chargepoint ChargePass smart card that is doing no contact payment.

As there are many other payment systems, there is still an issue of compatibility of the means of payment as well as of transparency. Some attempts are being made by some companies to provide charging payment for a large number of charging stations, by they are generally limited to a specific country or area and does not cover all charging stations. For instance, PlugSurfing is only restricted to Germany and Netherlands, and allows to pay through the app. This decentralized payment system with no transparency is a real challenge, which is a barrier for the development of the market. Many EV users are dissatisfied and confused about this situation. We believe that in this area, the use of a decentralized and transparent payment system could help the market to thrive. Internet payment system with Bitcoin or Blockchain technology could help a lot in uniforming the payment system in the World, and should be a technology to be considered in a few years.

"Internet payment system with Bitcoin or Blockchain technology could help a lot in uniforming the payment system"

EV's battery and fuel cells

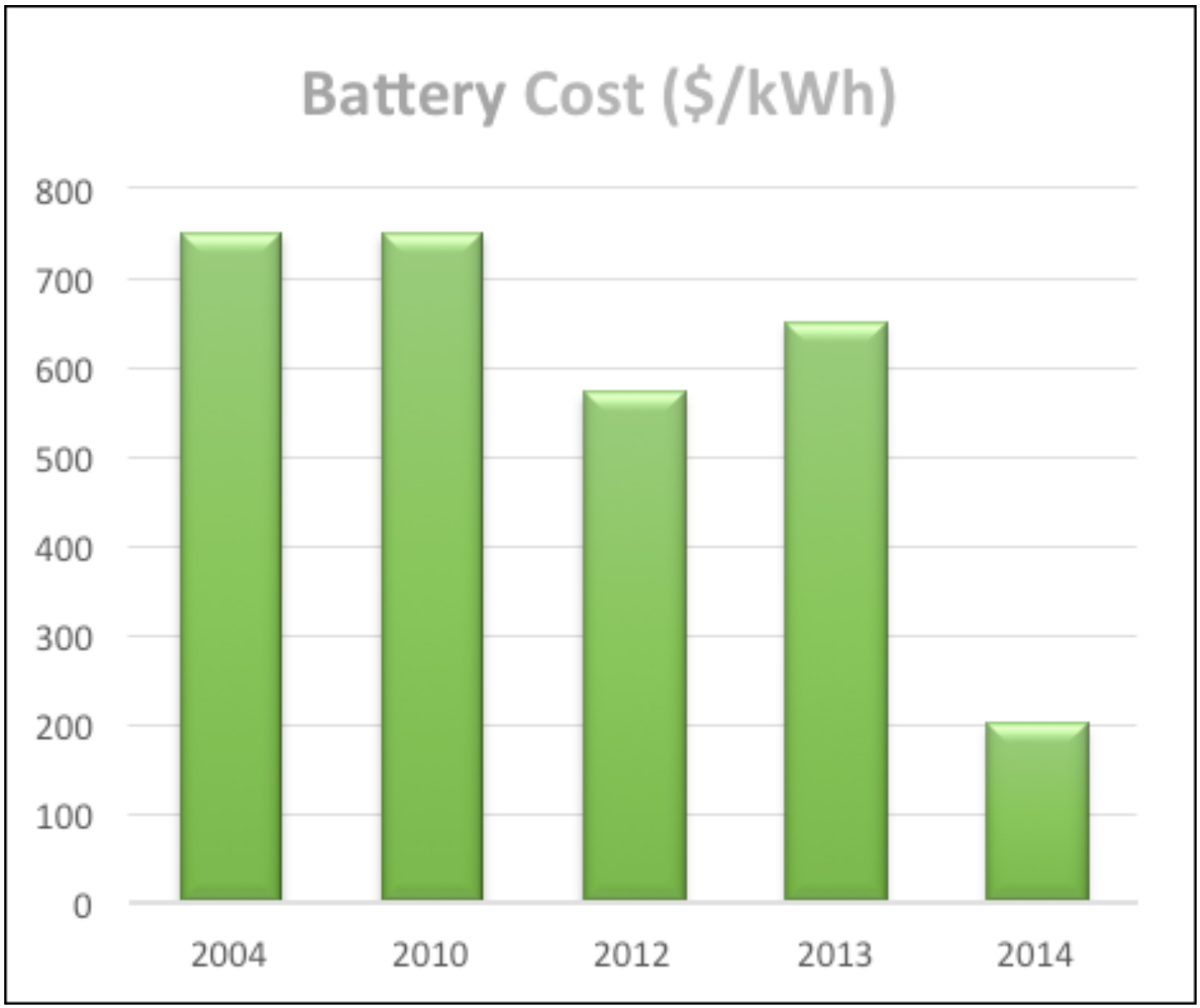
In most broad perspective, sustainable energy is not just inevitable need for our future but also more economic and profitable for the long run.

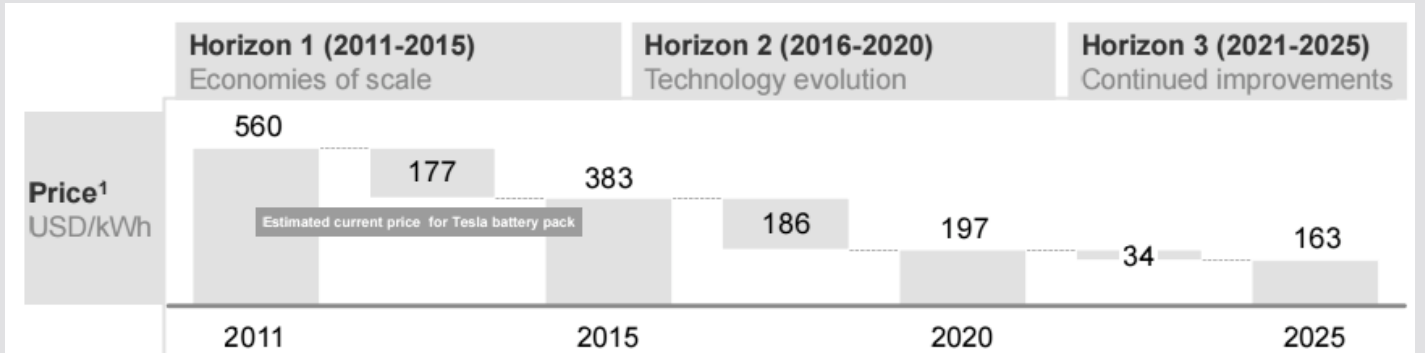
EVs are a subtopic of this broad subject. We need not just cheaper EVs to run, but also cheaper EVs to purchase. It is often considered that the battery is the main aspect that could help or hinders the development of the electric vehicle market and charging station industry.
"In 2010, battery professor Poul Norby stated that he believed that lithium batteries will need to double their energy density and bring down the price from $500 (2010) to $100 per kWh capacity in order to make an impact on gasoline cars. Citigroup indicates $230/kWh. As of October 2014, the cost of Tesla batteries is $180/kWh."
Prices get down more rapidly than expected because of mainly market leaders Tesla and Nissan with cost decreasing 8% per annum.

However, we can have some doubt about the sustainability of the supply of Lithium, the core component to manufacture the current batteries. According to the Meridian International Research Cabinet, the reserves will not be enough to develop completely the electric vehicle market; other battery ions, or technologies, should be investigated. This thesis is controversial, though: according to a German study from Zentrum für Sonnenenergie-und Wasserstoff-Forschung Baden-Württemberg, there is enough lithium on Earth to produce more than 10 billion electric vehicles, which should sufficient, because the market today is estimated at about 1 billion vehicles, and estimated to grow to 2,5 billion in 2050. USGS (US Geological Survey) institute concludes that there is a concern about this issue. Besides, the reserves of Lithium are globally only located in a few countries (Bolivia, Chile, Argentina, China, United States), which could have an impact on the supply chain and the price in the future. The dependency on oil could shift to a dependency on rare-earth materials such as Lithium.

Nevertheless, for the moment, due to economies of scale, better technologies, and the increasing extraction of Lithium, the price of electric vehicle battery is decreasing.

Alternatives to Lithium in the electrical vehicle market will be other ions to make batteries, or fuel cells. According to the Union of Concerned Scientists, both batteries and fuel cells could have a great impact on the electric vehicle market. Electric vehicle will be more used for an urban environment, whereas fuel cell vehicles will be more performant for long distance travels, or bigger cars. They are not considered as competitive, but rather as complementary technologies because they do not have the same advantages. But vehicles running with fuel cell technology will need hydrogen charging stations. When considering the charging station industry, it will mean that the electrical charging station and the hydrogen charging stations will coexist in the market, to fulfill different needs.


Battery Cost ($/kWh)
800
700
600
500
400
300
200
100
0
2004
2010
2012
2013
2014


Horizon 1 (2011-2015)
Economies of scale
Horizon 2 (2016-2020)
Technology evolution
Horizon 3 (2021-2025)
Continued improvements
Price[1]
USD/kWh
560
177
383
186
197
34
163
Estimated current price for Tesla battery pack
2011
2015
2020
2025

Factors in Architecture & Zoning

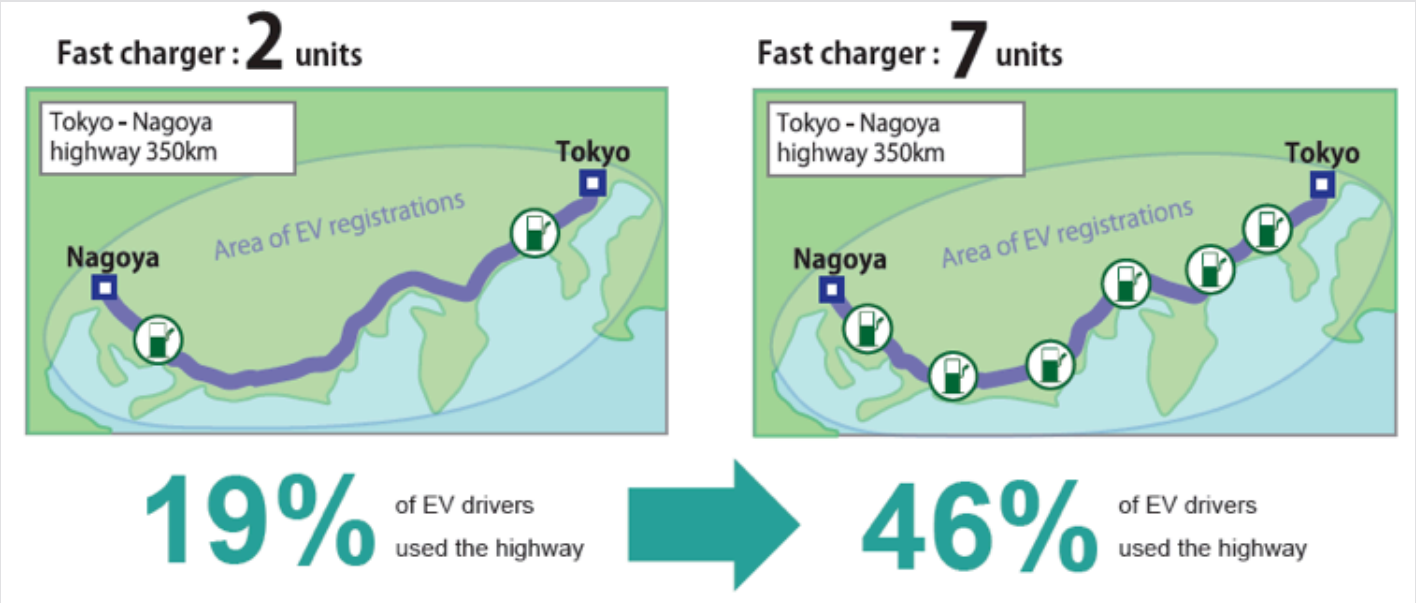
ALLEVIATE THE RANGE ANXIETY THANKS TO A GOOD DISTRIBUTION OF CHARGING STATIONS

As shown in the current situation about architecture and zoning, the range anxiety is a key deterrent to the potential buyers of charging stations. The combination of slow and fast charging stations is the key to make the market thrive. In Japan, some studies have shown that there is a high correlation between the number of fast charging stations and the adoption of electric vehicles.

The equipment of Tokyo-Nagoya highway with a dense network of fast charging stations managed to remove the range anxiety of electric vehicle users. When 2 fast chargers were installed on this highway of a length of 350kms, only 20% of EV drivers dared to take the highway. After 7 units were deployed (one each 50km), the percentage of highway users doubled. An experiment conducted in Yokohama has shown that the distance coverage was low in the absence of fast charger, even if the range of the cars were sufficient. After the deployment of the fast charging station, the EV usage had dramatically increased, but the fast charger was only hardly used. These results show that it is not only the real range limitation that is a challenge, but also the users' perception of their car's range.

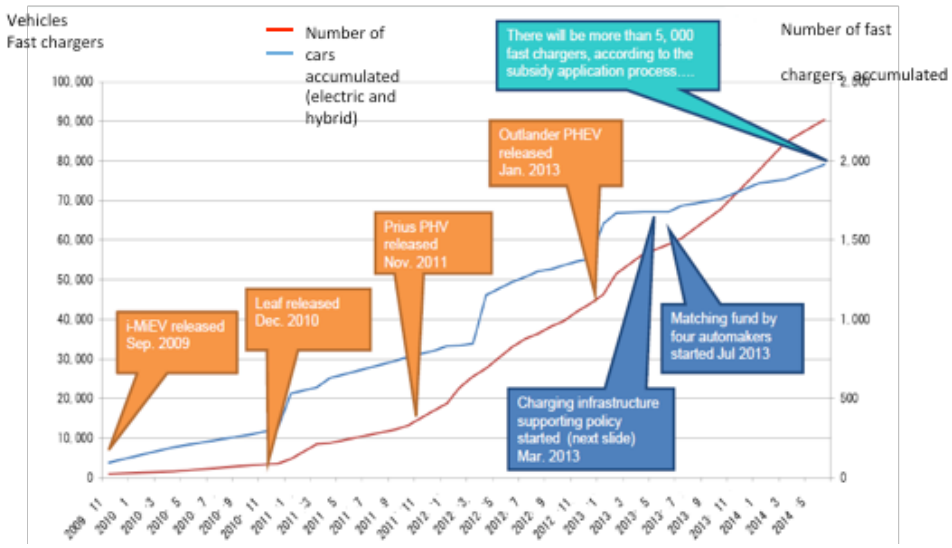
Fast chargers can respond to this issue and are necessary to make long distance travels possible and enjoyable.

Even if the price of fast charging station is still high, the costs are rapidly decreasing due to economies of scale and an improvement of the technology. As Fuji low cost fast charging station reveals (see the part about CHAdeMO), a first step could be to produce fast chargers at lower cost, even if the charging time is a little longer, in order to get credibility and to permit a fast expansion of the electric vehicle market.
However, in other countries like the United States, the use of slow chargers at home and work place are more developed compared to fast chargers, and it did not prevent the development of the EV market. On the contrary, as long as it is possible, installing chargers at home and at work is the simpler and most cost-effective way to target a big number of EV users. The market potential is more important, and the return on investment is easier to establish.
A good marketing analysis is required to have an insight about the need of the different types of charging station in different countries. A good compromise between both types has contributed to a good development of the market in Netherlands and Norway.



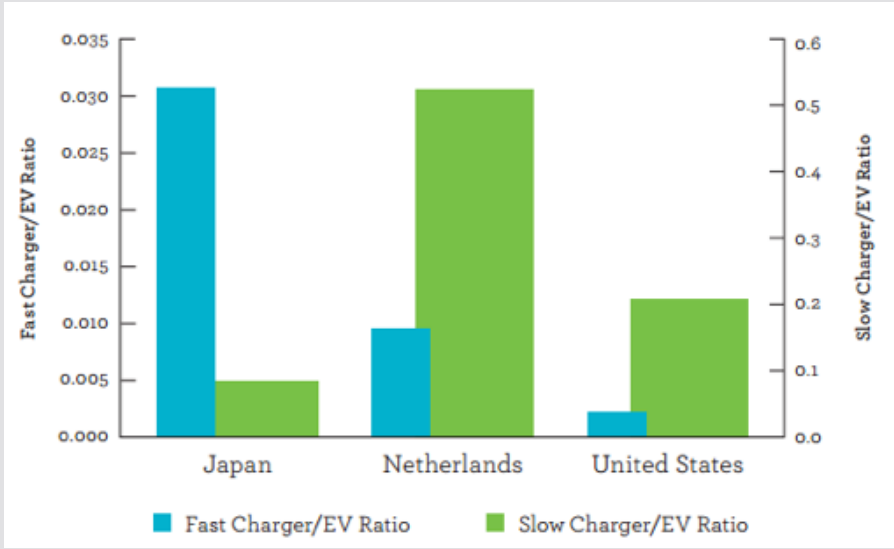
GUARANTEE INTERNATIONAL TRAVEL OR LONG-SCALE TRAVEL THROUGH STANDARDIZATION

Especially in Europe, the size of the countries and the multiple cross-border travels need to be considered. The compatibility between the different cars and chargers in the European countries need to be consistent. Following the standards is of paramount importance to be able to succeed in this market. With currently two existing standards for fast charging stations, and the lagging uncertainty about the result of this competition, it is recommended to propose fast chargers with both plugs in Europe at least.



CORRELATION OF 0.9

"It is not only the real range limitation that is a challenge, but also the users' perception of their car's range"



Conclusion

The electrification of the global vehicle fleet is undoubtedly a long-term ambition. Not only because the amount of cars needed to replace the existing fleet is enormous; but also because its fast development will never be sustainable without a reliable charging stations network.

And although companies are able to create and release new models rapidly, the network will take time to be deployed.
The technological and industrialization pace is fast, unlikely to slow down the market expansion. Costs and charging times are being constantly reduced, and through alternative technologies -such as Wireless Charging, EV charging is becoming more and more convenient. Performances of EVs are catching up with regular cars, even surpassing them – Tesla cars, and aim at providing equal or better service, on top of being environment friendly.

Still, uncertainties and risks remain. Oil prices keep the regular still attractive compared to the electric solutions, and, combined with a persistent – although no longer verified - lack of confidence in current EVs' performances tends to maintain consumers away from this new market. Also, the multiplicity of technologies and standards result in difficult strategic choices for companies. Finally, the risk of technology obsolescence and possibility of rare Earth material, especially lithium, shortage may have a tremendous impact on the market, on the long term.

Right now governmental support is needed to set up the global Charging Station Network, if only regarding financial support and regulation issues. Plus, since the development of the EV market is in accordance to major environmental objectives, government's actions tend to have a rather supportive than restrictive influence on the market. Evidence shows regional and governmental action results in efficient boosts in charging stations and EV sales. Close collaboration between government and companies is key to success in the market.

- The electrification of the global vehicle fleet is a long-term ambition.
- The technological and industrialization pace is fast, unlikely to slow down the market expansion.
- Still, uncertainties and risks remain, for example: market competition, consumer perception and technology choices
- Close collaboration between government and companies is key to success in the market.

FACTORS		SHORT TERM	
ENERGY	Oil Price	Increase public attention to high energy cost of gasoline vehciles by advertisment	
	Oil Availability	Increase public awareness oil availability by advertisement	
	Electricity Price	Increase public attention to low energy cost of Electric vehciles by advertisment	
LAWS & REGULATIONS	Subsidies	Team up with other companies, create research groups	
	Standardization	Increase awareness of standards via advertisement channels	
	Authorozation	Have standards recognized by governments, and used	
TECHNOLOGY	Material Resources	Secure long term supply essential materials	
	Human Resources	Set-up a team of experts in different related industries	
	Manufacturing Technology	Increase efficiency of material usage in current production methods	
	Software	Increase compatibility with the different elements in the smart-grid	
	Payment system	Standardization, f.e. by use of blockchain	
ZONING	Fast-Slow Charging	Increase focus on fast chargers to alleviate range anxiety	
	Network Expansion	Guarantee dense network coverage	
		Actively seek collaboration and projects with local governments to expand the network	
	Home-Office Travel	Offer a complete range of services and technical support for charging stations	
		Organize communication campaigns about the sufficiency of a charger at home/office for daily journeys	
EV'S	Battery	focus in research on how to keep good performance of batteries after many charging	
	Availability	Setup rental service	

Strategy for the Future

After concluding on the Industry Analysis Report, we have been able to determine what strategic moves, regarding several topics, would serve companies involved in the Charging Stations Market.

This matrix presents our suggestions regarding company strategy. As said before, the electrification of the global vehicle fleet is a long-term ambition, and companies should see further than short term strategy to stay competitive or even up-to-date technologically.

Topic and subtopics are detailed in the first two columns, and the associated short and long term strategies are stated in the other two columns. All statements are supported by the previous IAR analysis and conclusion.

LONG TERM
Increase next generation oil availability awareness through school's Textbook
Support academic to do more research about EV charging efficiency and effectiveness
Find new incentives for buyers
Switch to new subsided market branches
Aim for low-cost advantage
Research opportunities to use cheaper, less scarce materials
Invest in training of highly skilled employees with broad knowledge of the charging station industry
Develop more efficient manufacturing techniques that require a minimal amount of material resources
Increase flexibility and efficiency of object oriented software for use in f.e. home battery system
Ensure full compatibility and integration of all elements in the smart-grid
Increase the highway coverage
Organize campaigns to convince home building owners of their interest to deploy charging stations
provide plug compatibility with two-wheels vehicle, especially in emerging countries
Evaluate the impact of Lithium resources and possibly consider the hydrogen station market

The Future Technology

MATERIAL AND HUMAN RESOURCE

As discussed before, charging station hardware cost and labor costs have the biggest shares of charging stations. While the charging station technology advancing, other than electrician labor costs increase. This shows that advancing technology in charging stations requires highly skilled human resources that is not available enough for the market at present. Human Resource departments of charging station companies should focus to solve this problem now for the future. Hardware costs of charging stations in the future will down with developments in manufacturing and technology. Moreover, charging stations should be easy to setup and use. But it is also deeply related with the laws and regulations because usage of high level electricity related products covered by laws. Easy and more secure ways to set up charging stations can also decrease the costs labor.

EVS BATTERY

Future developments in EVs battery will always play a key role in both EVs and EVs charger industry. Not just cost issue but also technological innovations are also bounded with charger technology and industry. There are many important specifics about battery such as cost parity, range parity, charging, swapping, refilling, lifespan and safety. In order to have competitive advantage in EVs charging industry, it is vital to be updated and ready for innovations in EV battery technologies.

CHARGING SPEED

As it is mentioned before charging speed is the competitive factor in the market. To increase the charging speed, developments and innovations in the EVs battery must be followed closely. Although, DC fast chargers at present are fast enough, those still has very high costs. Decreasing cost of fast DC chargers with developments in manufacturing these systems will provide big advantage for EVs and EVs charging station market in the future.

HOME BATTERY

Tesla Energy developed an innovative product as home battery that is called Powerwall. “Home battery that charges using electricity generated from solar panels, or when utility rates are low, and powers your home in the evening. Powerwall offers independence from the utility grid and the security of an emergency backup. Without a home battery, excess solar

“EVs chargers will not just connect cars to grid in order to buy and sell electricity but also communicate and cooperate with home batteries to manage energy supply and demand of a house as being player of energy market”

energy is often sold to the power company and purchased back in the evening. This mismatch adds demand on power plants and increases carbon emissions. Powerwall bridges this gap between renewable energy supply and demand by making your home's solar energy available to you when you need it."

This innovative factor will have great impact on our understanding about energy market and grid systems most probably. After this kind of home batteries become common, EVs charger will not be just a bridge between grid and EVs. There will be three actors in the energy system as Smart Grid, home battery and EVs. All will be simply energy buyer and seller. This innovation will become real product in summer of 2015 in U.S. market. EVs charging manufacturers must consider possible effects of this new technology on EVs charging systems.

DC-CHARGER PRICES DROP

WIRELESS CHARGING

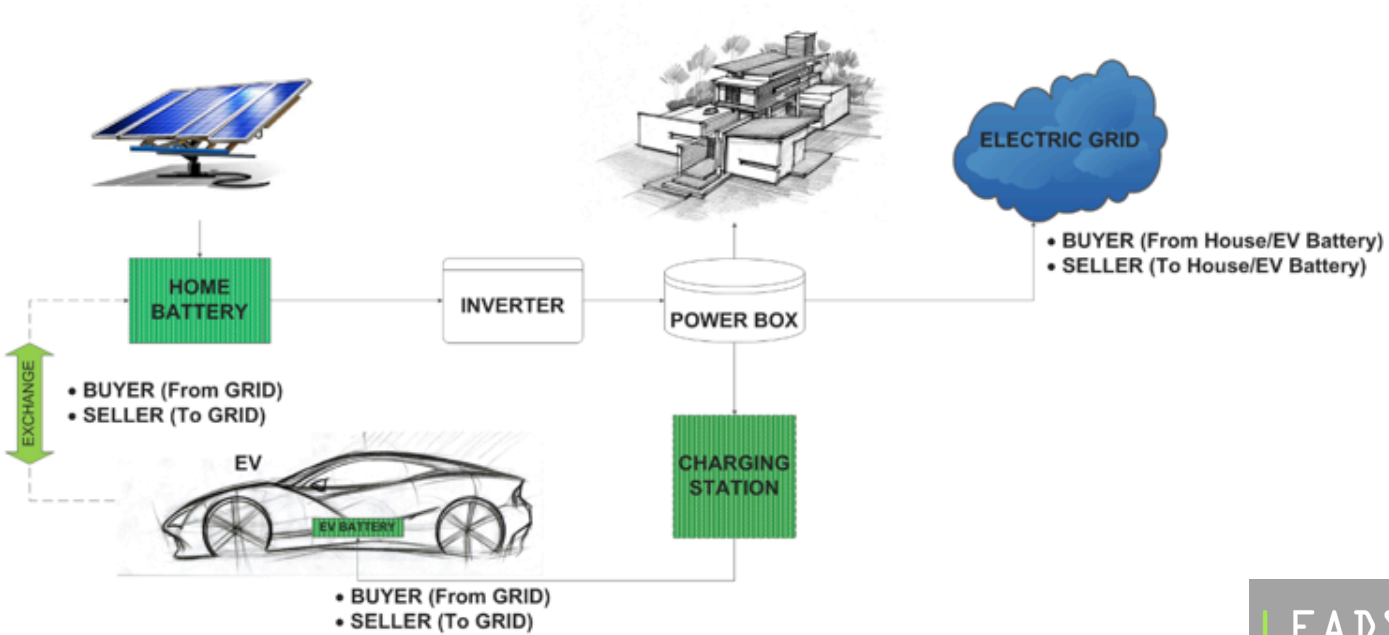
Wireless charging already in the market and new companies such as BMW, start to produce new products for this new technology. But most of these products are stationary wireless charging station that is tried to be standardized by a working group established by IEEE, in which academic experts, industry experts and government representatives. However, "The main advantage of wireless charging while the vehicle is in motion is the automation of the charging process and the resulting additional range –thus the use of an internal combustion engine as a "range extender" and the use of larger and thus heavier batteries are not necessary. The larger challenges are in the standardization of the energy transfer frequencies, the acceptable limits of electromagnetic field strengths to minimize health risks, the geometrical parameters of the positioning of the coils (package-relevant), and the cooling technologies for higher energy transfer power levels. It should also be noted that rules for infrastructure financing and technical standardization should be developed prior to commercialization." By Staff Editor of IEEE Transportation and Electrification Community and Joachim G. Taiber

SELL BACK TO THE GRID

PRICING

There are different kind of payments around the globe such as payment by the hour, the kilowatt-hour, per session fee and monthly or annual subscription fee. And bunch of charging stations are free. House charging is always cheaper than other stations that charge fee. Some of the stations are independently owned and prices set by the owner. "In California and many other states the most long term economical way to charge your electric vehicle is to install an electric vehicle meter dedicated to charging your electric car. This can be a complex and expensive project to undertake that depending upon your existing infrastructure, may take years in savings to see a return

The future of the grid lies in the integration of all electric systems we use



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