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ELECTRIC VEHICLES MARKET OUTLOOK – POTENTIAL CONSUMERS, INFORMATION SERVICES AND SITES TEST

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ABSTRACT

The purpose of this paper is to review the most recent and relevant business intelligence and market foresight analyses on electric vehicles in order to build a picture on the current market activities and offerings. The reference material was clustered in three main sources: 1) market foresight analyses 2) information services development activities, 3) probe of electric vehicle test sites. The future EV market is seen to have a promising growth potential, though the proper business models that could meet consumer aspirations are still called for. The growing potential of EV market has been stimulating the development of several types of services that support EV deployment, e.g. information services. The test sites are already emerging around the globe and the master driver seems to be the automotive industry.

Keywords: Electric vehicles; Information services; Market; Test sites

1. INTRODUCTION

Many countries nowadays are considering what electrification of their mobility system in fact means. The purpose of this paper is to review the most recent and relevant business intelligence and market foresight analyses on the topic in order to build a picture on the current market activities and offerings.

The work was performed as part of Finland's electric vehicles national test site programme that comprises several small-scale test sites in different parts of the country.The authors gathered information from several latest market research reports and websites. The reference material was clustered in three main sources: 1) market foresight analyses 2) information services development activities, 3) probe of electric vehicle test sites. After reviewing these sources, the authors identified the foreseeninformation services as well as the key bottlenecks for the market acceptance of EVs. Also the test sites which were built by the automotive manufacturers, power utilities companies, and city authorities were mapped.

2. MARKET FORESIGHT

A number of studies and analyses related to electric vehicle ecosystems were conducted by several consulting companies within their reports, white papers, etc. Their studies cover many aspects of EV, i.e. market forecast, customers' feedback, infrastructure, batteries, business models, among many others.

Frost and Sullivan (2010) reported a study about overview of the EV market, indicating the development in infrastructure, business models, initiatives and consumer research. Frost and Sullivan market research entitled *360 Degree Perspective of the Global Electric Vehicle Market - 2010 Edition,*presented the following market projections:

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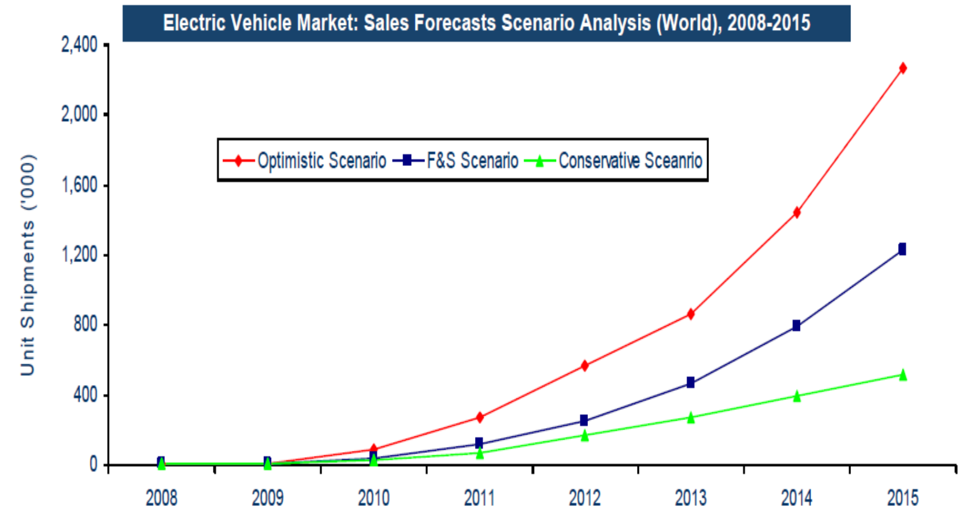
- *Urban mobility and its influence in shaping EV infrastructure;* by 2020, the emergence of mega cities in developing economies will drive personal mobility to a different level, further driving up the demand for EVs.
- *Global EV market size and forecasts;* Figure 1 shows three scenarios in EV sales forecasts for 2008 to 2015. It is predicted that by 2020, sales of EVs will comprise 4% to 12% of total car sales.



Scenario's	2008	2009	2010	2011	2012	2013	2014	2015	2020 (Total Car Sales)
Optimistic Scenario	5,103	7,260	94,985	273,116	574,435	863,160	1,439,147	2,266,450	12%
F&S Scenario	5,103	7,260	41,653	117,385	255,151	471,690	791,961	1,226,607	7%
Conservative Scenario	5,103	7,260	25,884	72,895	168,965	273,244	394,605	520,953	4%

Figure 1 World EV market forecast (2008-2015)(Frost & Sullivan, 2010)

- *The preferences of the consumer;* the high price of the initial EV's will be an inhibiting factor for consumers' adoption. Price represented approximately 40% of the share ofpreferences for EV's demonstrating how important pricing options will be. Some other criteria for EV adopters are dominantly age (26-35 and above 55 year old), the sex (male), and income level (higher disposable income). Women showed a greater dislike for the inconvenience of charging and monitoring charge of EV's. These consumer studies were conducted in Europe. For American studies, the results are slightly different, especially with regard to the profiles of early EV adopters. In North America, early adopters are geographically located mainly in suburban areas, aged between 36-45 years, female, and with an interest in luxury cars. It was also found that environmental benefits (77% mean index), green and tech-savvy image (70% mean index) and reduced fuel cost (70% mean index) are the key adoption drivers, whereas the range anxiety and performance concerns (73% mean index), high cost concerns (70% mean index) , battery concerns (69% mean index) are the key adoption restraints.
- *Business model analysis of key industry stakeholders;* the same business intelligence report identified four different business models scenarios as shown in Figure 2.

	Business Model 1	Business Model 2	Business Model 3	Business Model 4
TYPE	Energy Package	Maintenance Package	Part Subsidy	Full Subsidy
COVER	Partial battery lease + Electricity	Energy Package+ Insurance+ Maintenance	Maintenance Package+ Discount	Maintenance Package+ 100% Discount
ENERGY	Monthly Bill	Flat: Max 1250 miles/month	Flat: 15,500 miles/year	Flat: ~18,500 miles/year
CONTRACT	NA	NA	4 years	7 years
SUBSIDY	NA	NA	50% car price	Free car
MONTHLY LEASE	Up to $225	Up to $500	$750- $1100	~ $1350- $2250

Other Possible Leasing models

Flexible Mileage	Unlimited Miles	Max number of miles	Pay as you go
Flexible Contract	The customer opts for the number of years and flexible mileage- customized lease		

Figure 2 Business models analysis (Europe), 2009(Frost & Sullivan, 2010)

Another analysis is coming from Finpro (2010), which has also investigated EV ecosystem. Finpro's findings were the following:

- Key enablers for the market acceptance of EV's are costs (competitive products available), battery (e.g. range and reliability) and infrastructure.
- Electric vehicles ecosystem (or value chain) involves new actors. For the EV industry to succeed, new kinds of cooperation models are needed - not just the traditional partnerships between original equipment manufacturers (OEMs) and suppliers, but also with the players outside the automobile industry, such as utilities,and charging station manufacturers. A more active role of governmentsis needed as well (Figure 3).

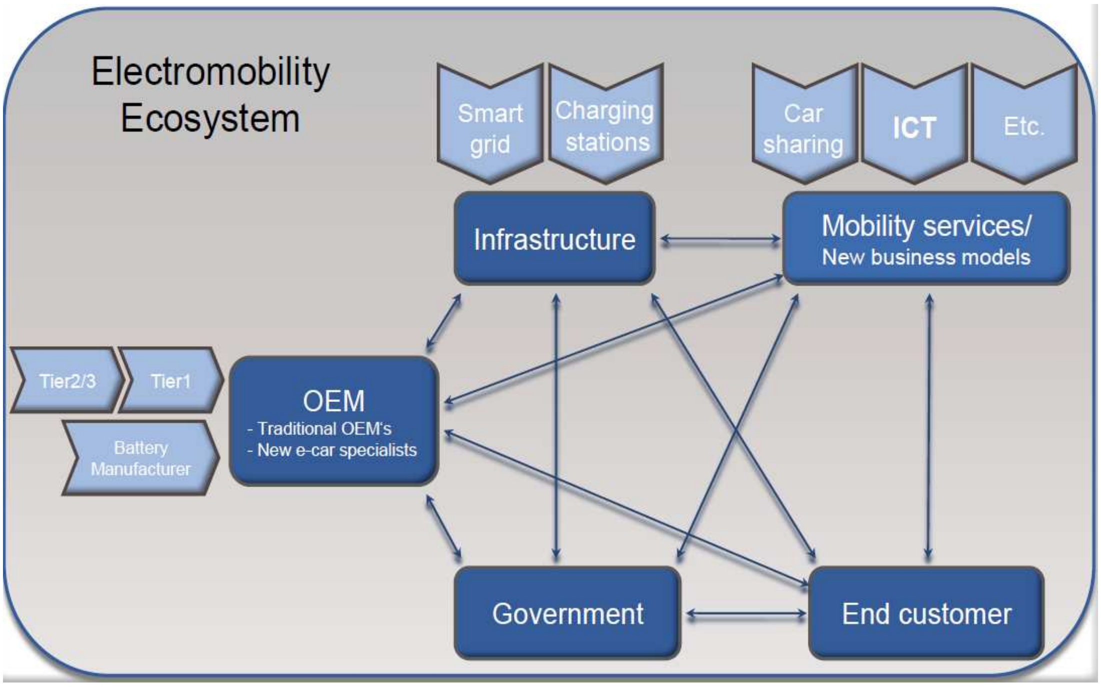


Figure 3 Electric vehicles ecosystem(Finpro, 2010)

- The whole picture for the future electromobility is still unclear, and the market predictions are partly contradictory as well as the opinions about the winning technology (e.g. battery electric vehicle vs. fuel cell).
- Electromobility will thoroughly shake up the automotive industry by creating many opportunities for innovative companies, but also will pose serious risks for both established and new players.
- There is uncertainty concerning earning logics – business models within electromobility can somewhat be foreseen, but a sharp picture is still missing.
- Standardization at European and global levels is needed for technology and preparing of the market for electric vehicles.

Catalyst Strategy Consulting with partnership of MEC Intelligence (2011) have presented some inhibitors and drivers for deploying EVs, based on data gathered from test fleet of electric vehicles, which was driven by families and public officials over a period of 12 months (2009-2010), in Copenhagen, Denmark (Figure 4).

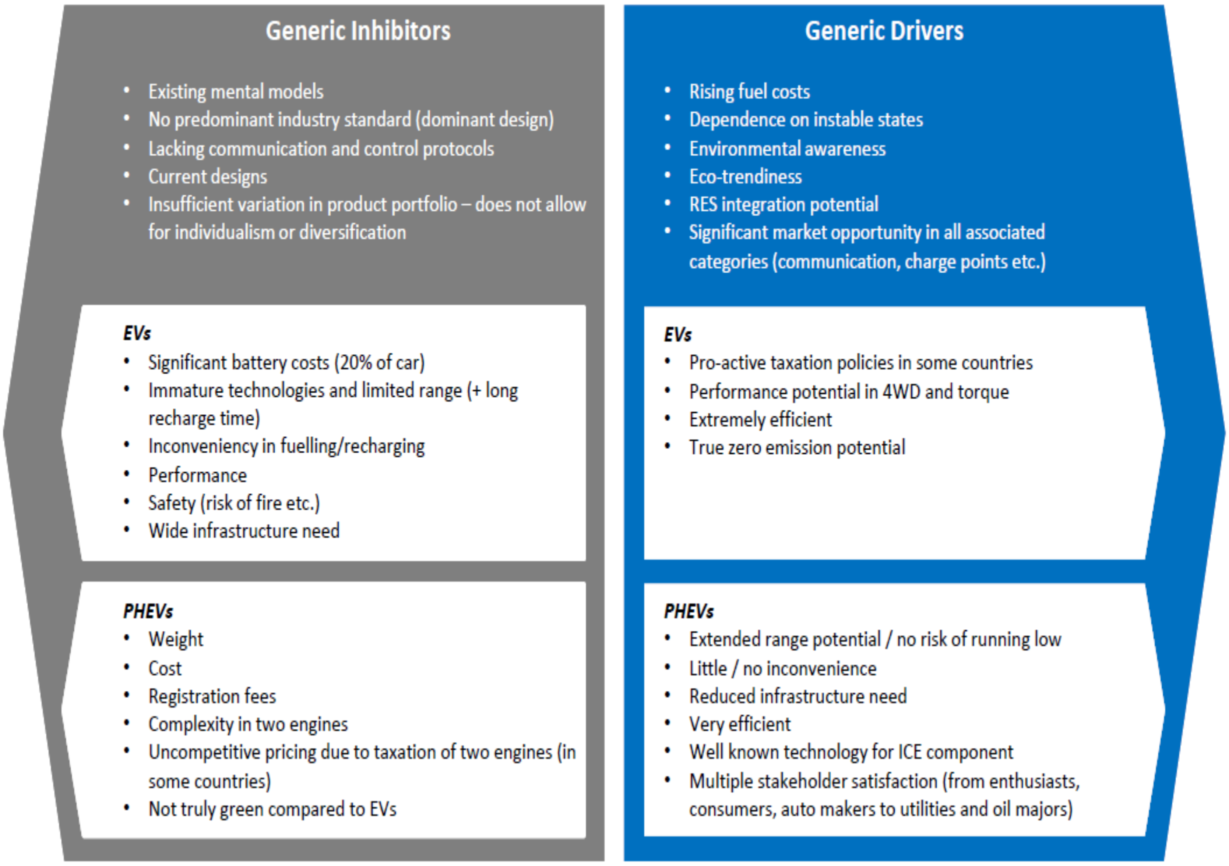


Figure 4 Overall assessment of main drivers and inhibitors of Electric Vehicles(MEC Intelligence, 2011)

Data Monitor consulting firm studied the market trends for hybrid and electric cars in the largest European automotive markets, namely France, Germany, Italy, Spain, and UK (Data Monitor 2011). Some aspects included in the study are the market trends and consumer insights. Based on this survey, the majority of respondents are willing to buy a hybrid/electric car, with a similar degree of willingness expressed among various demographic groups. Across the top five markets, initial purchase price, after-sales service, and running (fuel) costs are the most important criteria when buying a new car. The major drivers for the purchase of hybrid/electric cars are low running (fuel) costs, a low carbon footprint, and government incentives. Despite government incentives being one of the major drivers for the purchase of a hybrid/electric car, in all the top five markets except in Italy, the majority of respondents are not aware of these government incentives. Otherwise, across the top five European countries, concerns regarding charging infrastructure, after-sales services, initial purchase prices, and perceived high recurring costs are the major inhibitors for the purchase of hybrid/electric vehicles.

3. INFORMATION SERVICES DEVELOPMENT

3.1. Business intelligence sources

Several studies have been conducted to identify what kind of information services related to electric vehicles would be needed in order to speed up the EV deployment. Frost and Sullivan (2009) identify the EV telematics package that contains Point of Interest (POI) package and navigation package that are believed to be crucial to reduce range anxiety and range conservation (Figure 5). Other potential services for the EV drivers are monthly EV miles report generating, entertainment on-demand-information, remote vehicle diagnostics and interior pre-conditioning.

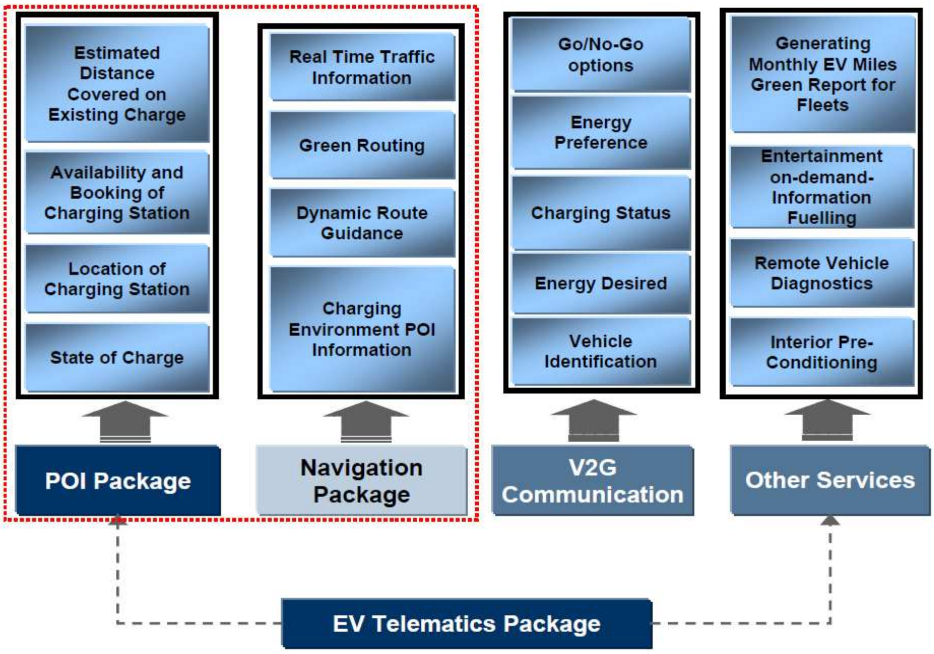


Figure 5 Telematics market for electric vehicles: services overview for Europe and North America(Frost and Sullivan, 2009)

SBD (2010) views that there are two main ways the EV telematics services could be implemented (Table 1). The first one is over-the-air telematics which replicates existing telematics services that use a cellular connection (either using an embedded phone module or via a Bluetooth connection to the user's mobile phone) to send data to and from the car. Secondly, there is a plug-in telematics which utilises charging connectivity that may be physically linked to a communication network, to send data to and from the car based on smartgrid. SBD (2010) also points out that the smart grid could facilitate two-way communications – for this purpose, Advance Metering Infrastructure (AMI) is needed. Some examples of undergoing cooperation related to the AMI are the e-mobility Berlin project (Daimler and RWE), Mitsubishi and JDS i-charger AMI programme, Nissan and General Electric in the United States, etc.

Table1 The overview of telematics use cases and challenges for EVs (SBD, 2010)

EV telematics approach		Key use cases	Challenges
Over-the-air telematics	Delivering services remotely via a cellular network	1. Charging status info 2. Charging station info 3. Charging billing services 4. Remote diagnotics 5. LBS services	1. Most services require embedded SIMS 2. Telematics value chain is still immature
Plug-in telematics	Delivering services via the charging plug whilst the car is physically connected	1. Optimised charging 2. Automatic payments & billing 3. value-added services	1. Different communication standards for different regions 2. Most charging stations and homes unlikely to be connected to a smartgrid for the foreseeable future

3.2. Automotive manufacturers' offering of information services

Several in-car telematics services are being developed by some vehicle manufacturers. The first example is Nissan Leaf with its telematics services namely Carwings. It provides services to the driver including information about state of charge, estimated distance with current charge, nearest charging station information and hours left until the battery is full when charging. The driver could also pre-schedule a charging time and turning on of the air conditioning system, among other services.

GM Volt is using its OnStar application in providing telematics services to the driver. Several services offered are not too different with Carwings. Navigation services as well as battery charging monitoring are delivered by this application. Charging status, charging mode, lock/unlock, remote air conditioning control are also provided.

Quite similar to the abovementioned, several basic telematics packages are offered by other vehicle manufacturers like Renault Zoe with its R-link, Peugeot iOn with its Peugeot Connect services, Ford Focus electric with its Airbiquity, MyFord Touch ®, and SYNC, etc. Table 2 shows several examples of over-the-air/ in-vehicle telematics services. However, several electric car manufacturers like Th!nk city, Reva, or Tesla roadster do not offer special applications or dedicated telematics packages besides the basic crucial information in the vehicle dashboard that are needed to operate EVs.

Car manufacturers are also seeking new partnerships and cooperation with other stakeholders in order to provide innovative information services that have a broader scope. For example, GM together with utilities, energy companies and technology firms will release smart grid Application Programming Interfaces (APIs) for integrating EVs with smart grid technology.

The smart grid APIs will be focused on several developed solutions including (Telematic News, 2012):

Demand response – This solution connects utilities to companies that have intelligent energy management products. These companies can use OnStar to manage energy use for Volt customers who opt in for the service. This future service allows the customer to save money in energy costs while enabling more efficient use of the electric grid.

Time-of-use (TOU) rates – OnStar can receive dynamic TOU pricing from utilities and notify Volt owners of the rate plan offers via email. Owners will be able to use OnStar to load the rate plans directly into their vehicle and access them to schedule charging during lower-rate periods.

Charging data – OnStar also sends and receives EV data to/frompower suppliers. This includes location-based EV data that identifies charging locations and determines potential load scenarios.

Aggregated services – This solution allows electric service providers to manage the charging of participating vehicles in a given geographic area, after customer consent. This includes the ability to control charging on a large amount of EVs simultaneously. OnStar recently showcased these capabilities on Google’s “Gfleet”, where a Volt would receive a renewable energy signal provided by an energy management company, opening up the potential to alert EV customers when renewable energy is available on the grid for charging.

Car manufacturers are gradually opening their in-vehicle and telematics data for third party developers. This is not restricted to electric vehicles but there is a need to boost telematics services for all vehicles. For instance, General Motors have also opened access to OnStar (GM’s telematics service suite available in the US, Canada and China) to selected developers via proprietary Application Program Interface (API) to create innovative mobile applications (GM, 2012). Car manufacturers are able to provide vehicle data via their telematics system by opening a data interface usually to selected partners. Application developers may have an access to multiple telematics systems and hence provide the same service for several vehicle brands.

One of the first third party mobile applications for electric vehicles is GreenCharging app, which can connect to Nissan’s Carwings and General Motors' OnStar services and retrieve accurate state-of-charge information about Nissan Leaf or Chevrolet Volt (Greencharge, 2012). Another approach comes from Ford that has launched together with Bug Labs an Open-Source R&D Platform called OpenXC. OpenXC is an open source hardware and software stack allowing third parties to connect to an OpenXC-compliant Ford car and read a limited set of vehicle data with an Android device. OpenXC platform will be officially released in 2012. (OpenXC, 2012).

One of the basic information services, which is offered to electric vehicle drivers usually by the vehicle manufacturer, is the location of the charging points. This information is provided via in-vehicle navigation system where charging points are one of the key destinations similar to other POIs. Location of the charging points is collected and integrated into digital maps by the map provider of the in-vehicle navigation system. For example, NAVTEQ has collected already in 2011 over 5,000 verified EV charging locations throughout Europe. The charging point data includes information on location, private access, connector- or power feed types, the number of connectors, and opening hours and payment methods. As the EV market expands, more dynamic information such as availability of a specific charging port at a specific time will be included (NAVTEQ, 2011). In the Nordic countries the collection of available electric vehicle charging locations is currently being collected into a common database from which the data will be open and freely available for developers as well as for map providers (Norden, 2012).

Table2 Examples of EV telematics from car manufacturers

Vehicle manufacturers	EV telematics services	Services offered
Nissan Leaf	Carwings	Estimated distance in current charge; climate control; fully-charged notification by email; timer function for charging
GM Volt	Onstar	Navigation, Battery charging monitoring, charge status, remote climate control
Renault Zoe	R-link	Includes a host of new functions dedicated to electric motoring and range management: histogram of energy consumption, display of energy flows and pre-programming of battery charging. The navigation system offers bespoke services such as a display of the vehicle's operating radius based on the range remaining in the battery, suggestions for the most energy-efficient itineraries and the location of nearby battery charging stations (depending on country), as well as their real-time availability. R-Link also lets drivers view their eco-driving performance and improve their technique with 'eco-scoring' and tips
Peugeot iOn	Peugeot Connect services	Peugeot Connect Fleet: Battery charge status, remaining range of vehicle, mileage before the next service, etc. Including Peugeot Connect SOS and Peugeot Connect Assistance for emergency or repair services.
Citroen C-Zero	Citroen eTouch	Includes two services on-board: Citroen localised assistance calls and Citroen localised emergency calls.
Ford Focus electric	Five -way buttons on the steering wheels; MyFord Touch®; SYNC; Airbiquity	Battery charger status, distance to the next charging stations, navigation, EcoRoute, climate control, entertainment
Toyota (Prius, RAV4 EV)	Owner's navigator, eConnect, Toyota Friend, Battery care and checking, Charging service.	Vehicle status (battery power and EV range), locations of nearby charging stations, etc.
Others: VW E-up, Daimler (Smart fortwo ed, Mercedes SLS E-cell), Mitsubishi i-MiEV, Audi E-tron R8, Fiat 500 E, Honda Fit EV, Th!nk city, Tata Indica Vista EV, Tesla (Roadster, Model S Signature),Reva (G-Wiz). There is no specific information available through websites concerning these manufacturers' EV telematics services.		

Telenor Connexion has been chosen as the European connectivity supplier for Renault's sophisticated telematics services available on new Renault electric and fuel vehicles. Telenor Connexion's dedicated connectivity solution helps Renault's sophisticated on-board unitto connect to the Renault Global Data Center in a private network environment,allowing Renault to provide its end customers with a wide range of services and information. This is made possible by seamless communications via cellular mobile networks in all of Europe, plus Russia and Turkey (Telenorconnexion, 2011).

Another set of services related to EVs are emergency charging services. The automobile club AAA (the American Automobile Association) plans to deploy mobile charging units for battery-electric vehicles. AAA already has at least one working unit and plans to post additional vehicles in California, Florida, Georgia, Oregon, Tennessee and Washington. Roadside assistance trucks will have Level 2 and Level 3 chargers, offering 240 volts and 500 volts of alternating current, respectively (Bright Sight Of News, 2011).

4. ELECTRIC VEHICLES TEST SITES

In the coming years the sales of EVs are expected to increase and seeing an EV in the traffic will become an everyday experience. With this development comes also a need to ensure that the EVs can be charged effortlessly on all charging posts regardless of car brand, EV service operator or power producer. The users will experience that charging and billing occurs seamlessly across operators and geographical areas. To ensure that all players experience true *interoperability*, a national test centre is founded in Denmark. To test the concept and obtain experiences with the first EV operators, the Nordic EV Interoperability Centre (NEVIC) will perform initial test procedures and demonstrate the concepts during late 2011, and first months of 2012. The new NEVIC will have both fast charging and standard charging facilities supplied by various service providers.

Many countries and regions over the world nowadays have conducted some test sites for electric vehicles deployment. These test sites for electric vehicles are implemented to monitor and evaluate the whole electric vehicles ecosystem performance, including vehicles, infrastructures, users, governments, etc. before massive implementation is employed.

Several regions in the United States are already implementing EV test sites, e.g. Greenville, Kearney, Dallas, Auburn Hills, and New York. General Electric (GE) has chosen Greenville as EV test city. There are more than 40 GE electric vehicle charging stations that will be installed at hotels, the Greenville–Spartanburg International Airport, downtown businesses and other locations. In addition, more than 10 electric vehicles will be delivered to a rental fleet. GE will also be launching a membership–based car sharing program, namely WeCar, in downtown Greenville using electric vehicles.

The Nebraska Clean Cities – Coalition has selected Kearney as a pilot community to introduce electric cars and charging stations in Nebraska. Kearney will become a model community for electric vehicles development. The next city participating in EV test site is Dallas, which plans three pilot programs that includes providing cars, charging stations, and free electricity. For the third program (providing free electricity to public), the city council still is still considering options.

One of the large car manufacturers, the Chrysler Group, in partnership with the US Department of Energy, will deliver four demonstration plug-in hybrid electric pickup trucks in the city of Auburn Hills, Michigan. This demonstration program is part of a national demonstration fleet of 140 vehicles during the next three years to evaluate customer usage, drive cycles, charging, thermal management, fuel economy, emissions, and impact on the regions’ electric grid.

Finally, New York City will participate to test battery electric vehicles (Nissan Leaf) in taxi fleet in 2012. There are six cars that would be tested in this pilot program, to study how electric – drive vehicles perform in the largest US taxi fleet.

In Germany, a logistic company that is providing postal and parcel delivery services will test Fiat 500 E electric vehicles. Whereas in Hanover, Volkswagen tested seven electric city vans, VW Caddies for two years in field trials.

In France, a new public electric cars scheme namely Autolib' has been applied since December 2011 in Paris. Autolib' is an electric car rental service that provides the users with 24/7 transport services in French capital and surrounding cities. To use this service, the users simply have to hold a driving license and subscribeto the service at the station. There are 250 stations located in Paris and 3,000 cars will eventually be available by 2012. Furthermore, French carmaker Renault has opened a new EUR28m electric vehicle test facility in Lardy, France, which houses most of the test facilities for electric motors and batteries. Renault has also opened the Renault ZE (Zero Emission) Centre in Boulogne-Billancourt, the first such center to be opened in Europe by a vehicle manufacturer. The center aims to share the ZE experience with all visitors by demonstrating Renault's EV offering and its ambitions in electromobility.

In Sweden, Test Site Sweden (TSS) will create world-class demonstration and testing environments for next generation of vehicles and transport infrastructure. They will deploy two CHAdeMO fast charge stations in the Gothenburg area and perform tests with EVs. The purpose is to establish a test environment that is open for organizations that have a need of testing EV fast charging stations.

Several countries in Asia-Pacific region like China, Singapore, Japan,Philippines and Australia have also participated in EV testing. In China, Honda has begun demonstration testing of its Honda Fit EV in the city of Guangzhou, whereas Volvo cars chose the city of Shanghai to test its C30 electric cars. An infrastructure of over 13,000 charging stations and 15 battery swapping stations is being built there. Furthermore, Zheng et al., (2012) conducted a survey among 13 pilot cities in China that have participated in electric vehicle demonstration programs. Table 3 shows the Alternative Fuel Vehicle (AFV) deployment plan in the 13 pilot cities in China.

Singapore has also launched its electric vehicle test bed involving three outdoor and two indoor charging stations. The first batch of EVs comprises five Mitsubishi i-MIEVs and four smart Electric Drive (ed) Daimler vehicles.A partnership is established between the Land Transport Authority (LTA), Ministry of Manpower (MOM), Mitsubishi Corporation and Senoko Energy. The test bed aims to gain better understanding of EV technologies, business models, and user preferences.

In Japan, Saitama city has a total of 57 EV charging station to test the EV infrastructure. This test aims to gather information about how often each station is used, how often each user charges their car, how much power is needed by each station, etc. Hitachi Solutions, NTT Data and NEC are participating in providing the monitoring system.

An electric vehicles test site for public transport is operated in Makati City, Manila (Philippines). There are 21 electric jeepneys, each accommodating 14 passengers, to be lunched there.

Australia has also tested 20 electric cars in Hunter and Sydney. There are fifty-six charging stations being installed for the trial. Moreover, Florianopolis city in Brazil will become the test city for the electric automobile Hiriko. Hiriko was first launched in January 2012 in Brussels as an example of sustainable mobility. Figure 6 shows these EV test site examples in one glance.

Table 3 AFV deployment plan of the 13 pilot cities (Zheng et al., 2012)

City name	Number of AFVs (by year)	Vehicle type	Services fields
Beijing	1000 (2009); 5000 (2012	HEV and PEV, considering FCV	Buses and sanitation vehicles
Shanghai	4157 (2012)	N/A	N/A
Chongqing	2550 (2012)	HEV (Gasoline Electricity Hydbrid Vehicle and Natural Gas Electricity Hydbrid Vehicle)	Buses, taxis, official-duty vehicles and passenger cars
Changchun	1000 (2012)	HEV and PEV	Buses, official-duty vehicles
Dalian	1200 (2010); 2400 (2012)	HEV, PEV and FCV	Buses, taxis, official-duty vehicles and passenger cars
Hangzhou	3000 (2012)	N/A	N/A
jinan	1600 (2012)	HEV and PEV	Buses, taxis, official-duty vehicles, sanitation vehicles, postal service vehicles, tourist buses
Wuhan	2500 (2012)	HEV and PEV	Buses, taxis, official-duty vehicles and passenger cars
Shenzhen	More than 800 buses (2010); 24.000 AFVs (2012)	HEV and PEV	Buses, taxis, official-duty vehicles, bussines vehicles, passenger cars
Hefei	1400 (2012)	PEV	Buses, taxis, official-duty vehicles
Changsa	4570 (2012)	N/A	N/A
Kunming	1000 (2012)	HEV, considering PEV	Buses
Nanchang	1100 (2012)	HEV and PEV	Buses, taxis, official-duty vehicles, postal service vehicles, sanitation vehicles.

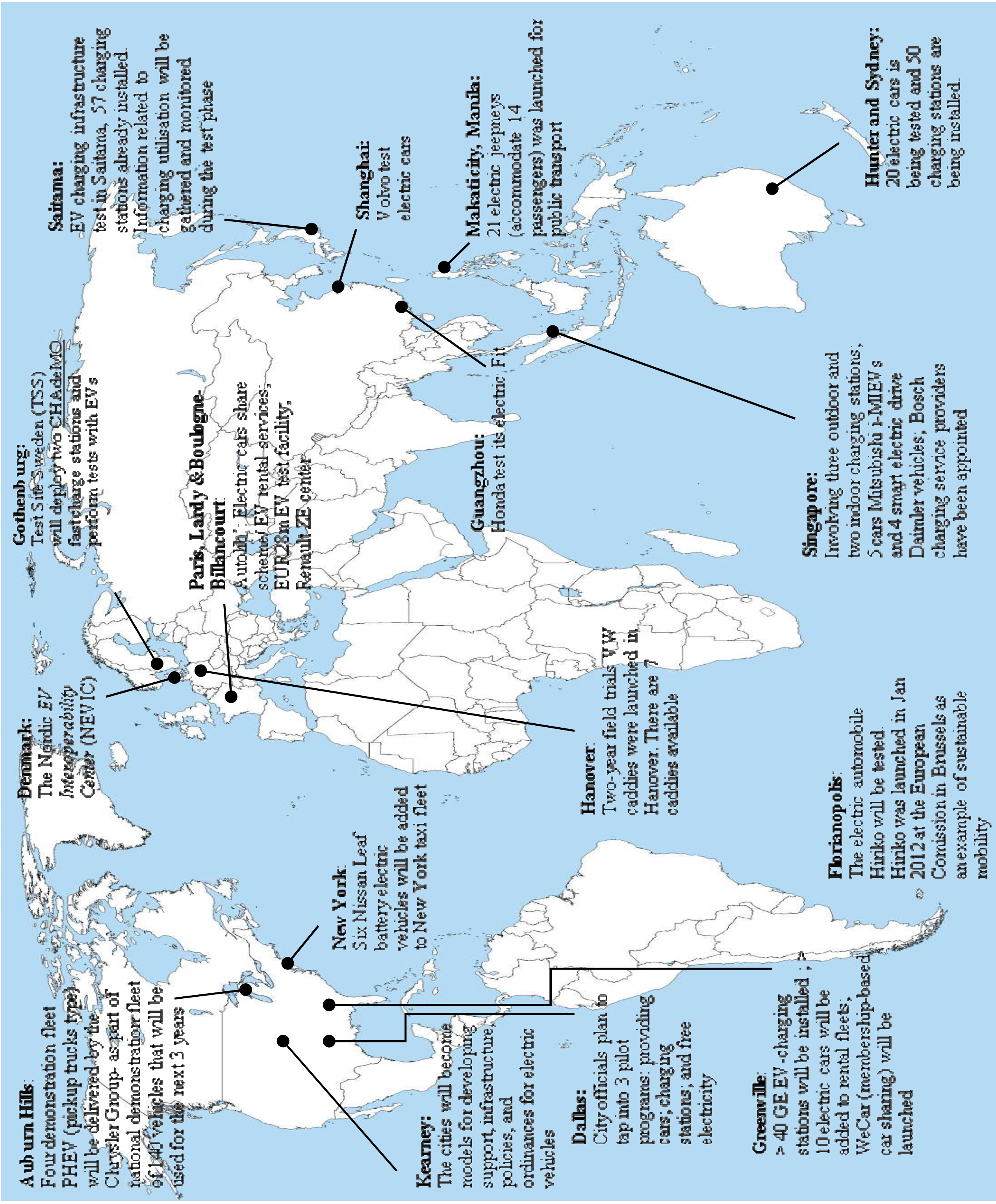


Figure 6 EV test sites examples

5. CONCLUSION

Clearly the business intelligence and market foresight analyses provide a picture of a vivid and active EV industry in its infancy. The test sites are already emerging around the globe and the master driver seems to be the automotive industry, which is not a surprise. Two other keen actors are the battery suppliers and energy utilities, particularly those who own their networks and not only the production facilities. Both the automotive sector and the utilities have a strategic expansion potential in the value network of EVs.

The market actors' work in developing novel service concepts and demonstrating them in their test sites is already running at full speed. Once the market penetration starts to take place for real, these early actors are in the best comparative position – provided that they have been able to successfully pilot their own concepts.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

Bright Sight Of News. 2011. *AAA pioneers mobile electric vehicle charging services*. available on: <http://www.brightsideofnews.com/news/2011/8/1/aaa-pioneers-mobile-electric-vehicle-charging-services.aspx> [accessed on June 1st 2012].

Data Monitor, 2011. *Hybrid and Electric Car Market in the Biggest European Automotive Markets: Trends, Consumer Insights, and Future Outlook*, January 2011

Frost, Sullivan, 2009. *Strategic market and technology assessment of telematics applications for electric vehicles.*

Frost, Sullivan, 2010. *360 Degree Perspective of the Global Electric Vehicle Market - 2010 Edition*

GM, 2012. Calling All Developers: OnStar Looking for Next Big App. available on: <http://media.gm.com/media/us/en/onstar/news.detail.html/content/Pages/news/us/en/2012/Jan/ces/0108_onstar_api.html> [accessed on May 25th 2012]

Greencharge, 2012. GreenCharge - Take control of your electric car. available on: <http://www.greenchargeapp.com/> [accessed on May 25th 2012]

Koskue, M., Talka, M., 2010. *Electric Vehicles*. Finpro report, 25 November 2010

MEC Intelligence, 2011. *Drivers and Inhibitors of Electric Vehicles: Based on data from a live test fleet of electric vehicles*. Report, December 2011

NAVTEQ, 2011. NAVTEQ's Latest Press Releases: NAVTEQ Adds More Electric Vehicle (EV) Charging Locations to Its Extensive Green Content Portfolio. available on <http://press.navteq.com/index.php?s=4260&item=26578> [accessed on May 25th 2012]

Norden, 2012. Mapping electric fuel stations. available on: <http://www.nordicenergy.org/project/mapping-electric-fuel-stations/> [accessed on May 25th 2012]

OpenXC, 2012. available on: <http://openxcplatform.com/> [accessed on May 25th 2012]

SBD, 2010. An overview of opportunities and challenges for EV telematics. White paper

Telematics News. 2012. GM releases Smart Grid APIs for Chevy Volt, via OnStar. available on: <http://telematicsnews.info/2012/02/03/gm-releases-smart-grid-apis-for-chevy-volt-via-onstar_f3032/> [accessed on April 4th 2012]

Telenorconnexion, 2011. New Renault electric and ICE cars connected through Telenor Connexion, available on: <http://www.telenorconnexion.com/news/new-renault-electric-and-ice-cars-connected-through-telenor-connexion#more-3336> [accessed on June 1st 2012]

Zheng, Jie et al., 2012. Strategic policies and demonstration program of electric vehicle in China. *Transport Policy* 19, 17-25