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Global Opportunities for Small/Medium Enterprises in e-mobility (GO4SEM)

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Europe has successfully extended its competencies in key enabling technologies for electric mobility in recent years, especially in the field of information and communication technologies, components and systems (ICT). Small and medium size companies (SMEs) have played a crucial role as sources of creativity at all stages of the supply chain. Given the new supply chains for e-mobility being established worldwide, many potential target markets are located outside of Europe, e.g. in highly innovative regions such as the United States, Japan and South Korea or in emerging markets like China and India.

In light of this situation, “*Global Opportunities for Small and Medium Size Companies in Electric Mobility*” (GO4SEM), coordinated by the Vrije Universiteit Brussel (VUB) and the European Association of Automotive Suppliers (CLEPA), is aimed at giving policy advice to sustain and enhance the successful access of European SME’s in supply chains in the abovementioned global markets. For this purpose the GO4SEM consortium (consisting of SMEs and regional clusters, Tier-1 automotive suppliers, and research institutions from all around Europe) intends to spread awareness of international market developments and technological trends in the electric mobility context, triggering an engagement of European SMEs in global FEV value chains by indicating potential and to show opportunities for bringing in expert knowledge. Furthermore, recommendations on standardization, education, and research matters are formulated.

In a broader sense, the project will support to strengthen the global competitiveness of the European industry being active in the domain of electric mobility by linking the relevant stakeholders, preparing them for and increasing the awareness of the opportunities and challenges of worldwide developments.

This contribution will present the output of the first term of the project. Firstly, in terms of mapping the global e-mobility supply chains and identifying possible entry points considering the above-mentioned target markets.

Keywords: e-mobility, global markets, value chain, ICT, SMEs

1 Introduction

The European automotive industry is of strategic value for the European economy, representing around 12 million direct and indirect jobs, and delivering a sizeable positive contribution to the EU trade balance (€ 90 million in 2011). However, Europe may lose its leading and pioneering position in the global automotive industry, especially with respect to advanced e-mobility. The BRIC countries global market share is set to rise over 40% by 2016, and China became the world's largest carmaker in 2009 with production hitting 13.79 million units. It is foreseen that China will export at least a million of cars by 2017.

The main goal of the new EU coordination Action Global Opportunities for small/medium-sized enterprises (SMEs) in electro-mobility (GO4SEM) is two folded: on the one hand it aims to support European SMEs for their entry in global emerging e-mobility markets with a focus on India and China. On the other hand it also assesses business opportunities in more mature international markets, with a known or renewed interest in e-mobility, such as Japan, South Korea and the USA. The objective is to raise awareness of global market trends and opportunities and to trigger the creation of dedicated professional networks in the field of electric mobility. Moreover, policy advice, e.g. on standardization or education, will be given.

This two-year project started in September 2013. It involves partners from Belgium (VUB and CLEPA), Germany (VDI-VDE/IT, HELLA), Italy (eTOED), United Kingdom (MIRA Ltd.), Luxembourg (Delphi Luxembourg), Spain (AUTOMON), the Netherlands (NXP) and Romania (ICPE). It includes European industrial and academic partners as well as associations. This project is funded by the European Commission (DG CONNECT - Directorate General for Communications Networks, Content and Technology).

The purpose of this paper is to provide insight into the status of global markets and e-mobility supply chains and technological state of the art. Potential entry points for European SMEs in the international supply chains are identified in view of trends on the leading and emerging electric mobility markets providing trade and cooperation opportunities for European experts. Moreover, the composition and performance of supply chains as well as mutual dependencies of the players involved in relevant global markets, e.g. USA, Japan, South Korea, China and India are investigated. And last but not least, the interplay of specific user needs, market requirements and supply chains is evaluated.

2 Analysis of global e-mobility markets

This section summarizes the analysis on selected e-mobility markets carried out in the GO4SEM project. USA [1], Japan [2], South Korea [3], China [4] and India [5] have been analysed in depth regarding new developments and trends in the field of electro-mobility, which potentially provide entry points for European SMEs on the respective market. This is based among other on the detailed investigation of the supply chains for battery electric vehicles and plug-in hybrids and of the strengths and weaknesses of the relevant industrial sectors within those countries. This information is complemented by insight into the current status of EV deployment, infrastructure development and supporting national policies. Complete reports on each country containing references for below information can be found on the GO4SEM project webpage: <http://www.go4sem.eu/public>.

2.1 United States of America

2.1.1 Situation and Framework Conditions

Nowadays the USA has the largest market share of plug-in electric vehicles (PEV) on the roads with more than 160.000 battery electric vehicles and plug-in hybrids. The evolution dynamics of this

new market is comparable to early phases of the deployment of hybrids in the U.S. though faster, and its global leading position is both due to the advancement in related technologies and to the remarkable success of the Tesla Model S introduced on the market in 2012. A wide variety of PEV models is currently available on the U.S. market, alone 17 American models suitable for driving on highways among which the most sold one is the plug-in hybrid Chevrolet Volt as well as various models of electric motorcycles, utility vans, and “neighbourhood electric vehicles” for covering short distances.

The USA seeks to reduce their strong dependency on foreign oil imports in order to guarantee more economic stability and sustainability; other motivations for the development and implementation of electric mobility in the USA are the creation of jobs in the emerging PEV industry and the reduction of CO₂ emissions. A full transition to electric-drive vehicles could lead to a reduction of the dependence on imported petroleum and of greenhouse gas emissions of the U.S. by more than 80% and 60%, respectively.

In order to promote the PEV market the U.S. government has launched some large initiatives and funding programmes, for example, the “EV Everywhere Grand Challenge”. The U.S. Department of Energy (DoE) aims at making PEVs accessible and convenient for the average American family. Thereby it follows the three main strategies of promoting technological R&D funding, pushing the installation of charging infrastructure, and raising the consumer acceptance and demand for PEVs. Monetary incentives such as tax reductions between \$2,500-\$7,500 or complete exemptions, depending on the state, or free charging at certain public facilities are provided to PEV drivers. In addition, non-monetary benefits as the use of high occupancy vehicle lanes for PEV drives and exemptions from a potential general ban on driving in city centres are important incentives. “Clean cities” is a further important programme from the DOE to facilitate the deployment of low emission vehicles and user-optimized urban charging infrastructure in collaboration with communities, catalysing up to 15 communities as real-world laboratories for PEV use in 24 states as yet. Public organizations and private companies in more than 100 coalitions contribute to the build-up of green transport solutions in communities by placing public charging stations at relevant facilities such as shopping centres or

hospitals. In addition, the DoE wants to accelerate the development and deployment of solutions for wireless power transfer (WPT) such as consumer-friendly inductive charging stations.

2.1.2 Trends

Both corporate and public research institutions are currently making large efforts to enhance the performance of PEVs and components and to develop the charging solutions required. The focus of their R&D activities is on battery technologies, foremost on the increase of storage capacity and power densities of lithium-ion batteries, in order to build a U.S. battery manufacturing industry. Tesla as a former start-up and now with the highly successful Model S the world’s biggest EV manufacturer invests large budgets in R&D and imposes new technological trends. In early 2014, Tesla indicated its idea to establish a plant for mass manufacturing of EV batteries in Nevada together with its strategic partner Panasonic. Construction works already started in the same year. The battery “gigafactory” shall equip as many as half a million Model S vehicles per year by in-house production.

Another trend is the application of on-route EV charging. In 2012 the California Department of Transportation (Caltrans) released the Draft Environmental Report/Environmental Impact Statement (EIR/EIS) on the “Interstate 710 (I-710) Corridor Project”. The goal of the I-710 Project is to turn the Long Beach Freeway in Los Angeles into a “Zero Emission (ZE) corridor” by the horizon year 2035, in order to improve air quality, public health, and safety on one of the busiest highways in the country. According to a study by the California-based clean technology organization CALSTART, the most feasible solution for achieving this is a “dual mode” or “range extender” hybrid electric vehicle (HEV) combined with an infrastructure power source such as overhead wiring, in-road or on-road charging, respectively. At NASA Ames Research Center, a wireless fast charging system has been developed based on Pulse Transmission Nanocomposite Magnetic Resonant Coupling (PNMRC); the system enables for charging electric vehicles both stationary or in motion with an expected efficiency exceeding 90%.

Another promising approach currently tested in the U.S. is the “On-Line Electric Vehicle (OLEV)” technology invented at the Korean Advanced Institute of Science and Technology (KAIST). The OLEV technology uses the Shaped Magnetic Field in Resonance (SMFIRTM) method to send electric

power over a significant distance without using conductive wires.

2.1.3 Entry Points for European SMEs

In view of the ambitious goals of the U.S. PEV market, an increasing demand for vehicle and component technologies, charging infrastructure and electric mobility services is expected. Thus, business opportunities are given for European companies, e.g. regarding their profound know-how in many key technologies of the electric power train. As the future common standard for multiple levels of electric vehicle AC and DC charging in Europe and the USA, the Combined Charging System (CCS) with the appropriate COMBO plug was unveiled in early 2013, developed with backing from American and German automakers. It will be implemented as a standard on vehicles from mainly German and U.S. carmakers. In general, good entry points to the U.S. market are given by joining one of the relevant industrial networks and alliances such as the Electric Drive and Transportation Association (EDTA) as the trade association promoting battery, hybrid, plug-in hybrid and fuel cell electric drive technologies and infrastructure.

2.2 Japan

2.2.1 Situation and Framework Conditions

Japan is a pioneer and the world's most advanced market for electric mobility. This applies to research and development in the field of batteries as well as to the production and market introduction of electric vehicles and plug-in hybrids. Today, all big Japanese car manufacturers have at least one model of an electrified vehicle in their portfolios.

The reasons for the remarkable success and progress can be attributed to various circumstances and early developments. One important factor is the governmental support of research and development of battery and energy storage technologies at an early stage. The entertainment electronics company Sony put the first lithium-ion battery on the Japanese market in 1991. Meanwhile, a number of other companies worked on its technological improvement, continuously funded by the government. Today, some of the world's biggest battery manufacturers are Japanese companies. A strong environmental awareness in Japan and the need for energy conservation measures, paired with the high technology affinity of many

Japanese people, served as an important trigger for the broad acceptance of electric vehicles and an enormous growth of the Japanese market for hybrid vehicles in the past decade. The lack of fossil resources on the Japanese island combined with an increasing energy demand further boost the development of electric mobility, since the second major part of Japan's energy consumptions can be attributed to the transport sector.

2.2.2 Trends

The development of electric mobility in Japan follows a systematic and holistic approach. Electric vehicles are integrated in so-called smart communities in which urban infrastructure and buildings are connected to an intelligent IT infrastructure and centrally managed to optimize energy efficiency within the entire system. In these smart communities, the batteries of electric vehicles are primarily used as mobile storage for fluctuating renewable energies and as emergency energy supplies for smart homes.

In Japan, the use of cars is usually constricted to urban areas thanks to a highly developed network of high speed trains for long-distance transport and hence, mostly short distances need to be covered by cars. In addition, a multitude of available (fast) charging stations (CHAdeMO) enable the use of electric vehicles also in rural areas. Financial purchase incentives from the government in various funding programs lower the barriers for potential customers and promote the broad deployment of electrified vehicles. Hence, limited range and high purchase price are much less a barrier in Japan. By today, a total of 74,000 battery electric vehicles are rolling on Japanese roads making Japan the second biggest market after the USA.

The supply chains of full electric vehicles are organized in traditional large network structures called keiretsu. These are determined by long-time faithful business relationships between the companies belonging to a keiretsu and close cooperation in the entire development processes. However, in the face of increasing globalization, these networks are forced to change in order to adapt to modern requirements. Moreover, the protective and long established keiretsu are, on the other hand, vulnerable to external forces, as became evident in the triple catastrophe in Fukushima in March 2011. For multiple months after the tsunami, large parts of the automobile production came to a complete standstill due to the damage of single suppliers. The reformation of automobile supply chains in the near future will

lead to good opportunities for the integration of foreign companies in the new value chains, primarily in regard of production related matters.

2.2.3 Entry Points for European SMEs

It is expected that Japanese carmakers will not only retain their role as a leader in plug-in hybrid and electric vehicle development and production in the future, but that the related industries will continue to expand their competitive position also into the growing external markets for electric vehicles. Opportunities for European companies on the Japanese electric mobility market (inside and outside of Japan) mainly arise from complementary technological know-how, for example in the field of energy efficient vehicle architectures, new materials and mechanical engineering.

2.3 South Korea

2.3.1 Situation and Framework Conditions

Since 2009, the Republic of Korea has been following plans to promote green growth and low-carbon vehicles. Though the Korean EV market is still small, exhibiting just about 3,000 electric vehicles on Korean roads in early 2014, it is most dynamic and has the potential to grow fast. The South Korean government envisions the ambitious goal to become the 4th largest market for electric mobility by 2015 and enacted a number of policies and implementation plans in this regard, pushing the country to the forefront of worldwide green initiatives. Almost all Korean car manufacturers announced plans to release EV models within the next year. At present, the Korean EV market already holds global leadership in battery technologies, as several of the world's biggest battery manufacturers are domestic.

The major motivations of South Korean green policies are gaining energy independency on the one hand, due to the country's lack of own fossil resources and high imports of foreign fuels, and climate protection on the other hand. The national target declared in 2010 is to reduce GHG emissions by 34% in 2020. With the long-term National Strategy for Green Growth (2009-2050) the Korean government follows the fundamental idea of a comprehensive transformation to a "Low Carbon Society" comprising sustainability, safety, high life quality, new jobs, and economic growth. A

central part of it addresses the implementation of a "Smart Mobility Concept" for an intelligent and intermodal transport system, based on electric vehicles. For stimulating the Korean green car production the government announced the "EV Masterplan" for green growth and transportation in 2011, which depicts a national roadmap for EV deployment and charging infrastructure development, targeting a number of 1 million electric vehicles and 2.2 million charging stations by 2020; this was modified in the year 2014 down to the delivery of only 200,000 EVs by 2020. Other low-carbon vehicles targeted to a total of 2.2 million embrace plug-in hybrids, hybrids, fuel cell vehicles as well as clean diesel and ICE-converted conventional vehicles. In order to accelerate the deployment of EVs quickly and convince primarily early adopters, a complex system of subsidies and a tax reforms with a bonus-malus taxation system were introduced in 2009. Purchase subsidies shall cover 50% of the price-gap between an EV and a comparable conventional ICE-vehicle.

2.3.2 Trends

Technological development in South Korea in the field of electric mobility is adapted mainly to the traffic situation in cities. To achieve a relief of the urban road traffic and air pollution, car sharing fleets and light electric vehicles such as two-wheelers and low-speed "neighborhood electric vehicles" (NEV) are planned to be progressively introduced in cities, e.g. by providing E-bike sharing systems in Korean shopping districts. In 2010, there were already more than 2.4 million electric two-wheelers on Korean roads. Special concern for the future mobility system is given to concepts for last mile transportation by EVs. Coming along with the trend to light electric vehicles was the unveiling of the foldable electric two-seater "Armadillo" in August 2013 by the Korean Advanced Institute of Science & Technology (KAIST). Another important development by KAIST is inductive dynamic charging, implying so-called online electric vehicles (OLEV) that are powered wirelessly on special roads. This technology is actually tested for buses in the City of Gumi as well as in other testing areas in Korea and the United States. Public and private R&D investments in electric mobility are focusing on EV core parts such as high-performance batteries and battery systems and on the development of smart grids, including quick and normal charging stations, seamless and dynamic road charging, and V2X technologies.

The Korean economic system and EV industry is dominated by large government-sponsored industrial conglomerates, known as “chaebols” which were formed after the Korean war and are usually characterized by comprehensive product portfolios over many industrial sectors and by a closed strictly hierarchical structure; foremost among them are the Samsung and Hyundai groups.

2.3.3 Entry Points for European SMEs

The South Korean car market is clearly dominated by Korean brands (over 80%), though the import of foreign cars has been increasing during the past 5 years with European brands having a share of 81.3% of all imported car models. The South Korean EV market is most promising for European companies to access due to the potential of the highly competitive Korean economy to build new markets and competitive industries quickly and the awaking aim of Korean companies for joining international projects. Comparatively low entrance barriers for foreign companies are given in the sectors for development of ICE-converted electric vehicles and of infrastructure for EV charging or battery replacing as of V2G services. South Korean chaebols are rather hard to access though, better opportunities are business cooperations with Korean SMEs; the government currently set up strategies for promoting the growth of SMEs and building up a stable middle class in Korea.

2.4 China

2.4.1 Situation and Framework Conditions

The automotive industry in China is comparatively young but the most dynamic in the world today. Lacking a long tradition and long-time experiences in the manufacturing of cars, China is pushing even harder on the development of new energy vehicles in order to gain technological know-how and competitive advances quickly and thus, to occupy a leading position on the international market. The Chinese government declared the new energy vehicle industry (NEV) as one of the seven key emerging industries, covering pure electric as well as plug-in hybrid vehicles; in 2011, already a number of 135 different vehicle models were declared as NEVs by the government.

Today, China is responsible for 29% of the global greenhouse gases emitted per year and therewith the world’s biggest emitter. The consequences of the heavy pollution can be

noticed foremost in big cities and industrial regions as grave ecologic and sanitary problems. In order to deal with these adversities the Chinese government released its first “National Action Plan on Climate Change” in 2007, setting targets for the replacement of fossil energy sources by renewable ones. The 12th Five-Year Plan fixed the target of a 17% carbon intensity reduction compared with 2010 levels. The enhanced use of zero emission vehicles is expected to relieve at least the situation in urban areas. The government goal is to have at least 5 million NEVs on Chinese roads by 2020, covering public and private ownership. China’s strategy to promote electric mobility can be categorized into support of R&D activities, of industrial manufacturing and of NEV consumers. High R&D investments have already been made by the government to industry as well as academic research institutions in order to boost the transformation into a green Chinese economy. For instance, the U.S.-China Energy Research Center (CERC) was founded in Beijing in 2009, promoting investigation and commercial success in fields like advanced battery technologies, biofuels, lightweight materials, vehicle electrification, and V2G technologies. A variety of model-dependent purchase subsidies and tax exemptions for NEV users have been introduced to accelerate the market acceptance of electric vehicles. Additional non-monetary incentives have been implemented such as the exemption from a general driving ban in cities for NEV drivers, a granted quota for new vehicle licenses or preferential parking in urban areas.

2.4.2 Trends

There is large potential of the steadily growing Chinese car market, considering the fact that four fifth of the customers are first-time car buyers. Large benefits of China to become a global leader in NEV industries are, on the one hand, the superior experience in electric two-wheelers such as pedelecs and E-scooters as the world’s biggest consumer and producer; on the other hand, the possession of essential natural resources for the production of modern vehicle components, particularly motors and batteries, is of great advantage for China, paired with high outputs of current battery research.

2.4.3 Entry Points for European SMEs

Nevertheless, a broad deployment of NEVs still faces problems such as the lack of charging infrastructure and common standards for charging technologies; though the responsibility for design

and operation of the charging infrastructure is given to the state-owned “State Grid Company” only, there are on-going harmonization and standardization difficulties in combination with the diverse actors in “SEVIA”, the State-owned Enterprise Electric Vehicle Industry Alliance. Furthermore, technological progress and manufacturing of NEV core components is still weak, for example technological know-how regarding safety issues for vehicles and production processes is needed. In sight of these technological weaknesses, there are several options for European companies to integrate in the Chinese NEV supply chain. It is recommended, though, to keep in mind the specialties and requirements of the Chinese market, especially the strong governmental market regulation. One important condition for the establishment of business cooperation in China is the contract of a 50:50 Joint Venture initiative with a local company.

2.5 India

2.5.1 Situation and Framework Conditions

The Indian EV market is at an early stage of development. There is a significant lack of high-tech solutions for electric mobility used in India as well as in the development of the electric grid and V2G technologies. However, India is an attractive market for EVs in the face of the remarkable growth of the Indian car market expected for the upcoming years, due to an immensely increased demand from private drivers; today, there are 13 vehicles per 1000 people, giving large potential for market growth. The Indian car manufacturing industry is the sixth largest in the world already, employing at least 13.1 million people. There is already some evidence for an intended shift into EV-technologies given by the releases of EV models such as the Mahindra Reva e2o, the Tata emo, and Tata Nano by the Indian car industry. Indeed, still Mahindra Reva is the almost sole important player in India, which is, at the same time, the only EV-charging point operator in India with over 100 installed charging stations. The Reva Electric Car Company is the only Indian manufacturer that in addition to domestic production facilities has plants for four-wheeler EVs in Europe.

India is a multicultural and highly hierarchical country that currently faces a strong urbanization and simultaneous increase of air pollution in cities. Moreover, it is the fourth largest oil

consuming country worldwide. In view of this scenario and the ecologic as well as sanitary problems, the Indian government has decided to widely promote the development and deployment of electric mobility in the country, setting a target for EV production of 6–7 million electric vehicles on Indian roads until 2020; though up to 5 million will supposedly be made up by electric two-wheelers as the fastest growing vehicle sector and most important market in India.

2.5.2 Trends

In 2012, the “National Electric Mobility Mission Plan 2020” (NEMMP 2020) has been announced by the Indian government as a national strategy to support the EV industry and, at the same time, the demand market for electric vehicles by providing incentives for EV deployment and use. Additional to incentives offered by the Indian federal republic, there are also various incentives programmes from a number of Indian states or union territories, such as Delhi, Rajasthan, Uttarakhand and Lakshadweep, which for example do not levy VAT on EVs. Primarily, the NEMMP aims for catching up the lack in EV technologies in relation to foreign competitors in order to enable India for becoming a global player in the EV sector; for example, the launch of Indian automotive “Centre of Excellence” hubs throughout the country is planned. NEMMP policies are focusing on support of the local automotive industry. The key technologies defined within the NEMPP having specific development priorities are Battery Cells, Battery Management Systems, Power Electronics, Electric Motors, and Transmission Systems.

Nevertheless, there are still many uncertainties regarding the market demand for EVs, which could impede the implementation of technological development strategies due to high costs and high market risk. India is in need of a substantial progress in adequate EV technologies and industrial capabilities for manufacturing of electric vehicles and components. For example, lead acid batteries are still state of the art in India since there is no Li-Ion manufacturing capability in the country and a high import duty of 18% on Li-ion batteries. Further, there is a significant lack of after sale services for customers and the development of EV infrastructure in India. Altogether, this poses barriers towards the adoption of new technologies in the EV industry and generates a weakness for the EV manufacturing sector in India.

2.5.3 Entry Points for European SMEs

There is a considerable scope for European SMEs to engage in the field of EV technology and infrastructure development in India. Opportunities are given to European companies to bring their know-how in order to close technological gaps and give necessary advice. There are good chances to integrate in the EV supply chain as new component suppliers for domestic OEMs. A further opportunity is building a joint venture company with Indian SMEs for technology transfer and expanding the EV development and business.

3 Outlook

This contribution has analysed the e-mobility industry in five different markets, taking into account their background in the business area, national strategic programs of future deployment, technology trends and supply chains. Based on trends and needs, possible entry points for European SMEs have been underlined, in terms of complementary technology transfer and joint international platforms and project that facilitate cooperation.

This gap analysis will be complementary to the European innovation capabilities analysis, also carried out within GO4SEM project. Finally the conclusions will converge into a policy paper where European actions will be suggested for strengthening the competitive position of European suppliers and SMEs in global e-mobility markets.

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