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Internationalisation as a component for successful industrialisation of electric mobility within Cluster Electric Mobility South-West

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Summary

Progressing electrification and digitalisation of the transport sector lead to an enormous shift in the automotive industry and create major challenges and opportunities for industrial stakeholder all along the value chain. Cooperation between industry and research as well as knowledge transfer across technological sectors are considered to be key factors for a successful industrialisation of future transport technologies in traditionally strong automotive regions. At the same time, both trends to lead to significant changes in national and international automotive supply and innovation chains. New technology manufacturers and service providers will enter the mobility sector and have the potential to develop into new competitors. In future, players from industry and academia can only be successful when cooperating within strong regional innovation networks and with international partners at the same time. By supporting their partners in cross-border cooperation, cluster networks will play an important role in shaping the successful industrialisation of future transport technologies. This paper gives an overview about the internationalisation strategy of Cluster Electric Mobility South-West, which connects more than 125 players in the automotive region of Baden-Württemberg and is one of Europe's leading innovation network on future transport technologies.

Keywords: industrialization, strategy, consortium

1 Industrialisation of future transport solutions

Mobility of the future is automated, connected and electrified. Megatrends such as increasing global warming, the finite nature of fossil fuel resources, the growth of urban areas and increasing standards of living impose new demands on mobility of people and goods. Concepts for sustainable mobility solutions, in which electric mobility is one of the key elements, are required to cope with these challenges and, at the same time, create economic growth.

Electrification and digitalisation of the transport sector lead to an enormous shift in the automotive industry and a progressing merger with technological developments in the information and technology sector as well as the energy sector. Automotive manufacturers as well as their component suppliers need to understand mobility of the future as a complex system of innovations across different technological disciplines (fig. 1)

that go hand in hand with profound changes in our economic and social environment. A successful development of future transport solutions requires new forms of cooperation between industry and research across technology sectors and also needs to involve competences from the fields such as urban planning, infrastructure development and social sciences.

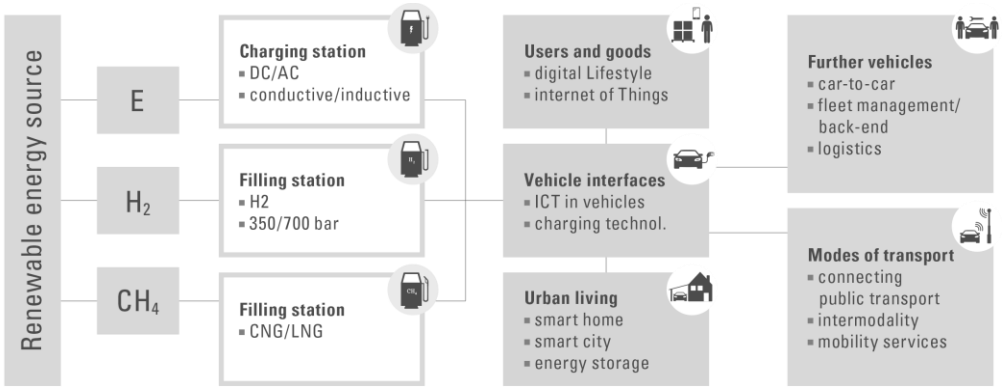

Figure1: System approach to future transport technologies (source: Fraunhofer IAO)

The technology change towards future mobility solutions creates major challenges but also significant economic opportunities for industrial stakeholders along the entire automotive value chain. By 2030, already more than half of all vehicles sold worldwide will be equipped with an electric drivetrain. At the same time, the share of new vehicles with an internal combustion engine will drop to about 25%. The gradually increasing volume of electrified drivetrain components will create an additional global market potential of 216,78 billion Euro by 2025 and 341,25 billion Euro (compared to 2013) [1].

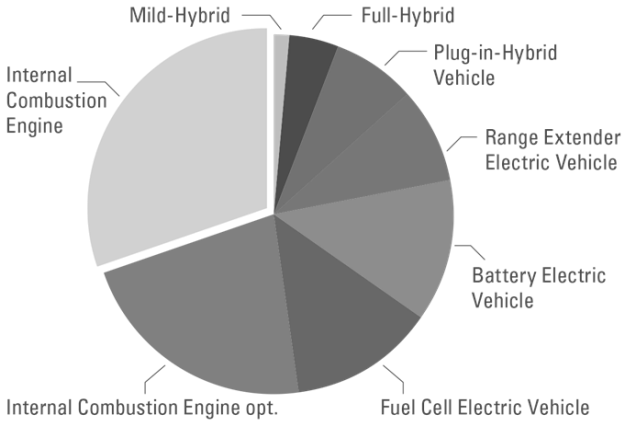

Figure 2: Expected global market volume of different drivetrain technologies by 2030 (source: adapted from [1])

For the State of Baden-Wuerttemberg, located in the south-west of Germany, automotive manufacturing is a key industry sector and major determinant for economic growth and employment. In 2016, about 225.000 people were employed by OEM or automotive component manufacturers located in this region and generated a total turnover of 79 billion Euro [2]. With major OEM facilities, world-leading component and system suppliers as well as internationally renowned universities and automotive research institutes located in this region, Baden-Württemberg is a leading international hub for automotive technology development and manufacturing.

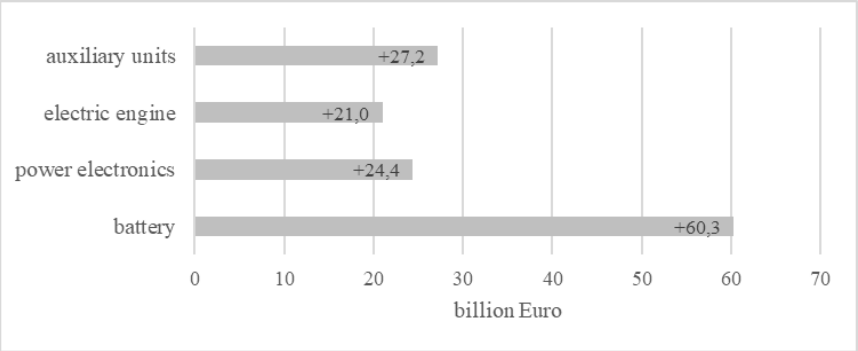

Figure 3: Potential growth in global market volume from 2013 to 2025 (source: adapted from [1])

At the same time, the component manufacturing and machinery industry is also deeply rooted within this region. More than 1.000 small and medium-sized enterprises represent the backbone of Baden-Württemberg's automotive supply chain and are important drivers for technology innovation. Within the industrial transformation process towards electrification and digitalisation of transport, especially these small and medium-sized enterprises are confronted with significant economic and technological transformations and have to identify new fields of application for their technological expertise. Cooperation between industry and research as well as knowledge transfer across technological sectors are key factors for a successful industrialisation of future transport technologies in traditionally strong automotive regions such as Baden-Württemberg. Clusters and innovation networks are essential to include small and medium-sized enterprises into the innovation process and to support them in developing new business areas and cooperation opportunities [3].

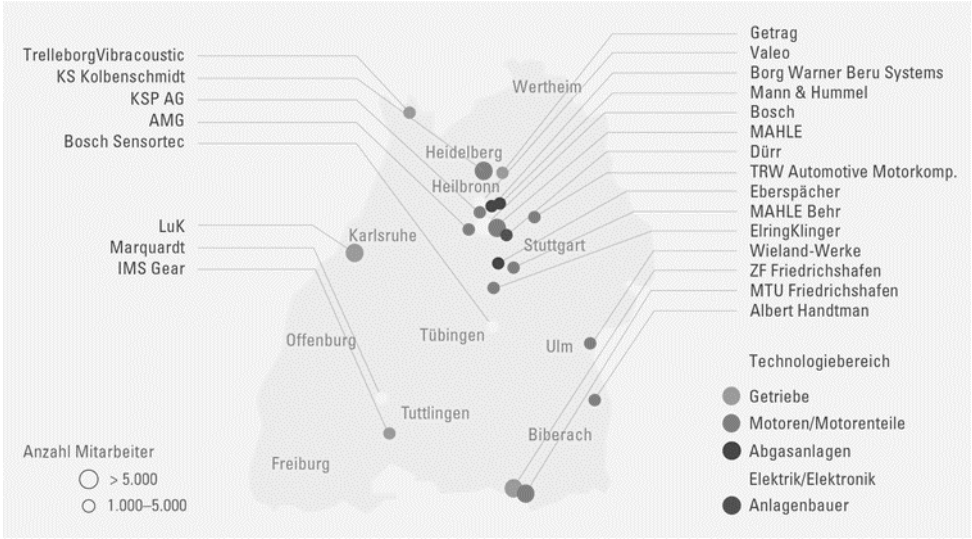

Figure 4: Major automotive suppliers in Baden-Württemberg (source: Strukturstudie BWe mobil 2015 [1])

With more than 125 partners from industry, universities and research institutes, Cluster Electric Mobility South-West, founded in 2008 by major stakeholders from Baden-Württemberg, is one of the most significant innovation networks on future transport solutions in Europe. It brings together the unique expertise on automotive and mobility technologies in the region between Karlsruhe, Mannheim, Stuttgart and Ulm with its long tradition of automotive development and manufacturing. In more than 20 joint research and development projects on key components of future transport solutions, the cluster has developed a vast technological expertise and profound understanding of the ongoing technology transformation process. The strategy-based integration of competences from the fields of automotive

engineering, energy technology, information and communication systems as well as manufacturing technologies creates unique synergies and enables an important cross-sector knowledge transfer. The cooperation between international industry players, innovative small and medium-sized enterprises and renowned research institutes is a key factor for the successful industrialisation of future transport solutions in Baden-Württemberg.

With their joint research and development activities, the members of Cluster Electric Mobility South-West intend to make a major contribution to a successful industrialisation of future transport technologies in Germany. By emphasizing collaboration across technology sector within a regional innovation network, the cluster links major technology providers as well as small and medium-sized companies to renowned universities and research institutes advancing knowledge development, specialisation and international competitiveness. Research and development activities within Cluster Electric Mobility South-West address four fields of innovation (automotive technology, energy technology, information and communication technology and production technology) and follow three strategic goals: (1) market and costs (establishing competitive life-cycle costs), (2) handling and comfort (satisfying customer expectations on e-vehicles) and (3) networked mobility (raising usability of electrified transportation strategies). As State Agency for Electric Mobility and Fuel Cell Technology in Baden-Württemberg, e-mobil BW provides the management of Cluster Electric Mobility South-West and supports its members from industry and research with specific services in the fields of knowledge management, international cooperation, public relations as well as education and human resources.

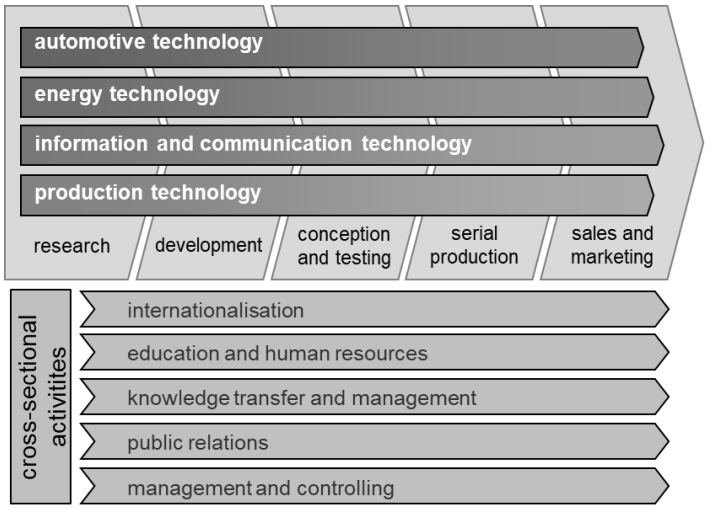

Figure 5: Activity structure of Cluster Electric Mobility South-West (source: e-mobil BW)

In 2012, Cluster Electric Mobility South-West was selected as one of fifteen excellent German Leading-Edge Clusters by the Federal Ministry of Education and Research. The significant research and development funding within this programme allowed the members of Cluster Electric Mobility South-West to realize a number of internationally relevant technology projects on systems and components of future transport solutions.

2 Internationalisation strategy

The advancing process of electrification and digitalisation in the transport sector will not only lead to significant changes in regional and national automotive supply chains, but also trigger an enormous shift in global automotive value creation. New technology manufacturers and service providers, especially from Asia and North America, will enter the mobility sector and have the potential to develop into new competitors for traditionally strong automotive manufacturing regions [3]. In order to ensure a successful industrialisation of future transport technologies and maintain their global market position, clusters and

innovation networks have to define a comprehensive internationalisation strategy that analyses their individual role in the global technology network and identifies major competitors from a technology-driven perspective. They can support their individual partners from industry and academia with joint internationalisation activities that provide access to international key players and give them a strong international visibility.

For a successful industrialisation of future transport technologies within clusters and innovation networks, it is essential to frequently analyse the international market and technology development and to identify international competitors in research and development, component and system manufacturing as well as technology deployment. Resulting in a dedicated internationalisation strategy, this analysis provides the knowledge base to define specific activities and measures to support members from industry and academia in initiating cooperation and market development with leading international locations in the development and deployment of future transport solutions.

In close dialogue with its partners from industry, academia and the public sector, Cluster Electric Mobility South-West has developed a dedicated internationalisation strategy that continuously monitors the development and deployment of future transport technologies worldwide, identifying relevant market competitors and technology locations and recommending specific activities and measures. Central basis for this strategy is a scientific analysis of the international development of electric mobility in Asia, Europe and North America which the cluster carried out in cooperation with the Fraunhofer Institute for Systems and Innovation Research ISI. Following the regional innovation systems approach, the study "Electric mobility worldwide – Baden-Württemberg in international comparison" [3] analyses 16 international economic locations with major competences in the automotive and mobility sector, including detailed analyses of the ten most relevant regions in technology development and deployment. The scientific analysis includes quantitative as well as qualitative indicators addressing the following characteristics: framework conditions (political strategy, funding programmes, major industry and academia players), research and development (patents, scientific publications, national/international research and development networks), technology deployment (vehicles with electrified drivetrains, charging infrastructure, major project initiatives).

Figure 6: Relevant international regions in the development of electric mobility
(source: Fraunhofer ISI, Study "Electric Mobility Worldwide" [3])

The following regions and their innovation networks (fig. 6) have been identified as the most important locations for technology development and deployment in the field of future transport solutions and significant competitors of Cluster Electric Mobility South-West [3]:

- Île-de-France (Paris metropolitan region) (2)
- California (3)
- Great Lakes (Detroit and Toronto metropolitan regions) (4)
- Seoul metropolitan region (5)
- Tokio metropolitan region (6)
- Aichi metropolitan region (7)
- Beijing metropolitan region (8)
- Shanghai metropolitan region (9)
- Shenzen metropolitan region (10)

To ensure availability of statistical information and comparability of results, Cluster Electric Mobility South-West is represented by the region of Baden-Württemberg (1).

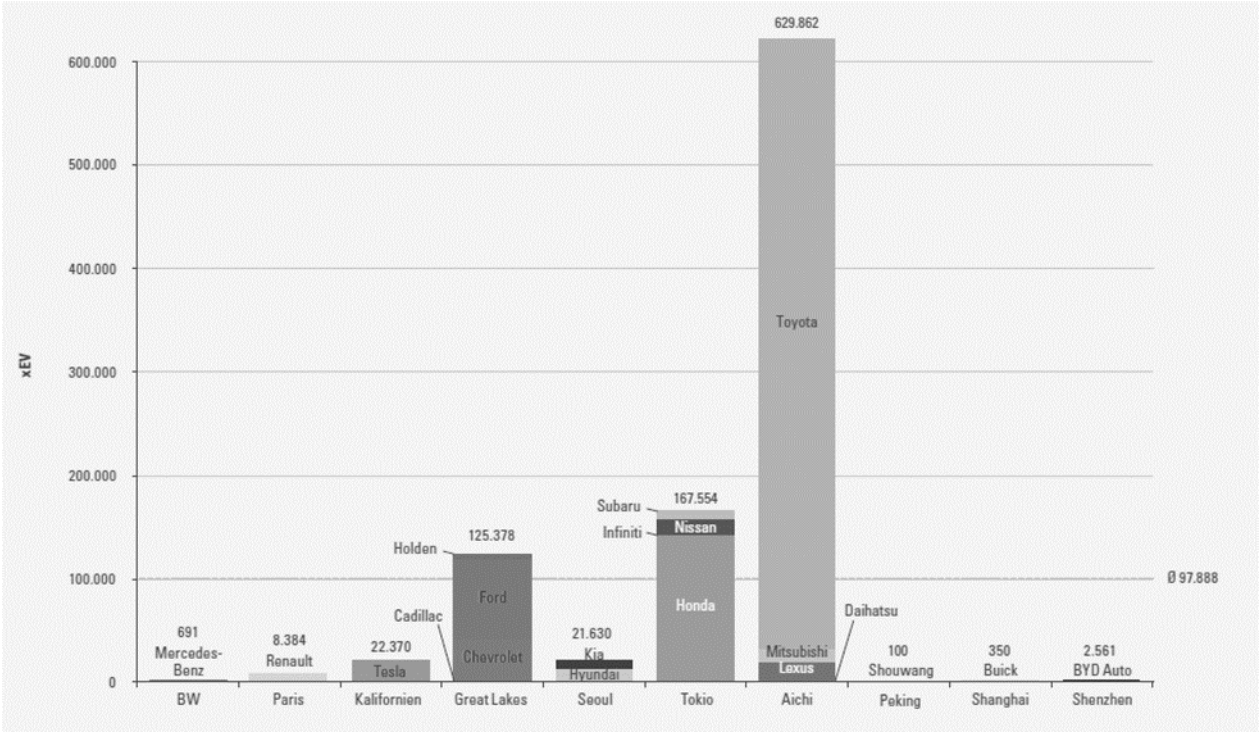

Figure 7: Production of xEV in compared regions in 2013
(source: Fraunhofer ISI, Study “Electric Mobility Worldwide” [3])

The results of the detailed analysis underline that the international development of electrification and digitalisation in the mobility sector follows very different paths. Japan is currently the internationally leading provider of electric and hybrid vehicles as well as components for electrified drivetrains (fig. 7). Its automotive innovation network is clearly dominated by Toyota Motor Corporation and its extensive supplier network. At the moment, the Japanese metropolitan regions around Aichi and Tokyo are clearly the world-leading innovation hubs for the development of future transport technologies. A specific industrial competence in the development and production of energy storage systems for electric vehicles is also located in Korea (fig. 8) where large companies like Samsung and LG increasingly apply their competence in the electronics sector on future automotive components [3].

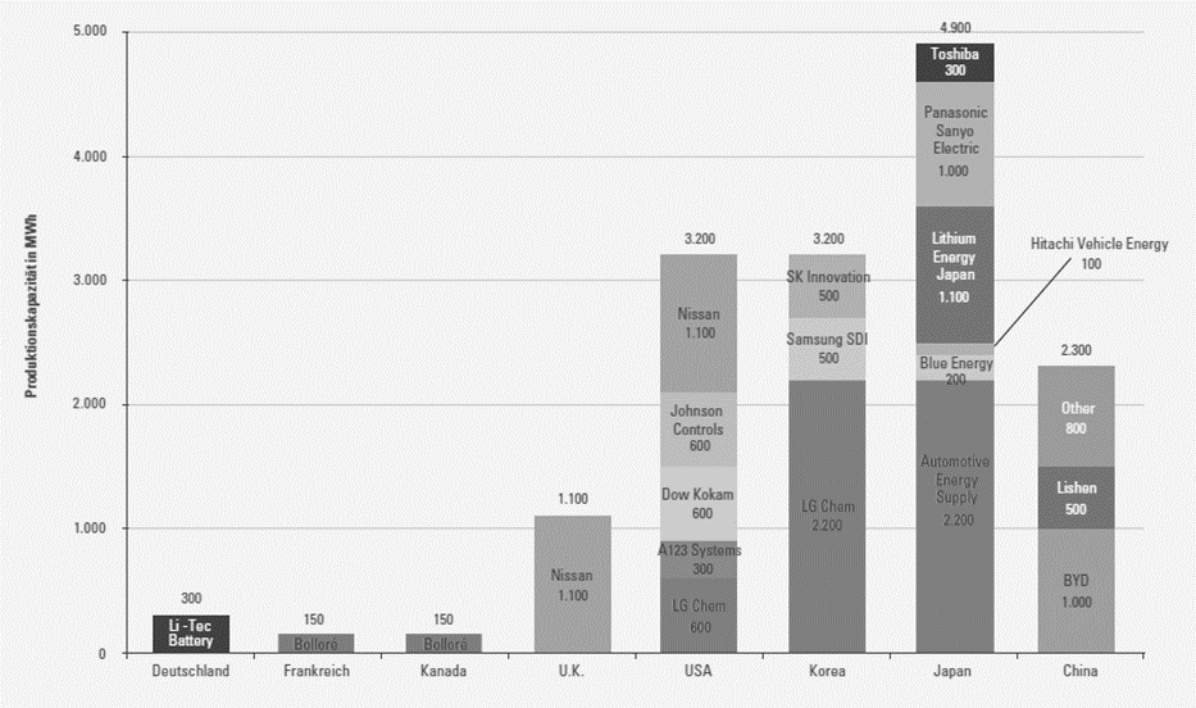

Figure 8: Production capacities of the globally most important manufacturers of lithium-ion batteries for xEV per country in 2013 (source: Fraunhofer ISI, Study "Electric Mobility Worldwide" [3])

Due to significant subsidies and a clear political strategy on emission reduction, California is currently the internationally leading region in the deployment of hybrid and electric vehicles (fig. 9) as well as EV charging infrastructure. With Tesla and internationally leading IT companies, major innovation drivers for future mobility solutions are located in this region. In Europe, the metropolitan region of Île-de-France has been identified as leading location in the deployment of electric vehicles and the establishment of a comprehensive charging infrastructure [3].

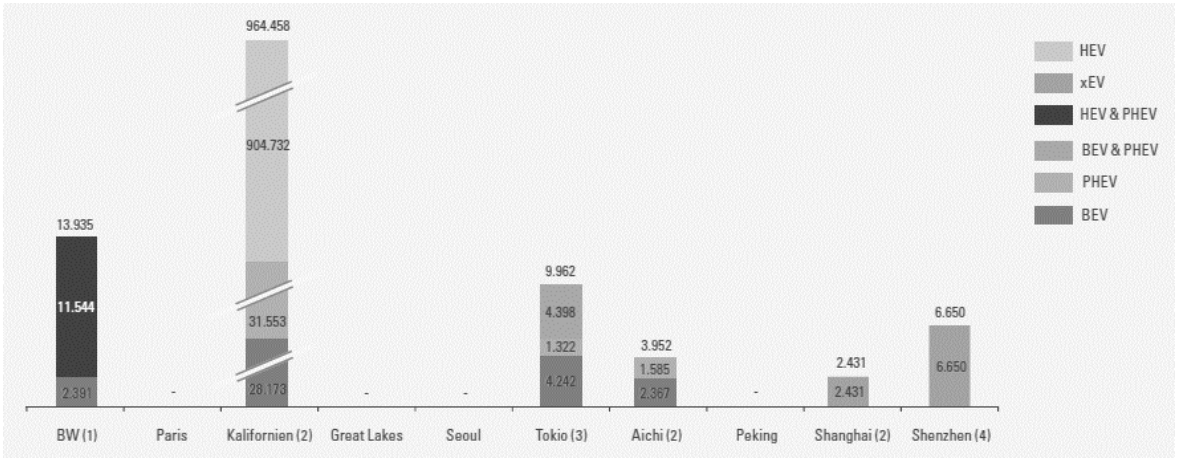

Figure 9: Stock of xEV at regional level, 2013/2014
(source: Fraunhofer ISI, Study "Electric Mobility Worldwide" [3])

Due to its traditionally strong competence in automotive engineering as well as established innovation and supply chains, Baden-Württemberg is well positioned to play an internationally leading role in the

electrification and digitalisation of transport technologies. Especially innovation networks such as Cluster Electric Mobility South-West have been identified as crucial factors for a successful industrialisation of electric mobility. They enable cooperation and knowledge transfer between industry and academia across technological sectors that, together with international benchmarking and networking, is considered to be a major success factor for innovation and technology leadership in an international comparison [3].

Since 2011, a cluster working group with representatives from industry, universities and research institutes continuously evaluates the internationalisation strategy, makes recommendations for adjustments and ensures that it addresses the interests and needs of the network partners. On the basis of the internationalisation strategy, the management of Cluster Electric Mobility South-West has developed a broad portfolio of activities that support the network partners from industry and academia in initiating and deepening their international business and cooperation relationships.

Regular business missions with representatives from industry and academia significantly contribute to the visibility of the cluster organisation and its members, help to identify business and cooperation contacts and support the continuous evaluation of the international market position of the cluster. Since 2011, delegations from Cluster Electric Mobility South-West have visited all leading economic locations identified in the internationalisation strategy (fig. 10). The visits have significantly contributed to the development of a broad knowledge about the international development of electric mobility and established cooperation contacts to major mobility innovation networks in Europe, North America and Asia.

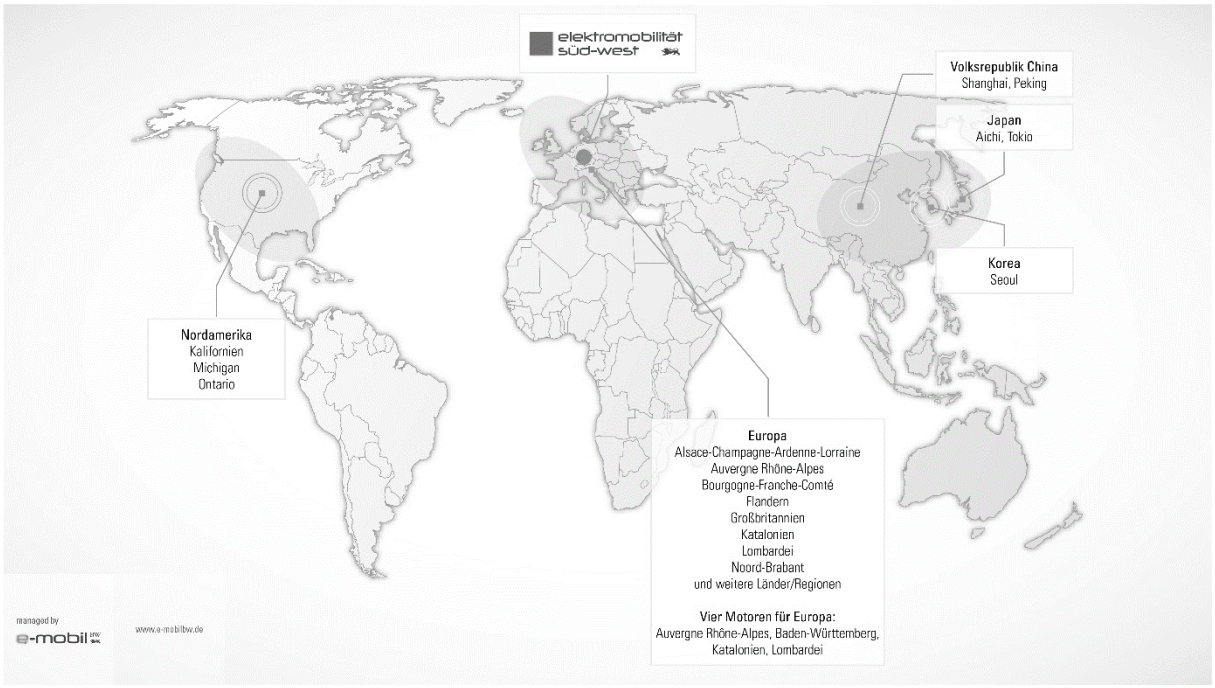

Figure 10: Overview of international missions of Cluster Electric Mobility South-West (source: e-mobil BW)

At the same time, representatives from Cluster Electric Mobility South-West regularly participate in international conferences and trade fairs. Since 2010, the cluster organises an annual participation of partners from industry and academia at the Hannover Industry Fair presenting the network's key competences, innovations and products to an international audience. Furthermore, cluster management and network partners regularly contribute to international conferences and symposia that address recent technological developments in automotive engineering and the design of future transport systems.

The support of small and medium-sized enterprises in international cooperation is a specific focus of the internationalisation strategy of Cluster Electric Mobility South-West. Different analyses of the regional

automotive supply chain in Baden-Württemberg underline that many small and medium-sized automotive suppliers are currently focussed mainly on regional and national markets [4]. In the context of the advancing electrification and digitalisation in the automotive sector and its increasingly international perspective, they risk to lose their economic and technological competitiveness. In order to introduce these stakeholders to the characteristics of international cooperation, Cluster Electric Mobility South-West provides specific support and events that allow small and medium-sized enterprises to initiate new business contacts and identify potential partners for cross-border innovation projects.

Internationalisation measures that have been implemented so far show that a major interest of small and medium-sized companies is the cooperation with innovation networks in Europe. The proximity to potential cooperation partners, a reliable legal framework and the availability of significant funding schemes for innovation and technology development in the transport sector are considered to be the main advantages of European cooperation. Since 2011, Cluster Electric Mobility South-West has developed a comprehensive cooperation network with different innovation clusters in leading European regions. The cooperation with the cluster network LUTB-RAAC in the French region Auvergne-Rhône-Alpes and the participation in the initiative "Four Motors for Europe and Associates" are major examples of this active European network.

3 Case study: German-French cooperation project AllFraTech

The exchange and close cooperation with leading European clusters and innovation networks in the field of future transport technologies is a major strategic priority of Cluster Electric Mobility South-West. As one the leading countries in the technological development and deployment of electric vehicles in Europe, France is an important target country in the internationalisation strategy [5]. Especially the regions of Auvergne-Rhône-Alpes and Île-de-France are major centres for the development of future automotive technologies and innovative mobility concepts.

Since 2011, Cluster Electric Mobility South-West maintains an active partnership with the cluster LUTB-RAAC that shapes the development of future transport technologies in the French region Auvergne-Rhône-Alpes. With more than 80.000 employees in about 700 companies, this region is a major centre of the French automotive and mobility industry. Its industry structure with major OEM and automotive suppliers as well as small and medium-sized enterprises is similar to Baden-Württemberg and provides an excellent basis for cross-border innovation and research partnerships. As one of the French excellence clusters, LUTB-RAAC has a strong technological expertise in designing transport of people and goods in urban environments as well as a vast experience in cross-sectoral collaboration between industry and academia.

Together with LUTB-RAAC, Cluster Electric Mobility South-West has developed the cross-border project "German-French alliance for innovative mobility solutions (AllFraTech)" to enhance the research and innovation partnership in the mobility sector between Baden-Württemberg and Auvergne-Rhône-Alpes. Furthermore, the project will extend the international cooperation network of Cluster Electric Mobility South-West by providing access to new technological expertise, cooperation opportunities and strategic partnerships. The project is funded by the Federal Ministry of Education and Research in the framework of the internationalisation scheme "Internalisation of German Leading-Edge Clusters, Forward-Looking Projects and Comparable Networks".

During a one-year concept phase in 2017, the managements of Cluster Electric Mobility South-West and LUTB-RAAC, in close dialogue with their network partners from industry and academia, define a long-term strategy to strengthen their cooperation on research and innovation in the field of future transport technologies. In different workshops, partners from both clusters will discuss strategic approaches to current challenges in the transport sector, identify potentials and needs for international cooperation and define focus areas for cross-border innovation projects. The specific support of small and medium-sized enterprises in international cooperation will be a specific goal within this strategy. A scientific analysis of the structural and technological framework conditions for cross-border cooperation between both regions will provide the knowledge base for the internationalisation concept and identify perspectives for a long-term cooperation between Cluster Electric Mobility South-West and LUTB-RAAC.

Until June 2017, Cluster Electric Mobility South-West and LUTB-RAAC have already organised two strategy and project workshops to bring players from both regions into contact and initiate an innovation dialogue on opportunities for cross-border cooperation. More than 60 representatives from companies, universities and research institutes in each workshop underline the significant interest within both networks. The results of the workshops provide an important background for the future strategy on long-term cooperation between the innovation networks on future transport technologies in Baden-Württemberg and Auvergne-Rhône-Alpes. At the same time, network partners from Cluster Electric Mobility South-West and LUTB-RAAC are already working on proposals for technological cooperation projects which are supposed to be financed in the framework of the AllFraTech project initiative. The discussions between players from both regions have shown a strong interest in cross-border cooperation in the fields of charging technologies, thermal management, testing and validation of future transport technologies as well as TCO analysis for future vehicles.

During EVS30, first results of the concept phase will be available for discussion and illustrate options for cooperation on innovative transport technologies and mobility concepts between major stakeholders in Germany and France. Based on the cooperation strategy, Cluster Electric Mobility South-West and LUTB-RAAC will initiate joint research and innovation projects on major challenges in the electrification and digitalisation of road transport. Further activities in the fields of innovation support, education and training and knowledge transfer will specifically address small and medium-sized enterprises and qualify them for international cooperation projects. The bilateral project initiative AllFraTech will make a significant contribution to the engagement of Cluster Electric Mobility South-West in the Four Motors for Europe and Associates and other European networks.

4 Case study: Four Motors for Europe and Associates

An important foundation of the international cooperation network of Cluster Electric Mobility South-West is the multilateral initiative “Four Motors for Europe and Associates”. This network of strong European economic regions has been initiated in 1988 by the governments of Auvergne-Rhône-Alpes (France), Baden-Württemberg (Germany), Catalonia (Spain) and Lombardy (Italy) as a basis to enhance cross-regional European exchange on technology innovation and major societal challenges [6].

As strong and innovative industrial regions, the Four Motors for Europe provide an ideal framework for a successful industrialisation and deployment of sustainable transport technologies in Europe. With dedicated strategies, innovative cluster networks and relevant project initiatives, all member regions are European frontrunners in the development of the future transport system. At the same time, all regions face similar economic challenges in the ongoing process of electrification and digitalisation in the transport sector.

In 2010, the Four Motors for Europe established a regular dialogue of innovation clusters and networks in the field of future transport technologies. The network dialogue “Electric mobility and future transport technologies” brings together experts from cluster networks, public institutions and research institutes from Auvergne-Rhône-Alpes, Baden-Württemberg, Catalonia and Lombardy as well as associated partners from Flanders (Belgium) and Noord-Brabant (Netherlands).

Regular meetings of the network dialogue “Electric mobility and future transport technologies” provide the basis for a continuous exchange of information and experience on the development of future transport technologies in the Four Motors for Europe. At the same time, the partners initiate cross-border activities and projects to support the development of future transport solutions in Europe. Meetings with representatives of the European Commission in Brussels, joint projects proposals as well as conference and trade fair participations are just a few examples of activities in the network dialogue.

As management of Cluster Electric Mobility South-West, e-mobil BW represents the activities of Baden-Württemberg’s future transport innovation cluster in the Four Motors for Europe and Associates and coordinates its network dialogue “Electric mobility and future transport technologies”. The active participation in this network of European regions gives Cluster Electric Mobility South-West access to other major automotive technology networks and innovators in Europe. With its strong associations to relevant EU institutions, the network of the Four Motors for Europe and Associates allows Cluster Electric

Mobility South-West as well as its partners from industry and academia furthermore to communicate its strategic priorities to European decision makers and policy networks.

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Stefan Büchele studied political science as well as English language and literature at the University of Stuttgart. Since, 2011, he is part of the team at e-mobil BW GmbH. He is responsible for the fields of international cooperation and funding policies. His focus is on the cooperation with international cluster networks in the field of sustainable transport technologies and the initiation of cross-border projects with partners from industry and research. Additionally, he informs companies, universities and research institutions about funding opportunities in the field of electric mobility and sustainable transport.