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Electric mobility in the interaction of electrification and digitalisation – activities of the industrial region Baden-Wuerttemberg

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Summary

Electric mobility is more than just substituting the drive train – the technological change is complex and includes not only matters of vehicle technology and energy but also of ICT elements. Baden-Wuerttemberg as an important and traditional automotive region in the South-West of Germany is aware of the profound effects on the mobility and the automotive sector which come along with electrification, digitalisation and automatization. In the following will be described more precisely how Baden-Wuerttemberg faces the challenges and in which way the region plans to become location for successful providers of innovative and intelligent mobility solutions.

Keywords: Germany, state government, policy, autonomous, intelligent

1 Introduction

The future mobility is electric, connected and automated. This triad stands for independent fields of technological innovation but only takes full effect in combination. Electric, connected and automated mobility offers a lot of ecological, economic and social chances. With the reduction of CO₂ emissions and the potential as energy storage, electric mobility is one of the key measures for the German so called “Energiewende”. The environmental protection is directly related to the change in mobility. The economic potential of the new technologies promises large benefits with regard to employment, newly formed business models and new fields of activity. Many new players are entering the global market and might have a disruptive impact on existing structures.

2 Electric Mobility – challenges and chances for Baden-Wuerttemberg

Baden-Wuerttemberg is a region in the south west of Germany with around 10.6 million inhabitants and a strong economy covering 15.1 % of Germany’s GDP and an export volume of more than 180 billion euros.

The region is not only the birthplace of the car but also considered as one of the most significant automotive locations in Germany. Baden-Wuerttemberg has an excellent national and international reputation as premium vehicle production site. The unique concentration of vehicle manufacturers, automotive suppliers, research institutes and universities with specialised courses of study offers outstanding location conditions for automotive manufacturing. The automotive industry, together with its suppliers, has a key function in Baden-Wuerttemberg. In 2014 nearly 217,000 employees subject to social insurance contributions, were active here in more than 300 companies involved in vehicle manufacturing and having an annual industry turnover of almost 97 billion euros. [1] With regard to sustainable mobility and especially to electric mobility, Baden-Wuerttemberg is based on 2011 technology indicators neither a leading supplier nor a leading user market and ranks in a middle position compared to other similar regions in the world. [2]

Therefore Baden-Wuerttemberg needs to face the challenges of the technological change in order to maintain its economic strength and the jobs in the automotive branch. In 2030 worldwide only one fourth of new produced cars will have only an internal-combustion engine, another fourth will at least have electric components, but almost half of it will be cars with electric drive train. The market volume of electrified components will increase by 341.25 billion euros in 2030 compared to 2013. The energy efficiency technologies will be a job motor for the region: in 2025 the total capability for employment will be 18,000 employees more than in 2013. Additional market potential can be found in the production of electrified components and batteries. [3] As a result of these challenges and changes the automotive sector is highly innovative and invests each year around six million euros in research and development of new technologies.

3 Activities made in Baden-Wuerttemberg

From the beginning, the State Government of Baden-Wuerttemberg is promoting the knowledge exchange between research and industry in the field of mobility. Since 2010 Baden-Wuerttemberg invested with its two electric mobility initiatives around 80 million euros in structural programmes and projects to support the transition from combustion via hybrid to electric and fuel cell-powered vehicles. [4]

In this context e-mobil BW, the State Agency for Electric Mobility and Fuel Cell Technology Baden-Wuerttemberg, was initiated in 2010 by the government of Baden-Wuerttemberg to support the change process towards electric mobility in the region. e-mobil BW works actively to shape the creation of the electric mobility system. The main strategic points in the working programme are not only the industrialisation of electric mobility, but also demonstration, setting up of suitable framework conditions, education and knowledge exchange.

3.1 The leading-edge cluster Electric Mobility South-West

An important role in the field of industrialisation is played by the leading-edge cluster Electric Mobility South-West, whose work is coordinated by the e-mobil BW. The activities ensure that the branches involved are sensibly networked and that the companies – from the start-up to the major corporation – are integrated in

the technological change process. The cluster exploits the unique opportunity offered by its region Karlsruhe – Mannheim – Stuttgart – Ulm to link together around 100 stakeholders. Noteworthy large, medium-sized and small enterprises are participating in the technological fields of vehicle construction, energy engineering, information and communication technology (ICT), and the interdisciplinary field of production engineering with local research institutes. The first technological innovation field “vehicle construction” considers the development of new components for electric vehicles and their integration in the whole system. Especially new thermomanagement systems and the possibilities for fault finding and technical service are central. With regard to the second innovation field “energy” questions concerning the use of energy within the vehicle but also to charging interfaces and charging infrastructure and the integration of the vehicle into the grid are playing an important role. In the projects research is done to different kind of charging options like wireless or conductive charging, with direct or alternating current. Another important issue is the energy storage in the vehicle. The third innovation field “ICT” is dedicated to car-to-car and car-to-x communication but also to intermodal mobility solutions. The fourth innovation field “production” deals with the increase of efficiency in the production and the reduction of costs. To accomplish the latter the improvement of quality and the enhancement of automatization are of great importance.

In 2012 the consortium successfully participated in the 3rd round of the Leading-Edge Cluster Competition, as part of the High-Tech Strategy 2020 of the Federal Ministry of Education and Research (BMBF). Up to 40 million of federal funding is provided for projects during the time period of five years, which will end in 2017. In addition, the State of Baden-Wuerttemberg supports with funding up to five million euros for interdisciplinary activities such as qualification, knowledge transfer and international exchange. By now, the cluster initiated 18 projects, 13 of them in the first funding phase and five in the second. Six of them have already successfully completed. The cluster was evaluated by the Federal Ministry in 2014 and was awarded with the "Cluster Management Excellence Label GOLD" of the European Cluster Excellence Initiative. In addition to that five new projects are initiated by cluster partners with a funding volume by more than seven million euros.

3.2 Cluster Fuel Cell BW

In addition the cluster Fuel Cell BW was established in 2013, which aims at advancing the industrialisation of mobile and stationary fuel cell applications. Around 60 stakeholders are active in the cluster and within a short time projects will be initiated in the topics hydrogen production and infrastructure, transport, energy and production. Fuel Cell BW coordinates at the moment for example the innovation programme H₂BW (four million euros) and a recently launched large power-to-gas project (four and a half million euros).

3.3 Implementation Projects and the Showcase Region LivingLab BW^e mobil

The research activities in the clusters are of great importance in order to reduce costs and advance the technology. In addition to the industrialisation programmes, the e-mobil BW is also initiating and coordinating implementation projects in order to bring electric mobility on the road and to support the roll-

out of the technology, for example as one of four Showcase Regions on Electric Mobility chosen by the Federal Government in 2012. The projects located in the region of Stuttgart and Karlsruhe were funded with around 45 million euros by the German Federal Government (Federal Ministry for Economic Affairs and Energy, Federal Ministry of Transport and Digital Infrastructure, Federal Ministry for the Environment, Nature Conservation, Buildings and Nuclear Safety, Federal Ministry of Education and Research) and with additional 15 million euros by the State Government of Baden-Wuerttemberg (Ministry of Finance and Economics Baden-Wuerttemberg, Ministry of Transport and Infrastructure Baden-Wuerttemberg) and the Region of Stuttgart. 34 projects were realised between 2013 and June 2016. The focus of the projects was to demonstrate the suitability of electric mobility in nine thematic core fields such as fleets and commercial traffic, energy and infrastructure, education, urban mobility planning and living concepts. In addition to that the public should be addressed and informed about the new technology. In 600 events more than 900,000 persons were reached. In the projects 1,900 electric vehicles run around 18 million electric kilometers during the project phase. The results showed that electric mobility works in everyday life and contributed to a high visibility of electric mobility in the region. In addition to that the Showcase projects illustrated further need of action for example in the fields of infrastructure, business models, research and development. New projects with regard to implementation of electric mobility are already in preparation and will be supported by Federal Government and State Government funds.

3.4 Connected and Automated Driving

For the prospective regional development it is necessary to encourage further technological key topics like connected and automated driving. These technologies have a high technical and economical dynamic and promise in combination with electric mobility high advantages to environment, traffic safety and economy. Therefore the “AG intelligent move” was founded in 2014. As part of the cluster Electric Mobility South-West, the working group is focusing on the strategic development of the topic. In the focus of interest is, beside the technological development and the legal and social framework, the implementation of a test field in the region. On recommendation of the AG intelligent move a study on electric, connected and automated driving was published by the e-mobil BW. [5]

To sum up the main results of the study:

- Connection and automatization of driving are two independent fields of technology which can exist without the other. But it can be foreseen that in combination the solution is smarter.
- Automatization and electric mobility aren't linked but due to synergies a parallel development is to be expected.
- Automated and connected driving offer a big potential for better management of traffic and an increase of efficiency.
- The legal framework has to be declared and defined.
- The material of road maps has to be very high due to locate the vehicle on the line.

- Mixed traffic and the interaction of different automated driving vehicles with non-motorized traffic participants are the main challenges.
- To enable automated driving as key elements were observed data fusion and interpretation just as prediction of the behavior of traffic participants in complex environment and in adverse conditions.

One of the core conclusions is that the local players of Baden-Wuerttemberg characterise essentially the technological development of connected and automated drive. Especially OEM and system suppliers out of the automotive sector but also small and medium sized enterprises and research institutes and universities possess a broad knowledge which can be transformed to or is already targeted on connected and automated driving. Research institutes and enterprises keep on working closely together on developing the potential of the new technologies. The cluster Electric Mobility South-West differentiates in the consequent way of collaborating between partners of economy, science and public hand.

As a next step, in January 2016 the call for bids regarding the test field for connected and autonomous driving was published by the Ministry of Finance and Economy Baden-Wuerttemberg. The construction and the implementation of the test field will be supported with 5 million euros by the Ministry. The setup of the testing environment and the enabling of field experiments in public space will support the technological development. The experiences in real life environment will help to improve the technology and to increase the social acceptance. Therefore it is absolutely necessary that the technology is embedded to an appropriate social and legal framework. It is a very important political task to regulate the framework for testing of automated and autonomous driving vehicles on the streets, even in this early stage of the technological development. In order to find the right solutions to these questions the Ministry of Science, Research and the Arts and the Ministry of Transport and Infrastructure Baden-Wuerttemberg have set up an additional research funding programme. The test field is to build up in 2016 and shall be in operation in 2017. For all bids it is necessary that the proposed testing area includes a motorway, city traffic and roads outside the village. An important factor is that the testing environment will be open for all technologies and all enterprises. Therefore small and medium-sized companies also gain the possibility to test their new technologies in a real laboratory and interact with OEM. The chance not only can be seen in profiting from the new business cases but also from a user perspective: the road safety and the traffic efficiency will increase significantly and as a result a strong relief of the regional road network and the cities can be foreseen.

Until the deadline of the Paper submission the decision concerning the test region was not taken yet. Perhaps during EVS29 we can provide more information about it.

4 Conclusion

With all the taken steps and initiatives Baden-Wuerttemberg has high potential to become one of the leading providers in the field of electric, connected and automated mobility. This was also proven by several studies published by e-mobil BW which see positive future development of the industry and research in the region. The involvement of small and medium sized enterprises in the change process by the cluster is one of the key

tasks to make the transformation process successful. There are big efforts to be done and hurdles to be overcome in order to maintain the strength of the Baden-Wuerttemberg automotive industry. The sustainability of the automotive branch is correlated to the successful transformation process.

Stuttgart, the state capital of Baden-Wuerttemberg, will be the venue of the EVS30 and has the opportunity to present the achieved progress in 2017.

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