EVS30 Symposium
Stuttgart, Germany, October 9 - 11, 2017

Challenges at the construction of a comprehensive AC and DC charging infrastructure in Baden-Württemberg

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Abstract

The presentation "Challenges at the construction of a comprehensive AC and DC charging infrastructure in Baden-Württemberg" tells the story of the development and establishment of the charging infrastructure in and around Stuttgart – host of the EVS 30. It will detail how the AC charging infrastructure was developed and how it was rolled out to its present extent. The second part of the presentation will describe the establishment of the DC network and thus the creation of a comprehensive, Baden-Württemberg wide AC and DC charging network. In this paper the challenges will be addressed that were encountered on this seven year long journey and which learnings can be gained for other regions from the experience in Baden-Württemberg. As the development of the EnBW charging network had a strong influence on the development of electric mobility in Germany these interconnections will addressed appropriately. The final part of the presentation will be an outlook on the further development of the charging infrastructure as well on the technical side, e.g. 350 kW DC charging, but also regarding the extension of the charging network.

1 Motivation and Background

The EnBW is one of the big four energy utilities in Germany and has started already in 2009 to invest into electric mobility. The EnBW sees electromobility together with renewable energies and the smart grid as the key sectors of its future business.

As a utility the EnBW has a profound understanding of how a power grid has to be managed, especially when it will face a much higher demand in the future due to electric vehicles. This is a USP no car manufacturer can easily acquire in a short time. To bring mobility and energy together for a successful electro mobile future EnBW has engaged in several projects with universities and car manufacturers as well as cities. One of the outcomes of these projects is a comprehensive EV charging network, consisting of over 500 AC charging points and over 68 DC charging points all over Baden-Württemberg.

2 AC Charging Infrastructure

Since 2009 EnBW has developed and deployed AC charging infrastructure in the area of Stuttgart and all over Baden-Württemberg. The first chargers were constructed during the R&D program MeRegioMobil from 2009 to 2011. In this time the first experience was gained, how charges could be installed in an urban area and which challenges have to be overcome, for example how to deal with the local political authorities to gain the permission to install charging stations in public areas. On top of these questions technical issues were addressed like the integration of EVs into a Smart Grid, the development of an IT Backend and communication protocol. Parts of this protocol have found their way into the ISO 15118.

Based on this expertise the charging network was expanded to the French boarder in the CROME project. Part of this project was the development of a cross-border E-Roaming system which lay the ground stones of the hubject intercharge solution.

During the following projects in the German "Showcase Electromobility" Program 500 AC charging points were built in Stuttgart and nearby cities and the EV only car2go fleet was enabled to use this network of charging stations. Another result of these projects was the establishment of a German E-Roaming solutions, which incorporated not only the EnBW chargers but also all other chargers in the four Showcase Regions via the intercharge network.

The latest development regarding EnBW AC chargers is the SM!GHT charging station, which is developed by the EnBW itself and integrates a Smart City solution with environmental sensors and wireless LAN into a charging station.

3 DC Charging Infrastructure

Following the rollout of the AC charging infrastructure the focus shifted to the DC infrastructure. Right now the EnBW is installing DC charging infrastructure on the two highest German road levels; the Autobahn and the so called Bundesstraßen.

Installation on the German Autobahn:

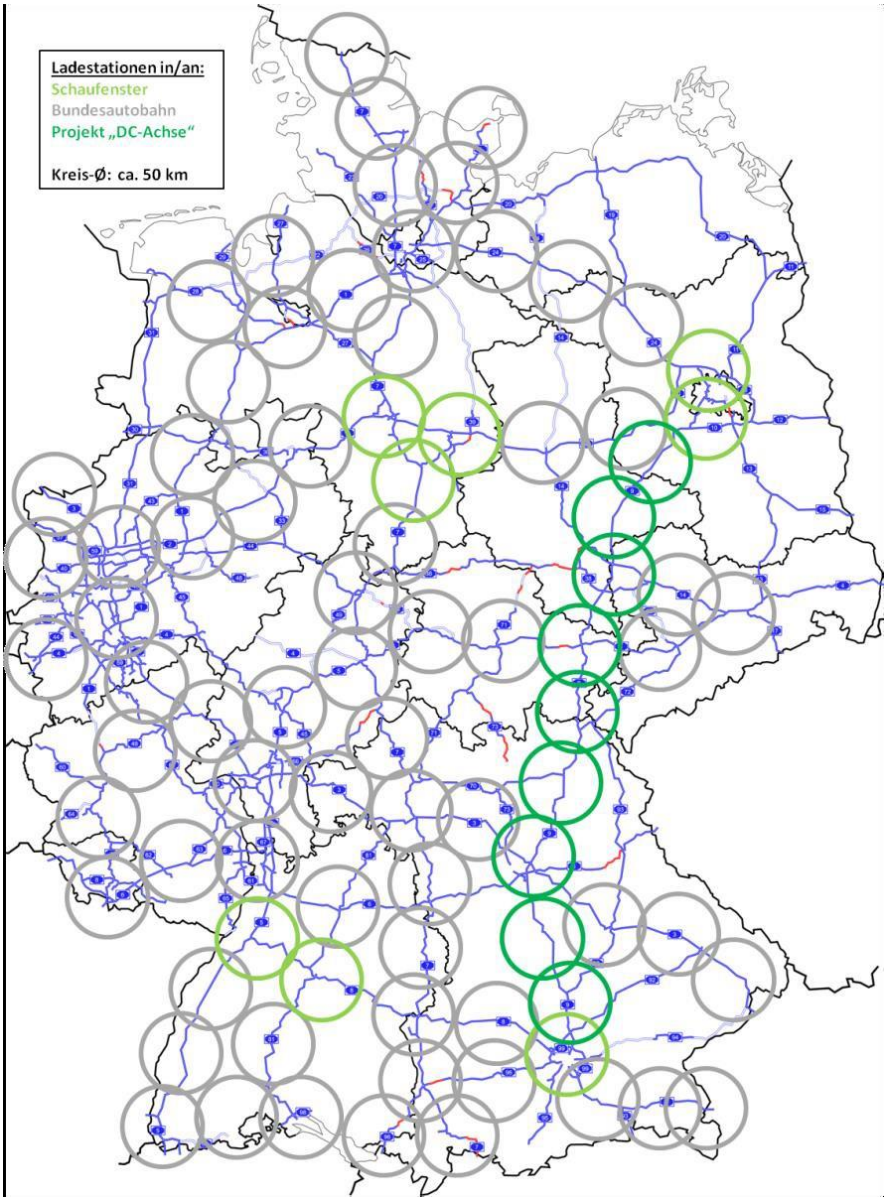

Figure 1: Initial required allocation of dc fast charging / SLAM consortium

The first proof of concept was the installation of 50 kW DC Chargers on the Autobahn. To realize this project EnBW took part in the BMWi funded project SLAM. In this project a framework was developed together with universities where to best install these DC chargers.

Based on the SLAM-developed STELLA model as well as a 50km distance between any two stations the map featured in Figure 2 has been developed to provide a basis for the development of any comprehensive DC charging network. As shown later EnBW's activities have mirrored this map in its buildup, both with SLAM as well in the Tank and Rast Case. This framework has also featured in the Gesamtvorhabensbeschreibung of the SLAM syndicate.

On top of this the billing models were adapted to fit the new needs of a DC charger network.

Figure 2: Access for EnBW costumers / EnBW AG

EnBW provides, in its role as EMP, access to its stations via RFID cards and its own charging point app (soon to come). Costumers are billed depending on the span of time they charge, with a range of options between prepaid and postpaid cards.

However, in order to make charging at EnBW's DC stations as easy and comfortable as possible for anyone, EnBW not only provides access via the nowadays taken-for-granted inbound roaming via e.g. Hubject or its intercharge direct service. To ensure maximum accessibility both EC and credit card access is also preinstalled, thus single-handedly providing not only the most convenient access but also confirming with the Ladesäulenverordnung's demand for an ad-hoc payment solution (see figure 3).

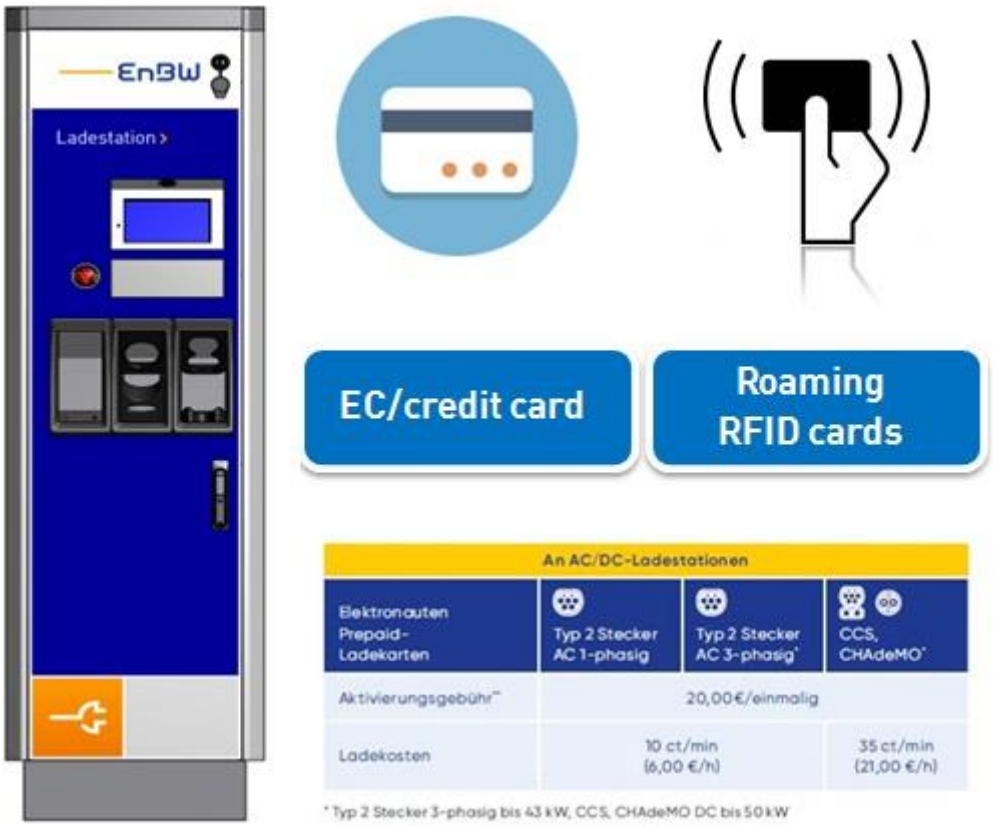

Figure 3: Access for anyone/ EnBW AG

Towards the end of 2016 and during spring 2017 EnBW installed 68 DC multichargers on 34 “Tank und Rast” stations all over Baden-Württemberg (see also figure 4).

Figure 4: Current EnBW DC charging network on highways of Baden-Württemberg

This first phase of buildup laid the groundwork and provided the lessons learned necessary for EnBW to expand its reach beyond Baden-Württemberg, enabling it with the capabilities essential for a nationwide Charge Point Operator (CPO). It also yielded a blueprint both in processes as in hardware used for the next stage of buildup along highways and state highways (“Bundesstraßen”).

The installed layout consists of two stations at each location comprising 4 charging points connected directly to the medium voltage grid via their own 630kVA transformer. This layout prepares the locations to be easily upgraded to higher output, making them eligible for High Power Charging stations in the near future.

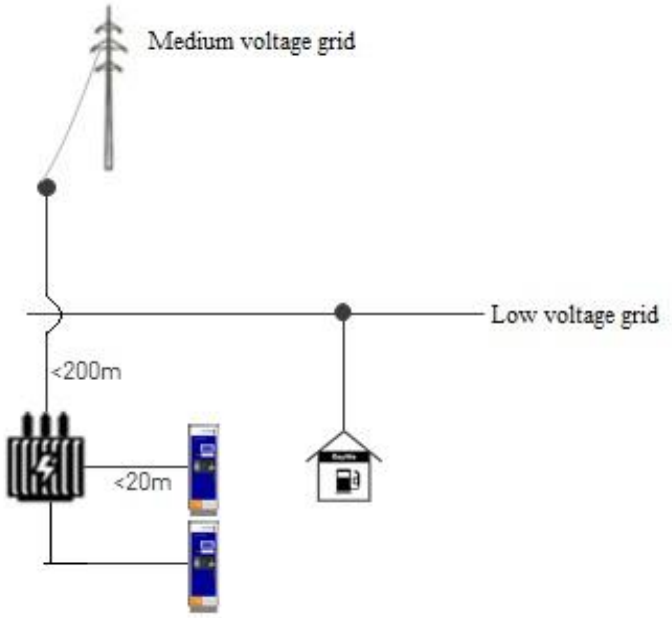

Figure 5: Station layout

Due to regulations of the SLAM project, charging locations should preferably be prepared to be suitable for high power charging in the class of 150kW per DC outlet. In order to meet these requirements the transformer and cable installation set up already support these higher charging powers which are at this point only limited by the charging station itself to 50kW DC an 43kW AC. The charging locations are accessible 24/7 and – in Baden-Württemberg – equipped with one CCS/CHAdeMO/TypeII multicharger and one CCS/TypeII charger.

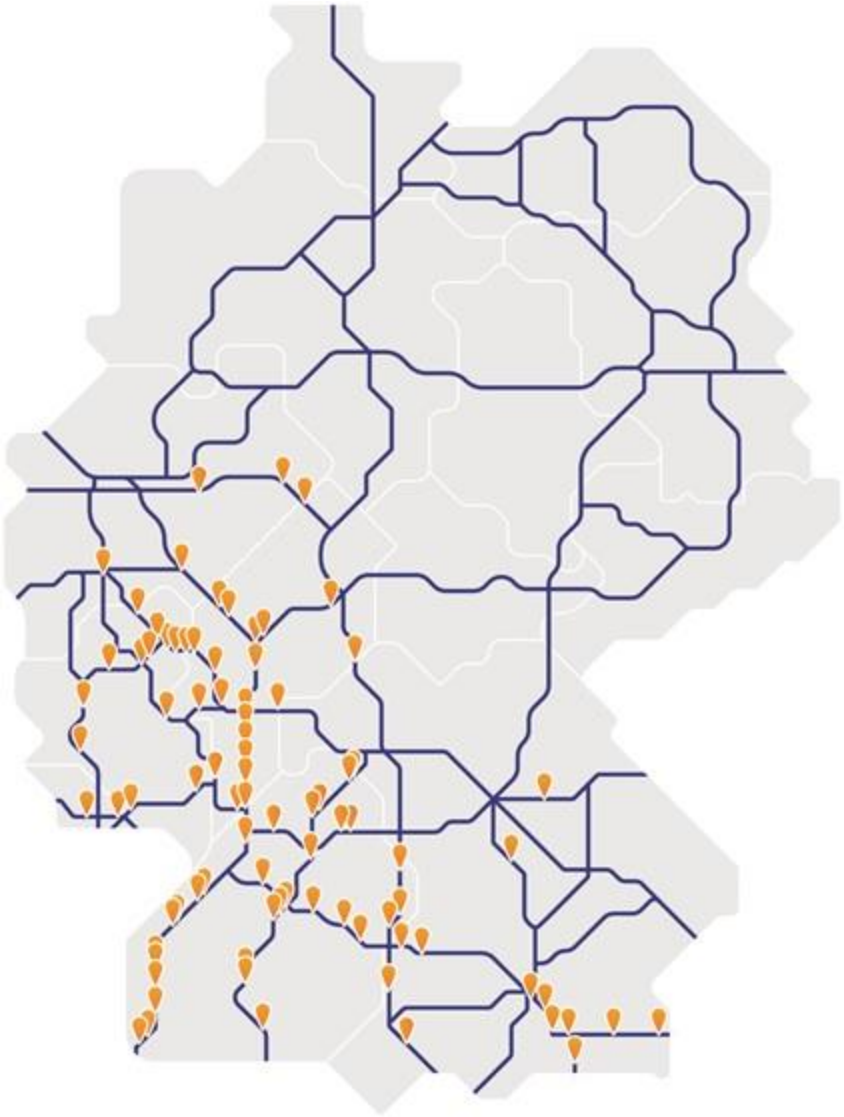

Figure 6: DC charging stations beyond Baden-Württemberg

During the rollout of these chargers a lot could be learned on the hands on challenges posed by the installation of charging infrastructure on the German Autobahn. The full paper and the presentation will elaborate on this topic. One of the new developed key feature of this DC chargers is the possibility to pay not only via the EnBW “Elektronauten” RFID card, but also via Smartphone App and credit and EC card. For this the IT Backend had to be updated. Besides these technical challenges it became clear during the project that the grid integration would be rather challenging due to construction constraints. This will also be one of the insights given in detail by the presentation.

State Highways (Bundesstraßen)

The next step after the Autobahn will be the construction of DC multichargers on the so called Bundesstraßen or state highways. The great challenge here is to find the most suitable spots for installing chargers. So far this proves rather challenging as there are no resting areas equipped with recreational facilities, like they are found on the highway. To further complicate the pinpointing of good locations, ownership of the land is often uncertain and thus has to be evaluated. Furthermore the power grid belongs in most cases to smaller utilities which further complicates the deployment process. So far EnBW is working on a streamlined process based on good practices. Anyway the EnBW is working on establishing a comprehensive charging network also on the state highways. In this case the EnBW is working together witch the state government and is trying to obtain funding form the BMVI.

"Always Charged" - DC charging infrastructure in the broader concept

Having proven the viability and utility of a comprehensive charging network it is necessary to explain its role within EnBW's concept of electromobility. EnBW pursues an understanding of charging habits stated in the words "always charged", opportunity charging wherever possible.

The charging scenarios can thus be comprised as follows:

All three of which are by now addressed by EnBW's efforts to develop and build a charging infrastructure. In order to provide comprehensive charging opportunities and effectively tackle range anxiety, thus elevating electromoblitiy out of its initial difficulties, all three of which have to be addressed. By providing the necessary infrastructure for the second and third scenario, EnBW provides a role model for further buildup.

4 Conclusion and Outlook

The development and deployment of AC charging infrastructure and DC charging infrastructure has shown, that both types of charging infrastructures pose quite different challenges to the charge point operator. The roll out process differs in basic topics and also the accounting of the charging poses completely different challenges. In one some cases a time based billing model may proof suitable while in others a billing model based on kWh in necessary or a combination of both. As the two types of charging infrastructure pose different challenges non the less both are necessary to establish a comprehensive charging network which can serve the EV customer's needs. Taking the so far established charging network as starting point the EnBW will develop its network further. In the near future the main focus will lay on the establishment of a charging network along the EU TEN-T corridors linking different countries and thus providing a hassle free experience for EV users and further the EU goals stated in the AFI Directive. The full paper and the presentation will elaborate on the specific upcoming projects, this is right now not possible as the negotiations are still under way.

Acknowledgments

The EnBW wants to thank the BMWi, BMVI, BMBF and BMUB for the funding provided in the R&D projects Model Region Electromobility, MeRegioMobil, CROME, iZEUS, SGI and all of the project belonging to the “Showcase Electromobility”.