EVS32 Symposium
Lyon, France, May 19-22, 2019

Learnings from the roll-out of public charging infrastructure in the Netherlands

Mr. J.S. Veger, MSc[*], Mr. H. Idema MSc[*], Mr. P. Zijlema MSc[**]

[*] *APPM Management Consultants, Spicalaan 8, 2132 JG Hoofddorp, The Netherlands*

(veger@appm.nl / idema@appm.nl)

[**]*Poffels Energy, (pieter@poffels-energy.nl)*

Executive Summary

The roll out of public charging infrastructure is essential to meet Dutch ambitions for electric transport and to establish a sustainable electricity supply for electic vehicles. This paper examines several cases from the roll-out of public charging infrastructure in the Netherlands, regarding smart charging, free choice of supplier and innovative roll-out strategies.

1 Introduction

In the next decade it is expected that the number of electric vehicles in the Netherlands will rise significantly. In the recent national approach for charging infrastructure, which is part of the Dutch conceptual public-private climate agreement, it is expected that in 2030 there will be around 2 million electric passenger cars on the road. In February 2019 this number was around 150,000. This creates a huge task to provide sufficient charging infrastructure that is integrated in the electricity grid and optimizes the use of renewables as much as possible.

An estimated 70 – 80% of the households in the Netherlands does not have private property to charge. Therefore, a large part of the electric drivers is dependent on public charging infrastructure. We have seen that large scale collaboration in joint tenders for charging infrastructure is a successful strategy to scale up public charging infrastructure. It leads to cost reductions and a more efficient roll-out process for the installation and operation of public charging infrastructure.

However, several challenges are still in a pilot phase. In this paper we provide an overview of these challenges and current pilots that aim to provide solutions to these challenges:

1. Smart charging solutions are needed to match the energy demand of electric vehilces with the capacity boundaries in the electricity grid, i.e. the electricity grid is not designed with the electric vehicle in mind and smart charging is seen as one of the solutions to charge large numbers of electric vehicles without high investments to expand the electricity grids;
2. The charging of electric vehicles could be integrated with the electricy market, which is also a smart charging service. Currently, vehicle grid intergration is mostly done by the chargepoint operators (CPOs), without any involvement of EV-drivers. With free choice of energy supplier the EV-driver could be involved and make individual choices regarding energy pricing, smart charging and charging with renewable energy;
3. The roll-out strategies for the installation of new public charging infrastructure have to become more effective, while the number of charging stations needed in public areas will increase rapidly in the next years. Currently, (potential) EV-drivers have to file a request for a public charging station and

it takes a few months before a station is available. With millions of EV drivers in mind, this approach is not sufficient anymore and should be changed from 'request' to 'charging certainty';

These developments are implemented in the Dutch market in different projects for public charging infrastructure. We provide an introduction to these projects and will conclude with main lessons learned for innovation strategies regarding public charging infrastructure.

2 Learnings from roll-out strategies

In this paper we examine learnings from three thought leading Dutch cases with the following focus topics:

1. Smart charging to avoid grid congestion
2. Free choice of energy supplier to involve individual decision making by EV-drivers
3. Roll-out strategies to scale up the number of charging stations in an effective and efficient way

2.1 Smart charging in Overijssel and Gelderland

In the provinces of Overijssel and Gelderland around 40 municipalities collaborate in a tender for the realization and exploitation of 4,500 public charging points. In this tender one CPO has the right and the obligation to roll-out, exploit and maintain publc charging infrastructure.

A main concern is the impact of this charging infrastructure on the local electricity grid. Around dinner time people come home and connect their electric vehicle to the grid, which will create a peak demand on the grid. This peak becomes even higher when households switch from stoves on gas to inductive cooking on electricity. For this reason, a smart charging pilot has been made part of this tender.

The goal of this pilot is to reduce the impact on the grid due to the charging of electric cars. In essence, the pilot focuses on two topics: measuring the impact on the grid and learning about the charging behavior of EV-drivers.

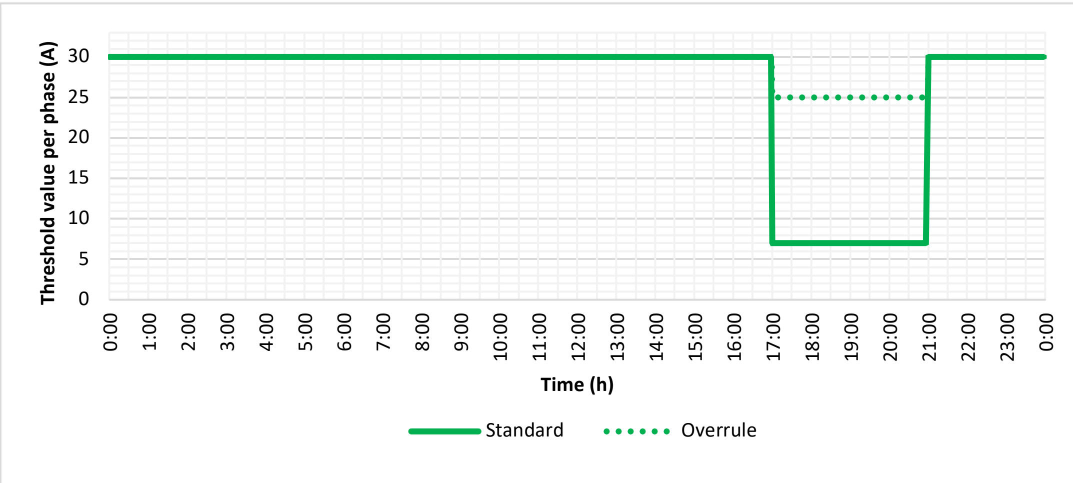

Figure 1: Charging profile in Overijssel and Gelderland, The Netherlands

The pilot is set up as follows. All charging stations have a simple static charging profile, as shown in figure 1. Between 17.00 and 21.00 hours, the power of all charging sessions is reduced. Beyond these hours, EV-drivers are offered more power than what is usual on public charging points. During peak hours (between 17.00 and 21.00 hours) EV-drivers have the ability to 'overrule' the charging profile using their (smart)phone. This means that in case of an emergency, EV-drivers can still charge with an acceptable speed.

During the pilot the behavior of EV-drivers is examined. This is done by implementing and testing several incentives that have to prevent the use of the overrule function. When the use of this function is avoided, there is less pressure on the grid. Examples of incentives include price-measures, saving for points, or saving for privileges such as the ability to reserve a charging point. The effectiveness of each incentive is measured by looking at the overrule percentage. The lower the percentage, the better the incentive.

Furthermore, charging data is plotted on the existing electricity grid in different scenarios. Charging data includes the level of power that is being used by the cars. The scenarios might differ in the age of the existing local grid. The assumption is that the older the grid, the less capacity, and vice versa. Another variable might be the level of penetration of cars and therefore the expected number of electric vehicles. The idea is to extrapolate this data and see where boundaries of the grid are met or exceeded. This way insight is gained in the potential of the simple charging profile with the overrule function: will it be enough to prevent short term investments in the existing grid?

2.2 Free choice of energy supplier in Groningen and Drenthe

In Groningen and Drenthe, two provinces in the northeast of the Netherlands, 30 municipalities participate in a joint tender for the realisation of 2,000 public charging points. An innovation that will be realised in this tender is the free choice of energy supplier: the EV-driver has the authority to select a licensed electricity supplier for the supply of electricity on the charging station. It is expected that the first charging stations will be placed in Q3 2019 and the system for free choice of supplier will be live latest Q4 2019.

Most tenders for public charge stations offer the winner of the concession the single right to install, maintain and operate the charging stations as well as the delivery of electricity to it for a period of 10 years. In the Netherlands we see a limited number of electricity suppliers that is active in this market. Moreover, at this moment there are few to no examples of involvement in tenders of decentralised renewable energy production or involvement of local renewable corporations. This leaves the innovative potential of dozens of suppliers and decentralised producers untouched which is in sharp contrast to the energy transition, where new concepts are often created and new parties frequently enter the market.

Also an EV-driver (as a private consumer or business fleet owner) might have different needs and demands for electricity supply compared to a CPO. For example, a CPO might have a focus on price, whereas an EV-driver might have a focus on sustainability and/or even own renewable production. However, in the current system the EV-driver is bound to the supplier contracted by the CPO and their offering. This limits the EV-driver, the consumer of electricity, to find the product that best suits their needs and wishes. Especially since most households are limited to the public charge point that is closest by.

In order to capture the innovation potential of all suppliers, give consumers the possibility to find products and suppliers that match their needs, and enhance the energy transition and unlock full market potential and future flexibility to new services and products, the tender in Groningen and Drenthe was split in two concessions. This leads to two transparent prices and a level playing field for all CPOs and licensed electricity suppliers. One concession is aimed at CPOs for the infrastructure, which results in an installation fee per kWh, the other concession is aimed at energy suppliers for the default supply of electricity, which results in an energy fee per kWh. The default supplier is responsible for the electricity consumption at the charging station and the electricity supply to the EV-driver in case the EV-driver has not chosen a specific supplier. However, when the EV-driver uses a supplier of choice, their unique ID is linked to their supplier of choice at the start of a charging session and that supplier will receive the charged volumes in the allocation by the distribution grid operator (DGO). The energy fee is settled between the energy supplier of choice and the EV-driver without intervention of the CPO.

A blockchain was created to use the data from the socket meters of the charge point for the allocation of electricity to the appropriate supplier. A smart contract assigns the consumption towards the appropriate supplier of choice and deducts the same volume from the default supplier. This is done on a 15 minute basis to match the allocation process and the sum of the two is always zero. The DGO collects the data from the smart meters of the charging stations as normal. On top of that the DGO also collects the data from the blockchain and allocates the summed data towards the appropriate supplier, which is done similar to the allocation of smart meters. As such the default supplier and suppliers of choice are responsible for the forecast, purchase and balance of the electricity consumption that is allocated to their portfolio and the CPO has no role or saying in the supply of electricity.

With this innovative tender the involved parties realise multiple goals:

- The EV-driver, as the consumer, can select an energy supplier and choose a product that suits his/her needs best.

- All licensed suppliers have access to public charging infrastructure to supply electricity, instead of one supplier selected by a CPO.
- All licensed suppliers can develop innovative products that help prosper the energy transition and (future) needs of customers, instead of one supplier selected by a CPO.

The use of self-produced renewable energy on public charging stations is an example of an innovative product that can be developed in this system. In this example the EV-driver, a private consumer or business fleet owner, owns solar panels on his/her house or business. Normally the solar production cannot be used to offset the consumption at a public charging station, since it is split over multiple suppliers. With free choice of supplier the EV-driver now has the possibility to select the home or business supplier at the charging station and the supplier can develop products and services that allows for EV-drivers to use their own production. As such the renewable energy finds its way to the charging station, the EV-driver is in control of own production and consumption, and the energy supplier has new products and services to offer.

2.3 Network development strategy in the city of Utrecht

The City of Utrecht is the fastest growing city in the Netherlands and has strong ambitoins regarding the reduction of greenhouse gas emissions. In 2030 all transport in the city center should be zero emission. Electric transport is the main solution to achieve this ambitious goal. Therefore, the city has developed a strategic plan for public charging infrastructure, as many citizens and visitors needed public parking lots and charging infrastructure for their electric vehicles.

Currenlty, the City of Utrecht is developing their network of charging infrastructure based on requests. EV-drivers get in touch with the city for the expansion of the charging network. On average it takes a few months before a new charging station becomes available, because of all kinds of formal procedures that have to be taken into account and because the planning of the construction work is a difficult issue as well. Despite this, in the past decade the city has developed a city wide network of public charging infrastructure. In more or less each neighborhood there is at least one charging station (with two charging points) available.

The City of Utrecht wants to improve their roll-out strategy and is going to make use of a data driven approach. Instead of the requests that EV-drivers have to file, the utilization rate of charging infrastructure will be leading. With this new approach the city aims to achieve charging certainty for all EV-drivers who are living in or visiting the city. Charging certainty, in this case, means that each EV-driver has a very high chance that a charging point is available in the neighbourhood of his or hers trip destination.

The charging utilitization will be determined by the occupancy of charging infrastructure in each neighbourhood, related to the number of charging points that are available in a certain neighbourhood. I.e. in a certain neighbourhood are 10 charging points, the maximum occupancy rate is for example 80%, so there are always 2 charging points available. In a different area there are 28 charging points, with a maximum occupancy rate of 90%, so always 2 charging points will be available. This information is used to develop the charging network. When the occupancy rate increases, the city and the CPO know that they have to expand the network before an EV-driver needs to file a request. Using this approach, the long waiting time between a request for a charging point and the installation is taken away.

In order to let the installation of new charging stations run smoothly, the city is developing a plan with potential locations of charging stations as well. In this plan, the city follows the strategy that charging has to take place outside public spaces. If this is not possible, charging stations are installed at the same locations (e.g. develop a charging plaza). The last and least preferable solution is an invidual charging station. In the long term even ultra fast charging (~350kW) might become an alternative for innercity charging of electric vehicles.

3. Conclusions

As we have stated earlier, we have focused on three main challenges that have to be met when it comes to the large scale realization of public charging infrastructure: (1) the integration of charging infrastructure in the existing electricity grid, (2) the integration of charging EVs in the electrity market, and (3) an effective demand driven network strategy. Theses challenges have been explored by looking into three Dutch cases with different approaches.

The discussed approaches for public charging infrastructure have a different focus and are innovative in itself. Currently, in the Netherlands we have experienced that privately owned CPOs are willing to invest in public charging infrastructure. This is a very welcome trend for cities with huge ambitions regarding electric mobility, but without high budgets to invest in public charging solutions. However, cities and regions are willing to get involved with their innovative ideas and ambitions in the roll-out of public charging infrastructure.

All approaches for the installation of public charging infrastructure show that charging infrastructure in public areas is a valuable public asset. If an authority such as a city or a regional goverment wants to successfully stimulate electric transport or smart charging, lessons learned from recent projects show that there is always a big role for that public authority. A long term vision on the network development, connecting charging with renewable energy and smart charging is very important in the transition that e-mobility is going through from an innovator and early adopter market today, to an early majority in the coming years.

Authors

Jeroen Veger MSc. is a senior consultant in E-Mobility and was a driving force in several projects for public charging infrastructure, including Overijssel / Gelderland and Groningen / Drenthe. His role included organizing the projects, as well as delivering in-depth knowledge of charging infrastructure and e-mobility.

Harm-Jan Idema MSc. has unique knowledge of and experience in e-mobility, charging infrastructure and smart charging. As a senior consultant he has been involved with e-mobility and has organized a great range of projects with a total of more than 15,000 charging points. Furthermore, he is deeply involved in international e-mobility projects and acts as smart charging expert for public and private organisations.

Pieter Zijlema MSc. is a senior expert in the field of Energy and Climate. Over the years he has built extensive knowledge of (renewable) energy, optimization, risk and data. He has had a significant role in the design and implementation of the free choice of energy supplier project in Groningen and Drenthe.