Smart charging based on grid load

In the coming years, the number of electric cars in the Netherlands will increase, potentially reaching 1 million in 2025. This may lead to overloading of the electric grid within the next 10 years. Simply laying thicker cables is not an efficient way of dealing with this and Enexis is therefore devoting efforts towards smarter use of the existing grid through Smart Charging.

The grid manager's challenge

An electric car can consume as much electricity in a single hour as a household in an entire day. If all electric cars attempt to charge at the same time, e.g. upon arrival at work in the morning or when returning home in the evening, this can overload the electric grid.

Smart charging as an alternative

The low-voltage network has a reasonable amount of overcapacity. This means that it will be possible to charge a large number of electric cars if people switch to electric transportation in large numbers, but this requires that the charging of these cars is managed in a smart way. Fortunately, there are broad opportunities for this, as the average car in the Netherlands drives approximately 37 kilometres per day. This means that the average car in the Netherlands is stationary for more than 23 hours per day. The required charging time for 37 kilometres of driving on electric power is at maximum two hours, meaning that there is a 23-hour window for a two hour charging session, which offers great flexibility. An alternative to the expensive option of grid reinforcement is to make smart use of the flexible potential of electric cars. This principle is illustrated in Figure 1.

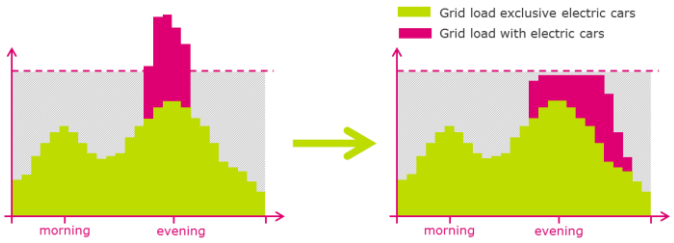

Figure 1: Uncontrolled charging vs. smart charging

Information about grid load

In order to prevent excessive grid load during peaks, grid load must be taken into account in the charging of electric cars. Information about the available net capacity is required for this. In order to simultaneously take into account the expected price development across the day or the availability of energy from sustainable sources, actual information only is not enough: information on expected grid load is also required. Based on that knowledge, choices can be made as to the most advantageous moment for charging.

Smart algorithm

Although the charging of electric cars affects the electric grid, it is not the grid manager's task to directly control the charging behaviour of individual electric cars. Instead, grid managers communicate with the operators of charging stations. They, in turn, can determine the most advantageous moment per customer.
For this purpose, Enexis's 'Smart Charging naar de Praktijk' (Smart Charging into Practice) project has developed a unique system for load management, which communicates about grid capacity with external parties. The system uses smart algorithms to predict local use, excluding the use of electric cars; this local use is the non-flexible load, represented in green in Figure 2. As long as the combined consumption of electric cars does not exceed the capacity indicated by the grey area, overloading is avoided. This system can be applied at all levels – for individual users, fuses on low-voltage cables, low-voltage transformers and even at mid-voltage levels.

Smart charging

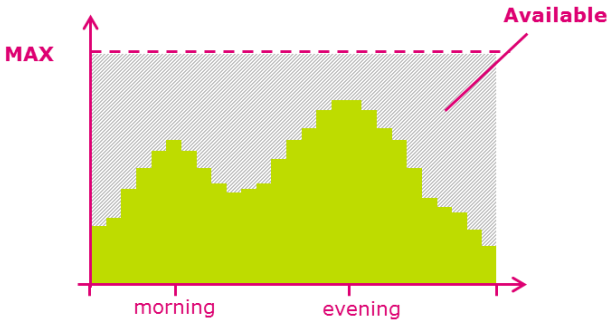

Figure 2: Grid load

Development of open standard

It is essential that the communication with the various parties occur in a standardised manner. With this in mind, Enexis has developed the Open Smart Charging Protocol (OSCP). This protocol has been accepted by the Open Charge Alliance (OCA), an international standardisation organisation for electric transportation, since 2014. The OSCP governs the communication between the grid manager and charging station operators, and involves:

- Sending of information about available grid capacity
- Feedback on usage
- Negotiation on capacity

Application of smart charging

The smart charging system was originally developed together with market parties for private areas, e.g. cars parked in the basement using less electricity around lunch time, when the canteen's use of electricity spikes. It is expected that load management using smart charging will eventually also become a necessity in the public domain, and that this management can be carried out on the basis of predictions. Experiences with this system show that it allows for the charging of 10 to 20 times more cars than uncontrolled charging permits, without grid reinforcements being required.

Much attention has also been given to privacy and security questions relating to load management. Effective security is necessary to ensure integrity of the information and by extension the stability of the grid. Research has been conducted in this area in collaboration with Radboud University in Nijmegen.

Future developments

We expect that Smart Charging will be a part of the Smart Grid in the future. For this reason, we are currently conducting pilot projects with other grid operators and other parties in the market in order to further explore the possibilities of and potential improvements to Smart Charging.

Another important question is under what circumstances consumers are indeed prepared to opt for flexible charging. After all, the law determines that grid managers must at all times ensure sufficient grid capacity. The idea is that an uncontrolled connection leads to greater expenses on the side of grid managers than a controlled connection. Based on this it can be justified that a 'flexible' connection can be cheaper than an 'inflexible' one. This can be attractive for consumers, and Enexis is experimenting with this as well.

Asset management / Innovation
Lennart Verheijen
+31 (0) 6 212 910 68
lennart.verheijen@enexis.nl

ICT
Paul Klapwijk
+31 (0) 6 120 47 046
paul.klapwijk@enexis.nl

The availability of energy is a major determining factor in how we live, work, produce and travel. Energy thus occupies a central position in society. What drives us at Enexis is our desire to bring energy to the places where people need light and warmth. We spend each and every day working on a smarter, safer and more sustainable grid – with expertise and personal commitment..
enexis.nl