New mobility solutions require smarter ICT

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The Dutch vehicle fleet will change drastically in the coming years. The percentage of electric vehicles is currently still very small but is expected to grow strongly in the coming years. This will undoubtedly lead to major problems in the electricity network. Therefore, a lot of new knowledge and a lot of smart ICT is needed to actually make the smart mobility solutions, that are currently being worked on, possible.

Apart from the question whether the grid will be able to cope with the rapid growth of electricity generated by windmills and solar panels, the demand for electrical energy will also drastically change. The moment at which solar energy can be generated in particular does not match the times at which the demand for electrical energy might peak. After all, electric cars will mainly be charged in the evening, while during the day most of the solar energy is generated. That is why, in the context of the European EV Energy project, we are looking at techniques and tools with which this mismatch can be prevented or adjusted.

Energy storage

One of the projects under EV Energy is 'vehicle2neighbourhood'. This project focuses on the Johan Cruyff Arena in Amsterdam. This stadium is equipped with a large number of solar panels: 4200 units that generate a total of 1128 MWp. This means that during the day the Arena is capable of generating much more electrical energy than it consumes on many days during those hours. The stadium - with a capacity for 68,000 visitors - needs a large amount of electrical energy in the evenings.

That is why the Arena has invested heavily in energy storage. Use is made of so-called '2nd life' batteries. These are from Nissan electric vehicles. In addition, the storage system has bi-directional chargers. This means that the Arena is in principle ready for a world in which energy is generated during the day via solar panels, which is first stored in batteries and then delivered to customers.

Supply energy

Depending on the circumstances, the energy in these batteries can be used for a number of purposes. For example, the (partial) feeding of the electrical installations of the stadium in the evenings. Any additional need for electrical energy can at that time be covered via energy that is obtained from wind farms. But the Arena is also able to load the electric cars of visitors to events during the evening hours. Moreover, the Arena will soon be included in a local grid that links the stadium and its energy storage to the electricity grid that supplies homes and businesses in the vicinity of the stadium with energy.

This makes the Johan Cruyff Arena a so-called hub in the local grid in this part of Amsterdam. Investments in energy storage and associated installations can earn back the Arena because it can, of course, demand money for the energy it supplies to other parties: motorists or, for example, the grid that resells this energy to companies and residents. With specially developed management software, The demand for storage and supply of energy coupled together to supply good and largely automated can be realized.

Flexible power

A second initiative carried out in the context of EV Energy concerns the strong growth in the demand for electricity that will be the result - and now as is sometimes the case - of the expected rapid growth in the use of electric vehicles.

This FlexPower project once again seeks a solution to the mismatch between the moment at which electricity is generated and the times at which it must be delivered to customers. The project - again in Amsterdam - investigates methods to solve this problem by varying the amount of energy that an electric car receives from a rechargeable vehicle. One of the questions the researchers had is: how does the owner of an electric car react to that?

The idea is actually fairly simple but requires the necessary advanced (ICT) technology. In a few years, many Amsterdam residents will be traveling with their electric cars during the day. By evening they come home and they want to recharge their car - ready for use the next day. However, if the cars are absent during the day, most of the solar energy is generated. And in the evening - when the car is 'at home' again - the demand for electrical energy is the maximum. That question could at times like that, according to many scenarios, even be so large that the current grid can not handle this question. Are we therefore going to expand the grid ? Or add energy storage in many places? Or are we going to look at smart technology to better match supply and demand?

Peak shaving

In Flexpower we looked at methods to achieve 'peak shaving '. For example, is it technically possible and acceptable to customers for the amount of electrical energy that a car receives from a charging station to vary depending on the amount of energy available at a given time? In other words, the time required to fully charge a Tesla or a Nissan Leaf can vary greatly depending on the amount of energy available at a particular location at a particular time of the day.

The Flexpower test has shown that this form of 'peak shaving ' can be realized technically well. The pilot also shows that owners of electric vehicles react reasonably well to this. They accept that their car sometimes recharges faster and sometimes slower.

In addition, Flexpower shows that there will soon be a need for better insight into the network. This applies - naturally - to the network manager, but also to the owners of electric vehicles. If data on the supply and demand of energy in a specific part of the network is also available to third parties, then good opportunities arise for, for example, paid apps and services that give the owner of an e-car insight into the amount of energy that is available in certain streets. or depart. Who then - for example - likes to charge his car very quickly, can drive to a certain street or neighborhood where a lot of energy is available. And in certain neighborhoods where little energy is available, demand can be curbed by possibly raising the price, which encourages the rider to go to another part of the city.

Generate locally

It can therefore be very interesting to make a potential problem - locally generated electricity causes imbalance in the grid - part of the solution. This solution could be, among other things, that local neighborhoods and neighborhoods themselves generate as much energy as possible through, for example, solar panels. How this process works in practice and how this has been further stimulated has been investigated in a third project that has been looked at in the context of EV Energy: the Amsterdam Prosumer project.

This project looks very broadly at local generation and consumption - from technical measures to social aspects. In every district or street, for example, all residents are financially capable or willing to invest in solar panels themselves. Legislation and regulations sometimes also stand in the way at unexpected moments.

Algorithms

Local generation and better matching of supply and demand during the day offer very interesting possibilities to manage the transition to electric transport. With the help of algorithms, supply and demand can be optimized. A lot more energy can be generated and consumed locally. As a result, the network operator is faced with imbalance in the grid but can prevent this - or steer it - by slowing down the demand for energy by temporarily increasing the price. While electric drivers themselves can choose how important fast charging is for them and how much money they have to pay for it.

All three projects have shown that there is a need for new tools. For example, it concerns tools to help governments with urban planning, whereby the boundaries that exist traditionally between disciplines such as planning, transport and energy should be broken. Network administrators need (automated) tools that help to gain insight into supply and demand during the day at neighborhood and street level. Only then they can prevent or reduce unwanted peaks in demand. In addition, they need the help of electric drivers who - based on price incentives or the speed with which their car is 'full' again - choose where and when they charge their cars. The future of mobility is thus increasingly becoming a game of smart and multidisciplinary ICT.

EV ENERGY is an INTERREG Europe- funded project under the thematic “Low Carbon Economy”, addressing the intelligent integration of the energy and mobility system by enabling interregional policy and good practices learning, transferring the most appropriate policies and good practices to cities and regions and large-scale implementation.