Intelligent E-transportation Management

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Effects of renewable electricity production

The increase of renewable energy sources e.g. wind energy will cause fluctuations in centralized power generation. Through the increased fluctuations in generation the stability of supply and power quality becomes more and more an issue. Due to market priorities, at night more conventional power plants serve as spinning reserve or run at low efficiencies with relative high emission levels. This is in contradiction with reliable power supply on one hand and sustainable electricity production on the other hand. Moreover for renewable energy sources it is often undesirable to turn off during night. Therefore the increase of renewable energy with large fluctuations in supply makes the management of the electricity network more complex. This is an issue, together with the difference in demand between the day and at night.

Manage the electricity demand

Two important trends can contribute to solve these problems: increased electric transportation using batteries (electric vehicles) and increasing of the implementation of electric heat pumps. Both options offer the possibility to better manage the fluctuating electricity supply over time by a controlled demand. But it is not only for the integration of renewable energy sources that a management system is needed. If no demand management system is used, the current grid infrastructure will limit the use of these electric vehicles and heat pumps strongly, as the peak demands from this equipment will exceed the maximum peak powers of the current grid. So the drawn developments to more electric vehicles and electric heatpumps generate new demands for management of the system.

ITM project

In the ITM project the specifications of such a management system are studied. This management is necessary to facilitate for a maximum contribution of renewable energy sources as well as to facilitate the introduction of large amounts of electric vehicles and

electric heat pumps, but it has to meet the technical and social-economic demands at the same time. In the ITM project the specifications are mainly realised by load flow simulations of a network of a typical Dutch quarter.

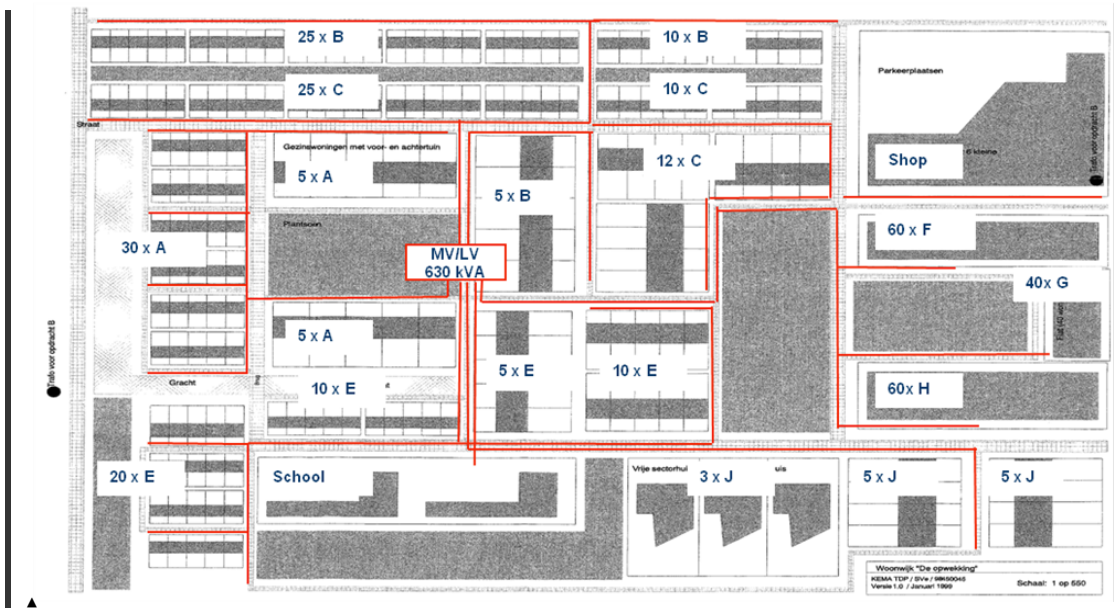
In the project the following issues are prognosticated to gather the data required as input for a network simulation of a for the Dutch situation relevant quarter:

- the development of (plug-in hybrid) electric cars resulting in partly flexible electricity demand for housekeeping's
- the charging facilities for electric cars
- the development of electrical heat pumps resulting in partly flexible electricity demand for housekeeping's
- the development of electricity networks
- the development of the electricity generating production capacity together with day/ night unbalance, power fluctuations, spinning reserve, etc.
- the socio-economic aspects relevant for the electricity delivery

Simulation tool

Based on load flow simulations (in PowerFactory from DIgSILENT) the consequences for the electricity network are determined. In these simulations the electricity demand in a typical Dutch quarter (fig.1) during a year is simulated (houses, apartments, school, shopping centre). After simulating the current situation electric vehicles and electric heat pumps will be added to the current electricity demand.

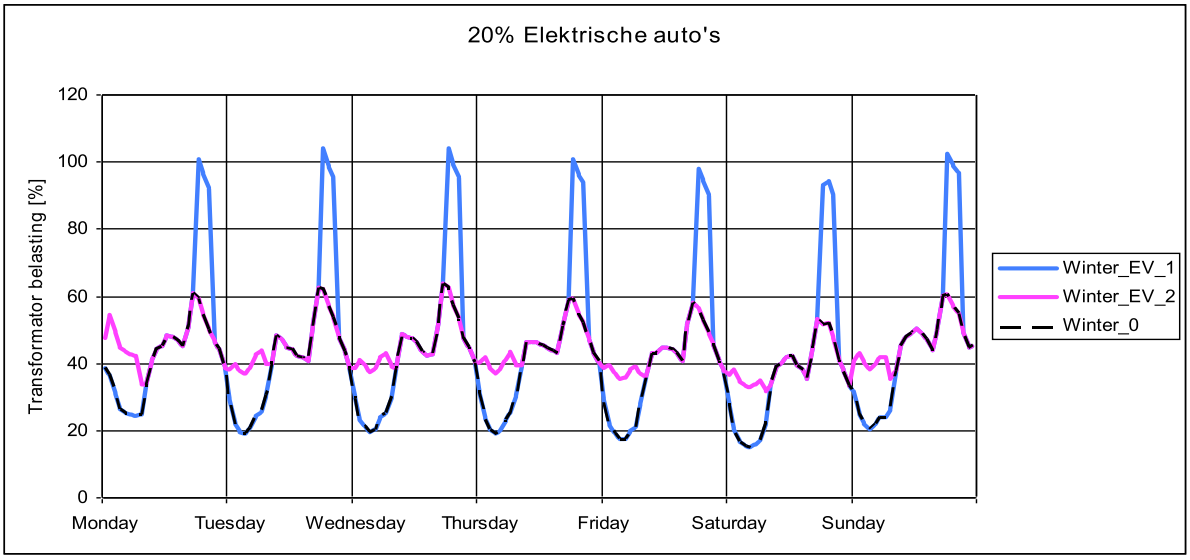
Fig. 1: Electricity network in a Dutch quarter consisting of 185 houses, several apartment buildings, a school and a shopping center



Preliminary results

The first simulations make clear why electric cars and electric heat pumps require attention (overloading of transformers and/or cables, voltage drops). Demand side management can help to introduce the electric cars and electric heat pumps with limited investment costs. The possibilities of demand side management and the consequences for the network will also be simulated within the ITM project. Figure 2 below shows a Dutch situation with 20% electric vehicles and the possibilities of demand side management just by charging the vehicles during the night.

Fig. 2: Transformer load in winter situations without EVs (winter 0), with 20% of all cars being EVs without demand side control (winter EV 1) and with control (winter EV 2)



Continuation of activities

This figure makes clear that even with a limited amount of electric cars (20%) the limits of the transformer will be reached. In older cities with more houses per cable or thinner cables, this will even be worse. In the scenarios described much higher amounts should be taken into account, also in combination with electric heat pumps. In the coming months these combinations and the possibilities of demand side management will be studied in more detail.

The ITM project is being executed within the Long Term Energy Research subsidy scheme of the Dutch Ministry of Economic Affairs. Project partners are Continuon, Essent Netwerk, Eneco Netbeheer, KEMA, ECN and IWO.