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MAXIMUM PV-PENETRATION IN LOW-VOLTAGE CABLE NETWORKS

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INTRODUCTION

Over the past years the number of PV-systems connected to the LV-network is rapidly increasing. An important question is whether the LV-networks are able to cope with large amounts of PV. In this paper a study will be presented that has investigated whether or not problems have to be expected in typical LV networks. A special focus will be on cable networks, as all LV networks in the Netherlands consists of cables.

RESEARCH APPROACH

The research question is, whether the existing LV distribution grid is able to cope with large amounts of PV when full streets are covered with solar panels. To make an assessment of the influence of PV on the Dutch LV grid Vision (loadflow program) network models of several neighbourhoods are used. These neighbourhoods form a representative mix of the different types of networks that exist in the Netherlands. Satellite images were used to estimate the average useable roof area for different household types, ranging from detached houses to apartments (see figure 1.).

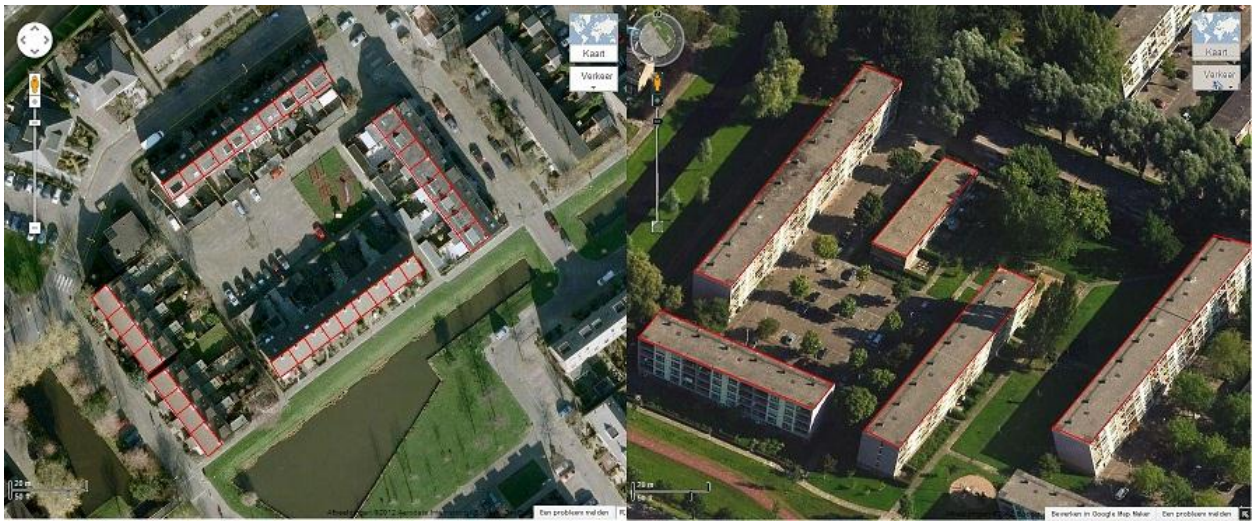

Figure 1. Satellite images to determine available roof area for PV (pictures courtesy of Google Maps)

Based on the useable roof area the maximum PV-production could be determined. Each household was then assigned a corresponding consumption and PV production value. These values are taken at 2 extremes that occur concerning PV:

- Moment of maximal production: Sunny summer day between 12 and 13 o'clock, at this moment the maximum amount of PV power is produced and load is relatively low.
- Moment of maximal load: Winter day between 18 and 19 o'clock, at this moment there is virtually no PV power produced and the load is at its peak.

RESEARCH RESULTS

For the two extremes the voltage variations on the end of the cable were determined. With these calculations it is possible to determine the maximum number of households that can be connected to different types of cables per cable length (see figure 2). The calculations were compared to simulations of the network models in Vision. In all simulations it was possible to stay within the regulatory voltage limits, although in several situations a (one-time) change in tap setting of the transformer was required. In only 1 of the simulations an overloading of the transformer occurred.

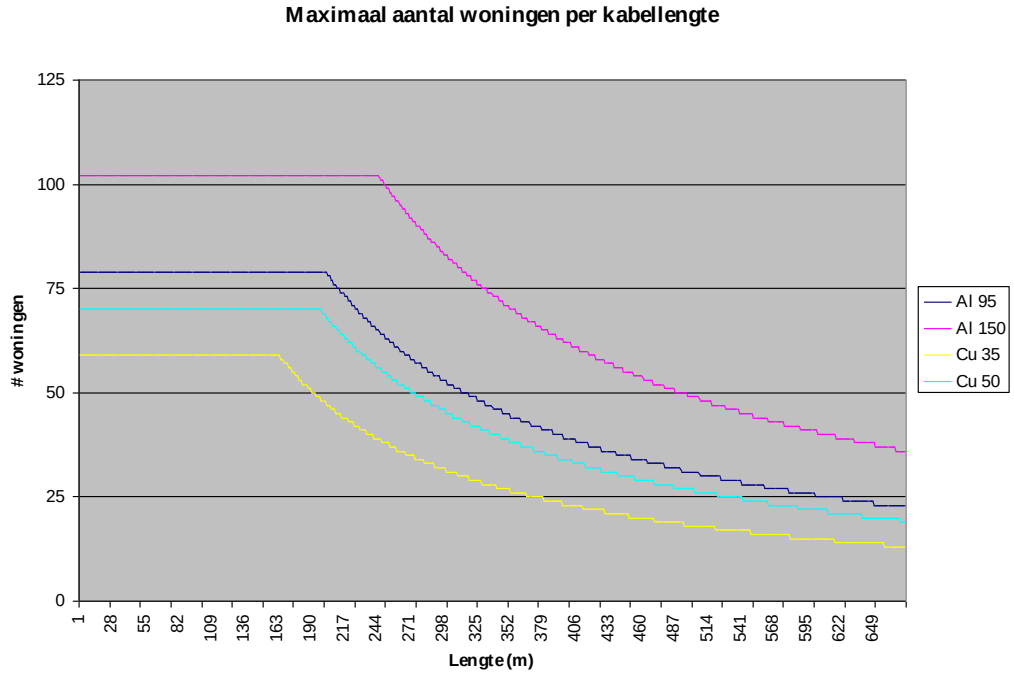

Figure 2. Maximum number of households with PV per cable type

CONCLUSIONS

In most parts of the network no problems will arise as a consequence of PV, as it is not possible to place enough PV panels to cause problems. Areas which have an increased risk can be identified on forehand. The highest risk for problems occurs in radial networks with long cable connections and a high household density. These types of networks tend to occur in villages and suburbs.