Track 2 - The smart energy system transition in cities and regions

**Title of the proposed paper**
Comparing the Effects of Different Load-Flow Feedback Approaches with Demand Side Management on Power Quality

**Name author**
Gerwin Hoogsteen

**Affiliation author**
University of Twente

**E-mail address author**
g.hoogsteen@utwente.nl

**Name co-author (if applicable)**
Albert Molderink, Gerard J.M. Smit

**Affiliation co-author (if applicable)**
University of Twente

**3 keywords**
Demand Side Management, Load-flow Calculations, Power Quality

**Text abstract (max. 300 words)**
The introduction of distributed generation in the low-voltage network can have effects that were unexpected when the network was designed and can lead to a bad Power Quality (PQ). These developments ask for better insight in the effects of demand side management (DSM) in a smart-grid.

Therefore, forward-backward load-flow calculations for a low-voltage distribution network are implemented in the TRIANA simulator developed at the University of Twente. Both the results from load-flow calculations and the structure of the network itself are studied to find possibilities to improve the DSM approach. These improvements target PQ enhancement and load on network assets.

Based on these results, different strategies are implemented and simulated using TRIANA. These strategies use either load-flow simulations as feedback or exploit the network structure using the network models. Both “the polluter pays” and a global objective approaches are used. This in contrast to unfair methods where households at the end of a feeder have to offer most flexibility.

Simulation results of the various approaches show significant improvements over both the original DSM strategy and the no control scenario. Simulations with peak shaving as objective for DSM without LF feedback show lower voltage levels, violating the EN-50160 norm despite a reduction in peak consumption. By adding a cost for energy transport, based on the cable properties, and splitting the problem in multiple partitions, improvements are made. The worst-case voltage level increases from 202V to 211V and the worst-case stress on grid assets decreases from 84% to 72%. Furthermore, transport losses and imbalance between the phases are reduced. However, the peak-shaving performance does not suffer from these PQ improvements.

The results show that it is important to consider distribution network properties when performing DSM optimizations as a decrease of PQ might occur. To benefit from DSM, it is important to find balance in both time and location for consumption and production.