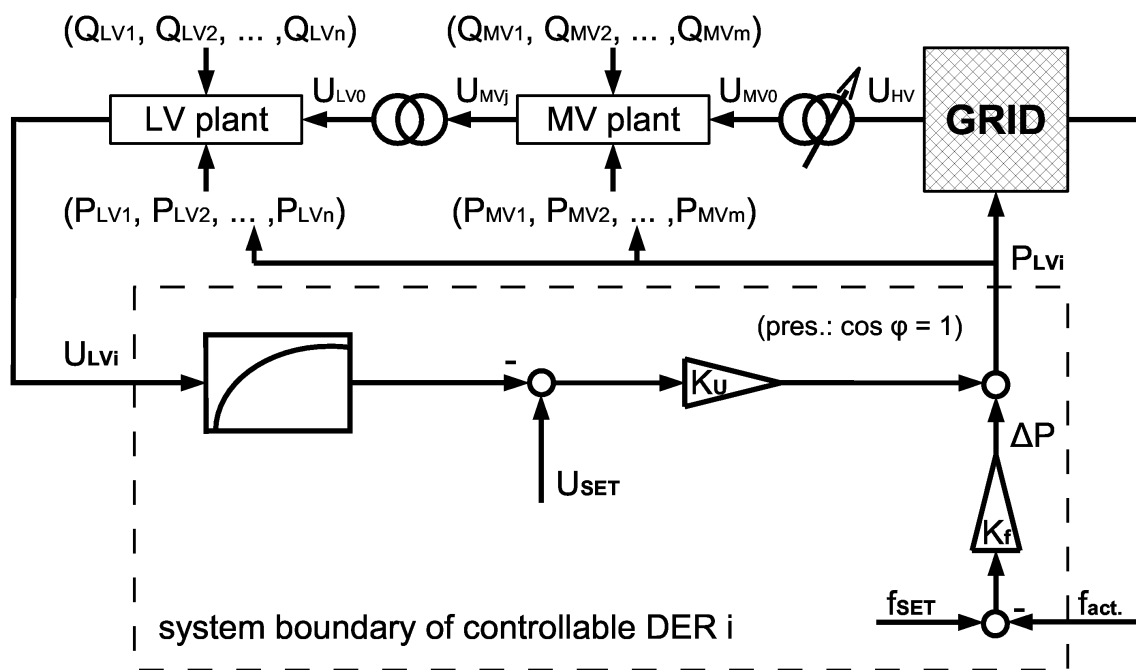


# Voltage Level as Information Carrier in Smart Distribution Networks

## Self-Organising Large Scale Low Voltage Virtual Power Plants

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In distribution grids, the parameters of low voltage lines are dominated by ohmic resistance. Thus, a voltage drop serves as a signal for detecting the load of the line [1]. By operating in voltage driven mode, controllable microsources such as small cogeneration units correlate with the grid load. Furthermore, stepping up and down the power transformer's on-load tap changer impacts the production level of the DER cluster (**Fig. 1**).



**Fig. 1:** control scheme of a self-organising low voltage virtual power plant (VPP)

Low voltage applications for primary active power control with droops are described in [2],[3],[4]. A secondary control without dedicated data links may be implemented via a triplet of restoration, disturbing, and balancing functions [5]. Tertiary control based on voltage is possible as the value of electricity correlates with the system load. In order not to expend the extra benefit generated by the VPP for elaborate metering, synthetic feed-in profiles [6] allow the settlement of power sources without the need for profile recording.

- [1] G Kaestle: *Virtual Power Plants as Real Micro Cogeneration Clusters*. 2nd International Conference on Integration of Renewable and Distributed Energy Resources, Napa, 2006.
- [2] A Engler: *Device for equal-rated parallel operation of single- or three-phase voltage sources*. US 6693809, 2004.
- [3] R Lasseter, P Piagi: *Control of small distributed energy resources*. US 7116010, 2006.
- [4] K De Brabandere: *Voltage and frequency droop control in low voltage grids by distributed generators with inverter front-end*. Dissertation, K.U. Leuven, 2006.
- [5] M Hauck, H Späth: *Control of a Three-Phase Inverter Feeding an Unbalanced Load and Working in Parallel with Other Power Sources*. EPE-PEMC, Cavtat & Dubrovnik, 2002.
- [6] K-D Maubach, M Schmidt: *Das Virtuelle Kraftwerk – Option für Verteilnetzbetreiber im anreizregulierten Energiemarkt*. in: 22<sup>nd</sup> supplemental set, June 2007, to H.-P. Beck, E. Brandt, C. Salander (Eds.): *Handbuch Energiemanagement*. VWEW - Energieverlag GmbH, Frankfurt, 2000.