

Analysis Environment for LV Networks

Analysis of LV Network Model Parameters by Smart Meter
Measurements

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Content

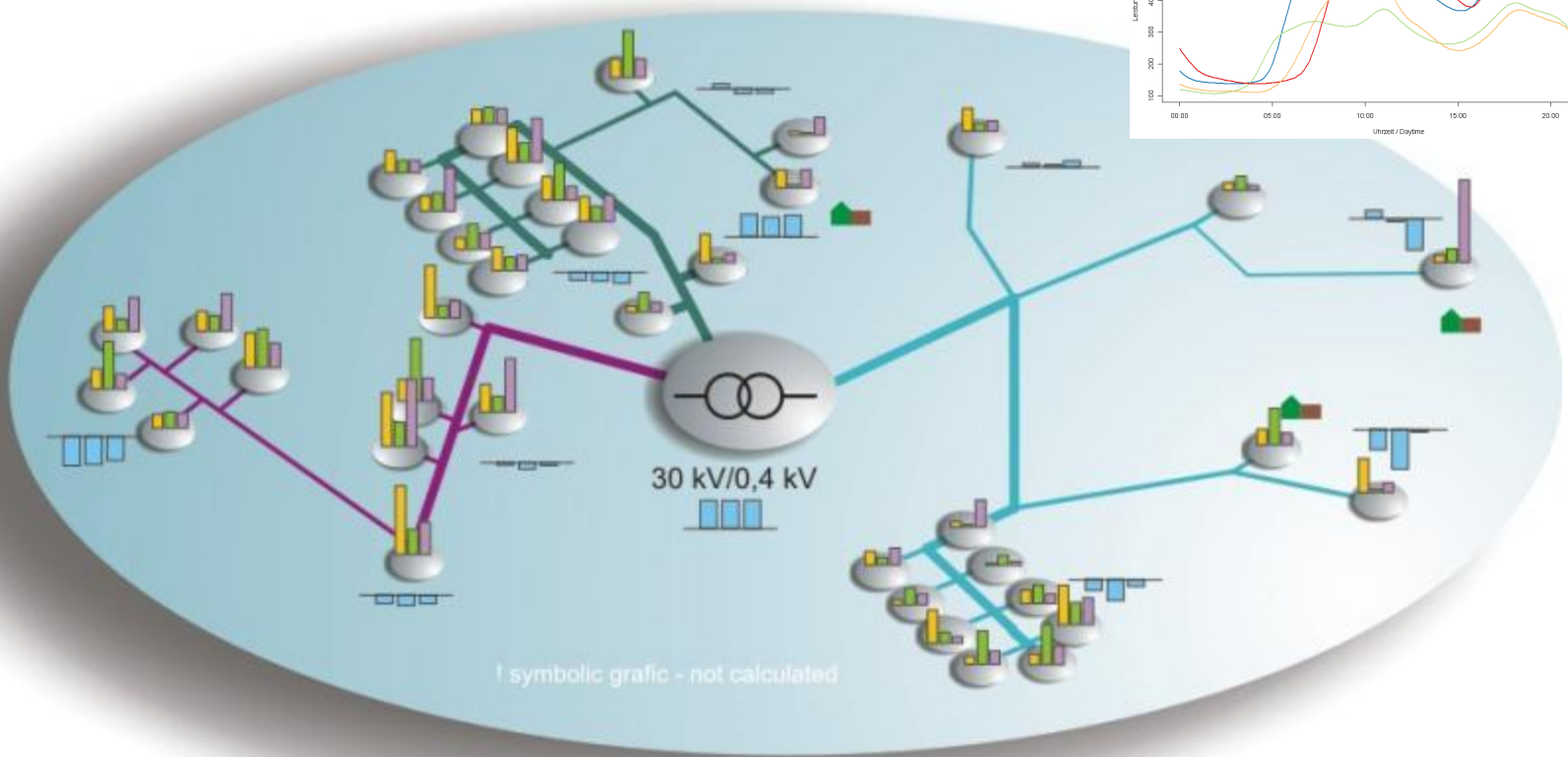
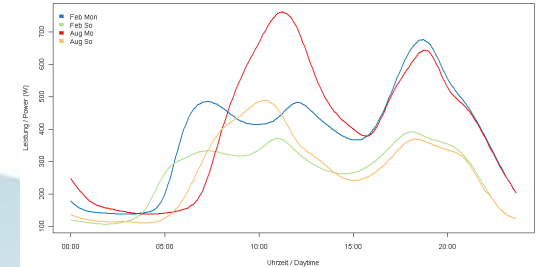
- Introduction
- PSSA Method
- Simulation of the PSSA
- PSS Host – Analysis Environment
- First Power SnapShot
- Outlook and first findings

Low Voltage Distribution Networks

Status quo in planning and operation

Low Voltage Networks

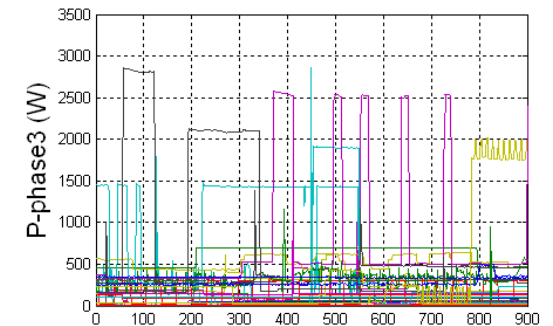
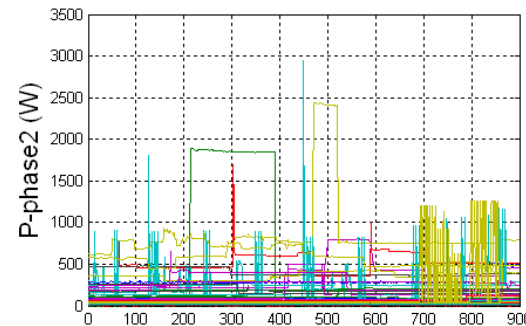
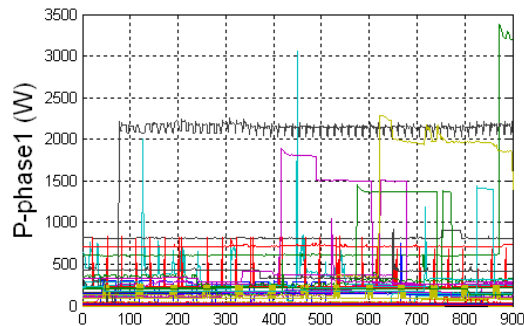
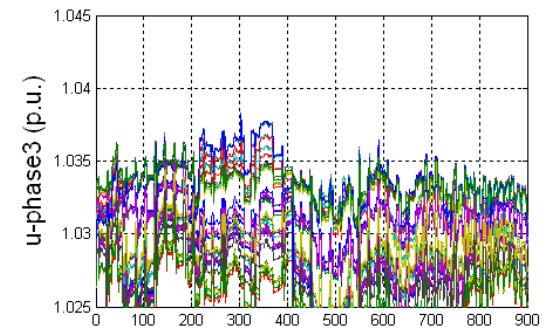
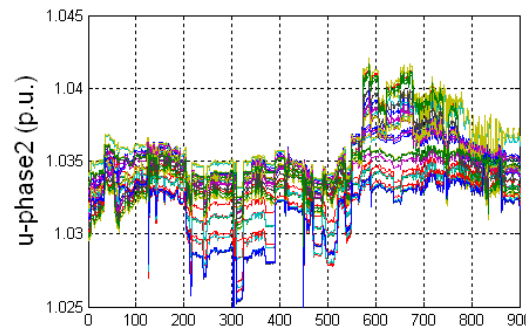
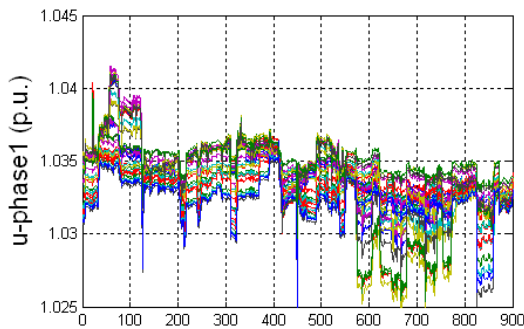
Current state of operation and planning methods



Low Voltage Networks

Real voltage and power profiles

- 900 1-sec RMS values of voltages and powers of all nodes



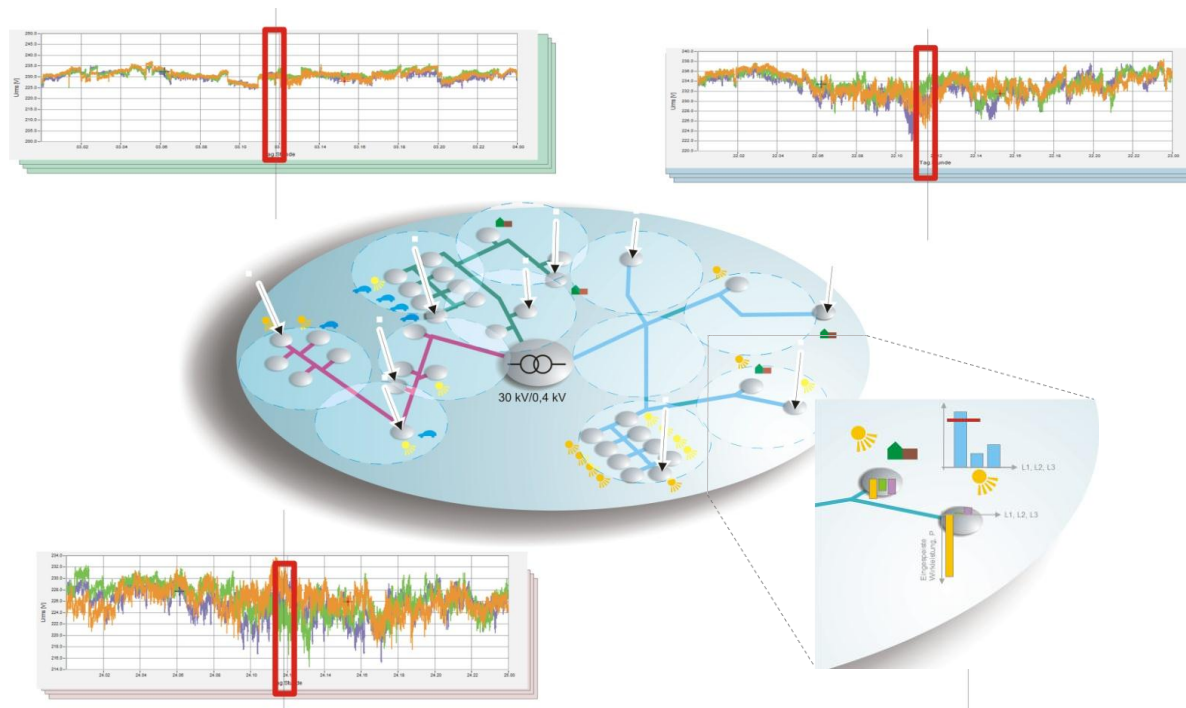
PSSA Method

Power SnapShot Analysis

PSSA Method

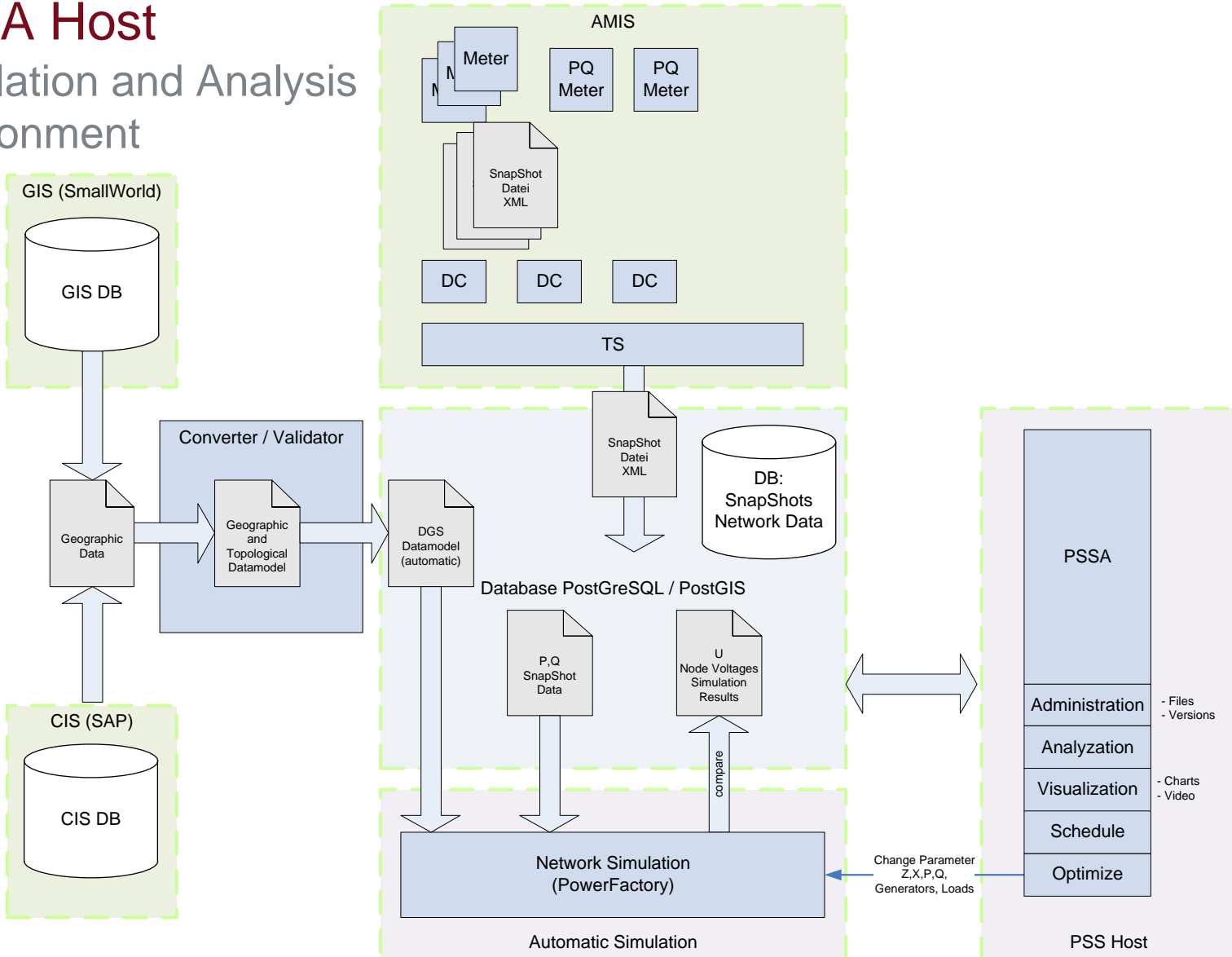
Power SnapShot Analysis

- **Synchronized measurements** per meter (1 sec-RMS)
 - 3x voltages, 3x current, 3x active and 3x reactive power
- **Trigger suggestions** sent to dataconcentrator, where triggers are selected



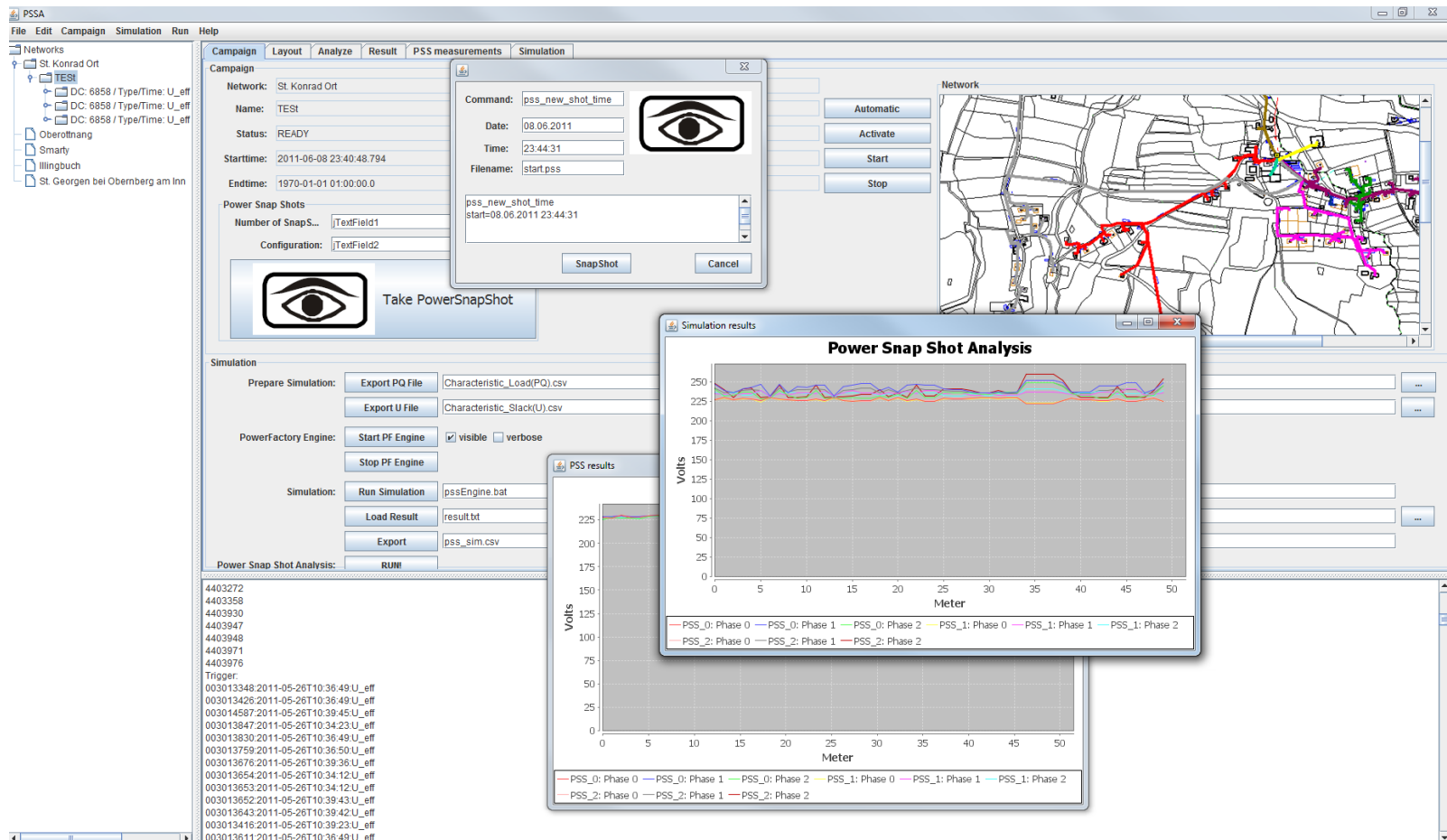
PSSA Host

Simulation and Analysis Environment



PSS Host

- Management and analysis of the Power SnapShots



The screenshot displays the PSSA software interface with several key components:

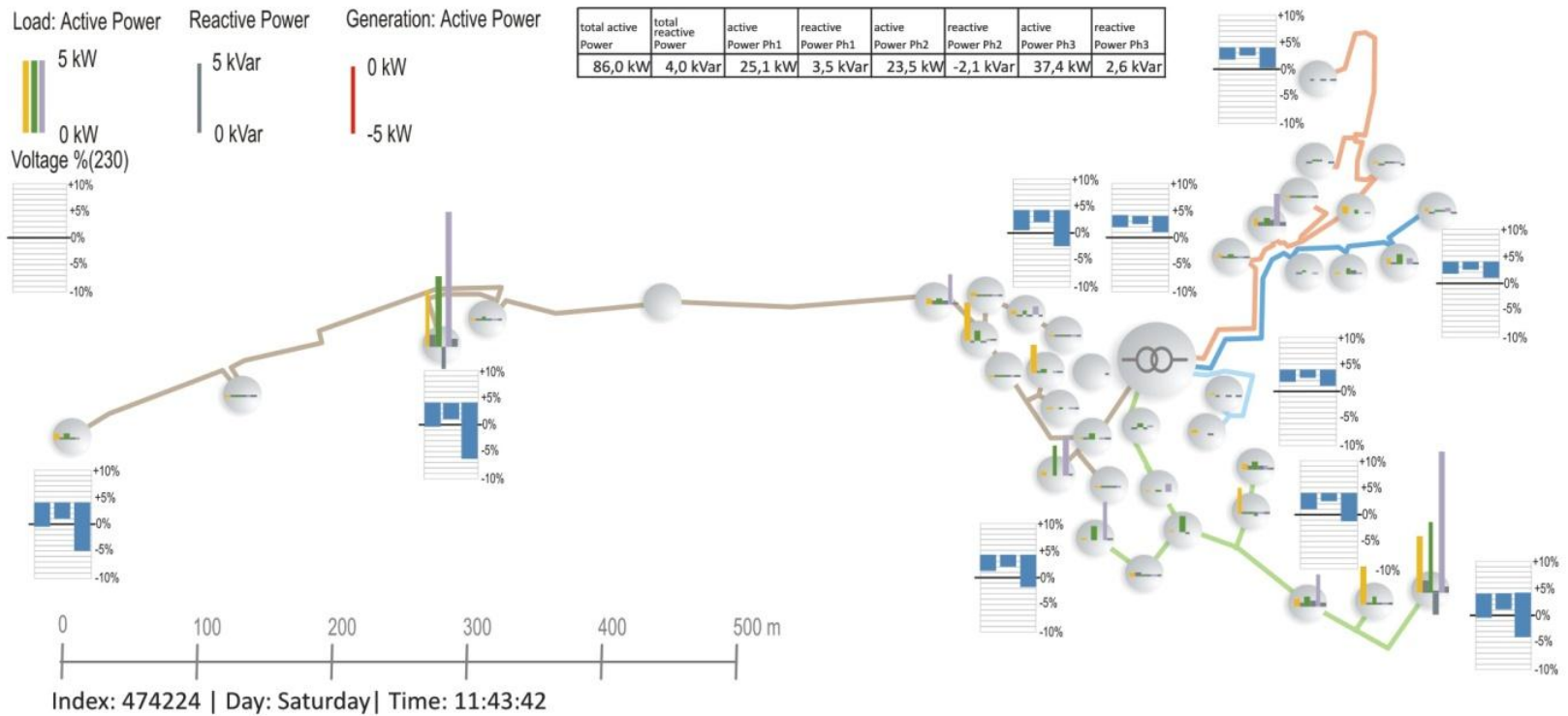
- Left Panel:** A tree view showing the network structure, including 'St. Konrad Ort' and various DC and U_eff components.
- Top Menu:** File, Edit, Campaign, Simulation, Run, Help.
- Campaign Panel:**
 - Network: St. Konrad Ort
 - Name: TEST
 - Status: READY
 - Starttime: 2011-06-08 23:40:48.794
 - Endtime: 1970-01-01 01:00:00.0
 - Power Snap Shots: Number of SnapS... (TextField1), Configuration: (TextField2)
 - Take PowerSnapshot button with an eye icon.
- Simulation Panel:**
 - Prepare Simulation: Export PQ File (Characteristic_Load(PQ).csv), Export U File (Characteristic_Slack(U).csv)
 - PowerFactory Engine: Start PF Engine (visible), Stop PF Engine
 - Simulation: Run Simulation (pssEngine.bat), Load Result (result.txt), Export (pss_sim.csv)
 - Power Snap Shot Analysis: RUN button
- Simulation Results Panel:**
 - Power Snap Shot Analysis graph showing Volts vs Meter (0-50).
 - Legend: PSS_0: Phase 0, PSS_0: Phase 1, PSS_0: Phase 2, PSS_1: Phase 0, PSS_1: Phase 1, PSS_1: Phase 2, PSS_2: Phase 0, PSS_2: Phase 1, PSS_2: Phase 2.
 - Another graph below showing similar data for a different meter.
- Bottom Panel:** A log window showing simulation output, including timestamps and component identifiers like '4403272', '4403358', etc.
- Right Panel:** A network diagram showing a map with various colored lines representing different components or phases.
- Buttons:** Automatic, Activate, Start, Stop.

Simulation of the PSSA Method

Power SnapShot Analysis

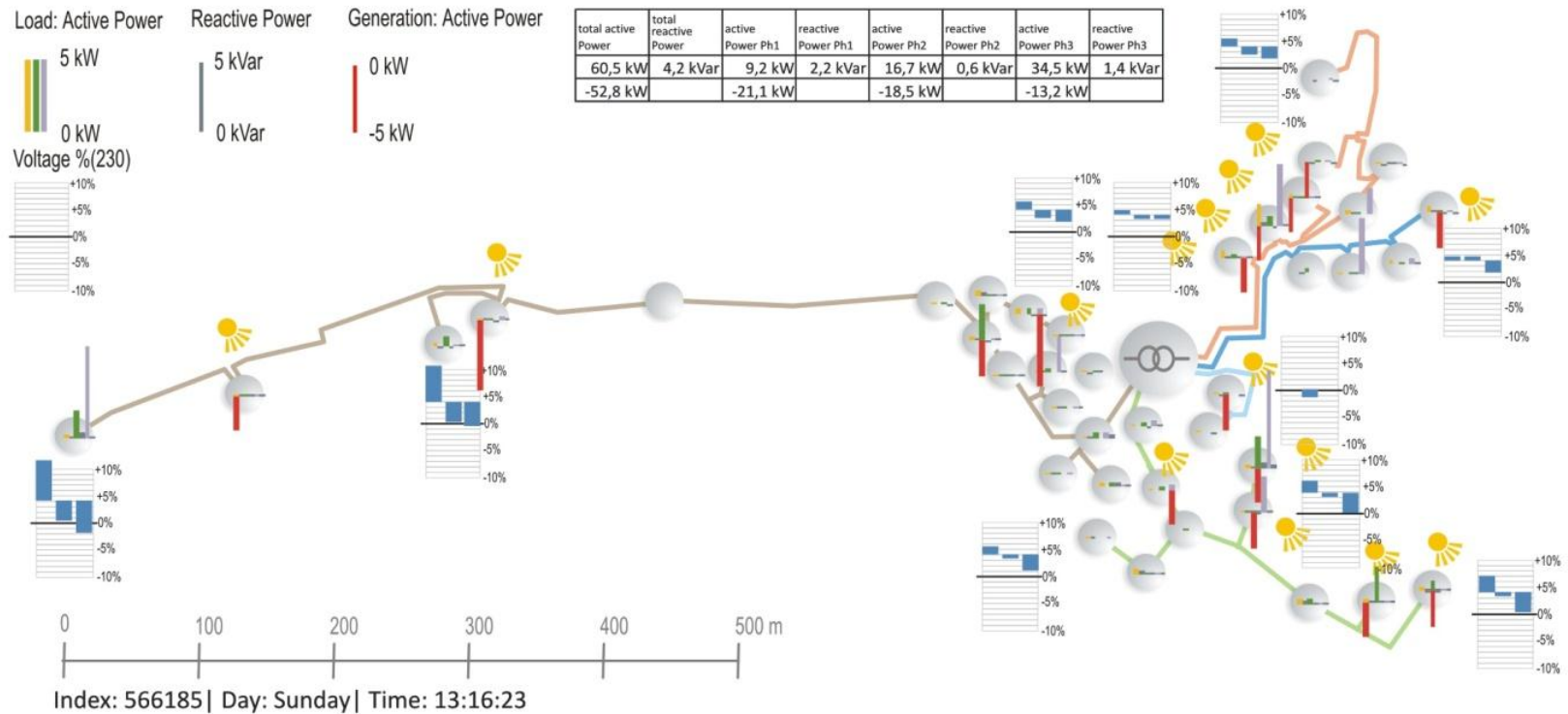
Simulation of the Power SnapShot Analysis

- Power SnapShot in the Smartie Grid



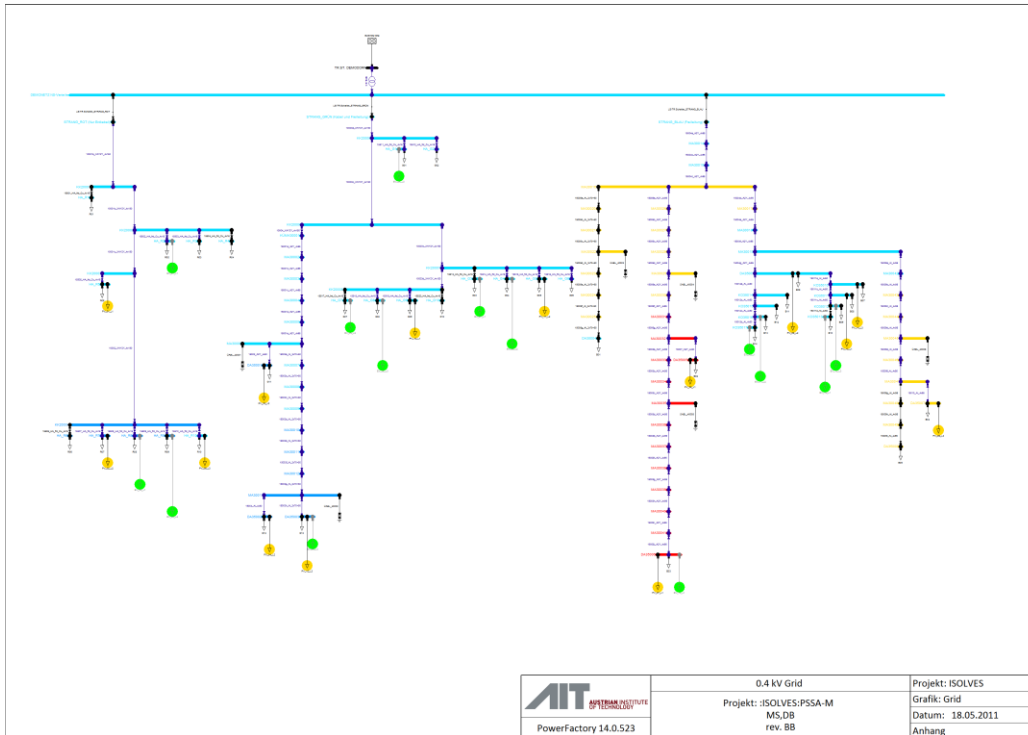
Simulation – Scenarios with PV

- Power Snap Shot with additional single phase PV

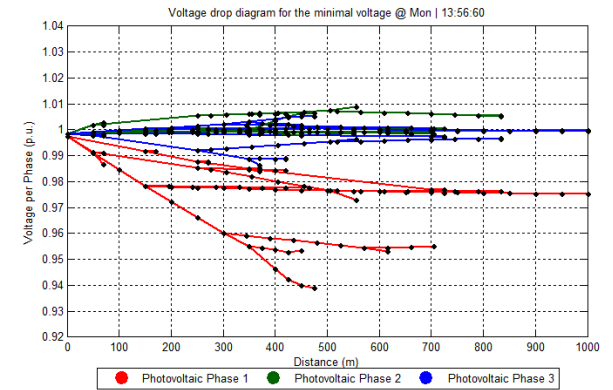


Simulation – voltage drop diagram

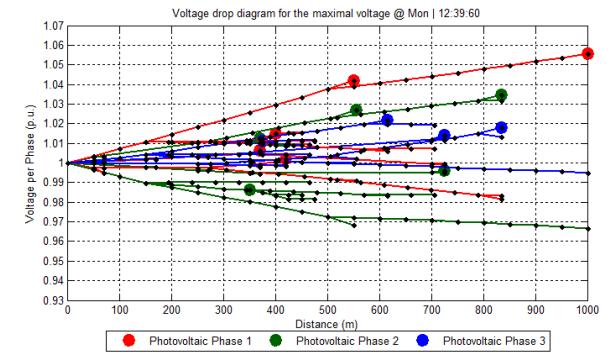
- Smartie Grid



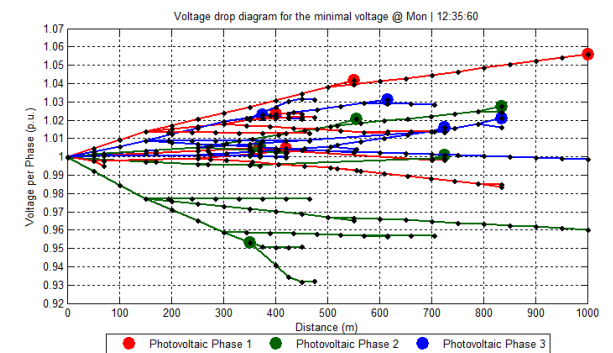
no PV
no EV



with PV
no EV

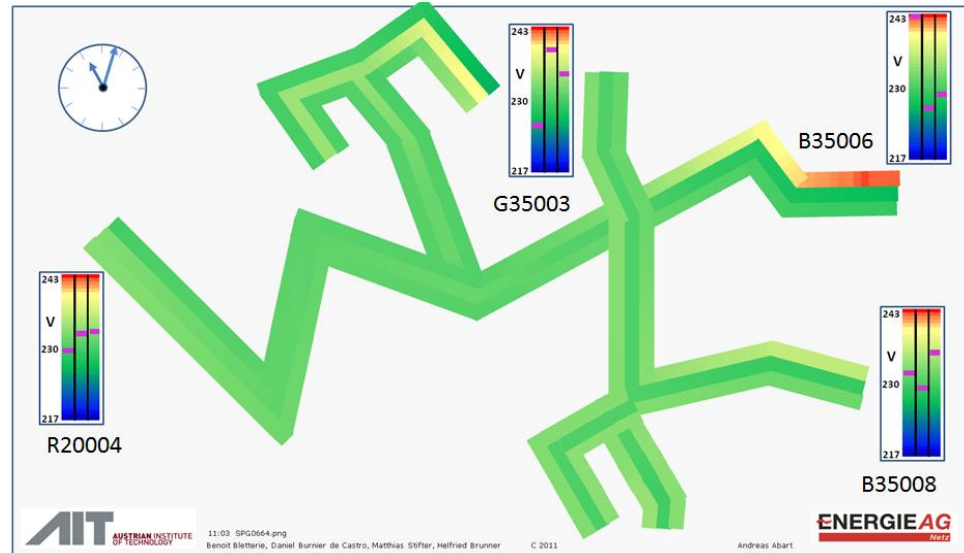


with PV
with EV



Visualisation of the network state during a day

- **Voltage rise** due to (single phase) PV
- **Reverse of the power flow**



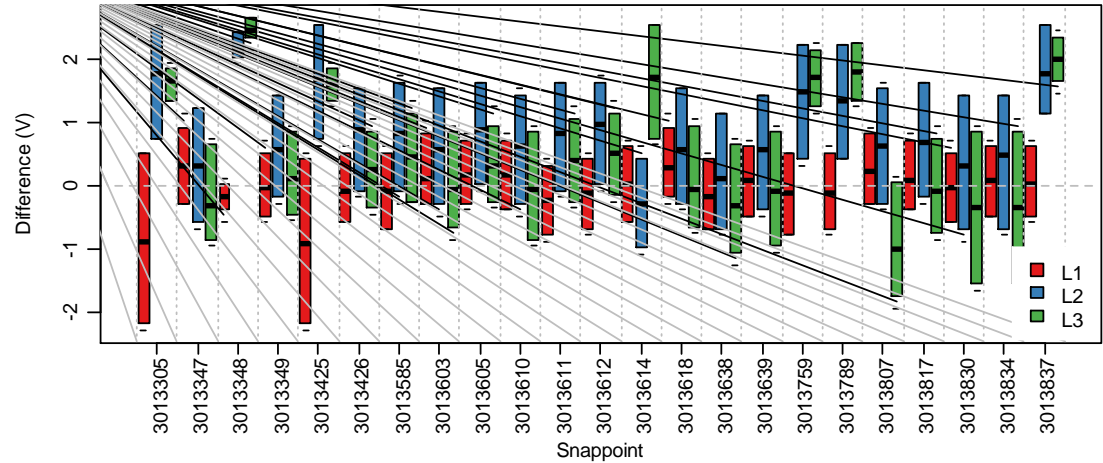
PSSA

Power SnapShot Analysis in Action

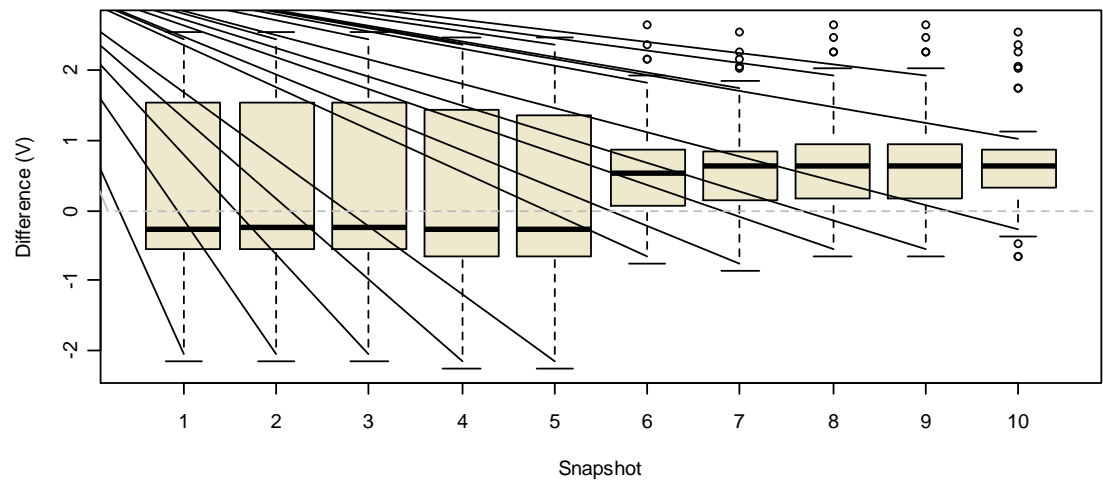
Validation of models

Box plots of the deviations

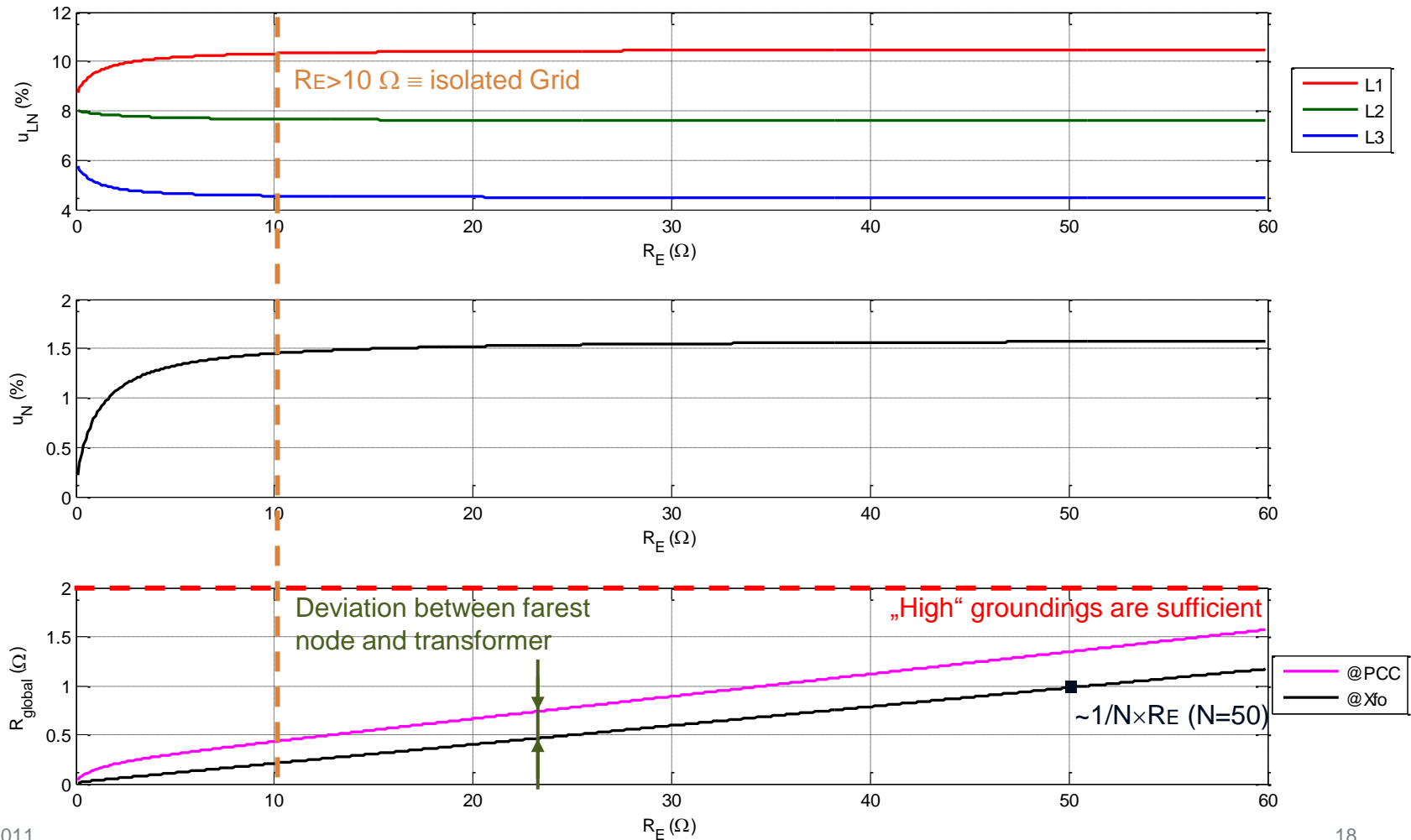
- One snap shot



- 10 snap shots



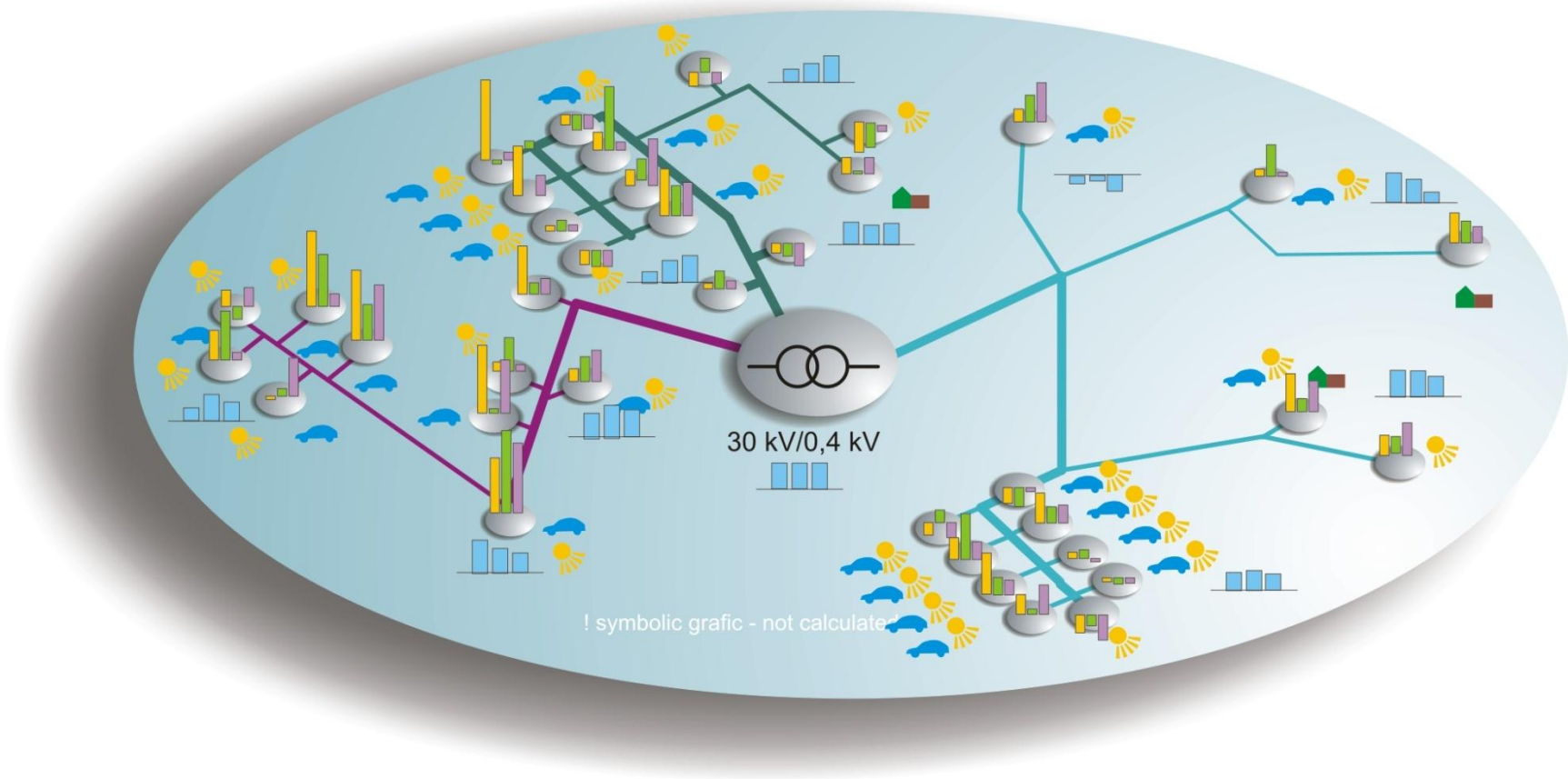
Influence of the grounding on the voltage level (sensitivity analysis of single phase PV)



Towards a ‚Smart LV Grid‘

PV und Electric Vehicles are the main drivers for a Smart LV Grid

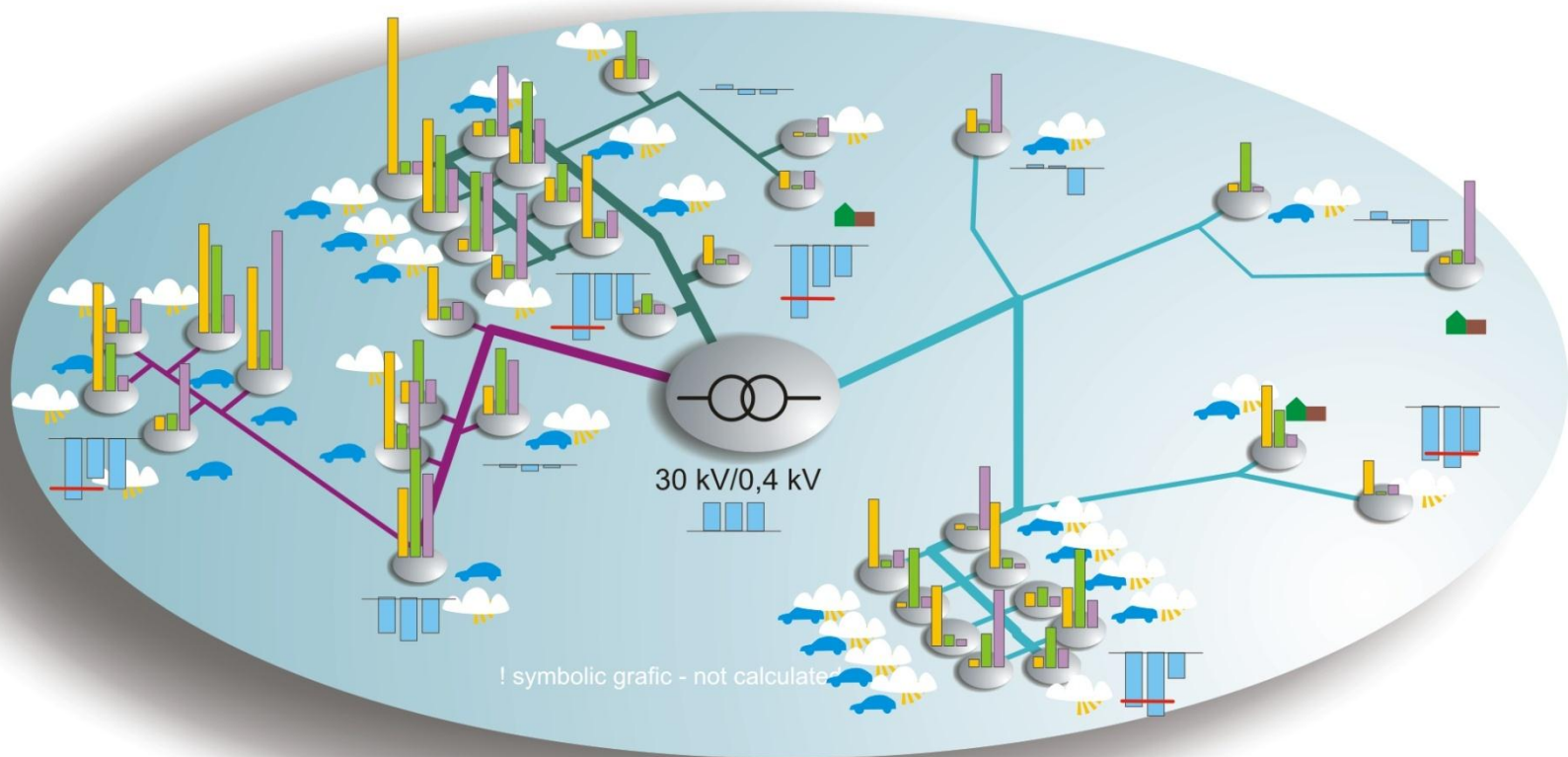
- PV and EV



Towards a ‚Smart LV Grid‘

PV und Electric Vehicles are the main drivers for a Smart LV Grid

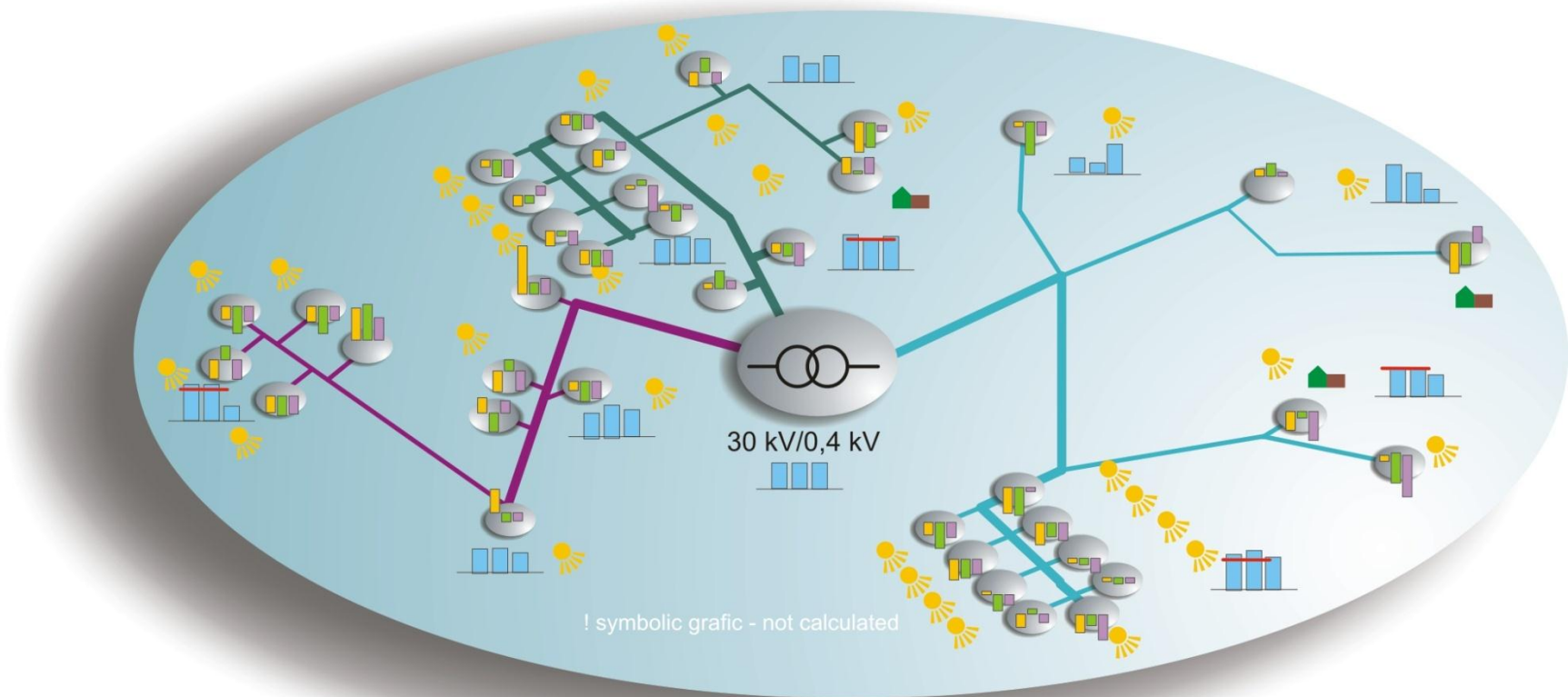
- No PV



Towards a ‚Smart LV Grid‘

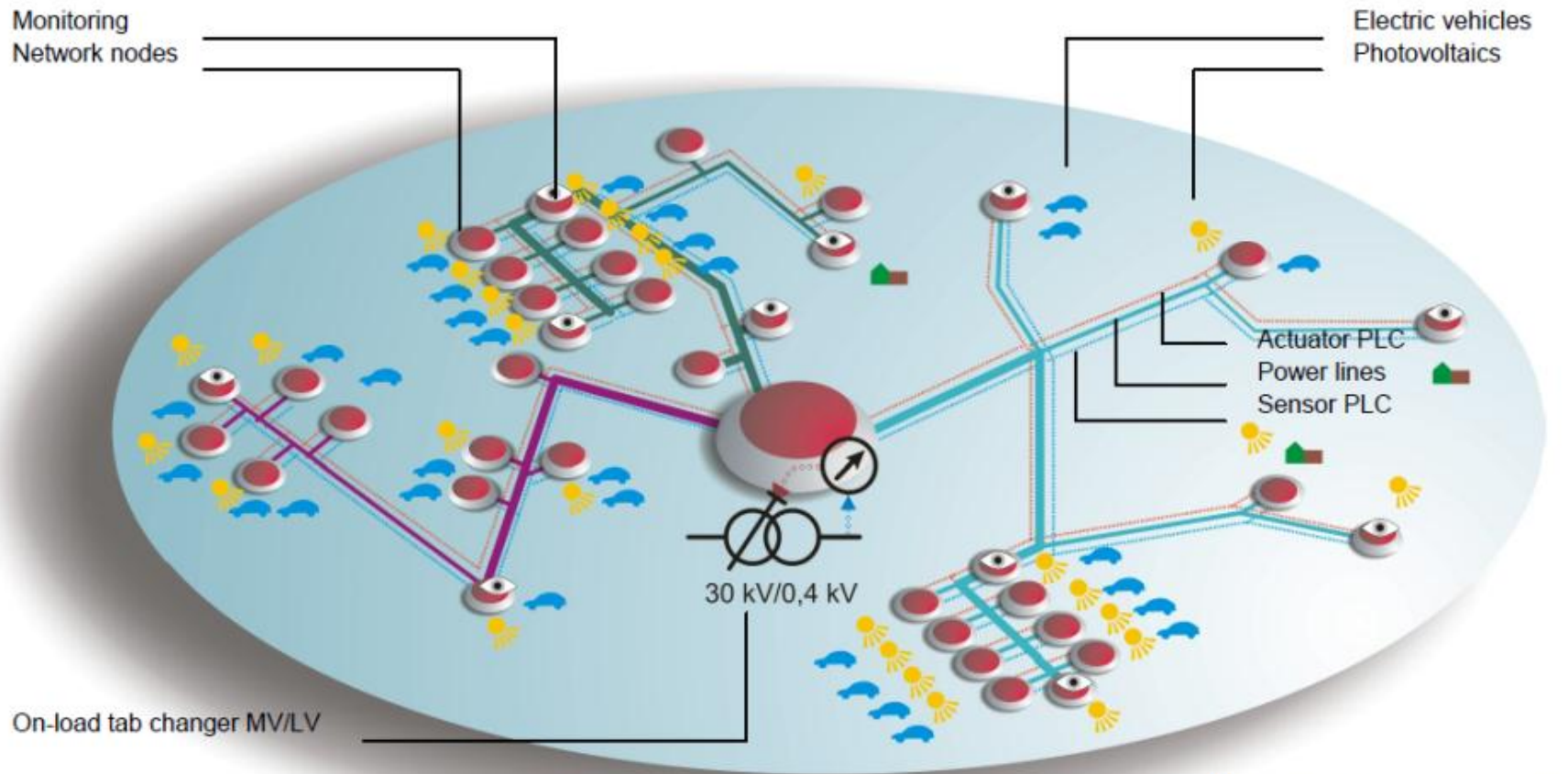
PV und Electric Vehicles are the main drivers for a Smart LV Grid

- No EV



Towards a ‚Smart LV Grid‘

PV und Electric Vehicles are the main drivers for a Smart LV Grid



PLC: Power Line Communication

Conclusion and Outlook

Preliminary findings

- **Power SnapShot Analysis** in distribution networks
 - ~35 rural
 - ~3 urban
- **Investigation and detailed analysis**
 - on asymmetry / neutral point displacement voltage
 - Influence of grounding
- **Simulation of scenarios**
 - Single / three phase PV
 - EV
- **Meter Measurement** will result in improving
 - planning → interconnection assessment
 - operation → critical voltage conditions, fault conditions
 - Control → voltage control, intelligent charging, topology

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