Smart Meters in “Upper Austria”

Challenges & Visions

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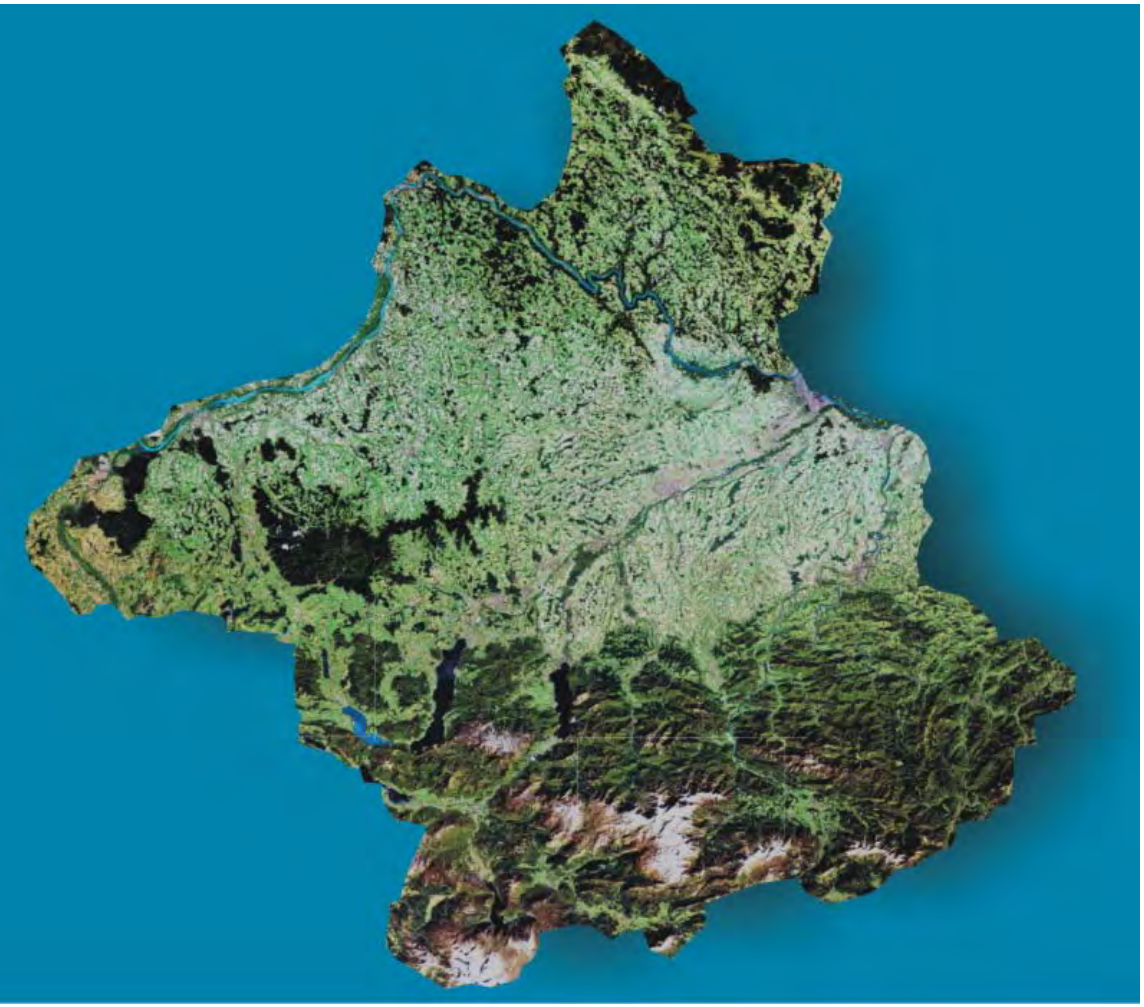
Agenda

- **Introduction**
  - Short introduction about Energie AG OÖ Grid & smart Grid activities
  - **AMIS** – Automated metering and Information System – the **project history at a glance - basic functionality**

- **AMR System - Smart Metering - Smart Grids**
  - **sensing** – using smart meters communication
  - **acting** by switching loads and controlling generation – using smart meters communication

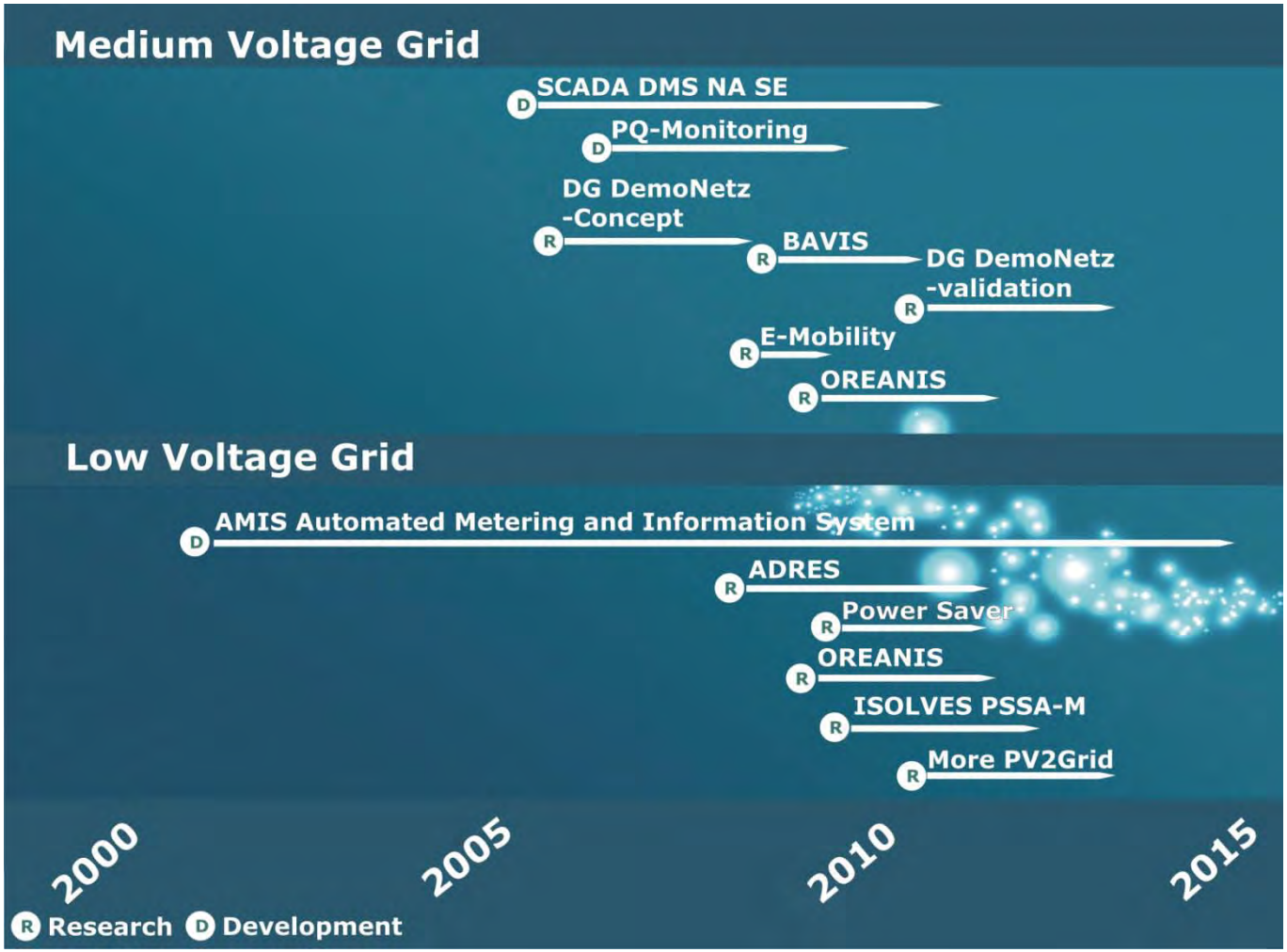
- **First Steps to smart Grids**
  - **LV grids**: many **unknown facts** → research on modeling
  - Smart Meters – **eyes to the grid**
  - **Voltage level statistics**
  - **PSSA – Power Snapshot Analysis**: development of a new generation of measuring and analyzing methods & tools (project ISOLVES PSSA – M)

Short introduction about Energie AG OÖ Grid



- 439.600 Customers 6,8 GWh/a
- 42 Stations 110/220 kV / 10…30 kV
- 4 110 kV-switching stations
- 8500 30/0.4 kV Substations
- Almost 9000 km lines (110 kV & 30 kV) about 20% cables
- Almost 21.000 km lines (LV) about 60% cables

Research and Development



Smart Grids Week 2010, A. Abart

AMIS – Automated metering and Information System – the **project history at a glance & basic fuctionality**

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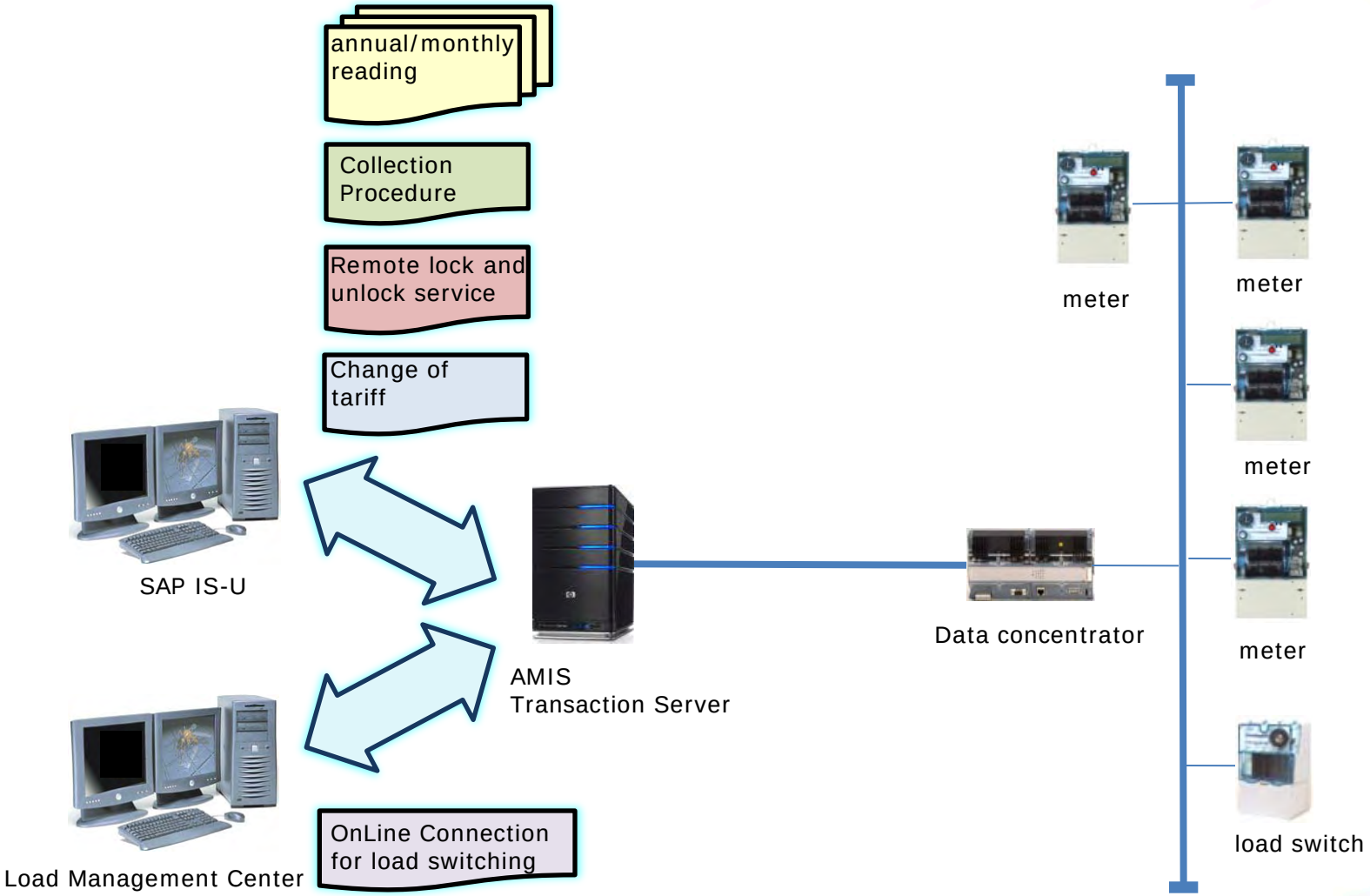
The project history at a glance

- 2003 definition of business plan requirements by operator
- 2003 feasibility study-project by manufacturer (SAT/Siemens)
- 2005 first pilot using DLC (Distribution Line Communication)
- 2006 - New Name: Smart Meters
- 2008 Integration Test 1000 meters
- 2010 field installation 10000 meters – tests completed
- 2010 Implementation of PSSA
- Future: Development of Smart Grid functions?

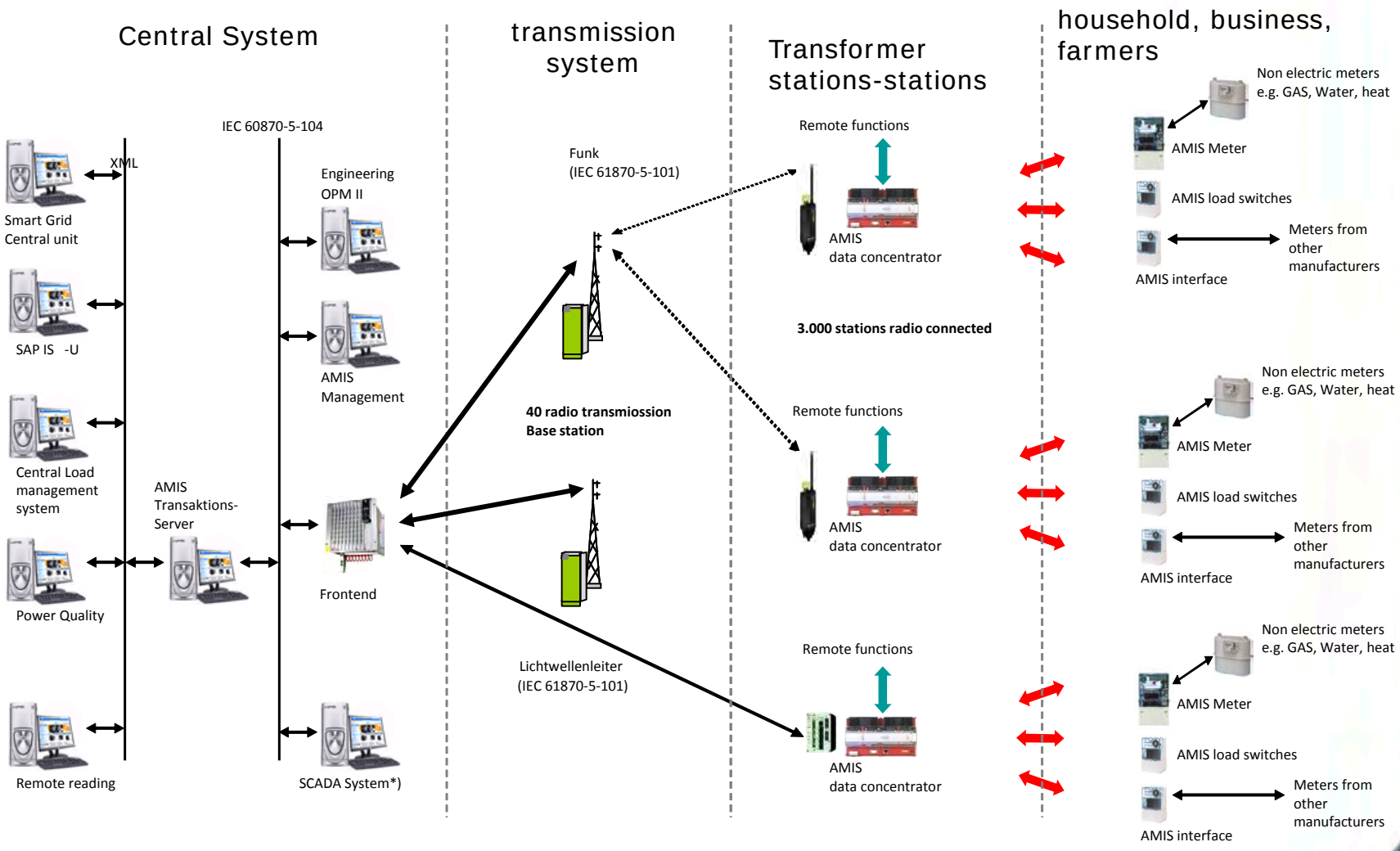
SM system basic functionality I

- **load profile of real and reactive Power in both directions (60 days stoarage)**
- **continous reading**
- **6 flexible programmable registers depending on time & load**
- **Power Quality: Voltage levels, dips and surges**
- **load curtailment**
- **lock- and unlock function**
- **collection procedure**

SM system basic functionality II



System Overview



AMR-System

=> SMART Meter

=> SMART grids

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Motivation

- Increasing demand of electricity can be covered in the long run only by renewable sources.
- Important parts of renewable sources are located decentral.
- Investments for grids could be optimized by implementing Smart Grids Systems.
- Smart Grid functionality has to be implemented at the meters and the metering system.
- Actual research has to focus on cost effective solutions, has to find out real given potentials.

Ideas & Visions

- detailed recording & quasi real time
  – e.g. online Load flow

actually

- voltage level monitoring – smart grid-planning
- „wide area“ measurements: PSSA

in future

- control of loads,
- control of DG
- ...

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critical points I

- „Data Tsunami“ – especially in case of high speed connections
- in case of operational use – high level of reliabilty required
- customers willingness to accept demand side management
- competition of energy and grid economics
  How much decentral located generation should be dropped to avoid inefficient reinforcements of the grid

critical points II

- can a smart Grid be intelligent to organize itself
- can we estimate the effort and complexity of service?
- how to restart smart grids in case of faults
- actually the legal framework is not ready for smart grids
- standardization is needed to ensure that components can be used over several years

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way to the smart grids - Step by step

- **2010** detailed analysis of low voltage grids
- **2011** analyzing real existing potential functions and effectiveness
- **201?** intelligent household appliances to the market
- **201?** developping smart grid specifications
- **201?** risk management– especially in case of faults and clearing of faults
- **201?** solutions covering the requirements for redundancy & emergency supply

First steps to smart Grids I:

Analyzing LV Grids

Voltage **L**evels **S**tatistic

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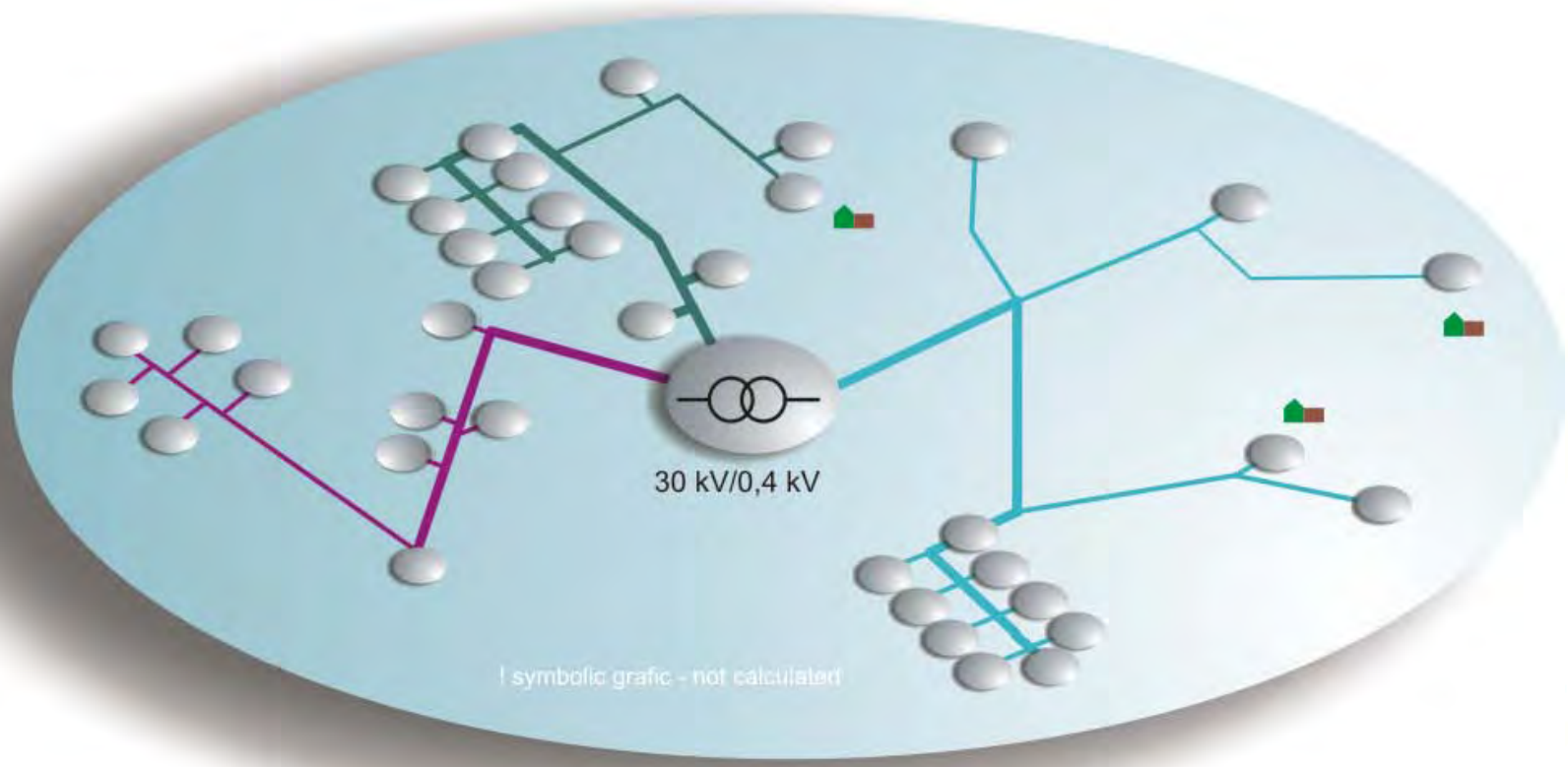
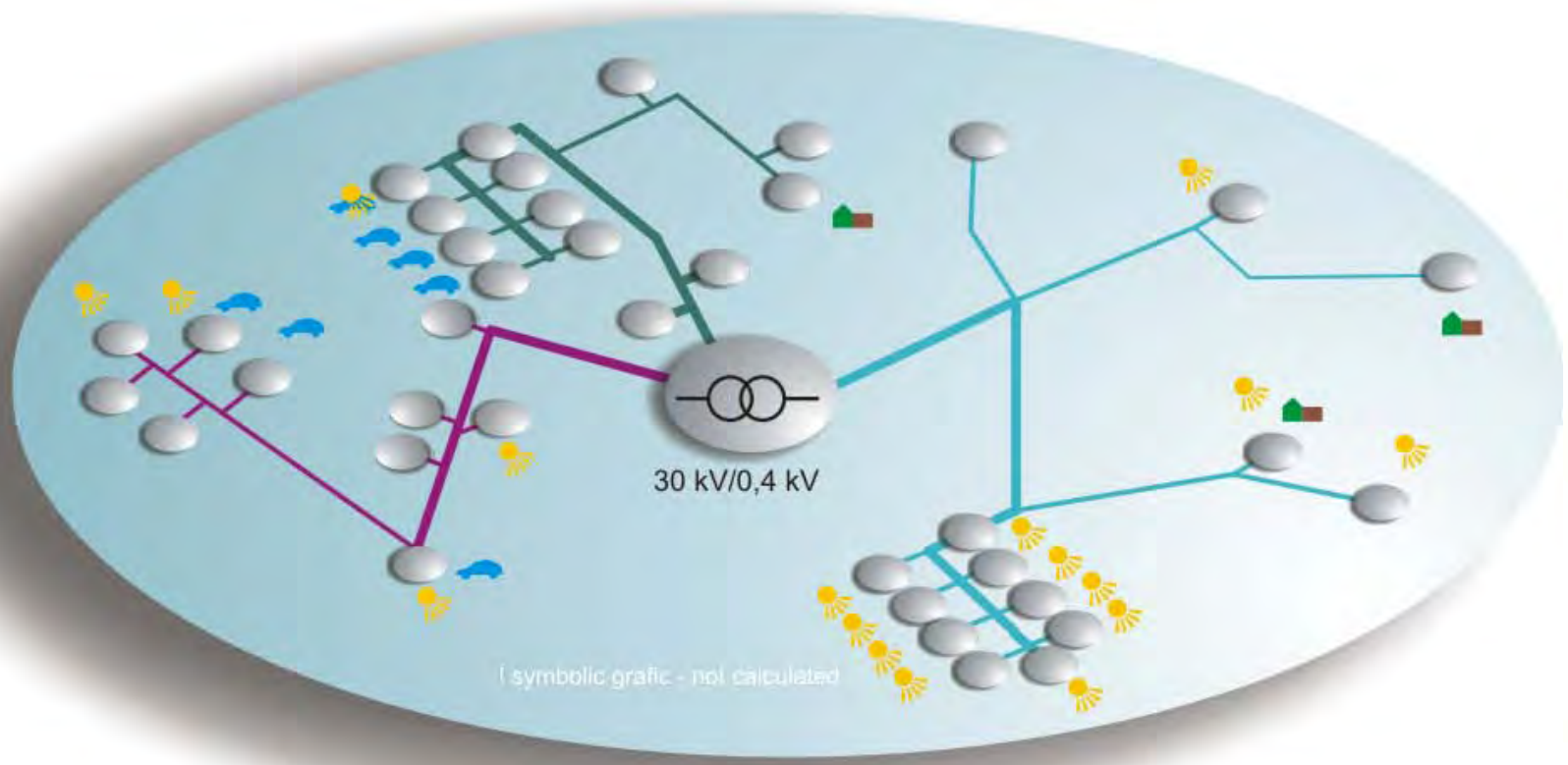
What do we know about LV grids?



Real impacts on LV Grid by e-mobility an high penetration of DG (PV)?



Smart Meter -Function: Voltage level statistic Introduction

- Rural distribution grids are planed in respect to voltage levels – urban grids in respect to maximum current.
- Actual methods for managing voltage levels: simple estimations and measurements in case of customer's complaints.
- Required: Long term and wide area observations using low cost systems (investment & operation)
- Solution: Using smart meters for doing weekly statistics of voltage levels and maximum load.

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Technical & functional aspects

- a fully automated organization and presentation of data
- a compression of data for transmission and storage.
- it is presupposed that a standard meter can be programmed for these functions without any additional costs for extensions of hardware.

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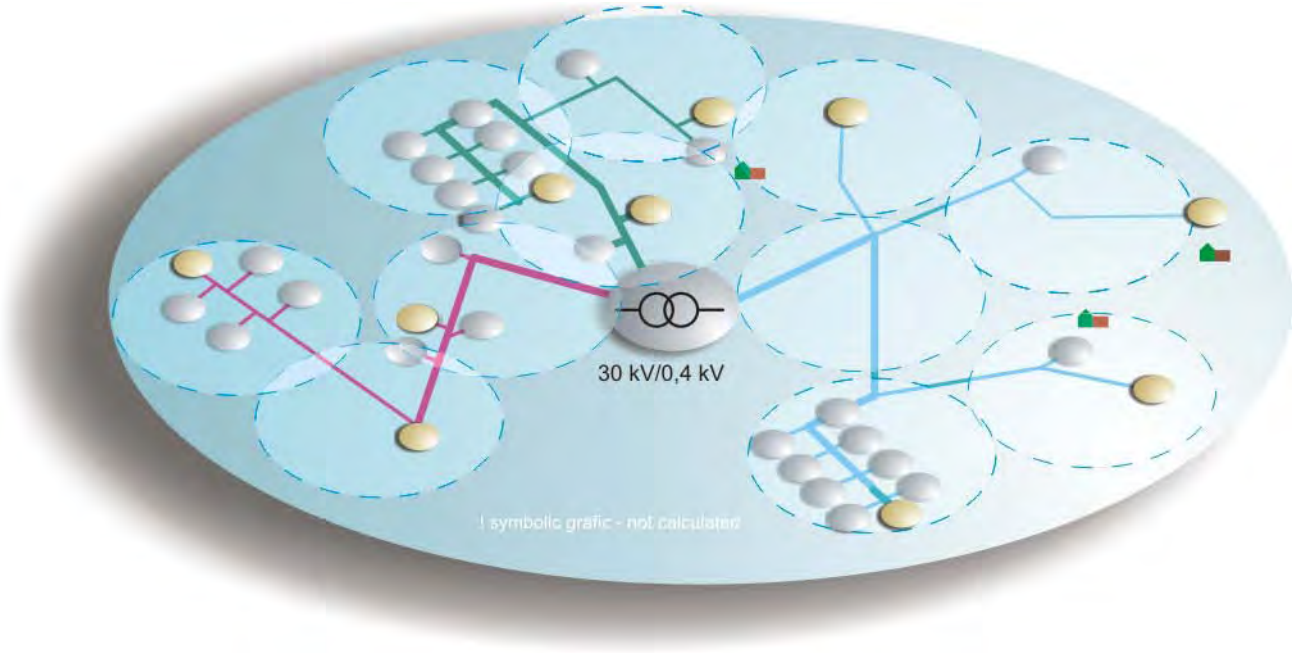
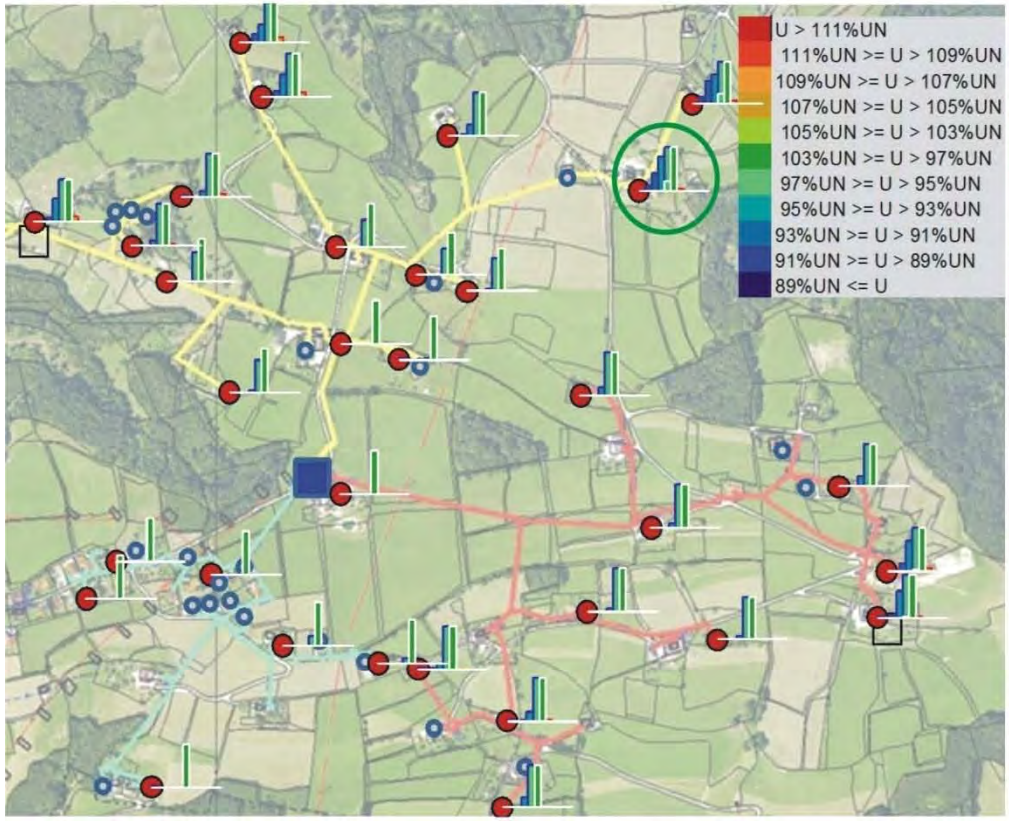
simple solution for long term and wide area voltage band observations

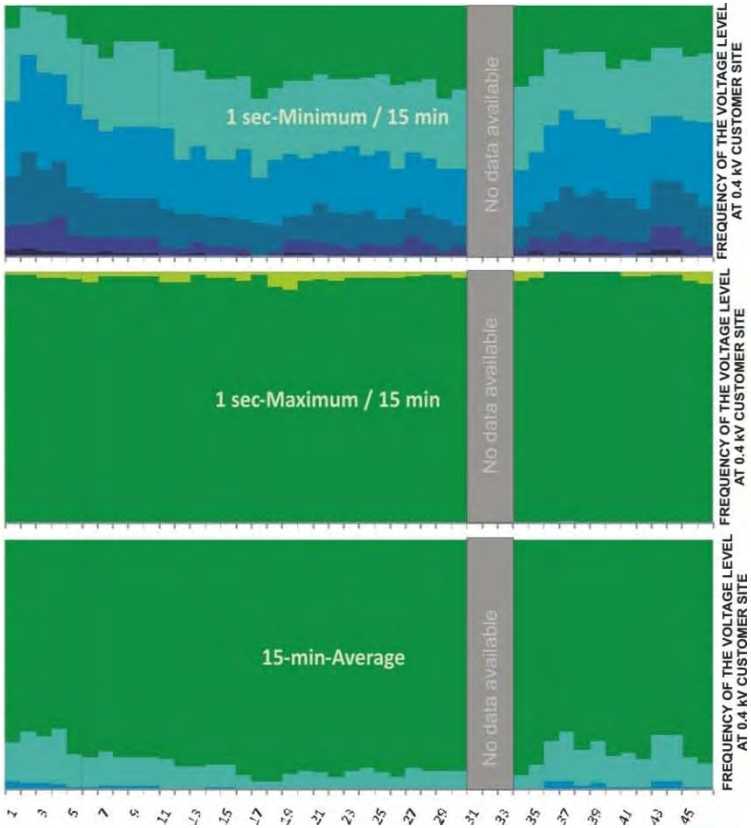
- weekly histograms: 15-min-AVG, -MIN, -MAX, balance
- no transmission of profiles – just histogram data
- maximum distance of points of observation 50…70 m



3 branches, 38 Meters, 10 PQ-Meters/ PSSA-Trigger

Long Term Analysis of results





First steps to smart Grids II:

Analyzing LV Grids

Power **S**nap**S**hot **A**nalysis

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ISOLVES–PSSA-M

- **I** nnovativ
- **S** olutions *for*
- **O** ptimization *of*
- **L** ow
- **V** oltage
- **E** lectrical
- **S** ystems

P ower
S nap
S hot
A nalysis

- *by*

M eters

Ein Projekt gefordert durch den Klimafond

Mit den Partnern: **AIT, Siemens, Salzburg AG, Wienenergie-Stromnetz**

PSSA starting point & motivation

- we know little about low voltage grids
- planning is based on assumptions and simple estimations
- **D**ecentralized **G**eneration – especially PV-systems- and in future e-mobility are upcoming issues
- detailed knowledge about low voltage grids, would allow a more efficient use

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Eyes to the grid- measuring real conditions in low voltage grids

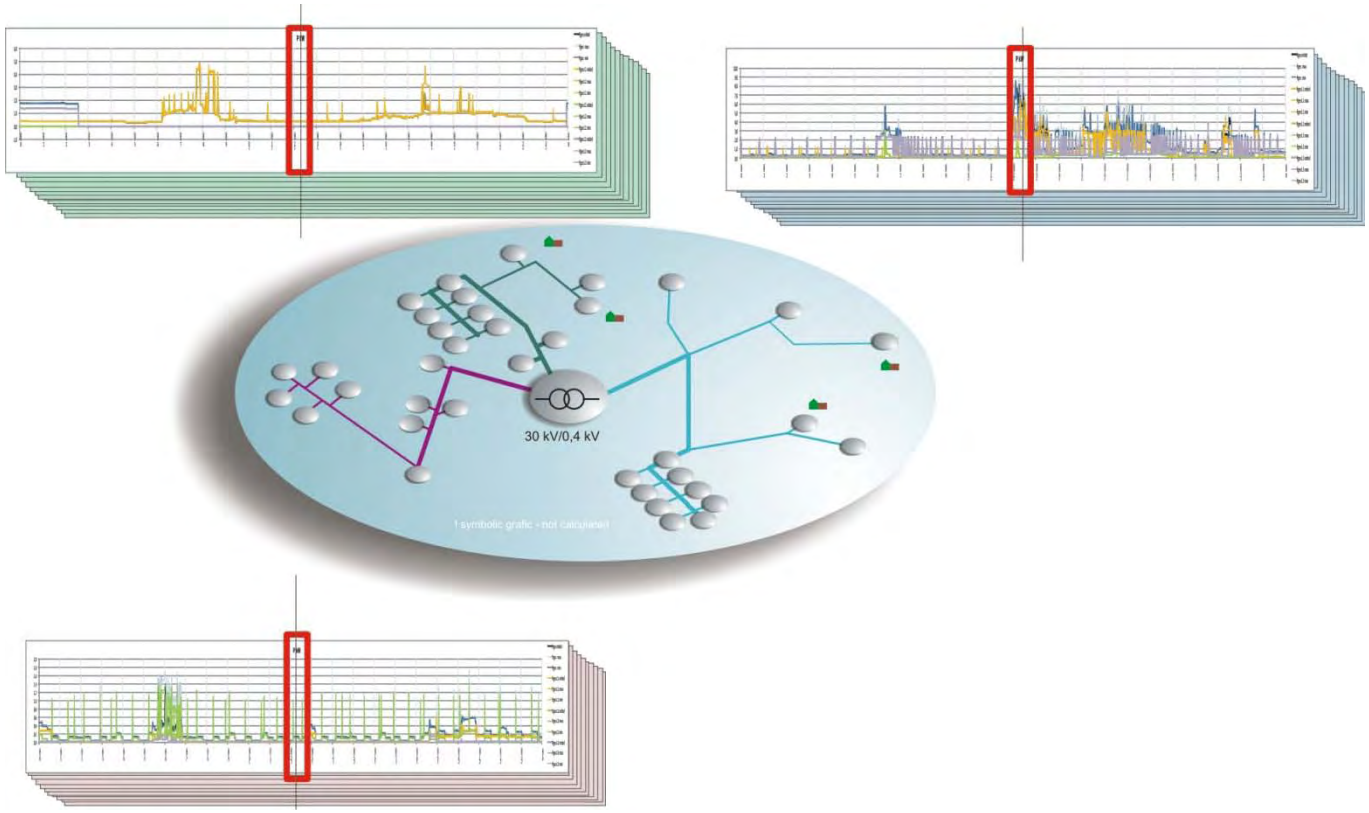
- long term recordings:
  - recording of timelines for several weeks- statistic analysis can reduce data volume;
  - for voltage observations- few measurement points can be selected.

- synchronous snap reading method

  The **P**ower **S**nap **S**hot **A**nalysis

Idea of Power Snap Shot

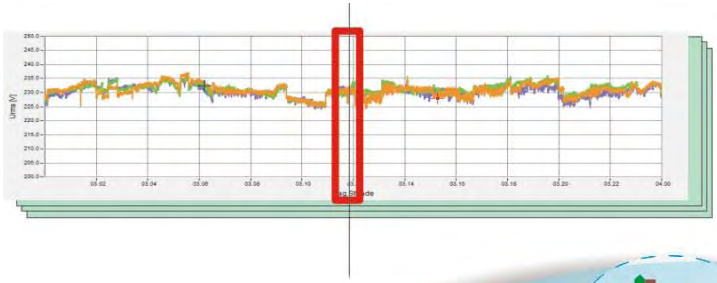
measuring 1-sec-rms in synchronous intervals at each meter:
3 x Voltage, 3 x Power and 3 x reactive Power;

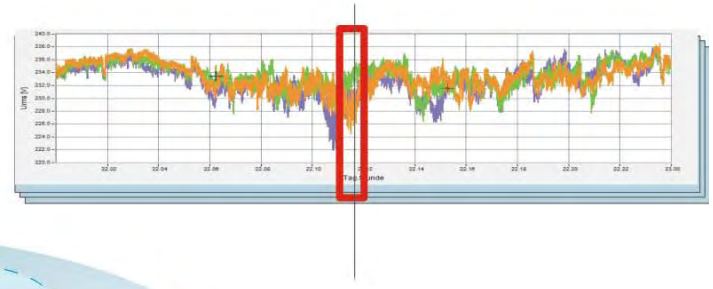


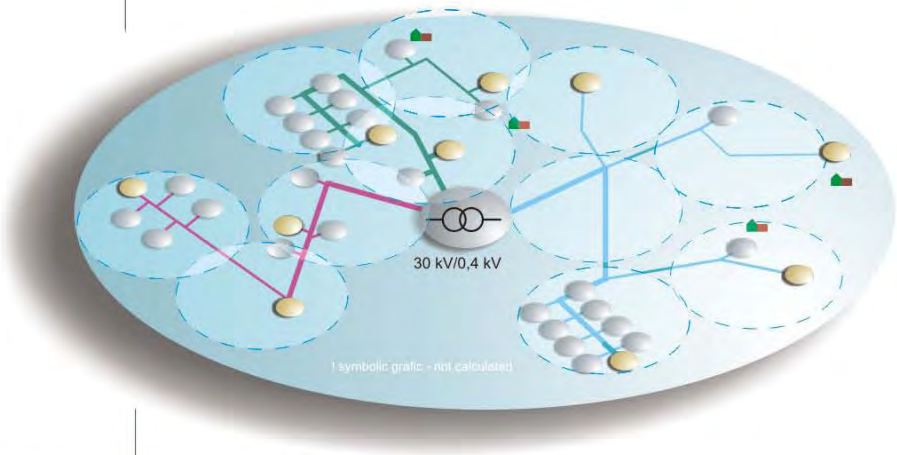
snapshots are done for several time stamps randomly and triggered

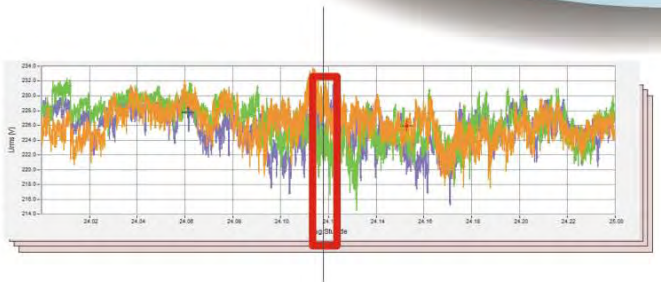
PSSA-triggering

About 20% of meters are defined to propose trigger.









Proposals are sent to the data concentrator where the trigger moment is selected.

PSSA aims

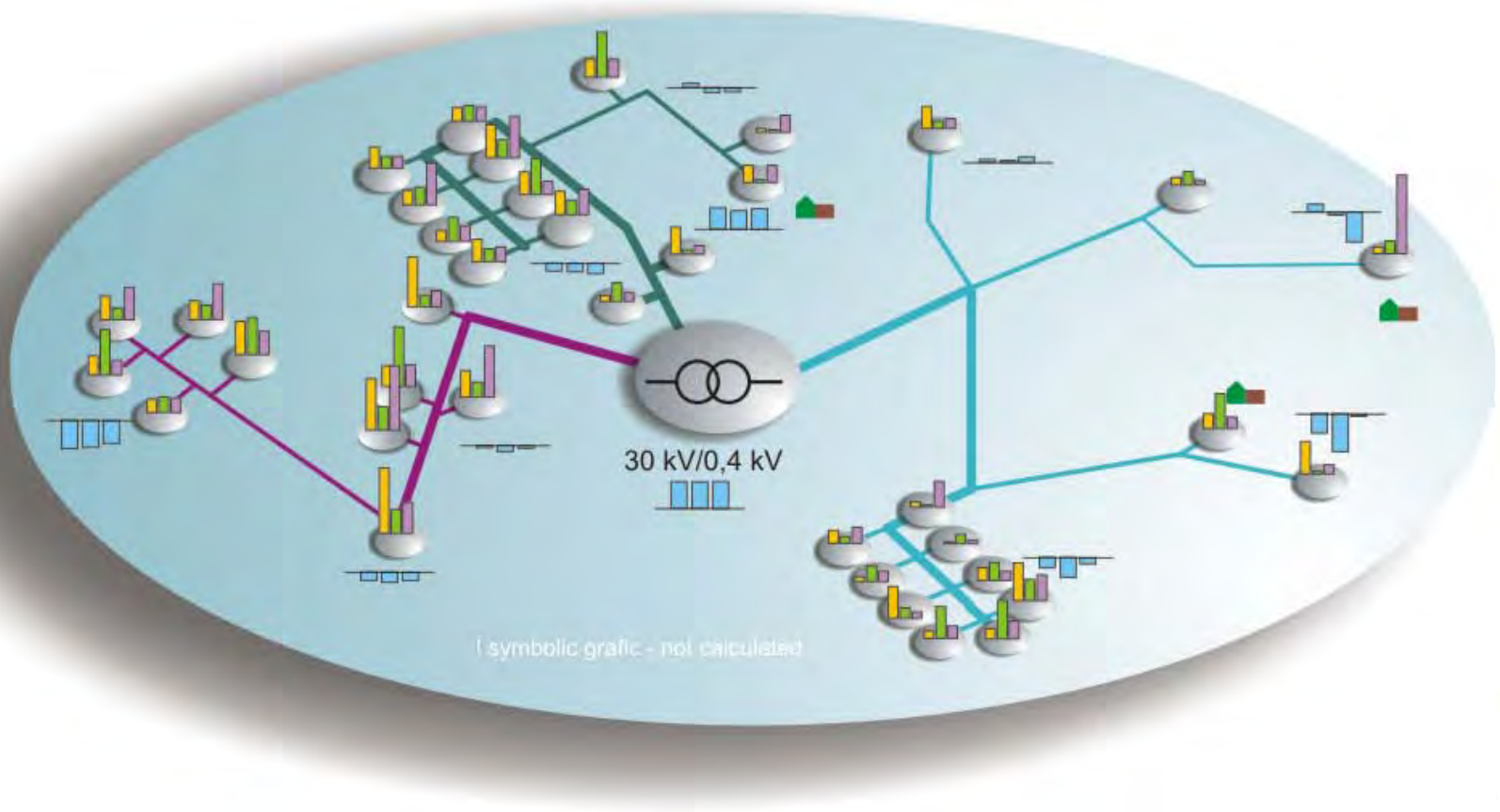
- **A**nalysis of low voltage grids
  four wire modelling and real unbalanced loads

⇒ Simulations of high level penetration of dezentralized generation and e-mobility using different smart-grid-approaches – e.g. voltage regulation.

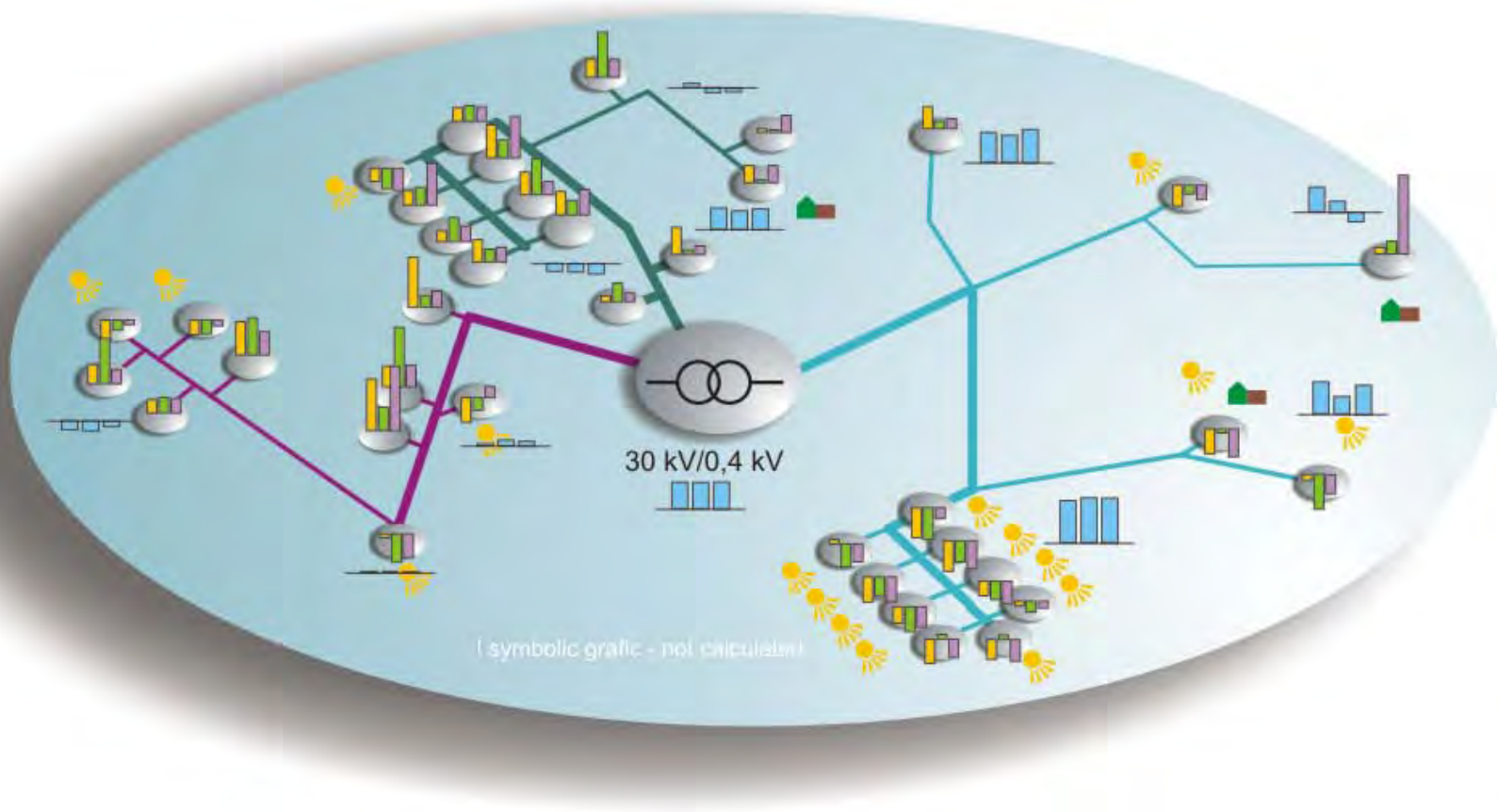
⇒ Evaluation of impact of unbalanced load or feeding

⇒ Influence of the grounding (TN-C) will be investigated

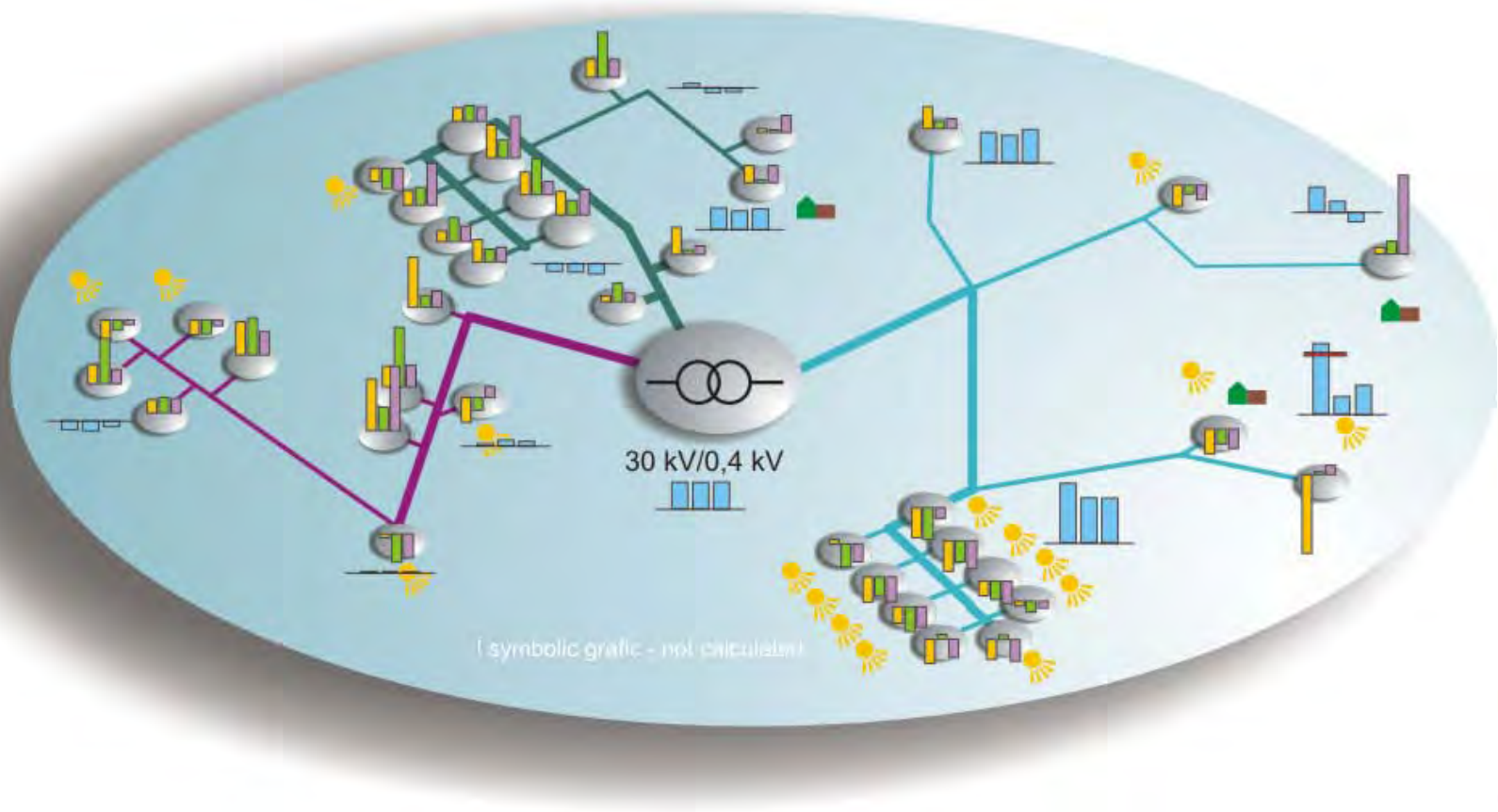
PSSA of real LV-grid today



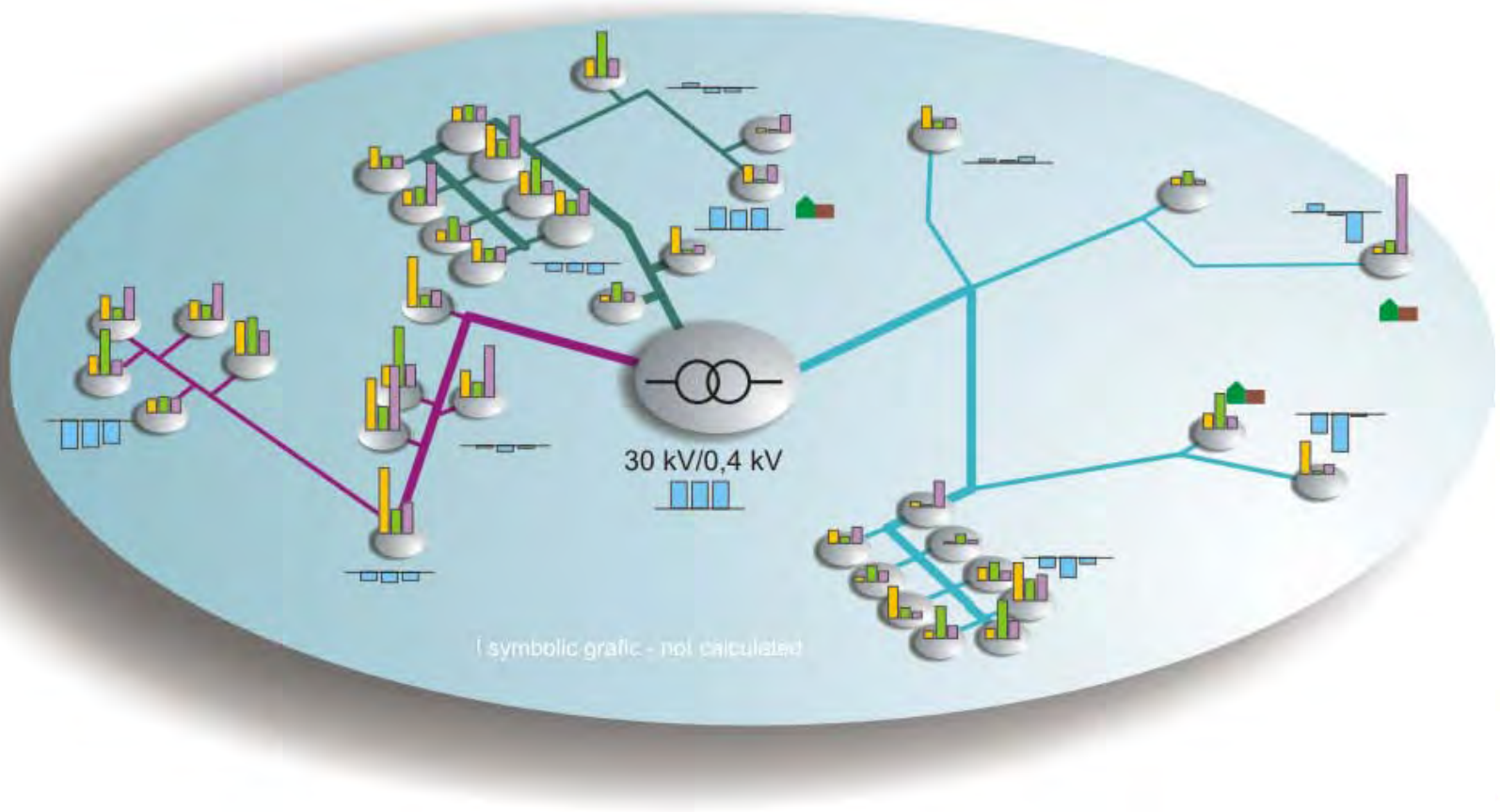
PSSA of real LV-grid tomorrow



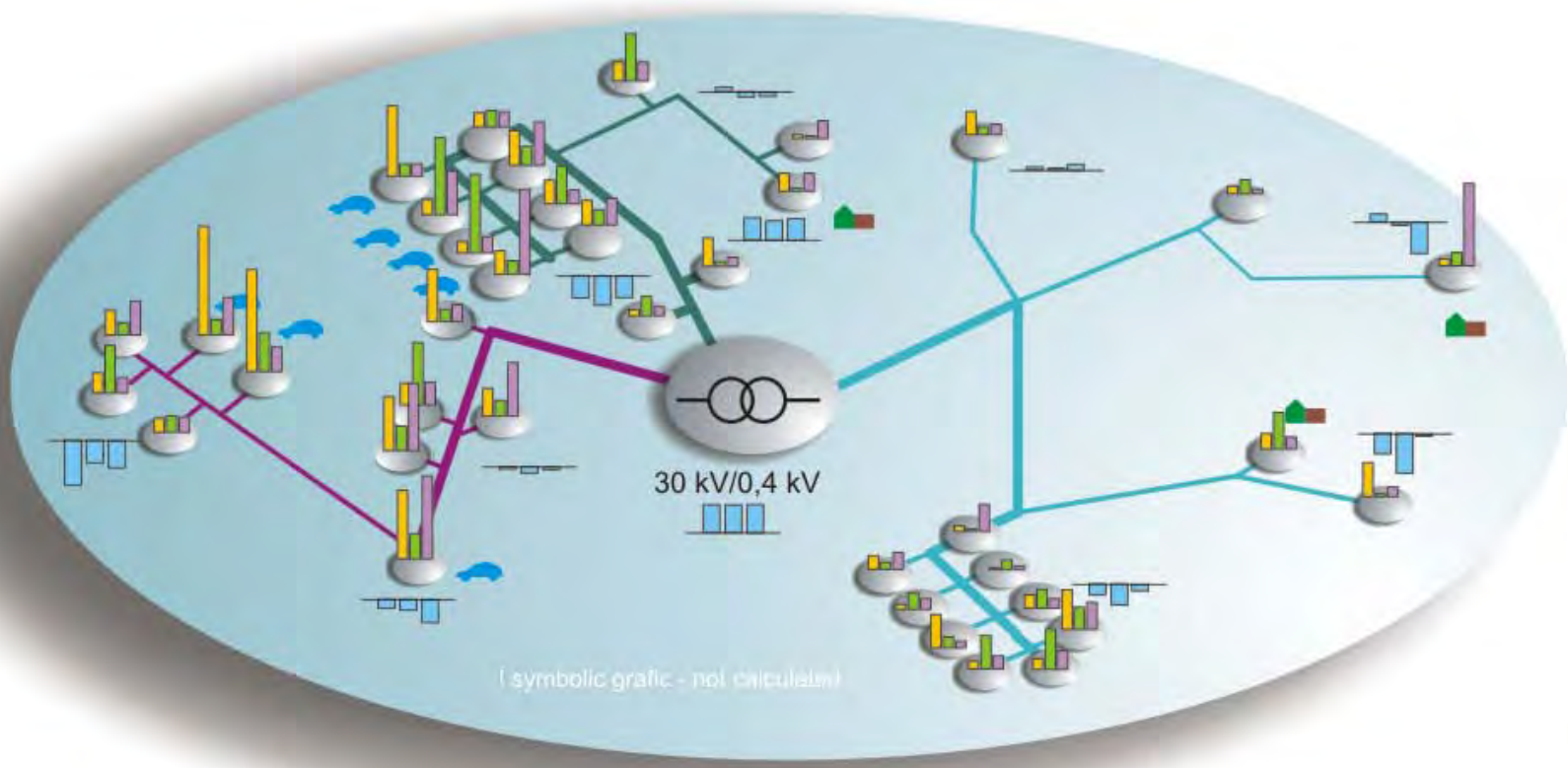
PSSA of real LV-grid tomorrow – single phase



PSSA of real LV-grid today



PSSA of real LV-grid tomorrow e-mobility



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Conclusions & Outlook

- using smart meters for analyzing tools are developed.
- results of voltage level statistics demonstrate e.g. the increase of voltage level caused by unbalanced load.
- further investigations in respect to voltage unbalance measurements and phase separated 15-min-average are in progress.
- in future grid planning can be based on voltage level date instead estimation of loads.
- Power Snap Shots will provide real data for loads and generation and allow to develop realistic models of impedances
- the presented functionalities will be very important for increased integration of decentralized power generation
- 1 Mio Snapshots: Hundred different LV Grids, for each 10000 Snapshots will be used to investigate impacts of high penetration of DG and e-mobility