Maximazing DER hosting capacity of LV and MV networks

Austrian Pilot Projects

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Content

Austria Facts and Figures (2013)

- One TSO and ~130 DSOs
- Fully deregulated retail electricity market
- Electricity consumed 69,613 GWh
- Peak demand 10,092 MW
- Installed power 23,164 MW

Electricity fuel Mix

	Production
Hydro Power:	40,963 GWh (60.5%)
Thermal Power[1]:	16,489 GWh (24.3%)
Wind:	2,237 GWh (3.3%)
Others (including PV):	8,027 GWh (11.8%)
Total:	67,716 GWh

[1] Coal 6,097 GWh, Oil 683 GWh, Gas 6416 GWh, Others (biomass, waste) 3293 GWh

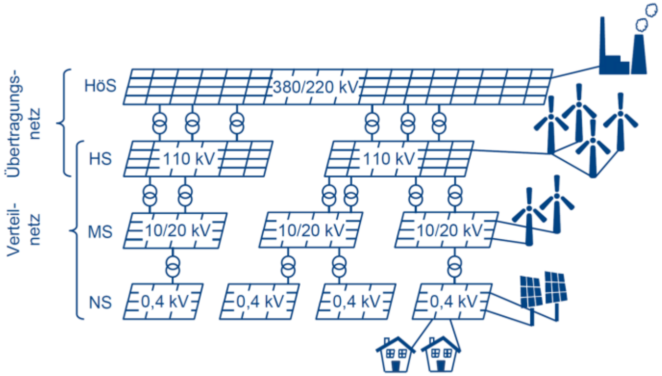
Electricity System

System Length					
Voltage Level	Overhead		Cable		Total
	km	Share	km	Share	km
380 kV	2.784	1,1%	55	0,0%	2.838
220 kV	3.662	1,4%	5	0,0%	3.667
110 kV	10.443	4,1%	725	0,3%	11.167
1kV < 110 kV	28.153	11,0%	40.184	15,7%	68.337
<1 kV	36.118	14,2%	133.057	52,1%	169.175
Total	81.160	31,8%	174.024	68,2%	255.184

Facts and Figures

- The distribution network in Austria typically is designed with three voltage levels:

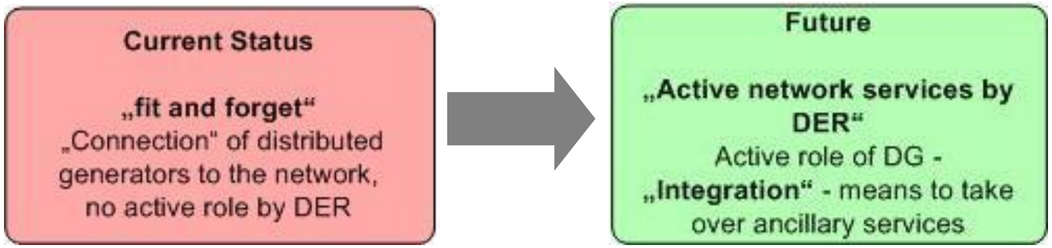
  - High voltage 110 kV
  - Medium voltage: 10 kV, 20 kV, 30 kV
  - Low voltage: 0.4 kV



- The main driver for the Austrian Demo Case Austria is the massive integration of renewable-based distributed generation in particular into the distribution system level in mainly rural areas.

Objectives

- to find an efficient way for the integration of renewable-based distributed generation with regard to optimized investment by maximizing the utilization of the existing asset base in medium and low voltage grids.
- The main challenge of integrating DER in distribution networks is to keep the voltage within the specified limits (voltage band, in compliance with EN 50160 “Voltage characteristics of electricity supplied by public distribution systems”).
- Thus the main functions elaborated in the field tests are
  - Smart planning
  - Smart monitoring
  - Smart control



Austrian Activities

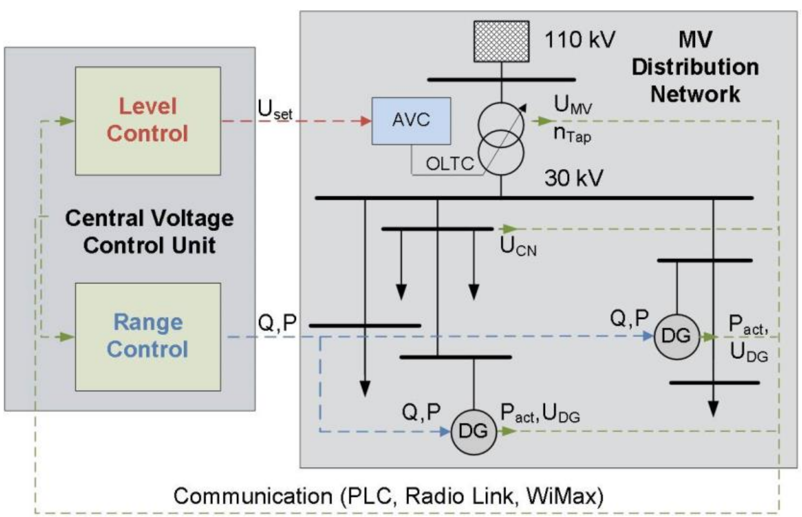
- Increasing DER hosting capacity in medium voltage networks and related voltage control concepts
  - Network operators: Vorarlberger Energienetze GmbH, Salzburg Netz GmbH
  - Field tests and demonstrations in Großes Walsertal and Lungau
  - Specific related projects: DG DemoNet- Concept & Validation, ZUQDE
- Increasing DER hosting capacity in low voltage networks and related voltage control concepts
  - Network Operators: Salzburg Netz GmbH, Netz Oberösterreich GmbH, Linz Stromnetz GmbH
  - Field tests and demonstrations in Köstendorf, Eberstalzell and Prendt
  - Specific related projects: ISOLVES: PSSA-M and DG DemoNet Smart LV Grid

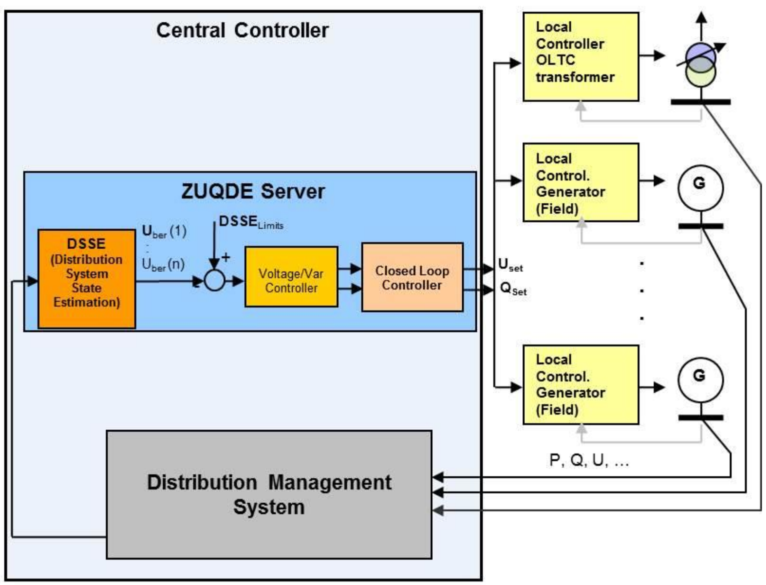
Impact

- Enhancement of RES integration
- Greenhouse gas emissions reduction
- Loss Reduction
- Integration between producers, consumers and prosumers
- Synergies with smart metering systems
- Future deployment of advanced services

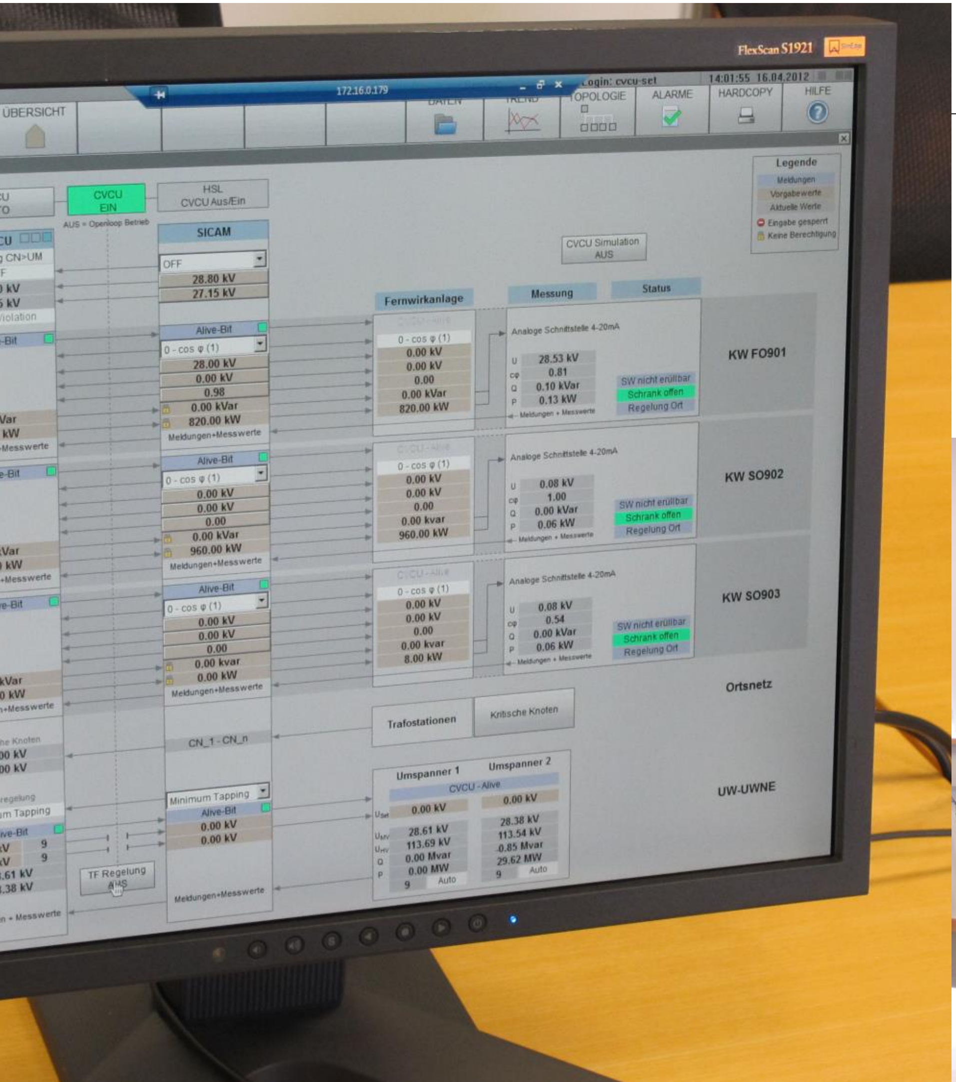
Technologies MV Network

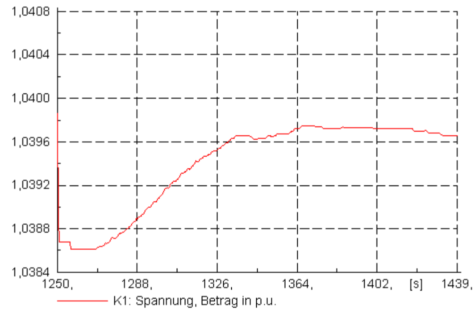
- Two approaches
  - stand-alone solution integrated at substation level (DG DemoNet approach) based on measurements in the grid
  - a solution integrated in a distribution management system based on state estimation (ZUQDE approach)

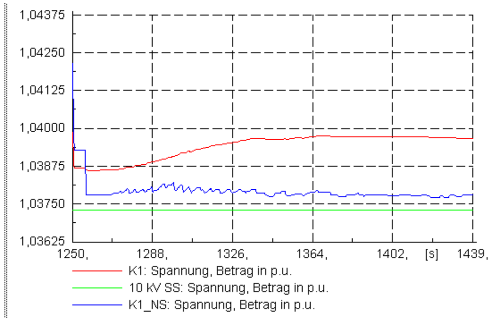


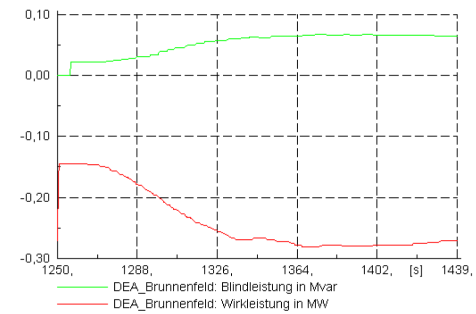


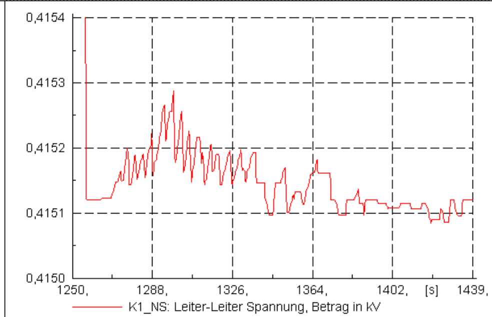
Pilot Operation in Vorarlberg











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Technologies LV Network

- Different controller steps
  1. The OLTC in the secondary substation, as well as the other components within the test area, use their integrated controls and characteristics without communicating with each other (**local control**).
  2. The OLTC receives measurement data from preselected points in the grid so that it can change the tap position to an ideal level for the whole grid (**distributed control**).
  3. In addition to approach 2, all distributed devices (e.g., PV inverters and electric vehicle charging stations) receive the same set points and characteristics (e.g., depending on reactive power control and voltage electric vehicle charging), which are optimized for the current status of the grid (**coordinated control**).

Technologies LV Network – Development Approach

Smart LV Grid Concepts
Smart planning, monitoring, control

Co-Simulation
ICT and power network as design platform

Photovoltaic
on every 2nd roof

Field test area
Low voltage grid section

validation of solutions for future problems

e-vehicels
in every 2nd garage

Technologies LV Network –Field Test Areas

Installation of a high penetration of PV and e-mobility

Eberstalzell, Upper Austria

Köstendorf, Salzburg

DG DEMO NET SMART LV GRID

Prendt, Upper Austria

Results

- The ZUQDE system based on state estimation (DSSE) and Volt/Var control (VVC) fulfilled the defined functionalities for supporting network operation in terms of voltage band management
- The DG DemoNet control functions can be expected to become a powerful and flexible tool for DSOs to economically integrate additional DGs in grids that recently were reinforced.
- In LV networks also smart planning and monitoring enables a increased hosting capacity
- Implementation of voltage control concepts in LV and MV networks can increase the hosting capacity significantly
- All smart grid applications developed and tested within the individual projects are seen as part of an overall smart grid approach, which should enable advanced services.

Next Steps

- DG DemoNet control is going to be commercialized within an industry cooperation
- Investigate the replicability and scalability of the developed solution in Austria. Therefore, networks where similar problems may occur should be identified and used to determine whether these solutions will be suitable.
- Additionally, based on the experiences in LV and MV networks, the next step will be to investigate, further develop, and demonstrate the interaction of all the controls in high voltage, MV, and LV levels and include them in the operational network management.

Summary

- The hosting capacity can be increased in LV and MV networks through smart planning, smart monitoring, and smart control.
- Different control possibilities for voltage band management in medium-voltage networks with high share of distributed generation were proven successful:
  - A stand-alone solution integrated at substation level based on measurements
  - A distributed management system based on state estimation both controlling set points of the on-load tap-changer transformer and generators
- With Intelligent planning of DG integration supported by monitoring, the hosting capacity of LV networks can be significantly increased. In term of active network control a distributed control approach seems to be the most successful.

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your ingenious partner

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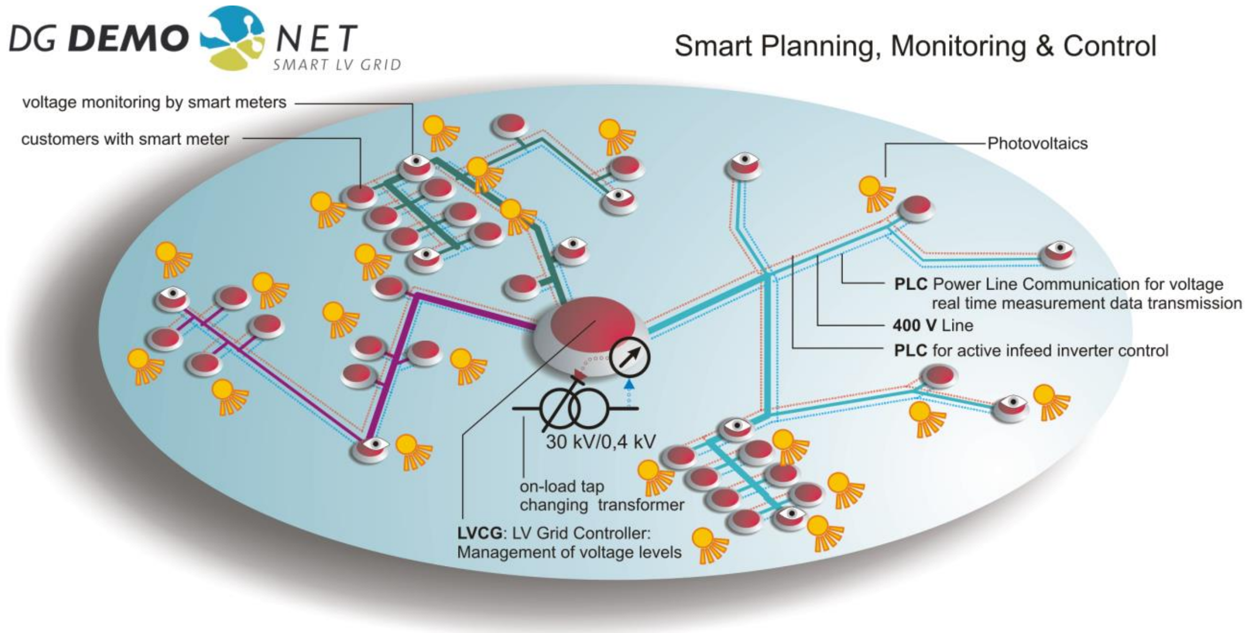
Backup

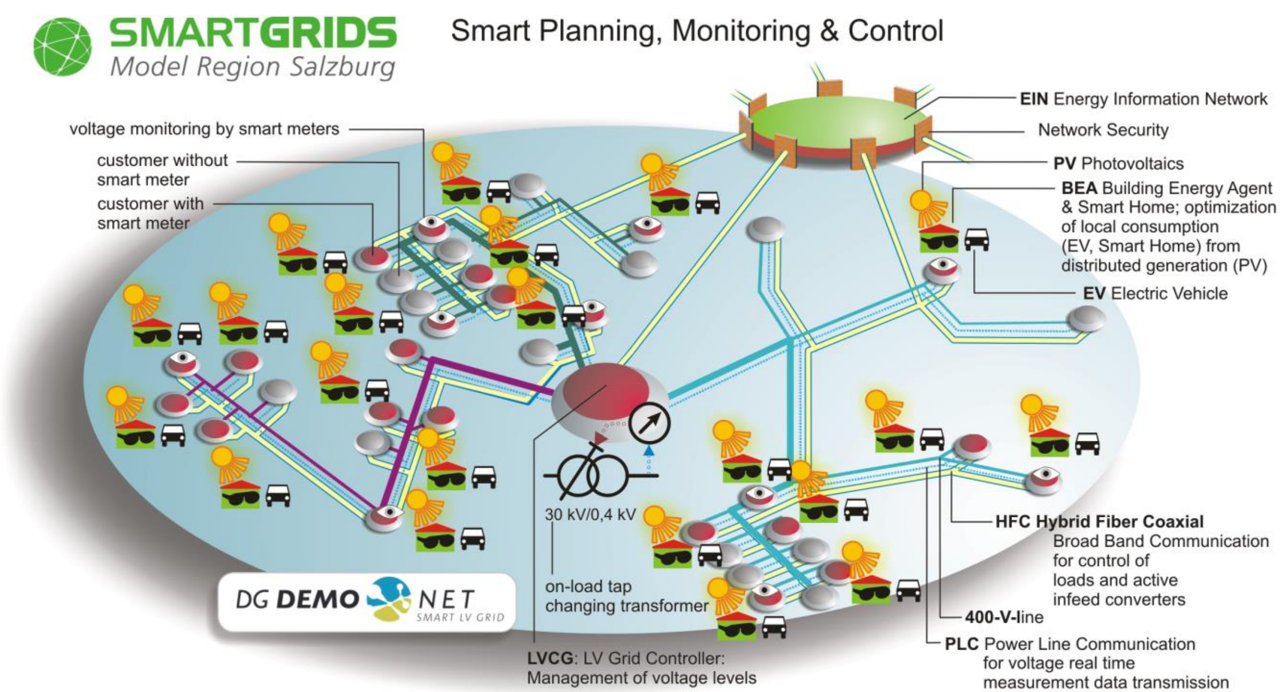
Facts and figures

- Use Case high penetration PV
- Eberstalzell (Energie AG Netz GmbH)
  - 30/0,4 kV – 630 kVA Transformer
  - *11 branches up to 600m*
  - 173 customers - 1,3 GWh/a 450 kW maximum load
  - 60 PV-Systems roof top 330kWp
- Littring (Energie AG Netz GmbH)
  - 30/0,4 kV – 250 kVA Transformer
  - *5 branches up to 1 km*
  - 54 Buildings/Customers - 0,35 GWh/a 120 kW maximum load
  - 15 PV-Systems roof top 140 kWp



Facts and figures

- Use Case High penetration PV and e-Mobility
- Köstendorf (Salzburg Netz GmbH)
  - 30/0,4 kV - 250 kVA Transformer, 6 branches up to 1000 m
  - 95 buildings / 127 customers - 0,6 GWh/a 210 kW maximum load
  - 40 PV-Systems roof top 180 kWp, 37 e-cars
  - Building automation for demand side management



Facts and figures

- Use Case probabilistic network interconnection
- Prendt (Linz Stromnetz)
  - Feeder Prendt 1, 14,54 kWp existing PV, 29,13 kWp new installations
  - Feeder Prendt 2, 11,34 kWp existing PV, 97,22 kWp new installations
  - Total 142 kWP