Country Report Germany

IEA PVPS Task 14 Meeting, UNSW, Sydney

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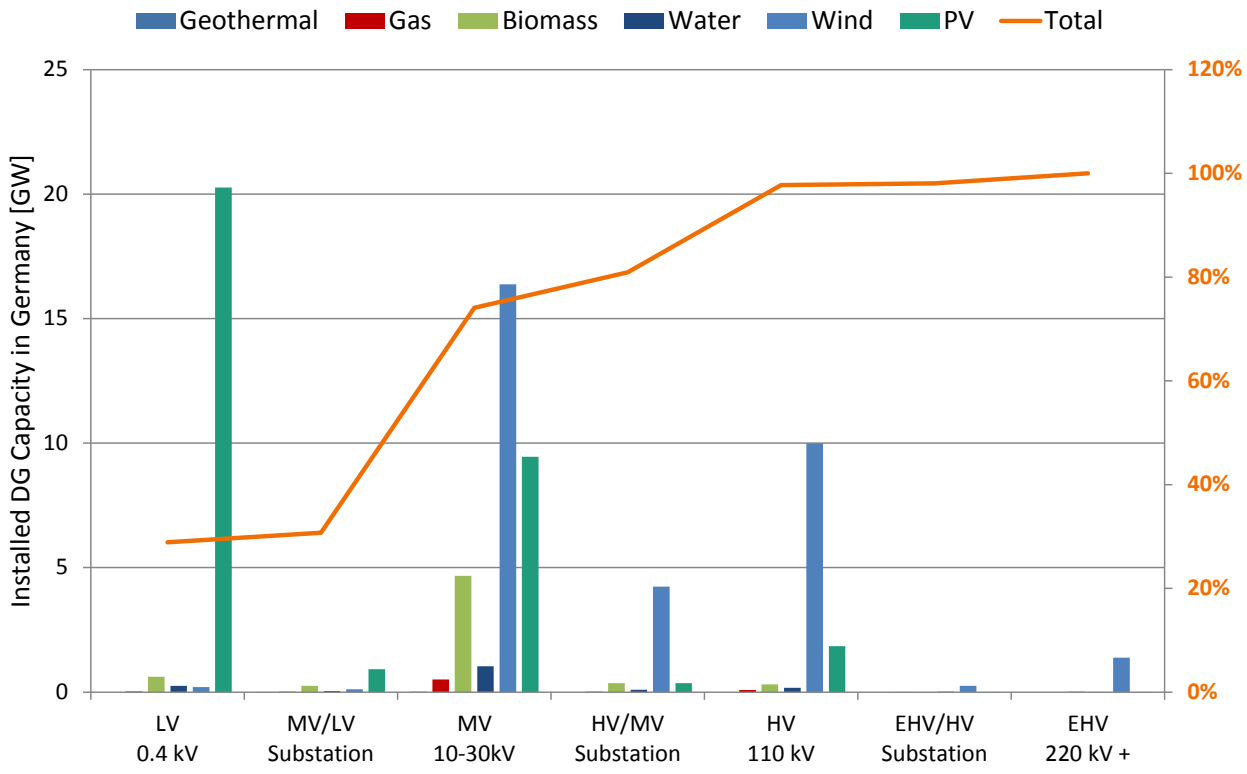
Agenda

- Part 1: Current Statistics on PV
- Part 2: Regulatory Framework
- Part 3: Research & Development
  - Cost-Benfit Analysis for Voltage Support Strategies by PV Systems
  - Minimizing Reactive Power Exchange at HV/MV Substations
- Part 4: Future Prospects

Part 1

CURRENT STATISTICS ON PV

Current Statistics on PV - An Overview



Total installed Capacity	**~ 35 GW**
Number of PV Systems	**~ 1.3 million**
Energy Provision	**28 TWh, ~5.3% (2012)**
PV systems < 30 kWp	**~ 40%**

Data Sources:
DGS, www.energymap.info
BDEW, Erneuerbare Energien und das EEG: Zahlen, Fakten, Grafiken (2013)

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Current Statistics on PV – Spatial Distribution

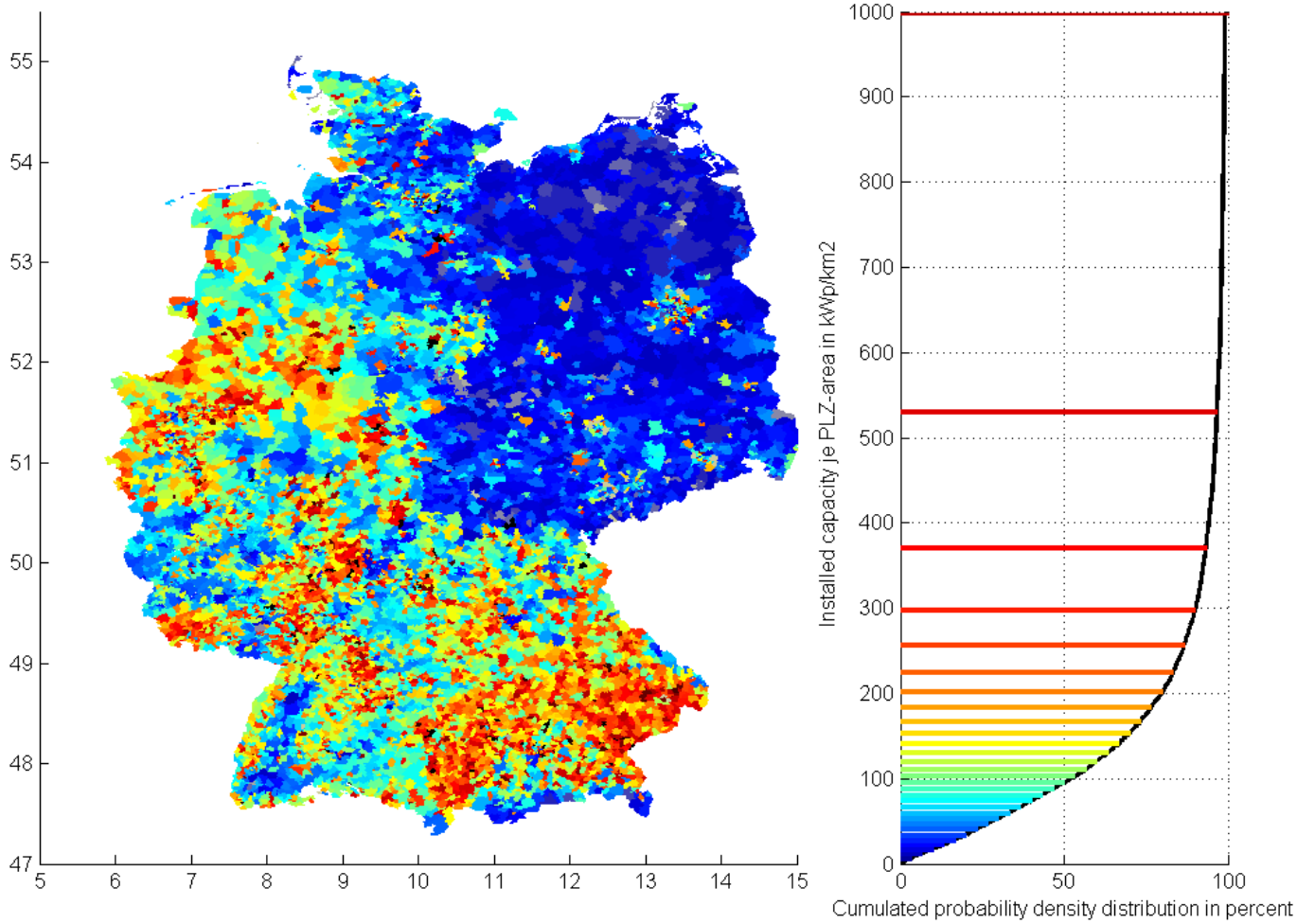

Figure by Y.M. Saint Drenan, Fraunhofer IWES

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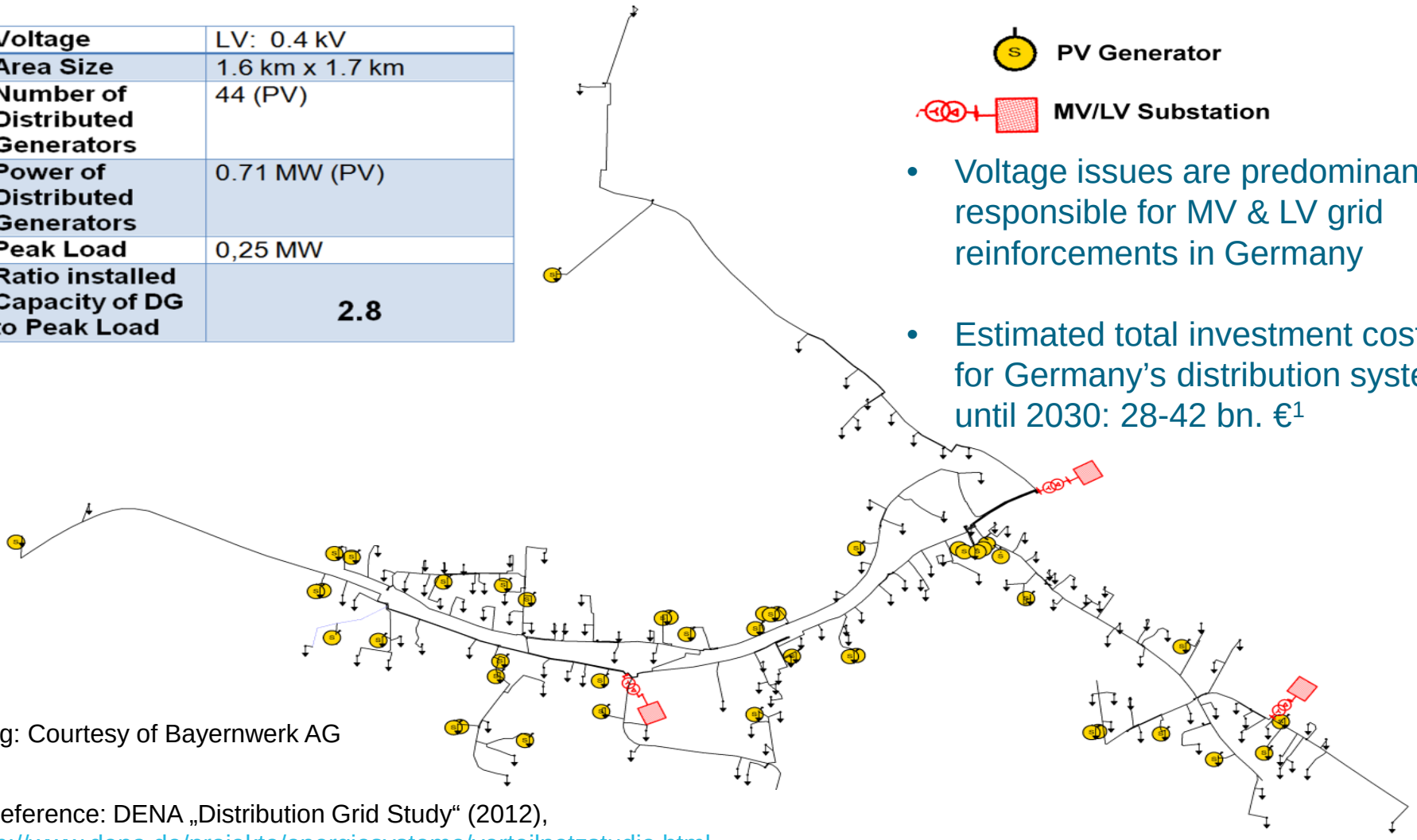
Current Statistics on PV – An Example LV Grid

Voltage	LV: 0.4 kV
Area Size	1.6 km x 1.7 km
Number of Distributed Generators	44 (PV)
Power of Distributed Generators	0.71 MW (PV)
Peak Load	0,25 MW
Ratio installed Capacity of DG to Peak Load	**2.8**

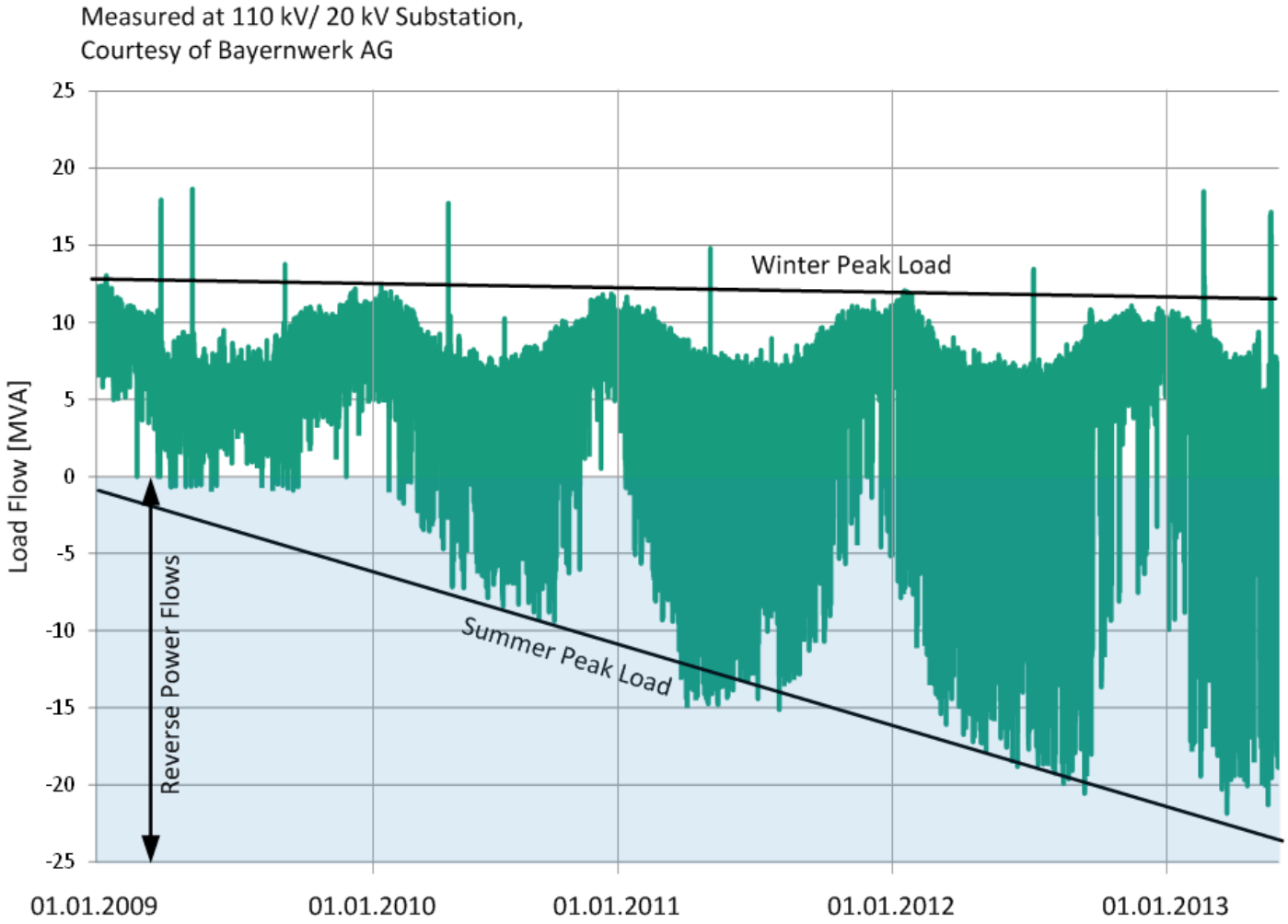


- Voltage issues are predominantly responsible for MV & LV grid reinforcements in Germany
- Estimated total investment costs for Germany's distribution system until 2030: 28-42 bn. €[1]

Fig: Courtesy of Bayernwerk AG

[1] Reference: DENA „Distribution Grid Study" (2012), http://www.dena.de/projekte/energiesysteme/verteilnetzstudie.html

Current Statistics on PV
– Transition from Consumption to Supply Grid



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Part 2

REGULATORY FRAMEWORK

Regulatory Framework

- Current Feed-in Tariff for PV: **9.88 – 14.27** ct/kWh (Status 10/2013)
- Electricity Tariff: ~ **25- 30** ct/kWh
- Feed-In Tariff Mechanism will be stopped at 52 GWp
  - PV self-consumption will become economically more important (smaller PV system sizes)
  - Market mechanisms will displace incentive systems (VPPs)

PV-Battery-Storage Incentive Program started in May 2013

- Low interest loan provided by national business development bank (KfW)
- 2000 request for financial support were filed

Part 3

RESEARCH & DEVELOPMENT

Distribution Management System – Local Control Strategies

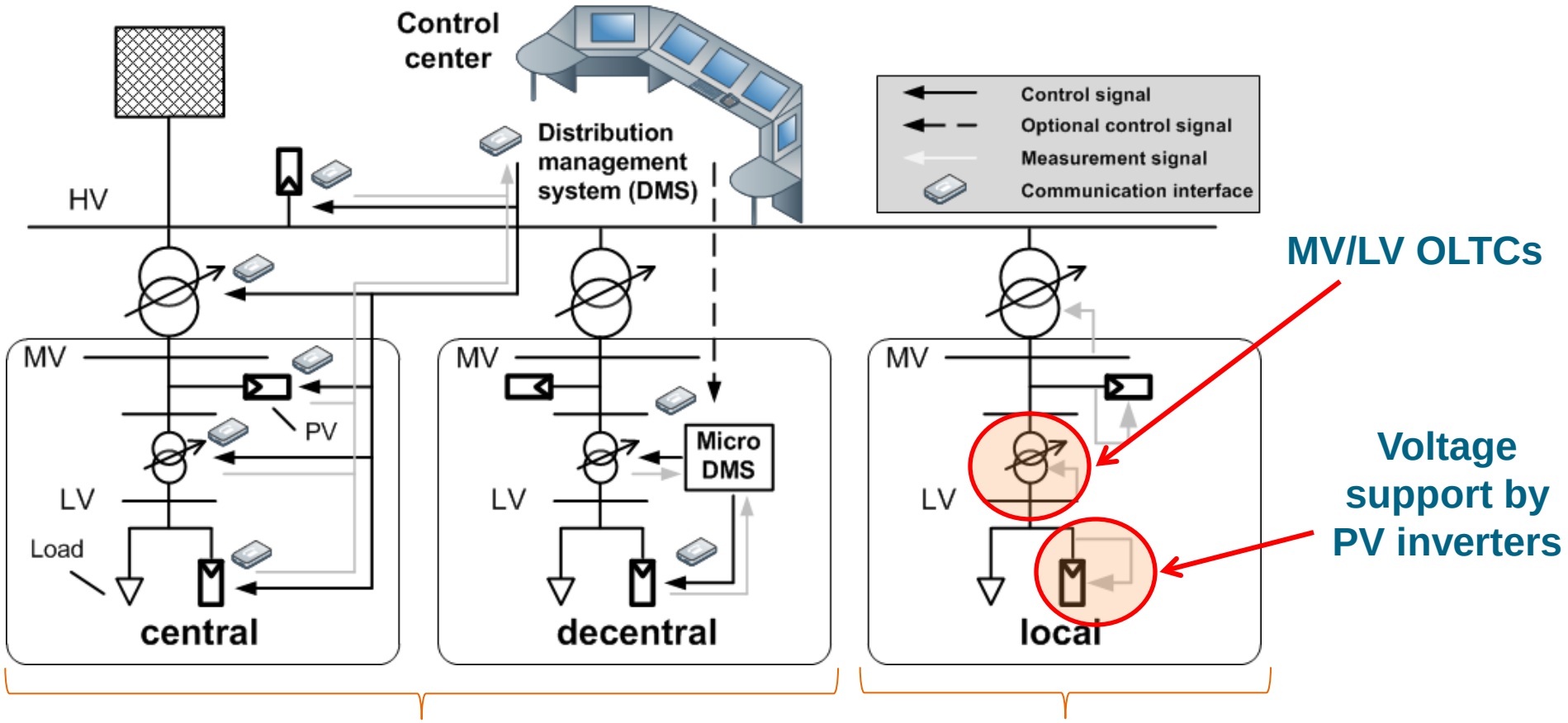

Fig.: J. von Appen et al., „Time in the Sun“, IEEE Power&Energy Magazine, March/April 2013

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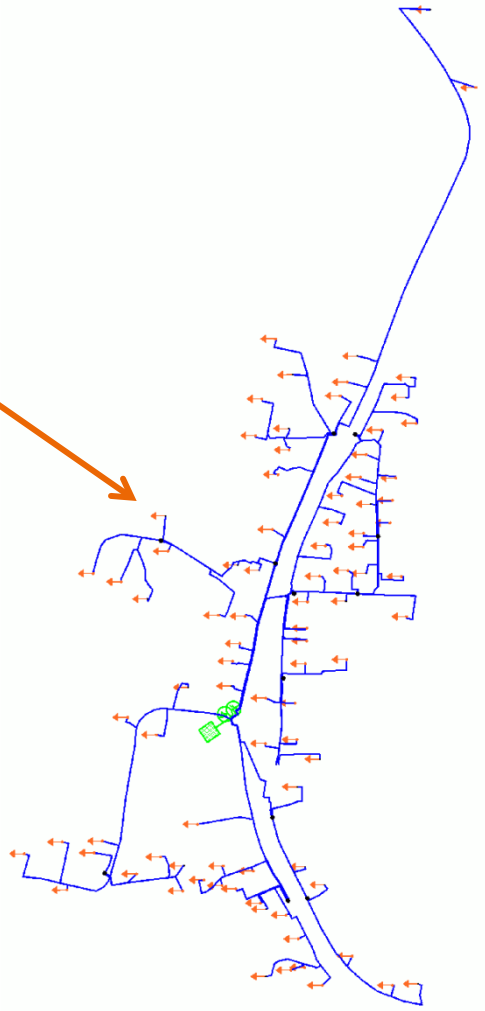
Investigated Low Voltage Grids

Smart-Meter
Measurement
Data



Grid No. 20

Grid No. 39

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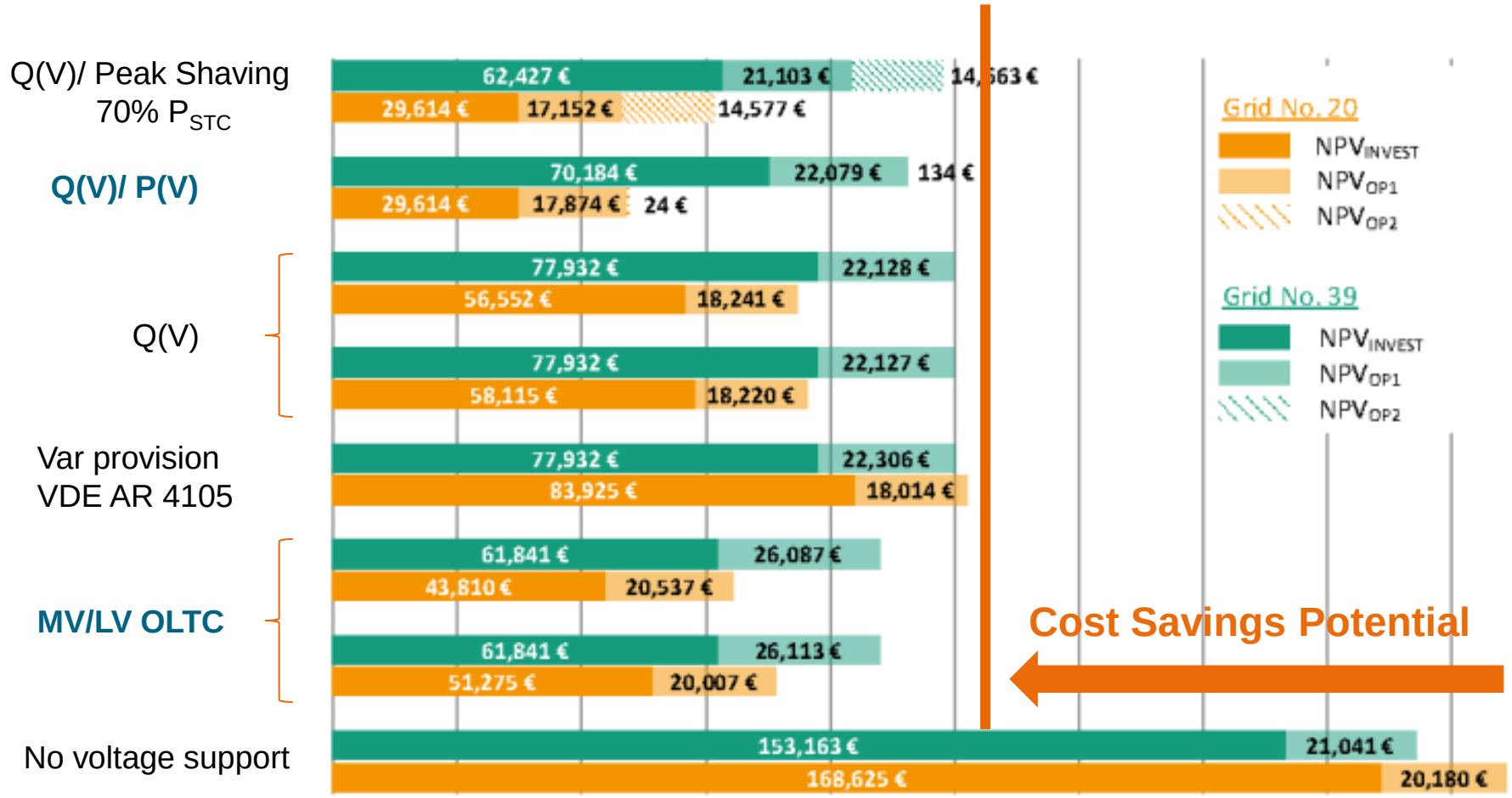
Cost Savings Potential by applying Voltage Control Strategies



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Distribution Management System – Central Control Strategies

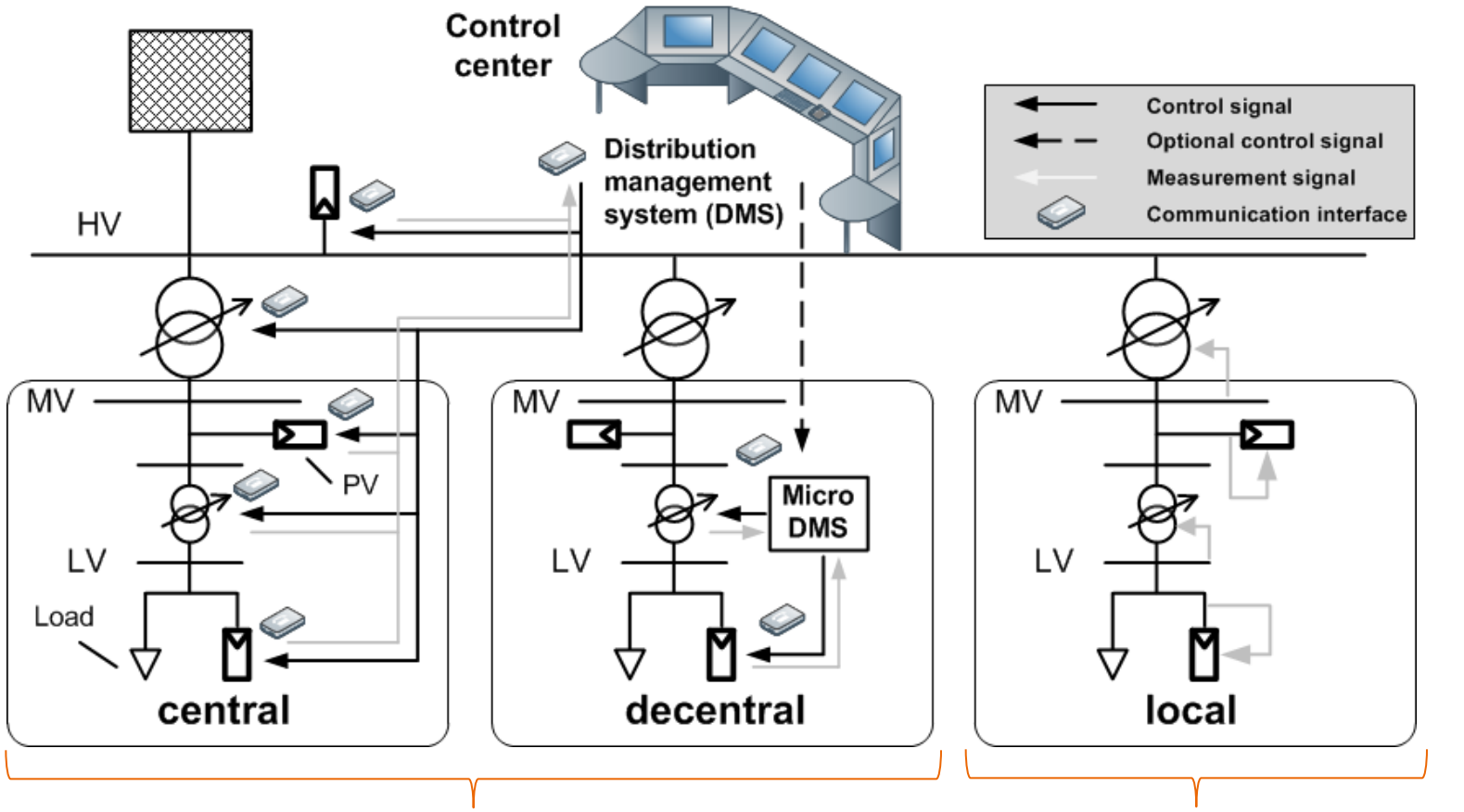

Fig.: J. von Appen et al., „Time in the Sun“, IEEE Power&Energy Magazine, March/April 2013

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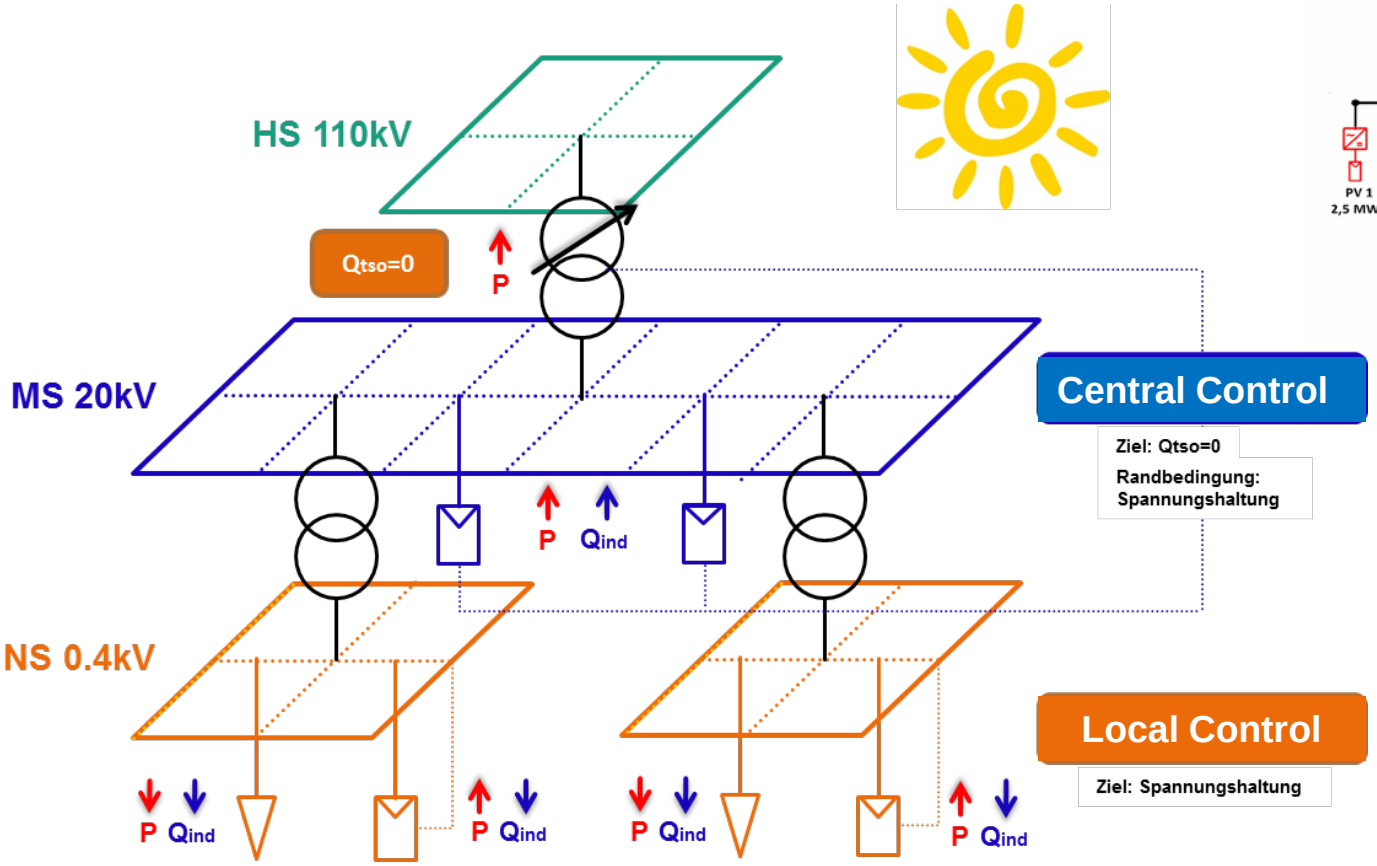
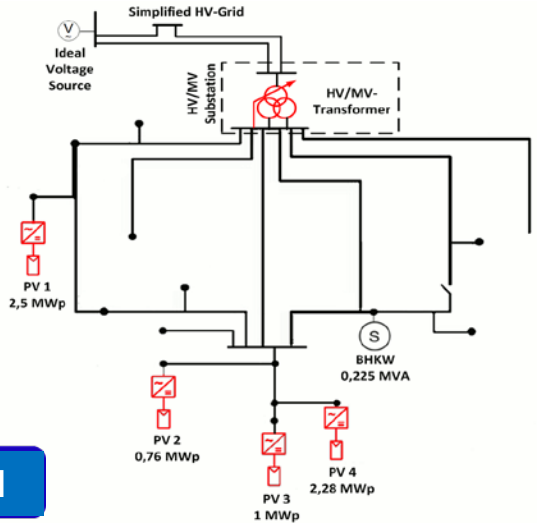
Reactive Power Flow Compensation by MV PV Systems





Source: H. Wang, Fraunhofer IWES

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Part 4

FUTURE PROSPECTS

Future Prospects

Germany's feed-in tariff system for PV will be ceased once 52 GWp are installed (currently ~35 GWp) – **Game Changer!**

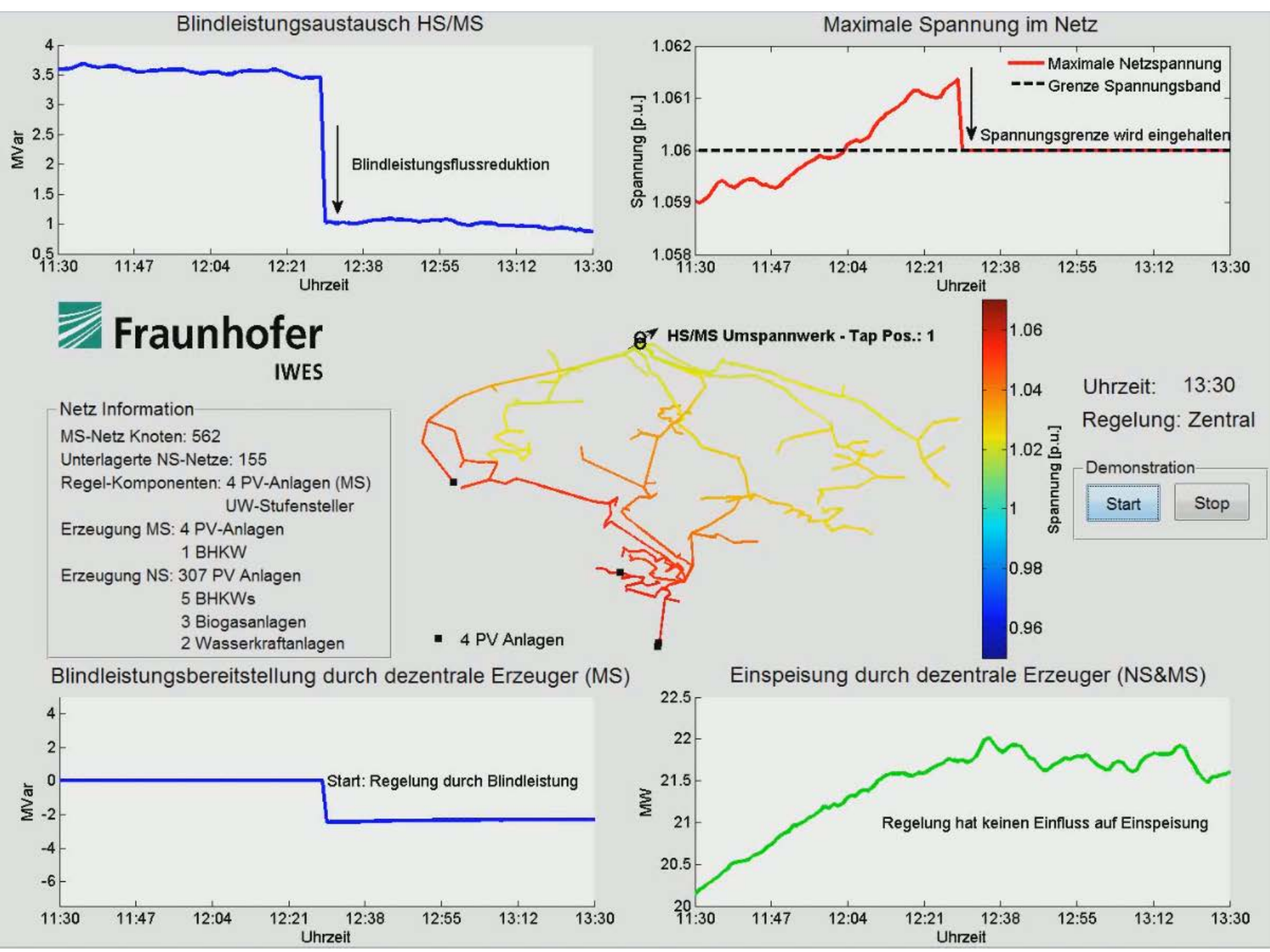
- PV self-consumption will become economically more important (smaller PV system sizes)
- Market mechanisms will displace incentive systems (VPPs)

Coordinated DG control at MV level gains in importance

- Ancillary services for TSO (VAr provision, congestion management)
- Compensation of VAr flows at MV level by DGs

Gas distribution systems and district heating systems could provide storage capacity for surplus PV energy (Power2Gas/ Power2Heat)

- Infrastructure required! PV is still a rural issue


Blindleistungsaustausch HS/MS
MVar
Blindleistungsflussreduktion
Uhrzeit
Maximale Spannung im Netz
Spannung [p.u.]
Maximale Netzspannung
Grenze Spannungsband
Spannungsgrenze wird eingehalten
Uhrzeit
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IWES
HS/MS Umspannwerk - Tap Pos.: 1
Spannung [p.u.]
Uhrzeit: 13:30
Regelung: Zentral
Demonstration
Start
Stop
Netz Information
MS-Netz Knoten: 562
Unterlagerte NS-Netze: 155
Regel-Komponenten: 4 PV-Anlagen (MS)
UW-Stufensteller
Erzeugung MS: 4 PV-Anlagen
1 BHKW
Erzeugung NS: 307 PV Anlagen
5 BHKWs
3 Biogasanlagen
2 Wasserkraftanlagen
4 PV Anlagen
Blindleistungsbereitstellung durch dezentrale Erzeuger (MS)
MVar
Start: Regelung durch Blindleistung
Uhrzeit
Einspeisung durch dezentrale Erzeuger (NS&MS)
MW
Regelung hat keinen Einfluss auf Einspeisung
Uhrzeit