Using distribution connected flexibility to support network operation

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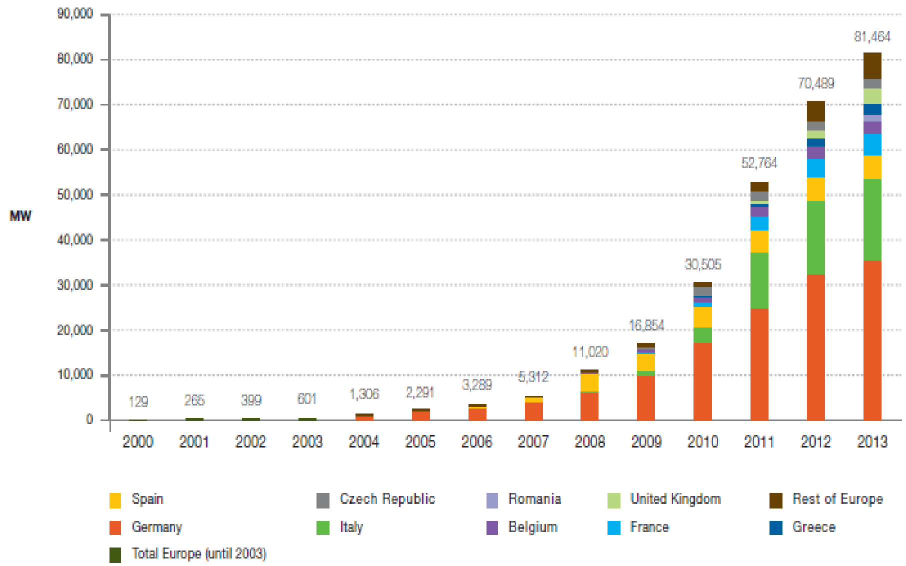
Evolution of PV

Installed PV Power (End 2013)

(EPIA, "Global Market Outlook for Photovoltaics 2014-2018," 2014)

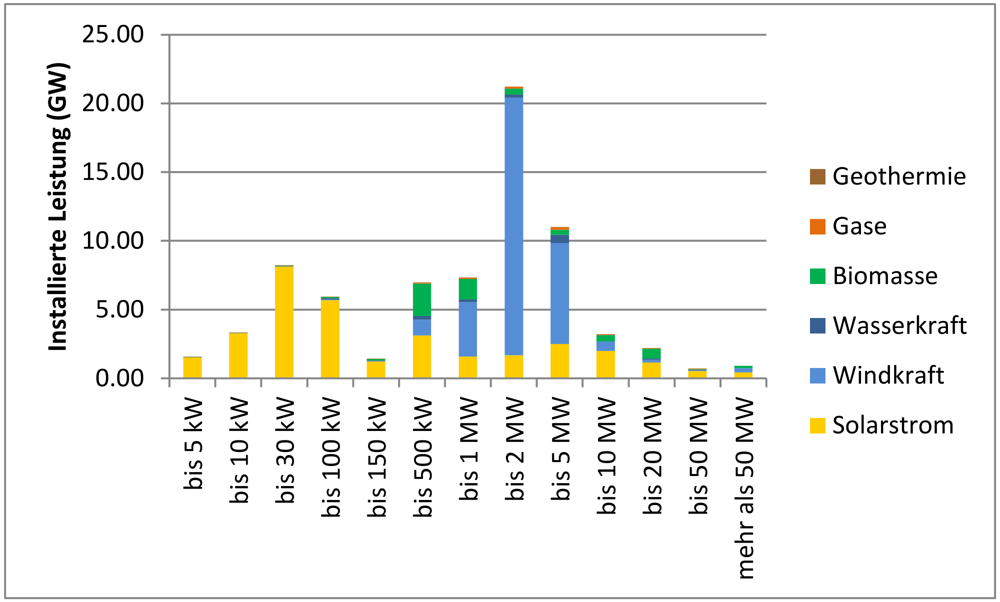


- > 80 GW (end of 2013)
  - >35 GW in Germany
  - >20 GW in Italy
- With increasing penetration: increasing need for PV to support grid operation

Distribution of PV

Distribution of Installed PV Power (2013)

www.EnergyMap.info Data from 04.06.2013

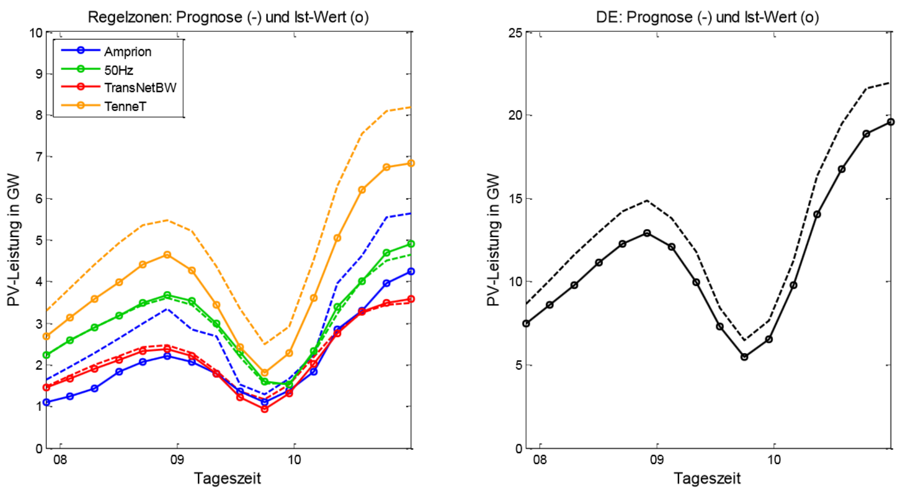


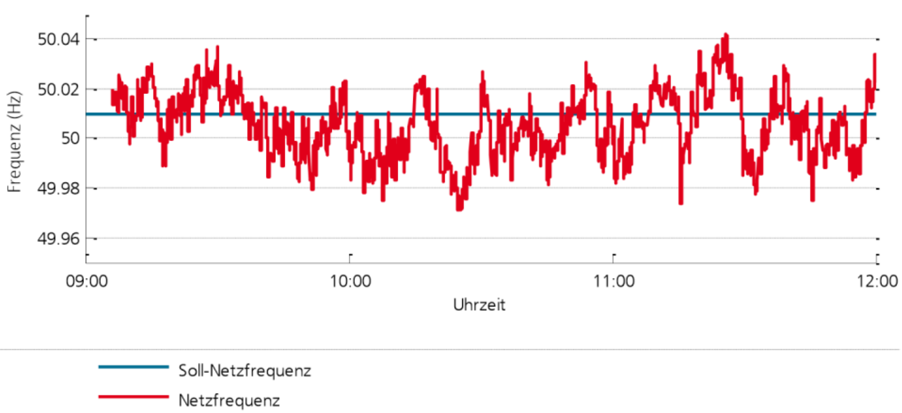
- +/- 70 % of power connected to low voltage

But…

- Impact on all voltage levels

Impact of PV





http://www.energiesystemtechnik.iwes.fraunhofer.de/content/dam/iwes-neu/energiesystemtechnik/de/Dokumente/Presseinformationen/2015/Auswertung%20des%20Effekts%20der%20Sonnenfinsternis_v6_ys_rf_ys_rf_dj_uk_dj_ys.pdf 2.6.2015

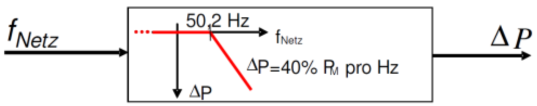
- Maximal power deviation compared to a cloudless day: 17 GW

- Frequency drop due to decreased PV production

Existing network support functions

Frequency support

- Changes on frequency boundaries: automatic disconnection within 47,5 Hz – 51,5 Hz is not allowed
- Reduction of active power in case of overfrequency



$$\Delta P = 20\, P_M \frac{50{,}2\,Hz - f_{Netz}}{50\,Hz} \quad \text{bei } 50{,}2\text{ Hz} \leq f_{Netz} \leq 51{,}5\text{ Hz}$$

P_M Actual available power

ΔP Power reduction

f_{Netz} Network frequency

Im Bereich 47,5 Hz $\leq f_{Netz} \leq$ No limitation

Bei $f_{Netz} \leq$ 47,5 Hz und $f_{Netz} \geq$ disconnection

Voltage support

Automatic disconnection at

- U = 1,15 Unom
- Uavg = 1,12 Unom (10 min. average)

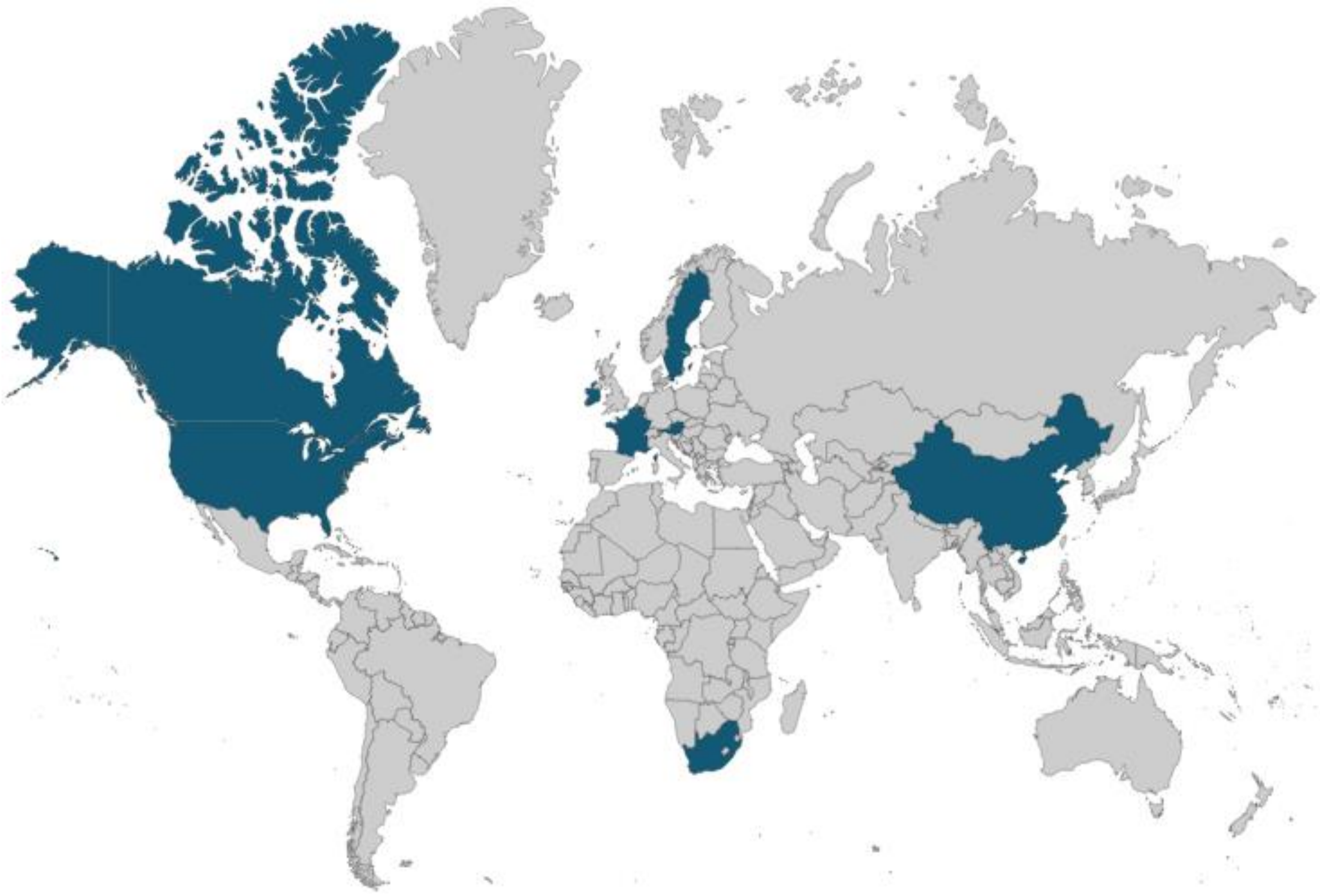
Examples from Austrian technical requirements

Need for grid operation support

Key question for discussion paper on
TSO – DSO interaction:

„Which grid operation challenges will require distribution connected flexibility to support grid operation?"

Feedback by Country experts from



6 cases to investigate TSO-DSO interaction

Expert feedback resulted in:

Grid support cases

1. Congestion of transmission-distribution interface
2. Congestion of transmission lines
3. Voltage support (TSO ←→ DSO)
4. Balancing challenge

Case 3 – Voltage support (TSO ←→ DSO)

Current interaction	Future interaction
• TSO supports DSO grid voltage using tap changer on the TSO-DSO transformer • Sometimes, TSO controls DSO grid capacitor banks • Examples of DG supporting voltage: units operate at a fixed power factor	• (Intensified) use of the DSOs' current capacitor banks • Coordinated use of reactive power from distributed generators

Case 3 – Process flow proposal

Party	Input	Analysis	Output
TSO	Setpoint of voltage, power factor or reactive power flow at DSO-TSO point of connection		
DSO	• Grid configuration • Grid load monitoring • Monitoring of flexible cutomers: active and reactive power provision & flexibility	Power flow calculations making use of flexibility to reach requested setpoint at DSO-TSO point of connection	• Reactive (& active) power setpoint per flexible customer • Capacitor bank setpoints

Case 4 – Balancing challenge

Current interaction	Future interaction
• Generally, DSO not involved in grid balancing • Sometimes, DSO customers take part in balancing process. DSO can be involved, for example in prequalification	• (Aggregated) distribution customers part of balancing process. • DSO with local balancing responsibility is investigated. • Market-based signals should not interfere with grid operation signals ⚠ New roles to discuss (e.g. aggregated distribution for balancing)

Key findings & discussion points

Technical aspects

- Flexibility on distribution grid is expected to support grid operation
- Technical requirements similar for identified challenges
  - Grid monitoring
  - Bidirectional communication to customers and other grid operators
  - Algorithms to be implemented
- Current technology is sufficient, practical experience to be gained

Key findings & discussion points

Regulatory aspects

- Necessary to limit impact of flexibility use (e.g. RES production)
- How to prioritize use of flexibility (TSO challenges vs. DSO challenges)?
- New markets / new market architecture necessary?
- New roles for DSO necessary?

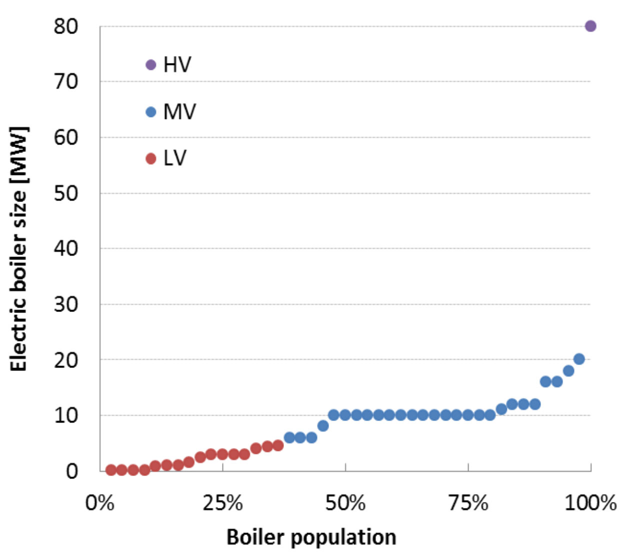
Master Thesis on
"Single Marketplace for Flexibility"

Customers' role to provide flexibility

- Existing network support functions of new technologies are expected to stay
- Extension of voltage support functions are currently implemented in some regions or countries (reactive power based voltage control)
- Balancing support might be extended to flexibility connected to the low voltage grid, but technically challenging

Denmark

- Production primarily CHP and wind; Power installed = 85% of peak load
- Challenge: excess production & export, sometimes cheap
- One solution: use flexibility of electric boilers (400 MW) and heat pumps (9 MW)



- Society: better use of renewables
- DSO: increased use of existing infrastructure
- Customer: produce heat when prices are low

Thank you for your attention

Customer

System Operator

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