

High penetration of PV in European Grid



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CONTENT

Ø High PV Penetration is coming soon...
Ø Challenges at high penetration...
Ø Methods how to meet...
ØOutlook...





Global Status of Photovoltaics



Ambitious International Targets and Visions (2020 - 2030 – 2050)

50 GW

3 GW

 $6^{0}/_{0}$

200 GW

20 GW

1

2009 PV Peak Power Production

On sunny weekend days in southern Germany PV supplies more than 10 % during midday peak hours!



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Main Challenges for PV to cope with...

 Integration into grids need some "smartness" mainly due to ist
 fluctuating feature





The old way of regulation in Europe....

Production:

Base load

- Nuclear
- Coal (Stored energy!)
- Hydro (River)
- Oil (stored energy)
- Gas combined cycle (Stored energy)

Peak load

- Hydro Power (Storage schemes)
- Gas power stations (single cycle)
- ???????





Load regulations (traditionally):

- Domestic hot water systems
- Household equipment like washing machine
- Pricing with extra charge for peak load demand
- ->





The future



Levels of Large-Scale Deployment of RE in Europe

1 High RE penetration at system-wide (ENTSOE-> European Network of Transmission System Operators for Electricity) level -> VLS-PV, large offshore wind farms, hydropower from the North, ...

2 High RE penetration at regional / country-wide level -> PV plants in Spain/Italy/Germany, wind farms in Denmark, ...

3 High RE penetration at local level -> Rooftop-PV in Germany, wind generators in Switzerland

4 High RE penetration in small grids -> PV plants in Cyprus

PVPS



ABB's Vision of DC-Interconnection (M. Bayegan, 2002)

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PROBLEMS IDENTIFIED

- Large load flows reduce available cross border trading capacities
- Grid congestions/ bottlenecks : Need for additional/new grid infrastructure
- Secure system operation at risk
- Increasing need for balance power and reserve capacity
- Increasing grid losses and reactive power compensation
- Economic impact on conventional power generation



MAIN RECOMMENDATIONS

- Harmonization of European support scheme for renewables
- Speeding up the approval procedures for new grid infrastructure
- Adjustment of market rules for imbalance management
- Improvement of connection requirements for wind turbines
- Re-examination of priority rules for RES-electricity



Technical Measures for Integration of RE Power Plants in Europe

- 1 System-wide (ENTSOE-) level
- New transportation "backbones" (HV-DC)
- New Pumped Storage
- 2 Regional / country-wide level
- New Transportation Lines (HV)
- New Storage Facilities (hydro, compressed air,...)
- DSM Demand side management
- Sufficient "conventional" power capacity

3 High RE penetration at local level

- New transportation lines (MV)
- "Smart Grid" -> DSM etc.
- Local storage (batteries, compressed air,...)
- 4 High RE penetration in small grids
- Sufficient "conventional" power capacity
- "Smart Grid" -> DSM etc.
- Storage

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Some new challenges for Electricity networks



Predominant technical Challenge: Voltage control



PV specific features

Ø Fluctuating generation

Daily profileSeasonal profileVariability

Ø Typical system size

Many small scale (domestic) installations -> aggregation
& Large scale installations

Ø Connection predominantly at LV grid - Inverter connection (no transformer)

Ø Heavily dependent on support incentives – in only a few markets / countries

Ø Frequently linked to buildings

Ø Suited for new decentralized storage solutions







Positive effects for the grid (I)





Further positive effects for the grid...

- Reduction of network
 losses due to more local generation and therefore decreased power transmission
- More transmission capacity opens space for other transmission services
- Active network services from multifunctional photovoltaic inverters can support the local network management





IEA PVPS

Just developing a new activity – TASK 14:



- High-Penetration of PV
 Systems in *Electricity Grids*
- Start: Spring 2010
- Lead: Austria

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IEA PVPS – Task 14 High Pentration of PV Systems in Electricity Networks

Ø PV generation in correlation to energy demand focusing on the consumer behavior to be better linked to the generation profile

The effects on PV generation to the local grid as well as to the general electricity system

 Smart inverter technology dealing with requirements for inverters at high PV penetration

Convincing case studies,Simulation





CONCLUSION 1

- Ø PV in High Penetration will come up soon, in some parts of the
- grid PV is already today a challenge
- Ø New Inverter Technology can take over responsibility for the grid
- **Ø** Standards, Rules and know how seems to be the main barriers, not technology
- **Ø** International collaboration is essential in order to have a smooth transition to electricity grids with a high share of PV







CONCLUSION 2

There might be a time to come in Europe where

- We switch on our domestic hot water boilers during midday (on sunny days)
- Daytime electricity is becoming cheaper than night time electricity
- We use our fossil resources not for base load but only for peak load





Thank you

