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Project PV-GRID
Enhancing PV Hosting Capacity in Distribution Grids

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Enhancing PV Hosting Capacity in Distribution Grids

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Related issues:
voltage limitation
thermal limitation
system stability
security of supply

Solution types:
DSO - installed and managed on the grid side - not requiring any interaction with the consumers or the PV plants
Prosumer - installed before the energy meter - reacting based on the grid characteristics at the grid connection point
Interactive – requiring a communication infrastructure linking the hardware located in different grid locations

DSO solutions I

Network reinforcement - the most frequently adopted action today - costs can be significantly high
On Load Tap Changer (MV/LV transformer) - tap changers are usually not automated – accompanied by increase in transformer losses
On Load Tap Changer (HV/MV transformer) - OLTCs are changed according to the voltage at the MV busbar and the transformer load - they must be combined with some advanced voltage regulation system based on measurements within the MV (and possibly the LV) grid
Static VAR Control - they provide instantaneously reactive power in a MV (mainly) or LV grid (resistive part of the impedance is prevailing)

DSO solutions II

DSO storage - for peak shaving, power shifting, ancillary services and backup in case of grid failure - may contradict with neutrality of DSOs to energy markets
Booster Transformers - MV-MV or LV-LV transformers that can be used to stabilize the voltage along a feeder
Network Reconfiguration - MV grids are usually topologically meshed, but operated radially - this solution has usually a quite low impact
Advanced Closed-Loop Operation - simultaneous feed from 2 points - moderate impact

Prosumer solutions I

Prosumer Storage - for peak shaving and buffering of fluctuating generation - mainly interesting in areas where PV capacity is located next to comparable loads (residential for LV grid or PV clusters for MV grid)

Self-consumption by tariff incentives
Fixed tariffs: if feed-in price lower than consumption price, the prosumer optimizes his demand
Direct or indirect incentives for self-consumption: a premium is granted for all the electricity self-consumed

Prosumer solutions II

Capacity curtailment - feed-in power never above a fixed value (AC , not DC reference) - even a significant reduction of the generated power (kW) would cause only a small loss of energy production (kWh)
Active power control by PV inverter P(U) - the grid voltage could be used as a proxy indicator for the grid situation and for the curtailment level - for economic reasons, should be used only when all other less expensive solutions have been applied
Reactive power control by PV inverter Q(U), Q(P) - as a function of the local voltage value [Q=Q(U)] or as a function of the active power production [Q=Q(P)] - more effective in MV networks than in LV ones

Interactive solutions

Demand response by local price signals - only available to consumers located in feeders, which experience voltage and/or congestion problems
Demand response by market price signals - low impact
Direct load control - DSO or energy aggregators allowed to remotely activate or curtail dedicated consumer loads, based on agreed contract (capacity payment is offered) - more suitable for MV grids
PV inverter control (Q and P) - reactive power provision and active power reduction remotely controlled by a feeder supervisory control system - less suitable for LV networks
Wide area voltage control - Smart grid technologies applied to enable measuring the voltage and power factor at several points, controlling the equipment, coordinating and optimizing the generation and load

Evaluation parameters and methodology

Parameter 1:
cost-benefit indicator - based on cost, impact on voltage and impact on congestion

Parameter 2:
regulatory priority indicator - based on availability of technology and applicability within existing regulations
for 2 grid levels:
LV and MV grids

Outcome:
three effectiveness levels (**high, medium, and low effectiveness**)

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Thank you for your attention

Panos Sarris

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