Energy Week 2024
PATHFNDR CONFERENCE

Input presentation

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The critical role of flexibility in local electricity grids

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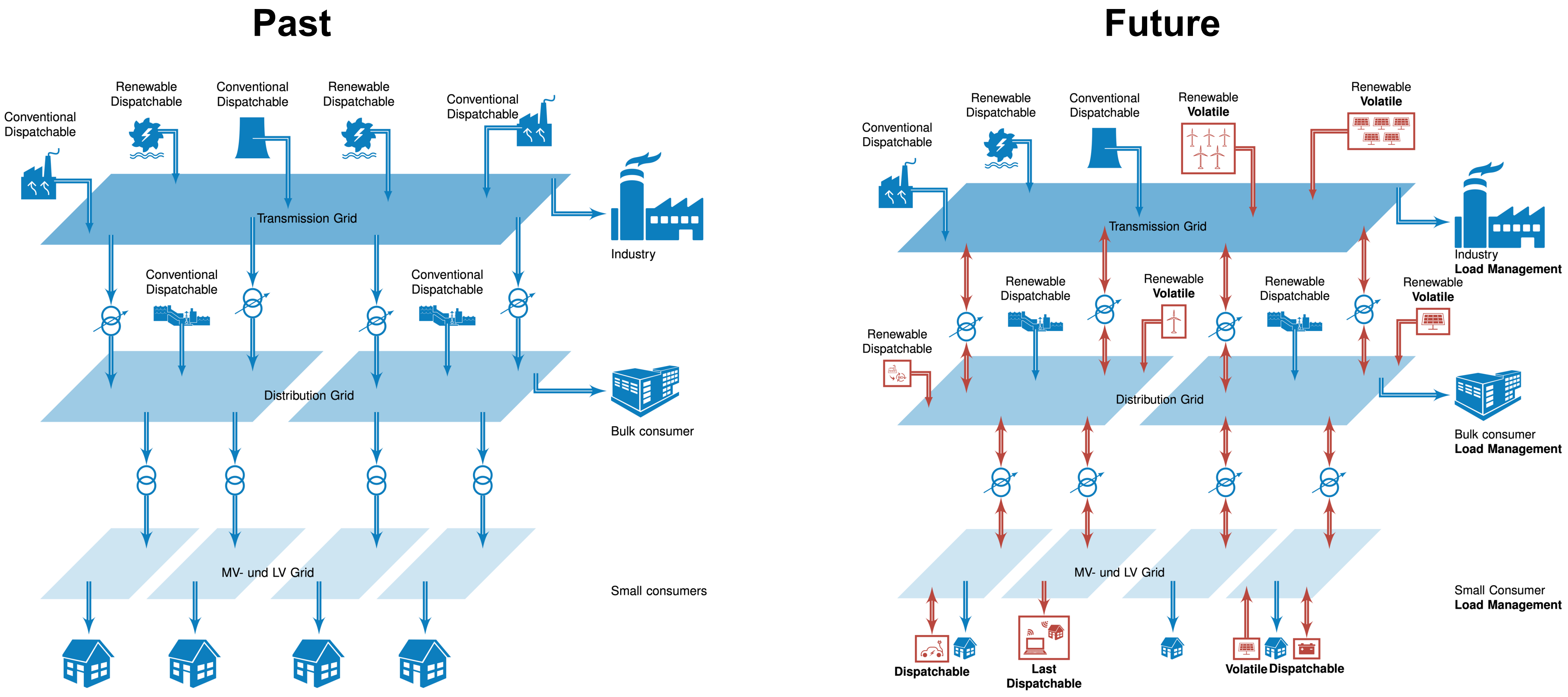
Are grids an enabler or a bottleneck of the energy transition?



~60 distribution networks have been analysed

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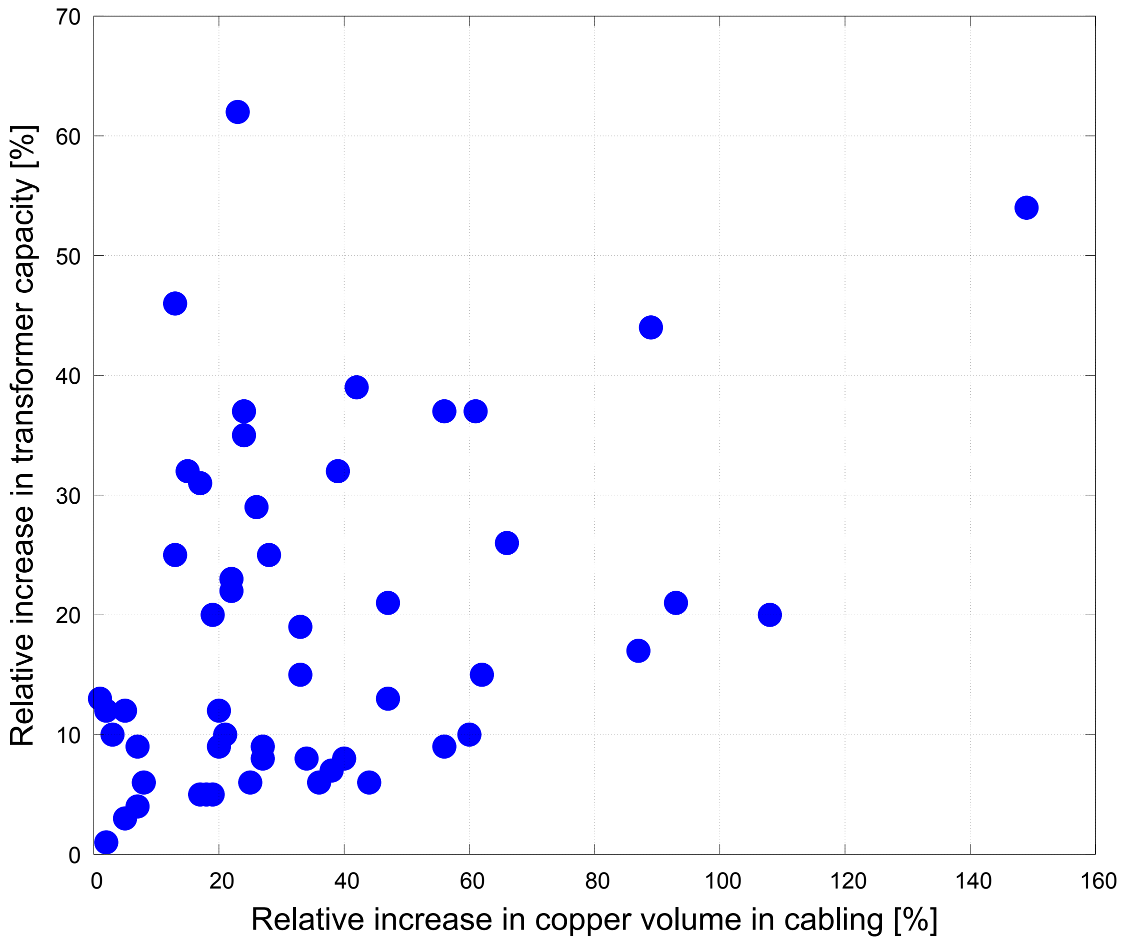
Heterogeneity of the grids

Grid expansion needs are highly dependent on the current state of the grids

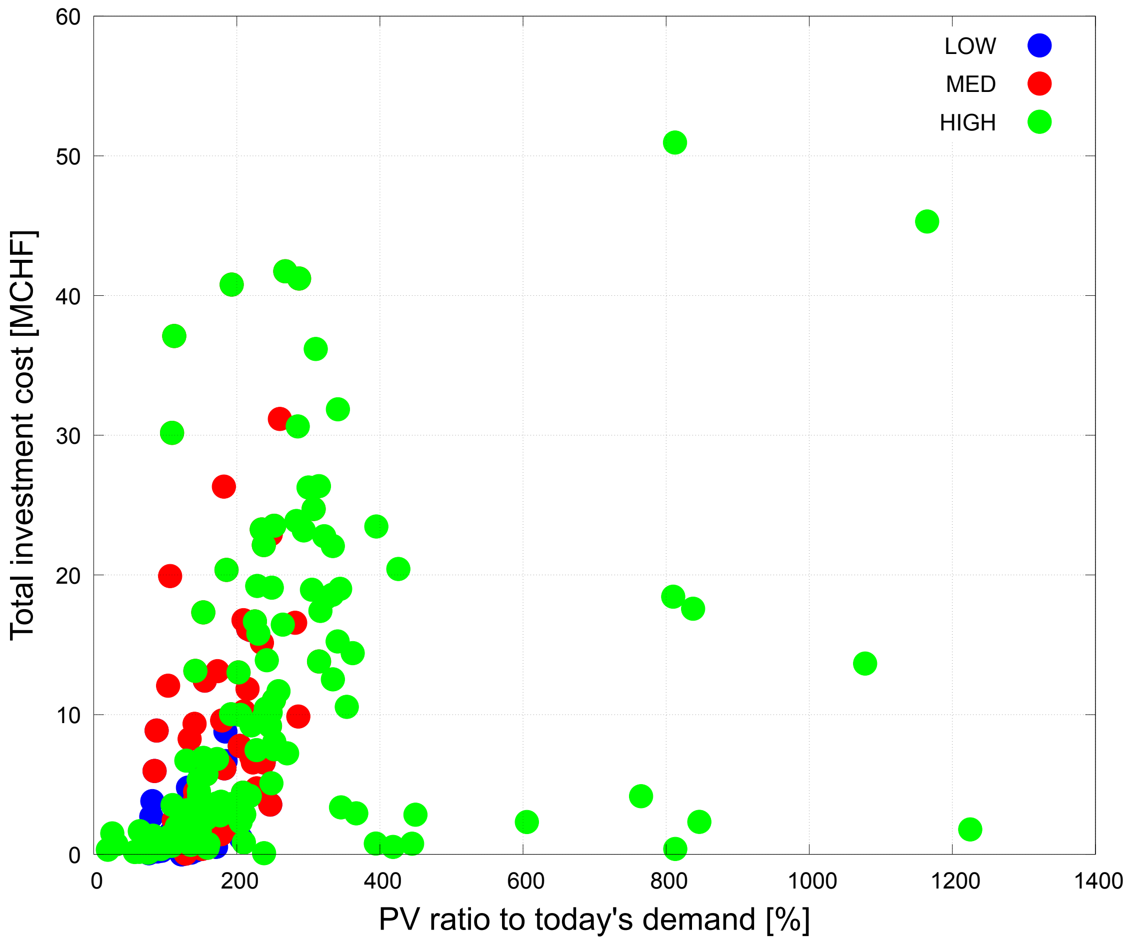
- Historically, **different investments** were made in different regions, leading to **different state of the grids**.
- Today's **cost-plus regulation** tends to lead to stronger grids
- The **average utilization of cables and transformers**, especially in low-voltage grids, is **30-40%** in many of the grids analyzed.



Main drivers of grid expansion needs without flexibility measures

In many areas, grid expansion needs are very much driven by PV

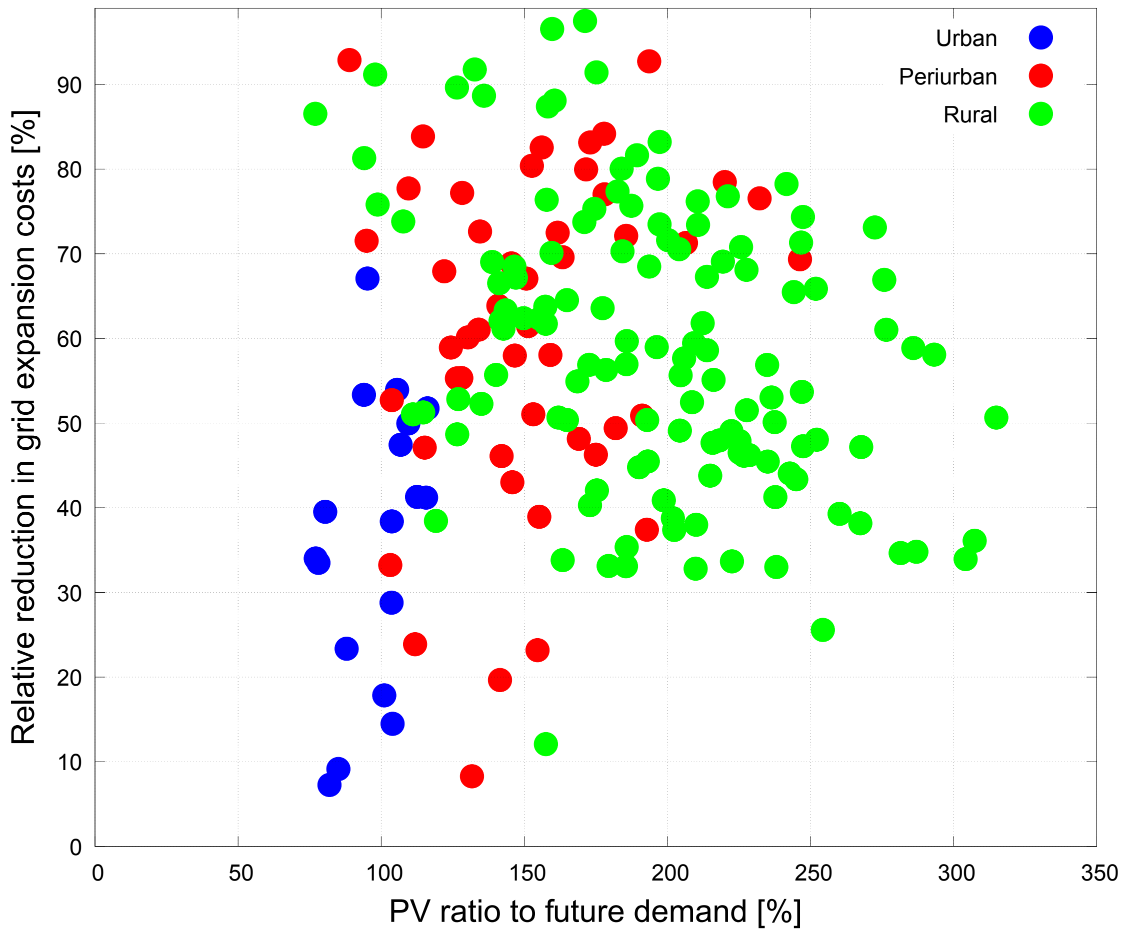
- Scenarios updated with Mantelerlass show **very high PV expansion**
- In many regions, there is **high solar feed-in to the higher-level grids**, which is greater than the respective power flow **during peak load**.
- In general, the **simultaneity of PV systems** is also **higher** than that of the loads, which increases the effect of high PV capacities on grid loading and network expansion.



PV feed-in management

PV feed-in management significantly reduces the need for grid expansion

- **Limiting the PV feed-in at 70%** of the maximum injection would **significantly reduces the network expansion costs**.
- **Limiting the PV feed-in at 70%** of the of the maximum injection would account for **less than 3% of annual PV generation** in Switzerland.



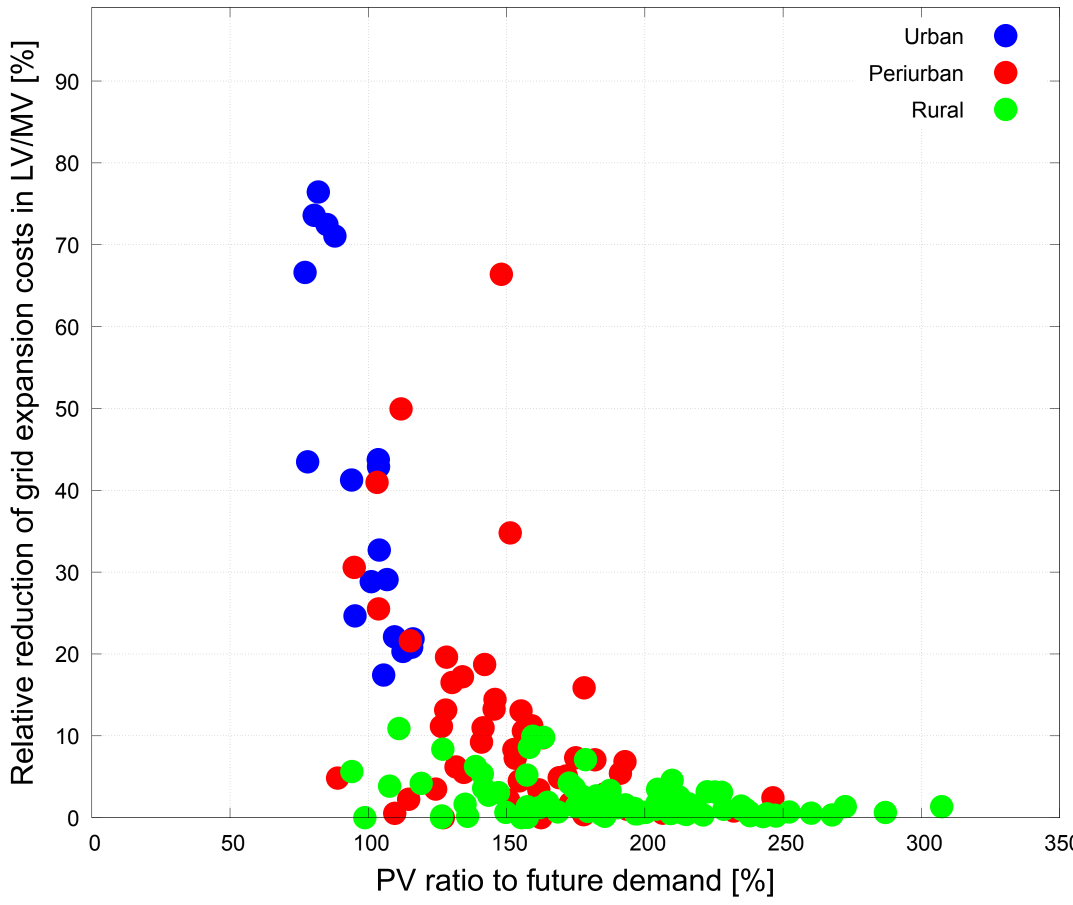
Demand-Side Management

Greater effect in urban than in rural or peri-urban grid areas

- In **urban grid areas**, the **effect** of demand-side active power management is **greater** because **the electrification of demand is an important driver** in addition to PV growth

- In **rural or peri-urban** regions, where **PV expansion is the main driver** of the grid investments, the **impact of demand-side management** by means of load shifting is **dampened** because the grid has to be already expanded due to PV feed-in.

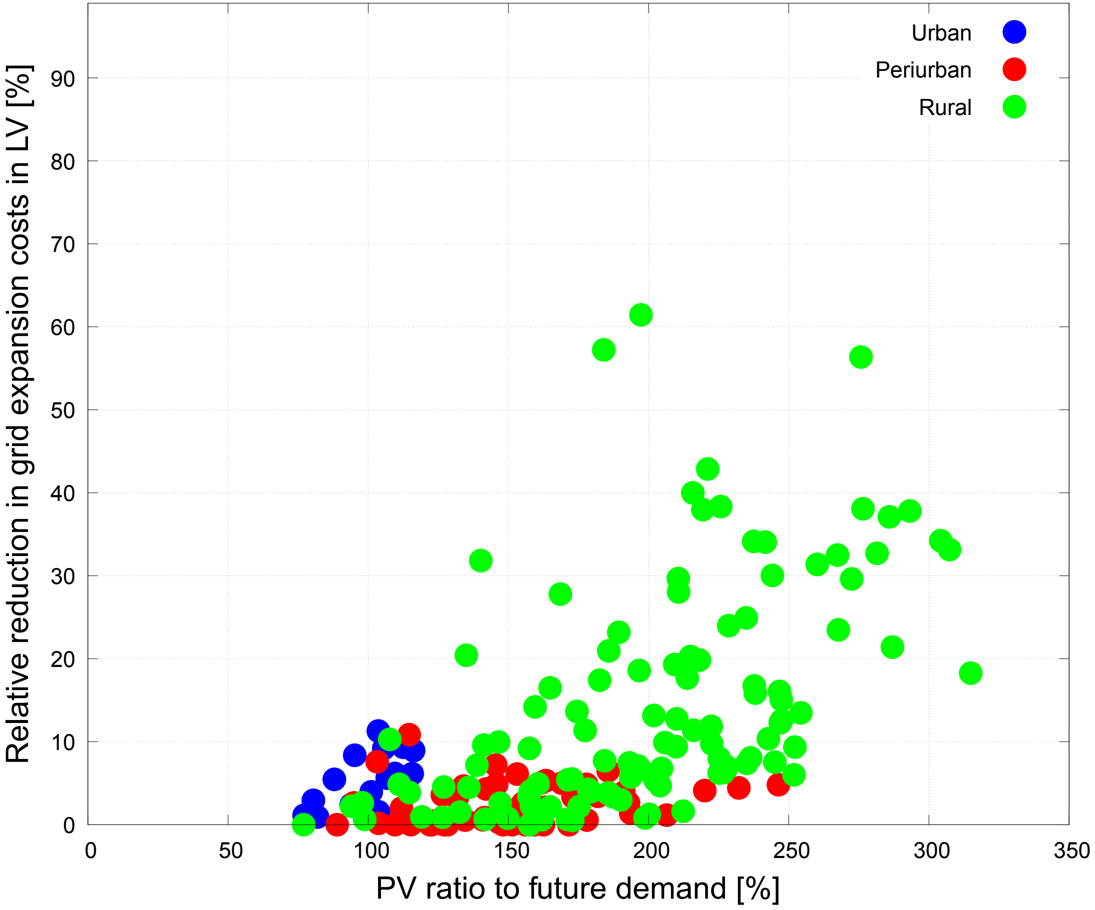
- **Shifting the load** to the time instants of **maximum PV feed-in** will significantly reduce grid expansion costs.



Voltage-Regulating Distribution Transformers and Reactive Power Control

VRDT combined with local Q(U) Control targeted measure for voltage support

- **VRDTs shift the voltage as a whole** in the respective sub-area of the LV grid but have **no influence on the voltage differences**.
- **Local reactive power control** is an **efficient measure** when **high voltage differences** occur in an LV grid.
- **Reduction of grid expansion costs** in the LV-grids by up to **60%**, particularly in **rural grids**, and by up to **15% in urban grids**.



Recommendations

Support flexibility, as it reduces grid expansion costs

- **PV feed-in management** is the most effective approach to reduce grid expansion costs.
- **Demand side management** through adapted customer behaviour and digitalisation helps reducing also the grid expansion costs.
- **Converter-interfaced distributed systems** such as PVs should be equipped with Q(U) control to mitigate voltage problems.
- **VRDTs with V(P) characteristics** should be used to mitigate voltage problems at feeder level.

Photovoltaic feed-in management by limiting peak power, operating photovoltaic-battery systems in a grid-friendly manner, or **shifting flexible demand** to peak photovoltaic generation times can significantly reduce the need for **grid expansion.**