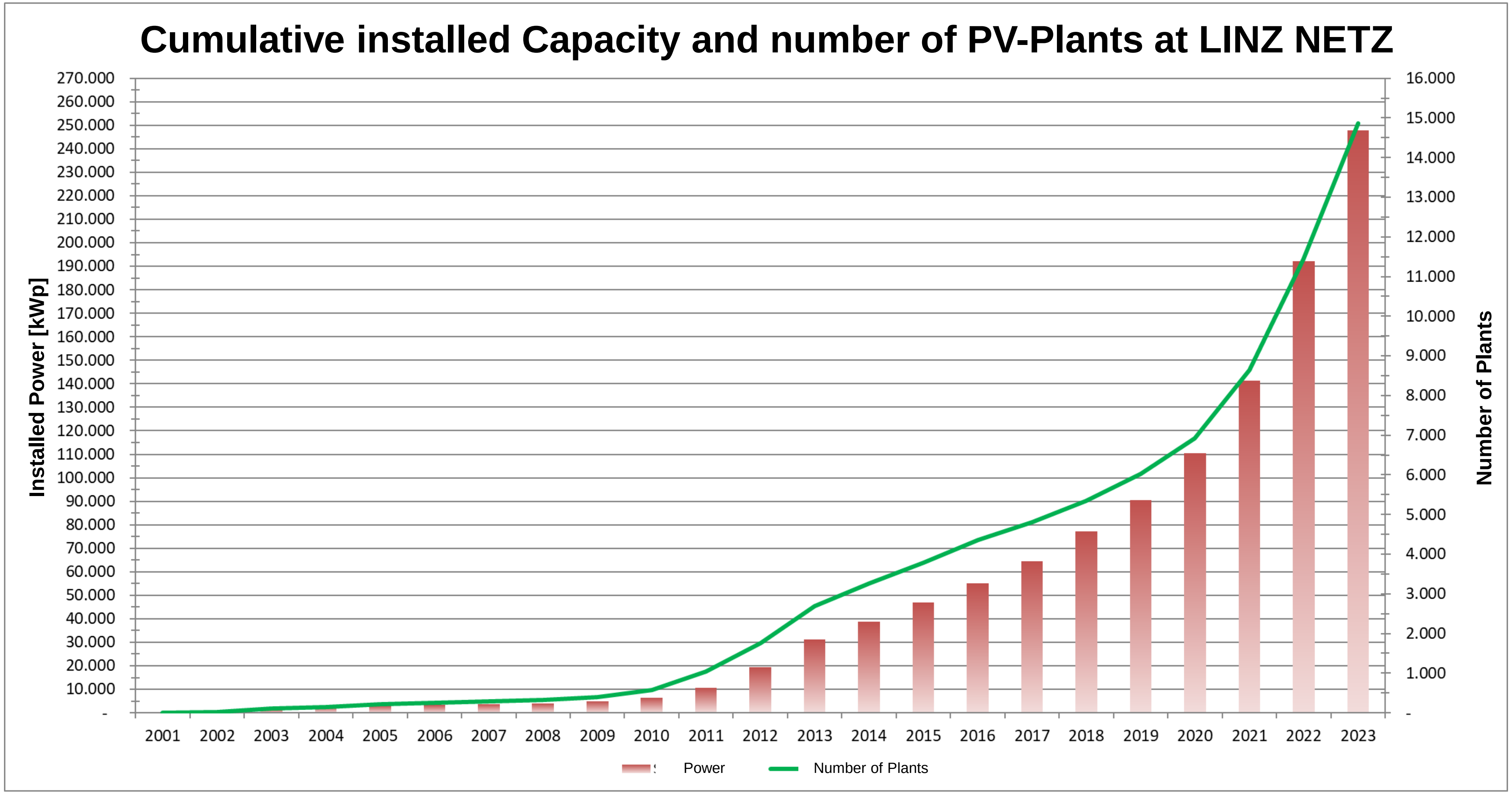
Ways to solve DSO capacity bottleneck issues

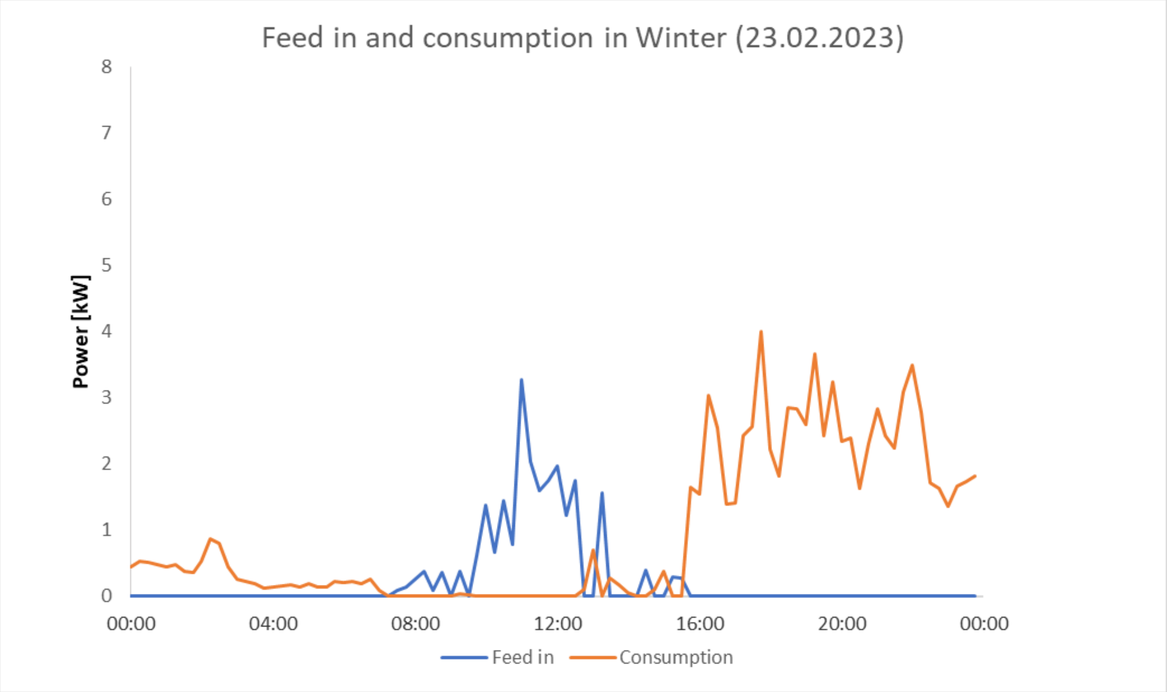
Johannes Zimmerberger

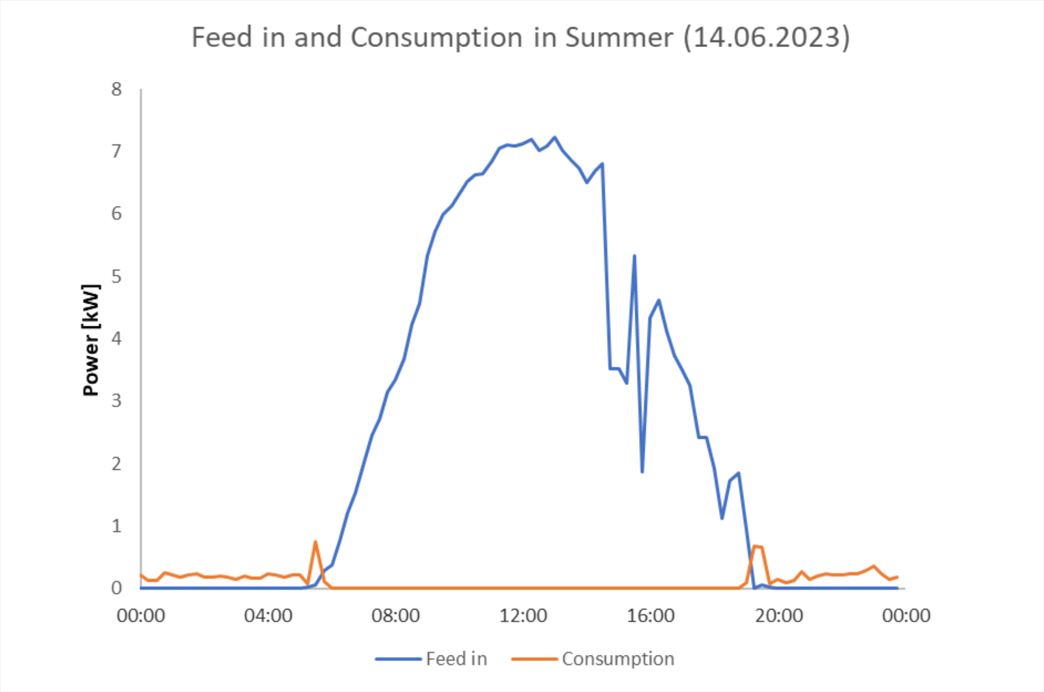
Number of PV-Plants increased rapidly at LINZ NETZ GmbH and other DSO´s



Austria: 5.5 GW installed Capacity + 200 MW/month

How customer behaviour changes after installation of a PV-plant:





Peak-load of consumption stays nearly constant
Peak-load of feed in exceeds thus of consumption
Peak-load is relevant for the dimensioning of the grid

Withdrawal from the network [kWh] is reduced by 30 to 50%
Grid-tariffs are predominantly kWh-dependent, so there is no incentive to reduce peak-load

Possible capacity bottlenecks / issues caused by PV-Plants

"Electrical Current Issues":

Current fed in by PV-Plants exceeds installed capacity of transformer, cable or overhead line

"Voltage Issues":

Increase of voltage driven by PV-Plants exceed the permissible limits

"Power quality Issues":

Inverters cause inadmissible flickers or harmonics

Power outage caused by PV-Plants near Steyr:

OÖNplus WIRTSCHAFT

Zu viel Solarstrom eingespeist: Stromausfall in ganzer Ortschaft

Von Alexander Zens, 11. August 2023, 13:37 Uhr

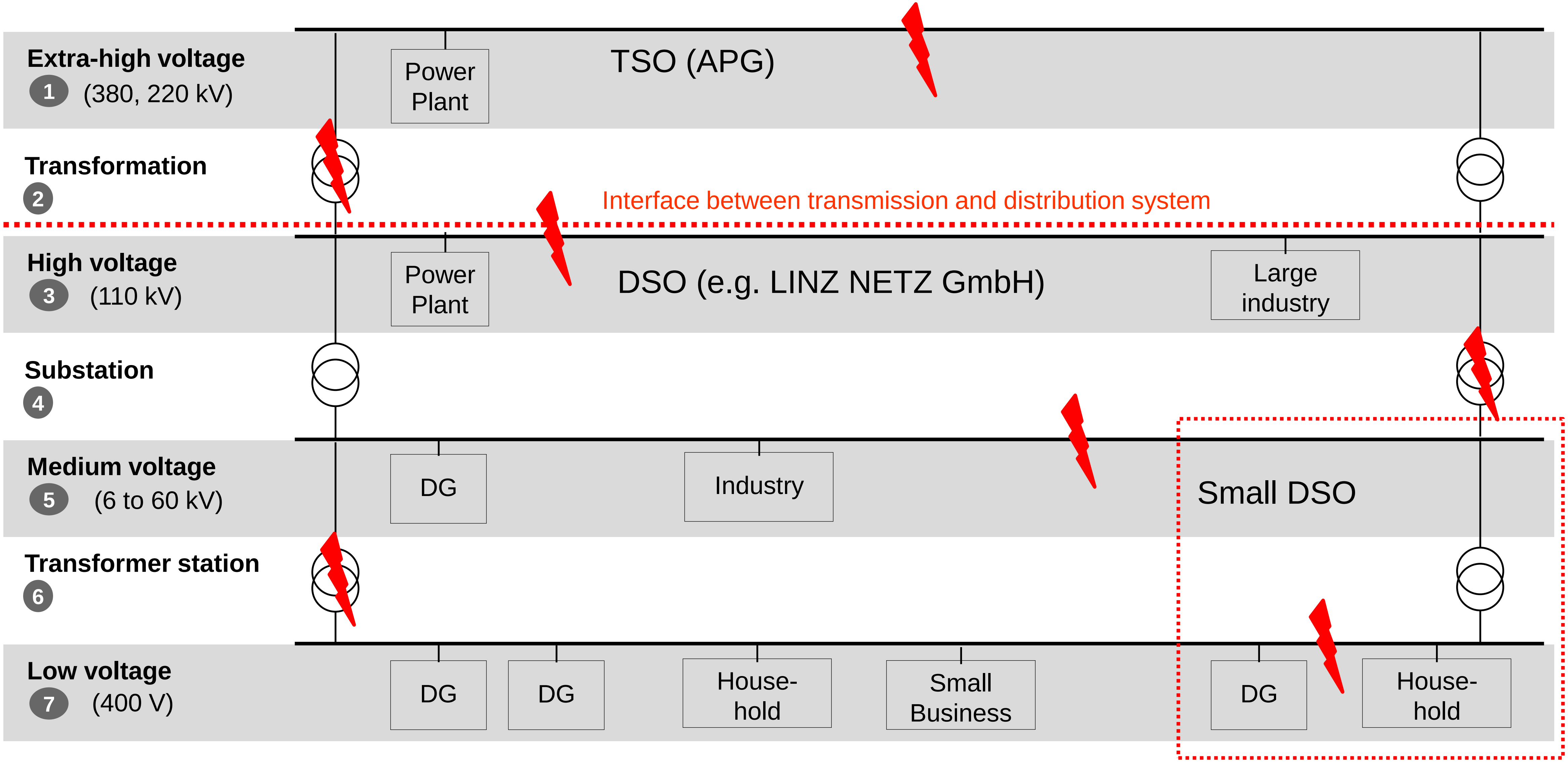
(Symbolbild) Bild: Marijan Murat (Deutsche Presse-Agentur GmbH)

STEYR. Wegen eines Vorfalls im Bezirk Steyr-Land verschärft die Netz OÖ die Kontrollen bei Photovoltaik-Anlagen-Besitzern im ganzen Land.

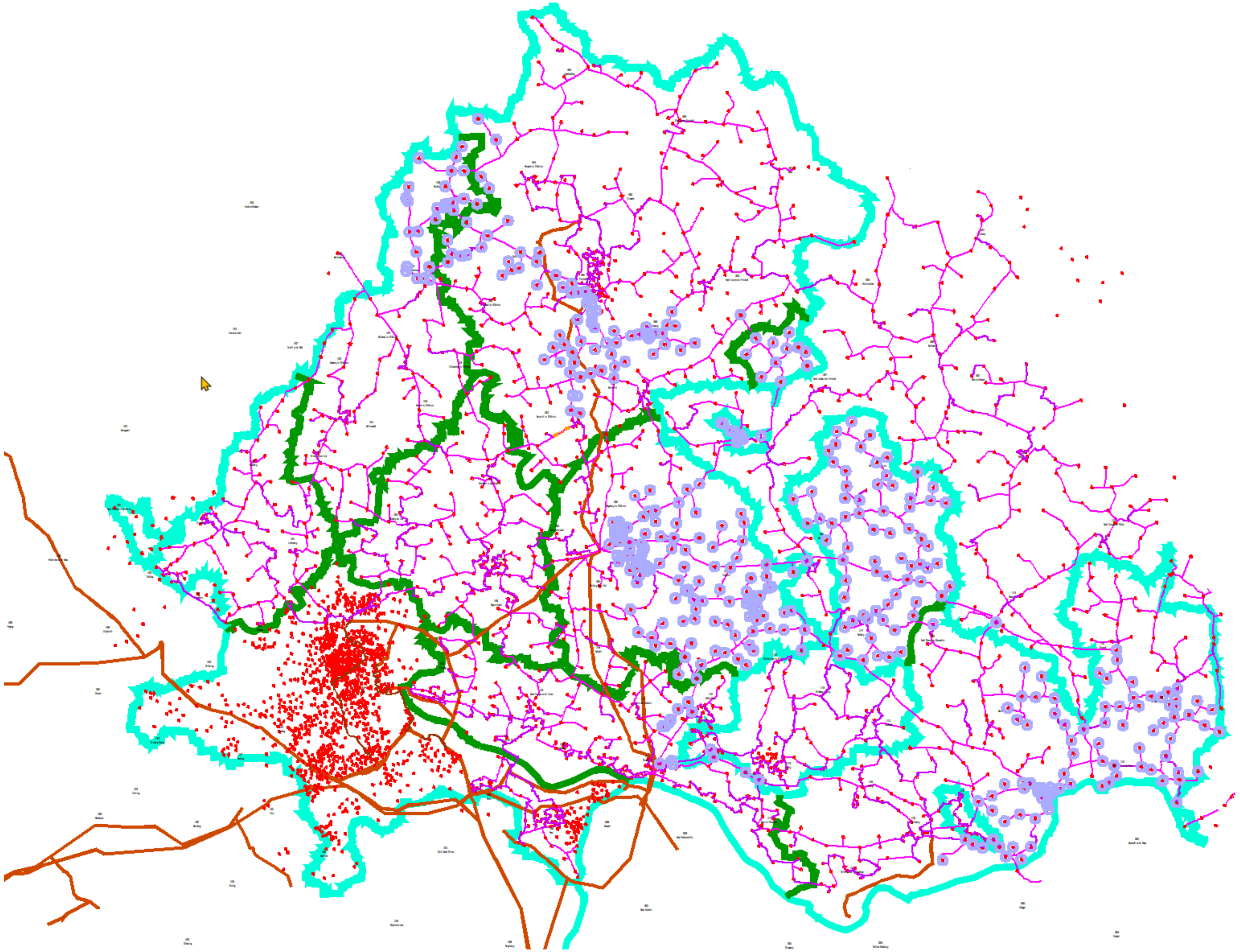
What happened?

- In the area of a transformer station, several customers with a PV-Plant were limited to 4 kW feed-in power due to a bottleneck.
- Such a limitation is made on the inverter and allows the construction of a system with a larger module output, e.g. for own use.
- In this specific case, the limitation was lifted again and therefore the plants fed into the grid with a significantly higher power. This led to an overload of the network and a protective tripping of the fuse elements.
- The result was a power outage in a settlement with 150 households and businesses.

Bottlenecks can occur in any part of the grid:



Parts of the MV-grid @ LINZ NETZ with critical voltage increase



- In these parts, feed-in power is limited to the contracted right for consumption right or 0 kW
- This limitation can only be lifted after the network reinforcement has been completed
- The implementation of these measures may take up to several years

Remedy for the customer:

- Installation of a storage

Possible ways to address capacity bottlenecks

Reinforcement of the network:

- ✓ Construction of additional feed-in points (substations, transformer stations)
- ✓ Reinforcement of existing substations and transformer stations
- ✓ Construction of additional lines (mainly cables)

Reduction of grid-effective power

- ✓ Incentives for “grid friendly” behaviour
- ✓ Use of flexibilities (storage, load management)
- ✓ Dynamic limitation
- ✓ Permanent (static) limitation

Examples for reinforcements carried out last year:

Substations:

- Increase of transformer capacity in several substations
- Construction / renewal of 2 substations

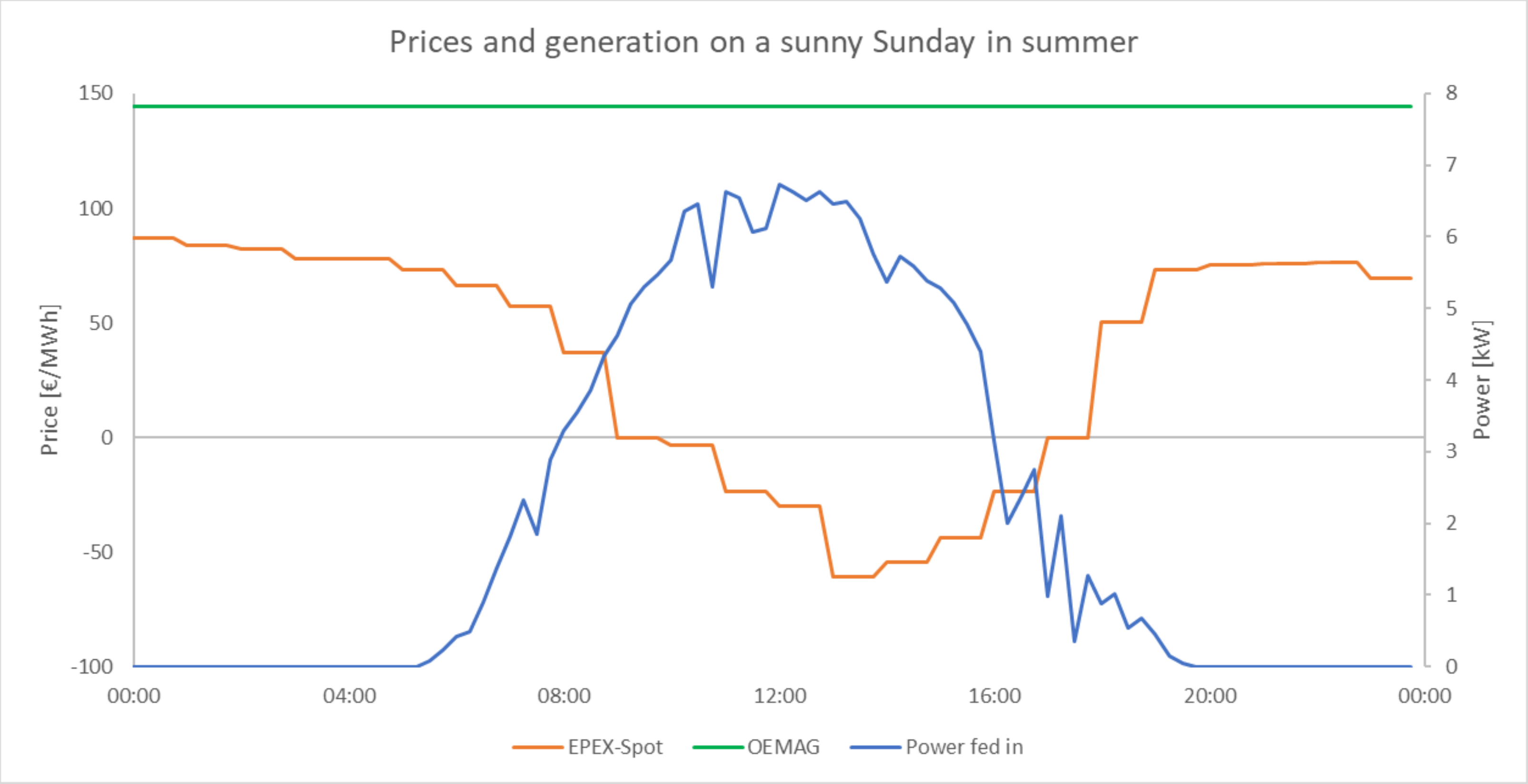
Transformer stations:

- Construction or increase of transformer capacity in 55 transformer stations

Other reinforcements:

- 64 medium-voltage projects
- > 500 low-voltage projects

Due to the current situation on the energy market, there are no incentives to cut peaks (“grid friendly behaviour”)



Research project on dynamic network tariffs

Issues Addressed

What **lead time** do consumers need to be able to take advantage of tariff incentives? In what form should the information be provided? Is the long-term nature of rigid high-low tariff times preferable to tariff with a 12-hour lead time in terms of control effect and consumer acceptance, or is the possibility of being able to react dynamically to grid and weather situations better overall?

Predictability: Grid tariffs that vary dynamically depending on weather and/or load situations are particularly effective when the effect on consumption or peak loads can be easily predicted. What fluctuation ranges can be expected in the effects and do they actually allow the grid operator options for action?

Does the **total amount** of electricity consumed remain the same in the case of tariff incentives to increase/decrease loads (rebound effects)?

Customer acceptance and concerns?

What **technical and administrative requirements** (e.g. data access) are necessary to offer services (prerequisite for services)?

Flexibility and automatic grid control

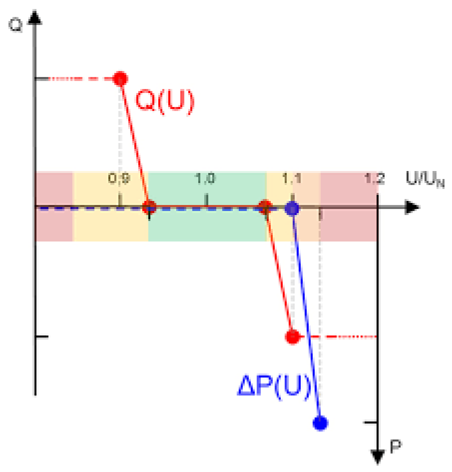
In addition to an incentive system for grid customers to behave in a “grid-friendly” manner via suitable tariffs, there is also a need for flexibility for grid operators to cut peak loads and reduce simultaneity.

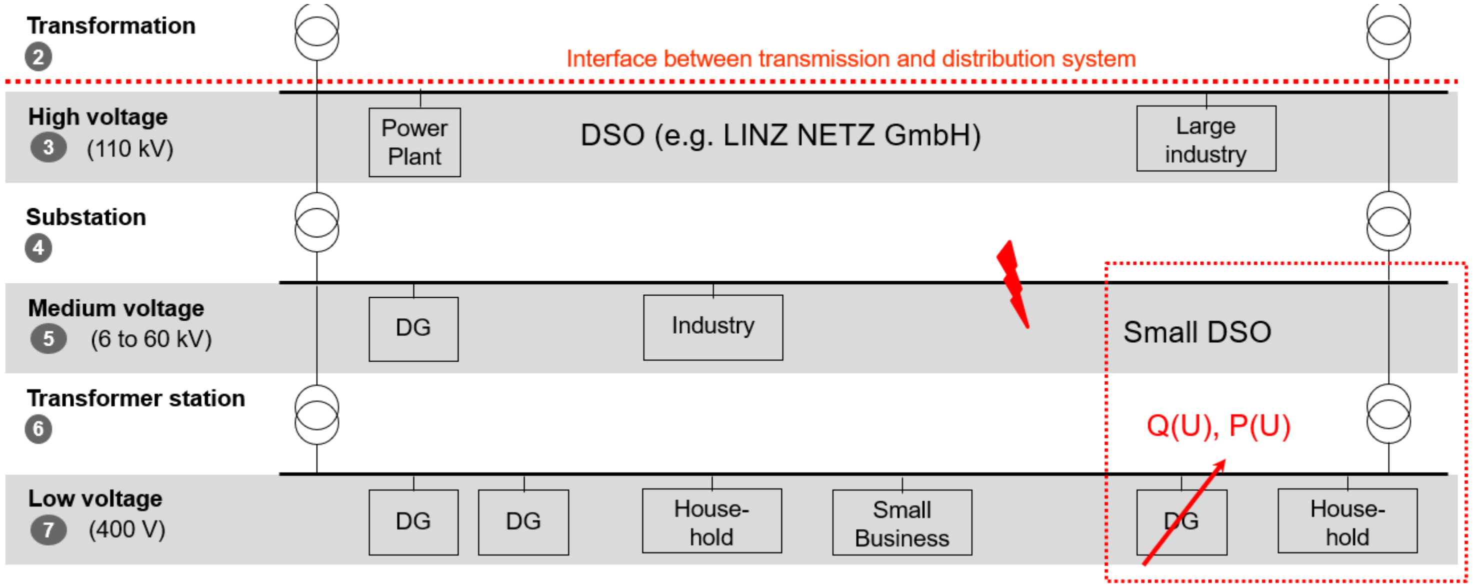
Examples:

- Loads that have a high degree of simultaneity "uncontrolled" (e.g. heat pumps, electromobility), but whose grid-supportive control is possible with little or no loss of comfort
- Storage for the reduction of peaks in the supply and feed-in direction
- Operational specifications for generation plants (for plants > 250 kW already dynamically possible, for smaller plants only static)
- Automatic control concepts (e.g. Q(U) / P(U)-Control) – but limited applicability, additional network codes needed

Standards for a "digital grid customer interface" are currently being developed in order to be able to dynamically control further producers / consumers

Limits of automatic grid control concepts





Q(U) / P(U) - control

Reactive and active power are controlled dependent on voltage by the inverter

Q(U) / P(U)-control in LV-grid may not address bottleneck in MV grid

Bottlenecks at all voltage levels have to be considered
Data exchange between all market participants have to be defined
Rules (e.g. Network codes) have to be defined

Conclusions

- PV-Boom causes a lot of bottlenecks at all voltage levels
- Grid reinforcements can not always keep up with the pace of PV expansion
- Affected customers have to be involved in solving the problem (information, incentives, …)
- Automatic control concepts must take bottlenecks into account at all voltage levels ➔ Project “Digital Interface”
- Information needs to be exchanged between all relevant players ➔ Austrian EDA can be used
- Rules and grid codes have to be defined

Thank you for your attention!

Questions?

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