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Technology Platform Smart Grids Austria

Battery storage as a new asset type for distribution grid operators in the Austrian market model

The European Union's Clean Energy Package has opened up a discussion of how to facilitate the connection of new distributed storage systems to the power grid. To this end, it is necessary to develop the (regulatory) framework for increased use of distributed electricity storage amongst other measures.

The objective of this position paper is to describe the advantages of the use of battery storage systems in the distribution grid. The term 'battery storage systems' refers to systems consisting of a battery and the converter required for charging and discharging (Appendix 1). In particular, these systems enable a larger share of distributed renewable generation units and charging infrastructure for electric vehicles in the distribution grid. This supports a more efficient grid operation as well as a grid design suited to the requirements of the energy transition.

The handling of tariff definition and taxes as well as the consideration of possible business models are not covered by this position paper, which focuses on the nature of the future framework conditions (Appendix 2).

Starting Point: The special status of battery storage systems

Pump storage power plants, which support the high level balance between energy generation and consumption, have long played a central role in the electricity system. However, these are insufficient to solve the new challenges of the energy transition at the low and medium voltage levels. As a result of continued technical developments and rapid price reductions, battery storage systems are now considered as valuable assets for local balancing between volatile distributed generation and the changing behaviour of consumers.

On the Austrian power market, battery storage is currently viewed as a consumer during the charging process and as a supplier (generator) during discharging. At present, the power market model does not stipulate a separate role as storage asset. Since the introduction of the 'Internal Market in Electricity' Directive and its national implementation in the 'Electricity Industry and Organisation Act', a separation of grid infrastructure and generation (unbundling) has been mandated by law. Power grid operators are currently not permitted to own any storage systems as long as these are classified as generation units.

Use cases for battery storage in the distribution grid

For grid-supporting use at the low-voltage level, storage assets in the performance class of up to a few hundred kilowatts are required. Together with suitable automation components, the distribution grid operator can use such systems to plan and operate its grid such that local energy surpluses (e.g. due to photovoltaics) do not result in overloading of the grid and such that peak loads (e.g. due to charging demands from electric vehicles) can be significantly reduced or even avoided altogether by local battery systems. Grid-supporting battery storage systems at local level, and with higher penetration at regional level, can significantly contribute to a reduction of (peak) loads at higher grid levels. Ideally, they enable more efficient utilisation of existing grid infrastructure while at the same time providing a technical platform for new energy products and services in energy trading. The necessary framework conditions are described below.

The new role of "storage assets" analogous to gas storage

The existing definition for storage in the Austrian gas market model should serve as a basis and be applied to electricity storage as well (Appendix 3). It is suggested that a strict market-compliant separation in terms of the offering of storage capacity as an infrastructure service and the energetic utilisation of the grid storage be applied to battery storage systems. The grid operator offers available storage capacities to the actors on the energy market (e.g. grid customers, prosumers or aggregators)

under the premise of supporting the grid. For example, these could be realised as local community storage systems in the sense of a local cloud solution for home owners, flat owners and tenants.
As a mandatory prerequisite, the energy does not change owners upon storage and retrieval and the market side remains unaffected. On this basis, battery storage systems should be introduced as a new asset type for distribution grid operators (storage asset). Market design requirements arising from this are described in more detail in Appendix 2.

Advantages and benefits of battery storage systems as asset for distribution grid operators

- **Customer benefits**

The ownership and operation of storage systems at low-voltage level by distribution grid operators enables prosumers to use storage systems in a similar way to ‘community generation systems’ or ‘citizen solar systems’ without owning them. This de facto places flat owners or tenants on equal footing with building owners, who today are already able to operate their own generation systems and storage systems. Tenants can now fully participate in the energy market by purchasing or leasing renewable generation and storage capacities.

- **Distribution grid operators**

Assumed that distribution grid operators are permitted to operate and own storage systems as grid-supporting assets in the future, they can determine the optimal asset location according to technical and economic criteria and optimise their grid planning activities. Distribution grid operators thereby acquire a tool for more efficiently resolving or avoiding local problems such as ensuring voltage stability in the event of increased power supply to the grid or short-term grid overloads. This allows for a more effective use of existing infrastructure and an optimisation of required grid expansions.

- **Improved efficiency of the entire energy system**

Optimised local balancing at distribution grid level leads to a reduction of power flows transporting ‘local excess’ energy to higher grid levels. Subsequently, balancing power flows at transmission level can be reduced. In addition, the required digitalisation at lower grid levels makes significantly more information available with regard to grid load and forecasting, which simplifies dispatching at transmission grid level.

Recommendations for shaping the framework conditions

- Legislative anchoring of battery storage systems as storage asset for distribution grid operators
- Enable distribution grid owners to own storage assets as an integral part of their grid infrastructure and to operate them in support of the grid
- Definition of an expanded framework for designing the grid tariff model and grid compensation system for feeding energy into and withdrawing it from storage systems in connection with billing for the provision of storage capacity at respective grid levels
- Development and recommendation of funding schemes for the installation of distributed generation systems combined with storage assets for the optimisation of local generation and consumption

Recommendation regarding the next steps

Initiation of the process of developing an Austrian position in collaboration with the decision makers. The technology platform offers to take on the role of organising the process and to provide the resources and expertise of its members.

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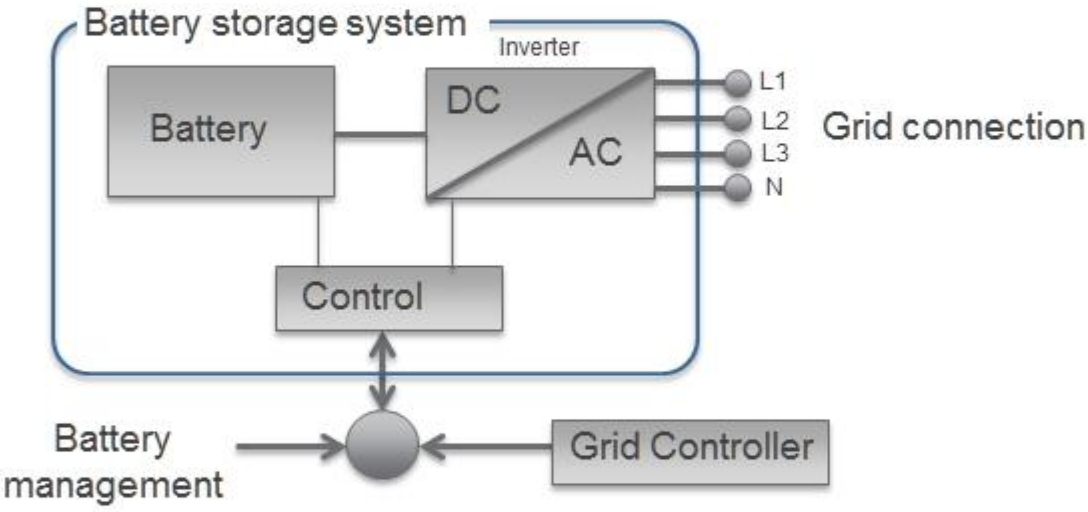
Appendix 1: Application scenarios for local power storage systems as asset in the distribution grid

Appendix 1 describes the technical details of possible scenarios for the use of battery storage systems in the distribution grid as well as requirements for battery storage systems that are suitable for grid-supporting operation.

Basic application:
De facto energy-neutral grid-supporting use of storage assets

In this use case, the batteries can be loaded over short periods. The resulting energy exchange is so small, however, that the nominal storage capacity is hardly reduced. The battery is offered to third parties for utilisation without consideration of a “local energy community approach” as described in the next section. Alternatively, a converter design is possible in which the battery is replaced by special capacitors so that only the potential grid-supporting benefits are available.



<u>Potential grid-supporting benefits of the storage asset:</u>

- Reactive power management (voltage stability, avoiding unintentional inductive and capacitive reactive power flows) and utilisation for system operation
- Provision of short-circuit power
- Compensation for voltage drops as a service for customer systems with elevated requirements (e.g. semiconductor industry)
- Grid balancing

Extended application:
Smart grids or local energy community approach: Coordination of local generation coupled with local consumption

For better utilisation and improved profitability of the storage asset, third parties should be enabled to use the storage asset in support of the grid. This use case is targeted to a technically isolated low-voltage grid region that is supplied by a transformer station. The battery storage is dimensioned such that it can take up most (ideally all) of the local excess energy supplied to the grid by prosumers. This energy will then be returned to the respective prosumer (without change in ownership) An additional criterion for the necessary storage capacity can be the resulting peak load of home charging stations, which must be effectively balanced at the local level.

In order to promote grid-supporting storage utilisation by third parties, including the bundling of available short-term storage capacities by aggregators into a cloud, the following steps are required (similar to the community generation system):

- The coupling of local generation with local consumption within a low-voltage branch, through storage assets provided by the grid operator must be more cost-effective for prosumers than alternative solutions (e.g. own home storage).
- The provision of higher charging outputs for electric cars can require the leasing of local storage capacities by prosumers.

Potential grid-supporting benefits:

- Reactive power management (voltage stability, avoiding unintentional inductive and capacitive reactive power flows) and utilisation for system operation
- Provision of short-circuit power
- Compensation for voltage drops as a service for customer systems with elevated requirements (e.g. semiconductor industry)
- Reduction of grid expansion costs at higher voltage levels
- More efficient utilisation of existing infrastructure
- Short-term coverage of prosumer growth through storage until the grid is upgraded (in cooperation with the respective energy supplier by means of temporary contracts, e.g. in the event of a rapid increase in the number of charging stations / PV systems)

Additional potential benefits

- Placing home owners and flat tenants on equal footing: The latter cannot in fact install any systems but can participate in 'community PV systems' and lease corresponding storage capacities. Additional trading processes are avoided; the energy always remains with the same owner
- Promotion of distributed structures: The share of energy from distributed generation units that must be shifted to the transmission grid can be noticeably reduced
- Balancing of PV generation peak loads at the local level
- Avoidance of distributed generation curtailment due to transformer overload or an overload in the medium-voltage grid
- Higher flexibility for distribution grid operators in grid expansion and investment management
- Aggregation of available storage capacities for utilisation on the energy market

Requirements for storage equipment

Technical and functional requirements for battery storage systems:

- Consideration of the requirements of the Network Codes for TSOs and the DSO grid connection conditions according to TOR D4:
  - Q(U) control at the distribution grid level (TOR D4)
  - Low-voltage-fault-ride-through (TOR D4)
  - Q=f(P,U) and/or cosφ=f(P,U) at the TSO-DSO interface
  - Emergency & Restoration Code: Frequency-dependent load adjustment
- Equal to PV systems (requirements for inverters)
  - 3-phase design (TOR D4)
  - Q(U) and/or P(U). P(f) (TOR D4)
- Power quality support

Examples of possible use cases for battery storage systems in the distribution grid:

- The owner of a PV system stores his excess production in a local grid storage system. Upon request, the energy is returned to him later.
- The grid operator offers available storage capacities to energy supplier, provided a grid-supporting operation. The energy supplier can manage and use these capacities accordingly and aggregate them in order to supply control energy.
- New storage capacity for the grid losses balance group for optimising the energy management and reducing costs

Appendix 2: Framework conditions and market model

The introduction of battery storage systems as new asset for distribution grid operators requires an accompanying market design that promotes use of these systems in support of the grid.

Requirements for the market model:

- The leasing of local storage capacities for local (excess) production must offer holistic economic advantages for the producers (costs for storage capacity, grid fees for storage management, taxes and fees)
- Introduction of general incentives for the installation and potentially the marketing of local generation systems combined with local storage systems
- To keep peak load problems to a minimum and restrict them to a small grid section at low-voltage level while leaving the higher grid levels unaffected, the following approach is suggested. Customers, who generate substantial load peaks and for whom the existing upstream grid capacities are no longer sufficient, should be enabled to buy previously deposited energy from energy traders. This energy required for covering peak loads is deposited by energy traders in local grid storage systems in advance and over extended time periods so as to reduce grid overload during the charging process.
- This scenario is of particular value in the event of more widespread use of powerful home charging stations for electric cars.
- The metering points of the grid-supporting storage systems can be assigned to the grid losses balancing group, for example. In this case, the energy does not change owners during storage and retrieval, and no formal impact on the energy market exists in terms of the unbundling by distribution grid operators.

Appendix 3: Additional information on the legal framework of gas storage systems

As supplemental information, the following excerpts from the legal framework for access to gas storage systems are provided.

Negotiated access to gas storage systems

Storage companies must grant authorised storage users access to their systems under non-discriminatory and transparent conditions on a negotiated basis. The storage fees are not regulated (are not defined or approved ex ante by the regulatory authority); rather they are subject to a maximum limit (120% of the average of comparable storage products at the European level).

In the awarding of storage capacities, the awarding procedure must be selected based on the respective capacity situation: an auction must take place when the demand is higher than the supply. Otherwise, the capacities can be awarded on a first come, first served basis. In addition, the storage companies must enable transparent and efficient trading of secondary capacities or cooperate on the installation of a shared trading platform.

Furthermore, the storage contracts must contain measures to prevent the hoarding of capacity and establish the possibility of offering unused storage capacity on a day-ahead basis and at least subject to interruption.