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EVN Gruppe

The Smart Grid Battery Storage Project Prottes (Austria)

ETIP SNET
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VLEVA, Brussels, Belgium

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Based in Lower Austria.
Successful in Europe.

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EVN – Competence from Lower Austria
Energy business in six countries

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	Network	Electricity	Gas	Heat	'Hydropower	Wind power	Photovoltaics	Biomass	Thermal power
Albania					✓*				
Bulgaria	✓	✓		✓		✓	✓		✓
Germany		✓	✓		✓**				✓***
Croatia	✓		✓						
Macedonia	✓	✓			✓				
Austria	✓	✓	✓	✓	✓	✓	✓	✓	✓

* EVN share: 50%

** EVN share: 13%

*** EVN share: 49%

EVN – Competence from Lower Austria
Environmental services in 18 countries

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	Drinking water supply	Wastewater management
Bahrain		✓
Germany	✓	✓
Denmark		✓
Estonia		✓
Croatia		✓
Latvia		✓
Lithuania		✓
Montenegro	✓	✓
Austria*	✓	✓

	Drinking water supply	Wastewater management
Poland		✓
Romania		✓
Russia**	✓	✓
Serbia	✓	
Slovakia		✓
Slovenia		✓
Czech Rep.		✓
Turkey		✓
Cyprus		✓

* Thermal waste incineration, drinking water supply

** Thermal waste incineration

EVN Activities in the Field of Batteries

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→ PV-small scale battery storage

- 3kW/2,2 – 22 kWh (400V)
- proven products for EVN customers

→ Large scale battery storage

- 10kW/100 kWh V-Redox Flow Battery
- 2,5 MVA/2,2 MWh Li-Ion Battery storage system

→ E-Mobility

- Charging infrastructure
- Electric vehicles fleet test
- Electric vehicles in EVN´s vehicle fleet
- Research project MegaWATT (Logistics with E-trucks)

Integration of renewable electricity
Challenges and solutions using batteries

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Balancing generation and consumption:

- Flexibility options for generation and consumption
- Sector coupling (e.g. Power to Heat, Hydrogen)
- Storage (e.g. Pump storage, Batteries)

Shut down of large scale power plants (fossile fuel):

- Tasks of primary regulation and „spinning reserve“
  - → Batteries!

Voltage problems in low voltage grids (local area):

- PV panels on single family homes
- Solution: grid expansion
- Solution: technical components (adjustable transformer, linear regulator, voltage monitor control)
  - → Batteries!

Project goals

- Installation and test of a large scale Li-Ion Battery system in the distribution grid
- Integration of increasing shares of renewable power (wind, solar) into distribution grid
- Grid stabilisation, ancillary services, black start and island mode capabilities

Project „Smart Grid Battery Storage“ basic data

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- Lithium-Ion Battery (2,5 MVA / 2,2 MWh)
- Location: Prottes substation, Windpark Prottes
- Grid connection: medium voltage 30kV
- Compact container solution
- Project cost: approx. 3 Mio. EUR (without research activities)
- Installation: summer 2017
- Research project „BatterieSTABIL“, funded by the Austrian „Climate and Energy Fund“ (KLIEN)
- Research partner: Vienna University of Technology and Austrian Institute of Technology (AIT)

Li-Ion battery storage: Prottes substation, Wind park Prottes

Location close to wind park at Prottes substation

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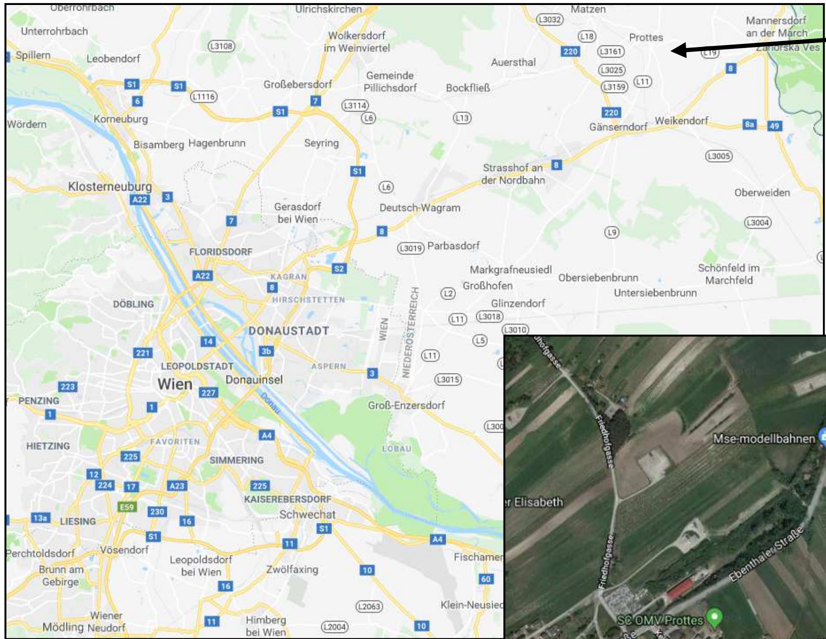

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municipality Prottes

Prottes substation

wind turbines Prottes

Battery storage

municipality Prottes

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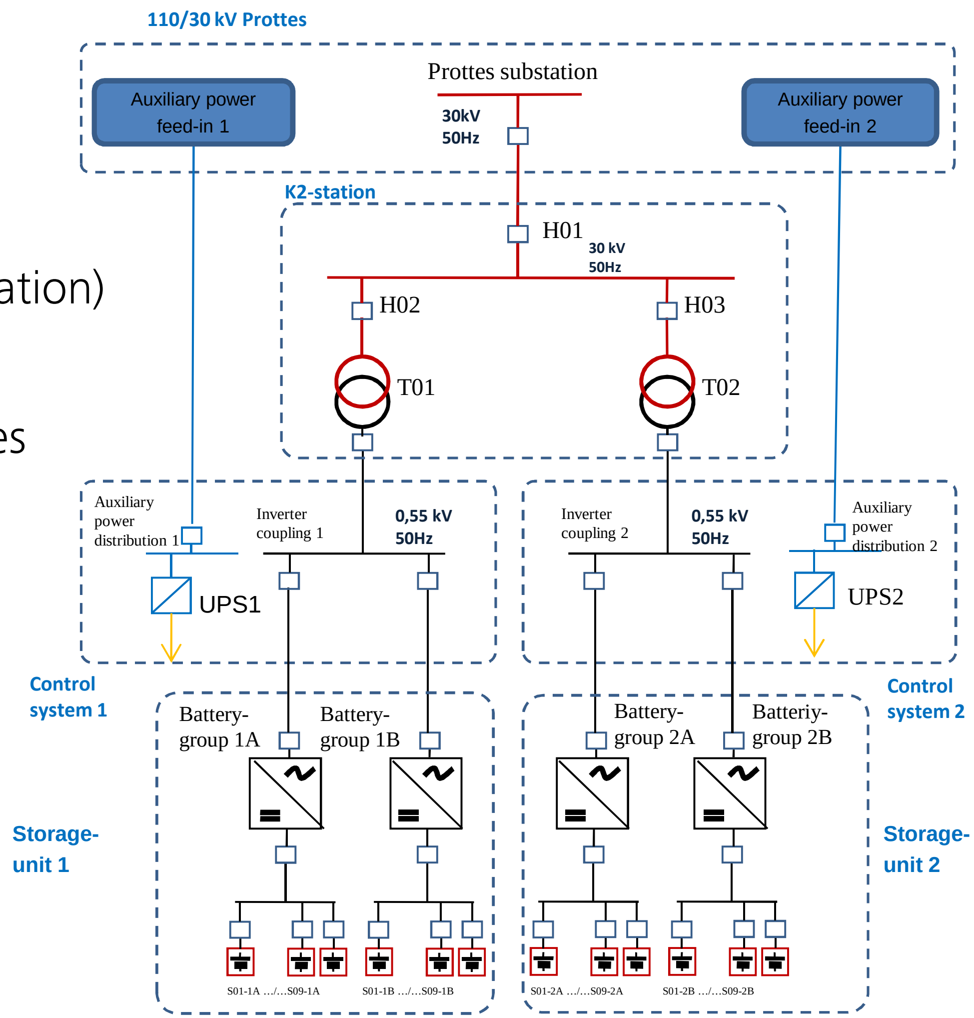
Design of battery storage system

Key data:

- 2,5 MVA circular
- 2,2 MWh (after 10 yr. operation)
- Lithium-Ion-cells
  14.112 cells in 504 modules
- 2 storage units,
  separately controllable
- 4 MW/s



Impressions

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Battery-container, Control-container, Transformer-station

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Battery-rack with Battery-modules

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Battery-module before installation

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30kV Transformer-station

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Functions

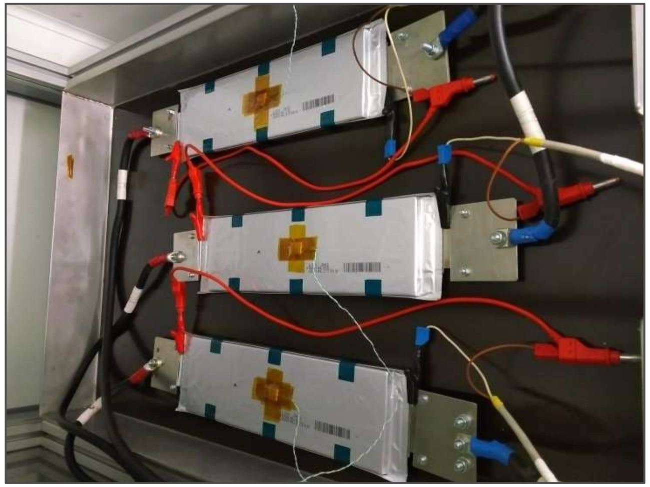
- „Peak Shaving“, scheduled operation (15“)
- Primary regulation
- Enhanced Frequency Response (EFR)
- Virtual Inertia
- Static voltage level maintenance
- Reactive power capability
- Low voltage ride through (LVRT)
- Active balancing between phases
- „Multimodale“ operation (functions simultaneously)

- Black start and island mode capabilities

Research project „BatterieSTABIL“ Detailed programme

- → Mathematical models (Vienna University of Technology)
  - – Offline simulation of functions
  - – Simulation multimodale operation
- → Laboratory tests (Austrian Institute of Technology)
  - – Characterisation of battery cells
  - – Laboratory tests of inverter unit
  - – Hardware-in-the-Loop (HIL) tests parallel to field tests
- → Field tests (Netz NÖ and Vienna University of Technology)
  - – Design of test program
  - – On-line Measurement equipment
  - – Execution of tests and data analysis
- → Business Models (Vienna University of Technology)
  - – Development of innovative business models
  - – Suggestions for a regulatory framework to encourage batteries

Laboratory tests



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Battery-cells at test bench

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Inverter unit at test bench

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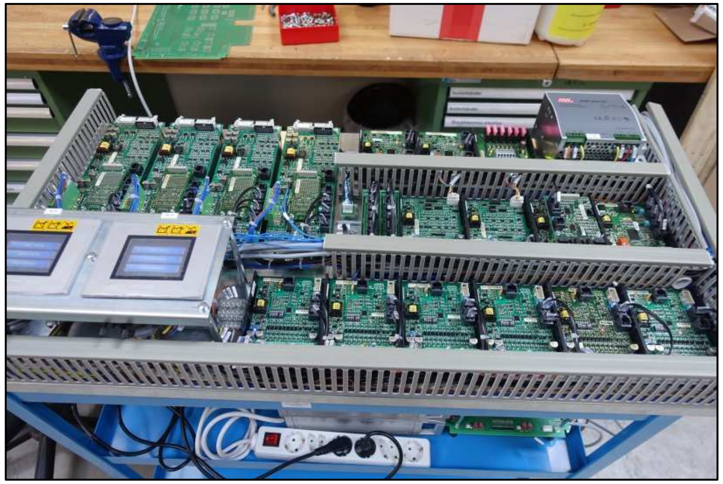

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Hardware-in-the-Loop (HIL) test rig

Project Key exploitable results

- Battery systems are available on the market, however suppliers focus on primary regulation and peak shaving
- Proven reliability of lithium ion battery system (High efficiency, low maintenance)
- Inverter technology is versatile for a variety of grid-stabilisation issues, key is the automatic control system as well as its control algorithms
- Key is the proper dimensioning of the battery system (power, capacity)

- CO_2 reduction possible due to higher exploitation of renewable energy sources during peak production at the same time benefiting the plant owner (no reduction of power due to over voltage)

Lessons learned and barriers to innovation

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- Considerable effort necessary to fully integrate batteries into the grid
- Regulatory framework does not allow batteries for grid operators
- Need for business models for new services like enhanced frequency response and virtual inertia to facilitate battery systems
- Improved profitability expected, if grid services and services for customers could be offered at the same time
- Still too high costs for battery systems for most use cases compared to traditional technologies in the grid
- Need to harmonize requirements by authorities (e.g. for fire protection)

Needs for future R&I activities

- Develop mobile solutions for temporary use cases
- Develop tools for system optimisation for high shares of renewables and different storage technologies (e.g. batteries, pumped hydro), interaction between different grid components
- Better knowledge about battery-ageing needed (micro cycling)
- Tools for optimizing power/capacity ratio for different use cases
- Optimizing systems with high shares of renewables as well as high numbers of electric vehicles (controlled charging)
- Grid stability of a fully decentralized system: high shares of renewables, interaction between large scale battery systems, behind-the-meter batteries, vehicle-to-grid, …

Needs for further testing

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- Close collaboration between grid operators and battery system developers necessary
- Interaction between battery systems and the grid
- Short circuit current capability during island operation
- Prediction tools for grid stability taking into account high shares of renewables, high numbers of electric vehicles and battery systems
- Testing of reliability of low cost battery systems (e.g. salt water battery)
- Develop control algorithms for different use cases

Battery storage

Integration of renewable electricity using electricity storage

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- Integration of renewables and decentral generation requires
  - Battery operation in order to supply consumers with electricity fulfilling security of supply
  - Battery operation for technical purposes for grid operation in order to ensure stable and cost efficient grids

- Future framework for storage operation
  - Installation, ownership, operation and management of storage systems
    - Retailers: new business models for customers (combination with PV, aggregation, e.g.)
    - Distribution System Operators: voltage level, reactive power control, e.g.
  - Incentives to reduce peaks in the system (e.g. balance between load- and consumption-tariff)

- Thermal power plants ensure security of supply as long as batteries with sufficient capacity will be available.
  - Increasing share of renewables lead to higher demand of backup-capacity and storage systems

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