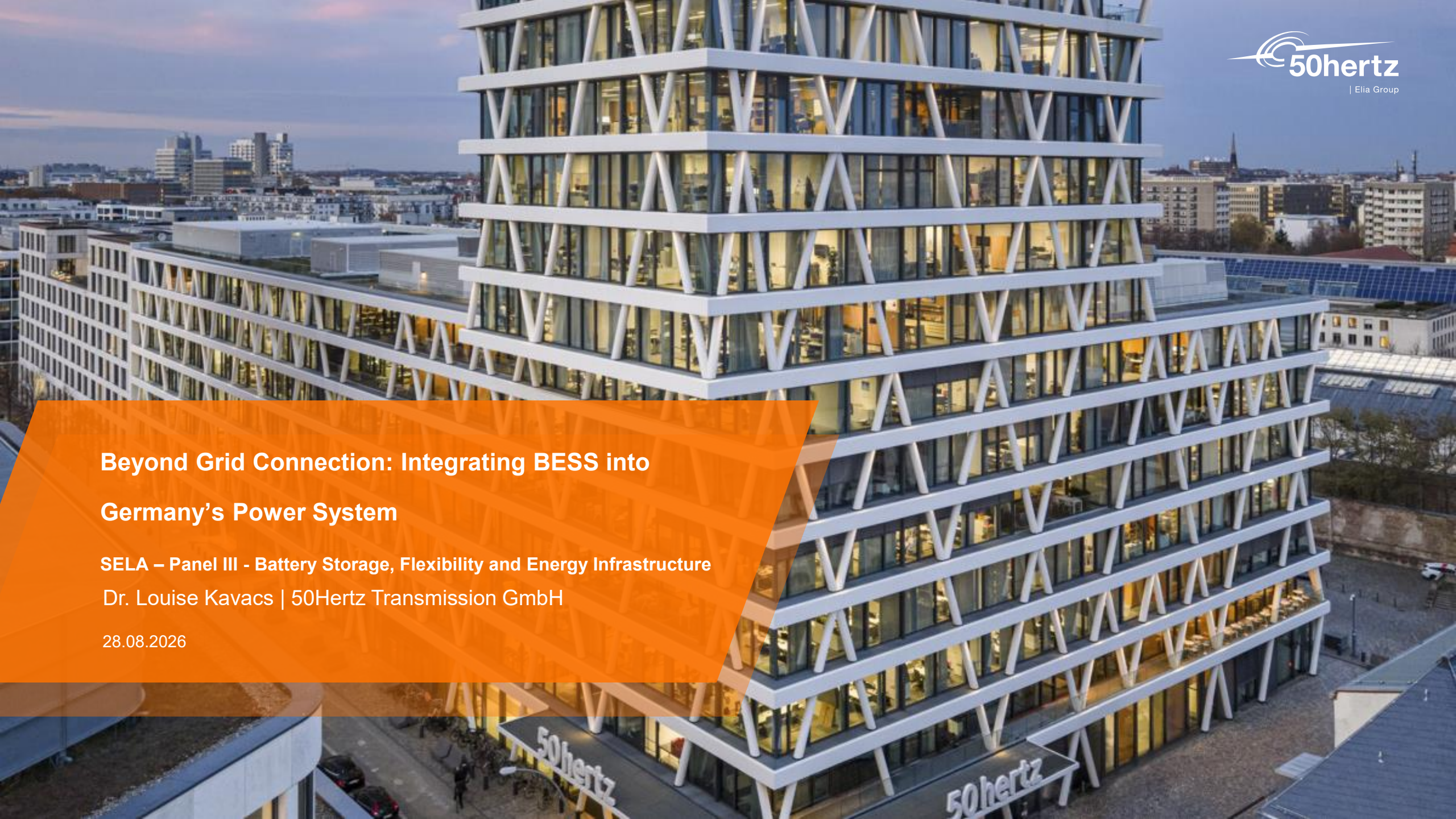

Beyond Grid Connection: Integrating BESS into Germany’s Power System

SELA – Panel III - Battery Storage, Flexibility and Energy Infrastructure

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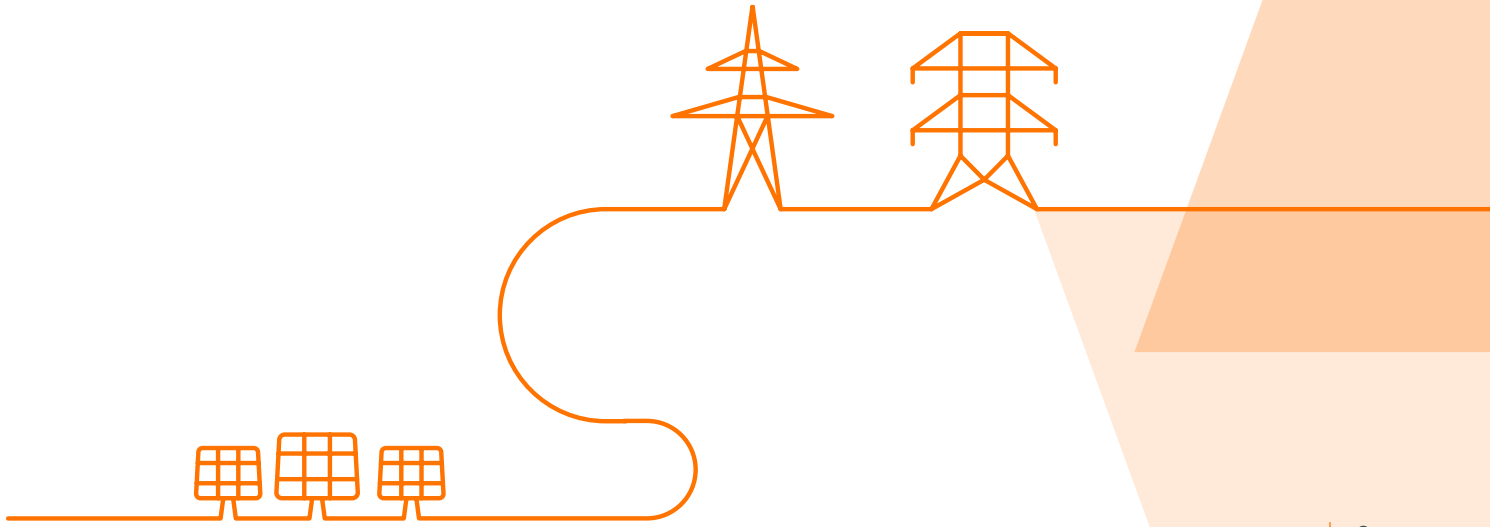
Agenda

1. Short introduction: 50Hertz within the TSOs in Germany
2. Status quo - legal framework: EU and German Law
3. Grid connection and challenges due to the development of the energy system: from „first come, first served“ to the maturity evaluation procedure („Reifegradverfahren“)
4. Beyond grid connection: the integration of BESS and ramping
5. Prospect: draft of the government cabinet (grid package: i.a. §§ 17a, b EnWG, FCAs)
6. Lessons Learned and conclusion

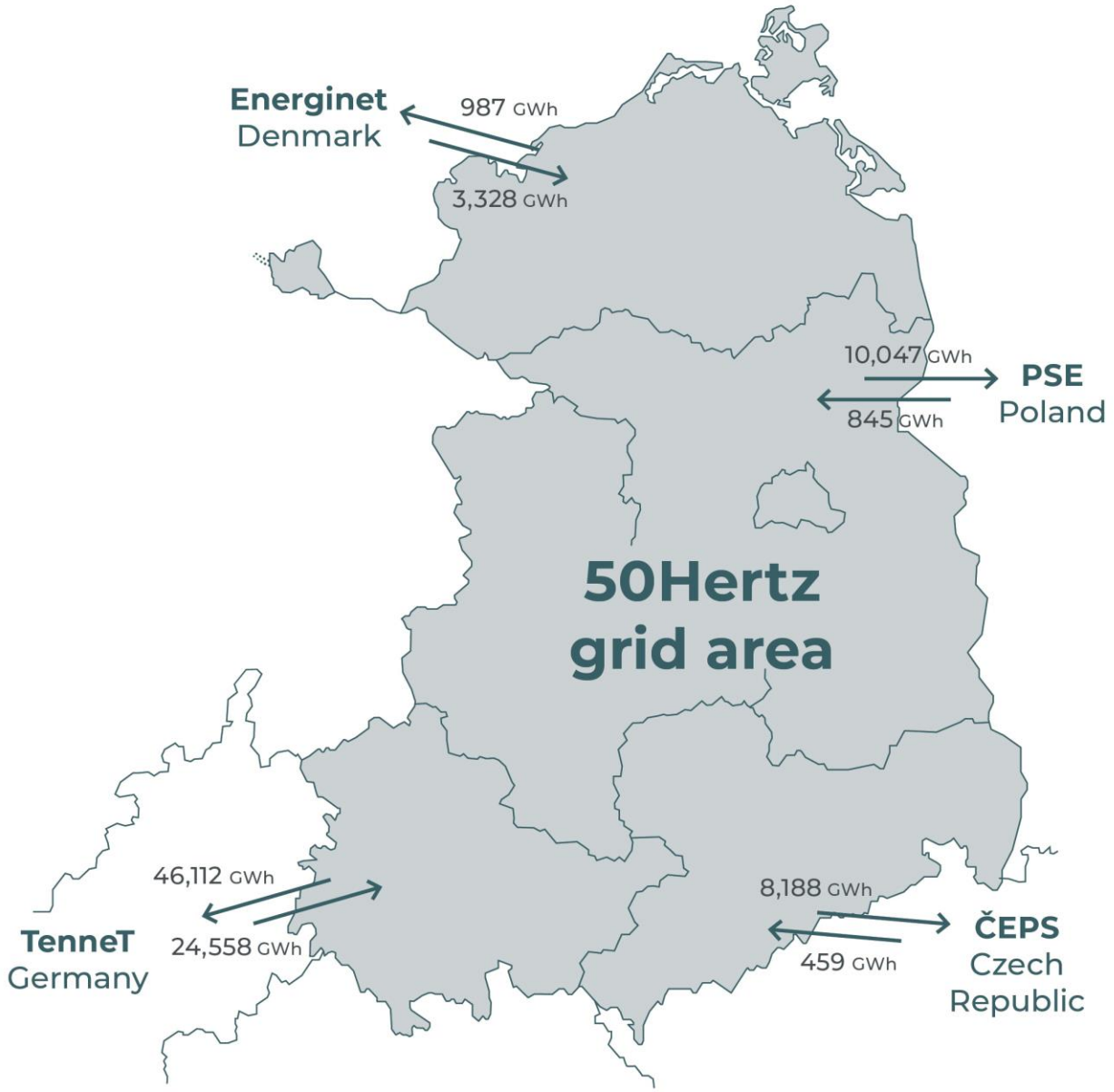


1. 50Hertz in Germany

One of four German TSOs & part of the Elia Group

The 50Hertz control area covers Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia, as well as the city states of Berlin and Hamburg. Within these regions, 50Hertz and its more than 2.500 employees ensure that 18 million people are supplied with electricity around the clock.
50Hertz is a forerunner in the field of secure integration of renewable energy. In our grid area, we want to integrate 100 percent renewable energies securely into the grid and system by 2032 - calculated over the year.

50Hertz as an electricity exporter in Germany and Europe



Total exports in 2025:	**65.334 GWh**
Total imports 2025:	**29.190 GWh**
Net exports 2025:	**36.144 GWh**

As of 12/31/2025

2. Legal framework: European and German Law

EU Law

Regulation (EU) 2019/943 on the Internal Market for Electricity

- Non-discriminatory access to transmission and distribution networks for generators, consumers, storage operators and other market participants (Art. 3 lit. q).
- Market-based and transparent operation of the electricity system, ensuring equal treatment of network users.
- Facilitation of renewable energy integration, demand response, storage and other flexible resources.
- Efficient use and development of transmission infrastructure, including cross-border integration of electricity market

Directive (EU) 2019/944 on Common Rules for the Internal Market for Electricity

- A right to third-party access to transmission and distribution networks based on objective, transparent and non-discriminatory criteria
- Obligations on TSOs and DSOs to operate and develop their networks in a manner that enables the connection of generation, demand, storage and new market participants

EU Law

- Network Codes (Tertiary law, art. 59 et subs. Regulation (EU) 2019/943)

  Network codes are binding Commission implementing regulations that translate EU electricity-market legislation into detailed and directly applicable technical and operational rules

  - System Operation Guideline (SOGL) Commission Regulation (EU) 2017/1485
  - Requirements for Generators (RfG) Commission Regulation (EU) 2016/631
  - Demand Connection Code (DCC) Commission Regulation (EU) 2016/1388
  - Electritiy Balancing (EB) Commission Regulation (EU) 2017/2195

- Details will be provided in the national design of the network codes, called VDE-Application Rules (VDE-AR N Number), i.a. including Technical Connection Rules (TAR)

German Law: German Energy Industry Act (EnWG)
Grid connection for BESS

- Existing grid connection rules are fragmented: Renewable Energy Sources Act (EEG), Power Plant Grid Connection Ordinance (KraftNAV), the Combined Heat and Power Act (KWKG) and section 17 EnWG (German Energy Industry Act)
- Special regiments for grid connection in EEG, KraftNAV and KWKG
- P: BESS and KraftNAV
  - BGH: BESS are producers and consumers under StromNEV (Electricity Network Charges Ordinance) - dual role
- Amendment for clarification purposes to the KraftNAV adopted in December 2025
  - Legislator: large-scale battery storage systems are not within Ordinance's scope
- Consequently, there is currently no specific statutory procedure governing transmission-grid connection applications for battery storage facilities.

BESS within Section 17 EnWG

  - Exception: Section 3 Nr. 1 EEG: take in stored energy originating exclusively from renewable energy sources and convert it back into electrical energy. As a result, a green electricity storage facility can qualify as an EEG installation
- Instead such applications fall under Section 17 (1) of the Energy Industry Act (EnWG)
  - grants TSOs broad discretion to determine allocation procedures
- Core principles of section 17 EnWG
  - Obligation to connect
  - under conditions that are appropriate, non-discriminatory, transparent
  - Limited refusal grounds (technical and economic reasons)

3. Reifegradverfahren

Germany's New Maturity-Based Grid Connection Process

From "First Come" to "First Ready": Germany's New Maturity-Based Grid Connection Process for BESS and Large-Scale Consumers

- Market ramp-up: Germany is seeing a sharp increase in BESS development.
- Application volume: 50Hertz, Amprion, TenneT, and TransnetBW face more than 700 GW of connection requests.
- Current allocation principle: Requests have traditionally been handled on a first-come, first-served basis.
- Key limitation: TSOs cannot systematically prioritize projects using objective criteria such as maturity and feasibility.
- Potential consequence: Early-stage or speculative projects may reserve capacity that could otherwise support more advanced projects.
- Market concern: Grid capacity may not always be allocated to the projects most likely to be realized.

From "First Come" to "First Ready": Germany's New Maturity-Based Grid Connection Process for BESS and Large-Scale Consumers

- Scope: Large-scale battery storage systems, data centres, electrolyzers, and other major consumers.
- Assessment: Evaluation against transparent and verifiable maturity criteria.
- Key criteria: Land security, permitting progress, technical concept, financial capability, and system benefits.
- Process: Applications are collected and compared within fixed assessment cycles.
- Prioritization: If applications exceed available capacity, the most mature projects are selected first.
- Outcome: Prioritized projects receive a grid connection offer and an associated schedule..

From “first come, first served” towards “first ready, first served.”

Applications in the maturity assessment process

- In the first cycle of the maturity assessment process, 347 applications were submitted with a cumulative requested capacity of 156.4 GW.
- Given the high total capacity requested, it is necessary to prioritise the applications for the allocation of connection capacity → projects ready for implementation can be connected to the grid in a targeted manner
- To this end, the transmission system operators are applying the assessment approach presented on 1 April: applications are prioritised on the basis of various maturity criteria and then technically assessed as part of a grid calculation.

50Hertz 179 applications, power draw (sum): 83,7 GW

The cumulative power of the applications refers to the sum of the power draw from the planned grid connection projects, which (for example, in the case of a development) is not necessarily identical to the sum of the requested active connection power on the TSOs' grids.

4. Integration of BESS and Ramping

Specific ramp rate restrictions and technical compliance standards

- Battery storage systems can store surplus energy for a short time and feed it back into the grid when needed.
- Energy production no longer has to correspond exactly to consumption at all times. This temporal decoupling makes the system more flexible and resilient.
- However: battery storage systems currently do not behave per se in the sense of grid stability, but in such a way that they are used as economically as possible for the operators in the electricity market.
- Another challenge in grid congestion management is that storage systems are highly flexible and can change their marketing almost every second. This makes it difficult for the TSO to predict their behavior.
- The extreme speeds of batteries when changing power – so-called ramps – can have a massive impact on the grid.

Ramp restrictions (Art. 137 SOGL, Art. 18 (6) EB GL)

These increasingly large discrepancies within the quarter of an hour results in large, fluctuating balancing energy requirements (deterministic system balance deviations), which in some cases already push the available balancing power to its limits and are visible in the frequency as deterministic frequency deviations (DFDs).

Due to the further PV expansion and in particular also through the addition of other very fast-acting assets, esp. BESS, deterministic system balance deviations will take on proportions in the near future that will no longer be controllable by the TSOs.

Possible solution: If all systems in the energy supply system make operating point changes with the same gradient, the problem of deterministic system balance deviations is completely solved.

5. Prospect: draft of the government cabinet (grid package: EnWG, EEG), FCAs, Datacenter

Prospect: New Rules for Grid Connection – „Grid package“

- At the heart of the Grid Package are comprehensive amendments to the Energy Industry Act (EnWG) and the Renewable Energy Sources Act (EEG)
- main objective:
  - provide grid operators with greater flexibility and expanded financing options
  - enable a more efficient management and processing of the rapidly growing number of grid connection requests – particularly from power plants, large-scale battery storage systems, and data centres.
  - § 17a EnWG: TSOs will be required to jointly develop transparent, non-discriminatory, and efficient procedures for granting access to the transmission grid.

Prospect: New Rules for Grid Connection

§ 17b EnWG: TSOs may prioritize connection projects that meet certain qualitative criteria

the security and reliability of the electricity supply system (in particular, priority may be given to projects in regions where additional capacity does not significantly exacerbate existing bottlenecks or stability constraints, or may even alleviate them);	statutory targets for the expansion of generation capacity, energy storage facilities, and consumption assets (e.g., expansion targets under the EEG);	the assumptions underlying the Federal Network Agency's grid development plan scenarios (e.g., regarding industrial electrification, the chemical sector, or the development of data centers);	the needs of upstream or downstream electricity grids;	the efficient use of grid connection points, in particular by multiple users (so-called "cable pooling"); and	designated land uses of particular importance under spatial planning law or zoning law (e.g., wind priority areas within the meaning of the Wind Energy Area Requirements Act or specifically designated areas such as sites for data centres);	site-specific nature (e.g., for industrial facilities expanding an existing grid connection).

Priority treatment may also be implemented by retaining grid connection capacity and allocating it on a quota basis to priority connection projects.

6. Lessons learned

„Lessons learned“

- Better linking of grid expansion planning, legal expansion targets and grid connections
- Energy policy must provide clear strategic guidance: Policymakers should define forward-looking priorities, including the intended contribution of different technologies and their role within the overall electricity system.
- Grid connection regimes should be better aligned: Greater consistency between the EnWG, KraftNAV and EEG is needed to create transparent allocation rules, reduce regulatory fragmentation and support efficient connection processes.

The overall objective should be a holistic and technology-neutral framework that supports renewable integration, makes effective use of battery flexibility and enables other new consumers, such as data centres and electrolyzers, without losing sight of the electricity system as a whole.

Thank you!