



Energy Storage in Germany

Guidelines to do business in the e-storage sector

E-Storage in Germany

- Energy Market
- Grid Aspects
- Permitting and Standardisation
- National energy and climate plan (NECP)
- Best Practices
- Top Talent
- Financial support
- Barriers

Energy market

Market designs, energy prices & capacity mechanisms

Stock market design

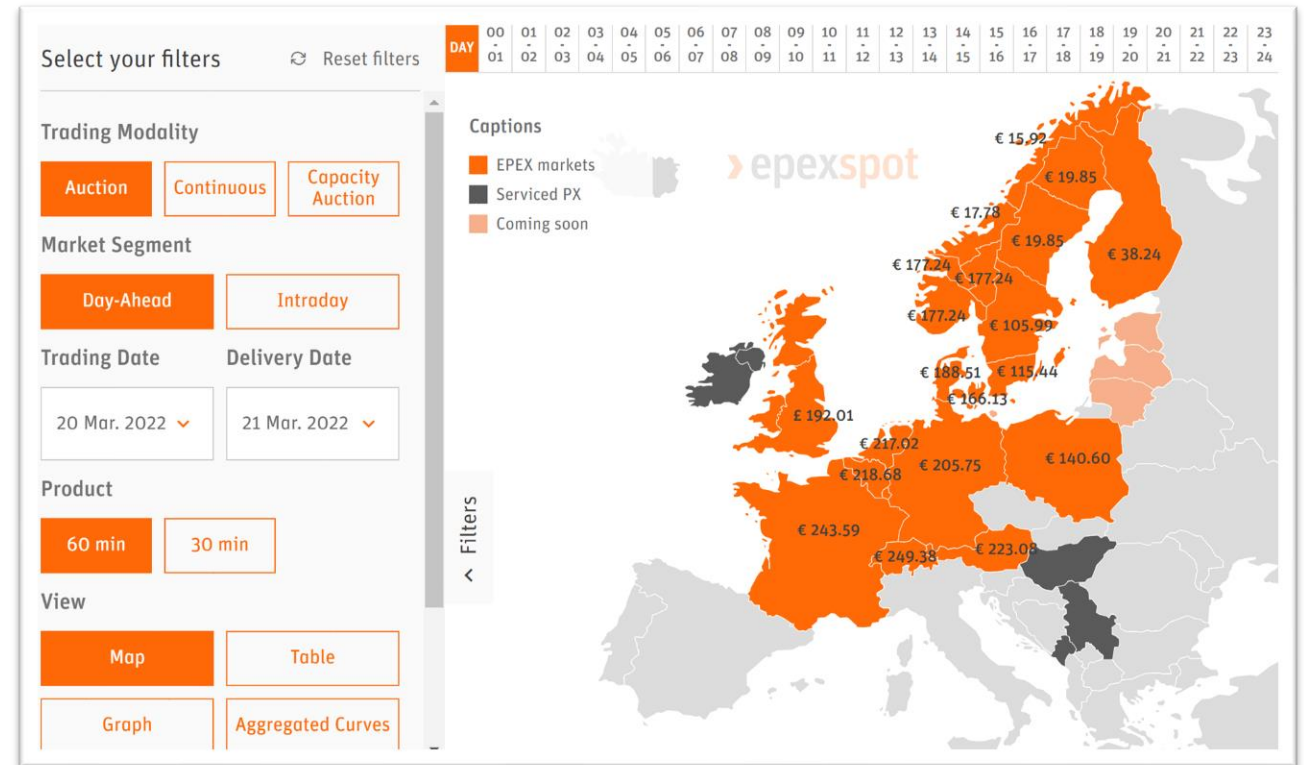
- **SPOT market:** The spot market serves for short-term transactions, where the traded amount of energy is to be delivered in the next two days:
 - **Day-ahead market:** participants can bid on hourly supply or demand blocks and other products (base or peak load) for the next day
 - **Intraday market:** supply or demand blocks with a minimal duration of 15 minutes within the day are exchanged.
- **Futures market:** main purpose is to provide the market players with the opportunity to hedge against risk in energy prices up to six years into the future. Arbitrage is also possible in general, but limited by cross-border-capacity.

Energy stock market

- In Germany, the so called electricity market 2.0 was initialized in 2017 by the lawmakers with the goal of enhancing fair competition in the electricity market. The undertaking should increase the competitiveness of flexible electricity producers, flexible consumers and flexible energy storage operators.
- Energy is traded at the European Energy Exchange (EEX) in Leipzig, Germany. Over 4000 firms participate in the German energy stock market.
- Certified market participants (only companies) can buy and sell electricity for determined time-windows.
- Non-discriminatory market access is granted to participants who have to comply with the EEX Exchange Rules and the German Exchange Act (Börsengesetz - BörsG §19(4)) and are admitted to the European Commodity Clearing AG (ECC), which is part of the EEX.

Energy prices

- The Electricity Bidding Zone (German: Stromgebotszone) defines how the German market is regionally divided regarding price formation.
- SMARD is the online platform of BNetzA, which gives all users insight into live market data.
- The ability to prognose intraday prices has increased over the past years, because operators of renewable energy plants as well as direct marketing players have been incentivized to do so by the Renewable Energy Act (Erneuerbare-Energien-Gesetz - EEG).



Energy prices

- According to **§40(5) of the EnWG** every energy provider must offer variable tariffs, but the order of magnitude of variation is not specified. And many providers offer contracts with lower charges during night hours in order to influence demand.
- For private consumers and small businesses, overall energy cost is comprised of a base fee and a so-called “Arbeitspreis” based on energy consumption in €/kWh.
- In addition to the base fee and energy cost, for large-scale energy consumers fees are also based on peak power (“Leistungspreis”) and on reactive power.
- To lower energy costs for industrial consumers, energy storage systems can be used for peak shaving, which can reduce costs based on peak power

Structure of the German energy market

The value chain of the German electricity market consists of several parties:

- **The producers of electricity:** They generate electricity.
- **The Transmission System Operators - TSO (German: Übertragungsnetzbetreiber - ÜNB) :** There are four TSOs in Germany: 50Hertz, Amprion, Tennet and Transnet BW.

The grid frequency balancing is administered by them, which can directly control the power generation of electricity producers they have contracts with. This automatized, demand-driven process is subdivided into:

- The Frequency Containment Reserve (**FCR**, R1, or primary control reserve, made available within 30 seconds)
- Automatic Frequency Restoration Reserve (**aFRR**, R2, or secondary control reserve, made available within 5 minutes)
- Manual Frequency Restoration Reserve (**mFRR**, R3, or tertiary control reserve, made available within 15 minutes)
- **The distribution grid operators – DSO (German: Verteilernetzbetreiber):** over 900 DSOs in Germany.
- **The energy suppliers:** They supply power to customers, both private and business.
- **Balancing reserve market:** In Germany, the TSOs are responsible to determine the demand for balancing reserve power and monitor its provision.
- **Consumer:** Uses electricity to power industrial processes, household appliances, etc., or to provide light and heat.

Capacity mechanism

- In Germany, the TSOs can only make use of their reserve power capacity if there is a need for stabilizing the energy supply. Market participation of the reserve power capacity is prohibited.
- Since November 2020, the balancing market is split into two different markets:
 - the energy market (Regelarbeit) and
 - the capacity market (Regelleistung).

The separation is in accordance with the European Electricity Balancing Guideline EBGL. According to the Federal Network Agency (BNetzA) this system promotes competition within the balancing markets. Companies can now take part in each market independently. The capacity market acts as a “safety net” if the energy market does not function properly due to technical problems.

- Since June 2022, the energy market products of R2 and R3 can be traded for segments of 15 minutes.

Grid Aspects

TSO's & DSO's

Grid Aspects

- TSOs and DSOs are obliged to grant network access to energy storage systems by law (EnWG §17(1)).
- **Amprion (TSO)** lists the minimum technical requirements for connecting general installations into its transmission network.
- **The European Network Code Requirements for Generators (NC RfG)** elaborates the connection requirements for generators at all voltage levels focusing on the cross-border electricity trade (European Commission, 2016).
- **The European Network Code on Demand Connection (NC DCC)** includes harmonized regulations for grid connection of consumption and distribution systems and focuses on the cross-border electricity trade (European Commission, 2016).
- **The VDE Forum Network Technology/Network Operation (FNN)** transformed the aforementioned European codes into national rules.

Area of Responsibility of German TSOs



Source: <https://www.cleanenergywire.org/factsheets/set-and-challenges-germanys-power-grid>

Permitting and Standardisation

Rules and regulations in the e-storage sector

European Regulations

- **EU Batteries Directive:** Energy storage solutions must comply with the European Batteries Directive, which:
 1. Prohibits the placing on the market of certain batteries manufactured with mercury or cadmium.
 2. Encourages the recycling of (parts of) batteries.
 3. Supports the improvement of batteries and environmental performance of all actors involved in the life cycle of batteries and accumulators.
- Currently, the EU is working on a proposal for a regulation concerning batteries and waste batteries, which would replace the Batteries Directive (2006). This 'new' regulation would govern the entire battery lifecycle.
- It would establish mandatory requirements for sustainability (such as carbon footprint rules, minimum recycled content, performance and durability criteria), safety and labelling for the marketing and putting into service of batteries, and requirements for end-of-life management. It would also introduce due diligence obligations for economic operators sourcing raw materials.

Safety and health regulations

- European Standards are to be applied in the member states by law and are therefore also relevant in Germany.
- **Standard requirements:** DKE (Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE) elaborates normative guidelines for issues related to electrical, electronic and information systems.
- **The DKE/AK 371.0.5** “Lithium-Sekundärbatterien allgemein” (secondary batteries in general) focuses on safety aspects of Lithium-Ion (Li-Ion) batteries.
- **VDI 4657** focuses on the planning and integration of energy storage systems in buildings.
- **DIN EN 62619 (VDE 0510-39:2017-11)** contains safety requirements for secondary lithium batteries and cells for use in industrial applications.
- The draft for **DIN IEC 62485-1 (VDE 0510-46):2014-07** will regulate requirements of battery systems with lead accumulators and Nickel-Cadmium batteries.
- The draft of the **DIN EN 62932-1 (VDE 0510-932-1)** focuses on flow-batteries.
- **VDE-AR-E 2510-2: 2021-02** includes standards for safety requirements for “Stationary electrical energy storage systems intended for connection to the low voltage grid”

Environmental permits

- In Germany, in most cases, neither environmental nor energy industry permits are required for battery storage system alone, though it must comply with the regulation on electromagnetic fields (26. BImSchV).
- Battery storage systems must be registered in the market master database (Marktstammdatenregister).
- A permit is required for battery systems that are installed together with infrastructure which requires permission: Applications for such energy storage systems are subject to:
 - the Federal Building Code (Baugesetzbuch – BauGB),
 - local building regulations (Bauordnung) (Helmes, 2018).

National energy and climate plan (NECP)

Policies regarding e-storage

NECP of Germany

- Encourage investments in storage technology and intelligent market concepts to guarantee supply reliability.
- Further development of battery production and research thereof.
- Improvement of the free formation of market price:
 - A market flexibility check will be conducted together with neighbouring countries. Barriers need to be identified and removed.
- Identification of remaining cases of double charging (taxes, levies and other charges).
- Further development of control concepts to allow decentralized storage to provide system services.

Source: https://ec.europa.eu/energy/sites/default/files/documents/de_final_necp_main_en.pdf

NECP of Germany

- As main part of the “7. Energieforschungsprogramm” (7th energy research programme), the research on system integration will focus on storage systems and sector coupling.
- The “Forschungsfabrik Batterie” (battery research plant) will unify all existing subsidies concerning battery research. Main topics are the improvement of energy density and fast charging capability, as well as safety, lifetime and reducing the use of critical materials.
- Foundation of a new Fraunhofer Institute for storage technologies.

Best Practices

Best practice: general information

- The [Fact Sheet Energy Storage](https://www.bves.de/wp-content/uploads/2017/05/Faktenpapier_2017.pdf)* (Faktenpapier Energiespeicher) describes current business models and methods to participate in the energy market. It includes recommendations to authorities to facilitate a viable participation of storage systems in the energy market.
- Most storage systems in Germany are currently used together with residential PV plants to increase self-consumption and reduce costs.
- Inexpensive storage systems can be built using Second-Life-Batteries (Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen, 2020). An application example of Second-Life-Batteries is the use of pre-owned electric vehicle batteries as stationary storage.

* https://www.bves.de/wp-content/uploads/2017/05/Faktenpapier_2017.pdf

Financial support

European battery storage funding

Battery storage, among other important key technologies and innovations, is one of the funding priorities within the European Union.

European funds are an important means to connect our energy transition ecosystem with other important hotspots in the EU, for example through cross-border cooperation and knowledge transfer.

Examples of European subsidies that SMEs and knowledge institutions in NWE are eligible for are:

- **M-ERA.NET:** Aims to strengthen the contribution of R&D in materials to energy-related applications.
- **Horizon Europe:** EU's key funding programme for research and innovation. It tackles climate change, helps to achieve the Sustainable Development Goals and boosts the EU's competitiveness and growth.

German energy storage funding and incentives

- Depending on the location, regional financing programs are also available. In Hessen, there are the so-called LOEWE projects which support the research of innovative technologies that are useful for the local communities. In general, the available funding programs are rarely exclusively focused on energy storage systems.
- EXIST Transfer of Research program – co-funded by the BMWi and the EU.
- The majority of the funding programs are federal state specific (Bundesland) and often in combination with renewables.
- Tax benefits by installing energy storage systems, e.g. the cost of the battery system can be written off the income tax in different ways.

Barriers

Current obstacles and challenges

Current Barriers

- Missing definition of storage systems and their uses/advantages
- The current structure of the energy market results in distorted prices, which deteriorates a profitable operation of storage systems
- High upfront investment with uncertain profit predictions
- Complex and lengthy permit processes
- Public reluctance to large projects: “Not-In-My-Back-Yard”-mentality
- No interest from conservative industry branches because of unpredictable profits
- Technological aspects: limited capacity and efficiency of the available energy storage technologies

Interreg North-West Europe STEPS

European Regional Development Fund

THANK YOU!