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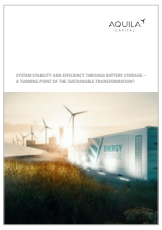

MANAGEMENT SUMMARY

SYSTEM STABILITY AND EFFICIENCY THROUGH BATTERY STORAGE – A TURNING POINT OF THE SUSTAINABLE TRANSFORMATION?

Abstract

The stability of grids and thus the security of energy supply depends on a constant balance between generation and consumption. Due to the dependence of renewable energies on the weather and relatively inelastic demand patterns, fossil power plants are persistently needed to ensure energy security. The resulting dual structure of Europe's energy supply leads to persistent emissions on the one hand and high costs on the other.

However, with increasing technological progress and economies of scale, significantly supported by the development in e-mobility, the competitiveness of battery solutions is rising. Utility-scale battery storage, i.e. systems with capacities of usually more than 20MW with a direct connection to the transmission and distribution grid, have seen a price reduction of more than 80 % in the last ten years.

In line with this development and the technological characteristics, significant competitive advantages are already coming to bear in the market for ancillary services [1]. For example, batteries can offer flexibility in both directions, while gas-fired power plants have to be connected to the grid with their minimum capacity and can consequently only offer lower flexibility. Due to the essential importance of this balancing energy for the stability of grids, renewable energies are subject to a curtailment in favour of the minimum output of gas-fired power plants. Battery storage avoids similar loads on the grids and improves the integration of renewable energies. As a result, system efficiency and cost efficiency would benefit.

However, in order to enable a significant expansion of battery storage, an appropriate regulatory framework is necessary. While investment is still relatively low in most EU countries, the opening of markets and special balancing energy products for batteries in the UK gave the technology an enormous boost. Today, the installed capacity of utility-scale battery storage in the UK is 1.3 GW, more than double that of the entire EU.

However, while Aquila Capital outlined the barriers to battery storage expansion in a 2018 analysis **(Insights: Charging ahead)**, there are signs of a reversal in the trend. Compared to 2018, the price reduction of batteries has significantly exceeded expectations and a new dynamic in the stationary battery sector can be observed globally (see USA, Australia). Due to market developments, more European countries have followed the regulatory model of the UK in recent years to create incentives for the expansion of battery storage.

A corresponding market environment enables battery storage to continuously optimise in various wholesale and balancing energy markets. But the ongoing heterogeneity of regulation in Europe requires a selective approach for investors. In particular, countries such as the BeNeLux, which offer a corresponding market environment, open up opportunities for investors to benefit from the development at an early stage.

Battery storage offers attractive business models in the long term through participation in the market for ancillary service and optimisation in electricity wholesale markets, benefiting from the increasing competitiveness compared to fossil power plants. At the same time, battery solutions stabilise the framework conditions for renewable energies and thus support the energy transition. The battery storage segment offers investors sustainable investment opportunities that also increase diversification within renewable energy portfolios.

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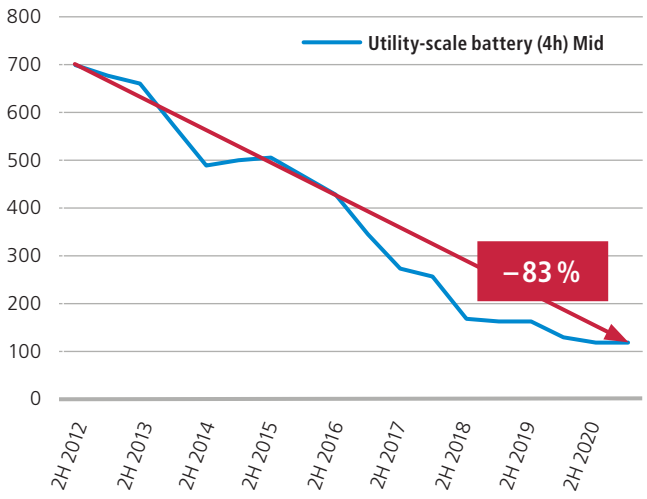
[1] Ancillary services are reserves held by grid operators to ensure the stability of grids. This means balancing out too high or too low frequencies.

Significant increase in competitiveness

LCOE [2] global benchmark (in EUR/MWh)[3]



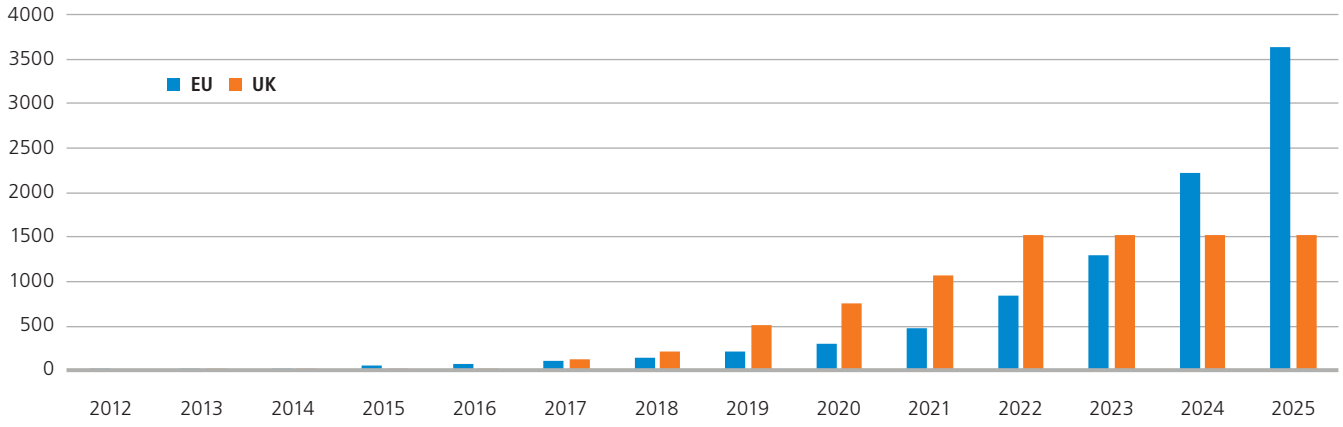
Spurred on by the developments in e-mobility, price reductions for large-scale battery storage of over 80% have been achieved due to technological progress.

Especially compared to the „bridge technology" of flexible gas-fired power plants, the competitiveness of battery storage has increased significantly. The increase in variable costs of fossil power plants due to fuel costs and emission certificates further supports this development.

Market design

In the long term, attractive business models arise in the battery storage segment depending on the regulatory framework. While market access for battery storage remains limited to the primary reserve market in some countries, an increasing number of member states are following the UK's market design.

Capacity development of utility-scale batteries comparison EU and UK (in MW)[4]



[2] Levelised costs of electricity
[3] BNEF (2021)
[4] BNEF (2021)

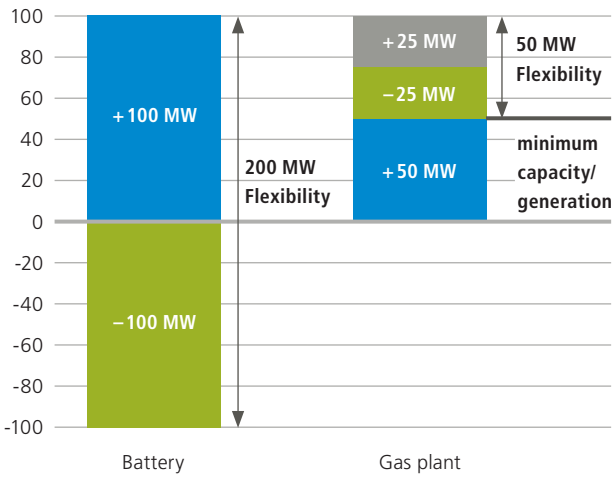
The figure illustrates the different developments in this context. The adjusted market design in the UK led to a reduction in market price risk, which increasingly created opportunities for institutional investors as well. Compared to the EU as a whole, the UK now has more than twice as much battery storage capacity.

However, the heterogeneity within the EU continues to require a selective approach. The BeNeLux countries in particular already have a market design that is oriented towards the UK market and thus provides a good basis for investing in batteries. For example, the market in Belgium and the Netherlands allows for continuous optimisation of battery yields across different market segments, especially in the very short-term and volatile sector.

Competitive advantage in ancillary service

In order to keep the grids stable and thus ensure security of supply, a sensitive balance between generation and consumption is necessary. For this purpose, the grid operators hold reserve capacities on the market for balancing energy, which can increase or decrease the supply in the event of an imbalance.

Comparison flexible capacity of a 100MW Battery and a 100MW gas plant (illustrative)[5]



Due to the technical superiority of battery storage compared to fossil alternatives, batteries already have competitive advantages in this segment.

While batteries can offer flexibility in both directions, fossil power plants have to be on the grid to reduce their output in case negative balancing power is needed and to be able to offer flexibility at all. In addition to the cost efficiency that battery storage offers, there are very positive system efficiency implications. On the one hand, fossil generation causes persistent emissions, and on the other hand, the minimum output partly causes renewable plants to be shut down.

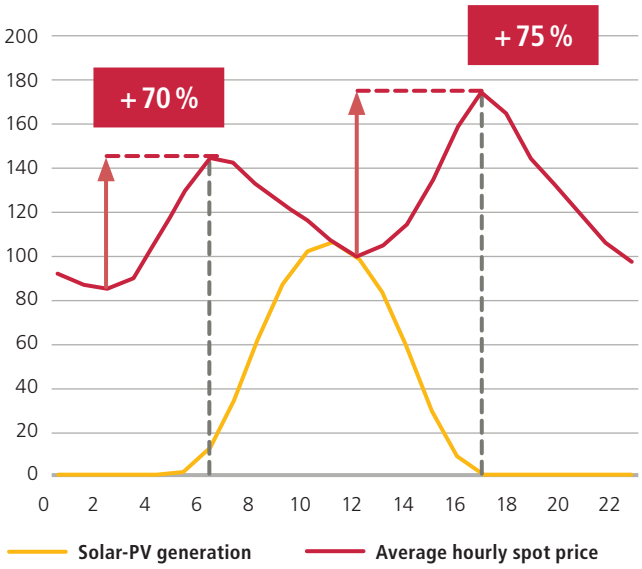
Storage requirements increase with the expansion of renewable energies

The described synergies between renewable energies and battery storage will become even more apparent in the course of the expansion of renewable capacities and will also sustainably strengthen the competitiveness of battery storage on the wholesale market.

Since renewable energies are dependent on the weather, they do not necessarily correspond to the load profile of consumers. On the one hand, this leads to curtailments, especially with increasing shares of renewable energy, and on the other hand, still necessary fossil-fuel power plants lead to significantly higher prices. The graph below illustrates this relationship using the example of the average daily generation from solar PV and the corresponding electricity price in Germany.

[5] *IRENA (2015)*

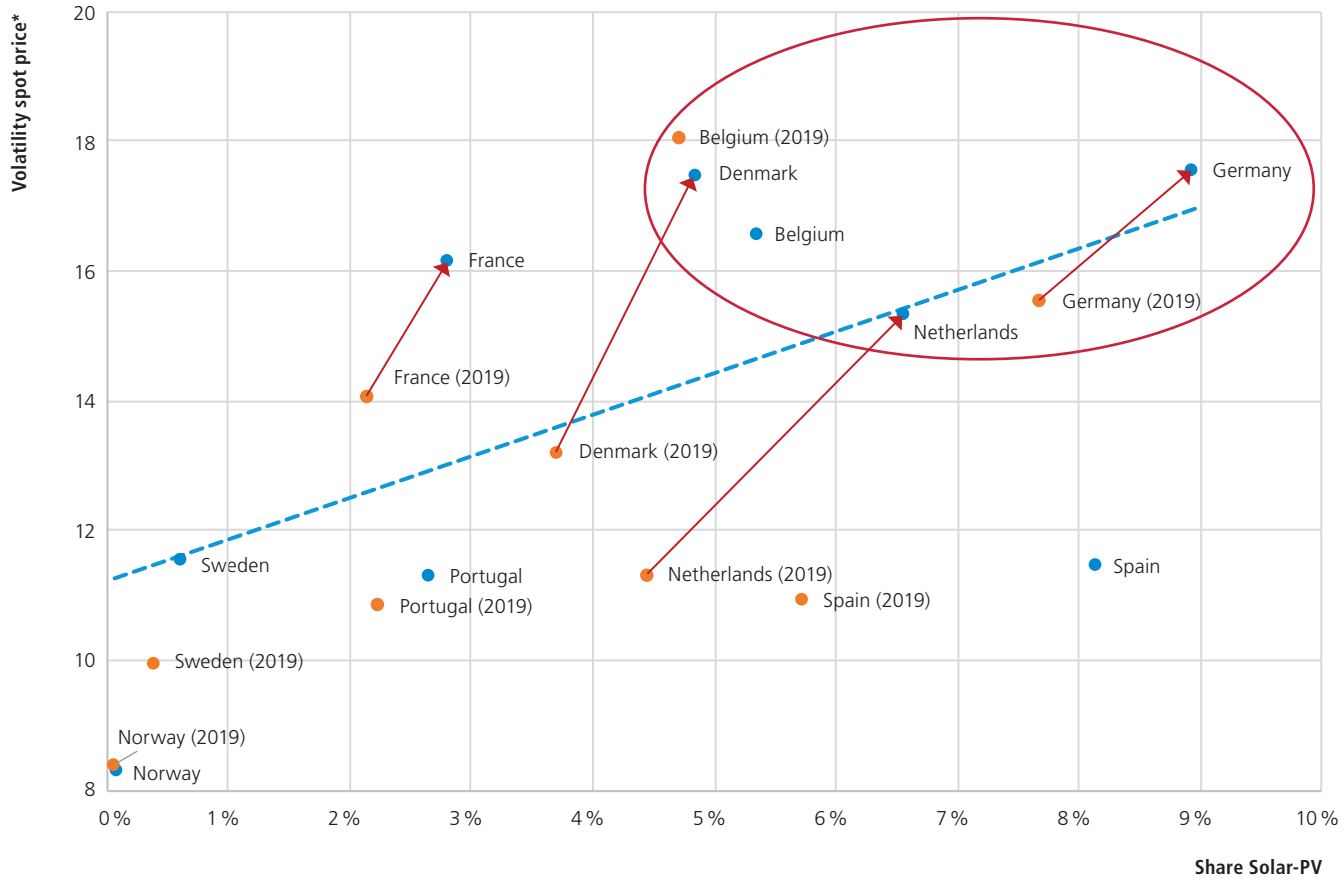
Index of solar-PV generation and wholesale electricity prices (12 o'clock=100) Germany 2020 [6]



Production from solar PV naturally reaches its highest output in the midday hours. But consumption is particularly high in the morning and evening hours. As a rule, flexible gas-fired power plants compensate for these deviations, which – as can be seen – is accompanied by significantly higher prices. In this context, however, battery storage can store the surplus energy and shift the load. The result is an effective use of renewable energy that reduces the need for fossil flexibility.

In the course of an increasing share of renewable generation, this connection will be sustainably strengthened. The year 2020 – which showed lower consumption and thus higher shares of renewable energy as a result of the pandemic – already showed a preview of the expected effects.

Volatility of the electricity price depending on the share of solar-PV in the national generation mix (comparison 2019/2020) [7]



[6] *Aquila Capital Research based on data from ENTSO-E (2021)*
[7] *Aquila Capital Research based on data of ENTSO-E and BNEF (2021)*
** Volatility as standard deviation of the hourly electricity prices of the respective year*

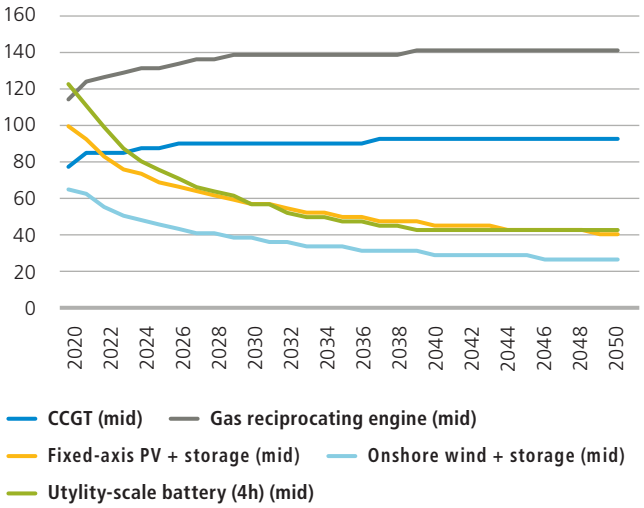
With an increased share of generation from solar PV in the energy mix, the majority of European countries experienced a significant increase in volatility in electricity prices. Battery storage can benefit from this development and at the same time sustainably improve the necessary integration of renewable energies.

Benefits and cost efficiency will sustainably strengthen the importance of batteries

Following these developments – supported by technological progress and economies of scale – the competitiveness of battery storage systems compared to the bridging technology of gas-fired power plants will continue to increase in the future.

The establishment of battery storage in the energy market thus offers sustainable business models in the long term, which increase system efficiency in a cost-optimal way and offer a sustainable way of transforming our energy supply.

Forecast of LcOEs in Germany (in EUR/MWh)[8]



Conclusion

The increasing expansion of renewable energies will continue to increase the demand for flexibility in the electricity grid. Due to technological progress, battery storage in combination with low-cost renewable energies offers a cost-efficient and sustainable alternative to fossil power plants.

The higher yield risk compared to renewable energies – due to the lack of hedging options (PPA) – must be viewed in a differentiated manner. While hedging against high price fluctuations for wind and solar parks ensures the security of earnings, batteries offer the opportunity to profit from these fluctuations.

Companies with expertise in renewable energies and the energy markets can benefit from entering the segment at an early stage. Service providers who increasingly specialise in trading flexibility offer the possibility of continuously optimising yields according to the price signals of the market. As a result of the low costs of batteries, which are increasingly lower than those of fossil alternatives, even when combined with renewable energies, optimisation in electricity trading results in potential returns in the high single-digit range for battery investments. In addition to higher potential returns, battery storage also offers positive diversification strategies for renewable energy portfolios.

While the energy transition benefits from the developments by increasing system stability and efficiency, sustainable and attractive investment opportunities arise in the current disruptive environment.

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[8] *BNEF (2021)*

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