WHITE PAPER

Bulgaria: Energy Storage as a Catalyst for a Changing Power Sector

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Introduction

The Current State of the Bulgarian Power Market: Why is Energy Storage More Relevant than Ever?

The Bulgarian power sector is currently attracting significant interest from foreign and domestic companies alike. Substantial investment will be required, as the energy system transitions towards a more diverse energy mix, including high levels of renewable generation and new approaches to power system engineering and management. Looking into the current power mix, the country relies heavily on the pillars of coal and nuclear generation which collectively account for approximately half of installed generating capacity. In 2022, 52.3 percent of generated electricity came from thermal power stations, and only 7 percent from solar and wind[1]. Historically, Bulgaria has also been a major producer and exporter of electricity for the surrounding region with a total of 10 interconnectors spread across Romania, Serbia, North Macedonia, Greece, and Turkey. The country thus has a critical role in driving a more secure, sustainable, and future oriented energy system for South-Eastern Europe.

The start of 2023, however, offers a stark contrast to the past and a glimpse of the new challenges Bulgaria will face on its energy transition. In May 2023, Bulgaria was for the first time in a decade a net importer of electricity[2]. The reason for this was not a lack of generating capacity, but instead the natural logic of power markets seeking the most price competitive source of generation, in that instance renewable energy. New investments in renewable energy generation, primarily solar photovoltaics (PV) in Bulgaria and neighboring countries, drove down power prices during periods of high supply. In May 2023, electricity generation from coal power plants slumped 58% compared with the previous May, while solar PV had its monthly contribution grow by more than 30%. Notably, PV also had its highest ever share of power generation for a period of several hours around noon in a single day. This was the direct cause of another first experienced by the power market in Bulgaria – electricity prices falling to zero on May 20th and 21st.

[1] ESO EAD (2022) Statistical Pocketbook 2022. (Accessed: 11th May 2022).

[2] Ahmadzai, E. (2023) Precedent: Bulgaria was a net importer of electricity in May. (Accessed: 13th June 2022).

Strong tailwinds for renewables in the country are also driven by the European Commission push for more ambitious decarbonisation and renewable targets[3]. As such, setting the focus on integrating higher share of renewables will ensure Bulgaria avoids losing billions of euros in European funding. Moreover, high-power prices, linked with the European energy crisis, only exacerbate market fundamentals to favor more economically competitive technologies. Solar and wind's continuously falling capital cost and minimal operating costs make them cost-competitive, but also require greater flexibility in the energy system.

Reports now indicate a 35 GW pipeline of solar and wind projects requesting connection to Bulgaria's grid[4], while according to data by the Association for Production, Storage, and Trading of Electricity (APSTE), over the last three-years Bulgaria has practically doubled its PV installed capacity to 2.2 GW with another 700 MW expected to become operational in 2023. In other words, Bulgaria could easily sail past its 2030 National Energy and Climate Plan (NECP)[5] goal for PV installations nearly seven years early.

Aiming to provide renewable energy at the lowest cost for customers at the same time as transitioning the grid from a largely dispatchable power source to renewables with variable output, such as wind and solar, is however no simple task. The transition will require integral planning around electricity networks and new market rules to incentivise investments in grid congestion management and distributed flexibility. Furthermore, and as in other European countries, a move away from coal is not just a challenge for the energy system. It also brings wider challenges around job security and an urgency for Bulgaria to seize the new regional opportunities created by the ever-growing renewable sector.

Fortunately, Bulgaria sits in the privileged position where it can profit from the experiences of other energy systems with high renewable shares. Here, battery-based energy storage is integrated as a reliable and cost-efficient solution that increases system flexibility and allows for integration of greater shares of low-cost renewables. Energy storage can also be deployed quickly with high public acceptance and provide both local and system services, benefiting utilities and Independent Power Producers (IPPs), grid operators, households, businesses, and commercial and industrial (C&I) consumers so long as the regulatory framework recognizes their value and enables private investments.

[3] In late June 2021, the Council of the European Union signed on the first European Climate Law, setting into legislation the bloc's stated goal of reducing greenhouse emissions by 55% (compared to 1990 levels) by 2030 and reaching climate neutrality in the next 30 years. On July 14, 2021, the European Commission followed up with its "Fit for 55" legislative package. The bundle of interconnected legislative proposals aims to align climate, energy and transport policies with the targets agreed in the European Climate Law, translating climate goals into concrete actions.

[4] Stanchev (2023) 'Angelin Tsachev, ESO: Bulgaria should also connect its network with Western Europe', Capital Bulgaria, 21 March. (Accessed: 11th May 2022).

[5] National Energy and Climate Plan (NECP), a 10-year strategy required from all member states of the European Union (EU).

How can Different Energy Storage Applications Benefit Bulgaria?

Energy storage applications play a vital role in the successful integration of renewable energy sources into electricity grid. They can bring the grid stability and resiliency crucial as a country strives to establish a reliable energy system with greater share of intermittent generation. In the context of Bulgaria's energy landscape, energy storage solutions present a diverse array of benefits to various stakeholders stemming from its unique ability to time-shift energy and rapidly respond when called upon. The applications below are just some examples of how energy storage can benefit Bulgaria.

PEAKING CAPACITY

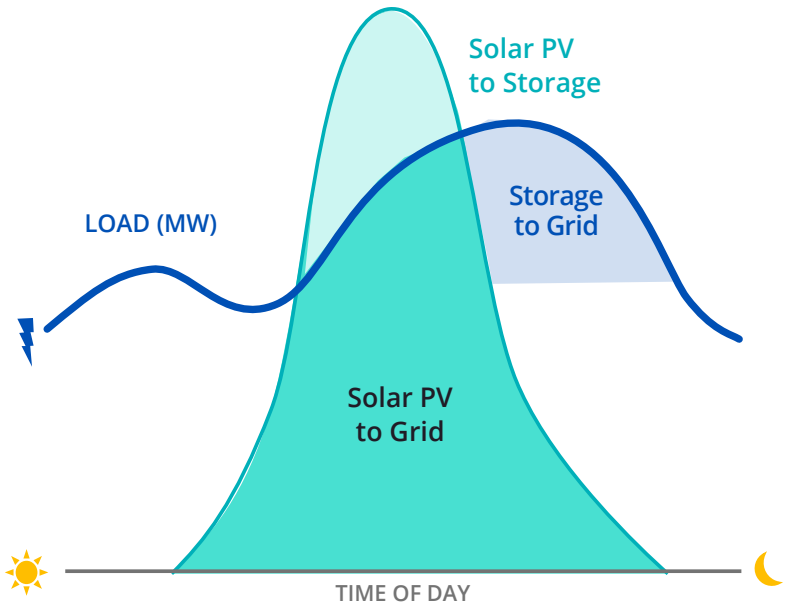
Energy storage can offer a cost-effective and fast-responding alternative for Bulgaria's peaking capacity needs. With limited natural gas reserves and uncertain costs for imported energy, storage can provide a reliable source of power during peak demand periods on the Bulgarian grid. Compared to traditional peaking plants, storage can also offer greater flexibility and efficiency in managing the grid. Furthermore, and although hydropower storage already makes up a significant source of peaking capacity in Bulgaria, battery-based energy storage can address peaking needs during times of droughts, meet requirements for more distributed peaking power, and be deployed at the much faster rates required for the changing system.

ENERGY SHIFTING

The production shifting opportunity of energy storage can also bring numerous benefits to Bulgaria's wider system and electricity producers. By charging the storage system when market selling prices are low or with otherwise curtailed energy, production can be shifted to meet demand during peak periods and high prices (see figure 1). This can also prevent the zero electricity prices seen creeping into Bulgaria's wholesale electricity market due to overproduction, ensuring the market retains the positive fundamentals needed for renewable investments.

FIGURE 1.

Clipping Solar Generation with Energy Storage



SOLAR + STORAGE

AES Gener

ANTOFAGASTA, CHILE
112 MW / 560 MWh

BENEFITS

- Provides flexible capacity by both absorbing over-generation and discharging at peak demand
- Offers greater grid services than standalone solar

BALANCING AND PORTFOLIO OPTIMISATION

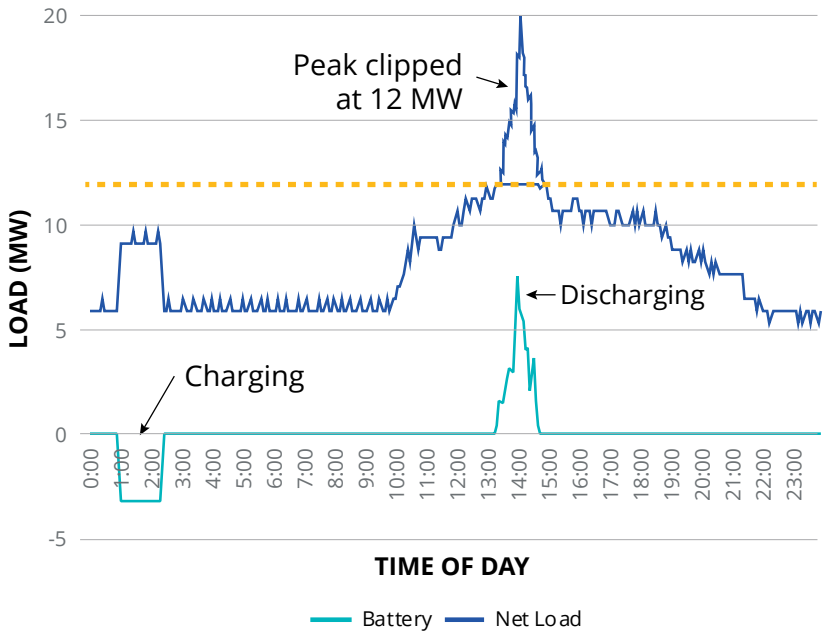
Considering the high imbalance[6] changes seen in Bulgaria, Balance Responsible Parties (BRPs) such as utilities, traders, and IPPs as well as DSOs can also benefit from energy storage through using it to lower imbalances within their portfolios. Here, the BRP would not need to actively bid on the imbalance market, but instead leverage the load flexibility of energy storage within its portfolio to balance output. Moreover, given balancing costs can make up to 10 percent of the final electricity prices in Bulgaria, utilizing energy storage to reduce system balancing costs will be passed on to reduce the final cost of electricity for consumers.

COMMERCIAL AND INDUSTRIAL APPLICATIONS

Power prices on the free market (where all businesses buy power) in Bulgaria are currently highly volatile. In 2022, Bulgaria saw wholesale electricity prices that were among the highest in the region, while in May 2023 it experienced its first zero prices. Coupling these large spreads and difficult to predict power prices with the sustained reduction in prices for both solar PV and storage systems is now leading many C&I business owners to invest in assets Behind-the-Meter (BtM). Here, energy storage systems can shield consumers from high energy prices by storing electricity during times of low demand and discharging it for consumption during peak hours when prices are high. Furthermore, co-locating storage with solar BtM can allow consumers to reduce their need to import from the grid, and thus exposure to market volatility, through increased self-consumption. Both co-located and standalone energy storage system BtM also have the additional benefit of "clipping" consumption to prevent exceedance of power import limits and subsequent economic fines (see figure 2).

FIGURE 2.

Clipping Consumption with Energy Storage



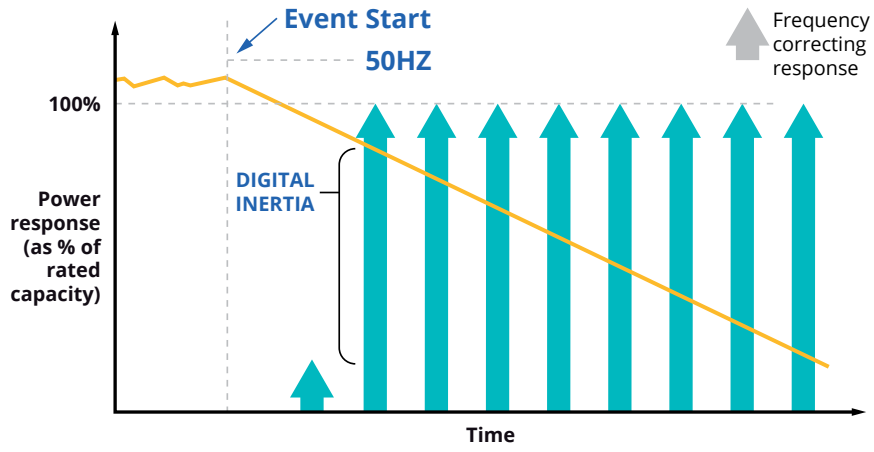
[6] Imbalance costs are financial penalties incurred when there is a deviation between scheduled and actual energy generation or consumption in the electricity grid. They occur due to uncertainties in demand and supply, such as weather changes or forecasting errors. These penalties incentivize accurate scheduling and help maintain grid stability.

FREQUENCY RESPONSE

As Bulgaria continues to expand its renewable energy infrastructure, it will face the challenges of compensating for the loss of system services traditionally provided by conventional power plants. At the same time, the need for specific services required to manage the complexity of an electricity system with high share of renewables will increase. Here, energy storage can play a crucial role in providing the ancillary services that support the stability, reliability, and efficiency of the grid. These can include frequency regulation (see figure 3), spinning, non-spinning and supplemental reserves, voltage support, reactive power compensation, and black start.

FIGURE 3.

Frequency Response with Energy Storage



TRANSMISSION INFRASTRUCTURE SERVICES

Over recent years, the concept of using the Storage-As-Transmission-Asset (SATA) has started to emerge in several power grids. At the transmission level, storage can help solve grid congestion and reduce technical losses for electricity transportation. This means that electricity can be transmitted more efficiently and reliably, leading to cost savings for consumers and a more stable grid. Storage can also defer or altogether replace high costs of investment in traditional grid infrastructure and increase network capacity. This is particularly important in Bulgaria, where due to the grid being developed for large and centralized power stations, areas suitable for renewable generators may not have sufficient grid capacity. Several countries in Europe, including Germany, Spain, Italy, France, Greece, Lithuania, and Latvia are currently developing SATA projects or evaluating their implementation. Most recently, Fluence signed contracts with the German TSOs TransnetBW and TenneT to deliver a 250 MW and two 100 MW projects respectively, while also completing a 200 MW portfolio consisting of four 50 MW projects for Energy Cells in Lithuania.

Read Fluence's recent blog series for more information on the specific use cases and benefits of SATA.

FREQUENCY REGULATION

Kilathmoy

IRELAND
11 MW / 5.5 MWh

BENEFITS

- Cost-effective way to manage second-to-second fluctuations and maintain stable frequency
- Can both delivery and absorb power (bi-directional)
- Faster response than thermal generation

Working Together to Bring the Value of Energy Storage to Bulgaria

Currently, Bulgaria has set out targets and investment plans for energy storage via its National Energy and Climate Plans (NECP) and National Recovery and Resilience Plan (NRRP). The NECP calls for an investment of €220m in the Yadenitsa pumped hydro storage plant, €200m for 180 MW of frequency regulation grid scale batteries, and €200m for storage co-located with renewable generation. Although the NECP shows good intentions to send stronger positive signals to developers, the plan must look to provide a more detailed proposal and timetable for the rollout. In addition, it should look to include concrete measures for encouraging non-discriminatory participation of renewable energy and storage within the market. Notably, some small steps have also been undertaken via the NRRP where a BGN 200 million rebate programme has been created for small and medium sized enterprises to install solar-plus-storage systems of up to 1 MW to increase self-consumption. More ambitious projects – a European funded tender scheme for 1.4 GW/1.68 GWh renewables- plus-storage as well as 6 GWh of stand-alone storage – were previously announced but still lack clarity with a 2026 implementation deadline looming so close that Bulgaria risks losing its funding.

As seen across many European markets, a lack of a comprehensive policy framework for energy storage is hindering Bulgaria in the development of an energy storage market. Furthermore, Bulgaria's energy legislation and grid codes have been historically written with thermal plants in mind, especially with regards to ancillary services provision where revenue stacking is difficult to model for modern energy storage systems. As such, the overall regulatory framework still favors outdated generation technologies, making private investing in new storage facilities challenging and perceived as high risk.

Fortunately, Bulgaria is in a unique position to apply lessons learnt from other countries and identify changes required. A substantial number of countries have already adapted their grid codes, connection rules, and market participation regulation to allow technological progress and found success in various policies and initiatives for driving the build-out of energy storage.

REGULATION, REGULATION, REGULATION

Eliminating market and regulatory barriers for modern energy storage technologies to participate in wholesale energy markets, balancing energy markets, or ancillary services and capacity mechanisms, is widely accepted as the most efficient way to drive developments. The European Clean Energy Package that was adopted in 2019 provides clear guidance of policy measures for adoption by member states, including:

- Removing double-charging and grid fee barriers for energy storage
- Adopting a definition for energy storage in national energy legislation
- Enabling full access to markets for energy, capacity, and ancillary services
- Developing of market-based procurement of frequency regulation services
- Considering energy storage as an alternative to costly grid investments

Another key proposal from the EU level was also released in March 2023, when the European Commission published its reform proposal for the current Electricity Market Design. The proposal defines energy storage and flexibility as cornerstones of our future energy system[7] and requires member states to:

- Assess their flexibility requirements to implement the energy transition
- Define indicative national objectives for energy storage
- Implement flexibility support schemes to achieve national objectives, also allowing state-aid to be deployed to achieve stronger storage deployments

This new European policy framework provides Bulgaria, as well as other member states, both clear instructions and a great opportunity to speed up the deployment of energy storage. Some European member states, including Greece or Hungary are already implementing some of the most recently proposed flexibility support mechanisms and thereby provide templates for Bulgaria to follow.

TAX BENEFITS

When it comes to BtM energy storage systems in Bulgaria, several efficient methods can be implemented to incentivise investment. For example, tax and fees exemptions to prosumers could be offered, which include exemptions from charges, fees, and taxes on self-consumed electricity. This would incentivize prosumers to maximise their self-consumption ratio thus encourage investment into storage. Notably, the implementation of tax depreciation for storage installations would allow entities to write off a portion of their qualifying capital expenditure against its profits, indirectly improving storage business cases through tax alleviations, while also minimising administrative work for the government and the energy storage owner.

HYBRID RENEWABLE ENERGY AUCTIONS

Renewable + Storage auctions are a tried, tested, and practical approach to reduce the impact of accelerated renewable penetration on the grid. If designed right, they help fairly compensate for the full value storage brings and increase bankability for private investors. Pairing storage with renewables further enables:

- Higher utilisation of grid connections, resulting in lower requirements for grid extensions and grid fees.
- Reduction of renewable curtailment.
- Increased investments in renewable assets through reducing exposure to negative or low-price periods (renewable cannibalisation effect).
- Making renewables dispatchable and increasing capability of inverter-based technologies to provide system services.

While not widely spread across Europe, these auctions have been successfully implemented in Germany through provision of long-term guaranteed revenues for renewable-plus-storage systems. These can take various forms, such as auctions solely for co-located assets, minimum shares for co-located assets to be awarded in renewable auctions, or stand-alone storage auctions if assets are operated as part of a portfolio. Nevertheless, for high success, Bulgaria should look to clearly define how the hybridisation will be incentivized and ensure clear operating guidelines such that systems provide additional, nonremunerated benefits to the grid.

Renewable auctions were also a policy recommendation made by Fluence in a recent policy proposal piece titled "Reforming Electricity Market Design: Integrating Renewables to Decarbonize the Power Sector".

[7] European Commission (2023c) Commission proposes reform of the EU electricity market design to boost renewables, better protect consumers and enhance industrial competitiveness. (Accessed: 11th May 2022).

CASE STUDY

Germany

The German Innovation Auctions is a state-run auction that is run in parallel to auctions for wind, solar and other renewable generators. In these auctions, renewable generators are awarded 20-year feed-in-tariffs for the electricity they generate. For the co-located Innovation Auctions, solar assets must be equipped with energy storage, and exact provisions are made regarding the minimum sizing of the assets. The feed-in tariffs of the innovation auctions are higher than for pure renewable auctions, accounting for the additional CAPEX cost of the battery. Apart from the higher feed-in-tariff that is paid for the energy produced by the co-located renewable asset, the operators can use the batteries to shift the produced energy into the evening hours, when power prices are generally higher. The first Innovation Auction in Germany took place in 2020 and across the five auction rounds that took place since then a total of 1.5 GW of solar assets with roughly 450 MW of co-located batteries were awarded. Based on the current planning, another 5.3 GW of solar assets with a co-located 1.5 GW of battery storage will be awarded between 2023 and 2028.

Conclusion

Bulgaria is just beginning its energy transition. Wind and solar are highly cost-effective and paving the path to accounting for a much bigger share of Bulgaria's electricity mix. However, energy storage is required to facilitate a transformation to an intermittent and distributed system, enhancing grid stability and flexibility, while bringing benefits to the wider grid and its stakeholders. Peaking capacity, commercial and industrial applications, energy shifting, balancing, frequency response, and transmission infrastructure services are key areas where storage can contribute, while various options to facilitate storage's build out persist; renewable auctions, revision of regulations to eliminate barriers, and tax benefits. Bulgaria also sits in the privileged position where it can apply lessons-learned from other European countries that have successfully implemented storage through various policy and regulatory changes. Here, tailored activation signals must be chosen to unlock the full value of storage and strive toward predefined outcomes.

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About Fluence

Fluence Energy, Inc. (Nasdaq: FLNC) is a global market leader in energy storage products and services, and cloud-based software for renewables and storage. With a presence in over 40 markets globally, Fluence provides an ecosystem of offerings to drive the clean energy transition, including modular, scalable energy storage products, comprehensive service offerings, and the Fluence IQ Platform, which delivers AI-enabled digital applications for managing and optimizing renewables and storage from any provider. Fluence is transforming the way we power our world by helping customers create more resilient and sustainable electric grids.

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To stay up to date on the latest industry insights, sign up for Fluence's Full Potential Blog.

About APSTE

The Association for Production, Storage, and Trading of Electricity (APSTE) is a non-profit organization supporting the development and market integration of renewable energy and energy storage technologies in Bulgaria. The association represents the interests of more than 50 local and international companies along the entire value chain of generation, storage, and trading of electricity from renewable energy sources, including project development, EPC services, technical, legal, and financial consulting, as well as R&D and manufacturing of power electronics and energy conversion technologies.

APSTE advocates for and works towards development of adequate policies and regulatory framework in Bulgaria to support the transition to a sustainable, low-carbon and secure energy system.

Find more about the association at www.apste.eu.