CENTER FOR THE STUDY OF DEMOCRACY

BALANCING BULGARIA'S ENERGY FUTURE

Policy Brief No. 160, October 2025

Bulgaria stands at a **critical crossroads of its energy transition**. While the rapid uptake of solar power demonstrates the market's dynamism and investor appetite for renewables, the **absence of coherent policy direction**, delayed liberalisation, and chronic underinvestment in grid and storage infrastructure have created **growing imbalances in the electricity system**. The result is an uneven and insecure transformation, where political resistance to phasing out coal coexists with the uncoordinated rise of intermittent renewables. Unless Bulgaria develops a balanced, technology-neutral approach that simultaneously strengthens the grid, scales up energy storage, and unlocks its vast wind potential, it risks replacing dependence on fossil fuels with new systemic vulnerabilities. Modernising the grid, improving market governance, and integrating Bulgaria more deeply into the regional electricity system can turn the energy transition from a reactive process into a driver of economic competitiveness and industrial resilience.

KEY POINTS

- Despite ambitious renewable targets, Bulgaria's energy transition remains stalled by **delayed market liberalisation** and volatile policy decisions.
- Power price subsidies and **regulatory uncertainty undermine investor confidence** and private investment in renewables and grid modernisation.
- Urgent investment is necessary to **modernise and digitalise the power grid**, improving flexibility, reliability, and regional interconnection.
- **Battery storage systems must be a priority** to ensure grid stability and efficient integration of intermittent renewable output.
- Onshore wind development is stifled by a lack of political commitment, **excessive bureaucracy**, outdated permitting rules, and revenue caps.
- Bulgaria is yet to adopt a **dedicated regulatory framework to attract offshore wind investment interest**, as well as upgrade port and grid infrastructure.

The EU is on course to meet its 55% emissions reduction target by 2030,[1] whilst completing its full decoupling from corrosive Russian energy dependence. In response to the emerging risks related to the security of clean tech supply chains and critical materials, the European Commission (EC) has adopted a more flexible and pragmatic approach towards achieving its intermediate **goal of 90% net GHG emissions reduction by 2040**, compared to 1990 levels.[2] This is supported by the Green Deal Industrial Plan.[3] EC policies for accelerating low-carbon economic growth offer Bulgaria both a strategic window of opportunity and the necessary financial resources to **enable the much-needed industrial transformation, while meeting its climate objectives**.

On paper, Bulgaria has embraced these ambitions. In reality, however, Bulgaria's **energy transition policy has stumbled**, on the one side, into the state-dominated, fossil fuel-heavy electricity system, which is resistant to change; and on the other, into a dynamic, market-driven push for intermittent renewables. **Successive governments have resisted phasing out coal,** benefitting incumbent oligarchic networks. Widespread information manipulation about the

[1] European Commission, REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality, July 2025.

[2] European Commission, 2040 climate target, July 2025.

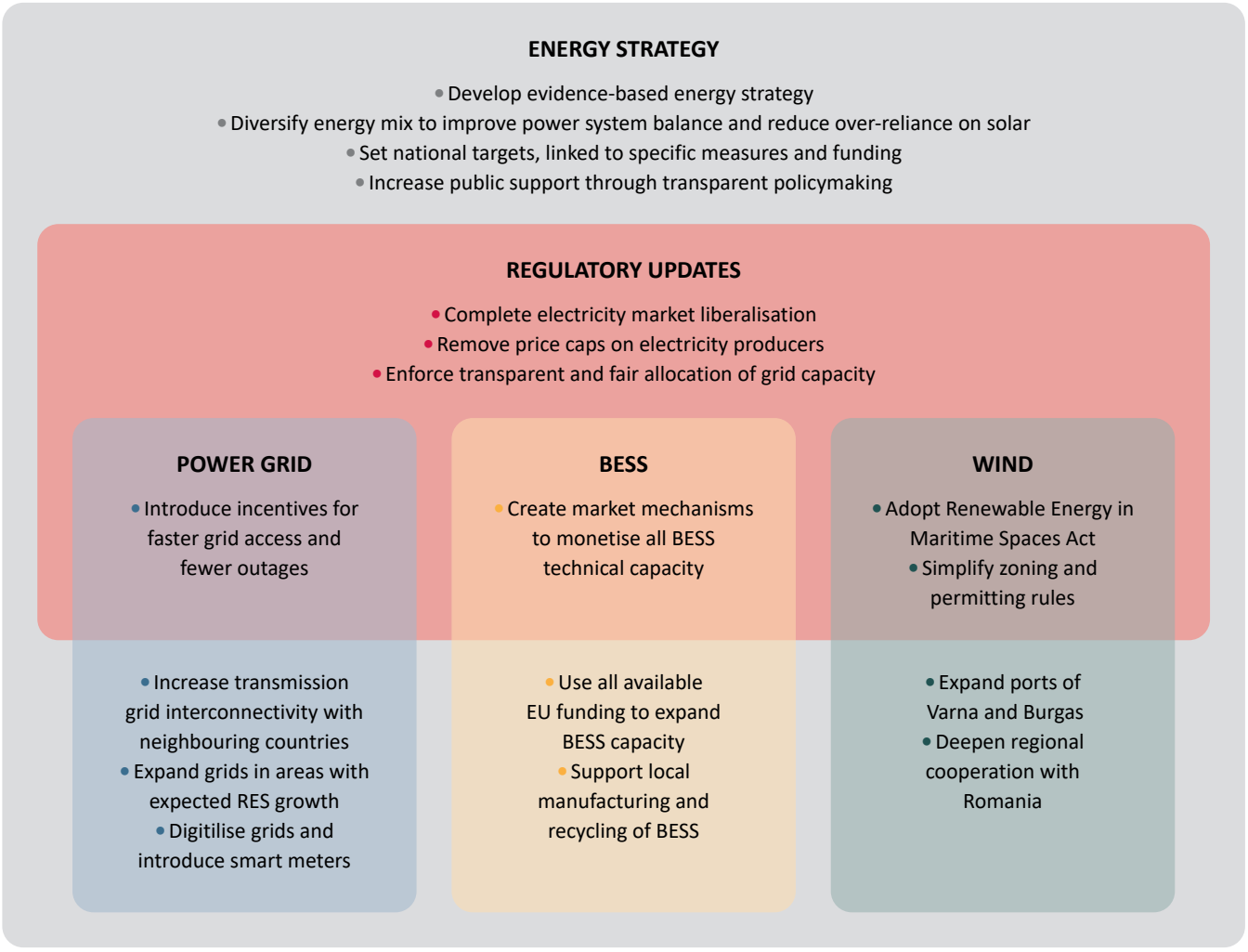
[3] European Commission, The Green Deal Industrial Plan: Putting Europe's net-zero industry in the lead, February 2023.

role coal power plants play in the energy system has **undermined public support for decarbonisation**. To maintain the coal sector through direct and indirect state support mechanisms, **Bulgaria has refused to liberalise the electricity market**. The EC, which included the power market liberalisation as a precondition for the disbursement of the second payment under the Recovery and Resilience Mechanism, has agreed to dilute the key reform so that households continue paying a regulated tariff, set below the average market price.

Bulgaria's renewable sector is booming and exceeding any official forecasts, despite being characterised by a **patchwork of policies**. Bulgaria now boasts 5.4 GW of solar photovoltaics (PV), with battery storage quickly catching up with 1300 MWh of installed capacity by mid-2025. At the same time, Bulgaria is missing a huge opportunity for the low-carbon transition of the power sector by **systematically obstructing the development of the wind sector**. Despite a techno-economic potential of over 10 GW, installed onshore wind capacity has remained below 1 GW for more than a decade. The lack of a dedicated regulatory framework and widespread political scare campaigns against offshore wind have blocked investments worth at least EUR 20 billion in the Black Sea.

While the surge in PV will likely help Bulgaria achieve its national objective of a 34.48% share of renewable energy in gross final energy consumption by 2030, it has also highlighted some emerging **imbalances in Bulgaria's electricity system**. The fundamental shift away from a few large-scale power plants, located away from consumers, towards smaller, dispersed and intermittent power sources requires a radical and carefully planned redesign of Bulgaria's electricity

Figure 1. Strategic Policy Measures Supporting Bulgaria's Low Carbon Transition



Source: *CSD.*

system. The transformation should be realised within a transparent, comprehensive and well-timed energy policy framework and strategy, based on three main pillars:

- **Modernisation of the electricity grid**, enhanced interconnectivity with neighbouring countries and widespread digitalisation. Bulgaria should make the most of available EU funding to upgrade and expand its power grid.

- Introduction of more **flexible energy storage** through Battery Electricity Storage Systems (BESS), especially in light of delays in repairing the 800-MW Chaira pumped storage hydropower plant. Market reforms must enable battery operators to profit from the technology's full range of services.

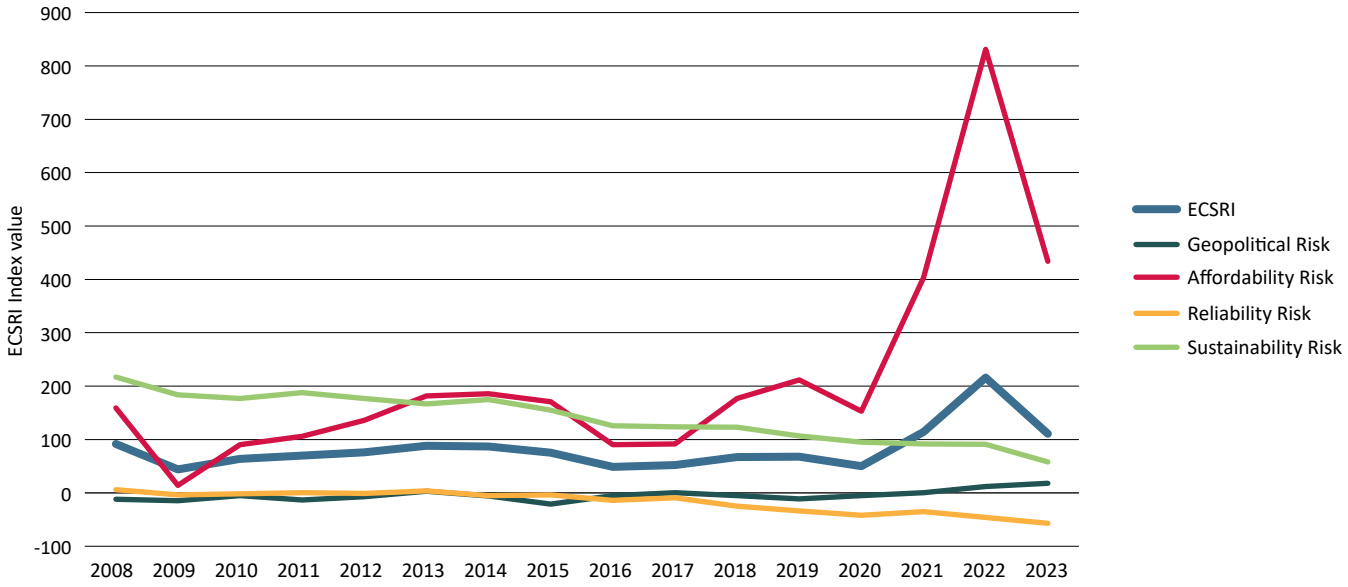
- **Unblocking Bulgaria's wind sector**, which can counterbalance PV at low production times (e.g. at night or on shorter winter days), thus reducing the reliance on expensive fossil fuel-based generation or imports. The wind sector, both onshore and offshore, should finally be recognised as a key asset for Bulgaria's energy transition, and regulatory roadblocks should be removed, first by simplifying the complex and lengthy permitting procedures and adopting the Renewable Energy in Maritime Spaces Act.

Diagnosing the Imbalance

Bulgaria remains among the most energy and climate-insecure countries in the EU, a reflection of deep structural vulnerabilities, including a fossil-fuel-heavy energy mix (77% in 2022, including 25% coal), slow progress on upscaling renewables, and the persistent dependence on Russian natural gas imports. The unbalanced energy transition exposes Bulgaria's carbon-intensive industries to mounting costs under the EU Emissions Trading System, with CO_2 intensity of its GDP among the highest in Europe. Energy **affordability risks pose the biggest threat to the country's competitiveness and decarbonisation** objectives. Around a fifth of households remain energy poor despite regulated power, district heating and gas prices. Without accelerating the diversification of the energy mix, the upgrade of the electricity grid, and the improvement of energy efficiency, Bulgaria risks an extended fossil fuels lock-in and losing competitiveness in a decarbonising Europe.[4]

These structural risks are compounded by the rapid electrification of the household and industrial energy consumption, which is placing mounting pressure on Bulgaria's outdated grid and exposing the limitations of an unbalanced expansion of renewable energy capacities. Bulgaria has the highest **rate of electrification** in the EU – 27.4% of final energy

Figure 2. Bulgaria's Energy and Climate Security Profile



Source: *CSD based on ECSRI data.*

[4] Vladimirov, M., Köppen, M., and Rickles, M., *Energy and Climate Security in Europe: From Crisis Response to Structural Transformation*, Sofia: Center for the Study of Democracy, 2023.

consumption, compared to a 24% average in 2023[5] – and the trend is set to continue, especially as many Bulgarians are switching to electricity to heat and cool their homes (as much as 71% in 2023, compared to 29% in 2011[6]).

The electricity grid is struggling to handle the growing electricity consumption, leading to **blackouts during peak demand periods**. At the end of 2024, over 20,000 households were left without power during the winter holiday season due to a lack of grid maintenance. Larger-scale blackouts, such as the ones on the Iberian Peninsula[7] and in North Macedonia[8] in 2025, are likely to occur if grid management protocols and technical upgrades are not introduced. Fears around unreliable electricity supply, often blamed on the surge of renewables, can in turn lead to even **lower support for the adoption of new low-carbon technologies** – 73% of Bulgarians support the EU's climate neutrality goals, compared to the EU average of 81%.[9] Yet, even these figures likely overestimate the actual social acceptance or understanding of low-carbon policies.

Given the current geopolitical environment, relying predominantly on one technology, in Bulgaria's case – solar photovoltaics, poses additional risks. While Europe is phasing out its dependence on Russian energy imports, it is becoming increasingly **reliant on the supply of raw materials and renewable energy equipment for the green transition**. To strengthen its economic security and strategic autonomy in the energy sector, Europe must strengthen its own manufacturing capabilities.[10] Both solar and wind are susceptible to supply chain disturbances and reliance on China. PV production is dependent on copper, aluminium, glass and components such as power converters, while turbines require copper, rare earths, power inverters, and blades. Europe is lagging significantly behind China in terms of cost competitiveness in solar panel and inverter manufacturing, but still has a competitive edge in wind turbine and blade technologies, especially in the offshore wind subsegment.

Bulgaria can contribute to Europe's industrial resilience by developing local clean-tech manufacturing that complements renewable deployment. Around 7,000 Bulgarians are already employed in the sector, with **firms increasingly moving beyond assembly**, mostly of Chinese components, into engineering and energy-flow optimisation software, leveraging the country's strong information technology sector. Bulgaria is also becoming a **leader in large-scale battery storage manufacturing** thanks to an EU Strategic Project,[11] designed to meet up to 15% of Europe's demand for batteries. By investing in fully automated production and using its own engineering for inverters and liquid cooling/control systems, the project is a direct competitor to Chinese products. Furthermore, a large share of the components originates from other European countries, while the raw materials are sourced in Bulgaria, reducing the manufacturer's import dependence. This industrial shift is still at an early stage, but it highlights Bulgaria's potential to become not only a consumer of low-carbon technology but a contributor to Europe's net-zero manufacturing base.

In light of these risks and emerging opportunities, Bulgaria's successful low-carbon transition and upscaling of low-carbon technologies requires a transparent and evidence-based approach, based on a combination of **regulatory updates and technological upgrades** that address the widespread public susceptibility to disinformation and growing mistrust towards expert opinion and complex analyses, thus ensuring public support for decarbonisation. The 2025 update of the National Energy and Climate Plan (NECP)[12] provided an ideal opportunity to develop a coherent long-term strategy, integrating both decarbonisation and energy security goals. However, the Plan was largely used to justify the **preservation of the coal power plants and the construction of two new nuclear reactors**, instead of defining evidence-based policies and comprehensive measures that would support the balanced adoption of different low-carbon technologies, going beyond PV[13].

[5] Eurostat, Rate of electrification.

[6] Bezlov T. et.al., *Mapping Illegal Logging And Timber Trade: Promoting Sustainable Environmental Solutions to Tackle Energy Poverty in Bulgaria*, Sofia: Center for the Study of Democracy, 2023.

[7] ENTSO-E, 28 April 2025 Blackout.

[8] ENTSO-E, Incident in the power system of North Macedonia on May 18th.

[9] European Commission, Eurobarometer on Climate Change, June 2025.

[10] Center for the Study of Democracy, *Economic Security and Strategic Autonomy*, Policy Brief No. 156, March 2025.

[11] Chepilski, A., "The Bulgarian company IPS aims for 15% of the European battery market", [Българската IPS се цели в 15% от европейския пазар на батерии], *Capital*, 17 October 2025.

[12] European Commission, Bulgaria – National Energy and Climate Plan 2021-2030, 15 January 2025.

[13] Center for the Study of Democracy, *Realigning Bulgaria's Energy and Climate Strategy*, Policy Brief No. 154, March 2025.

Industrial and System Resilience Through Grid Modernisation

The strengthening of the European **electricity grid is a key enabling technology** for digitalisation and rapid electrification.[14] To reach its 2050 net-zero target, the EU's share of renewable electricity production must reach 65% by 2030[15] and handle larger and more fluctuating power flows.[16] Yet, the EU's distribution grid, where most renewable capacity is connected, is ageing, and by 2030, up to **55% of European low-voltage lines will exceed 40 years in service**.[17]

Grids face mounting **interconnected challenges** that threaten both reliability and decarbonisation goals. Renewables are located in remote areas and create variability and **congestion risks**, often leading to production curtailments. Insufficient investments hinder the system's ability to handle **intermittent and bi-directional energy flows**. Long permitting processes and **extended lead times** between planning and implementation delay the necessary upgrades. Finally, **extreme weather events and growing cyber threats**, especially from Russia,[18] create high risks for a major reliability of supply crisis, such as the blackout episode on the Iberian Peninsula in April 2025. Whether the cause of an outage is technical, environmental, or malicious, the economic costs can reach billions, underscoring the urgency of modernisation actions.[19]

The Russian invasion of Ukraine exposed the **fragmentation of Europe's energy market** and the limited integration of its national electricity systems and grids. Stronger cross-border infrastructure and market integration would both support the shift to renewables and lower regional price disparities, supporting economic growth.[20] Southeast Europe, including **Bulgaria, faces higher electricity prices** than Western and Northern European countries, due to inadequate interconnection capacity. Bulgaria aims to increase its current net transfer capacity from 4500 MW to 10,000 MW[21] and is developing joint projects with Romania[22] and Greece[23] to expand capacity by at least 1200 MW. Despite these expansion projects, Bulgaria is expected to remain a net importer of electricity until 2030.[24] To alleviate the import dependence, Bulgaria should aim to mobilise the regional cooperation formats for the realisation of the **East and Central Balkan Corridor projects**, adding 2000 MW of cross-border capacity. The result will be price convergence, improved system flexibility, and more cost-effective cross-border RES projects integration.

Alongside insufficient interconnection capacity, Bulgaria's domestic electricity grid suffers from additional bottlenecks. Despite the limited grid capacity to accommodate all new generation facilities, Bulgaria has seen a **massive surge in PV** installations since 2020 and, more recently, in batteries. By mid-2025, the country's solar capacity amounted to 4.5 GW and is expected to reach 6 GW in 2026, if all planned projects become operational.[25] While positive for the overall decline in energy sector emissions, the rapid expansion of PV facilities **far exceeds official scenarios, including those of the Transmission System Operator (TSO)** and requires the introduction of more complex balancing activities. Yet, there is no clarity about which entities should bear these system costs. Furthermore, there is an urgent need for more accurate and timely information exchange between different market players.

Bulgaria's grid infrastructure suffers significant **losses, amounting to 5.37% or 2516 GWh in 2022**[26] (close to the EU average), the cost of which is passed

[14] Draghi, M. et. al, *The Future of European Competitiveness—A Competitiveness Strategy for Europe*, European Commission, September 2024.

[15] European Commission, Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people, Brussels, 17 September 2020.

[16] Heussaff, C., and Zachmann, G., *Upgrading Europe's electricity grid is about more than just money*, Brussels: Bruegel, 12 February 2025.

[17] Eurelectric, "Why the distribution grid must be a critical enabler of Europe's energy transition", 24 May 2024.

[18] Eurelectric, "Cybersecurity in the power sector", 21 February 2025.

[19] Faus, J., "Post-blackout in Spain and Portugal, companies count the cost", *Reuters*, 29 April 2025.

[20] International Monetary Fund, Integrating the EU Energy Market to Foster Growth and Resilience, 13 January 2025.

[21] Electricity System Operator, "ESO's projects for network development and expansion of interconnection capacity has set a target of 10,000 MW cross-border capacity" [10 000 MW да достигне трансграничният капацитет на страната ни целят проектите на ECO за развитие на мрежата и разширяване на междусистемната свързаност], ESO, 17 June 2025.

[22] ENTSO-E, project TR 138 – Black Sea Corridor.

[23] ENTSO-E, project TR 142 – CSE4.

[24] Electricity System Operator, Development Plan For The Transmission Electricity Network Of Bulgaria For The Period 2025-2034.

[25] Capital.bg "Another 1,500 MW of new photovoltaic capacity will come online in Bulgaria very soon" [Още 1500 мВт нови фотоволтаици ще заработят в България съвсем скоро], 28 July 2025.

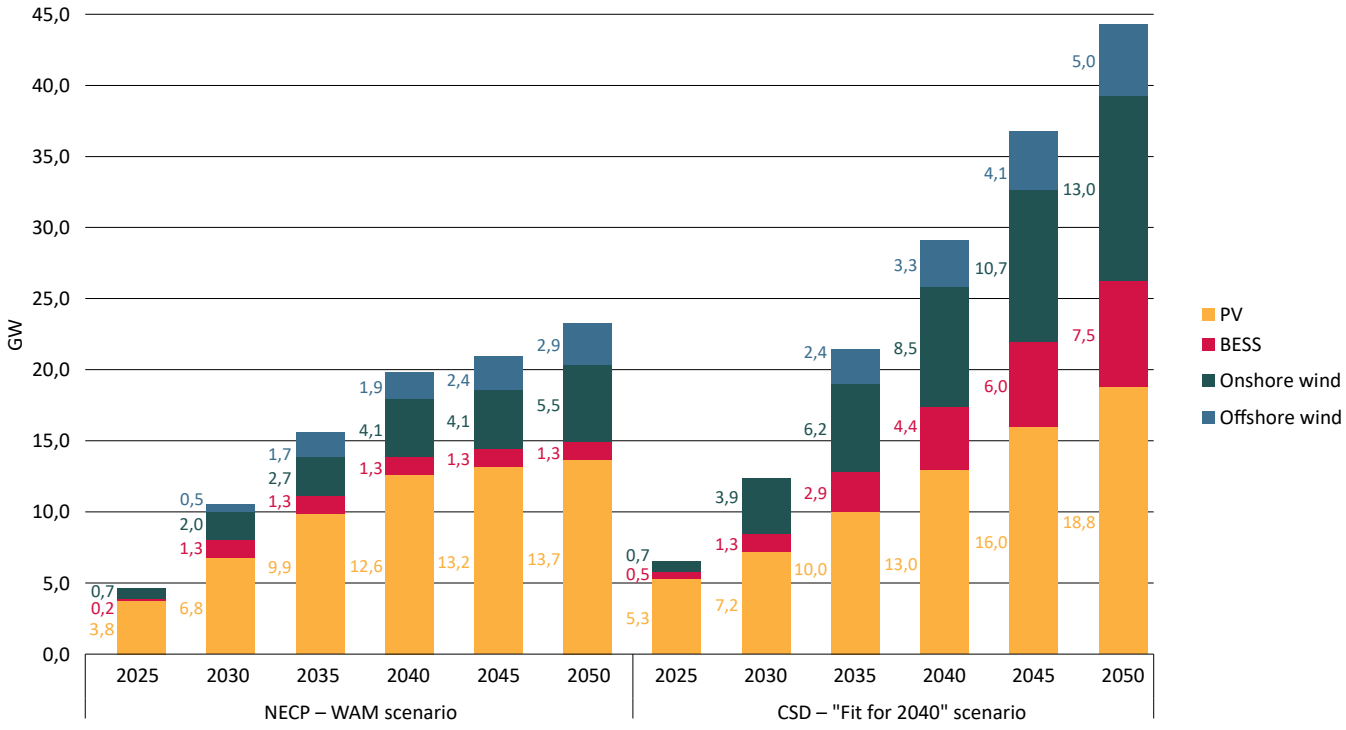
[26] Council of European Energy Regulators, "3rd CEER Report on Power Losses", Brussels, 11 February 2025.

directly to the final consumer. Frequent **service interruptions**, exacerbated by recent extreme weather events, led the government to adopt **legislative amendments** increasing the fines for outages up to fivefold, strengthening regulatory oversight over investment plans and mandating Distribution System Operators (DSOs) to allocate 30% of their investments to grid modernisation.[27] These **punitive provisions** target DSOs, while excluding the TSO, and risk double penalties for the same incident. The collected fines are diverted into the state budget and do not go towards actual grid upgrades. A more effective approach would link financial incentives to lower outage periods or reduced distribution losses, ensuring resources flow directly into system modernisation and reliability.

Given DSO's limited capacity to absorb new renewable projects and their restricted budgets, **operators have exploited regulatory gaps to delay or obstruct new connections**. They do not publish data on available grid capacity, and allocation procedures are opaque and highly bureaucratic. The process of estimating and allocating grid expansion costs is not well defined, which DSO's use to their advantage and often **overburden investors with excessive upgrade costs**. To improve the maintenance of the distribution system, the government should fill regulatory gaps and **create direct incentives for faster connections** of new users and maximising existing grid efficiency, either through upgrades or digital tools.

The **slow pace of digitalisation** remains a major weakness and smart meters, essential for grid management and consumer empowerment, are barely deployed. The official smart meter penetration rate in Bulgaria as low as 1%,[30] but DSOs claim that as much as 34% of currently installed meters have remote

Figure 3. Projected Installed Capacity of Solar PV, Onshore and Offshore Wind and BESS in Bulgaria Until 2050



Source: *NECP WAM scenario,[28] CSD "Fit for 40" scenario.[29]*

[27] Amendment to the Energy Act, [Закон за изменение и допълнение на Закона за енергетиката], last amended on 11 August 2025.

[28] European Commission, Bulgaria – National Energy and Climate Plan 2021-2030, 15 January 2025.

[29] Vladimirov, M. et al., *Fit for 2040: Reconciling Climate Ambition with Energy Security and Growth*, Sofia: Center for the Study of Democracy, 2025.

[30] European Union Agency for the Cooperation of Energy Regulators (ACER), Energy Retail and Consumer Protection: 2023 Market Monitoring Report, September 2023.

functionalities.[31] DSOs are responsible for installing, maintaining, and managing smart meters,[32] but there is **no clear regulatory mandate for nationwide deployment**. This could be rectified by introducing amendments to the Energy Act to allow dynamic pricing and billing based on smart meter data and new rules under the Electricity Measurement framework to mandate DSOs to provide hourly or 15-minute metering. Traders should receive preferential access to manage the settlement process, and a data-sharing framework to ensure secure, GDPR-compliant exchange of information with full consumer control over permissions should be introduced. If consumers have accurate and transparent information about their power usage, they will have an incentive to save more electricity, while DSOs would collect real-time data on grid use, enabling them to provide more reliable and efficient services.

Box 1. Norway's Grid Regulation: Balancing Profits, Security of Supply and Decarbonisation[33]

Norway's **regulatory framework** requires DSOs to ensure reliable supply and non-discriminatory access while complying with technical standards for safety and stability. The regulator enforces these rules through quality standards, grid codes, and system responsibility obligations. DSOs must also maintain emergency preparedness and coordinate with the TSO. This ensures DSOs prioritise secure operation while upgrading networks to meet demand.

Norway's **revenue cap model** combines cost recovery with efficiency incentives. DSOs recover 40% of actual costs and 60% through benchmarking against peers, providing predictable investment income, while encouraging efficiency. This mechanism cuts revenues when outages occur, directly linking financial performance to supply reliability, ensuring that operators can invest while being held accountable for service quality.

Grid tariffs fund operation, maintenance, and reinforcement, while encouraging efficient grid use. Households face a fixed fee (partly capacity-based) as well as variable charges that rise in peak hours. Industrial users pay according to load profiles and marginal losses. This structure reflects real costs, supports demand management, and gives DSOs steady income for upgrades, all under strict regulatory oversight.

Grid connections require technical and economic feasibility checks to ensure grid stability and socio-economic value. DSOs plan and deliver necessary reinforcements, while applicants are offered standardised terms and costs. Conditional connections may be approved, but only if they safeguard the system. This ensures that integration of new capacity strengthens, rather than destabilises, the grid.

When demand exceeds capacity, DSOs and the TSO run **transparent capacity queues**, combining first-come-first-served with maturity criteria. From 2025, only projects meeting strict readiness standards will secure access to the grid, preventing speculative or inactive projects from blocking access.

Local flexibility markets give DSOs an alternative to costly grid reinforcements. Platforms such as NODES allow operators to procure demand response, storage, and distributed generation to manage congestion. By sourcing flexibility products, DSOs can stabilise the grid, integrate more renewables, and defer major investments. Success depends on active participation, clear regulation, and digitalisation.

[31] Eurelectric, Power Barometer 2023

[32] Electricity Measurement Rules and Grid Connection Ordinance [НАРЕДБА № 6 ОТ 24 ФЕВРУАРИ 2014 Г. ЗА ПРИСЪЕДИНЯВАНЕ НА ПРОИЗВОДИТЕЛИ И КЛИЕНТИ НА ЕЛЕКТРИЧЕСКА ЕНЕРГИЯ КЪМ ПРЕНОСНАТА ИЛИ КЪМ РАЗПРЕДЕЛИТЕЛНИТЕ ЕЛЕКТРИЧЕСКИ МРЕЖИ].

[33] Norwegian Energy Regulatory Authority.

Batteries as the New Backbone of Flexibility

Alongside the expansion and modernisation of the grid, **battery storage will play a key role in balancing of the power grid**. Until its breakdown in 2022, Bulgaria relied mostly on the 800-MW Chaira pumped storage hydropower plant (HPP). The government aims to increase Chaira's continuous operation time in power generation mode from 8.5 to 22 hours,[34] as well as construct two new HPPs at Batak and Dospat, which would provide approximately another 800 MW in generation mode and 730 MW in storage mode each.[35] However, the National Electricity Company has struggled to choose a contractor to repair Chaira and secure EUR 1.8 billion for the two new facilities, whilst **losing about EUR 20 million monthly** due to the failure to produce electricity, when power prices are high.

Bulgaria has recently deployed a much more flexible solution for its power storage needs – BESS. Since the first utility-scale facility became operational in June 2024, in just one year, the country has already installed 450 MW worth of batteries, amounting to around 1500 MWh of storage capacity, and the TSO projects that the installed capacity can **reach 11,000 MW (32,000 MWh) by the end of 2026**.[36] This would amount to the entire output of Kozloduy nuclear power plant for 5 hours, or the country's entire electricity consumption for about 3 hours during the day.[37]

The exponential growth in battery storage is largely thanks to the RESTORE project[38] for the allocation of EU funding support for storage infrastructure and a smaller tender, targeting hybrid RES facilities co-located with BESS,[39] launched in 2024. Although the government hopes to disburse about **EUR 0.77 billion**, secured through the Recovery and Resilience Facility, before its March 2026 deadline, industry representatives are concerned that **many projects will not be implemented in time** due to a lack of administrative capacity and technical training within the government. The administrative bottlenecks may be further compounded by intentional order delays, as many investors only placed their orders in May 2025 to incorporate the newest BESS technologies available on the market.

Despite the uncertainty around the completion of the government-funded project, the price, construction times, flexibility in locations, and environmental footprint of BESS compared to HPPs suggest that the **government should double down on its support for the expansion of battery storage** in the coming years, which will balance the growing share of RES in Bulgaria's power system and ensure the long-term revenue predictability for RES investors.[40]

Since 2023, Bulgaria's electricity market rules[41] have provided a clear legal framework for BESS operators, distinguishing them as a **distinct category of commercial participants**, with defined processes for registration, grid connection, and participation in wholesale and balancing markets. Most importantly, the regulation allows them to participate in both the balancing and ancillary services markets.

Storage operators can offer both upward and downward balancing by either injecting or withdrawing electricity. They are eligible to **provide reserves for primary, secondary, and manual frequency regulation**, earning revenues either through fixed payments for keeping capacity available (capacity reservation), or through variable income when called to deliver balancing energy (activation). Importantly, all activated balancing offers are remunerated under a **"Pay as Clear" model**, which rewards efficient bidding and creates additional profit potential.

Beyond grid services, BESS operators can also **trade electricity on the Day-Ahead and Intraday markets**, engaging in price arbitrage by buying at low prices and selling at peaks. They are entitled to conclude bilateral contracts at freely negotiated prices and may also participate via aggregators, pooling capacity with

[34] National Electricity Company.

[35] European Commission, Bulgaria – National Energy and Climate Plan 2021-2030, 15 January 2025.

[36] Electricity System Operator, "ESO's projects for network development and expansion of interconnection capacity has set a target of 10,000 MW cross-border capacity", ESO, 17 June 2025.

[37] Stanchev, I., "Battery-powered sun: Bulgaria can now store 1,300 MWh of energy from renewable sources", [Слънце на батерии: България вече може да съхранява по 1300 мВтч енергия от ВЕИ], *Capital*, 10 July 2025.

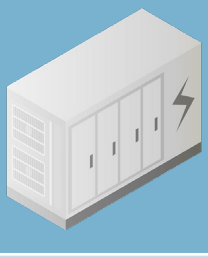
[38] Ministry of Energy, "National Infrastructure for Storage of Electricity from Renewable Sources (RESTORE)".

[39] Ministry of Energy, "Support for new capacities for electricity generation from renewable sources and electricity storage".

[40] European Commission, Recommendation of 14 March 2023 on Energy Storage – Underpinning a decarbonised and secure EU energy system 2023/C 103/01.

[41] Energy and Water Regulatory Commission, Rules for trading with electrical energy [Правила за търговия с електрическа енергия], last amended on 1 July 2025.

Table 1. Main Features of BESS and Pumped Storage Hydropower Plants

	Battery Energy Storage Systems	Pumped Storage Hydropower Plants
		
Installed Capacity Mid-2025	450 MW	1400 MW (generation mode from HPPs Chaira, Belmeken and Orfey)
Planned Installed Capacity	11 000 MW – 2027	3000 MW (following construction of Batak and Dospat) – 2032 at the earliest
Construction Costs	EUR 2 billion for 10 000 MW of capacity	EUR 1.8 billion for construction of two new HPPs (1600 MW)
Time for Installation/ Construction	Several months to 2–3 years (depending on scale). Modular, deployable at various sites.	7–10+ years. Requires extensive civil works, permits, and large infrastructure projects.
Environmental Footprint	Small land footprint; scalable; can be located near demand centers. Environmental impact mainly linked to mining and disposal of lithium, cobalt.	Large footprint due to dams, reservoirs, and water diversion; significant ecosystem disruption (habitats, river flow, biodiversity). Long-term landscape alteration.
Supply Chain Issues	Dependent on critical minerals (lithium, nickel, cobalt, rare earths). Vulnerable to global supply disruptions and price volatility. Recycling technologies still emerging.	Requires conventional construction materials (concrete, steel, turbines). Less exposed to rare mineral supply chain issues, but highly site-specific (needs suitable topography and water resources).

other assets to access more complex services. The regulation also includes provisions to **prevent double-charging** of network fees, by applying tariffs only to net consumption, further strengthening profitability.

BESS' profitability could be enhanced if authorities introduce additional market mechanisms, thus enabling **revenue stacking** through varied short and long-term funding sources. Following the UK's example, Bulgaria could set up a **capacity market mechanism**,[42] also open to BESS, which uses competitive auctions, held either one or four years before the electricity is actually delivered. This method secures a reliable electricity supply, encourages new RES and storage capacity development and lowers investment risks. DSOs can also make use of BESS' services by offering **local congestion relief/ flexibility contracts**, procured either through tenders or local flexibility markets, ensuring local flexibility and other system-level services that sit outside national balancing markets.

[42] UK government, Capacity market.

Unlocking Wind Power to Balance the System

Bulgaria can significantly reduce grid imbalance risks by tapping into its wind power potential, a free, domestic resource that could anchor its green transition. The country's **wind sector has stalled at only 0.7 GW of installed capacity since 2015**. This is not only detrimental to Bulgaria's decarbonisation goals and discouraging for investors, but also misses the opportunity to use a mature and profitable low-carbon technology to balance the power grid, particularly at times of limited PV production. Neither the NECP nor any other government strategy take any concrete steps towards unlocking the sector and removing the artificially imposed regulatory and legislative barriers currently blocking its development.[43] Under the NECP WAM scenario, by 2050, the combined onshore and offshore wind capacity would amount to 8.3 GW, but CSD's estimations suggest that **Bulgaria could have as much as 23 GW of installed wind capacity** (10 GW onshore and 13 GW offshore) by mid-century.[44]

Onshore Wind: Breaking the Deadlock

Half of Bulgaria's onshore wind potential could be realised through projects already under development, but these face significant barriers that undermine investor confidence. Although **onshore wind has a lower average levelised cost of electricity (LCOE) in Europe than solar** (EUR 0.044 /kWh vs EUR 0.051 / kWh, weighted average for 2024[45]), and can operate for roughly 2,600 hours per year, compared to no more than 1,700 hours for PV, the uptake of new projects in the sector has stalled for 10 years.

The first challenge is the slow, opaque, and bureaucratic permitting processes, with unclear methodologies for calculating grid connection costs and multiple layers of approval. The **absence of a coherent national strategy or long-term planning framework** leads developers to submit speculative applications, further clogging the administrative system. To unlock the sector's potential, the government must **demonstrate clear political commitment** by aligning its NECP target of 13 GW of installed wind capacity by 2050 with concrete actions, including streamlining environmental assessments, simplifying zoning rules, and clarifying grid connection procedures.[46]

Another key obstacle is the revenue cap for electricity producers, set at EUR 153.39/ MWh,[47] which undermines market principles and discourages long-term investment that can take up to 10 years to complete from concept to operation. Under this regime, **producers cannot benefit from high wholesale prices** but continue to bear the full market risk during low or negative price periods. As a result, their effective revenues fall well below the capped level, particularly when combined with existing obligations, such as the 5% levy paid to the Electricity System Security Fund, trading fees due for participating on the power exchange, and rising balancing and operational costs. These overlapping restrictions significantly limit profitability, creating uncertainty for both current and prospective renewable investors.[48]

Left without strategic support, **onshore wind continues to face persistent social acceptance and environmental challenges**. Public opposition, often driven by concerns over noise, landscape impact, and biodiversity, is compounded by disinformation campaigns exaggerating potential health and environmental risks. Common unfounded myths include high risks to wildlife, and birds in particular, as well as a miscalculation of the actual footprint of wind farms on agricultural land. In fact, all existing RES projects occupy less than 0.1% of Bulgaria's arable land, far less than the area used by coal infrastructure. These false narratives have made local authorities increasingly hesitant to issue wind construction permits. Moreover, Natura 2000 protections, while not prohibitive, often result in rejections or delays, adding further uncertainty.

Last but not least, grid infrastructure remains a critical constraint before the projects' implementation. The concentration of wind energy resources in Northeastern

[43] CSD, *Realigning Bulgaria's energy and Climate Strategy*, 2025.

[44] Vladimirov, M. et al., *Exiting the Vicious Cycle: Long-term Vision for Decarbonisation and Transformation of the Bulgarian Economy*, Sofia: Center for the Study of Democracy, 2024.

[45] International Renewable Energy Agency, Renewable Power Generation Costs In 2024, Abu Dhabi, 2025.

[46] Center for the Study of Democracy, *The Lowest Hanging Fruit: Wind Energy Potential in Bulgaria*, Policy Brief No. 138, September 2023.

[47] Council of Ministers, Decision 340 from 28.05.2025 on For Determining the Values Used to Calculate the Revenue Cap for the Respective Type ff Electricity Producer [Решение 340/ 28.5.2025 г. За определяне на стойностите, които служат за изчисляване на тавана на приходите за съответния тип производител на електрическа енергия].

[48] Official position of representatives of the renewable energy sector in relation to the proposed extension of the revenue cap applied to electricity producers, 24 June 2025.

Bulgaria coincides with limited transmission capacity. While the TSO has recognised the need for upgrades, its current investment plans underestimate the required scale, creating a risk of bottlenecks that could block otherwise viable projects. **Competition for grid access between wind and solar** projects aggravates this challenge, while the introduction of high booking fees for grid capacity further deters investment, especially from smaller or new market entrants. Without timely network upgrades and transparent rules for grid allocation, many planned projects risk becoming stranded assets, jeopardising Bulgaria's ability to reach its 2050 wind and overall renewable energy targets.[49]

Offshore Wind: Bulgaria's Unseized Opportunity

Offshore wind continues to be a linchpin in the EU's energy and competitiveness plans, potentially reaching 88 GW of installed capacity by 2030 and up to 360 GW by mid-century.[50] Yet, Bulgaria remains one of the few littoral states with a non-existent offshore wind sector, which amounts to at least EUR 20 billion in missed investment opportunities. Bulgaria's Black Sea holds **116 GW of technical offshore wind potential** (26 GW bottom-fixed and 90 GW floating), with suitable areas near Shabla, Varna, Obzor, and the Turkish maritime border.[51] To unlock this potential, Bulgaria must set clear national deployment targets, linked to timelines, develop the necessary regulatory framework and market mechanisms and commit to developing the necessary port and grid infrastructure, whilst building public support for the industry.

The first step in developing a dedicated, transparent **regulatory framework** for offshore wind is to determine national, legally-binding objectives for offshore wind deployment, which should amount to at least 1 GW of installed capacity by 2030 and **6 GW by 2050**.[52] To meet these targets, Bulgaria must adopt the **Renewable Energy in Maritime Spaces Act**,[53] which already passed the first reading in Parliament. This is a crucial prerequisite to attract investments, as the legislation sets out key provisions clearly defining the duties and responsibilities of all public authorities, the appointment of a permanent advisory body to manage the different stages of each project, the inclusion of offshore wind in Marine Spatial Planning and the establishment of relevant auctioning, permitting and licensing procedures.

Developing offshore wind requires significant upgrades in infrastructure and skills. Bulgaria must **upgrade the ports** of Varna and Burgas to increase their load capacity, deep berths, and large assembly areas, all necessary to support turbine storage, installation, and maintenance, turning them into decarbonisation hubs. At the same time, the TSO could use the ample EU funding available for grid modernisation to **increase grid connection capacity** in Bulgaria's coastal regions, so that it can accommodate future offshore facilities. Furthermore, Bulgaria should **strengthen regional cooperation** with Romania and other Black Sea states to unlock cross-border synergies, optimise grid integration, and attract greater investments in line with NATO and EU security plans.[54]

Equally important is **addressing the wave of mis-information** that has undermined political consensus and public trust in the offshore wind industry and ultimately halted its development. Russia-leaning political parties, civil society organisations, and media outlets used a targeted disinformation campaign to undermine the Renewable Energy in Maritime Spaces Act. The campaign misportrayed offshore wind as harmful to tourism and property values, destructive to fisheries, and dangerous to marine ecosystems and local health (including claims about low-frequency noise causing cancer).[55] The campaign's effectiveness clearly highlighted the urgent **need for strategic communication efforts and stakeholder engagement**. At the same time, the government must adopt a transparent approach to environmental assessment and develop mitigation strategies for ecosystem protection.[56]

[49] CSD, *The Lowest Hanging Fruit*, Policy Brief No. 138, September 2023.

[50] European Commission, "Commissioner Jørgensen announces first 2 sectorial tripartite contracts", 5 September 2025.

[51] Trifonova, M., and Vladimirov, M., *Wind Power Generation in Bulgaria: Assessment of the Black Sea Offshore Potential*, Sofia: Center for the Study of Democracy, 2021.

[52] Vladimirov, M., Gantcheva, N. and Filipova, A., *Low-Carbon Technologies: Roadmap for Deployment in Bulgaria by 2050*, Sofia: Center for the Study of Democracy, 2024.

[53] Bulgarian National Assembly, Renewable Energy in Maritime Spaces Act, 2023.

[54] Trifonova M. et al., *Winds of Change: Offshore Renewable Energy for a More Secure and Resilient Central and Eastern Europe*, Sofia: Center for the Study of Democracy, 2023.

[55] Vladimirov, M. et al., *The Kremlin Playbook against Offshore Wind Energy in Bulgaria*, Sofia: Center for the Study of Democracy, 2025.

[56] Center for the Study of Democracy, *Offshore Wind in the Black Sea: Towards A Strategic Legal Framework in Bulgaria*, Policy Brief No. 151, November 2024.

Box 2. Europe's Dominance: Floating Offshore Wind as Bulgaria's Strategic Leapfrogging Strategy[57]

China dominates renewable energy scale and cost, driving its offshore wind's LCOE down to EUR 0.048/kWh due to massive investment. Yet, **Europe maintains a critical competitive edge in operational performance and advanced deep-water technology**. Furthermore, European manufacturers are spearheading the commercialisation of Floating Offshore Wind (FOW). A total of 1.2 GW of capacity for FOW projects was awarded in 2024 tenders (750 MW in France and 400 MW in the UK), and the technology is expected to be commercially viable by 2030, unlocking deeper waters, in which Europe already has more technical and commercial experience.

FOW offers strategic advantages that Europe must exploit. It has lower installation costs stemming from easier and faster assembly, which significantly reduces the need for costly large jack-up and installation vessels, mitigating a key cost driver. Furthermore, FOW turbines are sited further from shore, mitigating the visual impact and reducing potential harm to coastal bird and marine species, addressing key concerns from coastal communities, including those opposed to the sector in Bulgaria.

Bulgaria is uniquely positioned to maximise this FOW advantage and leapfrog its competitors, both in Europe and beyond. With an estimated 90 GW of FOW potential due to the Black Sea coast topography that plunges to a depth of almost 2000 m in its exclusive economic zone, decisive action in setting up the necessary regulatory environment is crucial. Bulgaria can leverage other European countries' experience in operating projects further from shore, at deeper water depths, and with larger turbines compared to China's fleet, allowing it to establish itself as an FOW hub in Eastern Europe.

Research is already underway to **unlock the Black Sea's floating offshore wind potential** with the development of a 5 MW cost-efficient demonstrator[58] optimised for low and medium-wind speed areas. The demonstrator aims to achieve a LCOE of EUR 87/MWh by 2028 (and EUR 50/MWh beyond 2030) and an environmental impact reduced by 40%. While the commercial potential of the technology is already on the way to being demonstrated, the bigger obstacle faced by the pilot project is the inconsistent regulatory environment around the Black Sea region, and especially Bulgaria, which lacks the regulatory framework to attract investors and unlock the sector.

[57] IRENA, Renewable Power Generation Costs In 2024, Abu Dhabi, 2025.

[58] "Black sea fLoating Offshore Wind" project.

What's Next: A Coherent Path Forward

Bulgaria's national energy policy requires a strategic redesign coupled with technology-specific reforms that remove persistent barriers to investment, integration, and public acceptance. Only a coherent approach that combines macro-level reforms with sector-specific instruments will allow the country to shift from fragmented and reactive policymaking **towards a modern, resilient and investor-friendly energy system**:

- Bulgaria must redesign its energy strategy to **diversify the renewable energy mix** beyond solar PV and **prioritise system balancing** as core strategic objectives. Planning documents such as the NECP and TSO investment plans should be aligned with real market developments based on independent modelling. The government should develop strategic communication and rebuild public trust through transparent, evidence-based policymaking and structured stakeholder engagement.

- A predictable, **investor-friendly regulatory environment** is essential to accelerate the energy transition. Bulgaria should advance **full market liberalisation**, remove revenue caps on renewables, and streamline environmental permitting procedures to ensure fair market access for all low-carbon technologies.

- Bulgaria should **upgrade its transmission and distribution grids**, expand cross-border interconnections, and move to incentive-based regulation that ties DSO revenues to reliability and efficiency. Regulatory gaps must be closed to ensure transparent and fair allocation of grid capacity. A nationwide smart meter rollout, and **dynamic pricing rules** will empower consumers and improve system visibility.

- **Battery storage should be fully integrated** as a key balancing and flexibility tool. The government must ensure long-term revenue predictability, timely disbursement of Recovery and Resilience Facility funding, and the introduction of market mechanisms that support revenue stacking. Supporting **domestic manufacturing** and assembly of batteries will reduce Bulgaria's exposure to global supply chains and reinforce its strategic autonomy.

- **Unlocking Bulgaria's wind potential** requires both regulatory and infrastructural reform. Onshore wind deployment should be prioritised through zoning of high-potential areas, digitalised and streamlined permitting and transparent methodologies for grid connection costs. For offshore wind, Bulgaria should urgently **adopt the Renewable Energy in Maritime Spaces Act** and modernise its port infrastructure. Public trust must be strengthened through environmental safeguards and local benefit-sharing, ensuring that wind energy becomes the backbone of Bulgaria's energy security.