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Enhancing Jordanian Energy Security Through Battery Storage System Deployment

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Abstract

As Jordan navigates an increasingly volatile regional energy landscape, battery energy storage systems (BESS) are emerging as a pivotal enabler of the Kingdom's transition toward a more resilient and self-sufficient electricity sector. Jordan has achieved remarkable progress in renewable energy deployment, with clean sources accounting for approximately 27% of the national generation mix by 2024, positioning the country among the region's renewable energy leaders. However, persistent dependence on imported natural gas, coupled with heightened exposure to regional supply disruptions, highlights the strategic importance of complementary technologies capable of enhancing short-term resilience and unlocking the full value of variable renewable generation. This paper examines the evolving legislative landscape governing BESS in Jordan, tracing its development from the foundational Renewable Energy and Energy Efficiency Law No. 13 of 2012 to the landmark Electricity Law of 2025, which formally established energy storage as a recognized pillar of the national electricity framework. While this legislative evolution reflects significant institutional progress,

BESS deployment continues to face structural challenges, including the absence of a dedicated regulatory framework, residential capacity provisions that constrain battery sizing, an undefined tariff structure for hybrid renewable-storage systems, infrastructural readiness gaps, and limited financial incentive mechanisms. Rather than representing barriers to progress, these challenges point toward clear opportunities for policy innovation. This paper proposes four actionable approaches to accelerate BESS deployment, namely developing a comprehensive regulatory framework, upgrading grid infrastructure, introducing flexible battery sizing provisions, and establishing targeted financial incentives informed by international models such as Australia's Cheaper Home Batteries Program. Collectively, these measures offer a pathway to enhanced grid stability, fuller utilization of Jordan's renewable energy resources, and strengthened long-term energy security, while positioning the Kingdom to play a leading role in the region's clean energy transition.



General Overview

Jordanian energy security

Energy security is commonly defined through multiple dimensions, including availability, affordability, and accessibility. Jordan's energy security remains particularly vulnerable to four interconnected challenges: dependence on imported fuels (extensively natural gas), exposure to regional supply disruptions, the cost volatility associated with fuel substitution, and the increasing need to integrate variable renewable energy into the electricity system. In 2024, Jordan's electricity generation mix (figure 1) comprised natural gas at 58.08%, renewable energy at 26.92%, and oil shale at 15%. Natural gas in Jordan is mostly imported, with liquefied natural gas supplied through Aqaba, and limited domestic production from the Risha field (1) (accounting for approximately 8% of the Kingdom's total needs (2)). With the recent abrupt escalation of regional conflicts on February 28, 2026, natural gas supply was temporarily suspended. This caused the Kingdom to rely on other expensive substitutes such as diesel, with reported increase in generation costs by approximately 1.8 - 3 million JD per day (3). Prolonged disruption of natural gas supplies could impose cumulative financial pressures on the electricity sector, with estimated impacts reaching hundreds of millions of Jordanian dinars. In response to such challenges and to ensure short-term resilience, Jordan maintains strategic fuel reserves ranging between 30 to 60 days depending on the type of petroleum product (4).

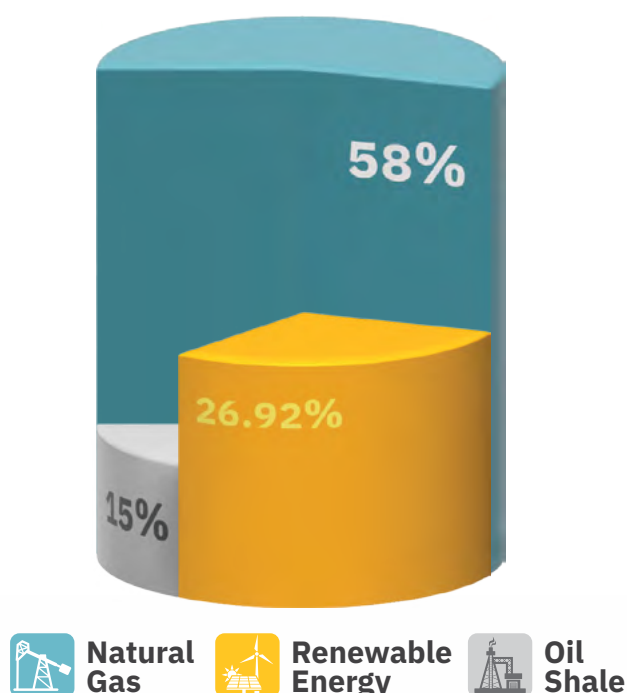


Figure 1. Jordan's electricity generation mix.

Battery energy storage systems (BESS) can address some of energy vulnerabilities by providing short-term backup during supply disruptions, reducing reliance on costly diesel generation, and facilitating the integration of variable renewable energy. However, BESS cannot independently address Jordan's dependence on imported fuels or exposure to regional supply disruptions. These challenges require complementary measures, including fuel diversification, strategic fuel reserves, domestic energy production, and grid infrastructure strengthening. BESS should therefore be considered one component of a broader energy-security strategy, primarily supporting short-term resilience, system flexibility, and renewable energy integration.

According to the National Electric Power Company (NEPCO), the Jordanian electricity system operates with an installed capacity exceeding 6 GW against a peak demand of approximately 3.2–4.1 GW (5), to ensure reliability, system stability, and reserve adequacy. However, with increasing penetration of variable renewable energy (solar and wind), the generation would sometimes exceed real-time demand or grid absorption capacity, requiring or leading to curtailment of renewable yield. This reflects structural limitations in grid flexibility and integration capacity rather than inefficiency and is increasingly addressed through energy storage deployment and grid reinforcement strategies. This research paper aims to study the current laws and regulations of BESS, the challenges and potential opportunities of BESS deployment in Jordan to provide comprehensive and practical recommendations.

The renewable energy sector in Jordan

The energy sector in Jordan has undergone a significant structural transformation over the past two decades to primarily reduce the heavy reliance on imported energy. In the 2000s, Jordan imported approximately 94% of its energy demand; however, this dependency gradually decreased to around 74% by 2024 (6). This reflects a strategic national shift towards energy independence through source diversification and the deployment of renewable energy.

With high solar irradiation levels (more than 300 sunny days annually), and viable wind speeds, Jordan's natural capabilities have substantially enabled renewable energy development. Alongside these natural advantages, the Kingdom's efforts and strategies, such as the Energy Strategy

(2020-2030), reinforced the rapid expansion and advancement of renewable energy technologies, positioning Jordan as one of the leading countries in renewable energy penetration. Jordan has strategically prioritized renewable energy expansion achieving a significant milestone where the contribution of renewable energy to the electricity mix increased dramatically from less than 0.5% in 2014 to approximately 27% in 2024. The Jordanian government has also set ambitious targets to increase the renewable energy generation to exceed 50% by 2030. By the end of 2024, the installed renewable energy capacity reached roughly 2,840.2 MW, dominated mainly by solar energy of around 2,194.8 MW (77%), and comprising 622 MW (22%) from wind energy, in addition to minor inputs from other renewable sources (<1%) (6). Jordan's main renewable energy projects include the 117 MW Tafila Wind Farm, the 160 MW Shams Ma'an solar photovoltaic (PV) plant, and the 200 MW Baynouna Solar Power Plant, along with several other utility-scale wind and solar developments that collectively support the country's strategy to diversify its energy mix and increase the share of clean energy (7) (8) (9).



The growth has been supported by a strong institutional and regulatory framework, which includes multiple mechanisms for integrating renewable energy, such as net metering/ net billing, all imports all exports, and zero-export systems. This enables different consumer categories (industrial, commercial, agricultural, and residential) to participate in distributed generation schemes. Economically, total investments in the renewable energy sector have reached approximately 2.15 billion Jordanian dinars, which promotes economic and employment stimulation (10). The sector has also expanded to include more than 600 registered and active energy companies in 2024 (11), indicating sustained development and strong market growth.

Battery energy storage systems in Jordanian context

Globally, energy storage technologies encompass a broad spectrum of solutions, including pumped hydro storage, thermal storage, compressed air energy storage (CAES), hydrogen-based systems, and electrochemical battery systems. Among these, Battery Energy Storage Systems (BESS) have emerged as the most widely deployed solution. BESS are electrochemical systems engineered to store electrical energy in chemical form, enabling grid balancing by capturing surplus energy during peak generation periods and supplying it during low generation or high demand times. This widespread adoption is attributed to their high-performance efficiency, rapid response capabilities, and scalable modular

architecture, making them suitable for both distributed and utility-scale applications. Despite this global momentum, BESS deployment remains comparatively limited due to their higher capital expenditures and regulatory complexity.

The Jordanian regulatory framework has recently begun the accommodation of BESS at multiple operational scales. Several battery technologies are commercially available in Jordan, differing in performance, and operational characteristics (Table 1). The Kingdom has already taken initial steps in energy storage deployment, exemplified by Al Badiya solar-plus-storage plant in Al-Mafraq, developed by Jordanian manufacturer Philadelphia Solar. The project reached a total solar capacity of 23 MWp paired with a 3 MW/12.6 MWh lithium-ion Tesla Powerpack system, giving the battery roughly a 4.2-hour discharge duration at full power, making it the first utility-scale solar-plus-storage project in the MENA region, with the battery designed to perform peak shaving and power shifting to enhance grid stability during peak load hours (12). Even with this early progress, the expansion of energy storage remains restricted by the absence of a comprehensive regulatory framework that adequately supports deployment across the generation, transmission, distribution, and end-user levels.



Table 1. Characteristics of batteries available in Jordan

Battery Type	Lifespan	Efficiency	Advantages	Disadvantages	Sources
Lithium-ion (LiFePO₄)	10–15 years (4,000–8,000 cycles)	90–95%	Long lifespan, low maintenance, compact size, high efficiency	High upfront cost	(13) (14) (15)
Lead-Acid (Flooded / AGM)	3–7 years (500–1,500 cycles)	70–85%	Low initial cost, widely available	Short lifespan, higher maintenance, bulky	(16) (17) (18)

Recognizing these structural vulnerabilities, Jordan has increasingly turned toward the reliance on diversified and renewable-based systems which may introduce new challenges related to grid stability, intermittency, and energy balancing. In this context, BESS represent a critical enabling technology that can enhance system flexibility, improve energy security, reduce dependence on imported fuels, and support Jordan's long-

term ambition of becoming a regional hub for clean and sustainable energy. Therefore, this research paper will study the current Jordanian legal and operational framework related to renewable BESS, highlight potential gaps and limitations, and emphasize opportunities of storage systems to strengthen policies, fully leverage renewable generation, and improve energy security.

Enhancing Jordanian Energy Security through BESS

The regulatory framework governing BESS in Jordan is anchored by a layered body of legislation that has evolved considerably over the past decade. The Renewable Energy and Energy Efficiency Law No. 13 of 2012 served as the foundational instrument, initiating Jordan's shift toward wind and solar PV and driving renewable penetration, and introducing feed-in tariffs to provide financial incentives across multiple sectors. Yet it contains no explicit provisions governing BESS and the law was primarily oriented toward enabling renewable energy investment and grid connection frameworks, and BESS only became a regulatory consideration in subsequent instruments.

Building upon this foundation, the updated Renewable Energy and Energy Efficiency Law No. 12 of 2024 and its accompanying Bylaw No. 58 of 2024 restructured connection mechanisms, imposed a Grid Fee across most on-grid solar connection options, and established the tariff conditions. The Electricity Law of 2025 formally introduced the concept of energy storage into Jordanian statute for the first time, encouraging investment in electricity storage and green hydrogen projects in a public-private partnership model. Under this law, licensed entities involved in transmission, generation, or distribution are expressly authorized to

establish and operate energy storage facilities expected to strengthen national grid stability and resilience, with implementation to be guided by forthcoming regulatory guidelines from the Energy and Minerals Regulatory Commission (EMRC); private individuals are similarly permitted to construct and operate storage stations for personal use (figure 2).



Figure 2: Timeline of Renewable Energy Legislation in Jordan (2012-2025)

Legislative and operational challenges

1. Lack of a dedicated policy and regulatory frameworks for battery energy storage systems

Despite the instructions and regulatory measures issued by EMRC in recent years, Jordan still lacks a dedicated and comprehensive regulatory framework specifically addressing the energy storage sector, including battery storage. Instead, energy storage sector is often treated as a subsidiary component within broader regulations governing renewable energy and the electricity sector. As a result, investors may face uncertainty regarding the long-term regulatory environment, which can increase perceived risk and potentially discourage sector investment.

2. Restrictions on solar system capacity and their impact on battery storage sizing

Some existing regulatory restrictions may limit the adoption of residential battery storage systems. A key example is the system size cap under Bylaw No. 58 of 2024, which limits residential solar PV systems to 5.4 kWp for single-phase meters and 15 kWp for three-phase meters, and further fixes the DC:AC ratio at 1.5 for residential systems and 1.2 for all other sectors. Since home batteries are typically sized to match the solar system, they are paired with, both the capacity cap and the DC:AC ratio restriction directly constrain how much storage a household can effectively deploy.

3. Absence of a tariff structure for combined renewable energy and battery storage

Bylaw No. 58 of 2024 tariff structure is designed between solar PV generation and the grid, with battery storage treated as an add-on rather than an integrated component of the system. The law does not establish

specific rules governing how stored energy in a battery is metered, valued, or compensated when discharged to the grid or used to offset consumption. This means that households deploying a combined renewable energy and battery storage system are subject to a regulatory framework primarily designed for direct renewable-to-grid configurations, with

no explicit provisions governing the dispatch of stored energy during peak demand periods, or the classification of battery discharge within the time-of-use tariff structure, or the eligibility of grid-injected stored energy for compensation under existing net billing or buy-all/sell-all mechanisms.

4. Grid infrastructure advancement as a prerequisite for BESS deployment

A foundational challenge facing Jordan's energy transition is the need to advance its existing grid infrastructure before battery storage systems can be deployed at scale alongside renewable energy without risking negative consequences. Jordan's grid was designed primarily for centralized fossil fuel generation and already struggles to integrate decentralized solar systems effectively; as of 2023, Jordan's national battery storage capacity stood at only 50 MW against 600 MW of installed solar capacity, contributing to grid instability and curtailments frequently reported in solar-rich areas (19). Without a distribution network capable of handling bidirectional power flows, deploying residential batteries at scale may risk combining these existing challenges (such as causing voltage fluctuations and unexpected load surges). By the end of 2024, smart meters covered about 69% of Jordan's electricity subscribers (20), so roughly 30% still lack the advanced metering that residential battery integration is likely to depend on.

5. Lack of financial BESS incentives

Despite the well-established incentive landscape for solar PV in Jordan, battery storage systems remain largely excluded from targeted financial support mechanisms. Unlike solar PV, BESS lacks dedicated financial support mechanisms, especially due to their high upfront costs and limited standalone revenue streams. The absence of a dedicated financing mechanism for energy storage has been identified as a critical gap, with low investment levels and affordability constraints continuing to hinder sector growth.

Recommendations

The following approaches represent key recommendations aimed at addressing the main technical, regulatory, and infrastructural barriers to the deployment of BESS in Jordan. These measures are intended to enhance grid integration, improve investment conditions, and support the long-term sustainability of the national energy transition.

Approach 1: Development of a robust BESS regulatory framework

Establishing a clear and comprehensive regulatory framework for BESS, separate from broader renewable energy legislation, is essential for accelerating deployment in Jordan. This framework should define battery technical standards (in coordination with the Jordan Standards and Metrology Organization), along with clear provisions for installation requirements, operational rules, tariffs, fees, exemptions, and the regulation of battery imports and exports. It should also include a structured tariff system specifically designed for hybrid renewable-storage systems, addressing the interaction between solar generation, battery storage, and the electricity grid. Beyond these foundational elements, the framework should also clarify ownership and licensing rules for standalone and paired storage assets, define procurement mechanisms such as tenders, set out the tariff treatment of charging and discharging activity, establish remuneration for ancillary services (e.g., frequency regulation, voltage support), enable revenue stacking across multiple value streams, and standardize grid-service contracts between storage operators and system operators.

The developed regulation must define how stored energy is metered, valued,

and compensated when discharged during peak, partial-peak, or off-peak periods. Developing transparent and predictable pricing structures is critical to improving the economic viability of BESS across all sectors. Without such regulatory clarity, both investors and end-users face financial uncertainty, which significantly slows adoption and limits progress toward Jordan's renewable energy and grid stability objectives.

Approach 2: Upgrading Jordanian electrical infrastructure

It is quite crucial to upgrade the current infrastructure to accommodate, support, and leverage the new innovative technologies and systems, especially the ones for BESS. This maintains grid stability, efficiency, control, and responsiveness of the grid by enabling advanced monitoring, smart distribution, and improved bidirectional power flow management. Infrastructure advancement is not merely a technical consideration but a regulatory and planning prerequisite that must be addressed in parallel with BESS storage policy establishment in Jordan.

Approach 3: Introducing a flexible regulatory approach for battery storage sizing

Decoupling battery storage sizing from solar PV capacity limits is essential to remove unintended regulatory constraints on residential and commercial BESS adoption in Jordan. This approach should allow energy storage systems to be sized based on actual electricity consumption patterns, peak demand requirements, and desired self-consumption levels, rather than being indirectly restricted by PV system caps or fixed DC:AC ratio rules. Practically, this

would require revising existing net metering and distributed generation regulations to define battery capacity as an independent parameter from installed solar capacity, while still safeguarding grid stability. Such reform would enable households and businesses to optimize solar-storage hybrid systems more effectively, improve peak load management, and increase overall system efficiency. Importantly, it would also enhance energy resilience by allowing critical loads to continue operating during grid disruptions or outages, ensuring greater energy security for households, businesses, and essential services. In turn, this would improve the economic attractiveness of distributed storage, support better utilization of renewable energy, and reduce stress on the national grid during peak demand periods.

Approach 4: Initiate financial incentive mechanisms to accelerate BESS deployment

Capitalizing on Jordan's position as host of the regional office of the Green Climate Fund can significantly enhance access to international climate finance, particularly for the clean energy sector. The implementation of tailored financial incentives and programs such as capital subsidies, investment tax

credits, low-interest green financing, and performance-based payments for grid services provided by storage systems can improve project bankability, reduce upfront investment barriers, and shorten payback uncertainty associated with standalone battery projects. Simultaneously, establishing dedicated national climate and energy transition funds, supported by international partners and multilateral development banks, would further de-risk investments and channel concessional finance into priority BESS projects. Therefore, dedicated financial support would stimulate private sector participation, increase deployment rates, and ensure that energy storage can fully contribute to grid stability, renewable energy utilization, and long-term energy security.

A good example could be Australia's Cheaper Home Batteries Program which installed battery systems in more than 490,000 houses, adding upwards of 13 gigawatt-hours of behind-the-meter storage within about a year of launch (21). A similar model can be replicated in Jordan through direct, upfront capital subsidies that make residential batteries immediately affordable rather than relying on tax credits alone.

Figure 3: Challenges and recommendations towards energy security in Jordan



Conclusion

In conclusion, BESS offer a critical pathway for Jordan to enhance energy security, improve grid flexibility, and support its transition toward a more sustainable energy mix. Despite progress in renewable energy integration and initial storage projects, the sector remains constrained by regulatory gaps, limited tariff structures, infrastructure challenges, and insufficient financial incentives, all of which hinder BESS deployment. Jordan's emerging BESS market also presents an opportunity to build a domestic battery manufacturing industry by offering targeted incentives for local assembly or production of batteries suitable for BESS applications, the government can reduce import dependency, strengthen supply-chain resilience, and position Jordan as a regional hub for energy storage manufacturing.

Therefore, addressing these challenges requires a comprehensive and coordinated approach that includes clear regulatory frameworks, upgraded grid infrastructure, transparent pricing mechanisms, and better access to climate finance. By advancing these priorities, Jordan can fully leverage BESS as a key enabler of a resilient, reliable, and secure energy system aligned with its national development goals.



References

- (1)** Ministry of Energy and Mineral Resources. (2024). Annual report 2024. https://www.memr.gov.jo/ebv4.0/root_storage/ar/eb_list_page/annualreport2024-f.pdf
- (2)** Jordan News. (2026, March 26). NPC: Gas production from Risha Field remains unaffected by regional conditions. <https://www.jordannews.jo/Section-112/Economy/NPC-Gas-Production-from-Risha-Field-Remains-Unaffected-by-Regional-Conditions-50069>
- (3)** Jordan News. (2026, March 6). Energy Minister: 1.8 million dinars daily cost for transitioning to diesel. <https://www.jordannews.jo/Section-113/All/Energy-Minister-1-8-Million-Dinars-Daily-Cost-for-Transitioning-to-Diesel-49249>
- (4)** Jordan News Agency (Petra). (2026). Inner page news article. <https://petra.gov.jo/phpfinance/index.php/en/news/jordan-maintains-strategic-energy-buffers-amid-rising-fiscal-pressure-from-high-global-fuel-costs>
- (5)** National Electric Power Company. Electricity sector development. <https://www.nepco.com.jo/en/SectorDevelopment.aspx>
- (6)** Ministry of Energy and Mineral Resources. (2026). Achievements in the energy and mining sectors in Jordan: National success stories shining regionally and globally. <https://www.memr.gov.jo/Ar/NewsDetails/20255241>
- (7)** Masdar. Tafila wind farm. <https://masdar.ae/en/renewables/our-projects/tafila-wind-farm>
- (8)** Shams Ma'an Power Generation PSC. Shams Ma'an. <https://www.shamsmaan.com/>
- (9)** Masdar. Baynouna solar energy project. <https://masdar.ae/en/renewables/our-projects/baynouna>
- (10)** Jordan News. (2026). JD 2.15 billion in cumulative investments in renewable energy. <https://www.jordannews.jo/Section-112/Economy/JD-2-15-Billion-in-Cumulative-Investments-in-Renewable-Energy-45490>
- (11)** Energy and Minerals Regulatory Commission. (2024). Annual report 2024. https://emrc.gov.jo/ebv4.0/root_storage/ar/eb_list_page/%D8%A7%D9%84%D8%AA%D9%82%D8%B1%D9%8A%D8%B1_%D8%A7%D9%84%D8%B3%D9%86%D9%88%D9%8A_%D9%84%D9%84%D8%B9%D8%A7%D9%85_2024_.pdf
- (12)** Philadelphia Solar. (2019, February 18). Al Badiya second phase expansion COD. <https://philadelphia-solar.com/news/al-badiya-second-phase-expansion-cod/>
- (13)** U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. Energy storage. <https://www.energy.gov/eere/solar/energy-storage>
- (14)** Nitta, N., Wu, F., Lee, J. T., & Yushin, G. (2015). The lithium-ion battery: State of the art and future perspectives. *Materials Today*, 18(5), 252–264. <https://doi.org/10.1016/j.mattod.2014.10.040>
- (15)** Battery University. BU-808: How to prolong lithium-based batteries. <https://batteryuniversity.com/article/bu-808-how-to-prolong-lithium-based-batteries>
- (16)** U.S. Department of Energy, Office of Electricity. Energy storage. <https://www.energy.gov/oe/energy-storage>

(17) Sandia National Laboratories. Energy storage. <https://energy.sandia.gov/energy-storage/>

(18) Battery University. BU-201: How does the lead acid battery work? <https://batteryuniversity.com/article/bu-201-how-does-the-lead-acid-batteries-work>

(19) Al-Oun, S., AlMaaitah, M. F., & Al-Azamat, A.-M. (2025). Sustainable energy transition in Jordan: The interplay of regulatory frameworks and infrastructure. *Energies*, 18(5), 1220. <https://doi.org/10.3390/en18051220>

(20) Jordan Times. (2025, July 12). Over 29,000 electricity theft cases detected in 2024 — EMRC. <https://jordantimes.com/news/local/over-29000-electricity-theft-cases-detected-in-2024-emrc>

(21) No2NuclearPower. (2026, August 6). Australia home batteries. <https://www.no2nuclearpower.org.uk/news/australia-home-batteries-6-8-26/>

