Bird & Bird

Unlocking Energy Storage: *Revenue streams and regulations*

2025

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The Importance of Energy Storage Systems

To meet the Paris Agreement's target of keeping the average global temperature rise well below 2°C, the share of renewable energy sources is increasing globally.

Solar and wind are expected to contribute approximately two-thirds of this growth, serving expanding electricity markets and new sectors. However, other energy-intensive sectors, such as heating and transport, also need to significantly transform to end their reliance on fossil fuels. Since renewable energy production fluctuates on time scales ranging from hours or days to seasonal variations, various energy storage systems (ESS) are needed to smooth these fluctuations.

This report takes a global perspective on the role of energy storage systems in the clean energy transition. It provides an overview of the *global energy storage market and presents the key innovations and technologies to consider in the market.*

Energy storage's *role* in the *clean energy transition*

ESS play a crucial role in the clean energy transition. They enable grid stability and reliability by mitigating fluctuations in renewable energy generation by supporting voltage, balancing power fluctuations, and aligning supply and demand. Additionally, ESS provide grid ancillary services such as frequency control, energy time-shifting, improved power quality, load levelling, and peak shaving. These capabilities allow for better integration of renewable energy sources into the grid, reduce energy waste, and enable more intelligent energy use, ultimately leading to cost reductions.

Global energy storage market

The global energy storage market is experiencing rapid growth, driven by the increased demand for renewable energy integration and grid stabilisation.

By 2030, the global energy storage market is projected to grow at a compound annual growth rate (CAGR) of 21%, with annual energy storage additions expected to reach 137 GW (442 GWh). This expansion is largely fuelled by technological advancements, especially in lithium-ion batteries, which dominate the market due to their high energy density and cost reductions. China leads the global market, contributing significantly to capacity growth, with the U.S. following closely due to state-level targets and favourable market conditions.

By 2030, the global energy storage market is projected to grow at a compound annual growth rate (CAGR) of 21%, with installed capacity expected to reach 137 GW (442 GWh). The rising focus on energy storage is critical for balancing the variability of renewable energy sources like wind and solar, which are also expected to grow significantly. Grid-scale batteries, particularly lithium-ion technology, are becoming central to this transition, despite pumped-storage hydropower still holding the majority of installed capacity. As nations implement ambitious decarbonisation policies and energy storage costs continue to decline, the market is poised for sustained growth, with key players driving innovations in the sector.

Key innovations and technologies to consider in the energy storage market

ESS come in various forms, each with specific advantages and applications.

01

Mechanical ESS

convert electrical energy into potential or kinetic energy and back to electricity when needed. Pumped hydro energy storage (PHES) is the most widely used, representing 92.6% (171.03 GW) of global energy storage. PHES and compressed air energy storage (CAES) are ideal for long-duration storage, peak shaving, load levelling, and seasonal energy management. Flywheel energy storage (FES) has a smaller power range but responds quickly, making it useful in improving grid power quality, transportation, and managing fast fluctuations in renewable power.

02

Electrochemical ESS

include battery systems (BESS) and flow batteries (FBES), with a global capacity of 9.6 GW. Their versatility in power range and discharge times makes them suitable for power regulation and bridging applications. Research is ongoing, particularly into innovative solutions like paper batteries.

03

Electrical ESS

such as supercapacitors (SCES) and superconducting magnetic energy storage (SMES), are smaller scale but offer fast response times. Their short discharge duration makes them ideal for power quality control in industries and managing renewable energy fluctuations.

04

Thermal ESS

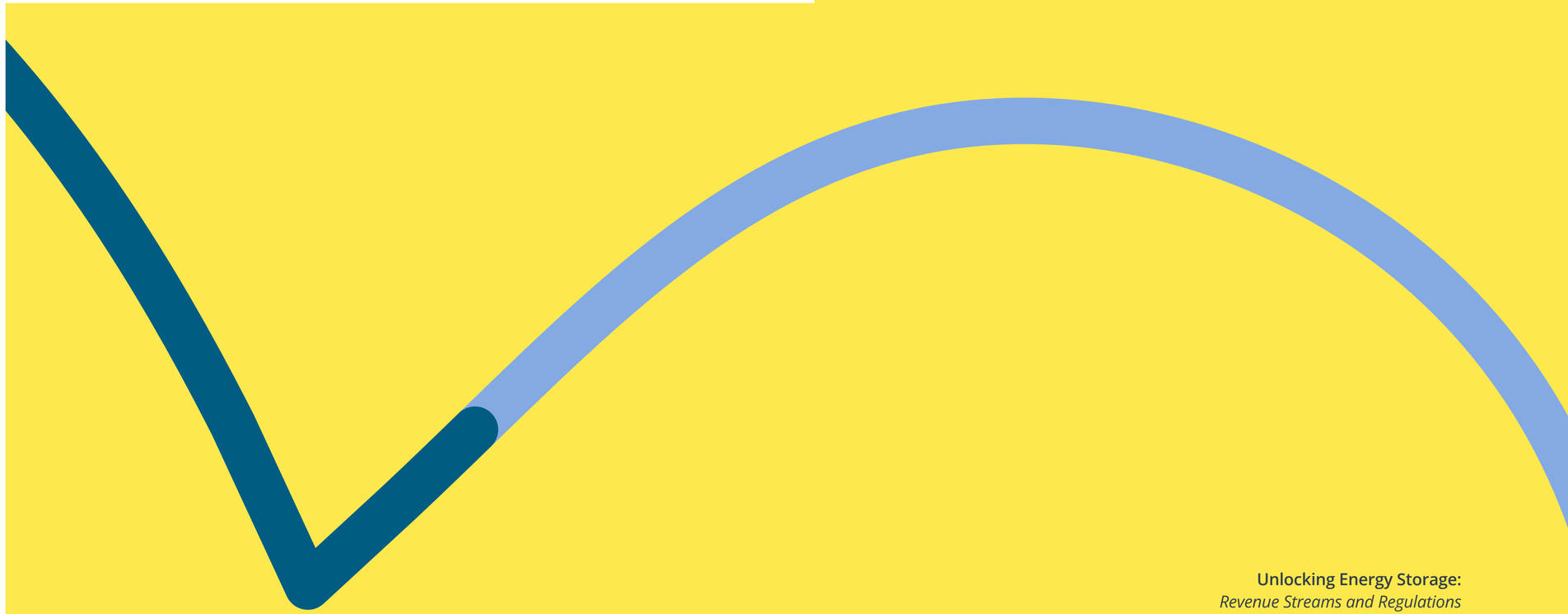
store heat, mainly for industrial cooling and heating. Chemical ESS, like hydrogen and solar fuels, hold significant potential by storing energy in chemical bonds, releasing it through reactions. Hybrid ESS combine features from different systems to meet specific performance requirements.

How can we help your business

At Bird & Bird, we assist energy storage businesses in navigating complex regulatory frameworks, securing project financing, and ensuring compliance with environmental laws.

Our expertise spans drafting contracts for the construction of large-scale energy storage facilities and energy sales, providing financing advice, technology licensing, protecting intellectual property, and managing risks throughout the entire lifecycle of energy storage projects, regarding all legal aspects.

Managing *risks* throughout the *entire lifecycle* of energy storage projects.



Country *profiles*

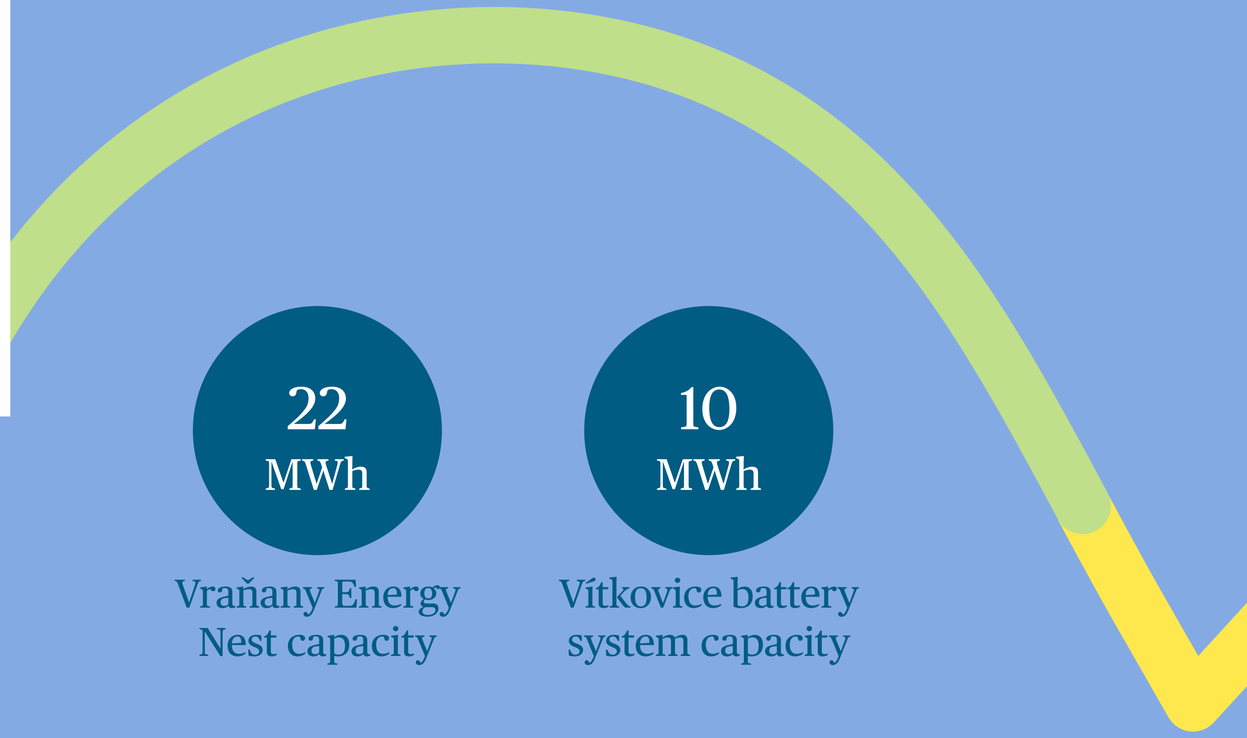
Czech Republic

The energy storage market in Czech Republic

The energy storage market in the Czech Republic is still in the early stages of development. So far, it has been driven by both residential installations and early large-scale industrial projects, primarily to store renewable energy and manage consumption.

As the capacities of photovoltaic and wind power plants grow in the country, new storage solutions are needed to ensure stability of the grid and continuous supply of energy. While pumped storage hydroelectric plants are one option, suitable locations are limited and project timelines are long. Battery storage systems, not constrained by natural potential, seem key to expanding storage capacity.

Currently, battery storage systems mainly serve residential photovoltaic installations. The lack of legislative support is primarily hindering the development of larger-scale storage connected to the grid, slowing market growth. However, experts predict continuing growth. Industrial projects like the Energy Nest in Vraňany near Mělník, with capacity of 22 MWh, and the battery system in Vítkovice, with capacity of 10 MWh, have already helped to bring the Czech Republic closer to European standards.



22 MWh

Vraňany Energy Nest capacity

10 MWh

Vítkovice battery system capacity

What revenue streams are available in Czech Republic?

In the Czech Republic, there are still limited options for bringing energy storage to market. At the moment, co-location and PPA contracts are in our view the key routes to market.

Co-location energy storage facilities

Energy storage systems, particularly battery storage, are currently operated exclusively in conjunction with aggregators. These systems are integrated with renewable energy installations, serving as storage solutions to enhance the efficiency and reliability of renewable energy generators.

Especially, co-location of storage and solar installations is becoming increasingly attractive due to rising solar curtailment in Europe, which drives the value of combining these technologies to maximize energy utilization and efficiency.

A notable example of co-location in the Czech Republic in terms of the capacity is the large-capacity battery system in Vítkovice, which operates in conjunction with the gas-fired power units and provides various support services such as primary frequency control.

Power Purchase Agreements (PPAs)

PPAs provide businesses with long-term agreements to purchase renewable energy at fixed prices, helping mitigate exposure to market volatility while supporting ESG objectives through zero-emission energy. There are several types of PPAs: On-site (energy generated at the business location), Off-site (energy generated remotely), and Virtual PPAs (financial arrangements based on price differences). Although PPAs are still evolving in the Czech Republic, they offer stability and cost predictability. However, the absence of financial incentives makes them riskier, and the development of PPAs is not as rapid as in neighbouring countries.

For now, investors are hesitant about battery storage, even though it offers potential upsides. Large-scale battery storage allows businesses to store surplus renewable energy for use when electricity prices are higher, potentially saving up to tens of percent on energy costs. It also serves as a backup power source during grid outages. The return on investment (ROI) typically depends on the battery size and usage, with potential subsidies (if used) and selling excess energy accelerating payback. Modern systems have a long lifespan up to 20 years, ensuring sustainable long-term returns.

What are the current regulations in Czech Republic?

The legal regulation of the Czech energy sector consists of three main pieces of legislation: the Energy Act, the Act on Supported Energy Sources and the Energy Management Act.

The battery storage, or the aggregation of small energy sources integrated into a unit, already operates. However, an explicit regulatory framework was only recently adopted in March 2025.

01

Energy Act

The Energy Act provides a common legal framework for business and state administration in the electricity, gas, and heating sectors in Czech Republic. The Energy Act newly explicitly addresses also energy storage.

02

Lex RES III

The major amendment to the existing legislation implements transposition of Directive (EU) 2019/944. The law amends all three main legal provisions in the energy sector: the Energy Act, the Act on Supported Energy Sources and the Energy Management Act. It newly regulates energy storage in the electricity system, aggregation and flexibility, and liability for deviation associated with the performance of these activities. It also strengthens the position of energy consumers and adds new obligations for electricity and gas suppliers.

The law was adopted by the Parliament and signed by the President on 13 March 2025. It has yet to be published in the official Collection of Laws of the Czech Republic. Most of its provisions will enter into force on the first day of the fifth calendar month following its publication.

03

Energy Regulatory Office (ERO)

The principal regulatory body in the Czech energy sector is the Energy Regulatory Office that issues energy licences, approves technical terms and conditions for access to the distribution network and specifies tariffs on an annual basis.

With the adoption of LEX RES III, the Energy Regulatory Office becomes authorized to issue the licences for the operation of battery storage.

04

Ministry of Industry and Trade

Ministry of Industry and Trade represents another important involved public player in energy sector. The Ministry is responsible for drafting relevant legislation, including Lex RES III and developing the National Action Plan for Smart Grids. Flexibility, aggregation and storage are among the targeted areas of the plan.

What are the key investments in Czech Republic?

The Czech Republic is in the start-up phase of developing the market for battery storage as it realizes its potential to increase energy security and support the transition to renewable energy. Although the market is already evolving, significant investments are expected once the new legal framework for battery storage becomes fully effective.

Currently, the Czech Republic has several programmes aimed at promoting energy storage, but these focus mainly on systems that are part of larger aggregators. Aggregators play a key role in balancing the grid by combining multiple energy sources and storage systems to ensure a stable and reliable electricity supply. These programs are fundamental for integrating renewable energy resources and ensuring grid stability.

An important source of support is the Modernisation Fund, which focuses on the modernisation of the energy sector. This fund has the potential to make a significant contribution to financing projects that include battery storage as part of larger energy systems. Further development of energy storage solutions will help stabilise the national grid and increase energy independence as the amount of electricity generated from renewable power sources increases.

As the legal framework for battery storage develops, direct government investment in autonomous battery systems is also expected to increase. This will further support the market and the country’s transition to a sustainable energy future.

Further development of *energy storage solutions* will help stabilise the national grid

Finland

The energy storage market in Finland

The Programme of the Finnish Government of Petteri Orpo, released in 2023, places a strong emphasis on creating clean economic growth. This includes doubling the production of clean electricity, to eventually become self-sufficient. The production of clean energy will be achieved through investments in nuclear, hydro, wind and solar power, as well as bioenergy.

Finnish electricity Transmission System Operator (TSO), Fingrid, estimates that electricity use in Finland will be 136 TwH in 2030. Of this, 76% of electricity will be produced with weather-dependent means, such as wind and solar power. To make up for the production fluctuations caused by these weather dependent production methods, energy storage is a key consideration.

The Finnish electricity company Helen (owned 100% by the City of Helsinki) estimates that, should the above predictions be true, Finland would require 40,000 MWh of electricity storage capacity, and 4,000 MW of regulating power capacity.

The electricity demand in Finland varies, particularly on a seasonal basis. For example, during the winter, Finland typically experiences peak electricity demand due to heating needed in the cold weather. By contrast, electricity consumption decreases in the summer. Thus, electricity storage is particularly important to ensure that these fluctuating electricity needs are met.

Fingrid, estimates that electricity use in Finland will be *136 TwH in 2030*

40,000 MWh

Electricity storage capacity

4,000 MW

Regulating power capacity

What revenue streams are available?

Using an Energy Storage System (ESS) enables electricity to be released for use at a later time, according to demand. It means excess energy does not go to waste and allows for peaks and troughs in both the production and distribution of energy. The energy crisis has led to many Finnish organisations and homes switching to exchanging electricity. Due to the high fluctuations in the price on the exchange, storing electricity in ESS and using it when the price is high, leads to significant savings.

The revenue streams available through ESS are similar to a number of other country markets. One of the main functions are ancillary grid services, which refer to specialised functions that help maintain grid stability and reliability. Another one is energy arbitrage, which is the process of buying electricity or energy products when prices are low and selling them when prices are high to generate a profit. The third significant revenue stream is the capacity markets, which means balancing is used to ensure that the TSO has a sufficient amount of Manual Frequency Restoration Reserve, to the extent allowed for by applicable law.

Investment from the Finnish government is also a significant revenue source. In 2024, Business Finland issued a number of grants focused on flexible energy systems, with a particular emphasis on research projects creating knowledge for the development of future flexible and sustainable energy systems, including storage and emerging technologies.

What are the current regulations in Finland?

The amendments to the Finnish Electricity Market Act came into force last year on 1 June 2023. As a rule, system operators are not allowed to engage in the energy storage business without specific permission from the Finnish Energy Authority. In addition, there are several other regulations which energy storage companies must adhere to.

For example, a building permit is required for building of an ESS. Battery storage is not specifically mentioned as an activity subject to an environmental permit, but the need for an environmental permit should be assessed and can materialise in certain circumstances.

Likewise, connecting an ESS into the national grid requires approval from the TSO. However, the TSO is obliged to grant access for all storages fulfilling technical requirements based on the Electricity Markets Act.

Finally, fire safety rules need to be followed when building and operating an ESS. This is covered in key regulations from the Finnish Environmental Ministry on fire safety of Buildings.

What are the key investments in Finland?

There are a number of interesting, published investments in this fast-growing area of sustainable energy. Utility company Helen is investing in a 40 MW Battery Energy Storage System (BESS) in Nurmijärvi, Finland. They aim to begin commercial operation in 2025. Neoen is also looking to build the largest battery in the Nordics, with an installed capacity of 56.4 MW/112.9 MWh, in Lappeenranta, Finland. Neoen already has its first battery in Lappeenranta. On the completion of second battery, Neoen will have a total storage capacity of 86.4 MW/142.9 MWh. Neoen has also announced it will develop Finland's biggest battery storage in Mikkeli, Finland, with an estimated capacity of 120 MW.

France

The energy storage market in France

According to the French Energy Code (FEC), energy storage in the electrical grid involves postponing the final use of electricity until after it was produced. Technically, it involves "the conversion of electrical energy into a form of energy that can be stored, by the conservation of this energy and its subsequent reconversion"[1].

France has been accelerating its commitment to energy storage capacities, getting up to speed with other countries who have invested in this critical field for energy supply.

France's commitment involves securing its regulatory framework, and developing its financing mechanisms, paving the path for new projects to emerge.

France has been *accelerating its commitment* to energy storage capacities

What revenue streams are available?

In 2022, the CRE stated that, under normal circumstances, energy storage should be considered as a competitive activity that is intended to be developed without public financial support.

That being said, it also admitted that the current crises in the energy sector justified the urgent use of public tenders dedicated to energy storage in order to accelerate its development in the country. A tender process should soon be announced by the Ministry for Energy.

In January 2024, the European Commission approved the French plan to grant €2.9bn to renewable energy investors as a form of Tax Credit. Part of these expenses are to be dedicated to the acceleration of renewable solutions, including energy storage.

It is a direct application of the RePowerEU Plan[2] adopted by the Commission in 2022. It is also in line with the 2023 amendment to the Temporary Crisis and Transition Framework[3] under which member states were allowed to use new aid regimes to accelerate investment in renewable energy and energy storage.

€2.9 billion

to renewable energy investors

[1] Article L.352-1 of the French Energy Code

[2] REPowerEU Plan, COM/2022/230 final

[3] Communication from the Commission, Amendment to the Temporary Crisis and Transition Framework for State Aid measures to support the economy following the aggression against Ukraine by Russia (C/2023/1188)

What are the current regulations in France?

The French Multiannual Energy Plan (MPE) 2019-2028[4] laid out the need to develop storage projects in the close future in response to upcoming demands. This meant starting to think about a new legal framework, more suitable for this industry.

In that process, the 2021 Climate and Resilience Act[5] was enacted. It created article L.352-1-1 of the FEC, which gives responsibility to the Minister for Energy to resort to a tender process in case storage capacities do not meet the MPE objectives, or in case RTE (French Transport System Operator) calls for flexibility.

Today, France's storage landscape focuses on PSPs (pumped storage projects), batteries and hydrogen. However, the article does not limit the Minister's intervention in these areas. The implementing decree was published on May 7 2022[6], defining the terms and conditions for the implementation of the tender process.

This decree marks the first concrete legal framework for the development of energy storage in France. Before that, storage facilities were only subject to overall grid connection requirements, which was shown to be counterproductive in creating an attractive market.

In a "Reflection and Orientation" study released in 2019[7], the CRE (the French Regulatory Commission for Energy) called for more interaction between the grid operators and the actors in the storage market to create a more precise framework on these connection requirements. Enedis[8] later published in 2020 new connecting requirements for storage facilities, with a simplified procedure[9].

Some of the key investments in France

01 Many French public or public-related entities are starting to play a key role in the financing of storage facilities.

- For instance, the Bpi (Public Bank for Investment) took part in May 2024 in the financing of ZE Energy's first solar park including a storage mechanism in France. This project will take the form of a CPPA with Orange France[10].
- The French Agency for Development (AFD) also participated in the financing of the Enercal centralised storage mechanism in New Caledonia. The project started in 2022 and should be ready by 2035. The Agency's main focus has been on isolated areas where the ability to store energy is fundamental[11].

02 Historical national companies are also taking action in the development of storage facilities:

- RTE has been experimenting since 2021 on the automated operation of a largescale battery network: the RINGO project. They were the first in the world to attempt automated storage at such a high volume. They invested €80 million for the installation of battery storage facilities in 3 areas.
- In 2018, EDF also launched an Electricity Storage Plan, with the ambition to become the sector's European leader. Already leading in PSP storage technology, EDF's project is to extend its Montézic PSP facility. However, the company is said to be waiting on more visibility on the evolution of hydropower before the concession contracts regulation.

03 Private companies are also investing in the storage market:

- Bird & Bird recently advised on the financing and construction of transformer stations linked to RTE's transportation network. These stations will serve as a connecting and regulating mechanism between the renewable energy produced and the electricity fed into the grid. They will also use additional storage batteries as a way of keeping energy available in case of a surge in demand on the grid.

[4] French Strategy for Energy and Climate, Multiannual Energy Plan, 2019-2028

[5] Law No. 2021-1104 of 22 August 2021 on combating climate change and strengthening resilience to its effects

[6] Decree No. 2022-788 of 6 May 2022

[7] Document de Réflexion et de proposition : Le stockage d'électricité en France, September 2019, CRE

[8] France's national grid manager and dispenser

[9] Enedis, « Connecting requirements for facilities able to inject and substract », Enedis-PRO-RES_78E, May 2020

[10] Bpi France, « ZE Energy boucle un financement sans recours avec la Caisse d'Epargne Ile-de-France et Pbifrance pour son 1er projet de parc « solaire + stockage » contractualisé via un CPPA avec Orange France », May 14 2024

[11] AFD, « Financement du système de stockage centralisé d'Enercal »

Germany

The energy storage market in Germany

The German energy storage market is rapidly evolving, driven by the government's ambitious energy transition goals and increasing reliance on renewable energy sources. The integration of the fast growing but volatile share of wind (target: 115 GW onshore wind and 30 GW offshore wind by 2030) and solar power (target: 215 GW by 2030) has accelerated the adoption of energy storage solutions.

Energy storage solutions play a particularly important role in stabilising the grid. The increase in the connection of renewable energy systems to the grid can lead to grid instability in cases of overproduction. Energy storage solutions may be used as counteraction allowing for controlled and consistent feed-in of power into the grid. In an industrial field, energy storage solutions focus on capping load peaks, grid-supporting power consumption, optimisation of self-consumption and provision of uninterruped power supply.

The energy storage market encompasses a wide array of technologies, including lithium-ion batteries, pumped hydro storage, and emerging innovations like hydrogen storage. While the market for domestic battery storage is becoming oversaturated and stagnating, large-scale storage projects are on the rise.

Energy storage solutions are gaining prominence, supported by promising measures laid down in the government's Electricity Storage Strategy. These include grid fee and levy exemptions, and facilitating the permitting procedure based on an overriding public interest in energy storage.

115 GW
Onshore wind by 2030

30 GW
Offshore wind by 2030

215 GW
Solar power by 2030

Energy storage solutions are *gaining prominence*, supported by *promising measures* laid down in the *government's Electricity Storage Strategy*.

What revenue streams are available?

Ancillary services, energy arbitrage, and capacity markets are key revenue streams for energy storage systems. As the demand for longer-duration storage increases and ancillary markets reach saturation, energy arbitrage is expected to become the dominant source of revenue for these systems.

- **Ancillary services**
  Energy storage systems provide grid stability services, earning revenue from grid operators for their contribution to maintaining voltage and frequency (so called flexibility services under Sect. 14c EnWG). Aside from grid operators, balancing group managers (sog. Bilanzkreisverantwortliche) have an interest in contracting with energy storage system operators. Balancing group managers are responsible for maintaining a balance between feed-ins and withdrawals in their balancing group. As the interface between grid users and grid operators, they assume economic responsibility for deviations between feed-ins and withdrawals in a balancing group. To secure their commitment towards grid operators and avoid compensation for deviations and imbalances in the balancing group, energy storage systems can provide lacking or store excess power.
- **Energy arbitrage**
  By storing excess energy produced during peak generation times and discharging it during periods of high demand, energy storage systems can capitalise on price differences in energy markets.
- **Capacity market payments**
  Energy storage systems can participate in capacity markets, providing assurance to grid operators that they can supply power during peak periods and receiving compensation for this readiness.
- **Stand-alone energy storage facilities**
  Stand-alone systems operate independently of specific generation sources, allowing them to be strategically placed within the grid to maximise their operational flexibility and market opportunities. As they operate independently, only the regulatory framework for energy storage systems must be complied with. Market-orientated charging and discharging of power allows for attractive revenues on the flexibility markets.
- **Co-location energy storage facilities**
  Co-location systems are integrated with RES, such as solar or wind farms. This integration allows them to utilise existing infrastructure, share operational costs, and optimise the synergy between generation and storage. At the same time co-location systems may be bound to stricter regulatory frameworks applicable to the RES and their financial performance is closely tied to the performance of the associated RES. Variability in generation can impact storage system revenues. Savings from a shared grid connection may however offset lost revenues in many scenarios.

Revenue streams also vary depending on the business model. Co-location battery storage systems benefit from reduced costs and optimised performance due to their integration with renewable energy sources (RES), but face challenges related to dependency and regulatory complexity. Stand-alone systems offer greater flexibility and access to diverse revenue streams not being connected to a particular RES. They may however come with higher cost as they do not benefit from shared infrastructure with RES and are more exposed to market-related risks.

Stand-alone systems offer *greater flexibility* and *access to diverse revenue streams* not being connected to a particular RES.

What are the current regulations in Germany?

The regulatory framework for energy storage systems (ESS) in Germany is complex, shaped by multiple regulations aimed at integrating ESS into the energy market.

Whilst Germany's regulatory framework for ESS is *evolving to support the energy transition,* challenges like unbundling, permitting complexity, double taxation, and grid connection costs need continuous attention to foster ESS growth.

01

Unbundling regime

Germany's unbundling regime requires the separation of energy generation, transmission, and distribution activities to prevent conflicts of interest and ensure fair competition, meaning storage operators must be independent of network operators. Whilst this fosters competition, it complicates business models for integrated energy companies investing in storage.

02

Permitting regime

The permitting process for ESS involves multiple steps and regulatory bodies, posing significant barriers due to compliance with environmental, safety, and planning regulations. Planned regulatory updates to the Renewable Energy Sources Act (EEG) and the Federal Building Code (BauGB) aim to streamline this process, recognising ESS's importance in achieving energy transition goals.

03

Overriding public interest

The reform of section 11c of the Energy Industry Act (EnWG) now classifies ESS construction as being in overriding public interest, prioritising these projects in planning and approval processes and potentially reducing permitting hurdles under section 35 BauGB.

04

Double-taxation

ESS in Germany faces double taxation, with energy stored and then discharged being taxed both as a consumer and as a generator. Tax exemptions are only currently available for electricity purchased for electricity generation per section 9 StromStG and section 12 StromStV. Policymakers are seeking solutions to address this issue, with a reform expected by 2025.

05

Costs and grid connection fees

ESS operators have a statutory claim to grid connection under section 17 EnWG or section 8 EEG, but must contribute 50% of the attributable costs (Baukostenzuschuss). This financial burden ensures ESS projects contribute to grid maintenance and expansion. To encourage ESS deployment, storage facilities are exempt from grid fees for 20 years if commissioned by 2029 (section 118 EnWG).

Under section 11 EEG, grid operators must take off, transmit, and distribute all electricity, but there is no statutory obligation for ESS operators to feed into the grid.

What are the key investments in Germany?

Germany has been making substantial investments in ESS to support its transition to renewable energy. As part of its energy transition initiative, the country aims to enhance grid stability and integrate more renewable sources like wind and solar power. This has led to increased funding and development in various ESS technologies, including lithium-ion batteries, pumped hydro storage, and innovative solutions like power-to-gas.

One prominent example is the “Netzbooster” project in Kupferzell, where a 250 MW battery storage system is being developed by TransnetBW. This project aims to stabilize the grid and reduce the need for conventional grid expansion by providing rapid balancing power.

Another significant project is the BigBattery Lausitz, a 50 MW lithium-ion battery system in Saxony, developed by LEAG. This facility supports the integration of renewable energy into the grid and enhances regional energy security by providing up to 50 MW of primary control power to compensate for short-term fluctuations in the electricity supply.

Additionally, the hybrid power plant in Gaildorf combines wind power and pumped hydro storage, demonstrating a novel approach to energy storage. This project integrates wind turbines with a water reservoir system, allowing excess wind energy to be stored and later used to generate electricity.

These investments and projects illustrate Germany’s commitment to developing a robust ESS infrastructure, crucial for achieving its renewable energy goals and ensuring long-term energy sustainability.

The hybrid power plant in Gaildorf combines *wind power and pumped hydro storage,* demonstrating a novel approach to energy storage.

250 MW

Battery storage system

Hungary

The energy storage market in Hungary

Hungary's energy storage market has seen remarkable growth in recent years, driven primarily by the strengthening role of renewable energy in the energy mix and the developments concerning grid stability and ancillary services. Not long ago, energy storage units were considered a niche technology in Hungary, largely unregulated due to its limited adoption. However, the rapid expansion of solar energy and the lifting of the wind feed-in stop has made energy storage a vital part of Hungary's energy strategy.

At the heart of this transformation is the government's ambitious target to boost energy storage capacity to at least 1,000 MW by 2026, along with plans to introduce 100 MW of demand-side response by 2030. These objectives are part of Hungary's broader push toward a more resilient and sustainable energy system. Implementation is supported by substantial funding initiatives, including a €1.1 billion program approved by the European Commission aimed at deploying between 800 MW and 1,600 MWh of energy storage units.

What revenue streams are available?

The primary revenue streams for energy storage in Hungary are grid ancillary services, energy arbitrage and capacity market participation. The market for virtual power plants and aggregators is quickly developing and diversifying with new entrants every other year. Co-located storage solutions with renewable generators, especially solar, are increasing in capacity following the appearance of negative electricity prices in the Hungarian market at solar peak production times in 2024.

On-site energy storage solutions are being considered at large industrial consumers, often combined with behind-the-meter renewable generation installations, which may be eligible for investment subsidies from the Hungarian state.

Hungary also operates a Contract for Difference type storage revenue support scheme (BESS CfD) which can be applied for through a tender procedure. The first of these was conducted in February 2024. Both grid-connected and standalone energy storage units may apply, allowing broad participation.

The BESS CfD subsidy is administered and distributed by the Hungarian electricity TSO (MAVIR). The BESS CfD offers support for up to ten years, aligning with the expected lifespan of energy storage systems.

The BESS CfD is modeled after the premium-based renewable support scheme METÁR. Under the BESS CfD, BESS operators receive compensation for the difference between the market price and a predetermined strike price, ensuring a stable revenue stream even in fluctuating market conditions. Payments are adjusted dynamically based on market performance, for example, if an operator's market earnings fall below the claimed revenue during the tender process, the TSO compensates for the shortfall; while if market revenues exceed expectations, the operator must return the surplus. To maintain financial balance, the BESS CfD formula is reviewed every two years, adapting to changing market conditions. There is a cap for the BESS CfD: total support cannot exceed eligible project costs, adjusted with a 10% interest rate cap.

The BESS CfD is expected to decrease the inherent risks of the now forming energy storage market and, especially if combined with a long-term aggregator agreement, may be key in ensuring financing for the implementation of new BESS projects in Hungary.

What are the current regulations in Hungary?

Hungary has established a robust regulatory framework to support the development, integration, and operation of energy storage units. The sector is primarily governed by Act LXXXVI of 2007 on Electricity (the Hungarian Energy Act) and its implementation decree, Government Decree No. 273/2007. These regulations lay down the key rules for permitting, grid connection, and operational compliance. In addition, ministerial decrees and directives from the Hungarian Energy and Public Utility Regulatory Authority (HEPURA) provide further detailed regulation. The BESS CfD is regulated by Government Decree 382/2023 and HEPURA Decree 17/2023.

The permitting process for energy storage projects depends on several factors, including location, environmental impact and capacity. If a facility is located in an area of natural protection or emits significant pollutants, additional regulatory bodies (such as archaeological or environmental bodies) may impose additional requirements or demand further approvals.

For energy storage units with a nominal capacity of 0.5 MW or more, HEPURA licensing is mandatory. The licensing process follows a structure similar to renewable energy projects, ensuring that energy storage units meet strict operational and safety standards before entering the market.

Beyond permitting, energy storage units must comply with rigorous technical and operational regulations, such as the TSO's Commercial Code (Kereskedelmi Szabályzat) and Operational Code (Üzemi Szabályzat) and, at the distribution level, energy storage operators must adhere to the Distribution Codes (Elosztói Szabályzat) as well as the Code of Business (Üzletszabályzat) of the competent DSOs.

To ensure transparency and regulatory compliance, energy storage operators are subject to strict monitoring and reporting obligations supervised by HEPURA. Additionally, operators benefiting from the BESS CfD must provide detailed financial and technical reports, including contracts with aggregators or other energy market participants to the TSO.

The BESS CfD is regulated by *Government Decree 382/2023 and HEPURA Decree 17/2023*

What are the key investments in Hungary?

Hungary is attracting major investments in energy storage, with several large-scale projects currently under development.

One of the most significant projects is E.ON's energy storage unit in Soroksár, announced in August 2024. This facility will provide essential grid backup and store surplus renewable energy, equivalent to the output of 4,000 solar panels. The project is scheduled for completion by November 2025, as part of E.ON's broader €1 billion investment in Hungary's electricity infrastructure.

Another key development is Forest-Vill's 20 MW, 60 MWh energy storage unit in Szolnok, set to be the largest energy storage unit in Hungary when completed in early 2025. The project aims to enhance renewable energy integration, particularly solar power, into the national grid.

Beyond energy storage, Hungary is becoming a major hub for battery production. Chinese battery manufacturer CATL is building a €7.3 billion battery plant in Debrecen, which will be Europe's largest battery production facility. This investment is expected to strengthen Hungary's position in the European electric vehicle (EV) supply chain. Additionally, BYD is expanding its electric bus and battery manufacturing plant in Komárom, as well as building an EV manufacturing facility near Szeged, further supporting sustainable transportation initiatives.

Huawei has also partnered with Hungarian firms to develop one of Central Europe's largest solar energy storage units in Szolnok, expected to double Hungary's current energy storage capacity and facilitate renewable energy grid integration.

November 2025

The project is scheduled for completion by November 2025

Italy

The energy storage market in Italy

The Italian energy storage market is growing rapidly, as confirmed by the excellent results in 2023, which marks an 89% growth compared to 2022. In 2023, 287,706 storage systems were connected in Italy, with a total capacity of 2.02 GW and 3.84 GWh (i.e. almost 58% of the cumulative connected capacity). The vast majority of the capacity connected last year is to be attributed to storage associated with photovoltaic plants of less than 20 kW.

Storage facilities will play a key role in future scenarios by providing valuable services to the electricity system, including time-shifting and dispatching services aimed at ensuring the security and adequacy of the electricity system. Analyses carried out by Terna S.p.A. - operator of the Italian National Transmission Grid ("NTG") for high and extra-high voltage electricity which is also the largest independent electricity transmission system operator (TSO) in Europe ("Terna") - show that in the 'Fit-for-55' 2030 scenario, around 71 GWh of new utility-scale storage capacity will need to be developed in the following years.

89%
Growth

Italian energy storage market from 2022 to 2023

In 2023, *287,706 storage systems* were connected in Italy, with a *total capacity of 2.02 GW and 3.84 GWh*

What revenue streams are available?

- **Capacity market payments**
  The Capacity Market mechanism, approved in June 2019 by the European Commission and managed in Italy by Terna, procures reliable, stable and long-term production capacity by entering in long-term contracts, awarded through competitive procedures, to ensure the security of supply and adequacy of power generation in the event of peak demand.

  This mechanism, which has been introduced in Italian law since 2003, provides compensation to plants that guarantee their availability for energy production.

- **Storage capacity supply mechanism (it. Meccanismo di Approvvigionamento di Stoccaggio Elettrico 'MACSE')**
  Legislative Decree No. 210/2021 foresees the introduction of a new mechanism to increase the chances of acquiring new electricity storage capacity through a competitive procedure. The mechanism will be designed and dimensioned with the objective to integrate renewables with an efficient level of overgeneration, taking into account the planned grid developments. MACSE will make it possible to integrate new storage capacity in the system through long-term supply contracts that will be awarded through auctions launched by Terna S.p.A.

  In particular, MACSE aims to improve the use of non-programmable RES by shifting their production over time (time-shifting service) and, at the same time, help provide dispatching services. The two technologies considered in the MACSE are hydro pumping and lithium batteries.

  The mechanism allows the exchange of resources to maintain the balance between energy supply and demand in real time, regulated by quarter-hourly time-shifting contracts. Plants selected in auctions provide these services to Terna, which can then aggregate them and make them available to the system.

  The first auctions are likely to be launched in the second quarter of 2025.

- **Feed-in-tariff for energy storage facilities integrated with RES plants**
  New RES plants integrated with storage facilities can receive public incentives managed by GSE S.p.A. (it. Gestore dei Servizi Energetici **"GSE"**) under the conditions established by national legislation.

  Moreover, the integration of a storage system into a RES Plants already receiving incentives and benefits allows the RES Plant to continue receiving them, subject to verification by GSE. From the date of the entry into operation of the storage system, new algorithms will be applied to quantify the electricity eligible for incentives, guarantees of origin and/or guaranteed minimum prices.

- **Ancillary services**
  Storage enables new services for the security of the electricity system (static reserve, regulation of frequency, voltage and restarting) which were previously the exclusive domain of conventional sources.

MACSE aims to *improve the use of non-programmable RES* by shifting their production over time

What are the current regulations in Italy?

The regulatory framework for energy storage systems (”ESS„) in Ţtaly is complex, shaped by multiple regulations aimed at integrating ESS into the energy market.

01

Permitting regime

The permitting process for ESS, in terms of its complexity and administrations involved, varies in relation to the power capacity of the system and the features of the area where the system will be located, ranging from more complex administrative procedures centrally managed by the Ministry of the Environment to free building activities for batteries with a power capacity up to 10 MW;

02

Grid connection

The first provisions relating to the integration of storage facilities into the national electricity system, with particular reference to the methods of accessing and using the network, were introduced by the Resolutions No. 574/2014/R/eel and No. 642/2014/R/eel of the Italian Regulatory Authority for Energy, Networks and the Environment (it. Autorità di Regolazione per Energia Reti e Ambiente “ARERA”). Such resolutions have amended the Italian relevant regulatory framework for connection procedures stated by the Resolution No. ARG/elt 99/08 of the Electricity and Gas Authority (it. Testo Integrato delle Connessioni Attive “TICA”), essentially adding the “Title IV - Provisions for the grid connection of storages systems”.

03

Technical regulations

The fragmented regulatory framework for the installation and operation of storage systems in Italy is then completed by the technical regulations of the Italian Electrotechnical Committee (“CEI”) CEI 0-16 (medium voltage) and CEI 0-21 (low voltage). These regulations provide technical specifications which storage systems must meet to be integrated into the grid and set out the appropriate certification requirements that manufacturers must observe to import and sell storage systems in Italy.

These regulations *provide technical specifications* which storage systems *must meet to be integrated into the grid* and set out the *appropriate certification requirements* that manufacturers must observe

10 MW

Batteries with a power capacity

Located in northern Italy, with *70 MW of power* and a *capacity of 340 MWh*, is amongst the *largest utility-scale storage projects in Europe*.

What are the key investments in Italy?

To date, the technologies with proven commercial maturity are lithium-ion batteries and pumped hydroelectric storage. However, other technologies such as mechanical storage using air or other gases as carrier fluid, power-to-gas-to-power and other types of storage (electrostatic and magnetic, electromechanical flywheel) are being developed.

2023 was a record year for the development of ESS. Among the systems entered in operation in 2023, one located in northern Italy, with 70 MW of power and a capacity of 340 MWh, is amongst the largest utility-scale storage projects in Europe (and the largest built in 2023). Any transformer stations used are 100% European-made, as is the batteries in the containers, which is made in Italy.

This storage system is expected to play a very important role in the medium to long term, as a support to the grid. Furthermore, it will make a decisive contribution to the decarbonisation process in Italy, as required by the PNIEC (National Integrated Energy and Climate Plan).

Regarding non-utility scale batteries, the most important segments are commercial and industrial (C&I), especially in relation to Renewable Energy Communities (RECs). Developments in the sector of ESS will only reach their peak when the market begins to realise the important advantages of RECs.

Morocco

The energy storage market in Morocco

The energy storage market in Morocco is rapidly expanding, driven by the government's ambitious energy transition goals and the growth of renewable energy sources. The country aims to generate 52% of its electricity from renewables by 2030, with a significant increase in solar and wind power. However, the variability of these renewable sources underscores the need for energy storage solutions to ensure grid stability.

Morocco is focusing on battery storage, pumped hydro storage, and exploring innovative solutions such as green hydrogen. These technologies help mitigate production fluctuations and ensure a consistent power supply.

Energy storage solutions play a key role in optimising self-consumption, reducing energy import costs, and providing uninterrupted power, especially in industrial zones. This sector is also supported by emerging legislative and regulatory frameworks to accelerate its development, ensuring that energy storage becomes a cornerstone of Morocco's sustainable energy future.

What are the current regulations in Morocco?

The regulatory framework for energy storage systems in Morocco is rapidly evolving, following recent reforms aimed at encouraging the integration of storage technologies into the national electricity system. Key areas of regulation include:

- **Competence**
  In accordance with Decree no. 2-14-541 of 8 August 2014, the implementation of the strategic storage policy falls within the remit of the energy and mines department of the supervisory ministry (article 1).
- **Energy storage facilities**
  Law 13-09, enacted on 11 February 2010, and amended by Law 40-19 in February 2023, governs renewable energy in Morocco. While the initial version did not mention energy storage, the amended law introduced its definition as "the operation of collecting energy produced for later use" (Article 1). It now allows private actors to develop storage projects and benefit from related services (Article 6). This includes incentive measures aimed at stabilizing and securing the power supply.
- **Grid connection**
  In January 2023, the Ministry of Energy was considered finalising a decree focusing on energy storage installations, to implement Law 40-19. This decree was supposed to clarify the technical and legal requirements for grid connection.
- **Self-production**
  Law 82-21 was adopted in May 2023, and the implementing decrees will complete this reform by enabling self-producers of electricity to store energy produced from renewable sources and access storage services. Its publication is still pending at the time of publishing this report.

52%

Electricity from renewables by 2030

What are the key investments in Morocco?

Morocco is making significant investments aimed at enhancing its energy sector and driving overall economic growth. These investments focus notably on renewable energy and energy storage.

One of Morocco's flagship projects is the Afourer Pumped Storage Plant (STEP), with a capacity of 465 MW, commissioned in 2004. This facility plays a crucial role in balancing the electricity grid by storing excess energy generated during periods of low demand and releasing it during peak consumption times.

Another major project is the Noor Ouarzazate Complex, comprising four solar power stations—Noor CSP I, II, III, and IV—totaling 580 MW. This complex relies primarily on Concentrating Solar Power (CSP) technology, which allows for energy storage in the form of heat. The production units include Noor I (160 MW), Noor II (200 MW), Noor III (150 MW), and Noor IV (72 MW). CSP technology offers superior storage capacity compared to batteries, enabling the system to meet electricity demand at all times.

An additional solar complex near the city of Midelt has been developed. The first plant within this complex is the Noor Midelt I Project, a hybrid solar facility with a capacity of approximately 800 MW. It utilises photovoltaic (PV) technology and Battery Energy Storage Systems (BESS) with a minimum storage duration of around 5 hours. This project is in its final development phase, with financial closure expected in the second half of 2024. Moreover, on April 10, 2024, Masen launched the Request for Proposals (RfP) procedure for the Noor Midelt II Project, another hybrid solar power plant within the same Midelt complex. This plant, currently in the tendering phase, will have a capacity of approximately 400 MW, incorporating PV technology and BESS with a minimum storage duration of around two hours.

The Abdelmoumen Pumped Storage Plant, under construction since July 2019, represents another strategic investment in energy storage.

Additionally, the "Green H2A" platform, resulting from an agreement signed in late 2021 between the Institute of Research in Solar Energy and New Energies (IRESEN), Mohammed VI Polytechnic University (UM6P), and the OCP Group, focuses on research and innovation in green hydrogen. The platform, expected to be operational by the end of the year, will also address the storage of green hydrogen.

Finally, nineteen standards, including the CEI 61427-1 standard on battery storage for renewable energies, have been made mandatory by a commission led by the Minister of Energy, Mines, and Environment. This measure aims to ensure high standards in the energy storage sector and support the country's energy transition.

These investments and initiatives demonstrate Morocco's commitment to developing innovative and sustainable energy solutions, solidifying its position as a key player in both regional and global markets.

One of Morocco's flagship projects is the *Afourer Pumped Storage Plant (STEP)*, with a *capacity of 465 MW*, commissioned in 2004.

Poland

The energy storage market in Poland

The share of coal (hard coal + lignite) in Poland's electricity generation in 2023 amounted to ca. 63%, the share of natural gas to ca.10% and the share of renewables to ca.27%. According to the Energy Policy of Poland until 2040, the share of coal in electricity production is to be only 36%, and of renewables - 48%. Decreasing disposable capacities in the energy system (for example, the phasing-out of hard coal fired units which do not comply with environmental requirements) makes storage an indispensable solution from the perspective of energy safety in Poland.

In Poland, energy storage based on power-to-power technologies is developing rapidly. Electricity storage in the form of lithium-ion batteries is the most common technology bundle, regarding capacities planned by investors. Poland also has a few pumped hydro storage plants, which until the introduction of appropriate regulations were treated as generation units. In 2021 Poland has introduced regulations explicitly dedicated to energy storage as a basis for their operation in the market. Additional funds and programs have also been launched to support investment in energy storage technologies, including grants and preferential loans.

Over time, further facilitation of the integration of energy storage with RES installations was introduced to allow better management of surplus energy and increase efficiency. The balancing market itself has also undergone profound changes by opening up to new technologies, allowing energy storage facilities to participate in the provision of balancing services.

So far, however, the biggest incentive to invest has been the capacity market. BESS made its debut in the capacity auction for period starting in 2027 (held in December 2022) - a total of 165 MW of planned BESS capacities were granted capacity contracts. In the most recent main auction - for deliveries staring in 2028 (held in December 2023), the new contracted planned BESS capacity amounted to 1.7 GW (10 times more than a year ago). BESS and other storage technologies can count on support in a form of capacity contracts with tenor of up to 17 years. The support can be stacked with revenues from other sources such as arbitrage or balancing services.

Energy transition and decarbonisation imply the need for profound changes to the architecture and operating rules of the electricity system. This is a universal principle. In the case of Poland, whose energy mix is still based on conventional sources, the scale and pace of changes required necessitates the application of solutions ensuring energy security and supporting the stability of the system undergoing transformation. Continued support for the development of storage facilities is key to system flexibility and further development of renewable energy sources in Poland.

In 2021 Poland has introduced *regulations explicitly dedicated to energy storage*

What revenue streams are available?

The main sources of revenue for energy storage are currently: the capacity market, arbitrage and ancillary services. In the future, energy storage facilities will also be able to derive revenue from providing flexibility services to network operators.

01

Ancillary services

In connection with the recent reform of the balancing market, energy storage facilities can provide services necessary for the operation of the electricity network, including balancing services and non-frequency system services. Particularly, the ability of energy storage facilities to provide services such as FCR, aFRR, mFFR and RR. The reform also brought a change in the capacity threshold for market participants that can bid on the balancing market. The new regulations allow smaller units of at least 0.2 MW to participate, instead of the previous threshold of 1 MW. This change opens up the balancing market to a larger number of smaller storage facilities. Participation in this market is also possible through aggregators.

02

Energy arbitrage

Energy storage can take advantage of arbitrage opportunities on both the day-ahead market and the intraday market.

03

Capacity market payments

To participate in the capacity market, a provider must win the auction (descending price auction) and enter into a contract with the Transmission Network Operator. A capacity provider receives remuneration for a unit's readiness to perform the capacity obligation, and the actual performance of their obligation if it's needed. New energy storage facilities can count on seventeen years of support. For an energy storage facility to participate independently in the capacity market, it must have a net achievable capacity of not less than 2 MW. Participation through an aggregator is also possible.

04

Flexibility services

The market for flexibility services has not yet been introduced in Poland, but the changes to the regulations introduced in 2023 already take into account the possible participation of energy storage in this market. Such services will be provided to distribution network operators.

New energy storage facilities can *count on seventeen years of support.*

What are the current regulations in Poland?

The regulatory framework for energy storage in Poland is shaped by multiple regulations. In addition to legal acts, the instructions for operation and use of the network adopted by network operators are of great importance for the operation of energy storage in the market.

- **License**
  Economic activity with the use of storage facilities with a total installed electrical capacity of more than 10 MW requires a license. In addition, any electricity storage facility with a total installed capacity of more than 50 kW requires registration in a register maintained by the operator of the network to which the storage facility is connected. In cases where the company uses such facility for purposes of arbitrage, it should also obtain an energy trading license.
- **Permitting regime**
  The Polish legislator has not provided for separate permitting procedures specifically dedicated to energy storage facilities. Such projects may require a decision on the environmental conditions of the project – if the planned investment is likely to exceed the statutory thresholds for the surface area of the planned energy storage facilities and their associated infrastructure. If a plot considered for the implementation of the project is not covered by a local spatial development plan, a zoning permit will be required. Finally, for industrial scale storage facilities - a building permit must be obtained.
- **Energy storage facility and RES**
  Storage of electricity taken from the network by an electricity storage facility that is part of a renewable energy source installation or a hybrid renewable energy source installation does not exclude participation in the support system dedicated to RES. This is under the condition that the storage facility is equipped with a metering and billing system that records the volume of electricity injected into and taken out of the electricity storage facility, which makes it possible to determine the volume of electricity taken from the network, and then injected into that storage, and the amount of electricity generated in a renewable energy source installation and then injected into that storage.
- **Costs and network connection fees**
  The fee for the connection of an electricity storage facility is determined based on 50% of the expenses incurred for the connection development. An entity applying for connection of an electricity storage facility to a network with a rated voltage higher than 1 kV can pay in advance for the network connection fee in the amount of PLN 30 for each kW of connection capacity specified in the application for connection conditions.

  The adopted regulations abolished double charging of energy storage by network operators providing energy distribution services. In general, the basis for calculating network charges is the difference between the energy taken from the network and injected into the network by energy storage in a given settlement period.

What are the key investments in Poland?

Poland has been making substantial investments in ESS to support its transition to renewable energy. As part of its energy transition initiative, the country aims to enhance network stability and integrate more renewable sources like wind and solar power. This has led to increased funding and development in various ESS technologies, including lithium-ion batteries, pumped hydro storage, and innovative solutions like power-to-gas.

One of the biggest investments is the one planned the PGE S.A. that plans to build a large-scale energy storage facility, which is expected to have a capacity of up to 263 MW and a minimum capacity of 900 MWh. The energy storage facility will be located near to the Żarnowiec Pumped Storage Power Plant. The same company has already started an investment in the 400 MW Gryfino energy storage, which is expected to be operational in 2029.

Investments in BESS which obtained capacity contracts are not yet operational, being at the late development stage or in course of construction process.

The country aims to *enhance network stability and integrate more renewable sources* like wind and solar power.

Singapore

The energy storage market in Singapore

Singapore has one of the most dependable electricity grids globally. As Singapore continues to harness renewable energy and power imports to rapidly facilitate its energy transition and development of low-carbon energy systems, they must simultaneously ensure the stability and resilience of its grid infrastructure through innovative technologies and well-planned deployment strategies.

Singapore has been steadily ramping up efforts to develop energy storage systems (ESS) on a larger scale to support the rise of renewable energy and the ever-growing energy demands of the city-state. However, various challenges remain in upscaling ESS deployment. There is demand for ESS solutions that are safer, more compact, and economically viable. The ESS market is also subject to disruptions and intense competition for raw materials from electric vehicle makers that have collectively contributed to rising costs for key materials used in battery production, in particular lithium.

In its efforts to secure a sustainable future, Singapore has had to navigate these complexities, investing in research and development as well as pathfinder projects to advance ESS technologies that can effectively support its energy transition goals.

Singapore has one of the
most dependable electricity grids globally

What revenue streams are available?

As noted by Singapore's Energy Market Authority (EMA), ESS can enhance the efficiency, stability, and reliability of the power grid by (i) supporting the integration of distributed and intermittent generation sources, such as solar power, into the grid, (ii) distributing peak electricity load to off-peak periods, helping to moderate fluctuations in electricity prices, (iii) regulating and storing energy, (iv) swiftly responding to power fluctuations within the grid, ensuring an uninterrupted energy supply, (v) and allowing grid operators to defer costly investments in grid infrastructure, which translates into cost savings for end-users.

The ESS sector presents several revenue and investment opportunities:

- **Provision of market services**
  ESS can provide in-front-of-the-meter services (i.e. services provided to the grid), such as frequency regulation and spinning reserves. In its policy paper, EMA noted the example of the Hornsdale Power Reserve in Jameston, South Australia. This facility comprises both a 315MW wind farm and a 100MW/129MWh battery. It participates in various competitive energy and ancillary services markets, receiving fixed payments for providing essential grid reliability services.
- **Provision of consumer services**
  ESS may be installed on a consumer's premises to provide behind-the-meter services (i.e. services provided to energy consumers). For instance, these systems may provide uninterruptible power supply services and prevent outages as well as help consumers avoid paying peak electricity costs by arbitraging the price of electricity during peak and off-peak periods.
- **Second life and recycling services**
  As the demand for ESS grows, managing electronic waste produced by ESS facilities becomes increasingly critical. Services focused on the second life and recycling of materials can mitigate environmental impacts while recovering valuable resources. The ability to cost-effectively recover precious metals from lithium-based batteries could provide a significant competitive advantage for operators in the recycling and waste management sectors.

What are the current regulations in Singapore?

The following non-exhaustive list of regulations are relevant to ESS:

01 **Electricity Act 2001:** regulates the licensing requirements and market participation and settlement for ESS. An electrical installation licence is required for all non-domestic electrical installations with an approved load exceeding 45kVA.

02 **Electricity (electrical installations) regulations:** covers the requirements relating to electrical installations, such as the engagement of a licenced electrical worker of an appropriate class, and the use of apparatus that are compliant with the applicable standard or specification issued by the Enterprise Singapore Board.

03 **Fire Safety Act 1993:** covers the requirements relating to fire safety and regulations pertaining to the import, transport, and storage of flammable materials, including compliance with the Code of Practice for Fire Precautions in Buildings ("Fire Safety Code").

04 **Fire safety code:** sets out the fire safety requirements for ESS which exceeds certain thresholds of stored energy.

05 **Workplace Safety and Health Act 2006:** regulates exposure to flammable materials at workplaces, necessitates the conduct of risk assessments to identify and control workplace safety and health risks (e.g. fire risk), and the implementation of risk control measures for dealing with emergencies.

06 **Environmental public health (toxic industrial waste) regulations:** sets out regulations on the handling, transport, treatment, and disposal of toxic industrial waste.

07 **Property Tax Act 1960:** An operator of an ESS may need to consider the value of the ESS when calculating the property tax payable on the entire property. While section 2(3) of the Property Tax Act stipulates that "machinery" is exempted from the property tax assessment, it is not clear from the guidelines and legislation that an ESS is considered "machinery" so additional property tax may have to be borne by the ESS operator or developer.

At the time of writing, there are no specific, customised laws for ESS in Singapore. That said, ESS-specific regulations may be introduced in the future to facilitate ESS' growing role in the Singapore power system. These regulations might deal with metering and billing arrangements, compensation mechanisms, and safety standards or safeguards to protect consumer interests.

What are the key investments in Singapore?

Recognising the potential of ESS in integrating renewable and intermittent energy sources, while ensuring a reliable electricity supply, the Singaporean government has launched several initiatives aimed at accelerating the development and deployment of ESS.

A prominent example of this effort is the commissioning of the Sembcorp Energy Storage System, which stands as the largest ESS deployment in Southeast Asia and is one of the fastest of its size to be operationalised. Officially opened on 2 February 2023, this utility-scale system possesses a maximum storage capacity of 285MWh, enough to meet the electricity needs of approximately 24,000 four-room HDB households for a day in a single discharge. Bird & Bird Singapore acted for EMA in this pathfinder ESS project.

In the fourth quarter of 2023, EMA issued a grant call, inviting proposals for industry-driven projects aimed at advancing research and development initiatives to facilitate and address the challenges facing wider deployment of ESS in Singapore. The grant call was open to research consortia comprising institutes of higher learning, public sector research institutions, public sector agencies, not-for-profit organisations, and private sector companies.

To accelerate the adoption of ESS, EMA has also rolled out the ACCESS programme. This programme is intended to facilitate ESS adoption by promoting use cases and business models. The programme focuses on securing space, matching demands with solutions, and facilitating regulatory approvals for ESS deployment in Singapore.

Spain

The energy storage market in Spain

Fuelled by an increasing need to integrate renewable energy sources into the grid, enhance supply stability and optimize energy consumption, the energy storage market in Spain (specifically regarding battery energy storage systems), is experiencing rapid and dynamic growth.

The new climate context has driven the implementation of measures and packages throughout the European Union which have affected the Spanish regulation. The increase in climate ambition at the European level, the need to strengthen strategic autonomy and the progress achieved thanks to the Recovery, Transformation and Resilience Plan (PRTR) (i.e. the Spanish instrument for the management of the NextGeneration EU funds) ("PRTR") have driven several updates of the National Integrated Energy and Climate Plan ("PNIEC") originally drafted in 2021, the latest update being approved just on 24 September 2024.

The PNIEC outlines renewable energy goals which are *powering the substantial growth in the energy storage sector in Spain.*

The PNIEC outlines renewable energy goals which are powering the substantial growth in the energy storage sector in Spain. Due to the incorporation of advanced technologies and cost reduction, storage solutions are becoming increasingly accessible to different sectors.

The latest update sets forth, among others:

01 The industrial value chain and strategic autonomy will be strengthened, with energy dependence falling from 73% in 2019 to 50% in 2030 and import savings of € 86.75 billion.

02 The greenhouse emissions reduction target for 2030 is 32%, compared to the 23% estimated in the original version of the Plan.

03 The final consumption target for renewable energy rises to 48% - with 81% of electricity generation - and the energy efficiency target to 43%.

04 76 GW of photovoltaic (with 19 GW of self-consumption), 62 GW of wind, 22.5 GW of storage and 12 GW of electrolysers for renewable hydrogen are expected to be installed by 2030.

Energy storage solutions play a dual role in Spain: (i) they enable the storage of energy produced by intermittent renewable sources (e.g., solar and wind); and (ii) they contribute to stabilizing the electricity grid by balancing fluctuations in supply and demand, storing energy in periods of surplus generation, so that it is available when there are shortfalls.

The Energy Storage Strategy 2030, promoted by the Ministry for the Ecological Transition and the Demographic Challenge, aims to develop the PNIEC, analysing from a technical perspective, the different generation alternatives, the diagnosis of the current challenges of energy storage, the lines of action to move forward in meeting the planned objectives and the opportunities that storage represents for the energy system and for the country. This strategy aims to achieve a storage capacity of 22.5 GW by 2030 and 30 GW by 2050.

Electricity storage is an essential tool for the future in Spain, given our nature as an energy island, the need for system flexibility and the unmanageable nature of renewables, among other reasons.

Types of energy storage systems and what revenue streams are available in Spain

There are two common types of energy storage systems: (i) stand-alone energy storage systems; and (ii) hybridized systems (Solar-Plus-Storage or Wind-Plus-Storage). There are several revenue and investment opportunities:

Stand-alone energy storage systems

These are independent installations, which draw and discharge energy from the grid through bi-directional inverters that rectify or invert the direct current of the batteries to adapt it to the alternating current of the grid to which are connected through transformers, which raise the voltage to the required value.

Stand-alone energy storage systems participate in ancillary services market and are much needed by the energy market, as curtailment increases even during solar hours. The Ministry for Ecological Transition is receiving the first large-scale storage projects in Spain, many of them on a stand-alone basis.

Hybridized systems

These are hybrid installations with power generation installations that are fed by the energy produced by the generation installation and share their access and connection point to the grid, so that only one access and connection permit is required.

The lack of a complete regulation in Spain regarding energy storage systems has hindered our ability to have a clear picture of the profitability they can generate.

Despite significant price reductions in the technology and regulatory changes that allow energy storage assets to participate in existing electricity markets in Spain, it is very likely that other revenue streams will be needed to ensure the profitability of investments in storage assets. It is highly likely that revenues from energy storage systems in Spain will highly depend on (i) ancillary services; and (ii) energy markets.

On 29 July 2024, the Ministry for the Ecological Transition and the Demographic Challenge published new regulatory bases for support for the manufacture of renewable energy and storage equipment and components. This €750 million incentive line is aimed at strengthening the industrial ecosystem and developing new technological and industrial capacities in solar energy, wind energy, heat pumps, batteries for energy uses and electrolysers for renewable hydrogen.

What are the current regulations in Spain?

The Spanish Government has published the Draft Royal Decree approving the General Regulations on Supply and Contracting, establishing the conditions for the commercialization, aggregation and consumer protection of electricity this July 2024, which finally clarifies the treatment of storage facilities in the handling of access and connection procedures.

The current regulations on the commercialization and supply of electricity, contained in Law 24/2013, of 26 December, on the Electricity Sector ("Electricity Sector Law") and developed by Royal Decree 1955/2000, are outdated and this step was one of the most eagerly awaited by the renewable energy sector, mainly storage.

Royal Decree 23/2020:
Through this Royal Decree, (which among other aspects, partially amended the Electricity Sector Law) the Electricity Sector Law incorporated various aspects relating to energy storage, such as the definition of 'storage facility owner'. It also introduced a series of measures aimed at promoting new business models such as storage and hybridisation.

Royal Decree 1183/2020:
For the first time, it regulated grid access for storage facilities that injected energy into the grid, allowing hybridisation of new or existing production plants with storage systems. In addition, as a measure to promote their installation, it was established that, within the framework of capacity tenders, the incorporation of storage facilities could be included as an assessment criterion.

Amendment to Royal Decree 1955/2000:
Special features were introduced for hybridisation and storage regarding the validity of access and connection authorisations or applications for such authorisations, such as the fact that the addition of energy storage velements to the installation would not imply modification.The procedure for the authorisation of electricity storage facilities, whether standalone or hybridised, was also regulated, giving them the same treatment as electricity generation facilities for all purposes.

Law 21/2013 on environmental assessment:
Regarding environmental authorisation, storage facilities are not included in the scope of application of either the ordinary or simplified environmental impact assessment, unless they affect protected natural areas or cultural heritage, it should not be required to obtain such authorisation. However, the practice so far is that environmental authorisations are required for standalone facilities.

Resolution of 10 December 2020, of the National Commission for Markets and Competition ("CNMC"), which approves the adaptation of the system operation procedures to the conditions relating to the balance approved by Resolution of 11 December 2019.
By means of this Resolution, changes are incorporated into the system operation procedures for the participation of demand and storage in the balancing systems. The entry of demand and storage in these systems will benefit the Spanish operator (Red Eléctrica Española), which will have more resources to balance the grid, and the participants, as they will receive an economic return in exchange for modulating consumption.

Circular 3/2020, of 15 January, issued by the National Markets and Competition Commission
It established the methodology for calculating transmission and distribution tolls, and indicating that energy storage batteries connected to the transmission or distribution network are exempt from payment of tolls, adapting to Regulation (EU) 2019/943.

What are the key investments in Spain?

Spain is a pioneer in renewables and is working to become a pioneer in storage as well. As previously mentioned, the Spanish Government is focusing all its efforts on boosting investment in energy storage systems.

The Spanish Government granted €150 million to promote 36 storage projects connected to renewable generation plants on January 2024.

The beneficiaries are distributed across nine autonomous communities, with Castilla-La Mancha and Extremadura as the territories with the most power (632.4 MW) and the highest percentage of support (€95.4 million). Among the promoters of the storage projects we can find strategic players such as Naturgy, Iberdrola, Acciona, Q Energy and Enel. Other important European promoters as Field (with more than 4.5 GWh of projects in advanced stages of development across Europe) are now landing in Spain to develop storage solutions.

The selected initiatives have a total capacity of almost 1 GW and contribute to the PNIEC draft update target of 20 GW by 2030. In words of the Ministry for the Ecological Transition and the Demographic Challenge *"Storage is a key technology to guarantee a 100% renewable electricity system by 2050. By the end of 2023, almost 51% of the electricity generated in Spain will already be of renewable origin. The PRTR is a comprehensive programme of instruments and measures to develop technology, knowledge, industrial capacities and new business models that reinforce Spain's leading position in the field of clean energy. It will mobilise an investment of more than €16,300 million, between contributions from the Recovery Plan and private funds."*

In addition to these subsidies for innovative energy storage projects hybridised with renewable facilities, the PRTR includes three other lines of subsidies aimed at activating innovative projects and new business models linked to storage, including those related to independent electrical, thermal and reversible pumped storage, for a total of €446 million. In addition to these, there are also subsidy programmes for self-consumption and the promotion of renewables in island territories, which have already been resolved and are committed to storage as a key eligible technology.

€150m

to promote 36 storage projects connected to renewable generation plants

Sweden

The energy storage market in Sweden

Sweden's energy market is characterized by ambitious goals, particularly the aim to achieve 100% fossil-free electricity production by 2040 and net-zero greenhouse gas emissions by 2045. The former goal was recently amended from the previous target of 100% renewable electricity production, reflecting a shift to a positive view on nuclear power.

Hydro power continues to play a significant role in Sweden's energy system and initiatives for new nuclear power production are being launched, in order to ensure sufficient flexibility through the ability to act as both baseload and balancing power. This is deemed important as Sweden increases its reliance on intermittent renewable sources like wind and solar. The integration of wind and solar energy has accelerated the need for energy storage solutions to manage intermittency and maintain grid stability.

The deployment of energy storage assets in Sweden is competitive, with both state bodies and private investors ramping up pilot projects and commercial-scale systems. Falling battery costs and the economic returns from ancillary service markets and co-located renewable-plus-storage projects are significant factors driving this growth. The Swedish market is evolving rapidly, with increasing renewable energy penetration and rising electricity demand shaping the landscape for energy storage investments.

Sweden's energy market aims to achieve
achieve 100% fossil-free electricity production by 2040

What revenue streams are available in Sweden?

01

Frequency regulation and ancillary services

The Swedish Transmission System Operator (Svenska kraftnät) procures ancillary services such as Frequency Containment Reserve (FCR), Frequency Restoration Reserve (FRR), and other balancing products. Battery storage operators can bid into these markets to provide rapid response to frequency deviations, thereby earning service payments.

02

Energy arbitrage

Although price volatility in the Nordic power market has historically been moderate, opportunities for energy arbitrage are growing. Storage operators can strategically charge their systems during low-price hours and discharge during peak-price periods. This activity may become more lucrative with increased penetration of variable renewables.

03

Capacity and resource adequacy

While Sweden does not currently have a centralized capacity market akin to some other European jurisdictions, Svenska kraftnät has indicated interest in ensuring resource adequacy via targeted mechanisms. This could potentially evolve into a capacity-based remuneration in the future if security of supply becomes more strained.

04

Co-location with renewables

Many wind farm developers and solar park operators are exploring on-site battery solutions to offset the intermittency of generation. By storing excess generation and selling it when higher prices are available, these combined sites can increase revenue and improve the overall utilization of the grid connection.

05

Grid congestion management

In certain regions of Sweden, local grid constraints—especially in times of high wind penetration—open up possibilities for congestion management services. Energy storage can earn revenues by helping to alleviate bottlenecks, deferring or reducing the need for expensive network upgrades.

What are the current regulations in Sweden?

The Swedish regulatory framework for electricity is governed primarily by the Electricity Act (Ellagen), complemented by a suite of secondary regulations and directives. Although there is no specific standalone legal framework dedicated solely to energy storage, several provisions relevant to storage have either been introduced or clarified:

Licensing requirements

Operators who intend to buy and sell electricity on a commercial basis typically require a trading license. On the other hand, where storage is wholly behind-the-meter and used only for self-consumption, licensing requirements may be minimal or non-existent.

Ownership Rules and Unbundling

In line with EU unbundling principles, network operators generally cannot own energy storage assets unless specific exemptions are granted (e.g., demonstration projects). This structure encourages market-based ownership and competitive neutrality, so storage facilities are often developed by generation companies, independent power producers, or third-party investors.

Grid Fee Exemptions and Tariffs

There is ongoing discussion around tariff structures to ensure storage operators are not charged twice for the same electricity (“double charging”). While some reforms have reduced this risk, operators must carefully navigate existing network tariffs to maximize financial viability.

Environmental Permitting

Medium to large energy storage projects, particularly pumped hydro or any installation that could have significant environmental impact, may be subject to an extensive permitting process under the Swedish Environmental Code. Battery storage projects often face fewer hurdles, but can still be subject to local land use and safety requirements.

Support Schemes

Although Sweden has historically relied on market-based instruments such as green certificates (jointly with Norway) for renewable generation, direct subsidies for energy storage remain limited. Nevertheless, pilot programs and innovation grants are starting to emerge, especially for cutting-edge or larger-scale facilities

What are the key investments in Sweden?

Utility-Scale Battery Projects: Sweden has been actively investing in large-scale battery energy storage systems (BESS). The country has launched its largest energy storage investment, totaling 211 MW/211 MWh, across 14 sites. These projects aim to reduce grid congestion and increase power generation, proving to be cost-effective and scalable solutions for balancing the grid. Local authorities support these initiatives, recognizing the potential of large-scale batteries to alleviate network congestion.

Battery Manufacturing and Technology Innovation: Northvolt has been a prominent player in Sweden's battery manufacturing sector, establishing one of Europe's largest battery production facilities in northern Sweden. Northvolt's operations faced challenges, including financial difficulties leading to bankruptcy, and potential future impact on the industry remains to be seen. Although not successful, the project shows the potential in Sweden to bring together investors and public actors to gather the significant assets and expertise necessary to take on large-scale projects with high ambitions.

Hydrogen and Power-to-X Projects: Sweden is increasingly focusing on hydrogen projects, particularly in the northern regions where renewable energy is abundant. The Nordic Hydrogen Route project, for instance, aims to build a hydrogen pipeline from Finland to Sweden, facilitating green hydrogen production for steelmaking and heavy transport. This project is part of Sweden's strategy to enhance energy independence and security. Additionally, plans for hydrogen storage in underground caverns are being explored, offering potential long-term storage solutions.

Thermal Storage Solutions: Thermal energy storage is gaining traction in Sweden, particularly within district heating networks. The city of Vasteras has implemented a system using underground caverns to store hot water, which acts as a giant heat battery. This system helps balance heating loads in urban areas and reduces CO^2 emissions by minimizing the need for emergency boilers.

Commercial & Industrial (C&I) Sector: The C&I sector in Sweden is increasingly adopting behind-the-meter battery systems to manage peak loads, reduce demand charges, and mitigate risks associated with the intermittency of on-site renewable generation. These investments are driven by rising electricity costs and sustainability objectives, highlighting the sector's commitment to energy efficiency and resilience

14 sites

The country has launched its largest energy storage investment, totaling 211 MW/211 MWh, across 14 sites

United Kingdom

The energy storage market in the UK

The UK energy storage market is in a phase of considerable growth. RenewableUK reported in May 2024 that the pipeline of UK battery energy storage system (BESS) projects has grown by two-thirds in capacity for the second 12-month period in a row. Average project capacity has also risen from 27 MW to 80 MW in the period 2019-2024. The UK Government has committed to continued growth in the energy storage market, having identified savings of up to £10 billion per year and 24,000 jobs by 2050.

Whilst being ranked as the third most attractive jurisdiction for battery storage by EY (behind the US and China), the UK leads Europe in grid-scale energy storage, adding 26 GWh of new storage from 2022 to 2031; more than double the next jurisdiction. The Energy Act 2023 has further strengthened the regulatory framework for electricity and hydrogen storage, recognizing its importance to the UK's economy and net-zero goals. Alongside a recently confirmed cap-and-floor scheme to encourage investment in long-duration energy storage, the new UK Labour has committed to a net-zero power grid by 2030 and £8 billion in funding for renewables projects over the next 5 years which will certainly drive further growth in the energy storage market.

Whilst BESS, predominantly lithium-ion technology, dominates the market, it is just one of a number of different storage solutions. For example, the EFDA JET Fusion Flywheel is the UK's second largest storage project (400,000 kW) and there are a number of pumped hydro storage (PHS) projects in the development pipeline totalling 6.9 GW of installed capacity.

The UK leads Europe
in grid-scale energy storage

What revenue streams are available?

There are a number of revenue streams available to energy storage projects, particularly BESS. Whether a project can take advantage of such revenue streams will often depend on whether it is a standalone project or if it is co-located with a renewable generation project.

Ancillary services

Energy storage projects, in conjunction with smart energy management systems, can quickly provide considerable power to the grid and prevent potential power outages during periods of high electricity demand. The UK's National Energy System Operation (NESO) is procuring three ancillary services from energy storage operators: (i) stability services (volume provision and voltage maintenance); (ii) reactive power services; and (iii) constraint management services. These offer BESS projects a stable revenue stream for assisting the national grid. The initial projects have been procured through NESO's Stability Pathfinders programme and primarily relate to standalone BESS projects.

Energy arbitrage

Energy storage system operators can take advantage of price fluctuations in energy markets by storing surplus energy generated during peak production times and releasing it when demand is high.

Capacity market payments

The intermittent nature of wind and solar, as the UK's most popular forms of renewables generation, further offers energy storage systems an opportunity to participate in capacity markets. These storage systems provide a crucial power source during periods where renewable generation is insufficient to meet demand and the operators may receive compensation for this supply.

These storage systems provide a *crucial power source* during periods where renewable generation is insufficient to meet demand

Hybrid PPAs

Hybrid power purchase agreements (PPAs), where a business enters into an agreement to purchase electricity from a co-located renewable generation project and BESS, are on the rise in the UK. Typically, these agreements see split payments for the energy generation element and the BESS element. We saw the first such PPA in 2023 between DIF Capital Partners and Engie which has been closely followed by a recent 10-year PPA between Statkraft and FP Lux Group for the Scurf Dyke Solar Farm and an 8 MW BESS in Yorkshire. Hybrid PPAs allow energy storage projects to guarantee revenue which assists bankability at the development phase. Early offtaker identification further allows energy storage systems be tailored to the specific needs of the offtaker whilst assisting the issue of renewable generation intermittency. Moreover, these co-located BESS projects can benefit from the generation project's infrastructure which reduces capital expenditure for the BESS element.

Land leasing

Whilst not a revenue stream for energy storage projects in themselves, BESS in particular presents landowners with potential long-term, stable income far surpassing basic agricultural rents, for relatively little land use. Typically, BESS leases include a simple annual rent calculated by reference to acreage, not linked to energy supply. Developers look for between 10 to 15 acres of relatively flat-lying land with low flood risk. Batteries tend to take up little space compared to solar and are considered significantly more profitable per acre. An acre of land may hold a 15-30 MW battery scheme. On the other hand, a solar scheme producing the same amount of power may require 150 plus acres.

Contracts for Difference (CfDs)

Whilst energy storage projects are not eligible on their own for the UK Government CfD scheme, co-located BESS can assist renewable generation projects in receiving contracts. The CfD scheme is a government initiative which provides renewable project developers with a guaranteed 'strike price' against the market rate for electricity over a 15-year period. Contracts are awarded in yearly auctions and recent rounds have seen an increase in co-located BESS as it supports efficiency and reliability. 1.4 GW of BESS could be developed following the last round announced in September 2024.

What are the current regulations in the UK?

The regulatory environment in the UK is evolving to support the transition to net-zero. Whilst there is currently no energy storage specific regulatory regime, the market is instead regulated across a number of different pieces of legislation.

01 Generation

The Energy Act 2023 clarified that electricity storage is a subset of generation, requiring storage providers to obtain a licence from Ofgem unless they fall within small generator thresholds. Licensed storage providers benefit from not paying final consumption levies on electricity imported from the grid and avoid Balancing System Use of Service (BSuOS) charges – although all storage systems are now exempt from BSuOS charges thanks to a 2021 amendment to the Connection and Use of System Code (CUSC). This amendment addressed the issue of double charging on electricity imported and exported to the grid, which had previously hindered the deployment of BESS due to high operational costs. Storage systems must also comply with various industry codes, including the Grid Code, Distribution Code, Balancing and Settlement Code and CUSC with the latter two applicable only to systems of 50 MW or above.

02 Planning

BESS sites are no longer part of the nationally significant infrastructure projects regime and planning is therefore determined by local planning authorities in the first instance in line with the English, Welsh and Scottish planning policies. Consent from Scottish Ministers is needed for a BESS in Scotland over 50 MW.

03 Tax

As of 1 February 2024, there is no VAT chargeable on the installation of zero-rated domestic co-located, standalone or retrofitted BESS projects. Applying the rate of 0% means suppliers can recover VAT on costs related to making the supply of battery, and customers do not pay VAT on the purchase of a BESS.

Investors in UK renewable energy assets can also claim tax relief through capital allowances, reducing taxable income. Benefits for BESS investments include 100% first-year relief on new, unused main rate plant and machinery from April 2023, 50% first-year allowance for special rate assets like solar panels and long-life BESS assets, and up to £1 million through the Annual Investment Allowance on qualifying plant and machinery, including installation costs.

04 Grid connections

The long and intensive timeline for securing grid connections has been a barrier to energy storage investment in the UK. There are expected to be 800 GW of projects (including both storage and generation) seeking connection by the end of 2024 with many projected connection dates into the mid to late 2030s.The National Grid has launched a number of initiatives to improve this, including: (i) the TMO4+ process (aka ‘First Ready, First Connected’) which will prioritise projects upon new criteria (details to be published this month); and (ii) the Connections Action Plan developed together with the UK Government and Ofgem, which outlines reforms to streamline grid connection including raising entry requirements, removing stalled projects, better utilising existing network capacity, and improving data and processes. BESS also crucially features in points three and five of the NESO’s five-point plan which seeks to increase the volume of UK storage and remove barriers to BESS grid connection.

What are the key investments in the UK?

An increasingly favourable regulatory environment, government incentives and a rise in complimentary renewables projects increasing the demand for storage has produced significant investment in the energy storage market across a number of technologies.

BESS

The Trafford Low Carbon Energy Park in Greater Manchester is set to host the world's largest BESS. Carlton Power have begun construction on the £750 million project, which will have a capacity of 1GW and will be amongst four BESS projects in the UK's five biggest energy storage systems. NatPower has also committed £10 billion to expand the UK's grid-scale battery storage capacity, including the development of several "GigaParks" and new substations.

We have also seen substantial activity in the BESS M&A market with a notable recent deal being KKR and Infracapital jointly acquiring Zenobe, a UK-based fleet electrification and grid-scale battery storage company for £600 million.

Flywheel

Statkraft's Lister Drive Liverpool site became operational in 2023 under NESO's Pathfinder scheme. This system makes use of flywheels to provide crucial stability to the UK grid. Ed Miliband, the Secretary of State for Energy Security and Net Zero, and NESO further announced in October 2024 that they are seeking to develop a number of flywheel systems across the UK.

Pumped Hydro Storage (PHS)

Gilkes Energy submitted planning applications in March 2024 as they continue to progress the Earba PHS project. This project will be the UK's largest PHS system with an installed capacity of 1,800 MW and total storage capacity of 40,000 MWh.

Hydrogen storage

Following a bolstered regulatory regime under the Energy Act, 2024 saw the announcement of the UK's largest hydrogen storage site in Portland, Dorset, which is expected to provide 2 billion cubic metres of capacity. This is equivalent to the UK's Rough gas storage field.

Developing technologies

Under the Longer Duration Energy Storage Competition in 2022, the UK government awarded over £32 million to five projects focusing on innovative energy storage technologies like thermal batteries and liquid flow batteries.

Carlton Power, Highview Power and the UK infrastructure bank have further announced in June 2024 that they will, as part of the Trafford Low Carbon Energy Park, be constructing the world's first commercial liquid air energy storage project.

Our Energy & Utilities Group

Bird & Bird LLP is an international law firm. We combine exceptional legal expertise with deep industry knowledge and refreshingly creative thinking. We have over 1700 lawyers in 32 offices across Europe, the Middle East and Asia-Pacific, as well as close ties with other firms in other parts of the world.

Leaders in the energy transition

The global energy transition has for over 20 years been the central part of our work across the energy and utilities sector with an expert team of more than 250 lawyers internationally, giving us a deep understanding of the challenges our clients seek to address.

Our lawyers have been at the forefront of the green economy and global energy transition for over 20 years. We are a number 1 ranked renewable energy team who have advised developers, investors, funders, EPC contractors, off-takers and regulators across a number of jurisdictions around the world.

As an international team, our sector approach is not broken down by offices but into sub-groups that focus on particular aspects of the Energy & Utilities sector.

The combination of our strengths in the global energy transition and the technology specialism for which we are better known, means that we are ideally placed to support stakeholders involved in new methods of energy generation and management.

We understand key business processes and work closely with industry bodies in order to influence and shape markets. We will help you to anticipate change, deliver solutions and implement strategies.

With over 500 green economy cross-border deals in recent years, our expert team knows how to efficiently structure and manage renewable transactions and financings covering all legal and regulatory requirements with a risk-based approach.

We understand *key business processes* and work closely with industry bodies in order to influence and shape markets.

Key focus area: Energy storage

Our Energy & Utilities team push the boundaries of where the sector needs to go. We do not merely advise on energy transactions, but instead advise on the interaction of law and regulation with technology, energy market transactions and infrastructure. Bird & Bird's strategy to specialise in sectors being disrupted by technology means our work in the energy sector has always been focussed on renewables and other cleantech, including battery storage projects.

Our top ranked experience in renewable energy projects has provided us with an excellent platform to develop a track record in advising on energy storage projects. As the technology sitting behind energy storage has developed, we have become increasingly involved in advising clients on planned business streams, both behind and in front of the meter.

Examples of our work include:

- Advising BW ESS on their acquisition of the remaining shares of Penso Power. This transaction follows a strategic investment and development partnership with Penso Power in 2021. Prior to the latest acquisition, BW ESS was the largest shareholder of Penso. BW ESS is a global energy storage owner-operator, delivering market-leading projects across multiple countries. They have a multi-gigawatt pipeline, with over 1GWh of projects currently in construction, and they work with strategic partners in the UK, Italy, Sweden, and Australia. Penso Power develops and operates large-scale battery energy storage projects, primarily in the UK, Italy, and Australia. They play a crucial role in integrating renewable energy sources and enhancing the resilience of electricity networks.
- We advised the EMA on the Energy Storage Services Agreement to appoint Sembcorp Industries to build, own, and operate Singapore first commercial-scale ESS to enhance the resilience of Singapore's energy supply. This is the largest ESS deployment in South-East Asia, and one of the fastest of its size to be deployed.
- We advised EMA and drafted unique charge and discharge documents for an ESS Test-bed. The documents were aligned to the grant conditions and norms on the enforcement of security over assets. In this national project, EMA and Singapore Power jointly ran an ESS Test-bed to better understand the feasibility of deploying grid-level energy storage technologies locally.
- Advising on the possible acquisition of a standalone battery portfolio, includinglegal due diligence investigations in relation to the possible acquisition of 51% of the quota capital of the SPVs owning twenty stand-alone BESS projects, located in Italy through the signing of the relevant conditional quota purchase agreements.
- We provided day to day regulatory assistance for foreign operators investing in energy storage systems in Italy.
- Advising Reichmuth Infrastructure, a leading Swiss asset management company specialised in infrastructure investments, on a joint venture to build a new 100 MW battery storage plant in Bavaria, one of the largest in Germany, together with energy storage developer MW Storage. The facility has a connection capacity of 100 megawatts and a storage capacity of 200 megawatt-hours. As a result, the battery is one of the largest facilities under construction in Germany. It has already received all necessary permits and construction will commence shortly. Completion and commissioning of the entire battery storage power plant in Arzberg are expected for early 2025.
- Advising on the development of two in front of the meter 49.9 MW battery storage facilities located in Wiltshire previously developed by Penso Power. The combined capacity of both facilities means it is one of the largest battery storage projects in Europe. Our advice on the project included the negotiation of a capacity dispatch agreement that was to be entered into between the project company and Shell Energy Europe Limited. The contract was extremely innovative and enabled Shell to give dispatch instructions to the project company, for it to then to maximise revenues from that capacity (whether through arbitrage, embedded benefits, capacity market payments, other grid services).

- Advising the EMA on the Energy Storage Services Agreement to appoint Sembcorp Industries to build, own, and operate Singapore first commercial-scale ESS to enhance the resilience of Singapore's energy supply. This is the largest ESS deployment in South-East Asia, and one of the fastest of its size to be deployed.
- Advising a BESS developer in Poland on the participation of energy storage in the capacity market (preparation of legal opinions, conduct of workshops).
- Advising a client dealing with signing up options for various sites for storage systems, aimed at storing electricity to sell to the grid at times of peak demand. We drafted and agreed the option agreements (conditional on planning for example) and the actual leases, to include flexibility to allow for future developments and to include all relevant easements and rights for arrangements with the network operators. We also undertook property due diligence for the various sites
- Advising Sukari Goldmine (a joint venture between Centamin plc and Egyptian Mineral Resources Authority) on the design, build and operation of a large solar and battery storage project, located at the Sukari Gold mine in Northern Egypt.

Market recognition

We have one of the leading international energy practices in the world. Our Energy & Utilities Group has been recognised by the Clean Energy Pipeline Legal League Tables 2024 for closing 172 M&A and Project Finance clean energy deals globally in 2023 – the highest total of any law firm. This includes being the **number 1 firm globally for M&A deals by volume in clean energy in the Clean Energy Pipeline Legal League Tables 2024.**

Our energy transition work has won us The Lawyer's Energy & Infrastructure team of the year in 2021 & the European Corporate Team of the Year Award at The Lawyer European Awards in 2022.

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