

Energy Storage Financing for Sustainable Infrastructure



BRIEFING SHEET

Onshore / Offshore M&A and Financing

Contents

Stirling Infrastructure

PARTNERS LTD

Stirling Infrastructure is an M&A and capital raising firm focusing on energy storage technologies. The firm is familiar with the range of energy storage solutions across the renewables value chain. The firm has established relationships with institutional investors, listed companies and private market investors that allocate capital into scalable and bankable technologies.

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PURPOSE OF THIS PAPER

This paper will provide clear insight to interested parties on the growing importance of energy storage solutions. To do so a thorough methodology will be followed, covering why energy storage is crucial to renewables, key considerations for the financing of energy storage and the range of energy storage solutions available. For further information, inquiries concerning financing specific solutions, or project-specific advice, please contact us at: enquiries@stirlinginfrastructure.com

1. RENEWABLE ENERGY - GLOBAL GROWTH AND TRANSFORMATION

The electrification and decarbonisation of economies have driven a significant push towards renewable energy, especially solar and wind. Solar and wind energy capacity has grown dramatically recently, with solar capacity growing from 222 GW to 582 GW and wind capacity growing from 416 GW to 624 GW in the 2015-2019 period (IRENA, Global Renewables Outlook, 2020). This increase in installed output has been coupled with a paradigm shift of how the grid produces and transmits energy, with growing demand for energy storage solutions.

2. ENERGY STORAGE – THE PROBLEM AND THE GROWING LONG-TERM POTENTIAL

Renewable power generation has proven to be a cost-efficient and sustainable alternative method of producing energy to meet domestic and industrial requirements. However, due to its intermittent nature and the current grid infrastructure, electricity generated from renewables needs to be consumed as it is being produced. As policymakers demand the integration of grid-connected renewable generation, infrastructure that can store energy generated by sustainable sources and deploy this energy when there is demand will be instrumental in the transition to a clean energy future, as this enables greater grid flexibility. Renewable sources that are able to vary their output through storage will also be better positioned to capture revenue, as grid operators and consumers will value their electricity higher at peak demand times.

3. ENERGY STORAGE MARKET SEGMENTATION









Energy storage systems can be categorised as either “in front of” or “behind” the meter. Behind-the-meter energy storage involves customers who wish to optimise their energy strategy for their infrastructure separately from the electricity grid, for example a shipping port with onsite generation and energy storage requirements. In-front-of-the-meter energy storage operates in tandem with the electricity grid, able to provide various services to enable integration of grid-connected renewable generation. As renewables penetrate the grid further, regulators may start issuing tenders for energy storage projects, either independently or associated to renewable generation.

4. OVERVIEW OF ENERGY STORAGE TECHNOLOGIES

There are many types of energy storage system technologies, each with their own technological characteristics. Exhibit 1 on the next page gives a rough outline to 1) types of energy storage divided by their operating principles, 2) their applications and 3) technical and economic considerations for implementation.¹

¹ Koohi-Fayegh, S., & Rosen, M. A. (2020). A review of energy storage types, applications and recent developments. *Journal of Energy Storage* 27 (2020), 101047.

Exhibit 1. Energy Storage by Types of Technology, Applications, and Comparisons for Implementation

Energy Storage		
Types	Applications	Comparisons for Implementation
 Battery (Electrochemical) Energy stored electrochemically. Various types include lithium-ion (Li-ion), sodium-sulphur (NaS), nickel-cadmium (NiCd), lead acid (Pb-acid), lead-carbon batteries, zebra batteries (Na-NiCl2), and flow batteries.	General Applications Energy storage for water heating, air heating, cooking, greenhouses, space heating, cooling in buildings, off-peak electricity storage, and waste heat recovery.	Technical Performance Efficiency, energy capacity, energy density, run time, capital investment costs, response time, lifetime in years and cycles, self-discharge, maturity, etc.
 Thermal Energy stored as heat in a natural or artificial storage medium. Examples include hot water storage, underground thermal energy storage, rock filled storage, and storage in phase change materials (PCM).	Energy Utilities Energy storage deployed at any of the five major subsystems in the electric power systems: generation, transmission, substations, distribution, and final consumers.	Economics Capital and operational costs which depend on application, location, construction method and size, the price of the source of energy, etc.
 Thermochemical Storage systems that use chemical reactions to release thermal energy.	Renewable Energy Utilisation Storage that specifically addresses the intermittency of renewable energy generation to achieve high penetration.	Advantages and Disadvantages A balance of technical performance, economics, safety, environmental, social and legal/regulatory factors.
 Flywheel Energy is stored and released kinetically, with an electric machine acting as a motor or generator depending on the charge/discharge mode.	Buildings and Communities Storage that facilitates the integration of renewable energy into commercial, institutional, industrial and residential buildings, and acts as a buffer that manages user demand variability.	
 Compressed and Liquefied Air Pressurised air stored in underground reservoirs is released to power a turbine.	Transportation Hybrid electric vehicles use energy-storage systems such as flywheels, ultra-capacitors, batteries and hydrogen storage tanks for fuel cells.	
 Pumped Hydro Energy is stored as hydraulic potential energy by using an electric pump to move water from a lower water body to "charge" a higher water reservoir. The energy is discharged by allowing water to run down through a hydro turbine.		
 Magnetic Energy is stored in the magnetic field generated by dc current flowing through a superconducting coil kept at a very low temperature.		
 Hydrogen (Chemical) A reversible chemical reaction that consumes a large amount of energy produces hydrogen, which is oxidized later to recover the input energy.		

Source: Modified from Koohi-Fayegh & Rosen 2020.

When considering the financial and environmental sustainability of energy storage infrastructure, it is important to highlight that despite the current popularity of chemical battery storage, a range of other types of technologies are also available (Exhibit 1). Battery storage solutions can bring about challenges such as unsustainable extraction, mineral shortages, and long term efficiency degradation. Alternative solutions must be considered to ensure the highest value add from the addition of storage to the infrastructure.

For proven technologies with a sustainable and predictable cashflow provided by a suitable off-taker, Stirling Infrastructure can arrange debt and equity financing for project sponsors. If energy storage is of interest, an independent third-party viability study following the methodology below (Exhibit 2) can be carried out to assess whether energy storage is applicable, and what technology to use, to ensure best value to the sponsor.

Exhibit 2. Our Methodology to Assess the Sustainability of Energy Storage Projects



Source: Stirling Infrastructure Partners.





Industrial-scale energy storage is becoming increasingly commercial

5. FINANCING FOR ENERGY STORAGE: BANKABILITY AND KPIs

Investors need to understand the key performance indicators for a bankable energy storage project that will generate tangible returns. Among them, the first thing to consider is how suitable the storage technology is for the specific method of renewable power generation. For example, concentrated solar power when paired with thermal energy storage has a track record of successfully generating electricity. Once an energy storage type is selected, assessing the system efficiency and various risks of the storage type is crucial to the investor. This can be done through an independent engineering report, in addition to a legal risk assessment and financial advisory report. Moreover, the risk profile across construction, maintenance and decommissioning will heavily impact the bankability of the project. Health and safety studies must also be conducted to ensure no liabilities or unsafe practices occur.

It is equally crucial to secure a suitable off-taker for the energy storage services and to ensure that the contractual obligations are fulfilled, as this secures the post-commission revenue of the project.

Lastly, upon completion and integration of the energy storage solution, there needs to be KPIs to monitor the quality of the solution. These may include the volume of energy held, how quickly energy can be introduced to the grid, and the efficiency with which storage can be increased at off-peak times and decreased in periods of high demand. These criteria are some of the most important factors when considering the bankability of a specific energy storage solution.

6. RECENT AND UPCOMING EXAMPLES OF ENERGY STORAGE

With the acceleration of energy storage deployment, it is important to be aware of upcoming technologies and commercial commissions of such systems. The Sandia Laboratory provides insight into this through their Global Energy Storage Database. Exhibit 3 below provides a snapshot of some highlighted recent projects.

Exhibit 3. Recent Commissions in Energy Storage Projects

Name	Location	Commissioned (or expected)	Technology Type	Energy Discharge Capacity (MW)
Vistra Moss Landing	California, US	2018	Lithium Ion Battery	300
Kanagawa Pumped Hydro Plant no.3 – 6	Nagano, Japan	2020	Open Loop Pumped Hydro Storage	1880
NOOR I (Ouarzazate) CSP Solar Plant	Souss Massa, Morocco	2016	Molten Salt Thermal Storage	160
Energiepark Mainz	Rheinland-Pfalz, Germany	2015	Hydrogen Storage	6

Source: The Sandia Laboratory 2020.

These projects are highlighted to illustrate that different technologies are suitable for different applications. For example, the molten salt energy storage facility works well within the high radiation climate of North Africa, while pumped hydroelectric storage in Nagano, Japan can only be built where the hydrographical profile of the region permits such infrastructure. As more renewable projects are to be implemented around the world, the regulatory and environmental requirements for them will be just as varied.

7. CONCLUSION

Currently the world energy system is at an inflection point where renewables are recognised to be the way forward. However, the widespread implementation of renewables is challenged by intermittent power generation. Energy storage is the enabler for widespread integration of sustainable energy and there is significant scope for the development and financing of high-quality projects. Stirling Infrastructure supports project sponsors and institutional investors in arranging debt and equity for all key stages of renewable infrastructure development, including energy storage. For any requests for further information or for project specific advice please contact us at: enquiries@stirlinginfrastructure.com.

OUR OTHER PUBLICATIONS ON THIS SUBJECT

Wind Energy Investments: Forecast of Growth Markets and Innovations

Wind Financing: Financial Instruments and Key Considerations

FOR FURTHER INFORMATION

This report is a primer that presents our renewables M&A transaction team and debt & equity capital raising team's expertise in advising project sponsors, institutional investors and private market investors. The firm provides M&A transaction services and debt / equity capital raises for energy storage projects globally.

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