ENERGY TRANSITION IN SOUTHEAST ASIA: SOLVING THE STORAGE PROBLEM

The Southeast Asia region, with its rapidly growing economies, increasing energy demands and grid constraints, is facing unique challenges in the energy transition. The combination of the shift to renewable energy and the lack of grid stability in several Southeast Asian nations indicates the need for storage technologies, a need which is starting to be recognised at governmental level. This briefing examines the regulatory frameworks currently in place in Southeast Asia, what more can be done, and the revenue models necessary to attract private sector investment in utility-scale energy storage.

SOUTHEAST ASIA AND ITS STORAGE POTENTIAL

According to Global Energy Monitor in its 2024 report "A Race to the Top: Southeast Asia 2024", the ASEAN region has 32% of its total capacity sourced from renewables, with large utility-scale solar and wind power accounting for 9% of total electrical capacity in the region. Vietnam's operational utility-scale solar and wind capacity make up 25% of Vietnam's total energy mix, which is more than double the capacity of the other member countries combined (over 19GW compared with 9GW). Grid congestion caused by this rapid expansion of renewables has resulted in severe grid difficulties in Vietnam and as a consequence, the National Load Dispatch Centre announced that it would not approve any new wind or solar projects in 2022. Indonesia faces similar grid congestion, despite not having the same level of renewable penetration as Vietnam.

Vietnam and Indonesia demonstrated their interest in battery energy storage systems (BESS) as an option to solve their respective grid difficulties at COP28 in Dubai in December 2023. Vietnam participated in the launch of the BESS consortium of countries, which set a goal of installing 5GW of BESS by the end of 2025, and Indonesia expressed significant interest in participating although it has not yet joined as a member of the BESS consortium.

As other countries in the region increase their renewables penetration (countries in Southeast Asia are currently targeting to add close to 50GW of solar and wind capacity by 2030), they will begin to suffer from grid constraints similar to those seen in countries in Western Europe with a high renewables

Key issues

- In Southeast Asia, the rising energy demand, increasing grid constraints and the renewables transition, demonstrate an urgent need for energy storage.
- The necessary regulatory landscape to encourage the uptake of energy storage is not yet in place, with one key issue being the lack of a commercially viable revenue stack.
- Southeast Asia can look to Australia and Japan as examples of how to promote the adoption of energy storage systems (and, once the necessary regulations are in place, the potential speed of the rollout).
- Opportunities still exist for investors in Southeast Asia, particularly in the co-location of renewables projects with energy storage and Singapore's ongoing procurement of low-carbon electricity imports.
- Investors should keep an eye on the developing regulatory picture, as first mover advantage could be key to realising all the opportunities that energy storage provides.
- Structuring of the offtake agreements is likely to be particularly important for energy storage projects and will require a different approach than those for solar and wind projects.

penetration, such as the UK and Germany (due to both grid congestion and the intermittency caused by renewables).

Grid stability is clearly an issue in itself – the more unstable a grid, the more likely a country is to suffer from grid shutdown and blackouts. Further, it leads to the curtailment of solar and wind projects, which hinders the energy transition and the drive towards Net Zero. Wood Mackenzie predicts that the average curtailment in Southeast Asia could move beyond 10% into the 2030s.

To accommodate further renewables on the system, a solution is required. BESS can be part of that solution by balancing the grid and providing stability services, potentially being an attractive alternative to costly grid upgrades. Further, the curtailment of renewables projects can be expensive for the network operator and/or reduce the attractiveness of investments in renewables, given that the level of grid curtailment will have to be increasingly factored into the financial modelling for these projects. Additional BESS on the system would reduce the need for curtailment as excess generation on the grid could instead be used to charge the BESS; that excess electricity can then be released as soon as demand again exceeds supply. Further, BESS can play a crucial role in addressing frequency and voltage instability caused by intermittent renewables, given its ability to inject or absorb power within milliseconds to stabilise frequency, and to provide reactive power compensation, helping maintain voltage within safe limits.

CURRENT STATE OF PLAY

There have been several early success stories in the region. For example:

- Singapore has the largest operational battery storage facility in Southeast Asia, at 200MW/285MWh, built on Jurong Island. The BESS helps to integrate higher shares of variable generation from solar PV onto the grid. The project was delivered in just six months, from mid-2022 to commissioning in December 2022, and discussions are underway to further expand the storage facility.
- AmBank Group approved RM408.2m of financing in May 2025 for a 100MW/400MWh BESS project to be built in Sabah, Malaysia. To date, BESS in Malaysia has been directly procured; however, its first public auction for BESS is ongoing. Malaysia aims to allocate 1.6GWh of BESS under 15-year storage service agreements, split across four projects of 100MW/400MWh each.
- The Philippines has prioritised BESS and is set to become one of the world's leaders in the rollout of BESS projects. Actis has invested in what will be the world's largest integrated renewables and energy storage project, featuring 4.5GWh of BESS.
- In Thailand, Sungrow (the world's largest BESS integrator) cooperated with Super Energy to build a co-located solar PV and BESS project, comprising 49.01MW of solar PV and a 45MW/136.24 MWh BESS.
- A 7.5MWh BESS project co-located with the 50MW Khahn Hoa solar PV plant has been built in Vietnam, and Vietnam Electricity has recently secured approval for its first pilot stand-alone BESS project with a capacity of 50MW/50MWh.

- Indonesia's state-owned utility PLN and the Indonesia Battery Corporation (IBC) have launched a 5MW BESS pilot project. Further, Vena Energy plans a co-located 2GW solar PV and 8GWh BESS "megaproject" in the country (which will export electricity to Singapore).

The majority of BESS projects in the region have been co-located with solar PV, and the rise of stand-alone BESS is typically driven by direct awards by the local utility (as in Malaysia) or a government agency (as in Singapore). Until now, the Philippines has stood out in Southeast Asia for driving stand-alone BESS forward with its regulatory policies, although other countries (such as Malaysia) are beginning to catch up.

In the Philippines, there are multiple revenue streams for BESS projects, including capacity payments and frequency response, and revenues can be stacked. We have seen across Europe, the United States and Australia that revenue stacking is crucial to making a BESS project commercially viable.

In other jurisdictions, stand-alone BESS is facing the same challenges as elsewhere in the world. Southeast Asia can, therefore, look to the early adopters of BESS for how to overcome these challenges. For example, when developing their regulatory regime, Southeast Asian nations should consider whether the grid charging regime is fit for purpose. In the UK and certain EU states (such as the Netherlands), BESS projects were subject to "double-charging" – once, when the BESS took electricity from the grid, and again when it discharged the electricity. In the UK, this has been resolved by Ofgem classifying batteries as generation assets, and the EU's Strategy for Energy System Integration states that double-charging should not be applied to storage.

Further, revenue streams are lacking, with no capacity market or market for 'ancillary services' in most Southeast Asian jurisdictions. This issue will need to be resolved to facilitate the uptake of stand-alone BESS. Long-term revenue predictability is a prerequisite for electricity generation projects to attract foreign capital and project financing. Some argue that BESS is not well-suited to such revenue streams, given that a key advantage of BESS is its ability to react quickly and flexibly to changes in grid and market conditions. However, in our view, we are still some way from traditional lenders being willing to take full merchant risk in Southeast Asia. For a BESS project to be able to take advantage of project financing, it will need a long-term revenue stream as a significant proportion of the revenue stack.

LEARNING FROM ELSEWHERE IN APAC

Australia

As noted above, arguably the most pressing challenge in Southeast Asia is to develop a viable revenue stack for BESS projects to encourage widespread uptake. Commercially viable revenue stacks exist elsewhere in APAC, notably in Australia. Australia leads the region in solar and wind generation, with 36% of the country's total electricity generation in 2024 coming from renewable sources. According to Wood Mackenzie, this recent surge in renewable energy, and the competitive design of the Australian BESS market, has made Australia one of the most attractive markets for grid-scale energy storage globally, and Australia has a world-leading pipeline of more than 40GW of BESS projects.

BESS projects in Australia benefit from three distinct revenue streams, being capacity services, ancillary services (notably including frequency control ancillary services (FCAS)) and energy arbitrage. Energy arbitrage refers to the ability of the BESS to store (recharge) when the price to purchase electricity is low and discharge when the price to sell electricity is high. Greater volatility of prices brings greater arbitrage opportunities (given the delta between low and high prices) and, as with elsewhere in the world, Australia is suffering from increased price volatility. As the share of renewable generation on the system increases, volatility will also increase, as there will be certain days and times of day when renewable generation will be high (and prices will therefore be low) and other times at which renewable generation will be low or non-existent (and prices will therefore be high).

In terms of how a BESS project realises the revenue stack, a number of offtake arrangement models exist in Australia. The majority of early BESS projects simply entered into a physical tolling agreement, whereby the developer grants a "user" the right to operate and control the BESS, in return for a weekly or monthly tolling fee. The user retains all revenue from energy arbitrage and FCAS opportunities. This model has the key advantage of being attractive to financiers, given the guaranteed, fixed revenue stream. However, the developer then misses out on the opportunity to benefit from merchant upside.

As noted above, it is likely that lenders will require a significant portion of the revenue stream for BESS projects to be contracted in order to be bankable. However, the range of what we're currently seeing in the market in Australia is quite broad (e.g., physical and virtual PPAs, and derivative style offtakes), allowing the developer to take some merchant upside. Under revenue sharing agreements (for example), the offtaker pays a capacity fee for a defined contracted capacity and receives all revenue associated with such capacity. The developer will then operate the remainder of the project on a merchant basis, retaining the energy arbitrage and FCAS revenue associated with this part of the project.

The Australian government is also in the midst of rolling out the Capacity Investment Scheme (CIS) through a series of competitive tenders, which will solicit investment into 26GW of renewables and 14GW of firm, storage-based renewable capacity. Successful bidders benefit from a contract for difference mechanism, providing for pre-agreed revenue floors and ceilings, thus providing a fixed, guaranteed revenue stream. We have seen contracts for difference having significant success elsewhere, notably in the UK.

Japan

In Japan, a series of recent developments since our 2021 briefing, The renewable energy transition and solving the storage problem: a look at Japan, has led to significant interest in the BESS sector from international investors:

- Japan launched a Feed-in Premium (FiP) scheme in April 2022, as it looked to transition away from its Feed-in Tariff (FiT) scheme. The FiP scheme pays generators a subsidy based on the wholesale market price, plus a marginal rate (rather than simply a fixed price for electricity). This encourages generators to participate in energy arbitrage opportunities.
- The Electricity Business Act was amended in May 2022 to categorise stand-alone BESS as Electricity Generation Businesses and enable them to apply for grid connections.

- In early 2023, Japan launched a number of subsidy schemes for BESS projects, utilising JPY17 billion to subsidise projects which install new BESS facilities.
- In February 2024, Japan launched its 'Long-term Decarbonization Power Source Auction'. It effectively provides for a 20-year capacity market contract, with generators receiving a fixed revenue at the auction price for 20 years, subject to the successful bidder returning 90% of its total profit generated from the sale of electricity and environmental attributes relating to the BESS. The results of the first auction were announced in April 2024, with 1.1GW of capacity being awarded to BESS. Of particular interest was the success of international investors, with at least 20 of the 43 contracts going to companies with non-Japanese backing, such as Actis, Equis, CHC Energy (in partnership with Stonepeak) and Hexa Energy Services.
- BESS projects were the big winner of the second auction when results were announced in April 2025, being awarded 1.3GW of capacity. Global investors again were successful, with platforms backed by CDPQ, Macquarie and Stonepeak winning contracts.
- The first non-recourse project finance of a large-scale merchant BESS project was announced by MUFG on 7 May 2025, with revenue streams coming from energy arbitrage via the JEPX spot market, the EPRX balancing market and the capacity market.

This success shows the importance of regulation in the early days of a nascent BESS market, and Japan is widely seen as the next big BESS market to take off. A coherent regulatory framework allows a thriving market for BESS to develop, rather than the piecemeal direct procurement of individual BESS projects.

OPPORTUNITIES DESPITE THE LACK OF A REGULATORY REGIME

Lenders typically want to take on limited merchant risk when lending to an energy project. As we have seen, either the offtake arrangements or a dedicated support mechanism can provide the predictable long-term revenue stream required for BESS. The majority of Southeast Asian nations (with the exception of the Philippines and Malaysia) seem to be some way from having the necessary regulations in place to facilitate such solutions.

However, if BESS is co-located with a generating asset, the developer can enter into a long-term PPA which guarantees a set price for the electricity generated by the asset and delivered to grid. If the project only sells a proportion of the electricity generated via the PPA, the remainder could either be sold via the merchant market or used to recharge the BESS, depending on market conditions. Lenders may be conservative in their assumptions as to the likely revenues that will be generated by the project selling to the merchant market and the BESS participating in ancillary services markets without a long-term contract. Lenders may even exclude some or all of the variable BESS revenues for the purposes of debt sizing. However, the predictable long-term revenue from the PPA may be sufficient to give a project access to the debt funding that it requires, whilst the developer could still have some ability to access potentially higher returns from other market opportunities (which will primarily be energy arbitrage if there is no ancillary services market in place).

Another benefit of co-locating BESS with renewables in Southeast Asia is that where a project is curtailed (which will become increasingly common), the BESS can be charged during the curtailment period, so that the renewable project's ability to generate is not completely lost.

There may be a particularly interesting opportunity available in Vietnam for co-located projects, given the high penetration of renewables (particularly solar). Multiple gigawatts of solar PV projects were installed in 2020 and 2021 due to the generous FiT tariff then offered. However, the Vietnamese PPA was not considered bankable for various reasons, including that there was no take-or-pay obligation on the offtaker. Storage acts to mitigate this risk because where the offtaker is unable to take the generation (which would result in the solar generation being wasted), the developer can instead charge the BESS and discharge once the grid issues are resolved.

Singapore is seeking to procure 6GW of low-carbon electricity imports from its neighbours by 2035, whilst maintaining stability on the grid and security of supply. Therefore, a number of these projects will include a significant BESS element and the capex involved is presenting an interesting opportunity to international investors and lenders alike. Further, Singapore is looking to procure a number of "back-up" projects in Singapore itself, which can quickly ramp up in the event of an interruption to supply from the import projects. These "back-up" projects are likely to be a combination of gas peakers and BESS.

In the long term, the opportunities for BESS projects in Southeast Asia are even more widespread. With the right support mechanisms in place, stand-alone battery storage could be deployed on a large scale and we are beginning to see this in other jurisdictions, such as Malaysia. Under the IEA's Sustainable Development Scenario (SDS), solar PV and wind are set to reach an aggregate 18% share of generation by 2030 and 44% by 2050. The International Renewable Energy Agency forecasts a need for over 600GW of battery storage capacity in Southeast Asia by 2050 to integrate these higher shares of renewables at the lowest cost and balance the system flexibly. The planned ASEAN power grid could offer an excellent opportunity for designing a coherent grid, whilst integrating energy storage where it is necessary.

CONCLUSION

Energy storage has an important role to play in Southeast Asia, to not only help facilitate the energy transition but also to solve problems such as power outages, which are affecting consumers now. In many jurisdictions, the necessary regulations and revenue streams are currently lacking, but there has been a clear signal of intent from a number of governments to remove the barriers to integrating energy storage into the network. Southeast Asia does not have to look far for examples of how to facilitate the deployment of energy storage. Australia is clearly a success story, and Japan evidences how quickly energy storage can be incentivised with the necessary political intent.

Nevertheless, energy storage opportunities exist in Southeast Asia today and we expect that an increasing number of onshore wind and (in particular) solar PV projects will be co-located with energy storage. Once the necessary regulation and market reforms have been put in place to facilitate revenue stacking, Southeast Asia has the potential to be the next opportunity for investment into a nascent stand-alone energy storage market. As markets become more saturated with energy storage, competition drives down prices for ancillary services, therefore first mover advantage may be key in order for developers to access the greatest revenue opportunities.

As the energy storage market develops, we also expect offtake arrangements to develop that provide developers with a base level of fixed, guaranteed income whilst allowing developers the opportunity to take a certain amount of merchant risk and reward. The model is likely to be quite different from fixed price long-term PPAs used in the solar and wind industry, and it will be important for developers to engage the right advisers to assist them with designing a bespoke offtake arrangement to reflect the specific market and regulatory frameworks in which the project operates, as well as a project's financial model (which will likely differ significantly from project to project).

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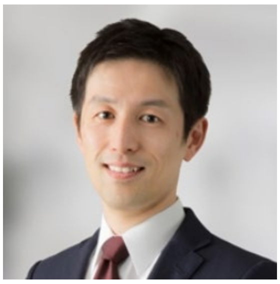

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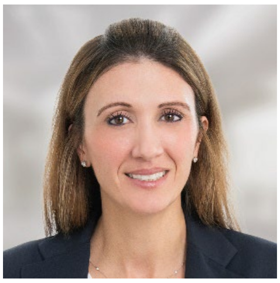

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