THE NEW FRONTIER – PF FOR ENERGY STORAGE

IN SOME WAYS, ENERGY STORAGE RESOURCES ARE CURRENTLY WHERE RENEWABLE ENERGY RESOURCES WERE A DECADE AGO. THE LAST DECADE HAS SEEN THE EXPLOSIVE GROWTH OF WIND AND SOLAR RENEWABLE ENERGY RESOURCES. ENERGY STORAGE RESOURCES ALSO APPEAR POISED FOR HEIGHTENED GROWTH OVER THE NEXT DECADE. BY NEERAJ ARORA, OF COUNSEL, MORGAN LEWIS & BOCKIUS.

In the past decade, the amount of energy generated by wind energy resources in the United States increased from 26,589 gigawatt hours (GWh) in 2006 to 190,927GWh in 2015 – a factor of more than seven. The amount of energy generated by solar photovoltaic resources increased from 15GWh in 2006 to 23,232GWh in 2016 – a factor of more than 1,500![1].

Energy storage resources also appear poised for heightened growth over the next decade. From 2014 to 2015, the total installed megawatt hours (MWh) of energy storage rose from 86MWh to 161MWh, an increase of 88% in one year[2]. Although part of this is because energy storage is starting from a smaller place than where both wind and solar were a decade ago, the numbers and trends indicate that additional growth is coming.

The growth of energy storage resources after the increasing penetration of renewable energy resources is no coincidence. In fact, energy storage is specifically cited as an enabling technology for the increased penetration of renewable generation[3].

One main reason is that many renewable energy resources, such as resources powered by wind and solar, are non-dispatchable, meaning that generation owners and grid operators cannot control when they will produce energy. As the penetration of renewable energy increases, grid operators will sometimes not be able to accept all of the renewable generation.

This results in curtailing renewable generation, which is inefficient because renewable generation tends to have little or no marginal costs associated with production. Energy storage resources mitigate this issue by storing excess generation until it is actually needed.

Policy and economic trends indicate that more renewable generation and energy storage resources are on the way. In 2010, California recognized that its increasingly aggressive renewable energy plans would require additional energy storage and thus enacted AB 2514 (2010), which required the California Public Utilities Commission (CPUC) to consider requiring California investor-owned utilities to procure energy storage systems[4].

Following that legislative mandate, in 2013 the CPUC mandated that California investor-owned utilities procure 1,325MW of energy storage by 2020[5]. More recently, in 2015 California enacted legislation mandating that 50% of the state's generation come from renewable energy resources by 2030, which will only exacerbate the need for new storage resources[6].

Moreover, the capital costs of both renewable generation and battery energy storage technologies are expected to continue to decline in the coming years. Solar and wind generation have already seen significant pricing reductions over the last decade and in many states have become competitive with or even cheaper than conventional generation[7]. Industry experts expect that prices for battery energy storage resources will also continue to decline[8].

Project financing energy storage

As energy storage developers prove the commercial viability of their technologies, they will seek to lower their cost of capital by replacing expensive corporate and venture equity investments with project finance debt. Such project finance debt has traditionally been used by large infrastructure developers to significantly reduce their cost of capital in connection with financing large energy infrastructure projects.

Project finance is a form of financing in which lenders provide loans based on the stream of cashflows that they expect a given project to generate. Project finance loans are typically non-recourse, meaning that the lenders' primary source of repayment is from the cashflows that the project generates, and the lenders typically cannot look to the project's sponsor in the event of a default on the underlying project finance loan.

Given the lenders' reliance on the project for repayment, they must carefully analyse and understand the quantity and quality of cashflows that a project is expected to generate against that which they are lending. For the purposes of this article, the quantity of cashflows refers not only to the amount of cash that a project is expected to generate but also to the timing of such cashflows.

Timing is crucial because project finance loans are typically carefully structured around the expected cashflows. For the purposes of this article, the quality of cashflows refers to the likelihood of actually receiving such cashflows when expected. Project finance lenders will typically only lend against high-quality cashflows.

Energy storage projects may be good candidates for project financing if they can demonstrate a sufficient quantity of high-quality cashflows. This article discusses potential issues that project finance lenders may encounter in connection with financing energy storage resources by examining the quality and quantity of cashflows of such projects. We begin with a discussion of project revenues and costs, and conclude with a discussion of the tools that project finance lenders can use to mitigate some of the potential issues associated with cashflows from energy storage projects.

Energy storage projects can take many different forms, including flywheels, batteries, and pumped hydro, and come in many different configurations and sizes, from small storage units that can be used behind-the-meter at residential, commercial, and industrial facilities to large utility-scale in-front-of-the-meter projects that can, in either case, be standalone or attached to existing generation.

This article focuses on standalone emerging utility-scale energy storage technologies, such as in-front-of-the-meter batteries, because such technologies are both large enough to support the transaction costs associated with project finance and are expected to be economically viable across many different electricity markets. Other projects and configurations will have their own unique sets of issues. In addition, this article will address issues unique to energy storage projects in the project financing context as compared with generation projects. Accordingly, we do not address the issues that would be the same across these types of projects.

Project revenues

This section explores issues related to the quantity and quality of revenue generated by energy storage projects.

- *Technology risk* – Unlike more established technologies, many nascent energy storage projects still must address the sine qua non of any project: does the technology work? Without reliable technology, a project will not be able to demonstrate revenues of sufficient quality to support a project financing.

Even if the technology works, for a project to be successful the technology must work for the project's expected uses. For example, the expected lifetime of lithium-ion batteries may be reduced depending on the cycling depth of discharge, and thus, any project using them should have appropriate limitations put in place to protect against full discharge[9]. On the other hand, certain technologies, like zinc bromine flow batteries, are actually required to be fully discharged on a periodic basis and thus may be better suited for load shifting and applications requiring high-energy density as opposed to high-power density[10].

Developers should also consider how long a given technology will work. The useful life of a project may vary widely depending on the technology used. Some sodium-sulphur batteries have an expected useful life of around only five years, whereas some nickel-cadmium batteries can last for 15–20 years[11].

Moreover, determining the useful lifespan of certain technologies may depend on different metrics based on the technology. For example, the useful life of lead-acid, nickel cadmium or lithium-ion batteries may be limited by the amount and depth of battery cycling, whereas the useful life of zinc-bromine flow batteries is unaffected by cycling and is determined solely by operating hours[12].

- *Degradation* – Like energy generation resources, the performance of energy storage resources will degrade over time based on their use. However, the degradation differs from that of traditional energy generation resources in a couple of crucial ways.

The performance degradation characteristics of well-established generation technologies are well understood. For example, many aero-derivative combustion turbine manufacturers provide a performance guaranty that specifies the performance of a given turbine, both in terms of heat rate and nominal output based on the number of fired hours. Similarly, solar panel manufacturers provide power output warranties that decline each year based on the panels' expected degradation. For emerging energy storage technologies, the degradation profile is not yet as well understood.

Moreover, storage technologies may experience completely different types of degradation than energy generation. Renewable and conventional generation can experience degradation in only two dimensions: output and efficiency[13]. If we think about storage projects as water bottles of electric energy, these two dimensions only account for two aspects of the project – how much water comes out relative to how much went in, and how quickly water can come out of the bottle.

However, three other performance metrics can also degrade storage projects. First, how quickly can water be put into the bottle? This is the equivalent of the battery's charging speed. Second, how much water can the bottle hold? This is the equivalent of the battery's energy storage capacity. Finally, how quickly does water evaporate while in the bottle? This is the equivalent of loss of charge.

Each of these aspects of performance degradation may be subject to their own unique curves that are based on, among other things, the current state of charge, the number and depth of the battery's cycling, the duration of the battery's operational life, and ambient conditions. If project revenues are based on actual performance, all of this variability may make it harder to predict project revenues as compared with generation projects.

- *Understanding project revenues* – Like energy generation projects, energy storage projects are expected to generate a steady and reliable stream of cashflows and are thus good candidates for project financing. However, for energy storage projects, these cashflow streams are not as well understood.

Energy storage projects with offtake contracts will have to address many of the same issues that energy generation projects encounter in power purchase agreements. These include items such as:

(i) whether payments are made by the offtaker for delivered energy, capacity, or ancillary services, or some combination of the three;

(ii) whether payments are given more weight during certain periods of the year when energy and/or capacity are more valuable (such as through monthly or daily shaping tables); and

(iii) how the project passes through its variable costs to the offtaker, including for projects that require inputs such as conventional gas or coal-fired projects or renewable biomass projects, and the costs of such inputs.

Although many of the issues are the same, the mechanics for these issues are still being developed for energy storage projects and are not as well understood. For example, an energy storage project's overall capacity may need to take into account not only the maximum amount of energy that a project can discharge at any given time but also the need to consider the total amount of energy stored and the rate at which the project can charge.

To properly determine the project's efficiency (which can affect an offtaker's obligations to cover the input costs of energy), the offtake contract may need to evaluate both the amount of energy coming out relative to the amount that went in, and how long such energy was stored and how much energy was stored at any given time. This may be necessary because some storage technologies may lose charge over time and have different efficiency characteristics at different charge levels. How these issues are addressed will affect an energy storage project's cashflows.

Energy storage projects without an offtake agreement can generate one or more streams of revenue by providing a variety of services to grid operators, utilities, and retail customers. The specific type of services that these projects may be able to provide will depend on whether the project is located in-front-of-the-meter, behind-the-meter, or on the distribution grid[14]. We note that such services and revenue streams are still being developed and generally do not provide sufficient quality or quantity to support project finance transactions (other than in the most developed energy markets and/or where hedges are available)[15].

Project costs

This section explores issues related to the quantity and quality of costs associated with energy storage projects.

● *Input costs* – Energy storage projects are unique because their major input is exactly the same as their output: electrons. For energy storage projects subject to a tolling offtake agreement, the cost of stored energy will be borne by the offtaker. However, the offtaker will typically not bear the risk of project efficiency.

Efficiencies can vary widely within technologies. For example, nickel-cadmium battery efficiency varies from 60% to 85%, and between technologies from 60% (low-efficiency nickel-cadmium) to 94% (high-efficiency lithium-ion)[16]. If the project does not operate within certain efficiency levels to be agreed, the offtaker may require the project to compensate for incremental energy. Moreover, these efficiency levels will need to account for efficiency issues that may be unique to the technology that the energy storage project employed, such as loss of charge over time or different efficiency levels, depending on the state of charge.

For an energy storage project without an offtake agreement, the project will need to bear these risks. In that case, a tremendous focus will be on both the cost of energy acquired for storage and the efficiency with which such energy can be stored.

Another key difference between energy generation projects and energy storage projects is that the former are typically permitted to use electricity generated by a project to service station use and deliver "net" energy into the grid[17]. Station use refers to the energy that a given project requires to operate. For example, many gas-fired projects self-generate the electricity used for compressors and chillers that are required for a project's operation and that consume a significant amount of electricity but increase the project's overall capabilities.

Because energy storage projects do not generate electricity, they cannot net out station power and thus it must be separately purchased and metered by the project[18]. The effect on cashflows of station use can be potentially significant and introduce cost uncertainties if the price of such power is not fixed. Certain types of batteries, such as sodium-sulphur batteries, have extremely high operating temperatures (300–360 degrees Celsius) and others require significant balance of plant equipment, such as flow batteries, which require pipes, plumbing, tanks, and other non-electrical components, all of which can introduce substantial incremental costs[19].

● *Operation and maintenance costs* – Just like energy generation projects, energy storage projects will have ongoing expenses for operation and maintenance (O&M). However, new energy storage projects have less certainty regarding these costs.

As a starting point, there is simply less operating history regarding such costs and thus the projections are less reliable. In addition, certain types of energy storage projects may have unique O&M costs that will need to be taken into account. For example, modular battery technologies may require inverters that may have a useful life that is less than a project's useful life and will need to be periodically replaced.

Moreover, some modular projects may address degradation issues by augmentation, ie adding modules to the project to improve its performance, which may increase the ongoing costs. Finally, some energy storage projects may require complex software to operate properly and have incremental costs associated with maintaining the licences for same and/or acquiring software improvements.

Lender tool kit

This section addresses structuring tools that project finance lenders can use to mitigate issues related to the quality and quantity of energy storage resources' project cashflows.

● *Technology risk* – Project finance lenders typically do not accept technology risk and thus will not lend to projects that use new technology that does not have a proven track record and that is accepted by the market. However, some work-arounds can address this issue:

(i) Warranties – Project finance lenders can mitigate technology risks by shifting those risks away from the project company and onto technology vendors. To do so, the technology vendor may be required to provide a warranty that adequately covers the applicable technology risk, including by warrantying that the applicable piece of equipment will perform at the levels set forth in the lenders' models.

If this approach is taken, the technology vendor will likely be required to be creditworthy or be able to provide performance assurance from an entity that is creditworthy, such as a guaranty from a parent entity with a significant balance sheet or letters of credit.

(ii) Sponsor guaranty – Another approach is for the project company to shift the technology risk to the project sponsor through sponsor guaranties or other credit support. This approach is unusual because sponsors may not be willing to bear technology risk either. Moreover, even if the sponsor is willing to bear technology risk, this approach will only work if the sponsor is sufficiently creditworthy.

(iii) Department of Energy Loan Guaranty Program – The US Department of Energy (DOE) has a loan guaranty programme under the Energy Policy Act of 2005, Title XVII, Section 1703. These Section 1703 loan guaranties may be available for certain energy storage projects that have high technology risk. The DOE loan guaranty programme, however, requires a multi-part application and can be a slow, cumbersome, and expensive process. Thus, it can significantly increase the transaction costs and time required to close on a project financing. The DOE periodically runs solicitations for projects and technologies, the most recent of which closed on July 13 2016[20].

- *Understanding project revenues and project degradation* – The revenue streams from energy storage projects may not be as predictable as revenue streams from energy generation projects. Project financiers can use the following tools to mitigate this issue:

(i) Offtake agreement/market analysis – Lenders may need to spend additional time to become familiar with the nuances of energy storage offtake agreements to understand how project revenues will be affected based on various operating cases. If a given project derives its revenues from market operations, the lenders will need to work closely with technical and market consultants to develop various expected use cases that account for variability both with respect to the price paid for the provision of services and the quantity of services provided during the applicable time period.

(ii) Higher debt-service coverage ratio/lower debt quantum – Project finance debt is typically sized based on a project's expected cashflows. The amount of debt relative to the expected net revenues for any given payment period is the project's debt-service coverage ratio. Project finance lenders can mitigate the risk of unexpected revenue reductions (including as a result of degradation) by increasing the required size of the debt service coverage ratio and thereby reducing the amount of debt and increasing the cushion before debt service is affected.

(iii) Cashflow sweeps – Project finance lenders can further protect themselves from the risk of future degradation by requiring that all or a portion of a project's excess cashflow, ie, cash that is not required for any other purpose, is used to prepay indebtedness.

(iv) Warranties – Project finance lenders may require that the project company shift the risk of excessive degradation to a third party through warranties from creditworthy counterparties.

(v) Shorter tenors – Finally, project finance lenders can protect themselves from unexpected degradation by requiring an early maturity of the debt. Note, however, that if a project experiences unexpected degradation prior to the debt's maturity, the lenders will bear increased refinancing risk.

- Input costs risk – Energy storage projects may be subject to input cost risks greater than, and not as well understood as, the input cost risks associated with generation projects. This issue can be addressed in a number of ways:

(i) Offtaker/hedges/market analysis – Project finance lenders often prefer that the risk of required inputs be shifted to the project offtaker. If that has not been done, project finance lenders may require that the project enter into hedging contracts to ensure that project inputs are available at a price that will permit debt repayment. In addition, the lenders will need to work closely with technical and market consultants to understand the costs of procuring energy for storage based on the project's expected operating profile.

(ii) Higher DSCR – Project finance lenders can mitigate the risk of higher input costs by increasing the debt service coverage ratio, thereby reducing the amount of debt and increasing the cushion for input costs before debt service is affected.

- *O&M costs* – The O&M costs for energy storage projects are not yet as well understood as O&M costs for generation projects. This issue can be addressed by the following:

(i) O&M contract – Project finance lenders may require the project company to enter into an O&M contract with an experienced operator. The contract has a term that is at least as long as the tenor of the debt and sets the operating and maintenance costs for the contract's term.

(ii) Reserve accounts – To the extent that there are any lumpy maintenance expenses such as an expected inverter replacement or incremental costs required to address project degradation issues, project finance lenders may require that a project's excess cashflow be used to fund a reserve account to a pre-agreed level before such cashflow is made available for distributions to the project's sponsors.

(iii) Assignment of intellectual property rights – Finally, if a given project relies on any proprietary intellectual property for operation (such as proprietary software that is required to control a battery array), the project finance lenders will want to ensure that the project company has sufficient rights to such intellectual property, including in the event that the operator is replaced or if the lenders exercise remedies to take title to the project. In addition, the lenders will want to ensure that in the event a new operator is required, the existing operator will be obligated to train such replacement to operate the facility.

Energy storage is a new frontier for project financing, and lenders will surely encounter issues that are not addressed herein, including some that will be unique to the specific energy storage resource being financed. Given the newness of this area, project finance lenders that have greater flexibility with respect to how they structure transactions – such as commercial banks or institutional investors that have developed customised structures – are likely to be better positioned for financing energy storage[21]. ■

Footnotes

1 - US Energy Information Administration, Electric Power Monthly (April 28 2016) available at https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01_a.

2 - US Energy Storage Monitor: 2015 Year in Review Executive Summary, Energy Storage Association, GTM Research (March 2016), p2.

3 - Paul Denholm, Erik Ela, Brendan Kirby, and Michael Milligan, The Role of Energy Storage with Renewable Electricity Generation, National Renewable Energy Laboratory, at 34 (“Energy storage is one of many technologies proposed to increase grid flexibility and enable greater use of VG”), available at http://www.nrel.gov/docs/fy10osti/47187.pdf.

4 - Energy Storage System, California Assembly Bill No. 2514 (2010).

5 - See CPUC D. 13-10-040.

6 - Clean Energy and Pollution Reduction Act of 2015, California Senate Bill 350 (2015).

7 - See Lazard, Levelized Cost of Energy Analysis – Version 9.0 (November 2015), available at https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-90. See also Zachary Shahan, Solar & Wind Power Prices Often Lower Than Fossil Fuel Power Prices, Clean Technica (April 13 2015), available at http://cleantechnica.com/2015/04/13/solar-wind-power-prices-often-lower-fossil-fuel-power-prices.

8 - See Zachary Shahan, EV Battery Prices: Looking Back A Few Years, & Forward Yet Again, Clean Technica (May 15 2016), available at http://cleantechnica.com/2016/05/15/ev-battery-prices-looking-back-years-forward-yet; Eric Wesoff, How Soon Can Tesla Get Battery Cell Costs Below US$100 per Kilowatt-Hour? Greentech Media (March 15 2016), available at http://www.greentechmedia.com/articles/read/How-Soon-Can-Tesla-Get-Battery-Cell-Cost-Below-100-per-Kilowatt-Hour.

9 - State Utility Forecasting Group, Utility Scale Energy Storage Systems, Benefits, Applications and Technologies (June 2013) (Energy Storage Systems), p42, available at https://www.purdue.edu/discoverypark/energy/assets/pdfs/SUFG/publications/SUFG%20Energy%20Storage%20Report.pdf.

10 - Id at p54.

11 - Andreas Poullikkas, A Comparative overview of large-scale battery systems for electricity storage, Renewable and Sustainable Energy Reviews (January 2013), at 786, available at https://www.researchgate.net/publication/258022527_A_comparative_overview_of_large-scale_battery_systems_for_electricity_storage.

12 - Energy Storage Systems, at 38, 40, 43 and 54.

13 - For conventional generating technologies, efficiency is synonymous with heat rate, which generally measures the amount of fossil fuel input required to generate a given unit of electric energy. For renewable energy generators, efficiency is the rate at which a project can convert primary energy sources, such as sunlight or wind, into electricity.

14 - See Rocky Mountain Institute, The Economics of Battery Energy Storage, How Multi-Use, Customer-Sited Batteries Deliver the Most Services and Value to Customers and the Grid (2015) at 18.

15 - Renewable Energy Systems Americas Inc was able to close a project financing for battery energy storage projects in late 2015 that were located in the PJM Market and did not appear to have a long-term offtake agreement. That said, the financing included approximately 50% leverage and a three-year tenor, so the transaction was significantly shorter and had less leverage than traditional project finance transactions. Whether the projects benefited from any hedges or if they were purely merchant was not publicly disclosed. See http://www.prnewswire.com/news-releases/res-announces-substantial-completion-and-project-financing-of-chicago-area-energy-storage-centers-300175915.html.

16 - Energy Storage Systems, at 39 and 73.

17 - See, for example, the California Independent System Operator (CAISO) Tariff, Sections 10.1.3, 10.2.9.2, and 10.3.2.2.

18 - We note that the line between what is station power and what is an efficiency loss is not always clear and the subject of further regulatory debate. For example, the CAISO is examining this area in Track 2 of the CPUC’s energy storage proceeding (CPUC Rulemaking 15-03-011).

19 - Energy Storage Systems, at 44 and 48.

20 - See http://energy.gov/savings/us-department-energy-loan-guarantee-program.

21 - This article was prepared as a follow-on to a portion of a Morgan Lewis webinar: Renewable Energy and Storage Trends for 2016. View the recorded version online at https://www.morganlewis.com/events/renewable-energy-and-storage-trends-for-2016. Of counsel Neeraj Arora, the article’s author, has benefited from the helpful suggestions and edits of others, and he extends a special thanks to of counsel Monica Schwebs and partner Wayne Song.