The energy-storage opportunity: What engineering and construction players should know

As the costs of energy-storage systems continue to fall, engineering and construction companies will need to improve their operations to stay competitive.

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Energy storage is rapidly growing in importance for the power sector. Some commercial uses for energy storage are already economical. Still more uses will become attractive for utilities and industrial customers as lower system costs, combined with developments such as the rollback of solar incentives that reward customers for exporting power to the grid, make it financially sensible to store power for on-demand use.

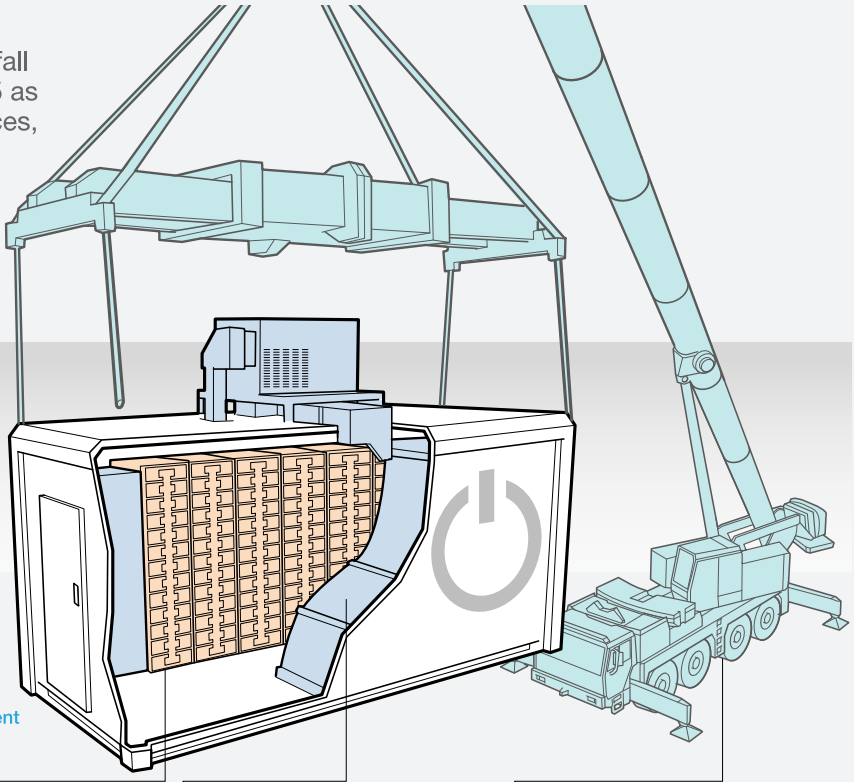
The growth of energy-storage projects will create new opportunities for engineering and construction companies if they can deliver the capabilities and efficiency needed to compete in this evolving market. The pace of change should be significant: we expect the fully installed costs of energy-storage systems to continue the rapid decline that occurred from 2012 to 2017 (exhibit).[1] In our base-case scenario, the installed per-kilowatt-hour cost of an energy-storage system would decrease roughly 55 percent by 2025. There is also a plausible best-in-class scenario in which additional process-efficiency gains and hardware innovations reduce the cost of an installed system by more than 70 percent. We anticipate the following cost declines for major system components:

- **Battery-pack costs** decline by more than 50 percent by 2025 in the base case as global competition intensifies, leading to larger-scale manufacturing, consolidation, improvements in manufacturing processes and technology, and commoditization of products. The best-in-class scenario envisions that battery makers incorporate multiple chemistries and formats (for example, reduced-cobalt cathodes and solid-state batteries), gain more efficiencies from automation and added scale, integrate their supply chains, and even move some operations like electrode manufacturing in-house. Expected reductions in the cost of capital facilitate the financing of improvements to battery-pack manufacturing processes.
- **Balance-of-system (BOS) hardware costs** drop by more than 50 percent in the base case. Design improvements remove unnecessary costs and complexity from inverters, wiring, containerization, climate controls, and other components. Further competition from incumbents and new low-cost manufacturers also pressure pricing for storage hardware. In the best-in-class scenario, the use of new materials and technologies (such as silicon carbide for inverters), the accelerated growth of low-cost manufacturers, and innovations in design (such as the development of prefabricated, modular components) enable additional cost savings.
- **Soft costs** drop 60 percent in the base case. As utilities optimize the use of battery storage, they streamline their procurement processes and require less time and effort from developers. The additional cost reductions expected under the best-in-class scenario stem from developers' efforts to digitize tendering and the emergence of standard approaches to permitting and interconnection.
- **Engineering, procurement, and construction (EPC) costs** fall in the base case because efficient, experienced EPC firms achieve economies of scale and reduce on-site labor by pursuing standardization in design and construction. Alliances with committed developers also provide EPCs with the confidence to invest in capabilities and resources that improve efficiency. The best-in-class scenario accounts for larger-scale EPC enterprises, the development of hardware and software with plug-and-play compatibility, and prefabricated components that reduce manual installation steps on-site.

The more the cost of an average energy-storage system goes down, though, the less room EPC companies and project developers will have to undercut competitors. That will make for a tough competitive environment—

Exhibit

The total cost of energy-storage systems should fall 50 to 70 percent by 2025 as a result of design advances, economies of scale, and streamlined processes.



Where battery-storage-system costs will be affected, range

(ranges indicate estimated price decreases under base-case and best-in-class scenarios)

Soft costs: Customer acquisition and development, interconnection, overhead, taxes, and duties

Developers spend less time educating increasingly savvy customers, digitized tendering speeds up bids, and permitting and interconnection get faster with standardization.

Decrease by 2025: 60 to 75 percent

Battery pack: Battery-management system, cells, and modules

Large-scale manufacturing, consolidation, and improvements in processes and technology drive costs down.

Decrease by 2025: 50 to 70 percent

Balance-of-system hardware: Climate control, containerization, controller and controls, and inverter

Design improvements remove unnecessary costs and complexity. New low-cost competitors put pricing pressure on incumbents.

Decrease by 2025: 55 to 70 percent

EPC: Engineering, procurement, and construction

EPC companies create economies of scale and reduce on-site labor by pursuing standardization in design and construction. Prefabricated, plug-and-play components also lessen manual effort.

Decrease by 2025: 40 to 55 percent

but a rewarding one for EPC companies and project developers that achieve significant cost reductions. As we explain below, EPC companies will need to streamline their practices, get greater value from their spending on key inputs, and standardize system designs, while project developers should cut their customer-acquisition costs and change their procurement practices to capitalize on falling battery and hardware costs.

EPC companies should adopt more efficient practices, such as lean construction (for example, optimizing crew sizes and eliminating downtime and wasted effort), prefabrication of major system elements, simplified bidding, and streamlined interconnection processes. Some of these practices will take hold naturally as companies gain experience. Purchasing components in higher volumes will reduce per-unit costs. Alliance-contracting relationships should enable companies

to work with sophisticated, low-cost installation partners across many projects.

EPC companies and project developers should also adopt design practices that save time and effort. Standardizing certain aspects of storage systems (for example, container and climate-control specifications) will lessen the need for expensive custom engineering. Ensuring that designs meet but do not exceed customers' requirements will help them avoid using components that are unnecessarily expensive. Modular hardware, along with hardware and software that are made to be compatible, will also eliminate manual installation steps.

For their part, storage-project developers should use technology to acquire customers more efficiently. Advanced analytics, for example, will help developers identify prospective customers and target them with attractive offers. Developers should also improve existing digital tools with automated capabilities for estimating savings and developing preliminary system designs (for example, simulating customer loads to help with system sizing, or using images from satellites and drones to lay out sites). For utility-scale projects, developing storage along with renewable-energy generation will boost profits by spreading out customer-acquisition costs, making more efficient use of land and site infrastructure, and improving the ability to optimize intermittent renewable generation (for example, time shifting generation).

Storage developers and system integrators should adopt more flexible approaches to procurement that allow them to take advantage of rapidly declining battery and BOS hardware costs. Like their peers in the solar market, some storage developers struck forward-pricing agreements with battery and component makers in the hope of achieving certainty over their costs—and came to regret these agreements as costs fell. Storage developers should be mindful of this risk as they plan ahead.

The cost projections we have described suggest that the market for battery storage will expand. While we are still assessing the potential for energy storage to open a new frontier for renewable power generation, energy storage should become a significant feature of the energy landscape in most geographies and customer segments. As battery packs grow cheaper, EPC companies and project developers will have to manage their costs well to stay competitive. Opportunities to do this, some of which we have outlined in this article, are plentiful—and real. Seizing them will require innovation and investment across the storage value chain, particularly in the next one to three years, when early-mover advantages will be there for the taking.

For more on this topic, see "The new rules of competition in energy storage" on McKinsey.com.

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[1] This decline could be held up for several reasons. For example, utility and power-market regulators might enact rules or policies such as those governing permitting and interconnection that make storage systems costly and time-consuming to install. Investments in manufacturing might produce smaller improvements in efficiency than they did in the solar photovoltaic market. Tariffs could boost the cost of imported batteries and balance-of-system hardware from low-cost manufacturing locations. Having assessed the potential for these developments, we think it is unlikely that they will materially impede cost reductions for energy-storage systems, and so we have not accounted for them in the two scenarios described in the article.