Driving down BOS costs in commercial installations

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ABSTRACT

This paper provides an overview of reducing the 'soft costs' of solar, with a focus on driving down the cost of balance of system (BOS) and operations, primarily in commercial-scale installations. Attention is drawn to the internal data and information on specific case studies/best practices that can be replicated by other companies. Mainstream Energy (which supports three business units – REC Solar, AEE Solar and SnapNRack) aims to simplify system design and configuration by utilizing new technologies and streamlining internal processes to reduce total system cost – and take solar to the mainstream.

Introduction

Amid global market uncertainty, the US solar market remains a bright spot. Residential, commercial and utility customers are on pace to install a record amount of solar in 2012, totalling more than 3.2GW of new capacity by the end of the year. In the second quarter of 2012, the USA added 742MW of PV installations – a 45% growth over the first quarter of this year and a 116% growth over the same quarter a year ago, according to a recent report from the Solar Energy Industries Association and Greentech Media Research [1].

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Some growth can be credited to rapidly falling module prices, which have dropped by 80% over the past few years and consequently decreased the overall cost of solar, spurring new installations. But as the solar industry looks to continue its impressive expansion, it must identify more cost drivers that will reduce the cost per watt in order to be competitive with traditional fuels. Low module prices alone are not enough to ensure industry success.

To cut costs further, solar developers must look elsewhere. Modules represent only 40% of system costs, and that percentage is shrinking. Soft costs and balance-of-system (BOS) costs have not decreased at a similar pace. In the past two years, these costs have actually increased by 3 to 5% as a percentage of total system cost, leading many in the industry to either advocate improvements in BOS components or investigate ways to streamline the permitting process to cut costs. These are important components, but a truly comprehensive cost-reduction strategy must include an entire-system approach to cost. This approach integrates innovative new BOS technologies, optimizes the construction and project development processes, and decreases the soft costs of solar (such as permitting, human resources activities, transportation and training) to promote end-to-end operational efficiency. In turn, this operational strategy allows solar system integrators to further bring down the overall cost of solar, enhance system value and ensure continued market growth.

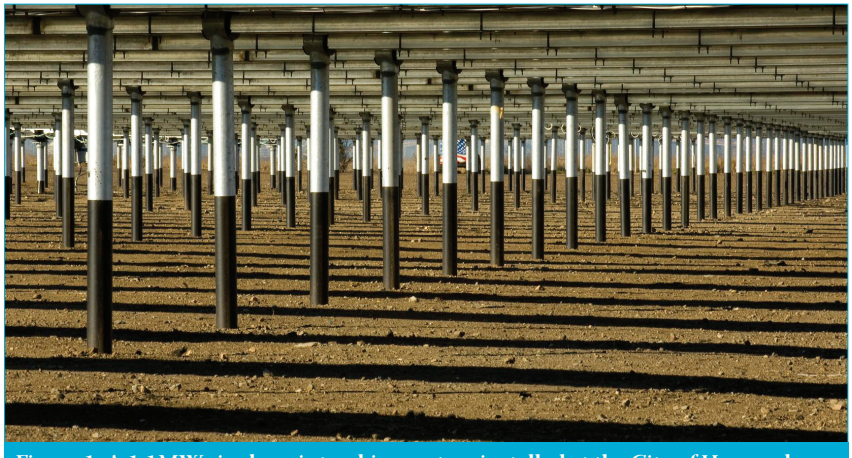

Figure 1. A 1.1MW single-axis tracking system installed at the City of Hayward Water Pollution Control District in California.

Additionally, this approach offers value beyond the cost per watt. That metric can be misleading and overly simplistic, undermining other value-added parts of a system, such as reliability and overall performance. Cost will always be a core driver, and it is proposed that the complete cost picture be looked at – including system lifetime, maintenance and efficiency. Moreover, installers and system integrators who attack cost drivers to meet market expectations without compromising quality can differentiate themselves in an increasingly commoditized marketplace, with system reliability and durability emerging as key metrics when evaluating value.

Driving down costs beyond the module: BOS innovations

BOS components represent a key area for cost reduction, especially given the potential impact on labour. Effective BOS utilization can result in lower parts count, lower commodity costs and increase speed of installation. Making informed decisions on things like technology, product quality, product life span and part count will directly affect other project cost drivers such as labour and subcontracts. These components also play a key role in market differentiation, as they allow installers to remain competitive in a marketplace that is increasingly focused on dollars per watt. Using the right technologies can increase a system's energy output and boost reliability while improving a project's levelized cost of energy (LCOE). For example, a horizontal single-axis tracker could increase system production by about 20%; however, additional operations and maintenance costs could quickly erode profits if reliability is compromised.

"BOS components represent a key area for cost reduction, especially given the potential impact on labour."

Mounting and racking systems can significantly streamline the number of BOS components and materials used in an installation, as well as reducing the amount of associated labour. Accounting for as much 10 to 15% of a system, new mounting and racking products provide a myriad of improvements, from self-ballasted and weighted systems that reduce the number of rooftop penetrations, to prefabricated systems assembled offsite that cut down on labour and inventory. If a racking system requires penetrations through the roofing membrane, a roofing contractor will typically be brought in to install flashings and maintain any warranties that may exist. Typically these costs can substantially inflate racking. Likewise if field labour costs are high, the contractor may opt to assemble portions of the system offsite with lower labour costs and higher efficiency, and then ship in the completed assemblies.

Ballasted and weighted systems are becoming increasingly popular with large commercial customers, such as big-box retailers like IKEA, to streamline the installation process, preserve rooftop structural integrity and cut overall costs. These systems allow installers to approach zero penetrations, depending on a full structural analysis. For a 1MW system, Mainstream Energy has achieved a 90% reduction in the number of penetrations, which is especially attractive to large-scale commercial customers. Recently, a big-box retailer wanted to install a large solar system that required a racking solution that reduced the number of penetrations. As the engineering team sought to secure the system without penetrations, the installation company identified a new solution they could use for other projects facing the same issues. The new product had minimal penetrations, using instead the weight to hold down the system.

Modular racking systems can be prefabricated and assembled offsite, reducing field construction labour and total part count. This means that the installation process is simpler, resulting in fewer mistakes, a faster install and less time devoted to inventory management. Additionally, prefabricated systems can benefit from greater component standardization, such as wiring. With a prefabricated wiring-harness system, fewer hours are required on site for measuring and slicing wire.

Electrical system considerations

Electrical systems optimization is a critical element in driving down costs while maintaining performance and reliability. Electrical code dictates much of the equipment utilization; however, through new innovations and code interpretation, there is significant opportunity here.

Credit: SnapNRack

Figure 2. Delivery of preassembled racking and modules to the site for installation (the North Carolina Progress Energy II project).

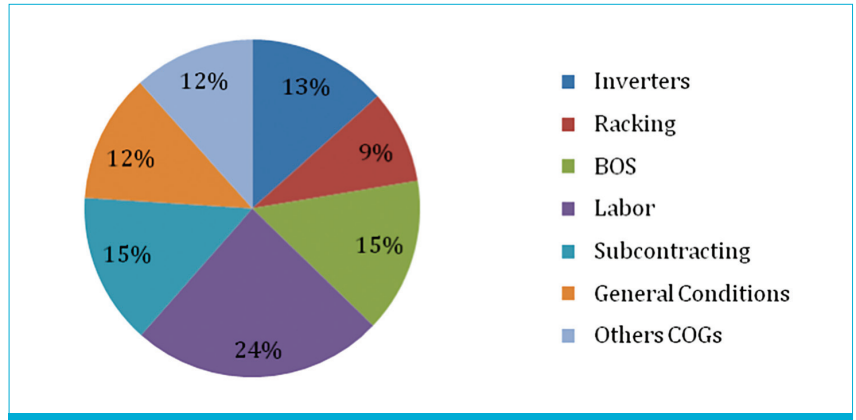

Figure 3. Cost distribution of a commercial system. (Other costs of goods (COGs) sold include permits, warranty, freight, bonds and consumables as primary items.)

Inverters require a different set of considerations than other system components, and each new product on the market raises questions about efficiency, uptime and the type of warranty offered. For larger systems, a simplified system design that uses high-voltage inverters represents the lowest cost option. This is true with both AC and DC wiring. For example, significant electrical cost can be saved in commercial and utility-scale ground-mounted systems by switching from a 600-volt inverter to a 1000-volt inverter. This lengthens the string of modules and reduces the number of BOS components needed. Additionally, through the use of module-level technology such as optimizers, string length can be increased by up to 30%, further reducing electrical equipment and labour costs.

Optimizing activity at the installation site

The greatest single expense for a commercial system is labour (Fig. 3). When combined with basic general conditions, this can represent up to 36% of total system cost. Companies that can minimize labour and general conditions – such as rental equipment, travel and fuel – will be able to offer the lowest cost system and achieve highest profitability.

> "The greatest single expense for a commercial system is labour."

The construction process provides several opportunities for driving down costs. In the case of ground-mounted systems larger than 500kW, adjusting foundation types can streamline installation and further reduce the labour hours required for a project by up to 20%.

A typical process for installing foundations for ground-mounted systems involves drilling one-foot diameter holes four to six feet deep, and then placing vertical posts and pouring concrete. Not only is this time intensive (on average fewer than 70 to 90 installations per day), but it also requires trucking/shipping materials over long distances. Partnering with pile-driving companies eliminates concrete and allows an installer to improve labour times and complete the system faster (on average 150 to 200 installations per day). By eliminating the need to procure pile-driving equipment and transport it to the site, REC Solar realized

Figure 4. Cost management system.

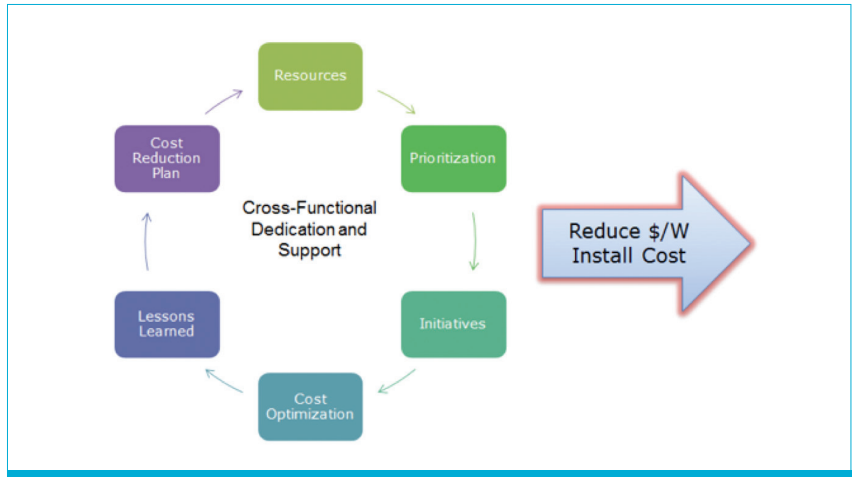

Figure 5. Continuous improvement.

significant savings and reduced overall general conditions (i.e. all ancillary project costs, such as equipment rentals and transportation). Over a two-year period, REC Solar realized savings of over 30% of foundation costs when performing pile foundations vs. concrete foundations.

The final step: attacking soft costs

An end-to-end approach to achieving operational efficiency takes account of component improvements that cut back on inventory as well as on-site labour hours, and considers optimized soft costs that improve operations. The cost of a solar system is not just in the modules – it is also in hotels, rental equipment, transportation costs, installer training and the per diems for the installation crew. It is in lead generation, sales teams, system design and engineering, and product procurement. Soft costs have become so important that the US Department of Energy's SunShot Program recently opened a $10 million competition in search of innovative business practices that reduce the soft costs of solar to $1/watt.

The overall goal of improving internal processes is to build a job faster and at a lower cost. This process starts when a job is first bid. REC Solar has implemented a process where the project's demands and milestones are openly discussed, with a special consideration for the tools and products needed to reduce mistakes in the development process and eliminate reworking. Project transparency helps line up the right resources quickly while streamlining internal processes. A successful organization has an effective system in place for cost management to provide regular forecasting and corrective action by the project team (Fig. 4). These systems are also evaluated within the ecosystem of cross-functional internal processes, including prioritization, company-wide initiatives, resources and lessons learned (Fig. 5). This helps determine the best steps to take to reduce cost while considering company-wide impact.

> "Project transparency helps line up the right resources quickly while streamlining internal processes."

Company dedication to continuous improvement is crucial, and should be circulated via feedback loops and open sharing that discuss lessons learned after the completion of each project. Instituting best-practice and lessons-learned communications through company newsletters, meetings and so on will ensure that this becomes part of the organization's culture.

Conclusion: how can the industry continue to drive down costs?

To maintain growth, the solar industry must continue to focus on driving down lifetime costs of solar beyond the modules, by focusing on BOS innovations, construction efficiency and soft costs.

> "The industry needs to move towards products and processes that boost reliability and performance."

Apart from the areas outlined above, there are additional opportunities for attacking cost and improving the overall value of solar installations. The industry must look to developing standards around components – such as wiring, racking, bolts and mounting equipment – which will further streamline system design and installation. Pushing for a universal permitting process will also cut the soft costs of solar further. More importantly, the industry needs to move towards products and processes that boost reliability and performance, and use these terms to shift how it evaluates system cost.

Reference

[1] Solar Energy Industries Association & Greentech Media Research 2012, "U.S. solar market insight report: Q2 2012", executive summary.

About the Authors

Ethan Miller is vice president of operations for Mainstream Energy and oversees logistics, procurement, engineering and construction for both Mainstream and its subsidiaries – REC Solar and AEE Solar. During his time with the company, Ethan has managed construction of more than 8000 projects, including complex utility and government projects. Additionally, he manages the supply chain, supporting procurement and logistics as well as the distribution to AEE Solar dealers and REC Solar projects. Ethan holds a B.S. in mechanical engineering from California Polytechnic State University.

Alex Griffiths is a project development engineering manager, overseeing all of REC Solar's commercial project development engineering, which totals over 1500 systems. He helps coordinate efforts between the commercial sales and engineering teams to develop the best solar solutions for customers. Alex has a degree in general engineering from California Polytechnic University, San Luis Obispo, and is also active in many professional organizations, such as the Association of Energy Engineers (AEE).

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