

Pre-construction, engineering and installation cost of utility-scale module installations – part 2

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ABSTRACT

PV industry module and component manufacturers have brought down costs significantly over the last four years. This trend is clearly evident as most publicly traded companies continue to grow revenue despite falling module and component prices. However, it is far less clear how downstream system integrators are handling the drop in system prices and contributing to value creation. System prices are generally higher in the U.S. than in Europe despite lower module prices in the U.S. This disparity often raises questions on the part of European PV professionals where these costs come from, and secondly, what have U.S. system integrators done to reduce costs. This article is the second of a two-part series shedding light on how U.S. integrators contribute to a decreasing installed-PV-system cost roadmap by championing value creation in the downstream segment. Focusing on the residential market segment, Part I delved into activity cost savings through innovation in engineering and construction [1]. Part II illustrates how changes in marketing and sales, rebates, interconnection, supply chain management and customer support have evolved considerably over the last several years to result in reduced costs.

Competitive pressures along with falling rebates in the U.S. residential market have forced a focus on cost reduction through the value chain. While the largest single cost reductions have been module costs, there have been major improvements in how PV systems are marketed, sold, installed and supported, resulting, in aggregate in a similarly high level of cost reduction. For PV system integrators, in addition to the direct project costs such as engineering and design innovation discussed in Part I of this article, indirect administrative costs are equally important including marketing & sales, rebates, interconnection, supply chain management, and customer support.

Based on analysis of internal REC Solar costs over the past five years, increased volume, process improvement and IT automation, particularly Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and web-based applications and services have driven indirect project overhead costs down by about 40% as shown in Table 1.

Changes occurring in each of these business processes are discussed further in this paper.

Marketing & sales

Marketing and sales activity centres on finding potential buyers, educating them, providing them with accurate proposals, and tracking the progress of opportunities to close sales predictably over time. Each of these processes has undergone and continues to undergo tremendous transformation primarily due to web and customer relationship management (CRM) software automation. This automation has become critical in creating more predictable, accurate demand forecasts tied to proper incentives and commission structures for the sales organization. Predictability is critical to achieving success in other areas of the business. Methods like sales and operations planning (S&OP) rely on frequently updated sales plans to drive production, inventory, and customer lead-time plans, so as to manage the resulting ongoing financial plan for the company.

Five years ago, finding buyers, or 'lead acquisition', relied heavily upon in-person seminars, home shows, and local print advertising. Home visits were often conducted in person by sales representatives to call on interested solar prospective customers. Today, channel partnerships with retailers like COSTCO, Home Depot and other major chain stores are common with in-store kiosks providing store visitors with information and the confidence that comes from a major brand name. Web advertising has become a major new source of leads with the emergence of 'pay-per-click' search-engine keyword buys and other increasingly sophisticated techniques. Search engine marketing is especially important as it allows for targeting of specific geographies. Google continues to drive down cost per lead from as much as US\$200 or more from offline sources five years ago to as little as US\$40 or less today. Radio and local television advertising are also increasingly common in more mature markets.

Once a lead turns into an opportunity, trained sales specialists are required to handle the opportunity. Five years ago, multiple home visits were required as prospects were educated in person on the various aspects of a solar electric system, resulting in a significantly higher cost of sales. Today, prospects are far better informed as they are initially routed to centralized call centres manned with pre-sales or inside sales representatives that provide solar education by phone. Representatives also typically use an online quote tool to provide customers with a preliminary evaluation of their rooftop and an approximate cost of a solar electric system. Such tools

	2005	2010 (e)	
Business process	\$/Watt	\$/Watt	% Change
Lead acquisition	0.48	0.27	-44%
Sales close time	0.56	0.39	-30%
Rebate	0.09	0.03	-67%
Interconnection	0.06	0.02	-67%
Material handling	0.08	0.05	-38%
Customer support	0.04	0.02	-50%
Total	1.31	0.78	-40%

Table 1. Estimated reduction in cost for key indirect project costs in the downstream integrator business.

Source: REC Solar internal analysis/estimates

Figure 1. An example of a quote tool used by customers online in advance of a home visit by a salesperson.

Figure 2. Online quotation tool example used by sales specialists in advance of a home visit.

combine Google satellite imagery with the customer's electricity consumption to provide a personalized quotation for their home (see Fig. 1). As a result, less time is required by field representatives to educate the customer and move a customer to close, thereby allowing for more calls and more closed sales by field representatives – and further driving down the cost of customer acquisition.

“The education and sales process has become more efficient and effective as the public has grown more familiar with solar estimation tools.”

Automation is also available to support preparation of formal proposals used by sales specialists once they visit a prospective customer's home. These tools reduce the amount of time the sales

specialist spends creating proposals and increases the amount of time spent closing sales. An example of a formal quotation tool involving a lease option used by REC Solar salespeople is shown in Fig. 2.

All in all, the education and sales process has become more efficient and effective as the public has grown more familiar with solar estimation tools and the web in general as a source of consumer research for major purchase decisions. Consequently, we regard web-based marketing and online quote tools, along with partnerships with major stores, to be primarily responsible for the cost reduction of an estimated 44% for Lead Acquisition as show in Table 1.

Furthermore, as an integrator grows in size, the number of potential sales leads grows into the tens of thousands and the number of sales opportunities into the thousands. Each must be tracked by both inside sales teams and outside sales specialists to ensure the sales process is managed, sales commissions are generated, and accurate demand forecasts are

provided to management and other areas of the business. Only through tracking and the establishment of metrics that guide evaluation of respective sales and marketing activities can refinements be made to these activities to further reduce lead generation and customer acquisition costs. A dedicated CRM system like Salesforce.com or SugarCRM is essential to scaling a sales organization to the national level. As shown in Table 1, a reduction of as much as 30% in the Sales Close Time between 2005 and 2010 has occurred due to the successful implementation of CRM systems to support the sales organization.

Rebates

Rebate requirements differ from utility to utility and continually change as programs, policies and systems are adjusted and amended. Scaling operations nationally requires that PV system integrators have experts on staff to build relationships with the various utilities throughout the country.

Five years ago, firms could gain a competitive advantage by ‘floating’ the rebate portion of the system cost, thereby reducing end customers’ up-front cash payment. Today, this has become common practice. The current sophistication is in maximizing cash flow in relation to rebate submissions across various utilities. To this end, the goal is to file rebate applications correctly and in a timely fashion. While this is easy for a small number of rebate applications, it becomes significantly more complex if the number of customers across various utilities increases.

Sophisticated installers incorporate the rebate information directly into the proposal tool, which allows for the uploading of necessary forms directly to those utilities that have online rebate systems. In California, for example, the three major, Investor-Owned Utilities – Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric – have banded together to create PowerClerk, an online rebate tool for all installers. While these three utilities cover much of the state, there are many others territories that they do not cover (see Fig. 3).

Table 2 provides a summary of the number of utilities and county government organizations that must be managed from

State/Region	Participating utilities
CA-N	17
CA-S	14
AZ	3
CO	9
NJ	1

Table 2. Numbers of utilities involved in rebates in areas served by REC Solar residential business.



a rebate, interconnect, and permitting perspective in order to best serve the regions where REC Solar currently installs residential systems.

Keeping up with the complexity of rebates, interconnections and permitting requires dedicated staff and document

management automation system. For larger integrators it requires integration of automated rebate application systems with an enterprise resource planning (ERP) system to ensure the seamless transfer of data between the different parts of the company, particularly sales, order

	\$30M in rebates	\$50M in rebates	\$100M in rebates
Six-week float	\$103,846	\$173,077	\$346,154
Nine-week float	\$155,769	\$259,615	\$519,231
Twelve-week float	\$207,692	\$346,154	\$692,308

Table 3. Opportunity cost of rebate float for varying lengths of time assuming an interest rate of 3.0% (Source: REC Solar calculations).

State/Region	Utility interconnection	Counties
CA-N	31	43
CA-S	25	15
AZ	6	15
CO	57	64
NJ	4	21

Table 4. Approximate number of utilities and County Governments to be managed in areas served by REC Solar residential business.

management, rebate administration and finance. Only with this level of seamless connection and the ability to view associated metrics is a system integrator able to identify the levers to optimize the rebate-related cash flow.

The impact on cash flow can be sizable. The cumulative impact of a hundred or more system rebates floated over six, nine and, in a worst-case scenario, 12 weeks, is shown in Table 3.

As Table 1 shows, we attribute a 67% reduction in the rebate costs between 2005 and 2010 to the successful implementation of an ERP system to automate rebate processing, in addition to automation tools implemented by large utilities such as the PowerClerk system in California.

Interconnection and permitting

As with rebates, the utilities regulate interconnection in a variety of ways, each of which merit the employ of an interconnection expert dedicated to monitoring the changing environment of interconnection requirements. A key to achieving efficiency in this area is specialization which favours medium-sized and large system integrators that can both afford a dedicated team focusing on process administration and optimization, as well as the investment in fully-fledged ERP-systems like Great Plains or Oracle. An ERP system provides visibility into and management of sophisticated business processes, especially as these processes need to be integrated with tens, even hundreds of utility systems.

By maintaining centralized databases of requirements for each utility, the integrator is able to submit the proper documents the first time in any jurisdiction, avoiding costly corrections which consume additional time and prolong the time required to float the rebates.

Variations in policies and procedures occur regularly across the many programs nationwide. Staying ahead of these changes from an operational perspective requires dedicated expertise in monitoring policies and procedures; omitting this vigilance can increase the cost of operations significantly in terms of time spent by personnel tracking down documents or completing forms a second or third time. As with those permitting processes required by municipalities, interconnection involves submission of an application regarding the site, the customer, technical specifications of the equipment, along with a single line drawing and a site plan that shows where the array and the inverter will be placed.

For installers interconnecting more than one system a day, an automated document management system is essential to cost-effectively manage the process. Large, nationwide system integrators can interconnect more than six PV systems

a day. This would not be possible, or cost effective, without automated document management systems.

As shown in Table 1, we attribute a 67% reduction in the interconnection process between 2005 and 2010 to the successful implementation of an ERP system and other proprietary IT and document management systems.

Supply chain management

Increased residential volume has provided the opportunity for mature supply chain management and distribution solutions to be applied to PV system integrators. By leveraging centralized supply chain management and distribution services, local inventories can be minimized. Variations in construction schedules caused by permitting delays, customer requirements, rebate application status and utility interconnection authorization can often lead to stagnant inventory in the residential branch. Centralized supply chain management provides consistent demand that would otherwise come at a potentially very high cost to the smaller integrator.

“By leveraging centralized supply chain management and distribution services, local inventories can be minimized.”

Further cost reduction advantages come from utilizing homogeneous product types within specific regional residential areas. This allows companies to accept a variety of module watt classes and product manufacturers while keeping consistency within a regional area. Aligning regional forecasts with manufacturer production capacity can result in a streamlined supply chain with minimized change orders. Nonetheless, change orders are common, costly and will continue to be a challenge in the future.

“Through web-based tools, a branch or smaller integrator can check on inventory and shipping status to allow for just-in-time product delivery.”

Small and sometimes also medium sized installers tend to rely on distributors as summarized in Table 5. Larger Integrators rely on a number of suppliers and manufacturers they deal with directly, up to 200 or more, requiring specialized, dedicated staff to administer.

For smaller and medium-sized system

Supplier type	Small installer (one installation per week)	Medium installer (five installations per week)	Large integrator (25 installations per week)
Commodity parts	10%	30%	5%
Distributor	90%	70%	10%
MIR manufacturer	0%	0%	80%
Internal pre-assembly	0%	0%	5%
Total # of suppliers	~30	~70	200+

Table 5. Variation in the supply chain for small, medium and large installers/integrators.

Source: REC Solar analysis and estimates



Figure 4. REC Solar monitoring operations incorporate special purpose monitoring software providing real-time status and alerting.

Photo courtesy of Karina Marchese

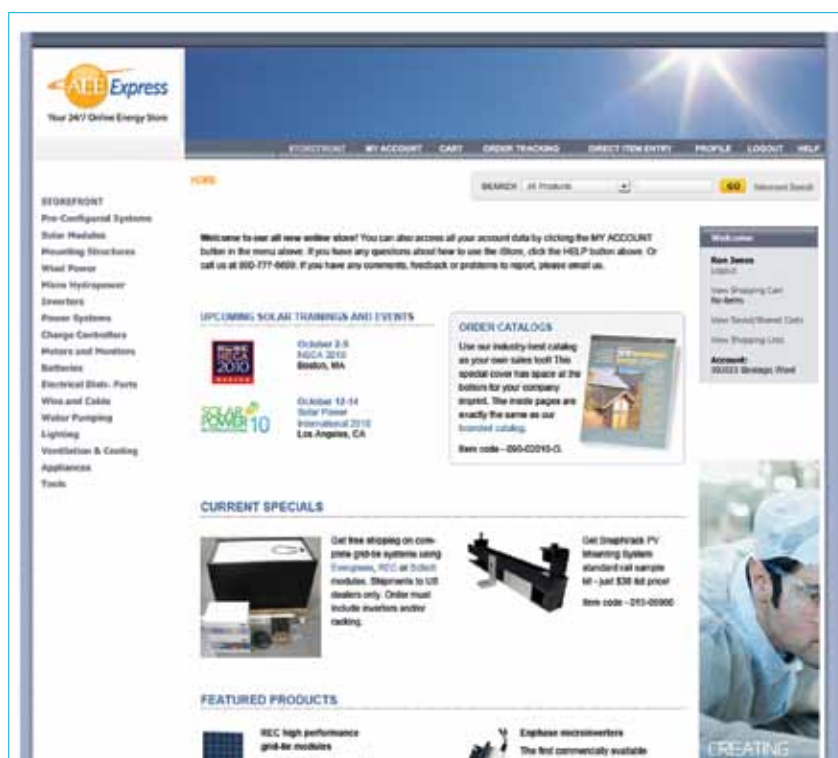


Figure 5. Value-added distribution partners provide easy access to the hundreds of suppliers via the web.

Power Generation

integrators, many of the benefits of the supply chain management strength of a large solar integrator can be gained through working with the right value-added distribution partner. This can allow a contractor to get the value of a broad product selection under a consolidated supplier who provides access to the right product, manages logistics and grants payment terms. Through web-based tools, a branch or smaller integrator can check on inventory and shipping status to allow for just-in-time product delivery, resulting in a lower cost for smaller integrators versus the alternative of carrying inventory and higher working capital investment.

Overall, the materials handling process between 2005 and 2010 saw a 38% reduction as a result of the implementation of an ERP system to support the supply chain management process spanning the organization and its suppliers (see Table 1).

Customer support & warranty

Handling customer service issues and addressing warranty work can be an expensive task with high opportunity cost. Large-scale residential integrators have centralized this service allowing for minimal interruption to field installation teams. Through standardized techniques (as are common in many other industries), the customer service department can minimize on-site troubleshooting by solving a majority of issues over the phone. If an on-site visit is needed, required equipment and the schedule is coordinated with a cross-trained and certified local installer to eliminate the need for dedicated local service technicians. Ideally, this would be combined with commissioned replacement inventory for components like inverters in order to avoid multiple on-site visits. The combination of more efficient means of service, minimization of on-site visits, and a perspective that considers longer-term system maintenance all combine to minimize customer service costs.

Additionally, low-cost advanced monitoring systems allow for increased consumer intelligence regarding system performance. Consumer-facing web-based monitoring solutions minimize customer

inquiries by way of self-service data availability. Monitoring solutions that are tied to a centralized monitoring service also allow the customer service team to quickly identify and resolve issues. The result of this data availability across the various parties is usually higher and more immediate service at a lower cost.

The data in Table 1 show that a 50% reduction in the cost of customer support between 2005 and 2010 was brought about by the successful implementation of a proprietary monitoring and tracking system in conjunction with the CRM system.

Conclusions and outlook

As the PV industry continues to mature in the U.S., there will continue to be opportunities for streamlining the integration business. System costs would not be at the levels they are today and we would not have such a thriving residential solar market without a laser-focused effort on reducing system costs with respect to marketing, sales, rebates, interconnect, supply chain management and customer support functions. Between 2005 and today, the total cost for these functions has come down by 40% from US\$1.31/W to US\$0.78/W, with the largest contribution being made via internet-based automation of marketing and sales tools.

Furthermore, the ability to scale operations to the national level requires implementation of an ERP, CRM and other enterprise software systems to effectively manage the complexity of the operations as they span the many suppliers, warehouses, trucks, sales people, installers, utilities and government entities involved in any single project. Finally, based on the improvements made over the last five years projected over the near future, we are confident in stating that combined with continued innovation in the design and engineering efficiencies discussed in Part I of this article [1], the total cost reductions required to maintain a healthy residential market in the US should be achievable despite the rapid decline of rebates.

Reference

- [1] Laviziano, A. & Miller, E. 2010, "Pre-construction, engineering and installation cost of utility-

scale module installations – part 1", *Photovoltaics International*, Vol. 9, pp. 207–210.

About the Authors

Angiolo Laviziano is the CEO of REC Solar and has over 10 years' experience in the global solar market. He joined REC Solar in 2005, prior to which he was one of the founding members at Conergy AG and worked as CFO and Chief Sales Officer. Before that he worked at an investment bank in Hong Kong and at the Prime Minister's Office of Laos. Angiolo has presented several papers in the PV field, and has a Master's degree in business from the Koblenz School of Corporate Management in Germany and a Ph.D. degree in financial economics from the University of Hong Kong.

As VP of Operations at REC Solar, **Ethan Miller** oversees the implementation of all solar projects, including branch operations, engineering, installation and service, as well as driving the company's expansion and product development. Since 2001, he has managed the engineering and installation of all REC Solar projects, and has a certification from the North American Board of Certified Energy Practitioners (NABCEP). He has a B.S. in mechanical engineering with a focus in renewable energy from California Polytechnic State University.

Josh Price is Vice President and General Manager, Residential and Light Commercial for REC Solar including P&L, sales, engineering and construction for all branches in California, Oregon, Colorado, New Jersey and Arizona. Since joining REC in 2007, Josh has over 20MW of roof and ground mount solar experience. He also has over eight years of construction project management experience including his prior experience while at Pulte Homes Inc, the nation's largest home builder. Josh holds a B.S. in construction management with a minor in business from California Polytechnic University, San Luis Obispo.

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