Smarter supply chains for a brighter solar future

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ABSTRACT

As other entrants in the solar industry scramble to build greater efficiencies into their supply chain, the leading companies focus on manufacturing strengths such as zero-defect quality along the entire supply chain. When it comes to supply chain excellence, the solar industry as a whole is playing catch-up. However, there are players who have already made substantial progress here, having already adopted 'lean' practices to eliminate inefficiencies at source. REC, the largest European brand of solar panels and a world leader in the industry, is maintaining its strong position. The company's practices and principles are explained in detail in this paper.

Introduction

When industry parameters change and competition heats up, previous inefficiencies at an operational level are suddenly laid bare. The solar industry provides an unfortunately apt example. Following unprecedented demand for solar installations around the world at the start of the millennium, and generous feed-in tariffs in many countries to sweeten investment, innumerable new entrants rushed in to snap up a piece of this lucrative market. Global manufacturing capacity increased exponentially until 2011, and the market space grew more crowded. We know what happened next.

System prices have tumbled by over 50% in the past six years. And to make an already challenging competitive situation even tougher, many countries have slashed incentives for solar investment. Even in Germany, traditionally a flagship for the global solar industry, cutbacks in feed-in tariffs are making themselves felt (with new surcharges on commercial and industrial self-consumption). In an industry that has turned frosty for many contenders, the companies that are making a success of their solar business are those which can derive competitive advantage from every element of their supply chain. It is also a matter of competitive advantage for the entire industry: cost savings aside, the ability to reduce system costs for end users will make solar a more competitive energy source and expand the market for every stakeholder.

> "The global solar industry loses up to US$500m every year through deficiencies in its supply chain practices."

Figure 1. REC's products consistently rank among the best in quality.

Other industries lead by example

For many established industries, the need for smart, efficient supply chains has long been acknowledged. Not so in the solar industry. According to the International PV Equipment Association (IPVEA), the global solar industry loses up to US$500m every year through deficiencies in its supply chain practices. Some shipments are delayed, or even lost altogether; others arrive at their destination damaged. Inventory goes missing. Products are stockpiled unnecessarily in warehouses. The IPVEA estimates that losses could exceed the one billion dollar mark by 2018 if the industry fails to change its ways. Wasteful practices that would be unthinkable at car manufacturers – who also operate in a global industry with global supply chains – are common in the solar world, and the solar industry might do well to look to car manufacturers for a lead.

Toyota's famous 'lean manufacturing' transformed the entire industry with its principles of waste avoidance, low inventory, continuous problem solving and respect for people. The automotive industry has over time created an approach to achieving operational excellence that other, unrelated sectors now look to for inspiration.

REC experiences near-zero delay in its shipments and achieves near-zero-defect product quality, and its claims rate is among the lowest in the industry. While REC's products consistently rank among the best in quality, they are also competitively priced; the company is also bankable and considered a 'safe bet' on the Bloomberg New Energy Finance (BNEF) bankability survey (published in February 2015). But like any other player in the solar industry, REC is renewing efforts to further boost demand as system prices continue to fall. So what is REC doing differently to maintain its success? How has it adopted the principles of 'lean' into the solar world?

Rather than short-term, tactical initiatives focusing on short-term cost-cutting gains, REC has always taken the longer view, steadily building – and staying in control of – an effective supply chain that is focused on collaboration with qualified partners.

The quintessence of supply chain excellence

At the heart of REC is the REC Business System (RBS), REC's standard operating system for improving and sustaining safety, quality and productivity (see Fig. 2). With this system, REC has looked to numerous models for inspiration on best practice. RBS is a marriage of Toyota's 'Lean Philosophy', Motorola's 'Six Sigma' (for process excellence) and other world-class manufacturing concepts, combining the best of REC's own business system and that of REC's new parent company, Elkem. It provides the techniques that enable REC to fulfil its mission: to create value through efficient and sustainable solar products and services, and to do so together with partners.

It is no coincidence that the RBS is built like a house – strong only if the roof, walls and foundations are strong. The structural elements are the principles and practices that run through every aspect of REC's business. Customer satisfaction – with the best safety and quality, the shortest lead time and the lowest cost – is at the peak of

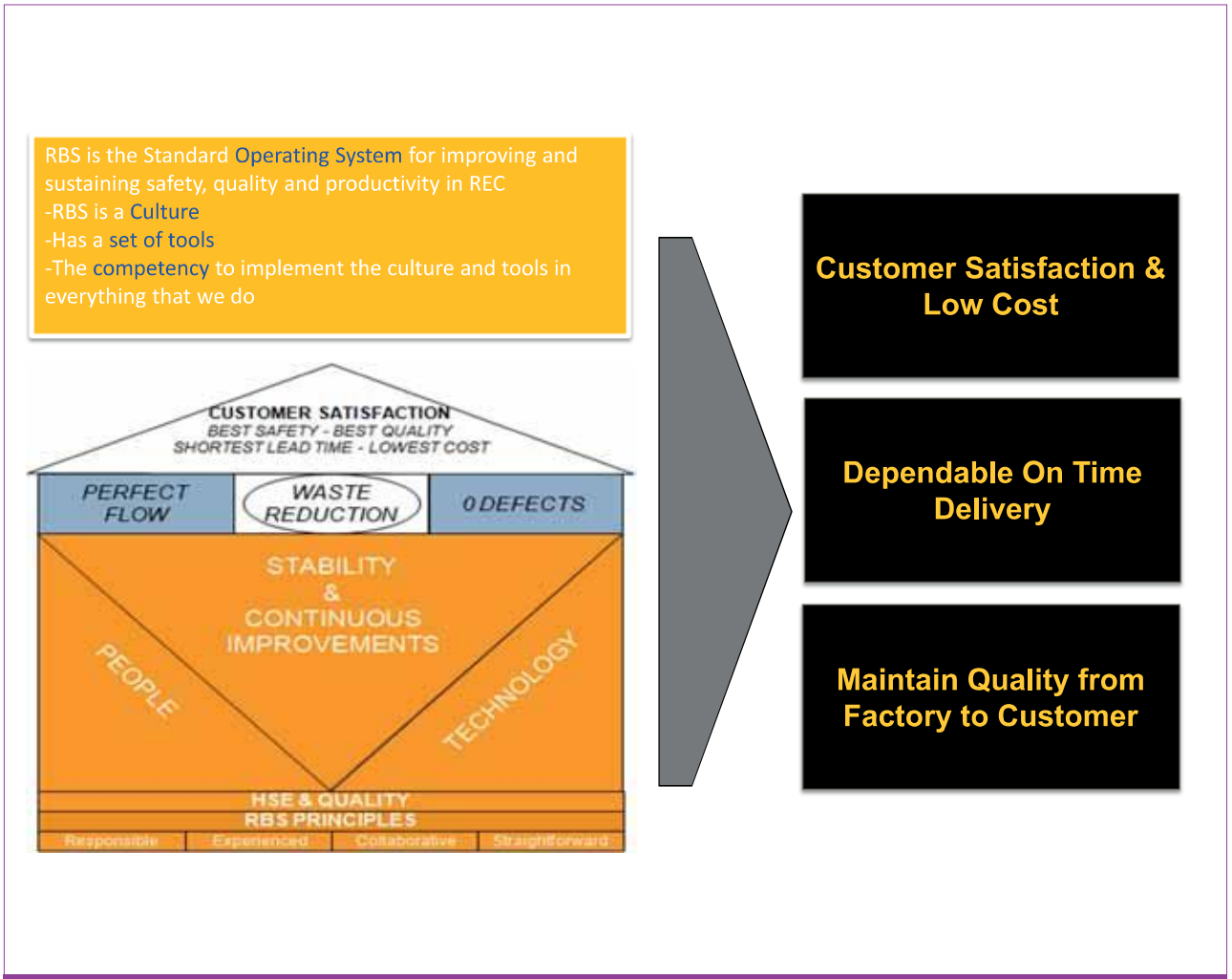
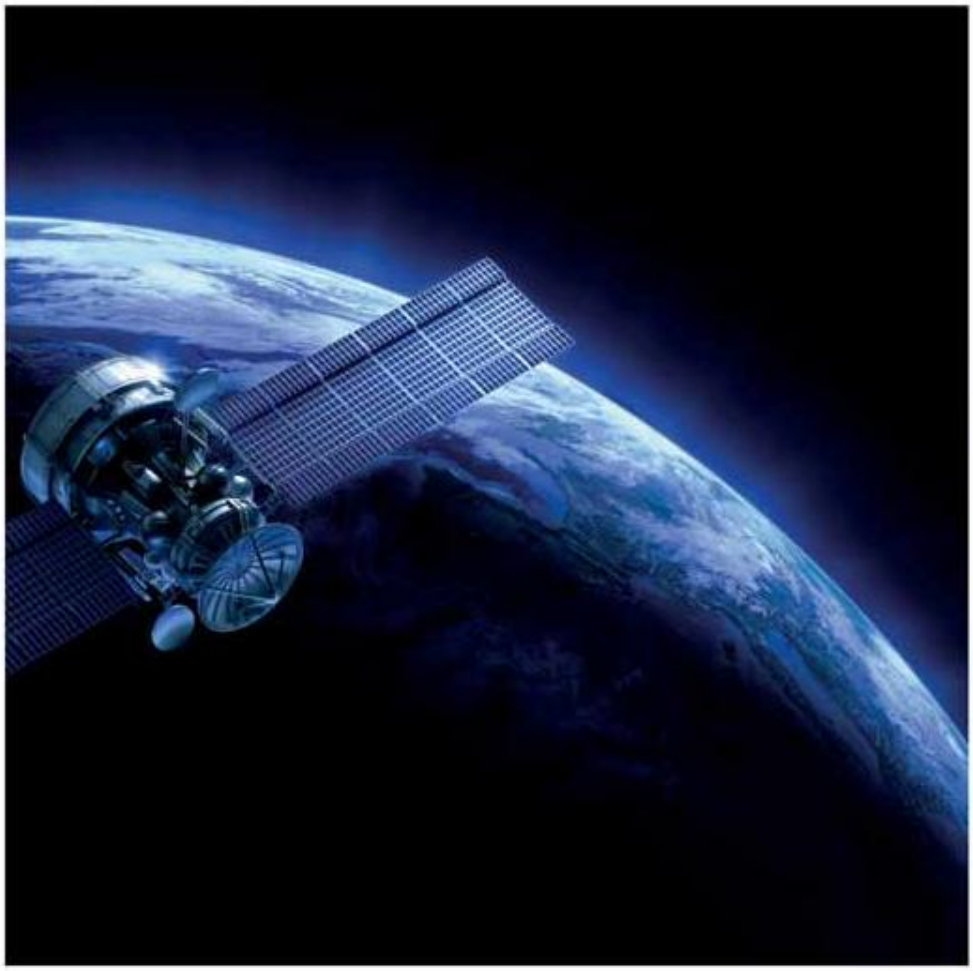


Figure 2. The REC Business System (RBS).



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this aspiration. This is the 'roof' of the RBS house, and is what REC always has in mind as the ultimate target.

Core values and principles

At the top of the house is the quality of the output which leads to customer satisfaction; the base foundation also comprises the qualities or values of people. These common qualities – being responsible, disciplined and straightforward, applying experience and collaborating with others – energize the measures that deliver excellence in the supply chain, and ultimately deliver cost efficiencies and zero-defect quality.

Moving up a floor, next come the RBS principles, which frame and inform everything REC does.

Principle 1 – Understand your business case

REC starts with the facts, figures and targets of the business case, and how activities affect safety, quality, lead time and cost.

Principle 2 – Organize your people

This is about how people and their roles are organized, ensuring that everyone engages with what is happening. In a vertically integrated organization such as REC, it is important to have teams that combine every relevant section of the value chain to ensure a big-picture view of workflows and processes. A lack of clear directions, or a lack of understanding of roles and responsibilities, is unproductive. In addition, zero physical harm on the job is paramount. If an employee's job is not safe and healthy, a company can forget about establishing an atmosphere of trust and respect for everything else it is trying to build. REC believes that accidents, injuries and occupational illnesses are preventable. The company's target is to ensure zero harm to employees, contractors, partners, customers and members of the public, and also to act with responsibility for the health of the planet.

Principle 3 – Design and improve your system

This is about continuous improvement of the systems. Technologies change, for example REC's own new floating solar solution; so do situations in the wider market, for example the reductions in feed-in tariffs that have altered the ROI calculations of investors. The agility to adapt is more important than ever for a true leader when conditions outside one's own sphere of influence change.

To design and improve a business system in the most straightforward way, REC has implemented four core rules (see Fig. 3).

Rule 1 – Standardize

Of these rules, standardization arguably delivers the most quantifiable benefits. To change or improve a process, it is necessary to know at the nuts-and-bolts level exactly how it works today. Standardization enables REC to achieve reliability and repeatability in its processes, which in turn lead to consistency in product quality and a strong commitment to deliveries on time and to contracts. Nothing is left to chance. The content, sequence, timing and outcome of every process are part of in-house

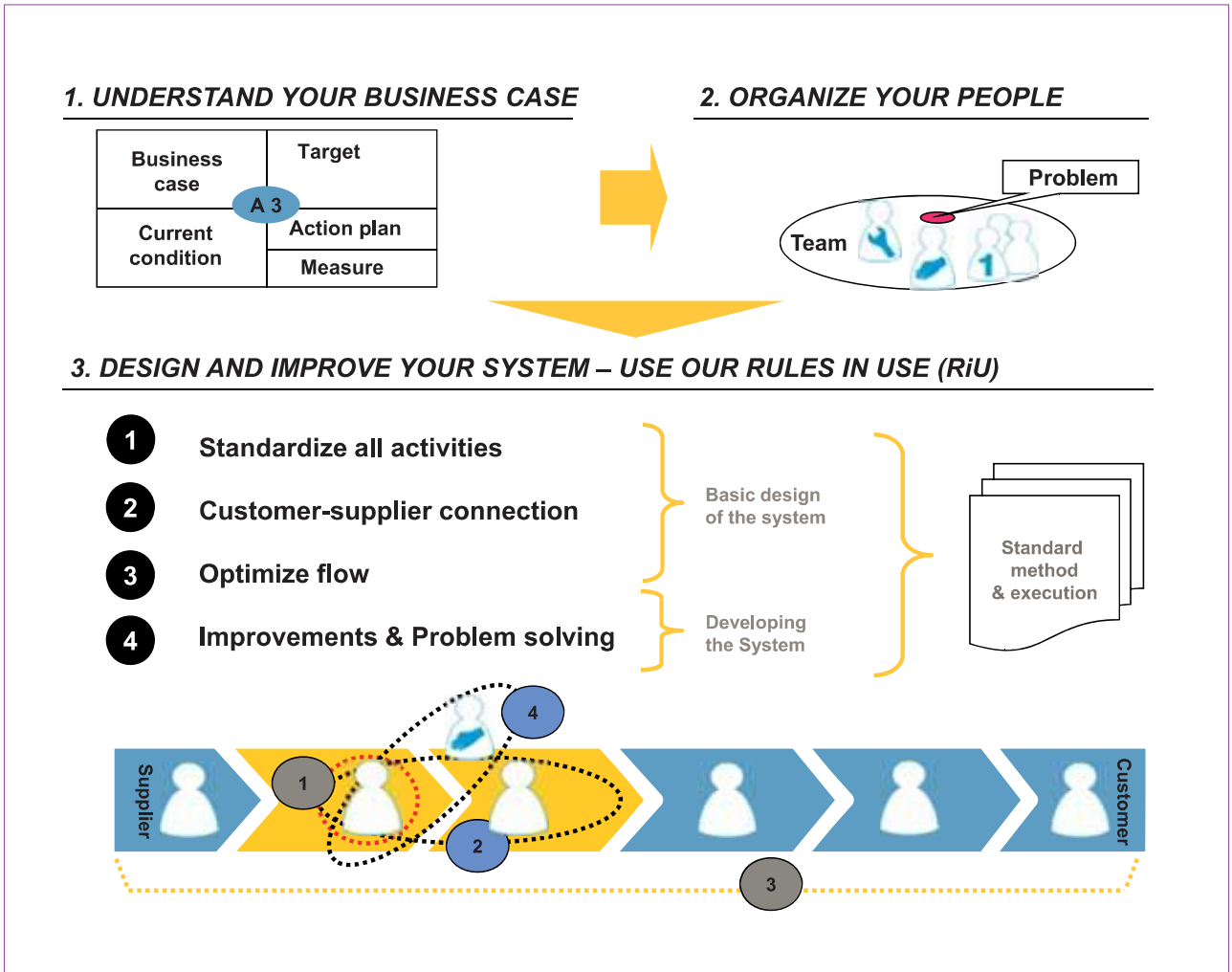

Figure 3. REC's principles and rules.

knowledge. If the results of a process are not exactly as expected, it is known exactly where to make adjustments. The payoff of standardization is in fact not just cost savings – it also provides the agility to respond quickly when changes are required.

Rule 2 – Maintain effective connections

Because standardization is in place, it is possible to specify what we want the previous stage to deliver to us, and what the next stage expects of us. Clarity and safety are key, with direct lines of communication between REC and the customer, and accurate input from customers about what is required, when and at what level of quality. This does not just apply to customers, in order to achieve optimum customer satisfaction; internal understanding, with effective connections within the company, also helps to improve productivity and efficiency.

"Anything that does not add value to the product is waste."

Rule 3 – Understand and optimize flow

Anything that does not add value to the product is waste: in the form of overproduction, for example, this could be unnecessary conveyance of work in progress, waiting, or even overprocessing with a higher quality than needed. All production lines or process sequences are set up so that every product or service flows along a simple prespecified path, without forks or loops that can stall efficiency. People should never be uncertain about what step to take next. In the factory, product and process are aligned as closely as possible, with as little waste as possible. This attitude has to be apparent along the entire value chain, not just in production. For example, inefficient transportation routes, or the late (or non-) arrival of shipping documentation, will interfere with efficiencies in the supply chain (and are responsible for a chunk of the US$500m going to waste through supply chain inefficiencies). REC ensures that optimal flow is maintained throughout.

Rule 4 – Make improvements

RBS is about always challenging the current situation. There is always a better way – and often a need to respond to a specific challenge on the horizon. REC became part of Elkem Group in early 2015, and is therefore now able to make even more improvements to its leading energy payback time and CO_2 footprint by increasing the share of Elkem Solar Silicon in its manufacturing. As REC expands production in its factory, it is also introducing new 'flexilines' that can each be used to manufacture several different products.

Assuring the quality of output

Values and principles are one thing – applying them effectively in practice is another. Actual quality is a function of combination of the processes and the product that emerges from this process chain. By designing and deploying its RBS system, REC has taken the strategic steps to make certain that the product itself is consistently excellent and that the perfect flow, zero-defect production and zero waste which are declared objectives within the RBS system are accomplished.

Products are designed specifically to permit as much recycling and as little waste as possible. Between 2012 and 2014, the share of recyclable components increased from 40% to 75%, well above the industry average. Very little material is left over: at REC's Singapore manufacturing facility, instead of spacious hoppers to receive waste from the production line, there are receptacles which are more shoebox-sized.

While many companies routinely outsource virtually all of their manufacturing, this comes at a cost of loss of control. REC is following the vertical integration route, de-commoditizing the components and products that make up a system. All REC solar panels come from the company's own production facility in Singapore, which opened in 2010. Capacity has been steadily expanded to keep pace with growth, and by the end of 2015 will reach 1.3GW.

Through automation and vertical integration in production, with the manufacture of silicon wafers, cells and PV modules all at one site, REC gains technology, quality and expertise advantages as well as better reliability and repeatability, as evidenced by REC's strong performance in tests and bankability audits. (Accolades received by REC include the Frost and Sullivan Customer Value Enhancement Award for the Solar Industry and the Top Brand PV Seal from EuPD Research.)

REC modules are designed and engineered to deliver reliable long-term power output over their entire lifetime, and come with a 25-year warranty. Of the four million solar panels the company produces every year, less than 400 – one in ten thousand of the company's total annual output, or under 100 ppm – have to be returned owing to defects. To offer this reliability (and longevity), REC's product qualification process is substantially more stringent than the industry demands. REC develops products to pass its own internal standards, rather than pass a set of minimum requirements; IEC, UL and JET compliance is the starting point rather than the end goal. Any major design change undergoes an extended qualification process, during which panels are tested well beyond normal industry standards. This extreme testing, with harsh environmental conditions and brutal stressing, ensures that panels can perform in the most severe surroundings. REC's solar panels have passed water tests to prove they maintain performance and standards, even for installations on freshwater bodies; they also have desert accreditation, confirming that they can withstand the sandstorms and searing heat of desert regions.

Ownership of upstream process quality: sourcing

Factors influencing product quality extend far beyond the factory doors, of course, and taking real ownership of the supply chain has the potential to make a huge difference. As well as vertical integration at its own manufacturing facility, REC retains control and ownership of every stage of the process upstream and downstream.

Components are also procured from outside suppliers. With its stringent supplier qualification programme, REC regards sourcing as a continuous practice rather than a one-off initiative, and places sourcing at the centre of a strategic framework. This ensures that the supply chain is energized by suppliers with the competencies and cost efficiencies to help REC deliver on its mission. The sourcing strategy also includes analysing the global supply market to understand cost drivers and scout out new developments. Local sourcing is also key: by moving its factory to Singapore, REC now has access to the dynamic and competitive sourcing markets in the Asian region. Between 2010 and 2013, REC reduced its solar panel costs by half; of these savings, two-thirds were down to factory and operational efficiencies, and one-third was the result of reduced material costs.

Downstream: on-time delivery

Trying to manage a global supply chain without knowing where the cargo is, what condition it is in and who has custody of it, or even when an event occurs, is asking for trouble. It is certainly not the way to guarantee on-time delivery. REC partners with Hellmann Worldwide Logistics, a specialist provider of solar energy logistics, to explore strategic approaches, innovations and value-added services to re-invent, optimize and maintain full control of the global supply chain from factory to customer, and – at the most basic level – to ensure that products are delivered on time and in pristine condition.

Shipping conditions are optimized to ensure that zero damage is suffered in transit. Temperature and humidity are carefully controlled and shocks minimized while the products are travelling to their destination. Thanks to a carrier space guarantee, which protects against peak season surcharges and general rate increments, REC does not risk paying penalties for late delivery and achieves up to 50% savings during peak season.

REC selects shipping providers based not just on price, but also on the strength of the provider's global network, reliability, consistency and responsiveness. As a result, REC has best-in-class transportation costs, 15% lower than the market average. Likewise, REC saves on storage cost by genuinely delivering 'just in time'. Instead of stockpiling inventory, REC uses shipping containers for storage, and its products spend their time en route rather than in store. Accurate planning along the entire value chain – from sourcing and production to freight scheduling in line with the customer's requirements – means that the company is nearly always sold out from one quarter to the next.

The last mile: customer satisfaction based on strong partnerships

REC does not simply hand over responsibility for the product once it reaches the installer. The partners through which REC solar panels are sold globally are also part of the REC value chain and key to ensuring customer satisfaction. The company is strongly committed to long-term partnerships with distributors, integrators, project developers and promoters. In October 2011 REC launched its Partner Program with a range of benefits, support and rewards to help partners take their business to the next level. REC now has 30 Platinum and Gold Partners worldwide.

Installation quality is also vital to solar projects' meeting and exceeding expectations. Complementing its Partner Program, REC has also rolled out a certified installer programme, and also trains and certifies installers through the REC Solar Professional Program. In total REC has 700 certified installers worldwide.

Continuous improvement

Even if they are already leaders, the best companies continue to evolve their supply chains in order to better manage risks, anticipate changes and identify and exploit new opportunities. REC scrutinizes every facet within the supply chain for cost-saving opportunities; for example, shipping routes are continuously reviewed to ensure that the best choices are made. REC also recently improved its packaging, partnering with packaging experts and carrying out continuous engineering and testing. The result is a double-stack pallet instead of a single stack. This seemingly minor tweak has in fact improved REC's sea freight container loading by 25%, enabling the company to reduce shipping charges to customers without any impact on module quality.

Outlook for supply chain excellence in the solar industry

Analysts at Fraunhofer Institute and Agora predict that solar will be the world's most common energy source by 2050, powering 40% of the world's electricity needs, at generation costs as low as 2 to 4 eurocents per kWh. The evidence does point in this direction: in 2014 a record volume of solar capacity was installed worldwide, and the total capacity now adds up to 100 times the level of that in 2000. There is therefore everything to play for in an industry that looks set to be one of the most important on our planet within the lifetimes of many of us. It is a global imperative that the industry smarten up its supply chains to deal with demand at this level.

In the more immediate future, efforts to improve supply chains will probably be driven by necessity. System prices are too low to permit the luxury of letting half a billion dollars simply slip through the cracks. These efforts, if successful, will benefit every stakeholder in the industry (not just panel producers) by lowering solar costs all round. Apart from enhancing the perception of reliability of PV suppliers, greater cost efficiency in the supply chain will have a positive impact on the competitiveness of solar energy, and increase the number of countries in which solar has achieved grid parity with other energy sources.

> "Greater cost efficiency in the supply chain will have a positive impact on the competitiveness of solar energy."

As REC shows, supply chains work effectively when ownership of quality and knowledge is retained, and the supply chain reflects the company's wider approach to doing business. Zero-defect quality, the importance of long-term strategic partnerships, just-in-time logistics and reliable shipping are the outputs of a robust value system. The danger of a rush to optimize supply chains in the solar industry is that enterprises will over-focus on mining obvious efficiency potential in individual operational processes, losing sight of the need to approach their supply chains in strategic rather than tactical terms. Cost-cutting and short-termism are unlikely to be the route to sustaining success. The most successful enterprises – in the solar industry as in others – are those that can leverage their supply chains into activities that genuinely unlock value, and translate their corporate strategy into effective processes at the operational level.

About the Authors

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