Communicating the Customer Benefits of Information Standards

A Guide to Defining How Standards Reduce Cost and Eliminate Risk in Solar Installations

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Executive Summary

When you look at the most ubiquitous technologies around us today, the success of each is most often tied directly to standardization. From electrical equipment, to video formats, to cellular communications, the establishment and implementation of standards has significantly reduced the cost and complexity of these systems and has enabled widespread adoption on a global scale.

Just as utilizing proprietary networking gear would limit the interconnectivity and usefulness of an organization's network, utilizing proprietary components and solutions limits the operational effectiveness of solar installations. In spite of this obvious truth, most solar deployments still utilize proprietary information formats, communication protocols, and monitoring and control technologies.

As a result, today's solar installations provide little flexibility regarding how solar plants are managed, monitored or controlled. This lack of flexibility limits the ability of solar component manufacturers and integrators to design low-cost, long-lasting installations; impedes plant operators from managing plants effectively; and makes it difficult for renewable energy consumers, utilities, and authorized third parties (such as equipment providers, service providers, financiers, and regulators) to access plant information without resorting to expensive, complex, custom-built systems that often result in "vendor lock in" and higher-than-anticipated long-term operating expenses.

One of the primary factors impeding the broad deployment of solar PV systems today is the lack of interoperable, standards-based renewable energy products on the market. By establishing information standards for solar inverters, meters, modules, string combiners, environmental monitors, data acquisition systems, and management applications, the SunSpec Alliance is significantly reducing the cost of solar installations while minimizing risk and increasing operational flexibility. The reduction in cost, mitigation of risk, and increase in efficiency provides a significantly higher return on investment (ROI) for solar installations, resulting in better margins for solar manufacturers, plant operators, and renewable energy consumers alike.

Today, however, many customers do not understand the benefits of standards. With this paper, the SunSpec Alliance outlines the benefits of standards for solar installations and provides guidance regarding how to communicate these benefits to customers or interested third parties. In doing so, SunSpec's goal is to educate the market on the role and the benefits of standards, and illustrate the significant value-add of standards-compliant solar PV systems.

Benefits of Solar Standards

Lower Costs From Top To Bottom

SunSpec's hybrid approach to standards development—deriving de facto standards from the PV industry while collaborating with traditional standards-making organizations to establish formal international standards—creates a network effect that reduces costs and encourages adoption as more systems are deployed in the field.

For manufacturers and solar integrators, information standards enable delivery of solar plant solutions that leverage off-the-shelf components and existing communications infrastructure, thus dramatically reducing cost and enabling massive economies of scale. By eliminating the need to design every product from the ground up, standards enable manufacturers and integrators to innovate on top of existing designs while ensuring that new products interoperate with existing equipment and infrastructure. The feedback loop enabled by information standards drives up plant uptime and drives down long-term costs such as warranty expense. The table below highlights the significant benefits of information standards to manufacturers and integrators during the PV plant design and construction phases.

> *"We are making a significant investment in solar, and we need that investment to provide a return on investment while ensuring that the system functions optimally. The only way to achieve that is with central, standardized monitoring. Otherwise, not only is our ROI not measurable, but it will most certainly be lower."*
> **City of Boston**

Table 1

Projected Cost-Per-Watt Cost Reduction of SunSpec Standards			
Cost Area	Baseline	Savings	Reduction Method
Electrical BoS	$0.70	($0.04)	Enable multiple types/vendors for all components
		($0.02)	Reduce component installation time
		($0.03)	Eliminate sensor installation/commissioning
Design, Overhead, Profit	$4.20	($0.04)	Simplify design process by reducing variables
		($0.04)	Enable standardization of design templates
System		($0.13)	Increase de-rating factor accuracy
		($0.01)	Reduce risk (insurance cost)
		($0.04)	Reduce construction and start up time (financing cost)
Total Reduction		($0.35)	

From the solar operator's perspective, information standards:

- Enable access to solar plant information for all interested parties without the need for time-consuming customization and expensive one-off administration
- Reduce component repair and replacement cost by providing the freedom to choose amongst competing suppliers
- Simplify long-term operations for all involved

These benefits result in significant reductions in operational expense, less complex operational procedures, reduced time to deploy new technologies, less time required to train staff, and the elimination of rip-and-replace expense when new components or management systems need to be deployed. This last point—rip-and-replace expense—is something that few operators consider at project inception and yet looms large when new functionality is required or when vendors go out of business or are consolidated into other organizations.

For renewable energy consumers and utilities, information standards provide visibility into the performance of solar installations without imposing administrative hassle, significant customization expenses, or management overhead. Standards also allow solar installations to more readily implement control functions—such as variable power factor and low-voltage ride through, thus enabling new revenue streams for consumers and grid optimization opportunities for utilities.

To summarize, the impact of information standards in the solar PV market is the dramatic reduction of installation cost, significantly increased plant uptime, lower long-term operational cost, greater visibility for all affected industry participants, a radical advancement of the state of the art of PV plant monitoring and control, and the enablement of ancillary grid services. Given these factors, information standards play a key role in making solar PV technology competitive with all other forms of energy generation and in helping to establish PV systems as a safe and bankable asset class.

Table 2

Who Benefits from the Cost Reduction of Solar Standards?		
Party	**Benefit of Standards**	**Resulting Cost Reduction**
Manufacturers	Rather than developing every new component from the ground up, manufacturers can innovate on top of standardized form factors and communications protocols.	Building from a standard platform results in faster time to market and greater economies of scale for new products.
Solar Operators	Standards enable solar operators to easily provide access to solar data to all customers without the need for expensive, time-consuming customization for each third party. Components can be swapped out at any time without the fear of having to rip and replace an entire system.	There are significant cost reductions in terms of the initial cost of equipment, the time to deploy new technology, the time required to train staff, and the elimination of rip-and-replace costs when new components or management systems need to be deployed.
Renewable Energy Consumers	Customers receive more visibility into the performance of solar installations without being charged for significant customizations and ongoing management costs.	Because solar plant operator no longer need to engage in costly customization for each customer, customers do not have to pay significant markups for these services.
Utilities	Adoption of SunSpec standards results in increased plant uptime and total energy output by enabling better oversight.	The backward and forward compatibility of components reduces lifetime costs for utilities and rate payers alike.

Lower Risk

By incorporating de facto industry standards—instead of starting from scratch—SunSpec information standards reduce risk by ensuring maximum interoperability. SunSpec Alliance standards leverage widely-deployed technologies such as Modbus, Ethernet, DNP3, TCP/IP, XML, Zigbee, and Web services interfaces. These technologies are embedded in many state-of-the-art PV monitoring and control systems, can be deployed over standard IP network infrastructure (i.e. the same infrastructure supporting most corporate networks and the Internet itself), and are well-understood by hundreds of thousands of IT professionals around the globe. By ensuring interoperability, SunSpec standards reduce the risk involved with upgrading or trading out old technology and replacing it with the latest, state-of-the-art components. At any time in a solar installation's life cycle, the operator can swap out components or management solutions, knowing that all are certified to work together.

In addition to reducing interoperability risks, SunSpec information standards help reduce performance and efficiency risks by enabling performance metrics that invite apples-to-apples comparisons. Customers can be confident that certified products are both plug-and-play and deliver the required level of performance every time.

> *"SunSpec certified products give us the flexibility that the industry currently lacks. We need the flexibility to replace products with parts that are standardized. In the end, standards help us escape the customized solutions that used to lock us in."*
> **NRG Energy**

Finally, SunSpec information standards pave a path towards emerging Smart Grid standards such as IEC 61850-7-420 and ZigBee Smart Energy 2.0. These standards have been under development by utility industry and consumer products companies for many years, and are currently being updated to reflect recent advances in inverter control methods. SunSpec Alliance members have been key participants in defining and promoting the adoption of smart grid standards for inverters and PV balance-of-system solutions from the beginning. Accordingly, SunSpec-compliant products are well positioned to integrate seamlessly into utility smart grids of all types.

Increased Flexibility and Scalability

Information standards ensure that the equipment and solutions you buy are going to work together, and that they are going to operate according to objective, well-understood rules. Accordingly, mixed-vendor plant installations—combining best-of-breed components—can be constructed, and ROI calculations can be made based on objective criteria, and not simply upon manufacturer claims.

Standards help companies simplify the procurement process and ensure that everything will not only work together, but will work optimally based on pre-defined specifications. When things are no longer under warranty and it comes time to upgrade or replace components, standards enable organizations to repair or replace elements without having to do a full rip/replace of the entire system.

> *"SunSpec standards help us reduce engineering time, reduce the need for customizations, and help us design entire systems faster for better deployment times."*
> **Siemens**

Standards also enable certain components and technologies to be utilized on any size of plant. This means that manufacturers, integrators, and operators can exercise tremendous buying power when building up portfolios of plants of varying sizes and leverage a common management infrastructure. For a multi-

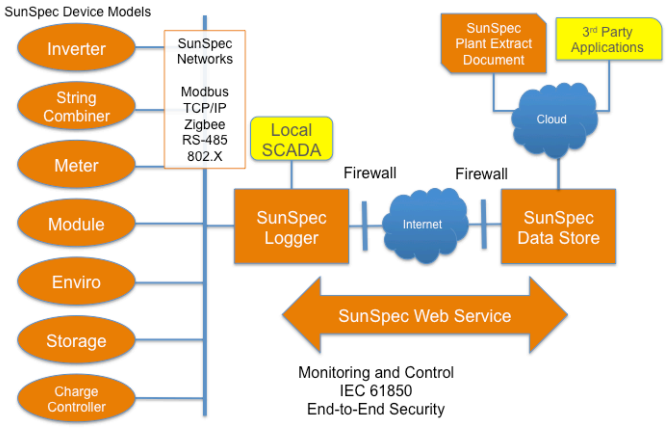
megawatt plant portfolio, the flexibility and scalability advantages of standards can result in savings of hundreds of thousands, or even millions, of euros/dollars over the portfolio lifetime.

How the SunSpec Alliance is Standardizing Solar

Developing Information Standards

The SunSpec Alliance's primary objective is to reduce the cost of building PV plants by developing open information standards—information models, communications protocols, and system interfaces—that can be used by component vendors and integrators to create interoperable solutions.

The diagram to the right depicts the areas of standardization that SunSpec standards address.



SunSpec Architecture

SunSpec has worked with the Electric Power Research Institute (EPRI) and the ZigBee Alliance to define a specification called "WS-61850" that harmonizes SunSpec inverter standards, IEC 61850, and ZigBee Smart Energy 2.0. This specification specifically addresses the needs of Distributed Energy Resources (DER) such as solar PV plants. The Smart Energy 2.0 model integrates generation, storage, and advanced controls as defined in the EPRI "Advanced Inverter Control for DER" and is derived from the IEC 61850 standard. SunSpec members participated directly in the creation of this standard. This work is being further proliferated through the ASHRAE SPC201 Facility Smart Grid Information Model sponsored through the U.S. National Institute of Standards and Technology (NIST) and Smart Grid Interoperability (SGIP) process.

Developing Software Reference Designs

While open SunSpec information standards are a good first step, documents alone are insufficient. In addition to defining open standards for all relevant sub-systems—modules, inverters, interconnection systems, and management systems—the SunSpec Alliance is also chartered with creating software reference implementations for each type of component.

While the PV industry wishes for high uptime, reality is different[1]. A review of 4,000+ power plants monitored by Power-One[2] showed that average uptime was below 80% in 2009. Sun Edison estimated that typical commercial plant uptime ranged from 50% to 80%[3] industry wide (while Sun Edison's fleet was in operation 99% of the time). Considering that 1% of downtime for a 1 MW plant results in $3,750 in production losses[4], and that contractual penalties add further pain, the present situation is untenable.

Adoption of reference designs will result in increasing plant uptime and total energy output by enabling faster vendor deployment and better customer oversight. The backward and forward compatibility of components reduces lifetime costs. The opportunities for savings are substantial, and are in addition to the savings listed above.

Enabling Software To Activate Inverter Capabilities

Inverter makers in the SunSpec Alliance are active in European markets and many have implemented the BDEW grid codes mandated by Germany[5]. In the U.S., grid support services provided by inverters

(fault ride through, active and reactive power control, frequency, and other regulation services) will be required in the near future. By applying the reference designs to access latent inverter functions, SunSpec aims to evolve U.S. and global grid standards in record time. Work in this important area commenced in 2011. SunSpec Alliance members can expect that ratified specifications will be available during 2012.

Establishing A Test, Certification, and Branding Program To Drive Adoption

A key requirement for standardization is a testing and certification program to ensure interoperability of vendor-supplied devices. Products incorporating SunSpec specifications must pass a certification test in order to be deemed "SunSpec certified." SunSpec administers this program and hosts regular "SunSpec Plug-Fest™" events to facilitate interoperability testing.

Similar to the interoperability exercises that enabled the Internet to become rapidly and widely usable, the principle objective of a SunSpec Plug Fest is to establish plug-and-play communications among renewable energy devices, thus driving down total industry integration costs and creating a vibrant market for compatible devices and services. Engineering practitioners benefit by establishing best practices and by helping to define standards that are shaping the Smart Grid. Customers benefit from reduced costs from the economies of scale delivered by manufacturers.

Each SunSpec Plug Fests leverages the SunSpec specifications ("SunSpecs") that are then available and enables participating vendors to easily create compatible solutions that can plug into the information technology services comprising the Smart Grid. Current SunSpecs define data formats for inverters, meters, modules, string combiners, data acquisition systems, and environmental monitoring systems. Test events are conducted in partnership with accredited labs to analyze and verify results. Third-party testing labs are utilized to ensure availability of testing resources globally and to ease the path to commercialization.

The SunSpec testing and certification program is lead by TÜV Rheinland, which is a leading test house for solar PV technology, Wi-Fi, ZigBee, and other smart grid technologies. Past test events have been well attended by SunSpec Alliance members, all of whom have signaled their support for standardization through their participation and contributions to SunSpec. SunSpec compliance has been specified by integrators and EPC's around the world. SunSpec compliant products are coming to market and are delivering value today.

Summary

The information standards being driven by the SunSpec Alliance enable significant cost reductions for solar component manufacturers, integrators, plant operators, utilities, and renewable energy consumers alike. Even more, SunSpec standards are the basis for rapidly integrating PV power plants into the smart grid, thus providing ancillary grid services that deliver value beyond the initial installation cost savings.

Acceleration of the growth of solar industry is dependent upon all interested parties being educated on and aware of the benefits of standardization. With SunSpec information standards in place, the PV industry can build upon the competitiveness it has already attained, sustain the profitability and economies of scale needed for widespread deployment and adoption, and compete on even footing in the market with other forms of energy generation.

Appendix

Common Language for RFPs

To begin taking advantage of the benefits of standardized solar equipment, the first step starts with the customer. SunSpec Certified equipment is available and ready, and will help ensure the performance, flexibility and cost-effectiveness of your solar installation – but only if you ask for it. This happens when people like you clearly specify that you want SunSpec Certified products to be used in your solar installations.

Below we provide a general value statement that you can include in your RFPs as an indication of the reason you want SunSpec Certified components used in your installations. This general statement is followed by more specific language that you can use depending on the components you are specifying.

General Value Statement

Whenever possible, we want SunSpec Certified components to be used for the following reasons:

- To ensure the performance of components comprising the solar PV system
- To avoid vendor lock-in and ensure the future flexibility of the system
- To reduce the total cost of ownership by reducing up-front planning/implementation costs as well as eliminating the need to rip and replace when updating to new components

Communications and Interoperability

In order to maximize design flexibility and minimize long-term cost of ownership, the winning bidder shall construct and deliver solar PV systems comprised of components that implement open communication protocols and industry-standard device interfaces based on SunSpec Alliance specifications. These specifications are available via download from www.sunspec.org.

PV Plant Protocols

Acceptable physical-layer communications protocols for PV plants include Ethernet (802.3, copper or fiber), ZigBee (802.15.4), WiFi (802.11 a, b, g), and RS-485. Acceptable application-layer protocols include Modbus/TCP or RTU, and native SunSpec-over-TCP.

SunSpec Alliance Data Model Support

Compliance with SunSpec Device Model standards ensures that PV components can be monitored and controlled by SunSpec-compliant monitoring, control, and SCADA systems. Accordingly, all PV system components must be certified compliant with relevant SunSpec Device Model specifications.

SunSpec Device Model specifications are currently available for inverter monitoring, inverter control, meter monitoring, module-level (panel) monitoring, and environmental monitoring. For a current list of companies supporting these specifications, visit www.sunspec.org/members.

PV Plant Data Acquisition and Control

PV Plant Data Acquisition and Control equipment (sometimes referred to as “data loggers”) must be certified compliant with the SunSpec Data Logger Communications specification and utilize the SunSpec Logger Protocol. This protocol, which defines communications between the PV plant and the monitoring and management system (which may be installed locally or remotely “in the cloud”), ensures that PV Plants may be monitored and controlled by SunSpec-compliant monitoring and management systems.

Significant attributes of this specification include the utilization of standard Internet protocols (HTTP, TCP/IP), communication ports (80, 443), and data encryption.

PV Plant Monitoring and Management

PV Plant Monitoring and Management software must be certified to interoperate with SunSpec-compliant PV Plant Data Acquisition and Control equipment communicating via the SunSpec Logger Protocol. For a current list of companies supporting these specifications, visit www.sunspec.org/members.

About SunSpec Alliance

The SunSpec Alliance is a federation of solar PV industry participants, united to establish information standards for solar power plants. SunSpec standards address all of the major sub-systems and operational aspects of any residential, commercial, and utility-scale PV system, thus reducing cost and risk, promoting innovation, and accelerating the growth of the industry. Over 60 organizations, including global leaders from Asia, Europe, and North America, are members of the SunSpec Alliance. Membership in the SunSpec Alliance is open to corporations, non-profits, and individuals. For more information about the SunSpec Alliance, or to download SunSpec specifications at no charge, please visit www.sunspec.org.

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