

A Solar Power Shift – Andalay AC

Revolutionizing Rooftop Solar Installations

An Andalay Solar Whitepaper

Introduction

Today's rooftop solar power industry reflects a three-way dance between consumers, government and, of course, the solar industry. Consumers bring interest: interest in reducing energy costs, reducing dependence on foreign oil, reducing their carbon footprints, and doing the right thing for the environment. Government brings incentives for investment: incentives such as tax credits and rebates that are helping to reduce a consumer's costs to go solar by as much as 50%. And what does the solar industry bring?

The solar industry, at its best, delivers innovations: innovations that make it easier, faster and more cost effective for installers to put high-efficiency, high-reliability solar systems on rooftops. In 2007, Andalay Solar delivered such an innovation with its award-winning Andalay integrated solar power system. Built from real-world experience and based on thousands of installations, Andalay Solar took a giant first step towards enabling true plug-and-play solar installations. This first release of the Andalay system comprised 70% fewer parts than conventional rooftop systems, slimmer more attractive and higher performing panels, integrated electrical cabling, and mounting requiring far fewer roof penetrations.

Yet, for all its advances, the initial Andalay system was just the beginning. The solar community still awaited an innovation that would bring the industry in line with increasing consumer demand and growing government incentives. That wait is now over.

This paper introduces Andalay AC, the first fully plug-and-play AC solar power system. It discusses how Andalay AC is the only rooftop system to take advantage of mainstream home AC electrical wiring standards, doing away with the need to work with dangerous DC circuits and resulting in faster, safer, more profitable installations with reduced engineering, inventory, supply chain and training requirements. And it examines how the innovations encompassed in Andalay AC not only revolutionize the way solar installation companies can do business, but also how consumers can benefit from the full promise of rooftop energy generation.

1. Andalay AC – Anatomy of the First True Plug-and-Play AC Solar Power System

If there were a trifecta for solar integration and installation companies, it would be the ability to offer a solar power system that enabled them to:

1. Slash installation costs from their current average \$2 per watt to less than \$1
2. Substantially shrink design, engineering, inventory, logistics and back office ordering costs
3. Deliver to consumers a more reliable, attractive and higher performing rooftop system with a faster Return on Investment (ROI)

Andalay AC is *that* system.

New Andalay AC solar panel

The heart, skeleton and nerve system of Andalay AC is the new Andalay AC integrated solar panel, which incorporates all key components of the system. As with previous Andalay panels, the aluminum racking for the system is incorporated right into the

frames of the panels themselves, so that they can be attached directly to the roof. Two stainless steel splices connect the panels rigidly together at the top and bottom, and provide a UL approved grounding path. The wiring is better protected, flush to the panel and has a stronger connection than ordinary solar panels.

What is entirely new in the Andalay AC panel – and a first for the solar industry – is that micro-inverters are built into the back of every panel, providing safe and reliable 240 volt AC output with panel-level monitoring. This represents a fundamental shift from the current practice of wiring DC circuits from a string of conventional panels to a central inverter. Instead, power conversion takes place at the point of production (the panel), resulting in advantages that are far reaching and, in many cases, game changing.

2. Advantages for Solar Installers

Andalay AC can eliminate up to 50% of a solar installer's design, engineering, purchasing, parts, logistics, and rooftop installation costs - leading to improved cash flow and much higher profits. For example:

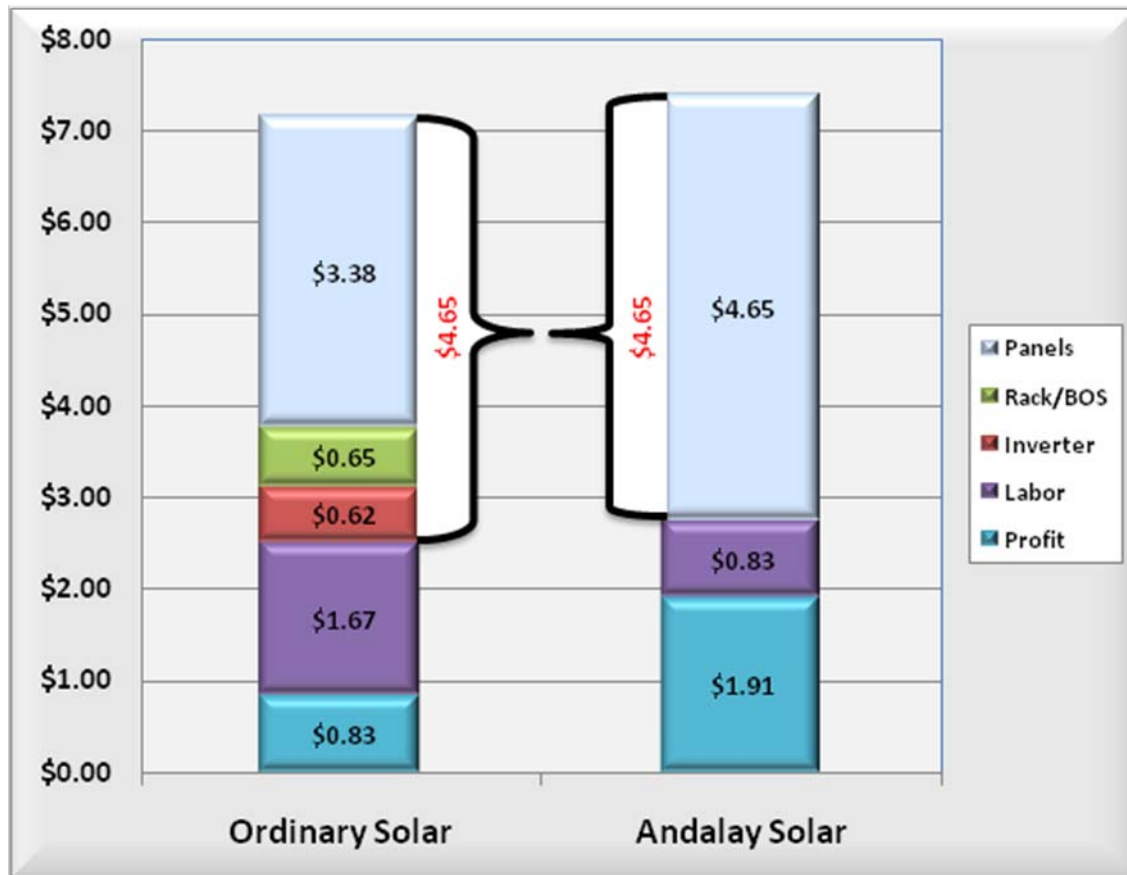
- **Design and engineering work is minimal** on an Andalay AC installation, essentially consisting of determining how many panels will fit area-wise on the roof, and making sure that the AC wiring is properly sized. Andalay AC panels can be successfully installed anyplace on a roof where there is sun, and even in places where there is partial shade, as discussed below. And they can be installed in multiple dissimilar orientations as part of the same system, to accommodate roof irregularities (such as vents) that would send designers of ordinary systems back to the drawing board.
- **Purchasing and parts costs are reduced** as there are 80% fewer parts than with an ordinary system (see figure 1), and they can all be ordered with just three part numbers. Administrative costs drop and there are fewer parts to inventory and account for.
- **Installation costs are dramatically slashed** because, with fewer parts, no external racking, fewer roof penetrations, no external wiring or grounding, and no DC connections of any kind to worry over (with their attendant danger, string sizing, temperature coefficient calculations and potential under/over voltage problems), Andalay AC installations proceed quickly, safely and easily. *In fact, a complete 3 kilowatt system can be installed successfully in a less than a normal workday.*
- **Logistics are improved** as Andalay AC panels arrive “small van-ready” 4 or 13 in a crate, without requiring un-boxing and consequent cardboard recycling. Everything required for installation is included, other than normal hand tools, homerun wiring and a circuit breaker.

- **Training costs are reduced** as installers need less than a day to learn all that's required to successfully mount, connect and wire Andalay AC panels. With self-grounding and with DC power removed from the equation, there is less risk of unsatisfactory electrical and building inspections along with their attendant hassles and costs. Aside from being intrinsically safer, AC power and its standards are well understood by building inspectors and universally approved by local jurisdictions.



(Figure 1) Andalay AC versus ordinary DC solar materials

The combination of these efficiencies can eliminate up to 50% of a solar installer's design, engineering, purchasing, parts, logistics, and rooftop installation costs - leading to improved cash flow and much higher profits (figure 2).



(Figure 2) Andalay Economics

Yet cost savings, no matter how compelling, do not represent the complete Andalay AC picture.

With Andalay AC, solar installation companies can offer consumers a truly differentiated product. This Andalay AC advantage helps installation companies increase profits through increased market share and the wide range of performance, aesthetic and reliability advantages not possible with ordinary solar systems. And the less time installers spend on the roof, the more time they can spend actually selling to customers.

3. Advantages for Consumers

With a renewable power-friendly administration, strong government incentives, and growing concern over the environment and dependency on foreign oil, consumer interest in rooftop solar power generation has never been stronger. Andalay AC helps solar installation companies turn that consumer interest into full-fledged consumer demand by delivering such advantages as:

- **Superior performance and thus a faster time-to-ROI** over any conventional rooftop solar system. Andalay AC is innately capable of generating 5% more energy on a per watt basis, and up to 25% more energy in situations where there is significant shading. This is a function of putting solar conversion on each panel. With conversion at the point of collection, every watt of output is

maximized for every panel because you have removed the potential for energy loss that comes with wiring separate circuits from a string of conventional panels to a central inverter. This decentralization provides further advantages as well. For instance, if one panel should become partially shaded, only the output from that specific panel is affected – an entire string of panels won't be shut down as is the case with ordinary systems. And if a problem develops with a panel, that panel is simply bypassed and the rest of the panels function at full output. Moreover, system degradation due to panel mismatch is a thing of the past. Most ordinary panels have a plus or minus 5% tolerance and the output of an entire string of panels is reduced by the output of its weakest member. But with Andalay AC, consumers enjoy full rated output from every panel in the system.

- **Improved reliability** due to fewer parts, integrated wiring and grounding, and decentralized power conversion. Centralized inverters common to ordinary solar systems are a notorious weak link, and should the central inverter falter or fail, the system goes down. Most inverters are guaranteed for only 10 years. The high-reliability micro-inverters built into Andalay AC panels are guaranteed for 15 years. And if one fails, the rest of the panels in the system continue generating power. Additionally, the racking integrated into each panel eliminates the risk of clips or bolts loosening over time due to wind and temperature fluctuations. And the built in wiring and grounding reduces the risk of wires shorting out or grounding lugs corroding.
- **Award-winning design** attracts customers. Resembling sleek, designer skylights, all-black Andalay AC panels hug the roof, mount close together, and display a continuous and pleasing visual appearance without visually jarring seams between panels and protruding racking or wiring. Unlike clashing, ordinary solar systems, home owners can proudly show off their attractive solar panels. Additionally, there is no need to mount an unattractive central inverter on the side of the house, as everything is integrated into the panels themselves.

Naturally, when consumers are happy and their numbers are growing, the industry is happy and growing. And Andalay AC drives numerous benefits for the solar industry at large.

4. Benefits for the solar industry

The entities at the end point of the solar value-chain, the solar installation companies and their consumers, have been waiting for a fully plug-and-play rooftop solar solution. We have outlined how Andalay AC meets this need and brings unique benefits to these parties. Yet it is also important to examine how Andalay AC benefits the solar industry as a whole, in terms of safety, reputation and capacity for profitable growth. For example, Andalay AC drives:

- **Visibility and accountability** through built in monitoring capabilities. Each micro-inverter possess it own IP address, thus allowing its power and energy output to be monitored via an optional gateway that a consumer simply plugs into a normal AC wall socket in the house. Communications from the panel to the gateway is done over the house's AC wiring using power line carrier signals.

There is no need to be a techno-wizard – this capability is as plug-and-play the rest of Andalay AC. Remote Internet monitoring is also available. Consequently, with no special effort, consumers can see exactly what they are getting for their investment, and installers can be fully accountable for their work.

- **Enhanced safety** through leveraging AC power. AC systems are inherently safer than ordinary DC systems. Andalay AC panels operate at a lower voltage than ordinary DC based systems. Further, they automatically shut down if the power grid fails. And with the breaker in the service panel off, there is no dangerous, live voltage on the roof – meaning shutting power off to the building, in the event of a fire for example, removes the risks of high voltage DC shock.
- **Expanded growth headroom** via easier to design and install solar systems. As demand for rooftop solar continues to ramp, the industry will have to respond ever more efficiently. The entities that cannot will be left behind. The design and installation education required for an AC system is considerable less than an ordinary DC system. Hence, Andalay AC will result in more qualified, rooftop-ready personnel available to more profitably meet mounting consumer demand.

5. Looking ahead – a solar power shift yields a solar power-play

Andalay AC provides so many strong benefits now that it can be easy to see it as a kind of end point. But it really is an important and powerful point along a continuum. The holy grail of solar installation is to total installation costs below \$1 per kilowatt. In the hands of a savvy installation company, Andalay AC, with its unique plug-and-play solar system model, brings us closer to that goal. Future advances in the Andalay AC system may help take these costs even lower. In this light, Andalay AC is much more than a competitive advantage – it is a competitive necessity as the market demands simpler, safer, more efficient and more productive paths to solar power.

For more information on Andalay AC, contact Andalay Solar at 888.395.2248 or visit www.AndalaySolar.com