

# Cool Vendors in Solar Energy, 2012

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Innovation in the solar energy industry is focused on cost reduction. We highlight four vendors working to improve photovoltaic solar cell efficiency and inverter design.

## Key Findings

- Despite extremely difficult market conditions in the photovoltaic (PV) industry, there remains a high level of innovation focused on driving down the cost of solar energy. While the level of venture funding has slowed, solar companies with practical solutions and sound business plans are able to attract investors.
- The rapid decline in the price of solar panels during the past two years has drawn attention to opportunities for cost reduction in the installation process and balance of system components. Inverters have become a target for improvements in efficiency, reliability and cost reduction.
- Improving the energy conversion efficiency of solar cells can be an effective cost reduction strategy, but only if increases in manufacturing complexity and cost are kept to a minimum.

## Recommendations

- Solar energy project developers and installers should evaluate these solar panel and inverter vendors for the cost reduction potential of their products when they become available.
- Established solar panel and inverter vendors should monitor the development of these technologies for their potential to have a disruptive impact on the market and consider the possibility of partnering with or acquiring these vendors.

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## Analysis

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### What You Need to Know

The PV solar energy industry is currently in a period of consolidation and rationalization of production capacity, following several years of rapid growth and excessive capital investment. While the long-term outlook for solar energy remains favorable, the near-term view is characterized by uncertainty over the future of government subsidies for renewable energy and severe margin pressures for manufacturers throughout the PV supply chain. In this difficult environment, opportunities remain for companies to develop products and technologies aimed at driving down the cost of solar energy.

The installed cost of a PV solar electric system can vary widely, depending on size, configuration, location and installation type (residential, commercial or utility). At the low end of the cost spectrum are large-scale utility systems that can be built for as little as \$2.50 per watt or less. With high-volume prices for solar panels sinking below \$1 per watt, due in large part to the influx of low-cost Chinese manufacturers, the greatest opportunities for cost reduction now lie in the other components of the PV system, such as inverters, and in streamlining the installation process. Solar inverters and power conversion electronics also represent a key element in the integration of distributed PV generation systems into the smart grid.

In this report, we highlight four vendors whose innovations could have a disruptive impact on the PV solar industry by dramatically reducing the cost of solar-generated electricity. Two of these vendors are focusing their efforts on PV cell technology to develop solar cells that convert more of the sun's energy into usable electricity while keeping the cost of manufacturing low. The other two vendors are innovating in the area of power conversion, creating new ways of converting the DC output of a solar panel into grid-quality AC power with lower energy losses and at lower cost.

### Alta Devices

Santa Clara, California ([www.altadevices.com](http://www.altadevices.com))

*Analysis by James Hines*

**Why Cool:** Alta Devices is a well-funded startup company that is developing a process for producing high-efficiency PV solar cells at a competitive cost. Increasing the efficiency of solar cells

is important because it can lead to higher energy production for a given system cost, lowering the overall cost of solar energy generation. Alta Devices has demonstrated a PV cell efficiency of 28.8% and a solar panel with an efficiency of 23.5%, both of which have been verified by the National Renewable Energy Laboratory (NREL). By comparison, solar panels made with the widely used crystalline silicon technology have efficiencies of 15% to 20%. Alta intends to close the gap between cell and module efficiency to bring modules of greater than 25% efficiency to market.

Producing a higher-efficiency solar panel is not enough; it must be done at a competitive cost if it is to be a successful product. Alta Devices has achieved these efficiency gains by using gallium arsenide (GaAs), a material known to have high intrinsic photoelectric efficiency and to perform well in high-temperature and low-light conditions, but one that has historically been quite expensive. Alta Devices has developed a manufacturing technique that exploits the high efficiency of GaAs-based PV cells while minimizing the amount of material used. The company uses an epitaxial liftoff process that enables PV cells to be made from thin layers of GaAs that are about one micron thick. The very thin solar cells produced by this process are flexible, which could prove beneficial in building integrated PV (BIPV) and other specialized PV applications. With high-energy density in a lightweight and flexible package, Alta's technology has the potential to address a wide range of applications, ranging from aerospace and military to BIPV and utility-scale solar power generation.

**Challenges:** Alta Devices is commercializing its technology at a difficult time in the PV industry. Uncertainty over the future of government incentives in key solar markets and a collapse in prices for solar panels are leading to an industry shakeout. The company is currently building out a pilot manufacturing line, and it will have to be very careful to scale up production at pace with demand to avoid becoming overextended. In addition, Alta Devices must prove its bankability to solar energy project financiers, establishing a track record of product performance and support that will take time to develop. Alta Devices should be aiming at a volume price target of 50 cents or less per watt to have a value proposition that is compelling enough to overcome these barriers.

**Who Should Care:** Solar energy system developers could benefit from the improved energy production and lower cost per kilowatt-hour of Alta Device's solar panels, when they become available. Established solar panel vendors should monitor the progress of Alta Devices as a potentially disruptive market entrant and as a possible acquisition target.

## Array Power

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Sunnyvale, California ([www.arraypower.com](http://www.arraypower.com))

*Analysis by James Hines*

**Why Cool:** Array Power has a new take on the problem of converting the DC power output of a PV solar panel to AC power that can be connected to the grid. Rather than relying on a separate inverter to perform the power conversion function, the founders of Array Power saw the entire PV system, the array of solar panels, as a power conversion device. Array Power has developed an approach that distributes the inverter function across all of the panels in a system. The heart of the Array Power solution is a sequenced inverter that is integrated into the solar panel to produce an AC power output for each panel in a PV system. High-frequency, amplitude-modulated current pulses

synchronize with the frequency of the grid and are sequenced by time-shifting the output of each panel relative to one another to synthesize grid-quality, three-phase power at 208 volts.

Array Power's sequenced inverter DC-to-AC power conversion results in a simple, flexible architecture that produces high-quality AC power from a PV array. The company claims its sequenced inverter system is cost-competitive with conventional string inverters, and it offers several potential advantages. Because it is integrated with the solar panel, it replaces the junction box, resulting in reduced parts count and a simplified installation process. Less energy storage is required for operation of the sequenced inverter, eliminating the need for capacitors, a primary point of failure in conventional inverters. And the parallel architecture results in greater system design flexibility and tolerance of shading and panel mismatch.

**Challenges:** Array Power faces the same challenge that many startup companies in the solar industry face: It is difficult to convince project developers and financiers to take a chance on a new technology or an unconventional approach to energy generation. By partnering with solar panel manufacturers, Array Power is mitigating some of this risk, but it is likely to encounter resistance from buyers who are wary of adopting such a radically different power conversion system. To adequately communicate its competitive advantage, Array Power will need to shift the discussion of price to the levelized cost of electricity (LCOE) over the life of a PV system.

**Who Should Care:** Solar panel manufacturers should evaluate Array Power as a potential partner to develop an integrated AC panel with significant potential advantages in installation cost, reliability and design flexibility. Conventional string inverter and microinverter vendors should watch Array Power's development as it represents a potentially disruptive technology.

## Ideal Power Converters

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Austin, Texas ([www.idealpowerconverters.com](http://www.idealpowerconverters.com))

*Analysis by James Hines*

**Why Cool:** Ideal Power Converters (IPC) has developed an innovative solar power inverter topology that results in 90% lower size and weight, higher efficiency, and lower cost than conventional designs. The smaller size of the inverter results in lower installation costs and less space required for a given power capacity. As solar panel prices have fallen, the cost of the inverter, balance of system components and installation labor have become a larger proportion of overall system cost, so technologies aimed at reducing these costs have become more important. IPC claims that its product saves 10 to 20 cents per watt in shipping and installation costs due to its small size and light weight. The company plans to price its product comparably with conventional inverters and differentiate itself on the basis of this lower shipping and installation cost.

IPC's innovation is its patented current-modulation topology, which uses commodity materials with a new approach to the power flow. This design employs indirect power transfer rather than the direct power transfer method of conventional inverters, and internal energy storage during the power conversion process is accomplished by a high-frequency AC inductor instead of large DC capacitors. In addition, the inverter provides isolation without the bulk and weight of the

transformer. This compact, high-efficiency inverter design has the potential to dramatically reduce the overall cost of energy produced by PV solar electric systems in which it is installed.

**Challenges:** IPC is still a relatively small operation, and it is entering the PV market at a challenging time. The company will need to remain highly focused on execution and avoid spreading its limited resources too broadly across multiple market opportunities. Like the other innovative startups we have highlighted in this report, IPC faces the challenge of proving its bankability to solar energy project financiers who are risk-averse and wary of taking chances on new technologies. Due to the unconventional nature of its approach, Ideal Power Converters will need to hit a volume price target that is below that of comparable inverters from established suppliers.

**Who Should Care:** PV project developers and installers will be very interested in the IPC inverter when it is available. The compact size and low mass of this inverter will have significant benefits to PV system installers. Conventional inverter manufacturers will want to monitor the progress of this development and may need to adjust their marketing strategies, particularly in the midsize commercial segment of the PV market.

## Suniva

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Norcross, Georgia ([www.suniva.com](http://www.suniva.com))

*Analysis by Alfonso Velosa*

**Why Cool:** Suniva is an American solar cell and solar module manufacturer that develops high-efficiency crystalline silicon PV cells. The company has 19% efficiency cells in production now, with a road map to reach over 22% by 2014. It also has modules that are over 16% efficient in production, enabling Suniva to produce modules with an energy generation capacity of up to 315 watts. The company's U.S. manufacturing plant, capable of making cells with an energy generation capacity of 170 megawatts (MW) per year, makes it compliant with "Buy American" rules, should they be implemented in the United States. The firm won a "showcase" project to power Marine One Hanger, in Quantico, Virginia. It also supplied one of the first grid-connected projects in India, a 3 MW solar power plant project near Bangalore.

Suniva achieves its high PV cell efficiency via a strong IP and patent portfolio and a novel manufacturing process. It started with early work at the University Center for Excellence in Photovoltaics (UCEP) at Georgia Tech to produce high-efficiency cells in the laboratory — simultaneously diffused, textured, in situ oxide AR-coated (STAR) cells. The company has since improved the process using ion implantation, thermal annealing and in situ oxide passivation to lower device cost. Its road map includes further process improvements, step reductions and back contact techniques to improve its PV cell energy conversion efficiency while lowering costs.

The company focuses on lowering its costs and managing its cash. This starts from managing its raw materials supplies to optimizing its manufacturing process to managing its contract manufacturing partners. The company also manages its technology improvements to avoid the high costs of the leading edge while still offering premium products.

**Challenges:** Suniva faces a dynamic PV market that presents it with multiple challenges. On the competitive front, there is excess supply in the market, with competitors that now have solar cell and module manufacturing capabilities in the gigawatt scale. These competitors have also leveraged their capabilities to integrate into project development or project financing. Most of these competitors have also invested strongly in technology and are rapidly increasing the efficiency of their products. On the customer side, incentive changes in key European markets have repercussions on a global basis, affecting pricing in all markets. In addition, the growth opportunities in the Chinese market favor local, low-cost suppliers.

**Who Should Care:** Solar energy system developers should evaluate Suniva's solar panels for their potential to deliver lower overall electricity cost. U.S.-based project developers can leverage Suniva's status as a domestic supplier in their marketing and in their sales work with government agencies. Residential solar installers may benefit from the higher-power density afforded by more-efficient panels. Established solar panel vendors should monitor Suniva's progress as a potential competitive threat.

## Recommended Reading

*Some documents may not be available as part of your current Gartner subscription.*

"Market Insight: Semiconductor Packaging Opportunities in Solar Panel Manufacturing"

"Forecast: Photovoltaic Solar Panels, Worldwide, 2011-2016, 1H12 Update"

"Market Share: Preliminary Top Five Photovoltaic Solar Panel Vendors, 2011"

"Predicts 2012: Photovoltaic Solar Energy Faces Slower Growth and Intensifying Competition"

"Emerging Technology Analysis: Distributed Power Electronics Enable Smart Solar Panels"

"Competitive Landscape: Photovoltaic Solar Power Inverters"

"Competitive Landscape: Photovoltaic Solar Modules, 2011"

"Hype Cycle for Solar Energy, 2011"

## Regional Headquarters

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