

## **SolarBridge Technologies Corporate Backgrounder**

### **MARKET OVERVIEW**

The solar industry is on a relentless drive toward grid parity — the point in time at which solar-generated electricity costs the same or less than utility-generated electricity. Many solar analysts predict that most major areas of the world will reach grid parity by 2015. As solar module pricing continues to decrease, balance of system (BOS) costs will represent an increasing portion of solar costs. As a result, pressure is mounting to produce lower cost, end-to-end solar energy solutions that are more reliable and simpler to use than existing systems.

The popularity of solar energy is growing, but it is still driven heavily by tax incentives in the U.S. and feed-in-tariff programs internationally. Utility-scale solar only addresses part of the world's growing energy needs. With significant environmental tradeoffs, utility-scale solar is capital-intensive and bankability is often a concern. Distributed, rooftop solar can be a significant piece of the renewable energy mix, particularly as module-integrated electronics such as microinverters enable the transition to lower cost, easy-to-use AC module solutions. In the next three years the market for residential and commercial rooftop PV is expected to be dominated by these types of solutions.

### **PROBLEM**

For solar energy to become truly mainstream, especially in smaller scale residential and commercial sites, the costs (both initial and ongoing) must come down and energy production must go up. Achieving this requires a more advanced system design that increases energy harvest, simplifies installation and improves system reliability.

In traditional rooftop solar PV installations, solar modules are connected together in series or strings, where power is transmitted from module-to-module until it reaches the central or string inverter. Unfortunately, when the performance of even one module is impaired, there is power loss along the entire string. The weakest module limits the energy production of the whole array.

When a central or string inverter experiences a performance issue, the performance of the entire system is compromised. Central inverters can only monitor performance at the system level, so problems with individual modules cannot be detected without sending a crew to inspect the roof. Additionally, central inverters pose a safety threat with high-voltage DC power (up to 600 volts) traveling across rooftops, which can lead to arc faults, the leading cause of PV fires.

A partial solution to these problems is the detached microinverter, which is mounted on the racking system beneath each solar module. Detached microinverters improve energy harvest, design flexibility and enable module-level monitoring. If one microinverter experiences a problem the others along the same string are unaffected.

But as detached units, microinverters available on the market today require separate installation, maintenance and management, which is an additional cost burden to the homeowner. Because of their location beneath each solar panel on the roof, microinverters must match or exceed the solar panel's lifetime to avoid costly replacements.

## **SOLUTION**

SolarBridge Technologies has developed an innovative microinverter and PV management system that is changing the economics of solar. The SolarBridge Pantheon™ microinverter is mounted directly on the solar panel to create an AC module. Designed for reliability, SolarBridge microinverters are backed by the industry's first 25-year warranty, enabling module manufacturers to offer the maximum end-to-end warranty on their modules. This directly reduces operating costs and system downtime by eliminating the need to replace inverters.

With AC modules enabled by SolarBridge, installation of rooftop PV systems is simplified because the microinverter is factory-installed on the module, eliminating the need for separate installation of a central inverter or detached microinverters. AC modules also do not require the same high-level installation skills as DC modules, opening up the market to general contractors, roofing companies and even do-it-yourself (DIY) homeowners.

## **TECHNOLOGY AT A GLANCE**

The SolarBridge AC Module System is a module-integrated microinverter and PV management solution that includes the following components:

- **SolarBridge Pantheon Microinverter:** a low-profile, DC to AC power conversion device mounted on the back of the PV module
  - Integrated onto a solar module by the module manufacturer
  - Backed by a 25-year warranty, matching most modules' warranties
  - Module-level maximum power point tracking (MPPT) improves energy harvest up to 25 percent with 95.5 percent peak efficiency
- **SolarBridge Power Manager:** the on-site communications gateway
  - Continuously monitors PV system
  - Outdoor-rated enclosure for flexible installation
  - Manages communications with the Power Portal and third-party systems
  - Smart grid-ready, open architecture
- **SolarBridge Power Portal:** a web-based management system for installers, module manufacturers and system owners
  - Provides detailed visibility into every site's performance
  - Non-proprietary architecture supports extensibility and integration
  - Easy to customize and install

The SolarBridge Pantheon was designed from the ground up with reliability in mind. Its unique architecture and patented electrical design requires a fraction of the capacitance of traditional inverter architectures, enabling the use of highly reliable film capacitors instead of failure-prone components such as electrolytic capacitors and optoisolators, which are common in other inverters. SolarBridge's innovative approach to thermal management keeps the Pantheon running at lower steady state temperatures, further enhancing reliability. The Pantheon undergoes a rigorous testing and qualification program—exceeding standard certification requirements to ensure it can withstand the same extreme operating conditions that a solar module endures.



As a result of its highly reliable architecture, the SolarBridge Pantheon is backed by a 25-year warranty and designed to last as long, or longer, than the module to which it is attached.

### **LOWERING THE COST OF SOLAR**

The SolarBridge AC Module System reduces the levelized cost of solar energy by as much as 30 percent in the following ways:

- **Lower upfront costs.** With plug-and-play AC modules, installation of a rooftop PV system is much simpler and less expensive. Installers are no longer constrained by string designs or the need to design systems into coplanar arrays. Because the SolarBridge Pantheon microinverter ships pre-installed, as part of an AC module, there is no need to install a central inverter or attach numerous microinverters to the racking system—a significant reduction in labor time and cost. And because the output from the module is AC, field personnel are not required to install components found in traditional systems such as DC circuit breakers and DC disconnect switches, further reducing costs and improving safety.
- **Lower operating costs.** SolarBridge Pantheon microinverters come with a standard 25-year warranty—and are covered by the same warranty as the PV modules to which they are attached. Central inverters and standalone microinverters typically come with a 5- to 15-year warranty, and the system owner will need to replace them once or twice during the life of a system. In addition, if a module fails in a traditional system utilizing a central inverter, it will need to be replaced with a module with the same mechanical and electrical characteristics. Module manufacturers can either perform costly rework on the failed module or stock their warehouses with a supply of modules from previous generations—a very costly solution. With AC modules, this issue is eliminated. Because the AC outputs from AC modules are paralleled, mixing module types and technologies is now possible. Current generation panels with the highest efficiency and lowest cost can be used to replace failed modules from a previous generation.

### **COMPETITIVE ADVANTAGE**

The SolarBridge Pantheon microinverter addresses a critical problem in distributed PV: the cost of solar adoption is still too high. A key targeted area for potential efficiency gains is the central inverter, typically the weakest link in terms of system reliability. In a DC-based PV system, central inverters are often replaced twice during the lifetime of a PV module, greatly increasing system lifetime costs. By definition, central inverters centralize the power conversion process so when a central inverter goes down, the whole system goes down. Similarly, the overall performance of a PV system can be compromised when a single module fails to perform.

SolarBridge's integrated microinverter provides higher reliability, easier installation and greater energy harvest, yielding a lower levelized cost of energy (LCOE) compared with other inverter solutions.

## **PRODUCT STATUS AND TIMELINE**

The SolarBridge Pantheon microinverter passed all tests required under the UL 1741 safety standard as certified by the Canadian Standards Association (CSA) in early 2011. SolarBridge is working with module manufacturers to develop integrated AC modules for the North American market, the first of which are now available.

The Pantheon microinverter is manufactured by global contract manufacturer Celestica in Dongguan, China, a center of materials and component suppliers for the power electronics industry. SolarBridge is rapidly increasing its production volume, which will enable the company to maximize supply chain efficiencies and aggressively reduce costs. In addition, SolarBridge is developing a second-generation design of its product that will further reduce unit costs and improve performance.

## **BUSINESS MODEL**

The initial market focus is on residential and small commercial sites. This model leverages the module manufacturers' existing manufacturing processes and established sales and distribution channels. The SolarBridge AC Module System differentiates module manufacturers' products with a complete AC offering and provides the opportunity for both module manufacturers and the solar installers they serve to increase revenue and capture greater margins.

## **MANAGEMENT TEAM**

### **Ron Van Dell**

#### **President and Chief Executive Officer**



With more than 30 years of experience, Ron Van Dell has an exceptional track record of success and proven leadership skills. Van Dell has overseen the development and launch of a ground-breaking microinverter solution, while raising \$46 million in funding. Before he joined SolarBridge, Van Dell served as president and CEO at Primarion, president and CEO at Legerity, general manager for Dell Computer's Dimension product line, and vice president-general manager of the Communication Products Business at Harris Semiconductor (now Intersil Corporation). He also held previous international management positions in the U.S. and in Europe at Groupe Schneider, Square D Company and General Electric. Van Dell graduated with a Bachelor of Science in Electrical Engineering, with honors, from Michigan Technological University and was a member of Eta Kappa Nu.

**Patrick Chapman, Ph.D.**

**Co-Founder, Chief Technology Officer and Vice President, Advanced Development**



Patrick Chapman leads product development for next-generation microinverters, plans the technology roadmap and manages the company's intellectual property. Before joining SolarBridge, Chapman was a tenured faculty member at the University of Illinois at Urbana-Champaign. His career at the university consisted of research, teaching, and professional service in the field of power electronics. Chapman holds a doctorate degree from Purdue University, and Bachelor of Science and Master of Science degrees from the University of Missouri-Rolla. As a senior member, Chapman is very active in the Institute of Electrical and Electronics

Engineers (IEEE) and was chairman of the IEEE Applied Power Electronics Conference in 2011.

**George B. Holmes**

**Vice President of Worldwide Sales**



George Holmes directs the company's worldwide sales and strategic partnerships. He has a record of success at organizations ranging from startups in rapid growth stages to multi-billion dollar companies. Previously Holmes was senior vice president of sales and marketing for PureEnergy Solutions in Boulder, Colo. He has served in strategic executive management and sales roles for companies including PowerCast, X1 Technologies, Agere Systems (formerly Lucent MicroElectronics), Ortel Corp. (acquired by Lucent), Level One Communications and Symmetricon. Holmes earned a bachelor of arts in business from the University of Puget

Sound and a diploma in international business from the Netherlands Graduate School of Business.

**Joe Lamoreux**

**Vice President of Engineering and Operations**



Joe Lamoreux is responsible for product/test engineering and volume manufacturing. His expertise in manufacturing readiness, global supply chain management and innovative product development enhances every aspect of the company's operations. Lamoreux was formerly CEO and vice president of operations at Coldwatt Inc., COO of Valence Technology, and has also held senior management positions at Dell, Compaq and IBM. He graduated magna cum laude with a Bachelor of Science in Mechanical Engineering from North Carolina State University.

**Judd Rabb, CPA**  
**Vice President of Finance and Chief Financial Officer**



Judd Rabb oversees the financial and administrative operations of SolarBridge, as well as leading future fundraising efforts. He has more than 20 years of comprehensive financial management experience, including mergers and acquisitions, treasury, controllership, strategic planning, fundraising, business development and financial analysis. He was formerly CFO and vice president of finance at Coldwatt (acquired by Flextronics), CFO and vice president of finance at Illumitex, Corporate Controller at Green Mountain Energy (acquired by NRG), and Corporate Controller at Silicon Laboratories, where he played an instrumental role in the company's initial public offering. Rabb began his career at PricewaterhouseCoopers. He has a Bachelor of Business Administration in Accounting from Texas A&M University. He was a founding member of the Private Company Financial Reporting Committee jointly sponsored by the Financial Accounting Standards Board and American Institute of Certified Accountants.

**Craig Lawrence**  
**Vice President of Marketing**



Craig Lawrence is responsible for strategic marketing, product management, product marketing and marketing communications. Prior to joining the company, Lawrence served in executive roles at SunEdison, a global leader in solar energy, including vice president of products and general manager of Sun Edison's Residential and Light Commercial Business Unit. Prior to SunEdison, Lawrence led the Energy Practice at IDEO, a global design and innovation firm providing product design, engineering and marketing services to leading renewable energy companies and utilities. Lawrence also led energy investing activities as a principal at Accel Partners, a top Silicon Valley venture capital firm. Lawrence holds a B.S. in Mechanical Engineering from The University of Texas at Austin, and an M.S. and Ph.D. in Mechanical Engineering from Stanford University.