Brainstorm: Renewable Energy

Shan Morgan, Sr. Vice President Sales & Marketing, Elma Electronic

Question: What type of innovation must take place to provide the ability to increase the efficiency of renewable energy while reducing its cost?

In regards to how the renewable energy market can become a more profitable business entity, we see it from a larger perspective than innovation at just the component, board or system level.

While product initiatives are still critical factors to the overall efficiency of renewable energy, industry and government must work together to create an environment where innovation can thrive to bring new technologies at the right efficiencies and costs.

Just as we have

by Doug Patterson, VP defense and aerospace business sector, Aitech Defense Systems

One of the major hindrances of renewable energy is the conversion of the source into a useable, cost-effective format of electricity. Although the sun and wind are 'free,' harnessing their power has traditionally not followed suit.

There is an exorbitant amount of power lost in the conversion from the wind turbine or the solar cell to the inverter unit and distributor that it

by Steve Grady, Vice President of Marketing, Cymbet

Three key areas of innovation increase the efficiencies of using renewable energy sources while making the economics of these solutions viable. First, an energy harvesting powered device must be maintenance free for the life of the device to realize high return on investment. The energy storage device used in the design must last the life of the system. New life-of-product rechargeable batteries are the best solution, given 10 to 20 year operational life

by Paul Kierstead, Director of Marketing at Cree

When examining the solar market we find most power inverter companies are claiming to achieve up to 98% efficiency in existing designs or have plans to introduce products with this level of efficiency in the near future. It is extremely challenging to get significant efficiency improvements without adding considerable cost. However, a recent innovation introduced by Cree this year –– the industry's first commercially available Silicon

NASA and DARPA to work on pure research projects, we should create a government funded think tank for energy research projects. The results of those research projects would then be made available back to the market and industry at large that can then develop innovative products, which can be applied to the creation of new energy solutions.

Without the existence of NASA, we would not have the scientific and practical innovations such as Velcro and memory foam; without DARPA, we would not have the internet. These same principles of innovation should be applied to renewable energy resources.

Rather than the government funding individual companies within specific industry segments, such as solar or wind only, have it fund the independent research to develop the technologies that allow the market to implement innovative products and solutions.

almost makes these unlimited resources a counter productive source of energy.

Bringing the embedded electronics, which convert the energy to grid AC, closer to the source itself is one innovation that could greatly impact the efficiencies of renewable energy. This can be done through small, ruggedized sub-systems that contain many of the conversion electronics traditionally housed closer to the energy distribution point. A self-contained control unit with environmentally-sealed connectors, like the NightHawk ICU, could withstand harsh weather conditions that may have forced engineers to place electronics farther from the generation source.

Once energy is more efficient, costs will go down. These are the innovations that renewable energy needs in order to make better inroads into the consumer and business markets.

requirements.

The second is high efficiency energy harvesting transducers and power chain energy conversion, energy storage and power management electronics. For small devices, every joule counts. Innovations have been introduced in the area of Maximum Peak Power Tracking electronics that optimize the power output of energy harvesting transducers. High efficiency MPPT-based energy harvesters only operate when the EH transducer conditions change. This reduces overall power use. MPPT energy harvesters are also intelligent devices that operate as a smart power layer.

The final key is “energy aware” design. In order to implement, the state of input power, state of battery charge and all system operational states must be known and actively managed. New smart power layer electronics

Carbide MOSFET (Z-Fet) –- promises to increase efficiency while boosting the overall system ROI.

Although Cree’s 1200V Z-Fet MOSFET carries a higher device cost when compared to the existing silicon IGBT devices it is meant to replace in the inverter stage, the overall system costs may be reduced when implementing silicon carbide power devices by improving the overall energy efficiency; or by increasing switching frequencies and delivering cost benefits from the reduction of size, weight and cost of associated magnetic components. According to published work by a prestigious research institute, a 7.5kVA 3-phase solar power inverter design using a SiC Z-Fet MOSFET together with SiC Schottky “free-wheeling” diodes has resulted in a documented efficiency of 99%.

SiC has been demonstrated to be a better power semiconductor than

		coupled with energy aware based Microcontroller firmware and low power wireless protocols provide optimal system operation. An example is the IPV6 Wireless Sensor network demonstrated by Dust Networks and Cymbet. All of the wireless nodes in the network, including the IPV6 routing nodes, ran on either thermal or solar energy harvested power. Optimizing power efficiency using energy aware design is a key driver in reducing both the first cost of the system components and the overall life cycle costs of system operation.	Silicon (Si) due to its much higher electric field breakdown capability (almost 10x higher), higher thermal conductivity, and higher temperature operation capability (wide electronic band gap). The performance and increased reliability of the SiC Z-Rec diodes and the new SiC Z-FET MOSFET have made them market successes. The question in adopting an “all SiC solution” for the inverter stage then quickly becomes one of system ROI (Return on Investment) to overcome the increase in component cost. In other words, at what point does the customer achieve the ROI for the ~1% efficiency improvement? Part of this ROI equation involves the increase in overall system reliability provided by the use of SiC components, as indicated by reliability data from customers who have designed SiC devices into their systems. As with any leading-

edge technology, the cost of SiC MOSFET is expected to continually come down over time, as yields increase with process improvements and future designs iterations shrink the size of the device. In addition, Cree's ability to leverage material costs reductions from its high-volume LED lighting divisions will further bend this cost curve. For example, the anticipated move to 150mm wafers will double the number die per wafer. If the relative cost reduction achieved since the introduction of the SiC Z-Rec diode 10 years ago is any indication, cost reductions of 60% are likely to be achieved. We expect similar cost reductions over time for SiC MOSFETs. Adoption of new SiC devices for power electronics will clearly increase over older silicon; and as the SiC cost comes down, the cost of copper, shipping and system installation will continue to go up.

Posted by Janine E. Mooney, Associate Editor

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