# What's the Next Big Thing in Alternative Energy?

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Microgrids and distributed energy resources (DERs) are the next big thing in alternative energy; the question is how they will interact with our current system. The electricity grid is evolving, with a trend away from the traditional centralized grid and toward a more distributed grid utilizing local sources of electricity generation, resulting in more and more microgrids that utilize distributed energy resources. DERs include electricity generation sources like solar PV, electricity storage like batteries, and other resources such as smart thermostats and appliances. It's clear that DERs are becoming more common, but there is an open question about they will be incorporated with our current electrical grid system.

In *The Economics of Load Defection*, a recent report by my colleagues at Rocky Mountain Institute, two possible forward paths are outlined in regard to DERs. One path leads to grid defection, where customers disconnect from the grid and small-scale solar, storage, and other DERs are used to meet only local electricity needs. This results in an overbuilt system with excess sunk capital and stranded assets, both at the local level (installing more generation capacity than we collectively need) and at a larger scale (not utilizing the existing electricity grid infrastructure). Alternatively, the other path leads to a more integrated grid, where DERs are used in a connected, optimized way with the existing grid. In this case, DERs contribute value and services to the grid and to individual homes and businesses, just like traditional generators and other assets.

Microgrids and DERs will surely be a crucial part of our future electricity system. Decisions that we make in the near future around pricing and rate reform, new business models, and new regulatory models will help determine whether we move towards increased grid defection and separation, or instead towards a more integrated grid.

### Sol Jacobs, Tadiran Batteries

Everything around us is becoming smaller and more interconnected. Remote wireless devices powered by alternative energy are becoming increasingly feature-rich yet miniaturized, with increased product functionality being packed into smaller form factors. Meanwhile, extended battery life is an ever growing requirement. Efforts to minimize power consumption of the microcontroller and integrated peripherals can only go so far towards achieving these inherently contradictory goals, especially for devices that rely upon two-way communications. The ideal answer must also involve the right choice of power supply: a solution that delivers the normal background current required during periods of inactivity (the dormant mode), along with the high pulses needed to initiate data queries and wireless communications. Design engineers typically have two choices for storing the harvested energy: supercapacitors and rechargeable Lithium-ion (Li-ion) batteries. Of these alternatives, Li-ion batteries are better designed to support product miniaturization, as supercapacitors require bulky circuitry while delivering a lower temperature range and higher annual self-discharge rate. Also, multiple supercapacitors utilized in series require balancing circuits. Meanwhile, the recent introduction of an industrial grade Li-ion battery offers a valuable alternative to consumer grade rechargeable batteries, as these ruggedized batteries can deliver up to 20-year operating life, 5,000 full recharge cycles, and an extended temperature range. Enhanced rechargeable Li-ion battery technology will continue to play a role in supporting product innovation, as futuristic solutions using nanomaterials are still years away from commercial development.

## Sagar Jethani, Head of Content, element14

We're always looking for a better energy source to power our portable electronics. Rechargeable batteries have been a recommended solution for years and experiments with lithium batteries have been the most successful to date. Highly reactive chemicals within Li-ion containers, however, can overheat and even catch fire. Something better is needed.

Researchers have produced a new lithium battery that combats the overheating hazard while increasing energy output levels. A research team from Stanford University has made new advances by using lithium as both the cathode and the anode. These pure lithium batteries could more than triple the energy yield of traditional batteries and be sold at a lower cost.

With improved performance metrics, these batteries have the potential to make a large impact on multiple industries, including electric cars. Battery life is a major issue preventing the advent of electric cars and is often the determining factor for consumers considering a purchase. Not only would pure lithium batteries increase the range of battery life for these vehicles, they could also significantly decrease the price point. If this new battery composition can be standardized into a manufacturing process for commercial use, it could greatly improve user satisfaction with portable electronics.

## Marcelo Schupbach, Ph.D., Technical Marketing Manager, Cree Inc.

SiC MOSFET-based inverters, which deliver a quantum improvement in power density, along with higher efficiency and improved performance, are the next big thing in alternative energy. SiC MOSFET inverter technology is poised to significantly reduce both the installation and operating costs for new PV installations, and will subsequently lower the cost of the energy that such installations produce, which is likely to improve the global rate of adoption for solar energy.

Silicon carbide (SiC) MOSFETs have the potential to further advance inverter performance gains. Replacing the silicon (Si) IGBTs used in conventional string solar inverter designs with SiC MOSFETs offers several benefits. A SiC MOSFET-based topology enables smaller and lower cost inverters with significant efficiency improvements. For example, a 50kW string solar inverter using SiC MOSFETs and SiC Schottky diodes is approximately one-fifth the weight and volume of a comparably rated inverter designed with Si IGBTs. Additionally, the use of SiC devices reduces inverter losses by 40%, enabling an overall efficiency of 98.5%.

This dramatic improvement in weight, volume, and performance is due to the fundamental advantages of SiC device technology. SiC MOSFETs have significantly lower (6–10x) switching losses than Si IGBTs and switch at much higher frequencies with minimal cooling demands. The recovery charge of SiC diodes is also negligible, virtually eliminating diode switching losses. Finally, the higher switching frequency of SiC devices reduces the overall size and weight of inverter components, including inductors and filtering capacitors. The increase in frequency also has a substantial compounding effect, enabling size, weight, and cost reductions for other components, such as enclosures, wiring, and mounting hardware. Although the cost of SiC MOSFETs is higher than Si IGBTs, a SiC-based inverter design effectively reduces the cost of other components (e.g., the enclosure, inductors, and heatsinks), enabling a 15% BOM reduction.

With higher power density and lower weight, SiC-based inverters deliver a 40% reduction of solar inverter installation costs, which are estimated to be as much as 5% of the total installation cost. Thus, a SiC-based string inverter capable of delivering this type of competitive cost savings will have a distinct advantage compared to traditional inverter designs.