Brainstorm: Do-it-Yourself-Power Page 2

Edited by Jason Lomberg

Moving forward, what technology will dominate energy harvesting?

Steve Bowling, Microchip Technology, www.microchip.com [1]

There are two trends that allow commercially viable energy harvesting for electronic systems. First, mechanisms for energy collection and storage must be available that are cost-effective, efficient and reliable. Second, the power consumption of the electronic system itself must be reduced, to minimize the costs of the energy collection and storage.

The method used to collect energy will depend heavily on the application, so I don’t think that there will be a dominant technology in this area. Systems can use motion, vibration, temperature, light, flow and electromagnetic waves as an energy source. There will be numerous tradeoffs to make when selecting the energy-collection device, to balance cost and performance.

Most energy-harvesting applications will need a method to store energy locally when the power source is unavailable. If the power consumption is low enough, batteries can be used to keep the application autonomous for many years before replacement is needed. Rechargeable batteries can be used for higher-power applications, but they have a limited number of charge cycles. Super-capacitors could be another choice, but the power management for these devices can be tricky. Thin-film battery technology is a newer alternative that builds the battery on a wafer, like a chip. The thin-film technology allows more charge cycles, higher temperature extremes and easier charge management than conventional rechargeable batteries.

Regardless of the methods used to capture and store energy, I think microcontrollers (MCUs) with low-power functions will be an integral piece of energy harvesting. The intelligence provided by the MCU allows the energy-harvesting application to consume very little average power. Most applications need to take actions on a relatively infrequent basis. These actions include reading sensor data, detecting user interaction and sending a message to a remote device. The MCU can power down most of its own circuitry and other external circuitry during the interim periods. The designer has the flexibility to choose what receives power and when, through the application software.

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Today's temporary drop in oil prices only gives a momentary pause in our need to find new sources of energy or to use those sources more efficiently. The use of non-renewable fuels - oil, gas, nuclear or other types of raw materials - as an energy source is known as energy conversion. These sources are in limited supply and hence will become more expensive to use as demand increases and time moves on.

Another method for obtaining energy other than from the use of raw materials is to extract useful energy directly from an energy source. Energy harvesting, or energy scavenging, is the process whereby a portion of energy is removed, captured and stored from an existing source. This energy can come from alternative sources such as solar, wind, tidal or all forms of kinetic energy including thermal energy.

For both energy conversion and energy harvesting methods, energy can be generated from fixed sources, such as power plants, solar farms and tidal areas; and mobile sources, such as automobiles, planes, and other forms of transportation. Traditionally, electrical power has been generated from fossil fuels in fixed, centralized plants. To replace these with alternative energy sources depends on their location. Solar, for instance, attracts great interest but is better suited to climates and latitudes that offer an abundance of sunshine. A similar story may be told for wind turbines which work very well in areas of constant and predictable wind. Of course these power sources do not offer an easy conversion for mobile applications for all climates and all latitudes.

Scavenging energy from thermal sources offers the best opportunity to generate power from both fixed and mobile sources. The use of thermoelectrics, in which a temperature difference creates an electric potential, can convert waste heat into usable electricity. For example, the heat from an exhaust stack at a manufacturing facility can directly power devices such as wireless sensors used for chemical analysis. Heat produced during combustion in an automobile engine can be harvested to charge the battery. Harvesting thermal energy can improve the overall efficiency of existing combustion-based devices such as gasoline powered automobiles or in the future, hydrogen burning fuel cells; both of which are or will be used as a source of energy production for mobile applications.

To some extent, all energy scavenging applications will find a place in energy generation, but none except for energy scavenging from thermal sources can be used for both fixed and mobile sources.

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History will remember 2009 as the year America awoke to realize it had to develop and invest in renewable energy. Coming off a year with dramatically unsettled oil prices, increased political instability in regions controlling America's energy, and the need to create jobs to combat the ailing economy, utility-scale renewable energy generation became a national priority. Industry leaders, the new administration, and the American people are set to work together to double the nation's renewable energy generation within the ambitious timeline of three years. A goal set forth by President Obama.

What form of energy production will meet America's insatiable demand for energy? The answer can be found rising in the east, every morning.

While solar power is traditionally viewed as -distributive photovoltaics, there's another technology, called Concentrating Solar Power (CSP) that has been reliably producing hundreds of megawatts of energy in the Mojave desert for over twenty years. CSP is about to undergo a renaissance.

In CSP utility-scale power plants, great arrays of mirrors focus sunlight on receivers, raising the heat transfer fluid within them to high temperatures that then superheats water to produce stem, which ultimately drives a standard steam turbine. Combined with thermal energy storage technology, these power plants can even work at night. Within the CSP supply-chain, there are no material bottlenecks. Once the power plants are permitted, construction of power plants that exceed 50MW can be achieved in approximately one year.

CSP, especially in the parabolic trough configuration, is a proven, highly efficient and scalable technology and improved components will further boost efficiency by allowing even higher temperatures.

The American Southwest offers the continual sunlight required to make utility scale generation practical, especially when coupled to a new green power superhighway capable of transmitting electricity to distant cities.

Powering America's future will take hard work, a bit of sweat, and concentration.

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