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# MEMS energy harvesting devices, great technology: For which markets?

**MEMS energy harvesting technology has been a hot topic in MEMS R&D for some years with spectacular developments driven by DARPA programs and among them the Hi-MEMS cyborg insects. European funded programs such as VIBES (2004-2007) have explored different energy scavenging architectures using MEMS technology targeting mostly wireless sensor networks. Despite several announces in the past two years, commercialization of such devices is still difficult as batteries are still the solution of choice in powering remote or nomadic systems.**

MEMS energy scavengers convert vibrations or thermal gradients into electrical current. The fact that vibrations and thermal gradients do not need to be supplied ensures potentially infinite sources of energy over time. The issue is, current energy scavenging rates are small. They are so small that they need to be associated to batteries or supercapacitors depending on the application they are used for. But if you need to have a secondary battery… then why have an energy harvester at all. Current batteries can work for up to 10 years and they are cheap(er).

## Typical case : Energy harvesting devices for tire pressure control

Tire Pressure Monitoring Systems (TPMS) market is one of the applications we have analyzed at Yole. At first sight, it looks like an ideal application for energy harvesting devices with 90 million sensors to be sold in 2008. Currently placed in the wheel rim and associated to the valve, the pressure sensors cannot be wired and are hence powered by batteries. But batteries do not behave well in harsh environments with high temperature gradients such as in tires. Besides, with this architecture, changing a dying 50 cents battery implies removing the tire, which in manpower only at the tire shop would cost more than the full system itself. Located on the wheel rim, a TPMS system should be able to survive the entire life of a car. A lot of work has been done in order to get energy harvesting devices replace the batteries. But this is a market only driven by regulation, with no differentiation factor seen by the customer. Which means that the market is only driven by costs… And currently, all foreseen solutions are more expensive than batteries.

An alternative architecture is to place the pressure sensor in the tire itself and combine it with more functions, which would be seen as a differentiator. A major obstacle would be the lack of communication standards between sensors and electronic control units (ECU). End users are not used to be locked to one tire brand which would be the case if they have to have the right sensors set communicating with the ECU. And this is difficult to overcome. And then, a tire lifetime is of about three years only… A thin film battery would do the job.

## Energy harvesters, numerous potential applications

At Yole Développement we have analyzed which drivers could lead to the adoption of energy harvesters in commercial applications. We have identified five major axis for using them in association or in replacement of batteries. We have focused on wireless sensors networks and MEMS solutions in different application fields from medical to military and from automotive to industrial applications, taking into account that these solutions are competing with micro fuel cells and microbatteries as well. The results will be available in a report on MEMS Energy Harvesting Devices markets to be published in January 2009. In parallel to this report, Yole Développement is initiating a yearly action on Palm Power devices covering MEMS and Fuel cells, to monitor these technologies and markets.

For more information on :

- MEMS Energy Harvesting Devices (January 2009), please contact David Jourdan (jourdan@yole.fr)
- Yearly action focus on Palm Power Devices, please contact Ridha Hamza (hamza@yole.fr) and Laurent Robin (robin@yole.fr)



**Overview of energy harvesting microtechnologies**