

## Welcome

Welcome to the first newsletter of the Metrology for Energy Harvesting project. After considerable support from industry funding began in September 2009. Since then we have got the research programme well underway, and have already increased awareness of the challenges we are tackling through presentations at industry-relevant events.

Information and feedback from industry is essential to ensure that we remain focused on the key challenges. We are therefore convening an advisory group with members from industry – if you would like to be involved or suggest a matter for consideration, please contact Prof Markys Cain, [markys.cain@npl.co.uk](mailto:markys.cain@npl.co.uk)

With society increasingly focusing on energy efficiency and growing numbers of energy harvesting products becoming available, we predict 2011 as the year that metrology comes to the forefront of the sector. It's an exciting challenge, and we're looking forward to it.

**Dr. Jürgen Melcher**  
Project Coordinator

[juergen.melcher@ptb.de](mailto:juergen.melcher@ptb.de)



---

“When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers... you have scarcely, in your thoughts, advanced it to the stage of science”

- Lord Kelvin,  
‘Electrical Units of Measurement’, PLA vol 1, 1883

---

The Metrology for Energy Harvesting project is a research collaboration that brings together Europe's world-leading expertise in measurement, energy harvesting and systems engineering. Partners include many of Europe's national measurement institutes.

Reliable and accurate measurement is essential for European industry to develop and exploit the large growth opportunities for energy harvesting (EH) technologies. Companies in construction, transport, automotive, mobile communication, and sensors and instrumentation are already exploring the potential of EH.

This project will help Europe to commercialise EH technologies by developing ‘traceable’ (can be traced back to national standards) measurement methods, enabling industry to directly compare different EH technologies such as thermoelectric and vibrational harvesting devices.

### Project details

**Aim** – To provide the metrological framework, technical capability, and scientific knowledge to enable the development of effective and commercially successful energy harvesting technologies.

**Project partners** – Seven of Europe's national measurement institutes:

- PTB, Germany
- NPL, UK
- LNE, France
- MIKES, Finland
- INRIM, Italy
- SIQ, Slovenia
- CMI, Czech Republic

**Duration** – Three years, from 1 Sept 2010 to 31 Aug 2013

We welcome suggestions for articles and features. Please send your ideas to Robin Wilkinson [robin@proofcommunication.com](mailto:robin@proofcommunication.com)

# Project news

Dr Alexandre Bounouh (LNE) presented the Metrology for Energy Harvesting project in the plenary session at the **French National Conference on Energy Harvesting and Storage for Autonomous Microsystems** in October 2010. The predominantly industrial audience were convinced of the need for metrology in order to successfully develop energy harvesting technologies and autonomous microsystems. Interest in the project was significant, with several delegates interested in collaborating. To find out more about the presentation see the conference proceedings.

Prof Markys Cain (NPL) opened the **1st Energy Harvesting Research Theme Workshop – Human Power**, in November 2010 with a presentation on the state of the art in human powering of devices. This workshop aimed to:

- Facilitate the definition of new research challenges of energy harvesting outside and inside the human body
- Catalyse the creation of multidisciplinary teams to address these challenges

Dr Alexandre Bounouh (LNE) gave a presentation on MEMS voltage references at IEEE-MEMS 2011 (23-27 January 2011), which attracted 600 attendees from academia and industry. He attended the conference to investigate the latest in energy harvesting based MEMS, particularly piezoelectric devices. He met representatives from IMTEK (Department of Microsystems Engineering, University of Freiburg) and Siemens AG who expressed interest in the project's research work on piezoelectric energy harvesting.

Dr Alexandre Cuenat (NPL) has a presentation slot to introduce the Metrology for Energy Harvesting project at the **Thermoelectric Energy Solutions Workshop**, to be held at the Institute of Physics, London on 6 April 2011. This event is of interest to both academics and industry representatives.

Energy harvesting will be on show to the public at this year's **Royal Society Summer Science Exhibition**, 5-10 July 2011. Laurie Winkless (NPL) will demonstrate the potential of energy harvesting technology using thermoelectric generators, peltiers and piezoelectric devices to show how energy 'lost' in our daily lives could be harvested and used.

# Upcoming events

## Energy Harvesting 2011

7 Feb 2011  
London, UK

## Piezo 2011

28 Feb - 2 Mar 2011  
Sestriere, Italy

## Powering Wireless Sensor Networks

29-31 Mar 2011  
Munich, Germany

## Thermoelectric Energy Solutions Workshop

6 Apr 2011  
London, UK

## Dielectrics 2011

13-14 Apr 2011  
Canterbury, UK

## Nanomaterials for Space (working title)

May 2011  
NPL, UK

## Energy Harvesting & Storage Europe 2011

21-22 Jun 2011  
Munich, Germany

## Wireless Sensor Networks & RTLS Summit Europe 2011

21-22 Jun 2011  
Munich, Germany

## Royal Society Summer Science Exhibition

5-10 Jul 2011  
London, UK

## Euromech Colloquium on Structural Control and Energy Harvesting

25-27 Jul 2011  
Bristol, UK

# View from industry:

## Dr Klaus Prume, Manager Piezoelectric Test Systems at aixACCT



*aixACCT provides electrical test systems for material development and device qualification for:*

- *Non volatile memory technologies (eg FeRAM, RRAM)*
- *MEMS (eg cantilevers, membranes)*
- *Actuator/ sensor applications (eg multilayer actuators, pressure sensors)*

*aixACCT helps customers reduce time to market and prove functionality of new products at an early stage of development by offering novel testing concepts and system solutions. aixACCT covers the whole product development chain, from material study to prototype testing and quality assurance during production. aixACCT has helped develop numerous products to market, including printers, car injection systems, and memory devices.*

### **What is the relevance of metrology for energy harvesting (EH) to aixACCT?**

At aixACCT we characterise new materials and devices for our customers – everything we do is based on accurate measurement. We're seeing a lot of interest in EH materials such as piezoelectric and thermoelectric ceramics. R&D into EH materials and devices is progressing and the sector must develop traceable measurement methodology to support it.

### **What do you see as the main metrology challenges to development of EH devices?**

Measurement of material properties is the first challenge, assessing and comparing the various

devices is the second. Essentially, we need to have the capability to both measure and compare materials and devices to exploit the potential of EH technology.

At present, there is a big variety of proposed EH devices, which are based on different concepts. We need a system capable of measuring the materials' characteristics, but also the efficiency and functionality of the designed device. Then we need to be able to compare across the concepts. This is crucial because to develop the most efficient and cost-effective devices we must be able to properly assess and compare the benefits and costs of different concepts.

### **What will successfully addressing these challenges mean for aixACCT?**

We're seeing growing interest not only from industry in EH devices and systems, but also from the EU and many research institutes. As the challenges are addressed and the sector grows we want to be ahead in the development stages, in prime position to help expand the European market.

### **Some products developed using energy harvesting technologies are already commercially available – what impact has the lack of a traceable metrology methodology had on such products?**

So far it has had a minor impact because there are two stages to developing a new technology and we are only now entering the second stage.

First is proof of concept. You must prove that the technology has advantages over the existing; if you do this then the technology will become successful. The commercial EH devices to date have helped establish that EH is a viable technology.

The second stage is expansion into the market. This is where traceable measurement is crucial, because you must be able to compare the efficiency of different devices and concepts in order to have widespread adoption of the new technology.

At present there is a variety of devices based on the new EH technology principles. Our customers – both for material and device characterisation – are starting to ask if we have traceable measurement and how they should get ‘reliable’ data. The market now needs standardised metrology methods before it can develop further.

### Where do you feel that European capability ranks in terms of developing innovative EH products?

There are lessons to be learned from the R&D into solar technology – Europe is world-leading in both research and commercialisation because there was strong support from the EC, although competition is now increasing in China, Malaysia and other countries in Asia.

In other areas of EH Europe is typically good at research into new materials and technology, but Japan and the US have the edge at developing products. We provide the information, eg on material properties, processing and reliability, but commercialisation happens somewhere else. Europe is not currently at the forefront of development, but with continued support we could be. This is why EC projects with a focus on the industry challenges such as Metrology for energy harvesting are so important; they are vital for Europe to obtain that leading edge for development.

### What do you feel are/will be the main benefits or potential of energy harvesting technologies?

The main benefit would be the replacement of batteries. There has been, and continues to be, a massive expansion in the number of electronic gadgets per person. All of these require energy, which is currently supplied by batteries. Batteries have disadvantages, particularly with regard to the environment. Using EH devices to replace batteries would have huge societal benefits. This view is reflected by the EU – development of alternatives to batteries is a key area of funding.

Another benefit would be the independence from power sockets and batteries – this will make certain applications easier. For example, condition monitoring of bridges, pipelines, or railroad tracks would be much easier with EH sensors, as there would be no need for regular site visits to replace batteries.



aixCMA – a temperature controlled characterisation system with dynamic electrical and mechanical excitation for piezoelectric multilayer devices

*We welcome feedback, opinion and suggested articles. Please send your comments to [markys.cain@npl.co.uk](mailto:markys.cain@npl.co.uk) and [robin@proofcommunication.com](mailto:robin@proofcommunication.com)*

*This project is funded by the EMRP and national metrology research programmes.*

**EMRP**  
European Metrology Research Programme  
Programme of EURAMET



The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union