



Energy Harvesting Committee (EHC) Minutes 20th Dec 2018 (SESSION RECORDED)

Attendees	Apologies/Non attendees	
Joe Horzepa, PSMA Francesco Carobolante, G2nd Systems Lorandt Foelkel, Würth Thomas Becker, NTA- ISNY Robert Andosca, AEI Marcus Taylor, Silent Sensors Maeve Duffy, NUIG Brian Zahnstecher, PowerRox Mike Hayes, Tyndall	Johan Pederson, Sigma Design Mike Wingard, Amphenol Roberto la Rosa, ST Katherine Kim, UNIST Chris Chen, Alta Anthony Laviano, NRAIT Henrik Zessin, Fraunhofer IIS Justin Knott, FCI Jae-Do Park, Univ of Colorado Denver Nathan Jackson, Univ of New Mexico Warren Wambsganss, Astronics Jeffrey Jouper, Astronics Seshank Malap, Tektronix Ben LeNail, Alta Devices Gary Johnson, Ilika Scott Thielman, Product Creation Studio Michalis Kiziroglou, Imperial College London	Aaroji Vijh, Alta Devices <i>Doug Osterhout, Google</i> Wensi Wang, BJUT Peter Zou, Huawei Ajinder Singh, TI Aaron Stein, Dartmouth Kevin Parmenter, TSC Guoqing Liu, Huawei (HiSilicon) Jochen Koszescha, Infineon Laili Wang, Xi'an Jiatong University Denis Pasero, Ilika David Newell, NUIG Dan Stieler, PowerFilm Dusan Vuckovic, Delta Force Sam Jones, PowerFilm Baoxing Chen, Analog Devices Jamil Khan, Univ of Newcastle (AUS) Peter Haigh, Tyndall Liubov Ebralidze, Silent Sensors Raj Budhabhatti, Alta Devices

(Co-chairs in bold font)

Next meeting:- Tues Jan 8th at 1000 Central (Lisa to confirm availability)

Agenda for next meeting

1. Welcome any new/recent members
2. EnerHarv 2018 last issues
3. APEC 2019 – **MAIN FOCUS**
4. Updated goals – any suggestions from PSMA strategy meeting/EnerHarv feedback
5. Organise webinars for PSMA & PELS
6. Ideas - Sponsorship of a program where students build demonstrators.
7. Ideas - Assessment of ambient energies in real life use cases
8. Technical forum (links, list of forthcoming events, etc.)
9. Contribution to ETR (technology roadmap)
10. AOB, actions, next meeting, etc.

2. EnerHarv 2018

- IEEE PELS Magazine (sent 8/10, to be published in Dec. issue)...**BZ WILL SHARE LINK ONCE AVAILABLE**
- Tyndall to send €3.5K local surplus to PSMA which will be used to pay D Fogel (webmaster) et al **...CLOSED**
- Receiving industry queries about next EnerHarv, noting for now, think about consideration of EnerHarv 2020 after APEC '19 business settled. Consider soliciting EH Comm inputs in Jan meeting. **Will be a major topic for March face to face,**

3. APEC 2019

- **'Making the battery outlive the device it powers!'**
 - **NOTE: NEW APEC SUBMISSION PROCESS...SESSION CONFIRMED FOR THE AFTERNOON OF WED, 3/20/19 (Joe to note).**
 - <http://www.apec-conf.org/industrysessions>
 - **SUBMISSION REQUIREMENTS:** title, theme, abstract
 - **12/18/18 = Speaker DRAFT PPT submission for Comm review – OVERDUE & CHASING**
 - **1/08/19 = Speaker FINAL PPT submission for Comm review**
 - **1/11/19 = APEC USB materials submission deadline**
 - **Devise guidelines for reviewing presentations – Mike – 12/21 DONE (Ref attachment with minutes)**

1. **MH TO INTERFACE (+ REVIEW)** Steve Savulak, UTRC (Condition monitoring) – EnerHarv placeholder
 “*Perspectives on Energy Harvesting for Aerospace & Building Energy Management (BEM) Sensors*”
 1st draft due 12/24, will review 01/03, Marcus will co-review
2. **MH TO INTERFACE** Wensi Wang, BJUT (PMIC development)
 “*MicroWatts AC-DC Conversion IC Design for Vibration and RF Energy Harvesting*”
 1st draft due next week, Maeve will co-review
3. **BZ TO INTERFACE** Roberto La Rosa, ST, (PMIC) – EnerHarv placeholder
 “*A System on Chip for Energy Harvesting and Wireless Power Transfer*”
 A couple of drafts exchanged, [ask by email for volunteer to co-review final draft](#)
 A System on Chip for Energy Harvesting and Wireless Power Transfer
 (Shortened) Abstract –
 The increasing demand of WSNs (Wireless Sensor Nodes)... motivates engineers to look for EH (Energy Harvesting) and WPT (Wireless Power Transfer) to allow battery-free sensor nodes. RF (Radio Frequency) EH and WPT, due to the pervasiveness of RF energy, that can reach out-of-sight places, could be a key technology to power wirelessly IoT devices and smart sensing architectures....This paper presents a survey of methods to power Wireless Sensor Nodes through EH and WPT and an innovative system and technique to perform MPPT in ultra-low power photovoltaic EH....the level of power to be transferred is often so low to make quite difficult the design of an MPPT (Maximum Power Point Tracking) circuitry efficient enough to make the MPPT itself worthwhile. In this paper we suggest an innovative and efficient MPPT system architecture....an open-circuit measurement technique that can be undertaken during the normal switching of the converter with a minimal reduction in harvesting efficiency. The idea proposes an Energy Transducer device that conceptually consists of two main section, the “Power Section” and the Open Circuit Voltage (Voc) ”Sensing Section”. A SoC is used both as RF power receiver and as an ultra-low Power high performance power management for multi-source energy harvesting. Several different possible applications example and experimental results are shown.
4. **BZ TO INTERFACE** Marcus Taylor, Silent Sensors (IoT Sensor Integration, elastomers/polymers)
 “*Batteryless Monitoring System for Real-World Automotive Application*”
 Also have demo to offer (but may include video of application not pragmatic for a small room demo to complement HW display)
 Near final draft, ask, Robert will co-review final draft
5. **BZ TO INTERFACE**, Pat Hensley, Tektronix
 “*Solving the Energy Harvesting and IoT Power Consumption Measurement Challenges*”
 Brian will chase for due date, Thomas will co-review
6. **MH TO INTERFACE** Brian Zahnstecher, PowerRox & Francesco Carobolante, G2ND Systems
 “*Powering IoT Edge Devices: A Story of EnerHarv and the Birth of an Ecosystem*”
 Draft received, similar to recent webinar, [ask by email for co-reviewer](#)
 “Of all the exciting marketing projections for billions or even trillions of devices and exponential network traffic growth, very few analyses or info address the key, enabling technologies that will make these projections a reality. Furthermore, they lack the awareness there exists a significant energy gap between application needs and what can realistically be produced today. When it comes to micro power management and optimal load utilization, energy harvesting is a key driver because it motivates designers to explore what is truly possible with very low energy levels that can be harvested from the ambient environment instead of waiting on chemistry for a bigger battery. Addressing the misperceptions of negligible power and lack of production solutions, the PSMA Energy Harvesting Committee decided to address this by assembling a workshop that was unique in that it brought together many of the siloed members in the energy harvesting world to develop the necessary synergies to progress as a cohesive ecosystem. There was a mix of academia and industry with a heavy slant towards industry and production solutions that match today’s demand, particularly in applications to support the IoT, wearables, ubiquitous sensors, biometric sensing, industrial applications, etc. This talk will provide an overview of EnerHarv as well as explore some real-world use cases and identify some key resources product developers can use to bring those trillions of devices to fruition.”

7. Demos for final (demo) session

Get proposals on demos from all by mid Jan. So far we have:-

- Tyndall interested – condition monitoring + EnABLES pull up.
- Roberto will show a demo – BZ to chase for update
- Silent sensors will hopefully provide a demo, possibly involving EPEAS? Marcus checking.
- Alta suggested we approach Steve Knoth (Steve.Knoth@analog.com) for getting a demo
- Alta may be interested directly in having a demo – BZ will chase
- Scott knows of WPT applications in US NW area (Joshua Smith, Univ of WA, WPT spinouts), **did reach out, nothing so far, will delete unless hear otherwise**
- Lorandt Foelkel, Wurth – YES, water flow sensors, will send paragraph early Jan
- Denis Pasero, Ilika – MH will chase
- Dusan Vuckovic, Delta Force – Any update?? BZ will chase
- Baoxing Chen/Jane Cornett, ADI – Any update?? MH will chase, also mention Steve Knoth
- MH to ask UTRC

Items 4 onwards were not reviewed at the December meeting

4. Updated goals

- Open to suggestions.
- Consider a white paper? (Who will co-write and when?) – **REMINDER** can members please give Mike & Brian inputs offline
- Mike & Brian to revert with proposal for doing a white paper if so approved
 - OR other dedicated champion from EH Comm, **will put call out**
- Mike & Brian to prepare slides for strategy meeting before 20th Sept. – Done, **...WILL RESEND WITH MTG MINS AS REFRESH TO COMM**
- We should try to forge links with other groups/sessions, e.g. capacitor, magnetics, packaging. – addressing this via “Tiger Team” effort within PSMA (multiple focused initiatives with small teams from various committees)

5. Organise webinars for PSMA & PELS...not discussed during Sept meeting

- We are ok for PSMA webinars for now but need to discuss PELS et al.
 - Peter Haigh volunteered for Nov on EH applications (asset tracking and condition monitoring) – thanks Pete!
 - Mike & Brian will also work in an EnerHarv session on the **same webinar** in mid Nov. Need to write abstract with Peter Haigh by 09/26. – **DONE, around 60 attendees, went well.**
 - Dan Stieler, PowerFilm was considering one (will be chased by way of Sam)
 - Sample abstract suggested per existing blog (<https://www.powerfilmsolar.com/about-us/the-horizon-blog/2018/08/10/outdoor-vs-indoor-solar-the-key-differences>), BZ reviewed/supports, **need Committee input. Worth reviewing seeing as Powerfilm’s abstract did well in voting but was not in top 2.**
 - Lorandt willing to do 1 – getting back up to speed (in your own time Lorandt) – Q1/2 2019? Also depends on whether Lorant/delegate does APEC paper. **BZ TO FOLLOW-UP WITH LORANDT**
- Dan & Dusan willing to revert with suggestions – no commitment yet – Dusan thinking about an applications orientated presentation but no commitment yet.
- Brian and Raj (GeorgiaTech) gave IEEE EPS webinar on IoT with Dushan, Marc & Denis – Went very well. Can do a variant for PSMA later in the year.
- Would be good to do 1-2 on ‘practical real life performance’ of parts and systems – comparison of technologies. Saw some good examples at EnerHarv e.g. Ilika & ARM presentations

6. Ideas - Sponsorship of a program where students build demonstrators.

- Lorandt has a budget to supply kits
- Help with education links – Qualcomm ‘High Tech High’. Francesco will follow up.
- Green story. International dimension. Technology and applications dimensions.
- Wurth running design challenge.
- Keep simple, easy to use
- Competition or roadshow?
- PSMA has money to support.
- Action:- Catherine and Mike met at EnerHarv & discussed, She will write ½ page strawman for student engagement mechanism. Mike will ping again. **NEED A CHAMPION TO LEAD EFFORT FOR COMM**
“Here are Katherine’s thoughts on the competition:

There are two main styles of the competition that could be developed:

1. Engineering-Style Competition

- planning committee chooses specific EH devices that can be used and the target load
- planning committee also specifies energy input conditions (lighting setup, vibrational input, etc) for testing
- specifications are announced and teams would develop the power converter solution based on the specification
- teams can submit videos and/or reports on their team and proposed idea
- final teams are selected and they test their prototypes on site at an event competition (could be a conference)
- judging is based on technical criteria measured during the test (size, weight, efficiency, etc.)
- implementation is the most important aspect for this style of competition
- over different years, the specification and scenarios would focus on different technologies with the same basic format
- more similar to the International Future Energy Challenge run by PELS

2. Design-Style Competition

- planning committee could choose a theme based on a technology or application (e.g. smart homes, wearables, building monitoring, etc.)
- planning committee may want to specify some constraints or scenarios for the competition
- teams come up with complete EH design ideas (transducers, circuitry, load) and develop a prototype
- teams can submit videos and/or reports on their team and proposed idea
- final teams are selected and they present and demonstrate their prototypes on site at an event competition (could be a conference)
- judging is based on mostly qualitative and some quantitative judging criteria (so balanced judge selection will be important)
- this style of competition is more focused on the idea and design, but implementation is also important

There should probably be some discussion on which style the committee would like to see. The engineering-style requires a lot of prep work before even announcing the competition, while the design-style is more work for the judging and evaluation. I could see either being good for students. I hope someone can take these basics ideas and further development them into a competition.”

7. Ideas - Assessment of ambient energies in real life use cases

- Mike will start ball with EnABLES, an EU project that he is coordinating. There are 2 virtual access databases of vibration energy harvesting sources already available at www.enables-project.eu and more will be added

8. Technical forum (links, list of forthcoming events, etc.)

- Johan will review and update the list of events when he gets a chance but EnABLES project is creating a calendar of events, Mike should be able to share this (edited version) in July/Aug
 - Johan delivered updated list on 7/23/18, which **MH & BZ will digest and share with group.**
- Any volunteer(s) for white papers, weblinks, use cases, etc.
- Reach out to other societies/groups and cross link? – Mike & Brian to discuss.
- **Note activities underway separately to re-vamp PSMA website.**

9. Contribution to ETR (technology roadmap)

Q3 onwards. Links from EnerHarv. Looking for volunteers

10. AOB, actions, next meeting, etc.

- Software? Packaging/industrial design? Modelling?

Mike Hayes & Brian Zahnstecher,
21st Dec 2018