



Energy Harvesting Committee (EHC) Minutes 14th Dec 2023

Attendees	Apologies/Non attendees	
John Horzepa, PSMA Matthias Kirn, WTO Sebastian Bader, MIUN Thomas Becker, Thobecore Lorandt Foelkel, Wurth Cristina Rusu, RISE Toshi Yamamoto, Nichicon Brian Zahnstecher, PowerRox Mike Hayes, Tyndall	Prateek Asthana, Tyndall Jean Michel Bidault, ITEN Roberto la Rosa, ST Elias, Norm Elias Model/Sim Hani Kanaan, Dracula Tech Joe Horzepa, PSMA Ningning Wang, Hangzhou DU Soumyajyoti Maji, Univ of Galway Torben Dankwort, Fraunhofer ISIT Pallawi Joshi, Juniper Networks Dan Stieler, PowerFilm Francesco Carobolante, IoTissimo John Fiske, Armor James Rohan, Tyndall Ed Spence, TMIG (guest) Justin Henspeter, IBM Eric Swenson, IBM Pulgurtha Markondeya Raj, (Dr. Raj), FIU Sergiy Tykhonov, FRABA Baoxing Chen, Analog Devices Dinesh Kithany, Wired & Wireless Cem Som, Wurth	Lisa Horzepa, PSMA Peter Spies, Fraunhofer IIS Denis Pasero, Ilika George Slama, Wurth Renee Yawger, EPC Technologies David Tang, Netbit Michalis Kiziroglou, Imperial College London Steve Savulak, Collins Aerospace Gary Johnson, Ilika Toby Best, FRABA Johan Pederson, Ignion Nathan Jackson, Univ of New Mexico Mike Donnelly, Mentor/Siemens Christian Pennisi, Jennova TBD, Wisepower Juan Carlos Rodriguez, ADI Maeve Duffy, Univ. of Galway Andreas Beckes, FRABA Dusan Vuckovic, Zvertch John Flannery, Tyndall

(Co-chairs in bold font) (New/First-time members indicated in GREEN)

Next meeting:- Thurs 11th Jan 8.30am Central (note early start) Brian to chair, Mike to type.

Agenda

1. Welcome any new members/guests.
2. EnerHarv 2024.
3. APEC 2024 – IS demos & speaker updates
4. Industry Event Watch & List of EH companies
5. Media activities
6. 'Treasure Chest' at end of the minutes.

1. Welcome new members

2. EnerHarv 2024 planning Ref www.enerharv.com and [Energy Harvesting Forum | Power Sources Manufacturers Association \(psma.com\)](http://Energy Harvesting Forum | Power Sources Manufacturers Association (psma.com))

- **SEPARATE** Workshop committee created & meetings underway
- Will be in Perugia 26-28 June. F Cottone = Tech co-chair, R LaRosa = general chair.
- BZ/MH submitted SPECIAL PROJECT PROPOSAL TO BoD ON 10/13/23 and was approved. **BZ VISITING FOR FACT-FINDING MISSION WEEK OF JAN 22.**
- **Please send suggestions for demos, posters, presenters to any committee member...** it is by invite only. **MH TO ADD OPEN CALL FOR DEMOS/POSTERS TO EWC GANTT CHART.**
- There will be a sister event - NIPS Summer school 24-26 June. Will encourage young researchers to attend both where possible. <https://www.niplslab.org/>. **EWC discussing options for offering cross-registration support.**
- Website updated for '24 and Giacomo enabled with access (thx, Lisa!), mostly basics and updates to main page...**FINER DETAILS TO FOLLOW WITH GIACOMO SUPPORT.** Alex/Steve/Francesco/Shad enabled to help promote at PowerMEMS.

3. APEC 2024 - PSMA Energy Harvesting Industry Session

APEC '24 will be early next year (<https://apec-conf.org/>, Feb 25-29, 2024, Long Beach, CA).

APEC IS: **IS14: "Powering the IoT with Energy Harvesting and Wireless Power Transfer, with Functional Demos"**

- EHC being designated a 7 slot session (6 presentations + 1 demo session) on **Wed Feb 28th 1:30-5 pm PST**
- Who will be there in person at APEC for committee meeting, Industry session, etc.?

- **KEY MILESTONES**
 - DEC 20, 2023 = draft PPTs due for upload/review
 - JAN 8, 2024 = biography/headshot due for upload
 - JAN 11, 2024 = EHC monthly mtg, last chance for team review
 - JAN 19, 2024 = **FINAL** PPTs due for upload/review. A PDF of final, approved version
 - **NOTE:** must hit this deadline to ensure a PDF get included with the pre-event electronic proceedings.

From our target list we have the following confirmations (subject to peer review of presentation materials)

- Tyndall will provide one of each – Eoin Ahern
 - “Tyndall Energy Harvesting Platforms: eSIP, Testbed & Battery Life Simulation Model”
- BZ can confirm Hanh-Phuc Le, UCSD, participation
 - “Energy Harvesting Integrated Circuits for Thermal Electric Generators”
- BZ can confirm FUI participation (Dr. Raj) – multi-modal energy harvesting
 - “Scalable Multimodal Power Harvesting in Laminates and Flex Substrates with Advanced Packaging”
- BZ can confirm Ed Spence – The Machine Instrumentation Group, also covers work in conjunction with Nichicon, PowerFilm, & e-peas.
 - “Application of PV-based Energy Harvesting with Charge Storage Backup to Wireless Vibration Sensor for Condition Monitoring”
- MH notes Jennifer Hasler of GATech (via colleague work at UU) interesting work (also pinging for EnerHarv). **Confirmed interest/submission for APEC IS!**
 - “Configurable Physical Computing with Energy Harvesting”

“Mead hypothesized in 1990 that analog computation would require 1000x less energy than digital computation. This hypothesis has been experimentally proven in programmable analog systems over the last 20 years starting in 2004. This significant energy improvement can be the difference between an energy harvesting applications being successful and not being practically possible. Programmability is essential for these low-energy systems, both for counteracting threshold-voltage mismatches, providing parameters (e.g. Weight matrices) for the system computation, as well as larger system configurability. Programmability enables low-power voltage regulation techniques that can be distributed easily throughout a configurable IC. Large-scale Field Programmable Analog Arrays (FPAA) drastically improves computational energy efficiency (> 1000x), enabling several applications at 1-100uW of average power, power levels that can be supplied through a range of energy harvesting solutions. These directions lead to a range of analog design tools for targeting an FPAA. Next generation FPAA’s will include low voltage (250-300mV) configurable analog circuits that will further improve the energy efficiency. We will discuss some current and future programmable energy harvesting applications enabled through physical (analog) computing approaches.”
- Lorandt assigned as leader (also SUPER SUB for talk cancellation) for demo session
 - “See the Power IoT in Action! Live, Functional Demos of Solutions” **ANYONE PROPOSING A DEMO SHOULD REACH OUT TO LORANDT. LORANDT PREPARING LIST FOR TRACKING.**
 - List of demos:-
 - **TYN- Battery life simulation model**
 - **Nichicon:- discussing with Ed. WILL PROVIDE DEMO OVERVIEW/ABSTRACT/PIC.**
- MH reached out to Nathan Jackson to solicit interest. **Confirmed NOT available, target EnerHarv.**

The following are diversions

- Cristina mentions consideration from Peter Woias of Univ of Freiburg (originally contact of Jane C./Thomas B. from EnerHarv '18) -> **target EnerHarv**
- Maeve notes this talk on solid state batteries from TDK at PwrSoc that may be worth following up with the speakers on: CeraCharge™ – World’s First Rechargeable Solid-State SMD Battery Hiroshi SatoTDK, Japan -> **target EnerHarv**

4. Industry Event Watch & List of EH companies

- **Event tracker**
 - Revisit/update the list of good industry events for tracking. EnABLES turned into EU proposals for new research infrastructure (feasibility study) projects RISEnergy (retrofit EH powered WSN, **starts Apr 1**), Infrachip (Si on chip, **starts Feb 1**). More details to follow.
 - Next update target Jan '24. **Make more sense to transition from standalone doc to list in mtg mins...MIKE TO LOOK AT LATEST LIST AND PROPOSE SOLUTION HERE.**

- **Company ecosystem** (review quarterly, next due Feb-ish '24, supported by APEC/EnerHarv activities)
 - **BZ CONTINUES TO UPDATE AS INFO TRICKLES IN. BZ WILL ADD SOME COMP CONTRIBUTORS TO HIR CONTENT.**

5. MEDIA ACTIVITIES

(a) Webinars/ PTR? **PERPETUAL OPEN CALL TO EHC FOR WEBINAR SUGGESTIONS.**

- IEEE HIR 2023. HIR = heterogeneous integration roadmap, packaging and system integration focus
 - Effort led by Francesco Carobolante. Possible APEC presentation?
 - Final draft candidate 8/8/23. **BZ/MH WILL SHARE LINK WITH TEAM WHEN PUBLISHED.**
https://eps.ieee.org/images/files/HIR_2021/ch10_power.pdf
- Toshi Yamamoto, Nichicon – LTO Battery Tech. Possibly leverage material related to Sensors Converge (already has ~50% of required content)? Upgrade & share overview with team by next meeting (early-'24). **TOSHI TO PROVIDE PROPOSAL/ABSTRACT/DRAFT PPT BY 12/15/23 FOR TEAM REVIEW.**
- Lorandt Foelkel, Würth – EH Tech Update. **LORANDT SHARED PREVIOUS DIGIKEY WEBINAR FOR REFERENCE.** Mike & Brian feel it is good but needs higher % of new material – under review. **LORANDT WORKING TO CREATE A NEW PPT FOR '24 WITH ~90 % NEW MATERIAL BY END-FEB.**
- Ed (Spence) considering and will revert. **EHC CAN EVALUATE BASED ON APEC '24 IS CONTENT.**
- Any other topics?

(b) Conferences/workshops

(c) Publications

- Jean Michel – ITEN working on a white paper for release in Dec. Let us know if we can help with preparation, distribution, promotion, etc.
- Roberto – we should consider putting together an updated white paper, esp. application focused, with lots of new EHC members, leverage EnerHarv?
- Also looking at cross promotions for IPC – industrial automation, Industry 4.0, smart mobility, etc.
- Any material you want to re-cycle.... once not too much of a sales pitch?
- New suggestions
Hoping to mine upcoming events (APEC, EnABLES, APEX, EnerHarv, etc.)

(d) Virtual conferences, articles, etc.

- Suggestions please

6. Norm/Gabriel Collaboration Update

TREASURE CHEST

Approach these items one at a time in future meetings as people raise them.

8A. 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.
- Würth running design challenge.
- Keep simple, easy to use
- Competition or roadshow?
- PSMA has money to support.
- **Action:- write ½ page strawman for student engagement mechanism **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.”

7B. Updated Goals

- Open to suggestions.
- 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).

7C. Forward-looking Thoughts

- Software? Packaging/industrial design? Modelling? Hackathon?
- Incorporate some kind of student competition as part of EnerHarv (Best Student Demo/Poster) or otherwise.

**Mike Hayes & Brian Zahnstecher,
14th Dec 2023.**