Energy Harvesting Committee (EHC) Minutes
11th Jan 2024

Attendees	Apologies/Non attendees	
John Horzepa, PSMA Matthias Kirn, WTO Sebastian Bader, MIUN Hani Kanaan, Dracula Tech Cristina Rusu, RISE Steve Savulak, Collins Aerospace Ed Spence, Machine Instrumentation Group Joe Horzepa, PSMA Prateek Asthana, Tyndall **Brian Zahnstecher, PowerRox** **Mike Hayes, Tyndall**	Jean Michel Bidault, ITEN Roberto la Rosa, ST Elias, Norm Elias Model/Sim 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 Pulugurtha Markondeya Raj, (Dr. Raj), FIU Sergiy Tykhonov, FRABA Baoxing Chen, Analog Devices Dinesh Kithany, Wired & Wireless Cem Som, Wurth Lorandt Foelkel, Wurth Thomas Becker, Thobecore	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 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, Zvertech John Flannery, Tyndall Toshi Yamamoto, Nichicon

(Co-chairs in bold font) (New/First-time members indicated in GREEN, welcome guest Ed Spence)

Next meeting:- Special meeting Wed 17th Jan at 11am central to EXCLUSIVELY review slides and demos for APEC (DEADLINE 19th!) – note it will be Brian's zoom link then Tues 27th Feb 8am Pacific (in person only) Mike to chair, Brian to type. Who will be there in person at APEC for committee meeting, Industry session, etc.?

Please read the minutes carefully, esp. APEC and give inputs directly or offline for the special meeting on 17th.

Agenda for 27th Feb
1. **Welcome any new members/guests.**
2. **APEC 2024 – quick update before session the following day**
3. **EnerHarv 2024.**
4. **Industry Event Watch & List of EH companies**
5. **Media activities**
6. **'Treasure Chest' at end of the minutes.**

1. Welcome new members

2. APEC 2024 - PSMA Energy Harvesting Industry Session 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**
- KEY MILESTONES
  - 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.

Confirmations (subject to peer review of presentation materials)
- Eoin Ahern, Tyndall. "*Tyndall Energy Harvesting Platforms: eSIP, Testbed & Battery Life Simulation Model*" - feedback provided to draft slides on 11th Jan.
- Hanh-Phuc Le, UCSD, "*Energy Harvesting Integrated Circuits for Thermal Electric Generators*"
- Dr. Raj, FIU – multi-modal energy harvesting "*Scalable Multimodal Power Harvesting in Laminates and Flex Substrates with Advanced Packaging*" Brian has captured initial feedback at 11th Jan meeting and WILL SHARE WITH DR. RAJ.

- o 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*"
  Brian just sent email with initial feedback from BZ & MH
- o Jonathan Wright, Ambient Photonics, just confirmed as a speaker, details to follow, BRIAN CHASING.
- o Jennifer Hasler, GATech – MIKE CHASING DRAFT SLIDES, due in next 1-2 days
- o "*Configurable Physical Computing with Energy Harvesting*"
- o BrianZ has back-up presentation in case of any last minute cancellations.
- o 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.
  - o List of demos so far, MORE URGENTLY NEEDED:-
  - o TYN:- Battery life simulation model
  - o TYN:- enTIce enerhy harvesting tesbed framework
  - o Nichicon:- discussing with Ed. WILL PROVIDE DEMO OVERVIEW/ABSTRACT/PIC.
  - o Hani has self-powered BLE/LoRA beacon – has a flyer, will see if he can get someone to demo it.
  - o Ambient photonics;- hoping Jonathan will bring some demos, e.g. bifacial remote controls

  The following are diversions
  - o Cristina mentions consideration from Peter Woias of Univ of Freiburg (originally contact of Jane C./Thomas B. from EnerHarv '18) - > target EnerHarv
  - o 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

3. **EnerHarv 2024 planning Ref www.enerharv.com and** 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 5th Feb.
   - 3rd keynote Joshua Wright, Ambient Photonics confirmed. He will also present at APEC and HOPEFULLY bring demos.
   - 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 - Done
   - There will be a sister event - NIPS Summer school 24-26 June. Will encourage young researchers to attend both where possible. https://www.nipslab.org/ . EWC discussing options for offering cross-registration support. They are also looking for lecturers, let Mike/Brian know if interested.
   - 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. REGISTRATION WILL OPEN IN EARLY FEB with announcement on keynotes and call for demos and posters. Workshop agenda will also be cleaned up next week.
   - Still looking for commercial sponsors – FLYER WILL BE RELEASED NEXT WEEK.

4. **Industry Event Watch & List of EH companies (Items 4 onwards not reviewed since Dec 2023)**
   - *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? <mark>PERPETUAL OPEN CALL TO EHC FOR WEBINAR SUGGESTIONS</mark>.
- 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. <mark>BZ/MH WILL SHARE LINK WITH TEAM WHEN PUBLISHED</mark>.
      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). <mark>TOSHI TO PROVIDE PROPOSAL/ABSTRACT/DRAFT PPT BY 12/15/23 FOR TEAM REVIEW</mark>.
- Lorandt Foelkel, Wurth – EH Tech Update. <mark>LORANDT SHARED PREVIOUS DIGIKEY WEBINAR FOR REFERENCE</mark>. Mike & Brian feel it is good but needs higher % of new material – under review. <mark>LORANDT WORKING TO CREATE A NEW PPT FOR '24 WITH ~90 % NEW MATERIAL BY END-FEB</mark>.
- Ed (Spence) considering and will revert. <mark>EHC CAN EVALUATE BASED ON APEC '24 IS CONTENT</mark>.
- Any other topics?

(b) Conferences/workshops
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(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

<mark>TREASURE CHEST</mark>

<mark>**Approach these items one at a time in future meetings as people raise them.**</mark>

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.
- Wurth running design challenge.
- Keep simple, easy to use
- Competition or roadshow?
- PSMA has money to support.
- <mark> </mark>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,
11th Jan 2024.