Electronic Components and Systems for flexible, coordinated and resilient Distributed Renewable Energy Systems

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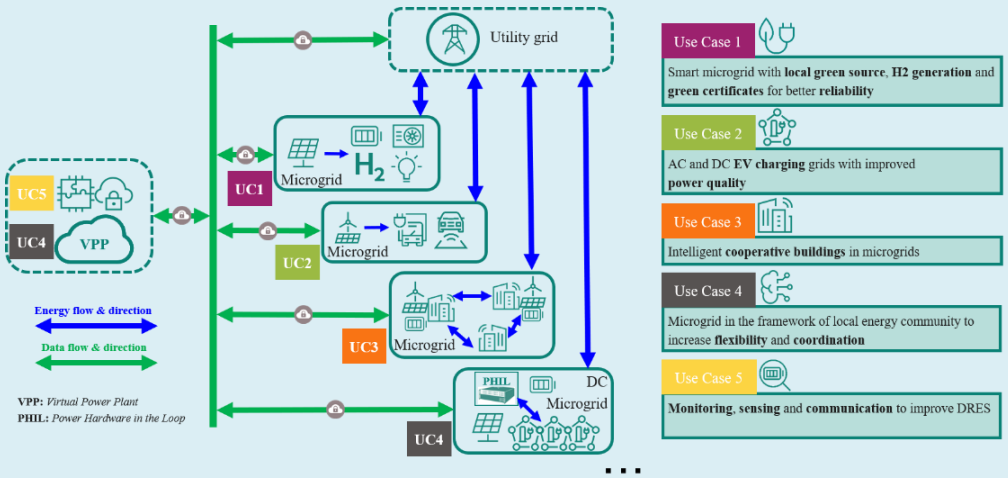
Consortium

ECS4DRES Overview

Newsletter August 2026 Issue Number 1

ECS4DRES will strengthen the long-term reliability, safety, and resilience of DRES by developing advanced monitoring and control technologies including integrated sensors capable of different types of detection for safety purposes, and for monitoring of energy transfers. Finally, ECS4DRES will achieve interoperable and low-latency communication systems, enabling the widespread interconnection of a large number of DRES, subsystems, and components to realize optimal energy management between sources, loads, and storages within the microgrid, to improve power quality and to enable resilient system operation. Minimum power consumption and maximum interoperability are further goals for the researched monitoring & control and communication solutions. The overall target is to align with the EU policy on energy efficiency and contribute towards reduction of CO_2 emissions of 55% by 2030 and to become climate neutral by 2050, and development for enhancing component technologies that guarantee security, trust and energy-efficiency for critical infrastructures and sectors in Europe. ECS4DRES strives to deliver a set of interoperable mature solutions centered around energy conversion and management for DRES, by designing, developing, and implementing the necessary electronic hardware and software components and systems. This includes the development of:

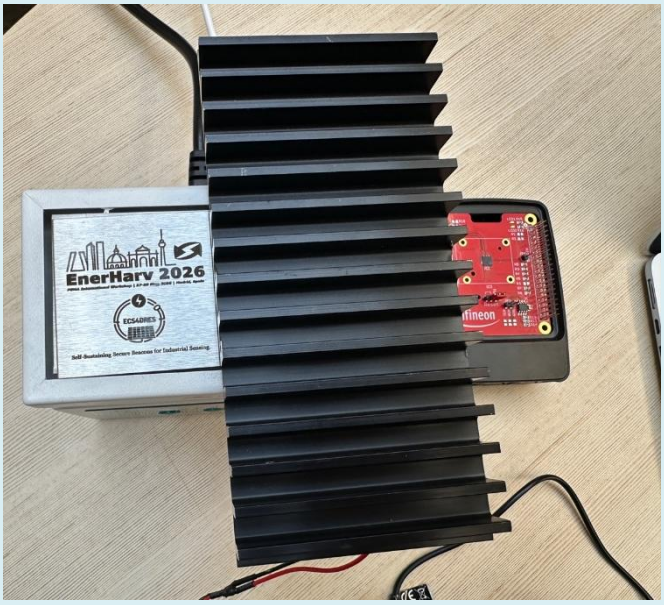
- hardware including highly efficient (e.g., > 97% efficiency) and high-power density (e.g., > 50 W/inch3 power density) power converters and their control systems, grid-interfacing components, sensor (e.g., hydrogen sensor with sensitivity better than RH2/R0 ≈ 50) and monitoring systems (e.g., 50% reduction of memory footprint and energy consumption of the applied neural networks) and their integration.
- algorithms and software tools including control techniques for DRES and at grid level, local balance between energy production and consumption in microgrids (e.g., > 50% peak power reduction), by taking advantage from AI (e.g., > 25% improved accuracy for energy management measures; > 95% probability to detect anomalies)
- communication techniques including applications of 5G (e.g., > 70% reduction of latency) and wireless extensions of power line communications



The ECS4DRES concept

Dissemination Activity EnerHarv 2026, Madrid 27-29 May

ECS4DRES is a Chips Joint Undertaking project in which Infineon Technologies AG participates. As part of its dissemination activities, the project took part in EnerHarv 2026, the International Energy Harvesting Workshop held in Madrid, Spain, presenting a thermoelectric-powered, hardware-secured Bluetooth Low Energy (BLE) sensor node for industrial predictive maintenance. The presentation, titled "Thermoelectric Energy-Harvesting Secure BLE Sensor Nodes for Authenticated Industrial Sensing," covered the following technical progress:



1. For the characterization of thermoelectric generators (TEGs) for industrial waste-heat harvesting, four candidate TEGs were fully characterized in terms of open-circuit voltage, short-circuit current, internal resistance and maximum power.
2. For the design of a compact, secure hardware platform, custom 4×3.5 cm PCBs were developed, integrating an ESP32-C6-Mini-1 microcontroller, an Infineon OPTIGA™ Trust M v3 secure element, a PT1000 precision temperature probe, and an SPV1050 energy harvester.
3. For the closing of the harvested energy budget, an analytical power-budget model relating TEG power, harvester and LDO efficiencies, and load draw was derived and validated across multiple TEG, ΔT, and advertising-interval scenarios. The results show that the node's battery can sustain net charging under realistic ΔT of 40–70°C for the higher-power TEG candidates.
4. For the adaptation of secure activation protocols to constrained BLE beacons, an OTAA-style join procedure was ported from LoRaWAN to iBeacons, using a hardware secure element to derive rotating Application and Network session keys from a pre-shared key, providing confidentiality, authenticity, and replay protection.
5. For the demonstration of the concept, a working demonstrator was built: a TEG mounted on a controlled hot plate powering a secure node that transmits authenticated temperature readings to a gateway and a live monitoring dashboard, and shown live to workshop attendees.

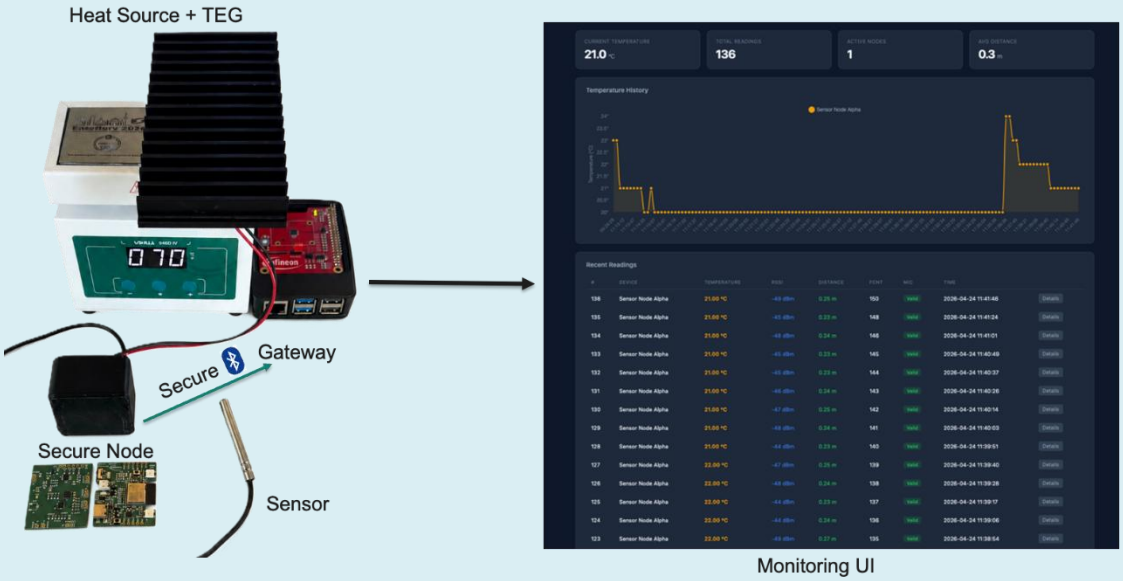
This work was supported by Infineon Technologies AG, as part of the Chips JU project ECS4DRES under grant agreement No. 101139790.

Dissemination Activity EnerHarv 2026, Madrid 27-29 May

As part of its dissemination activities, ECS4DRES took part in EnerHarv 2026, the International Energy Harvesting Workshop held in Madrid, Spain, where we were excited to present a thermoelectric-powered, hardware-secured Bluetooth Low Energy (BLE) sensor node for industrial predictive maintenance.

Our presentation, "Thermoelectric Energy-Harvesting Secure BLE Sensor Nodes for Authenticated Industrial Sensing," showcased great progress: Low Energy (BLE) sensor node for industrial predictive maintenance. The presentation, titled "Thermoelectric Energy-Harvesting Secure BLE Sensor Nodes for Authenticated Industrial Sensing," covered the following technical progress:

1. 🌡️ **TEG characterization**: Four candidate thermoelectric generators were fully characterized in terms of open-circuit voltage, short-circuit current, internal resistance, and maximum power output.
2. 🔧 **Compact, secure hardware platform**: We built custom 4×3.5 cm PCBs integrating an ESP32-C6-Mini-1 microcontroller, an Infineon OPTIGA™ Trust M v3 secure element, a PT1000 precision temperature probe, and an SPV1050 energy harvester.
3. ⚡ **Closing the energy budget**: An analytical power-budget model was developed and validated across multiple TEG, ΔT, and advertising-interval scenarios. The results are encouraging: the node's battery can sustain net charging under realistic ΔT for the TEG candidates.
4. 🔐 **Secure activation for BLE beacons**: We adapted an OTAA-style join procedure from LoRaWAN to iBeacons, using a hardware secure element to derive rotating session keys — bringing confidentiality, authenticity, and replay protection to a technology that was never designed for it.
5. 🎯 **Live demonstration** — We built a working demonstrator: a TEG mounted on a controlled hot plate, powering a secure node that streams authenticated temperature readings to a gateway and live monitoring dashboard, right in front of workshop attendees.



Monitoring UI

A great opportunity to connect with the energy harvesting community and share where this technology can go next!

This work was supported by Infineon Technologies AG, as part of the Chips JU project ECS4DRES under grant agreement No. 101139790.

ECS4DRES Journal Publications

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2. C. Sbrana, A. Catania, T. Toschi, S. Strangio and G. Iannaccone, "12-bit Delta-Sigma ADC Operating at a Temperature of Up to 250 °C in Standard 0.18 µm SOI CMOS", in *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 72, no. 12, pp. 7578-7587, Dec. 2025
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ECS4DRES in social media

ECS4DRES Coordinator

Holger Schmidt
Infineon Technologies AG

Contact:
https://ecs4dres-project.eu/index.php/contact

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