



InComEss

Innovative polymer-based composite systems
for high-efficient energy scavenging and storage



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Innovative polymer-based composite systems
for high-efficient energy scavenging and storage



This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 862597.

EU Funding
7 million €



42

Months



18

Partners



10

Countries

What's the

Challenge



Europe is committed to reach the 2030 targets of **40% reduction of CO₂ emissions**, and improve energy efficiency within the current scenario for growth of global electricity demand by almost **80%** **during the period of 2017-2040**.

What's our

Vision



A new green-and-cost-effective strategy for **high efficient energy harvesting** through a sustainable and efficient use of resources, in line with the **circular economy** perspective.

InComEss seeks at developing efficient smart materials with energy harvesting and storage capabilities

combining advanced polymer based-composite materials into **a novel single/multi-source concept**

to harvest electrical energy from mechanical energy and/or waste heat ambient sources.



Social and Environmental

Impact



Generate **high quality jobs** along the value chain



40% reduction of GHG emissions



50% reduction of hazardous waste



Accelerate the adoption of **IoT technologies**

We put forward our

Objectives



Implement innovative Green **Materials, Systems and Structures**



to develop **Energy Harvesting Systems**



able to power **FOS, GPS and MEMS sensors** in different Use Cases.



We will develop


New

Materials



Advanced lead-free Piezoelectric composites



 **Innovative high-performance
Thermoplastic-based
P-and N-type TE composites**

to be applied in single/hybrid PE/TPE generators





Printable high energy density PANI/carbon-based composite electrode materials

(with enhanced specific capacitance and stability)

to be incorporated into the monolithic supercapacitor (SC) to store the energy harvested.



Three novel

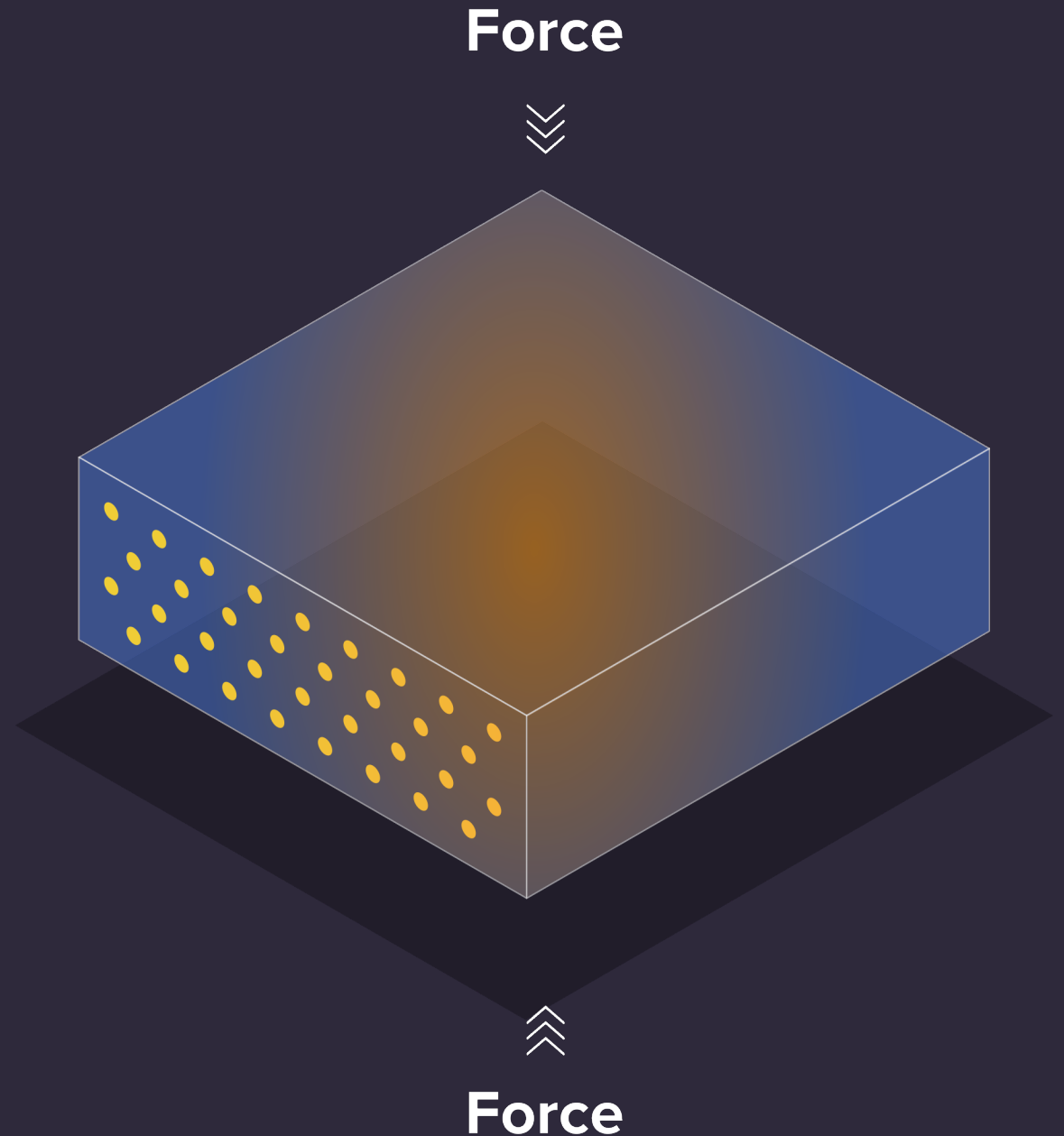
**Energy Harvesting/
Energy generator
components**

1

PiezoElectric Generator (PEG)

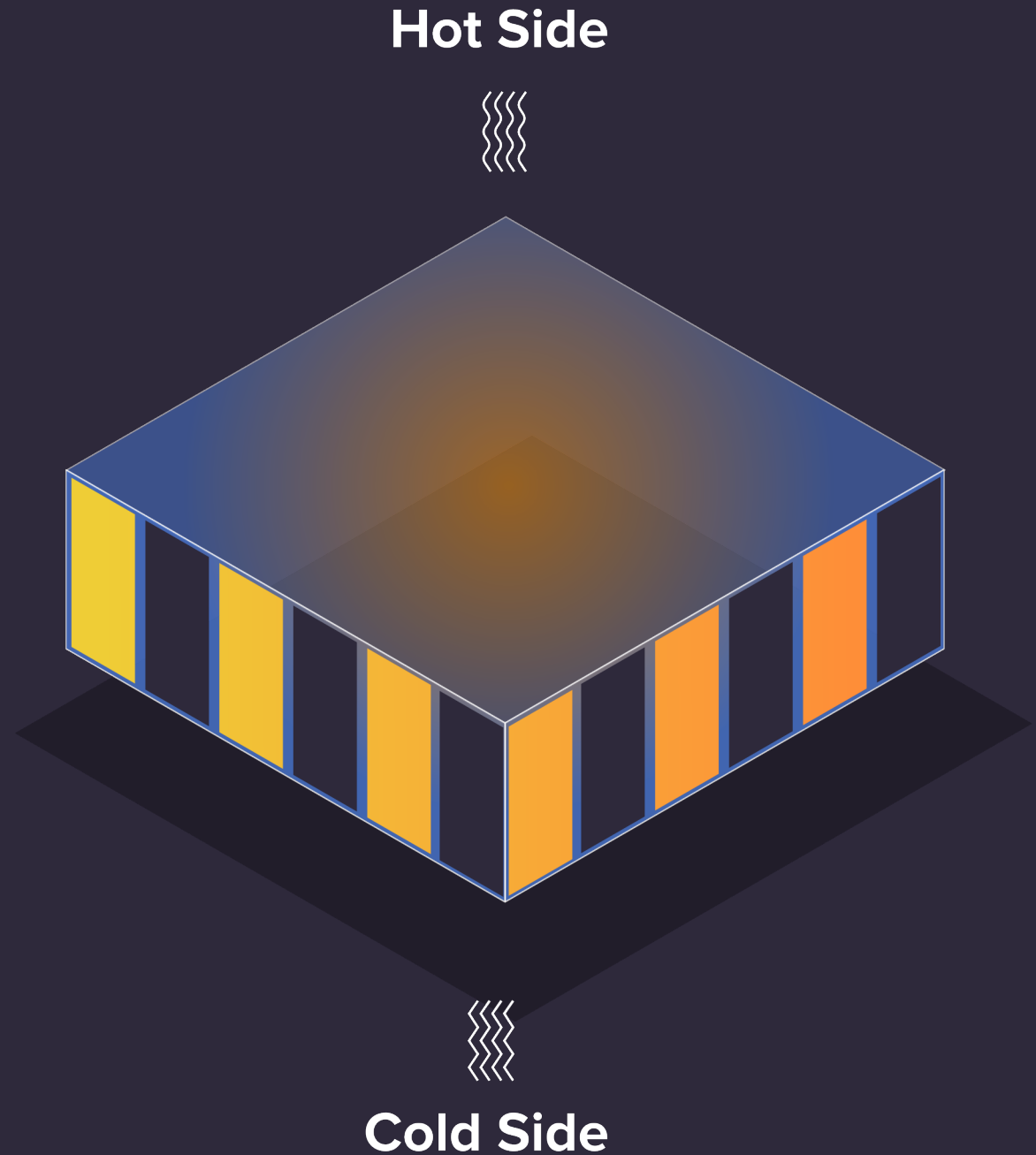
for Mechanical Energy Harvesting

The new PEG is designed for improved PE features, avoiding dielectric losses and maximizing the energy conversion during mechanical deformation.



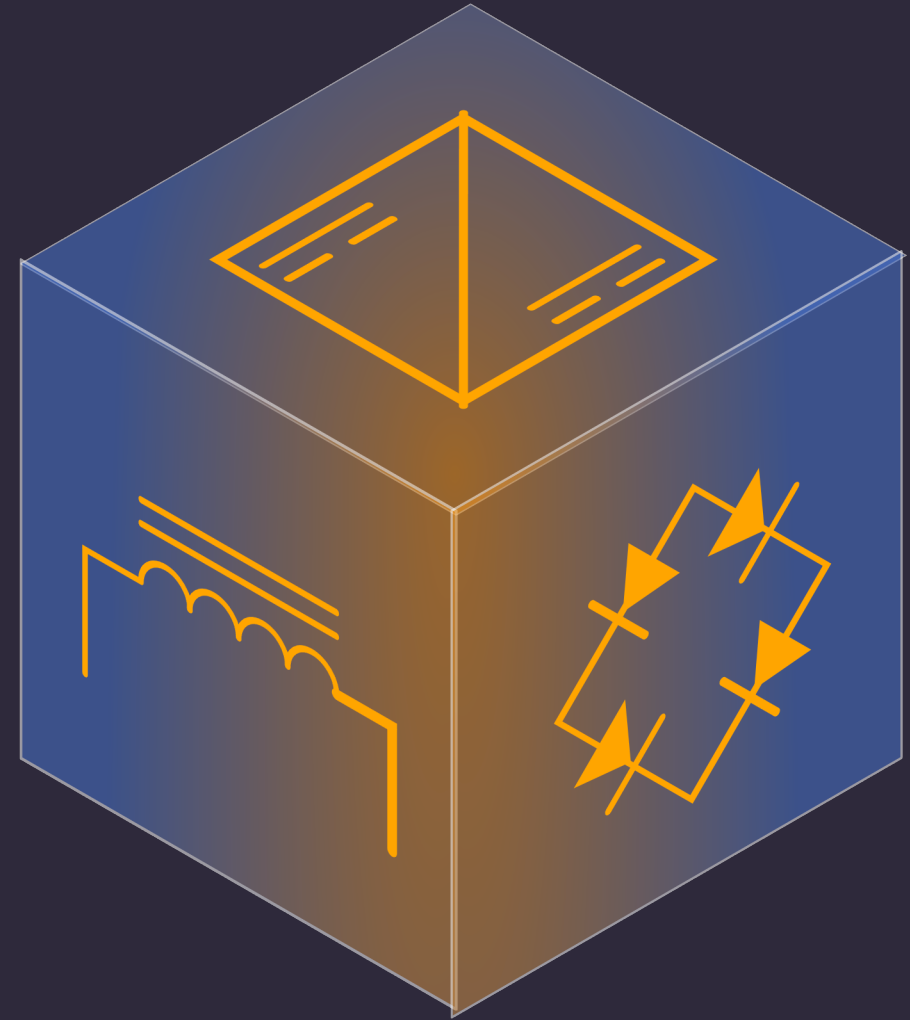
2

ThermoElectric Generator (TEG) for Heat Energy Harvesting



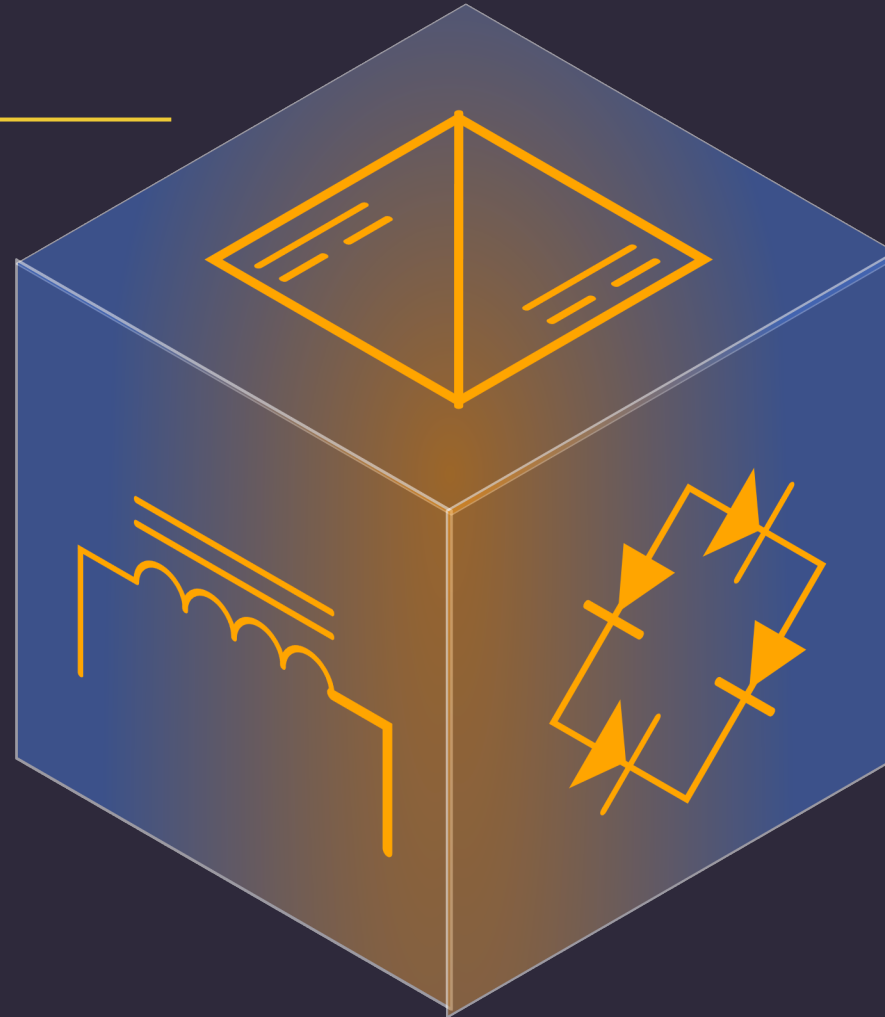
Power Conditioning and Energy Storage

**An advanced
Power
Conditioning
Circuit (PCC)**



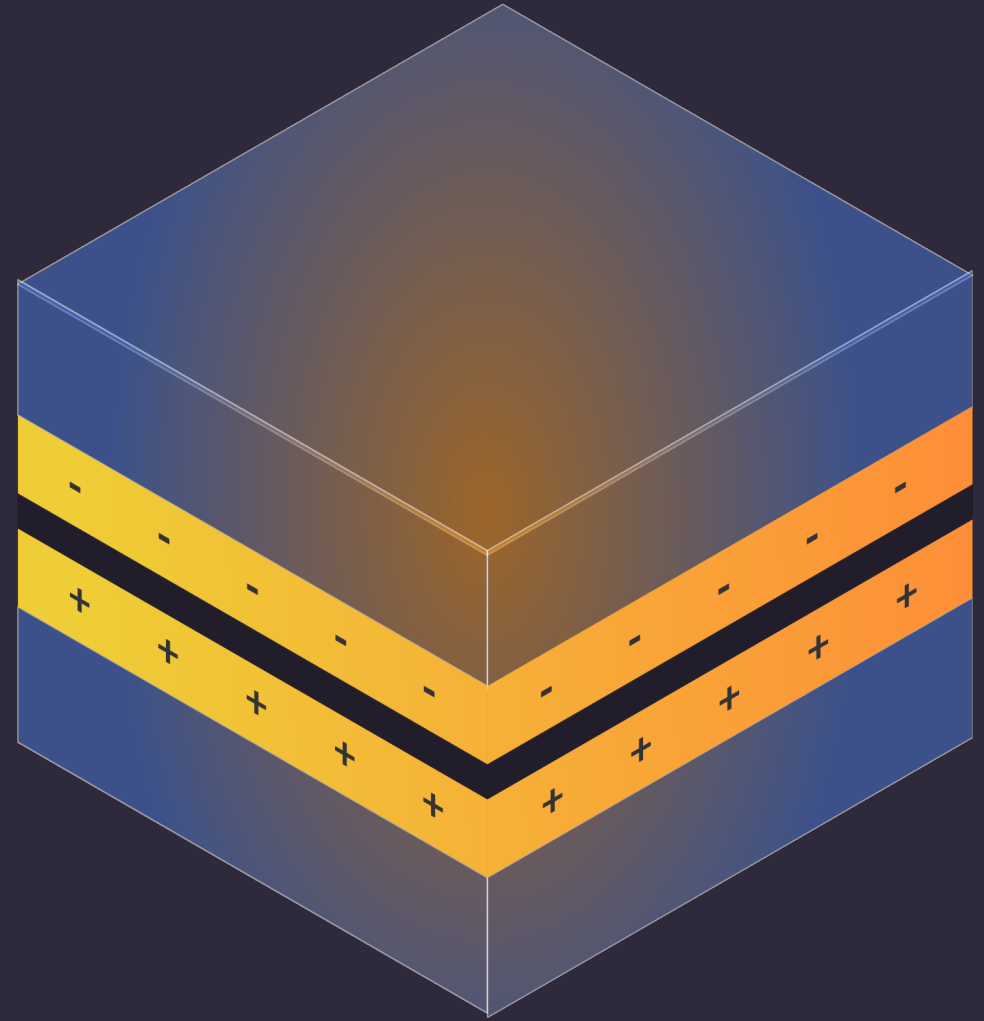
increase the **energy available** in the monolithic SC

improve the **conversion efficiency** by the energy generators



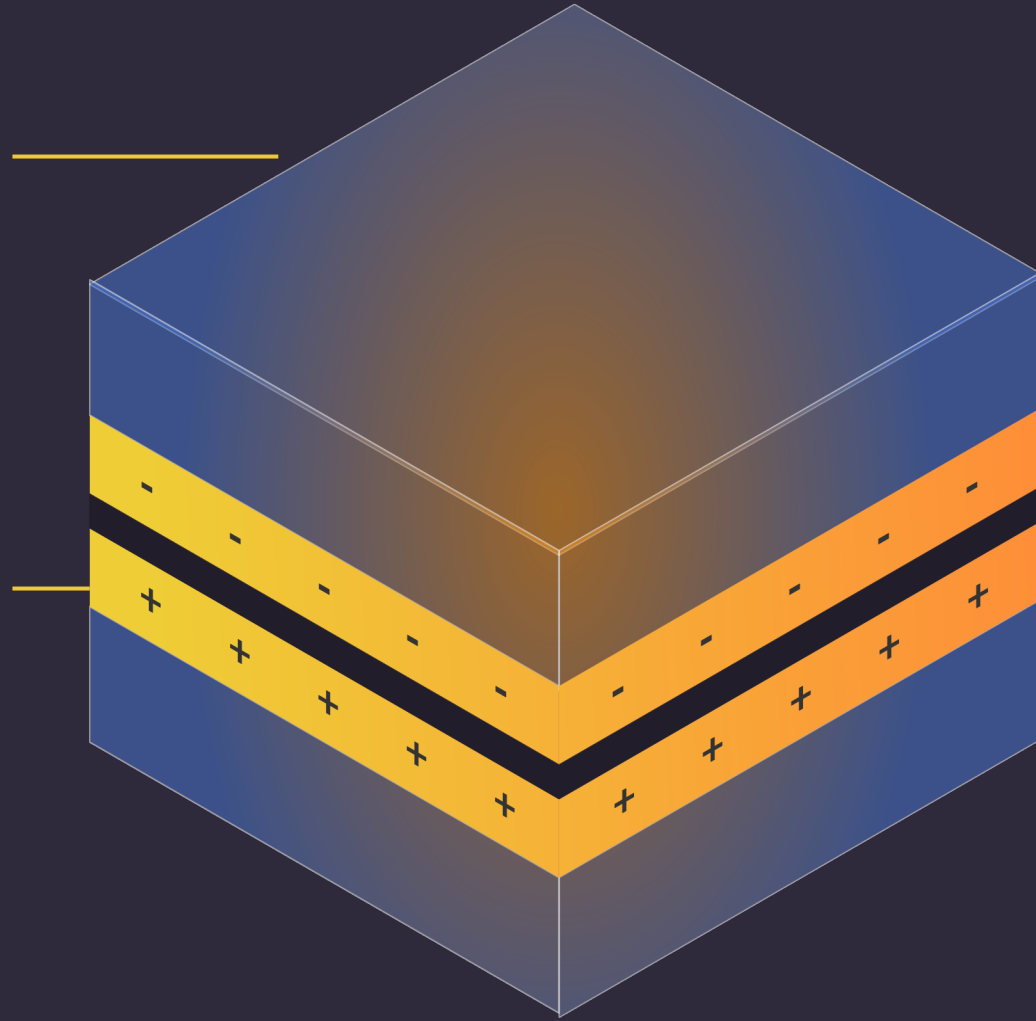
suitably transfer the energy for powering Wireless Sensor Nodes (WSN) by the implementation of **IoT** in different scenarios.

**A monolithic
supercapacitor (SC)**



Of **Advanced
Electrodes &
Electrolyte**

With high **power
density** and high
energy density



To be **integrated** on
the PEG, TEG or
TPEG devices to
store the electric
energy harvested
by each device to
be latter supplied to
WSN



Three
**Energy
Harvesting
Systems (EHSs)**



Energy Harvesting/ Energy Generator Components



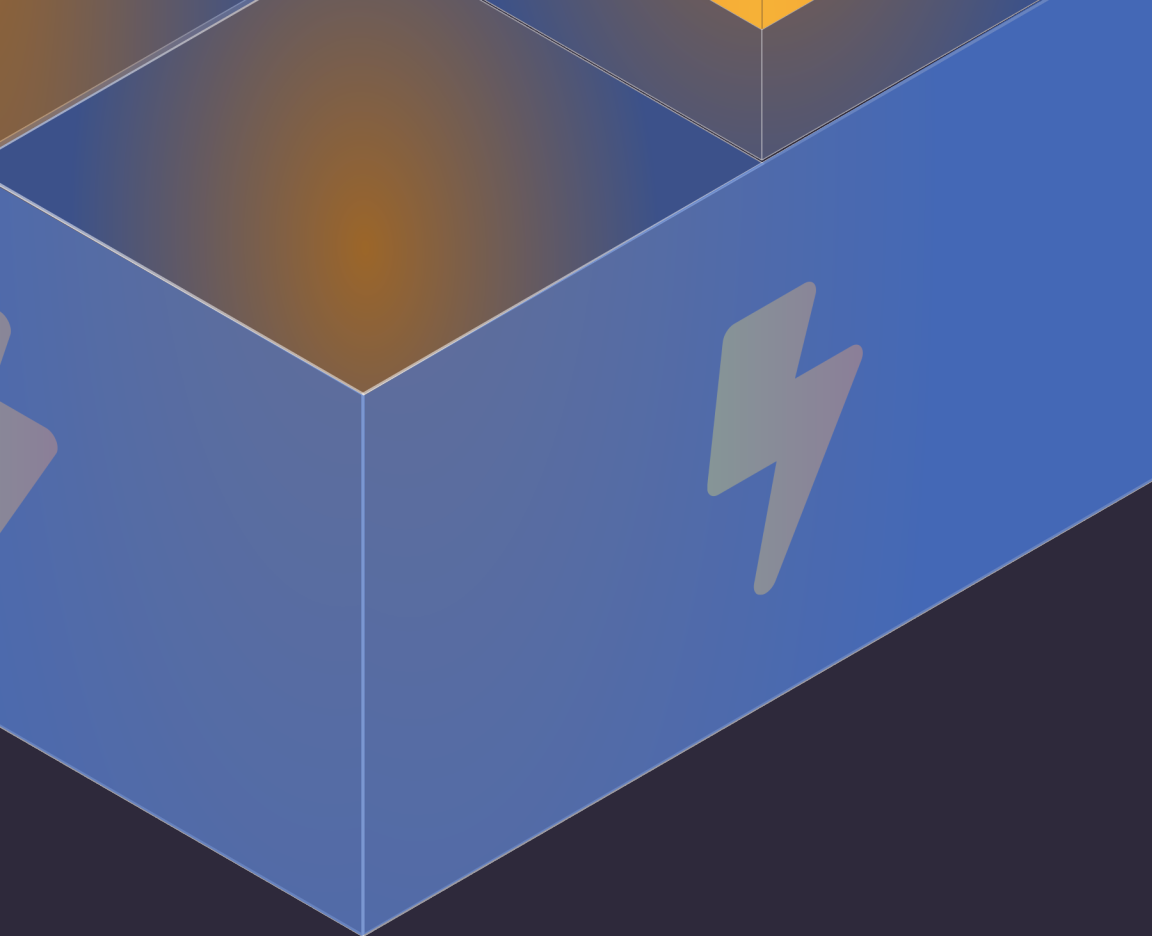
PiezoElectric



ThermoElectric

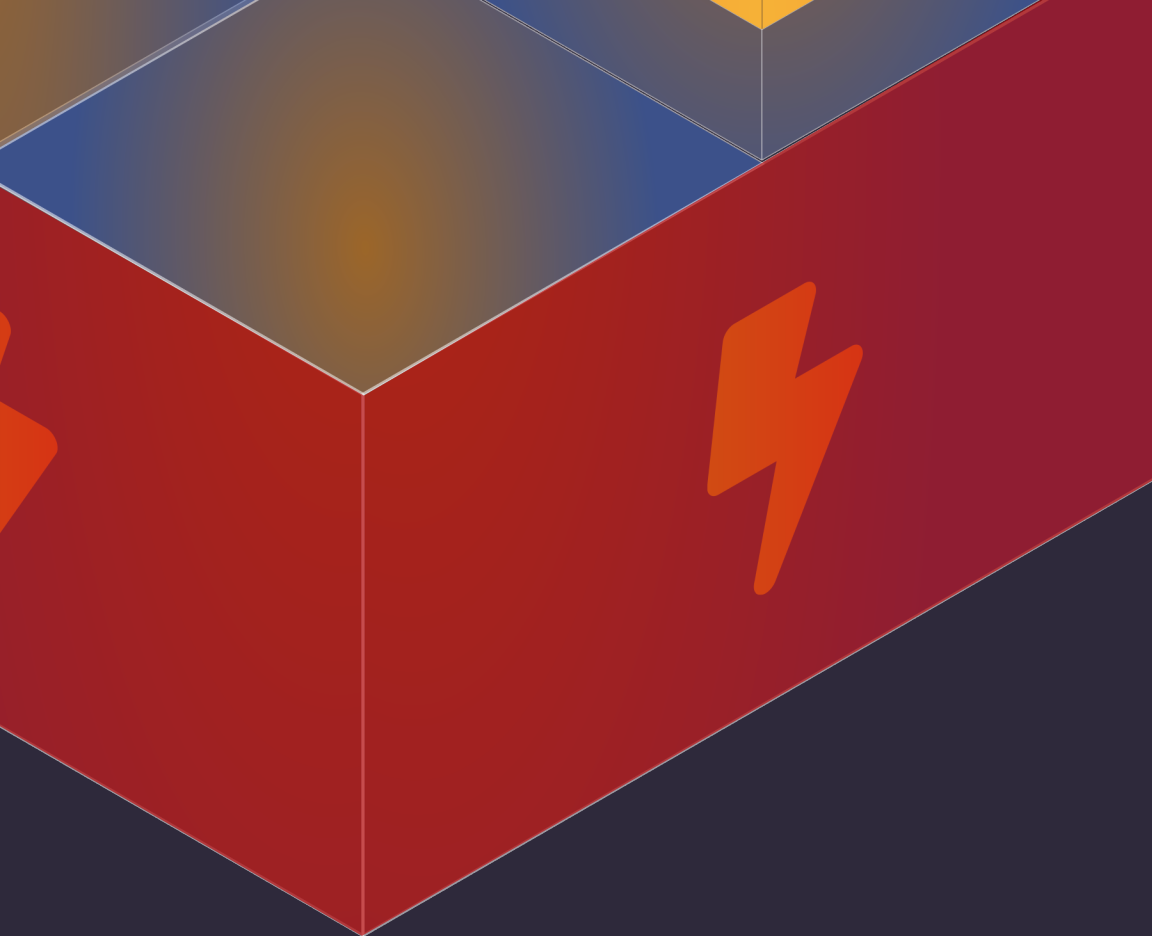


Thermo/Piezo
Electric



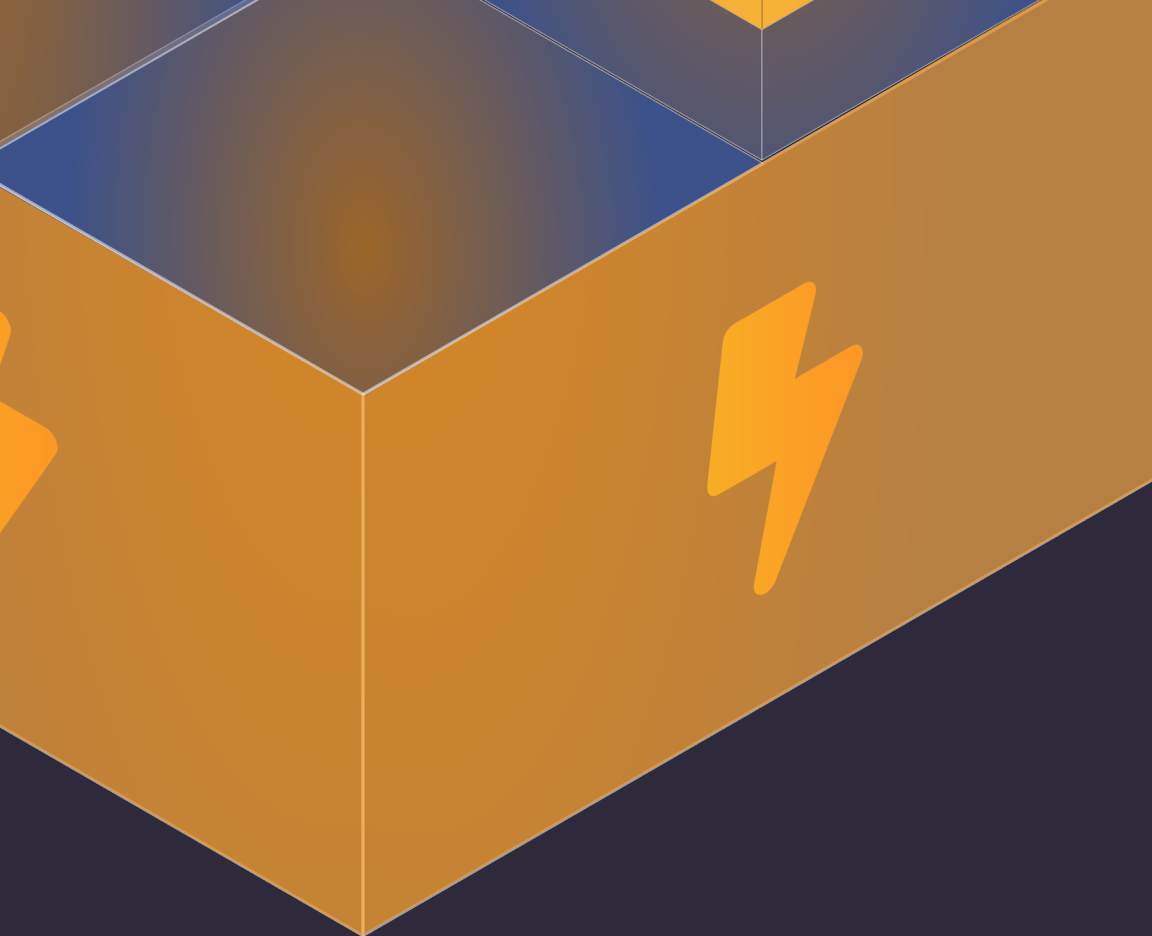
1. A single source PiezoElectric Energy Harvesting System (PE-EHS)

formed by a PEG that convert
mechanical energy into
electricity



2. A single source ThermoElectric Energy Harvesting System (TE-EHS)

comprised by a TEG that
convert waste heat directly
into electricity



3. A multi-source hybrid-ThermoPiezoElectric (TPE)-based EHS

consisting of a TPEG with capability to convert simultaneously vibrations and heat through



Powering **Wireless Sensor Nodes (WSN)**

Each connected with a **monolithic SuperCapacitor (SC)** through an **advanced PCC**



The 3 EHS'S
will power selected
**Wireless Sensors Nodes
(WSN)**

to be implemented
in different **IoT scenarios**





The 3 EHS'S
will power selected
**Wireless Sensors Nodes
(WSN)**

to be implemented
in different **IoT scenarios** for



Structural Health Monitoring

(SHM) in buildings and aircrafts (using
a new miniature wireless Fiber Optics
Sensing (FOS) interrogator)



Accurate location and monitoring of vehicles

through GPS and MEMS sensing.

Smart Buildings

Demonstration of PE-EHS integrated in the façade prototype




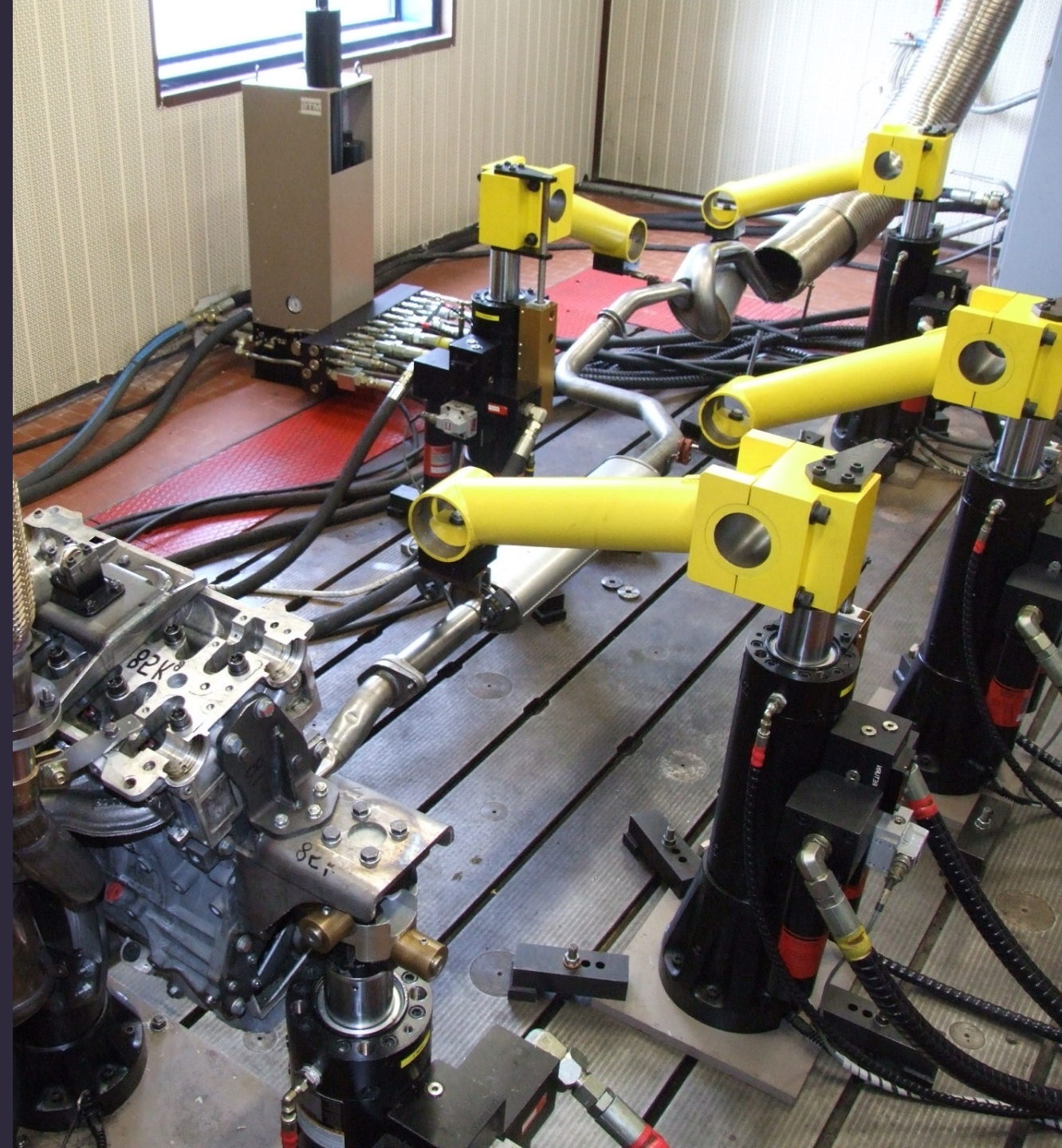
Evaluate the performance of the new piezoelectric-based smart material combinations



Automotive

Demonstration of TPE-EHS by integrating the (TEG) into the exhaust gas test bench

 Determine the overall power output and energy efficiency of the TEG constructed



Aerospace

Demonstration of PE-EHS through a TPEG demo prototype connected to the storage supercapacitors components to supply electricity to a miniature FOS interrogation-based FBG sensors integrated into the specimen panel.



Evaluate power output of TPE-EHS due to the utilization of both ambient sources for energy harvesting.



Energy Harvesting/ Energy Generator Components



PiezoElectric



ThermoElectric



Thermo/Piezo
Electric



Power Conditioning Circuit

Transformer

DC-DC
Converter



AC-DC
Converter



Energy Storage Component



Monolithic
SuperCapacitor



Wireless Sensor Nodes (WSN) & IoT



Sensors



FOS Sensors

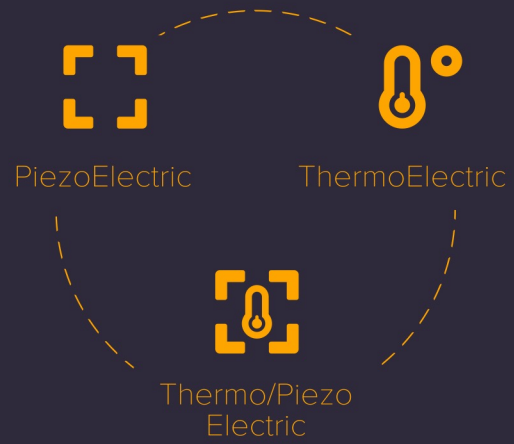


GPS, MEMS Sensors

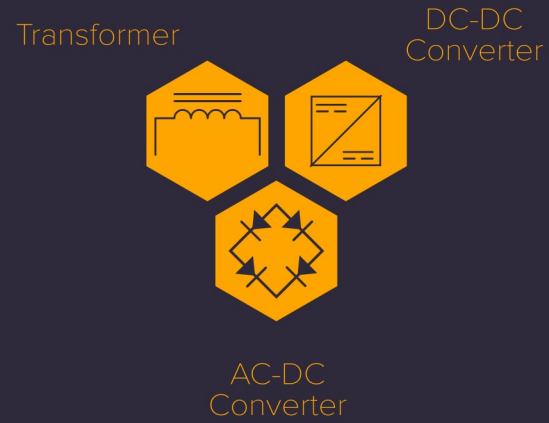


FOS Sensors

Energy Harvesting/ Energy Generator Components



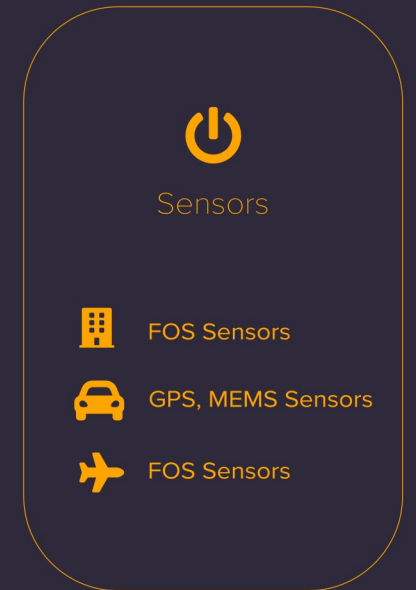
Power Conditioning Circuit



Energy Storage Component



Wireless Sensor Nodes (WSN) & IoT



**Energy
Harvesting
Systems**

Partners



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