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HARVEST

Hierarchical multifunctional composites with thermoelectrically powered autonomous structural health monitoring for the aviation industry

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769140

PROJECT OVERVIEW

- **Total budget:** 3 999 921,25 €
- **EU Contribution:** 3 999 921,25 €
- **Duration:** 36 Month Project
- **Start date:** 1 September 2018
- 11 Partners from 6 European countries
- 9 work packages (WP's)

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THE CHALLENGE

Background:

New disruptive breakthrough technologies are needed to reach the ambitious goals addressed by Europe's vision for aviation Flightpath 2050, in particular for maintaining & extending industrial leadership & for protecting the environment

Challenges:

- propose new or develop further highly innovative and exploitable breakthrough technologies for the medium term that will make feasible a substantial decrease of the impact on climate and the environment of air vehicles and/or enhance the competitiveness of the European aviation industry and the safety of civil aviation.

- demonstrate the proof of concept and consider integration issues without assuming fundamental changes at airport level.

- demonstrate the validity of the technologies and concepts following a sound technical and scientific approach as well as significant decrease in the environmental impact and/or high potential for new market opportunities for the European aviation industry.

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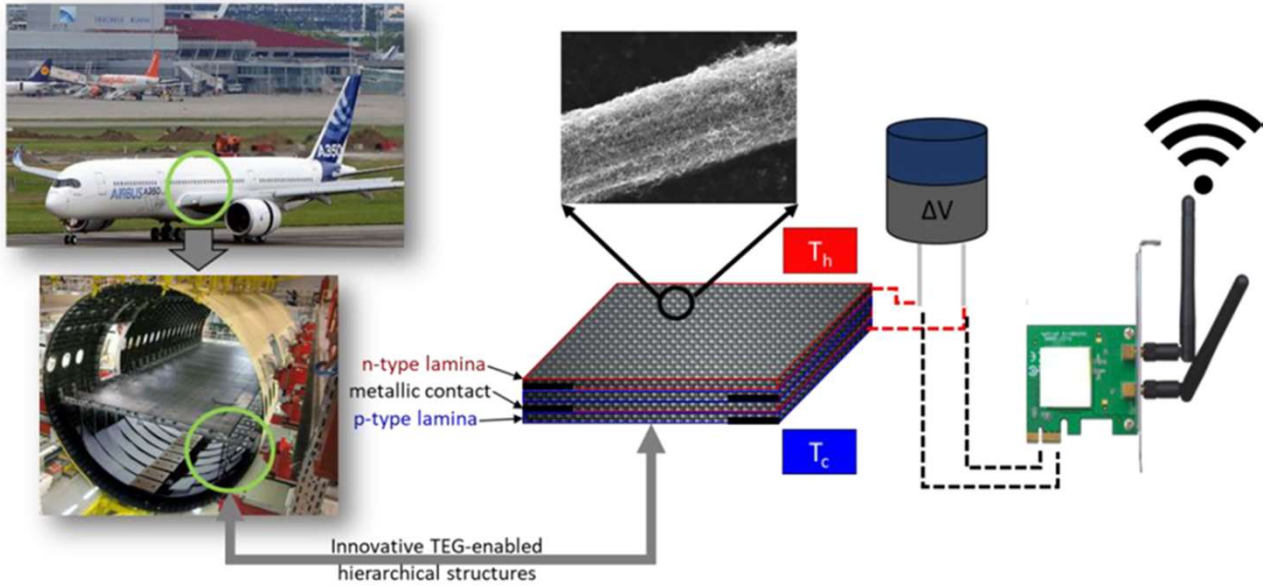
THE CONCEPT

Combination of Breakthrough technologies aiming at developing multifunctional TEG-enabled structural composite materials for the Aeronautics sector.



How?

1. Coating of CFs yarns or textiles with nanomaterials using facile & environmentally friendly deposition and doping methods in a Roll-to-Roll(R2R) pilot line targeting dramatically increased TEG performance;

2. Manufacturing of innovative TEG-hierarchical composites with new generation 3R thermoset matrix systems enabling out of autoclave manufacturing and self-repair;

3. Interfacing of the TEG-enabled composites with a purposely designed hardware to:
   (i) power inherent functionalities (e.g. strain, damage or UV exposure sensing),
   (ii) drive external elements (e.g. piezo electric sensors for SHM),
   (iii) transmit sensing signals to a remote panel, thus creating autonomous SHM systems;

4. Integration of the proposed technologies in two aircraft demonstrator parts.

OBJECTIVES

- Development of multifunctional composite materials with biomimetic hierarchical TEG-enabled CF reinforcements by R2R deposition of nanoparticle (NP) based inks
- Manufacturing of Smart 3R (Repairable, Reprocessable, Recyclable) nano-modified polymeric matrices with self-sensing and self-repairing capabilities
- Enhancement and optimization of the TEG performance using advanced analytical and numerical tools to simulate materials performance at different length scales
- Manufacturing of TEG-enabled laminated multifunctional composite structures (8 and 16 plies) with optimized number of p-n serially interconnected laminae.
- Design, development and integration of an electronic system (software & hardware) responsible for managing the energy harvesting, structural health monitoring (SHM) data accumulation and transmission
- Manufacturing of two Aeronautics Demonstrators and validation of the multifunctional capabilities under operational environments.

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EXPECTED RESULTS

- HARVEST will significantly enhance the readiness of TEG technology and the integration processes to realize TEG-enabled parts demonstrated in Aeronautics applications.
- HARVEST results might be extended to a wide range of applications where similar heat losses occur; e.g. buildings, greenhouses, smart textiles, smart autonomous systems, etc.
- HARVEST will guarantee EU-Industrial leadership in Nanomaterials and Aeronautics industries and create business opportunities of the European Transport sector industries.
- HARVEST will increase the market opportunities for EU aerospace related industries, whose interaction is expected to contribute to a future circular economy.
- HARVEST will realize the transfer of technology, promoting the collaboration of EU SMEs and large industries, toward a strong social and economic impact.
- HARVEST will allow reaching ambitious long-term goals, in particular for maintaining and extending industrial leadership and for protecting the environment (Europe's vision for aviation Flightpath 2050),

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CONSORTIUM

PARTNER	COUNTRY	MAIN EXPERTISE IN THE PROJECT
UNIVERSITY OF IOANNINA (Coordinator)	Greece	TEG-enabled hierarchical composites
FOM TECHNOLOGIES APS	Denmark	Roll-to-roll pilot line development
UNIVERSITA DEGLI STUDI DI PADOVA	Italy	Modelling of composites thermoelectric properties
INSTITUT FÜR VERBUNDWERKSTOFFE GMBH	Germany	Manufacturing and quality inspection of TEG-enabled composites
FUNDACIÓN CIDETEC	Spain	3R (Reprocess; Recycle; Repair) thermoset resins development
NANOCYL SA	Belgium	Synthesis of different carbon nanotubes, and their dispersion in thermosets
STEINBEIS ADVANCED RISK TECHNOLOGIES GMBH	Germany	Life Cycle Assessment, Life Cycle Cost , Standardization, Risks assessment
B&T COMPOSITES	Greece	Manufacturing of composites through filament winding
CARBURES AEROSPACE & DEFENSE GLOBAL SA	Spain	Manufacturing of composites through lamination + autoclave
TELETEL SA	Greece	Design and development of the electronic components required to exploit thermoelectric energy from TEG-enables composites
SOCIETE NATIONALE DE CONSTRUCTION AEROSPATIALE SONACA SA	Belgium	Manufacturing of composites through lamination + autoclave

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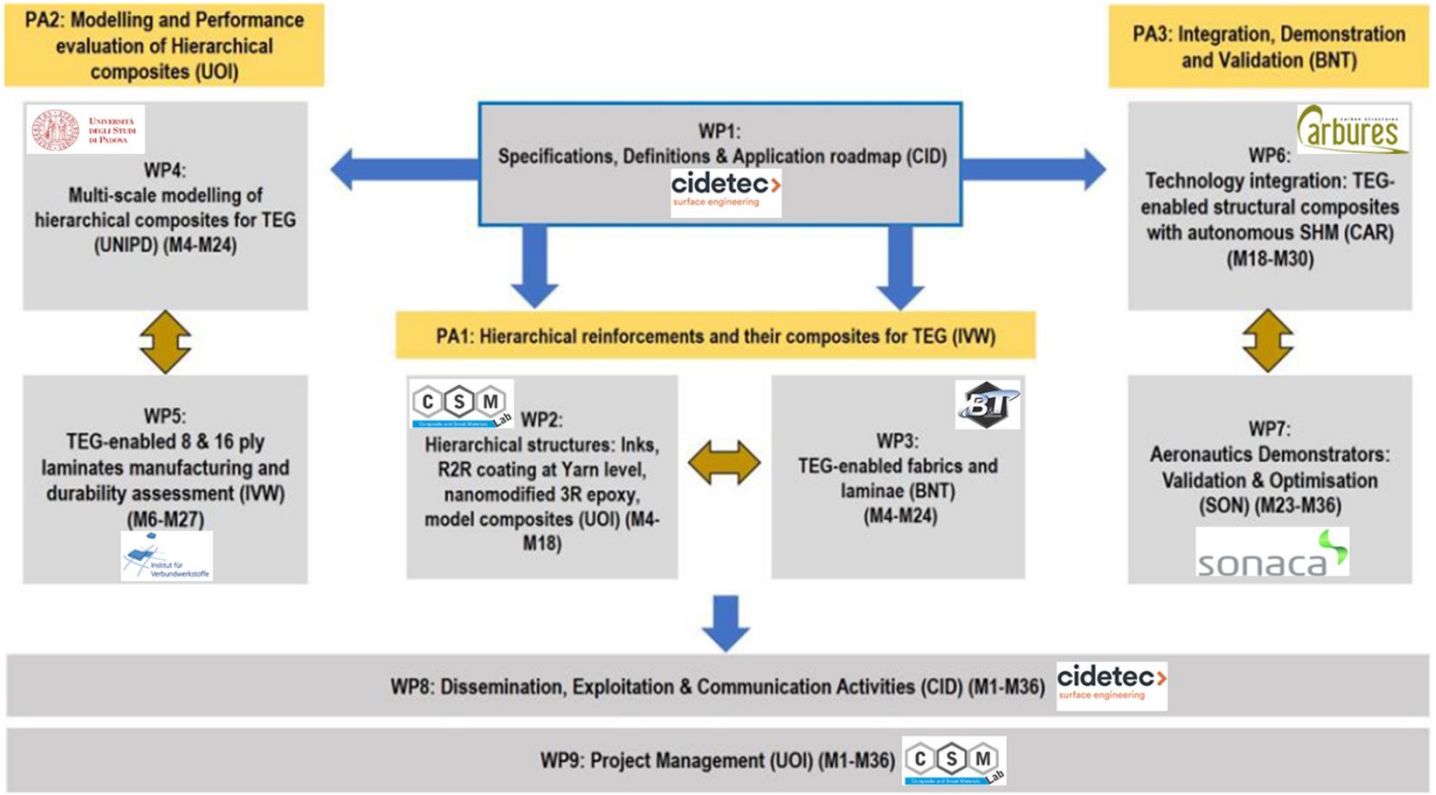
WORKPLAN

HARVEST will follow a well-defined path, divided in three project areas (PA), each one focusing on different materials engineering level, as presented in the figure below:



- **PA1**: study, modify and verify the TEG efficiency of constituent materials at the fiber, yarn and matrix nano-reinforcement level.
- **PA2**: modelling and the mechanical, electrical and thermal evaluation of the hierarchical composite structures.
- **PA3**: Integration and Validation activities.

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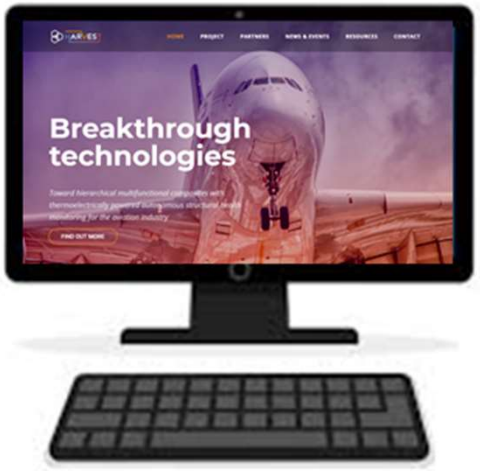
KEEP IN TOUCH



Webpage

www.harvest-project.eu

Social Media

https://www.linkedin.com/groups/8769848/

Coordinator

Professor A. S. Paipetis
UNIVERSITY OF IOANNINA
paipetis@gmail.com

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