N. Mechbal

morpho

CIRCULAR AVIATION FOR GREEN GROWTH

EU GREEN WEEK 2021 PARTNER EVENT

European Commission

ZERO POLLUTION #EUGreenWeek
for healthier people and planet

Embedded Life-Cycle Management for Smart Multimaterials Structures: Application to Engine Components

Arts et Métiers Institute of Technology

morpho

#CircularAviation #EUGreenWeek

SUSTAINair

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

FUTURE SKY

EREA

The project …

✈ Background ….

- **The call:** Next generation *multifunctional and intelligent airframe and engine parts*, with emphasis on manufacturing, maintenance and recycling
- **Challenge:** Extending EU industrial leadership through cost effective, flexible and ecological manufacturing, maintenance and recycling processes of the new generation of multifunctional airframe parts,
- **The project:** The ambition is to accompany the development of smart aeronautical *engine **fan blades***, to endow them with **cognitive capabilities**, and optimize their manufacturing and their **life cycle management**.
- **Started in April 2021** for 3.5 years – until September 2024

SUSTAINair
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952
FUTURE SKY
EREA Association of European Research Establishments in Aeronautics

The project …

10 Partners from 6 EU countries

Nr.	Partner organization name	Short Name	Country
1	Arts et Métiers Institute of Technology	ENSAM	France
2	Technische Universiteit Delft	TUD	Netherlands
3	University of Patras	UPAT	Greece
4	Safran	SAFRAN	France
5	Fraunhofer IFAM	IFAM	Germany
6	Syntesites	SYN	Greece
7	Comet Group	COMET	Belgium
8	FiSens	FiSens	Germany
9	ESI Spain	ESI	Spain
10	Fundación Empresa Universidad Gallega	FEUGA	Spain

SUSTAINair

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

Arts et Métiers Institute of Technology

morpho

EU GREEN WEEK 2021 PARTNER EVENT

#CircularAviation #EUGreenWeek

FUTURE SKY

EREA Association of European Research Establishments in Aeronautics

The project …

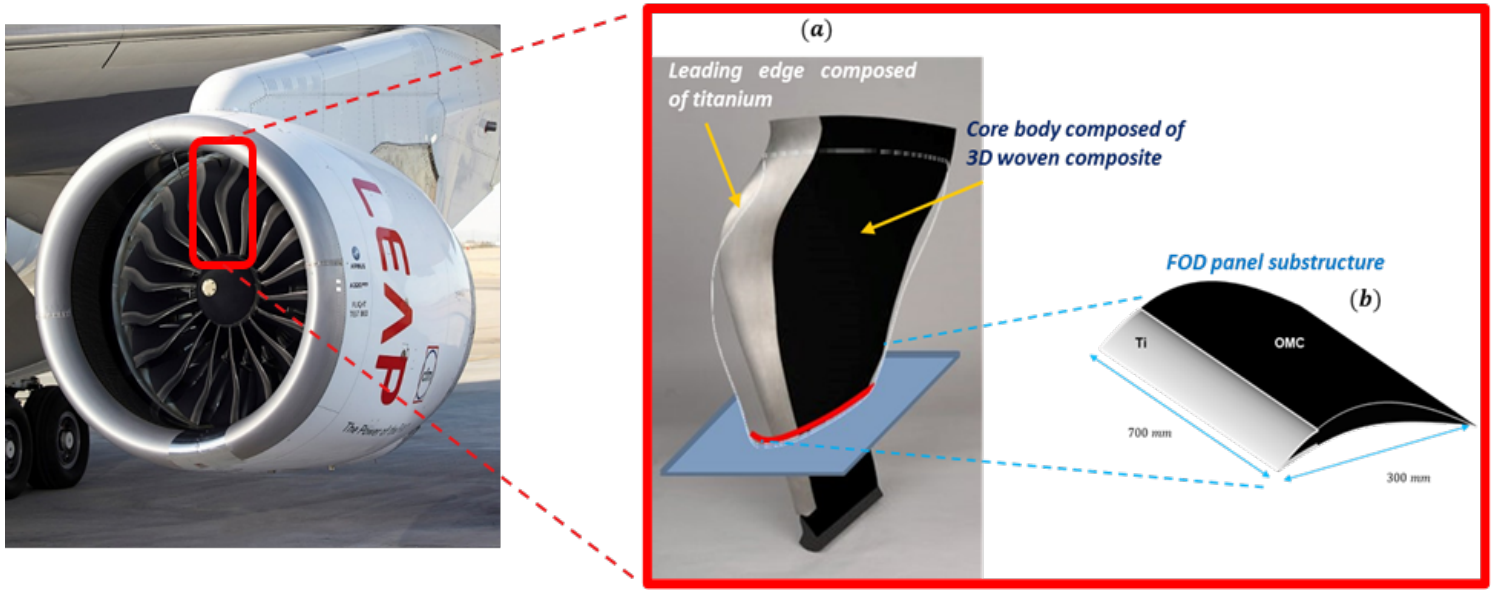
✈️ **MORPHO** aims to:

- define, design and validate an innovative, robust, and **environmentally friendly** industrial process to **manufacture, monitor during service and recycle** the new generation of intelligent, **multifunctional, multi-material structures** such as engine fan blades.
- rely **on embedded sensors**, **data-driven hybrid twins**, and **machine learning** algorithms to track the entire life cycle of the targeted aeronautical structures in real time.
- contribute to setting **standards** that will enable reliable, sustainable, agile, and cost-competitive industrialization of smart structures for aeronautics.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

Objectives …

- **Main MORPHO's objective** is to promote industrially the deployment of **smart Hybride engine fan blades (Leap)** by adopting a cognitive paradigm for their manufacturing, health monitoring during service and recycling.



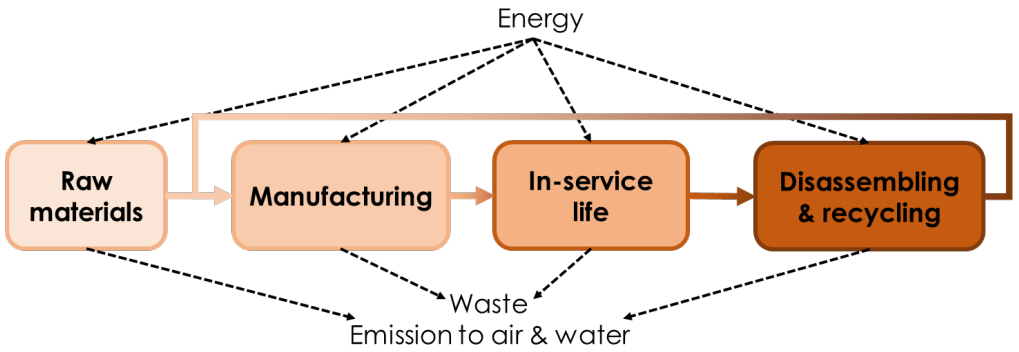
EU GREEN WEEK 2021 PARTNER EVENT

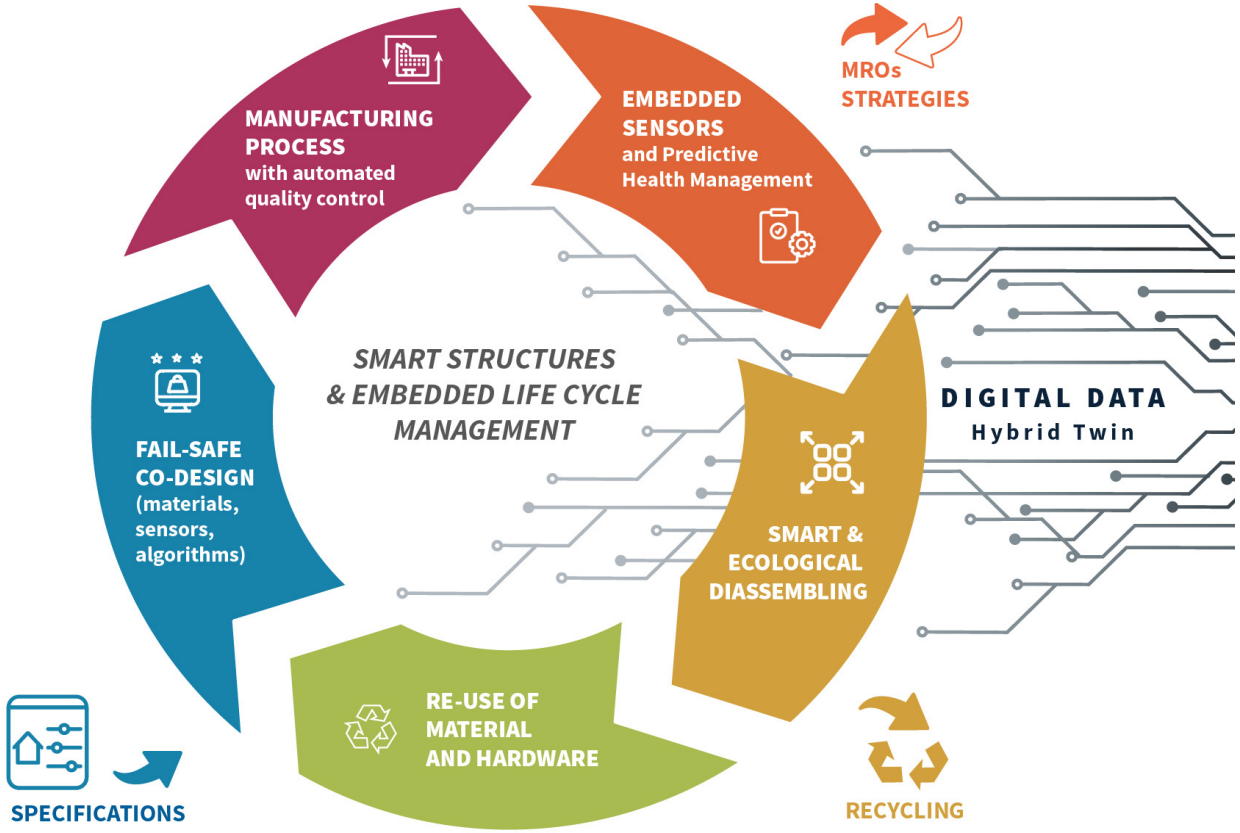
#CircularAviation #EUGreenWeek

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

Concept ...

Use **on-board sensors** and **hybrid twins** approaches to provide aeronautical structures **cognitive capabilities** allowing them to manage and assess their entire life cycle.





SUSTAINair

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

Arts et Métiers Institute of Technology

morpho

EU GREEN WEEK 2021 PARTNER EVENT

#CircularAviation #EUGreenWeek

FUTURE SKY

EREA Association of European Research Establishments in Aeronautics

Innovative technologies ….

✈ Prognostic and Health Monitoring Methodology

✓ *Probabilistic **SHM** data-driven methodologies for damage assessment as well as RUL estimation accompanied by **uncertainty quantification** will be developed and validated*

✈ Hybrid twin for smart structure and RTM process manufacturing

✓ Develop a **numerical tool** to simulate all the physics occurring to predict the final properties of the cured material that will be confronted and **adapted on-fly** using data provided by the sensors

SUSTAINair
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952
FUTURE SKY
EREA Association of European Research Establishments in Aeronautics

Innovative technologies ….

✈ Printed sensors and electronics for SHM and manufacturing

- ✓ ***Print*** *smart systems on top of composites for lightweight constructions*

✈ Advanced RTM manufacturing process:

- ✓ ***Embedding FBGs Sensors***
- ✓ ***Dielectric sensors for*** *process monitoring*

Arts et Métiers Institute of Technology

morpho

EU GREEN WEEK 2021 PARTNER EVENT

#CircularAviation #EUGreenWeek

SUSTAINair

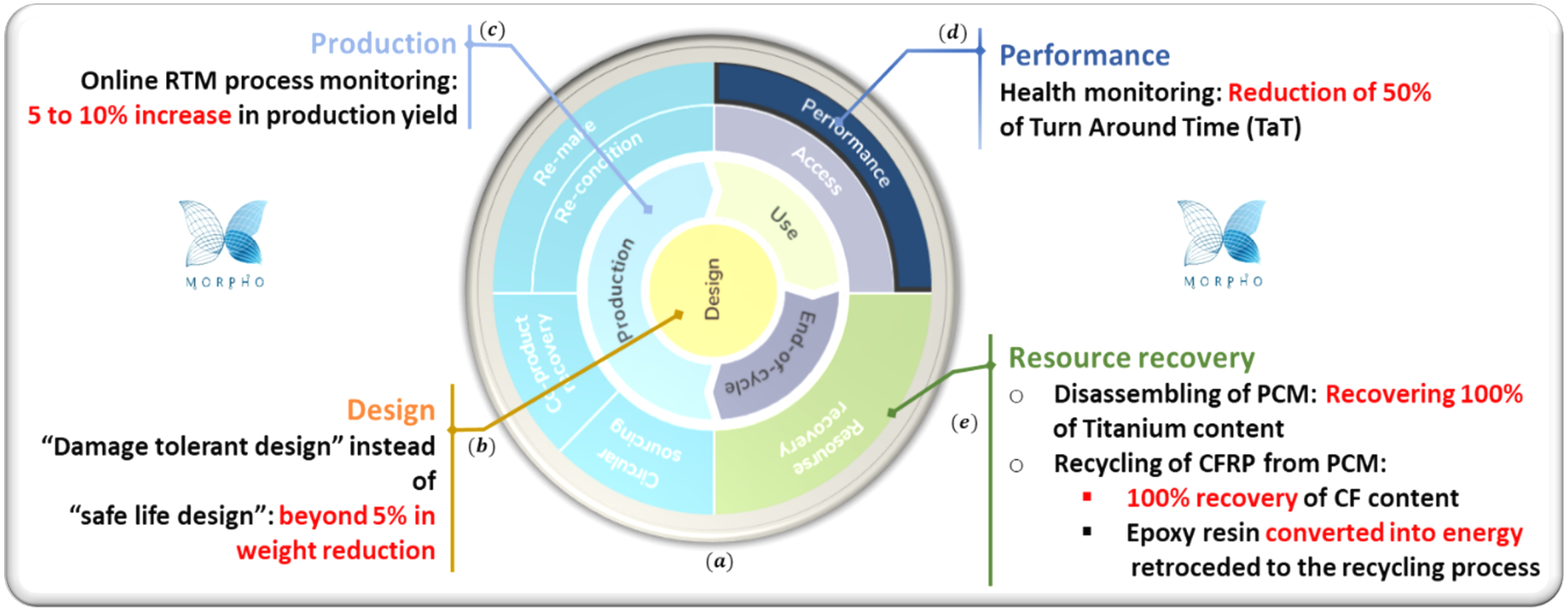
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

FUTURE SKY

EREA Association of European Research Establishments in Aeronautics

Outcomes …

MORPHO's outcomes in the circular economy business models:



SUSTAINair

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

Arts et Métiers Institute of Technology

morpho

EU GREEN WEEK 2021 PARTNER EVENT

#CircularAviation #EUGreenWeek

FUTURE SKY

EREA Association of European Research Establishments in Aeronautics

The project …

✈ Environmental-friendly manufacturing

- Efficient, profitable, and environmental-friendly **manufacturing**, maintenance, and **recycling** of these next-generation smart engine fan blades.

- Push industrial and environmental efficiency in line with the European Commission **Circular Economy** Action Plan

- New processes related to the **disassembly** of the hybrid material and the recycling of their parts: offer aeronautical products and services at competitive costs and in line with the concepts of the circular economy.

SUSTAINair
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952
FUTURE SKY
EREA Association of European Research Establishments in Aeronautics

morpho

Thank you!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006854

Arts et Métiers Institute of Technology

morpho

EU GREEN WEEK 2021 PARTNER EVENT

#CircularAviation #EUGreenWeek

SUSTAINair

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006952

FUTURE SKY

EREA Association of European Research Establishments in Aeronautics