ZERO EMISSIONS MISSION

Development of smart propulsion technology for zero-emission regional air transport.

VOLOTEA · AIR NOSTRUM LINEAS AEREAS · DA

Infographics: relajaelcoco · Data: Volotea + Dante

Objectives

01. To reduce emissions

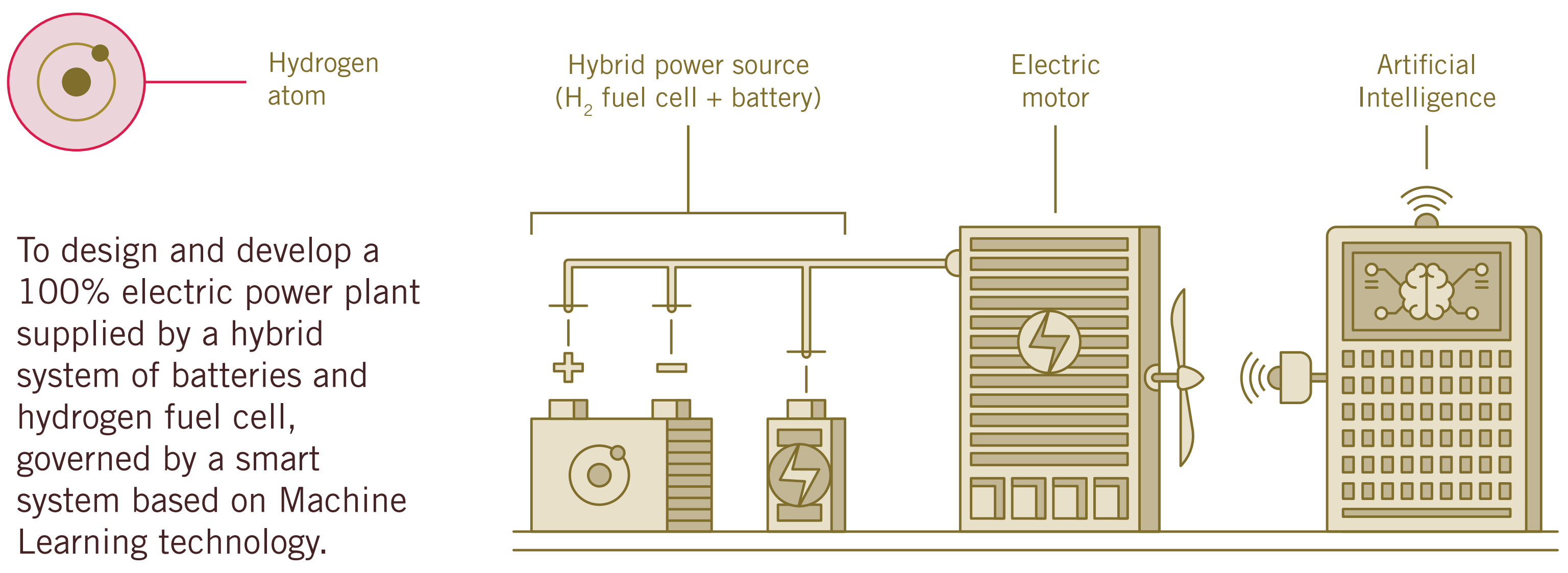
02. 100% electric aircraft

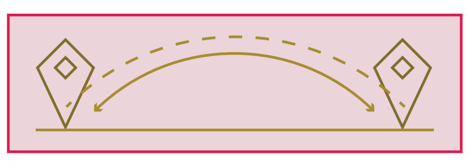
03. Sustainable regional aviation

04. To provide innovative solutions

Primary objective:

To design and develop a 100% electric power plant supplied by a hybrid system of batteries and hydrogen fuel cell, governed by a smart system based on Machine Learning technology.





This aircraft will enable point-to-point connections between small population centres thanks to its reduced operating costs, comparable to those of much larger aircraft. It will be the backbone of passenger traffic in regional Europe.

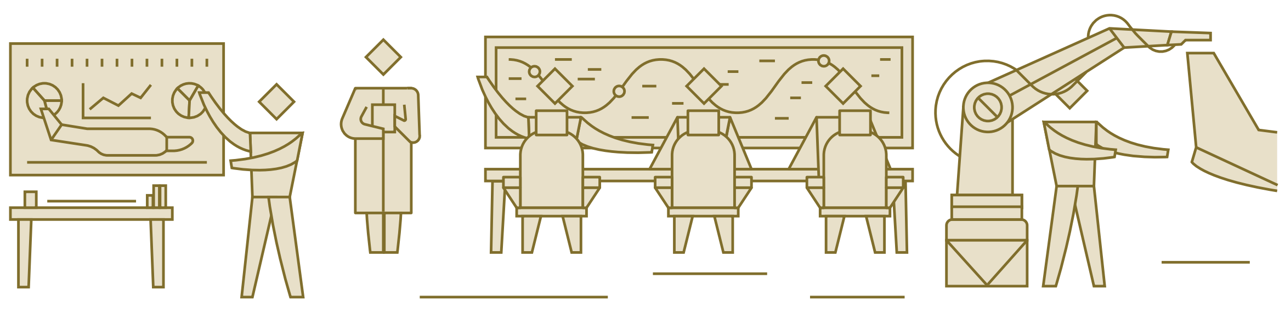
Secondary objectives:

1. Conversion of existing aircraft
Replace conventional powerplants with fully electric ones.

2. Paradigm shift
Cleaner, more sustainable and efficient air transport with a high technology component developed in Spain.

Technological challenge

Demonstrate that retrofitting existing aircraft into full electric by replacing their internal combustion engines with zero emission powerplants is technically and financially feasible.



Phases:

01. Design
Transformation of existing model.

02. Prototype
Production of the first pilot unit.

03. Flight Tests
Flight and ground testing to generate and gather data.

04. Iteration
Analysis of results and implementation of improvements.

05. Production / Scaling
Future move from single-engine to twin-engine aircraft.

Aircraft electrification

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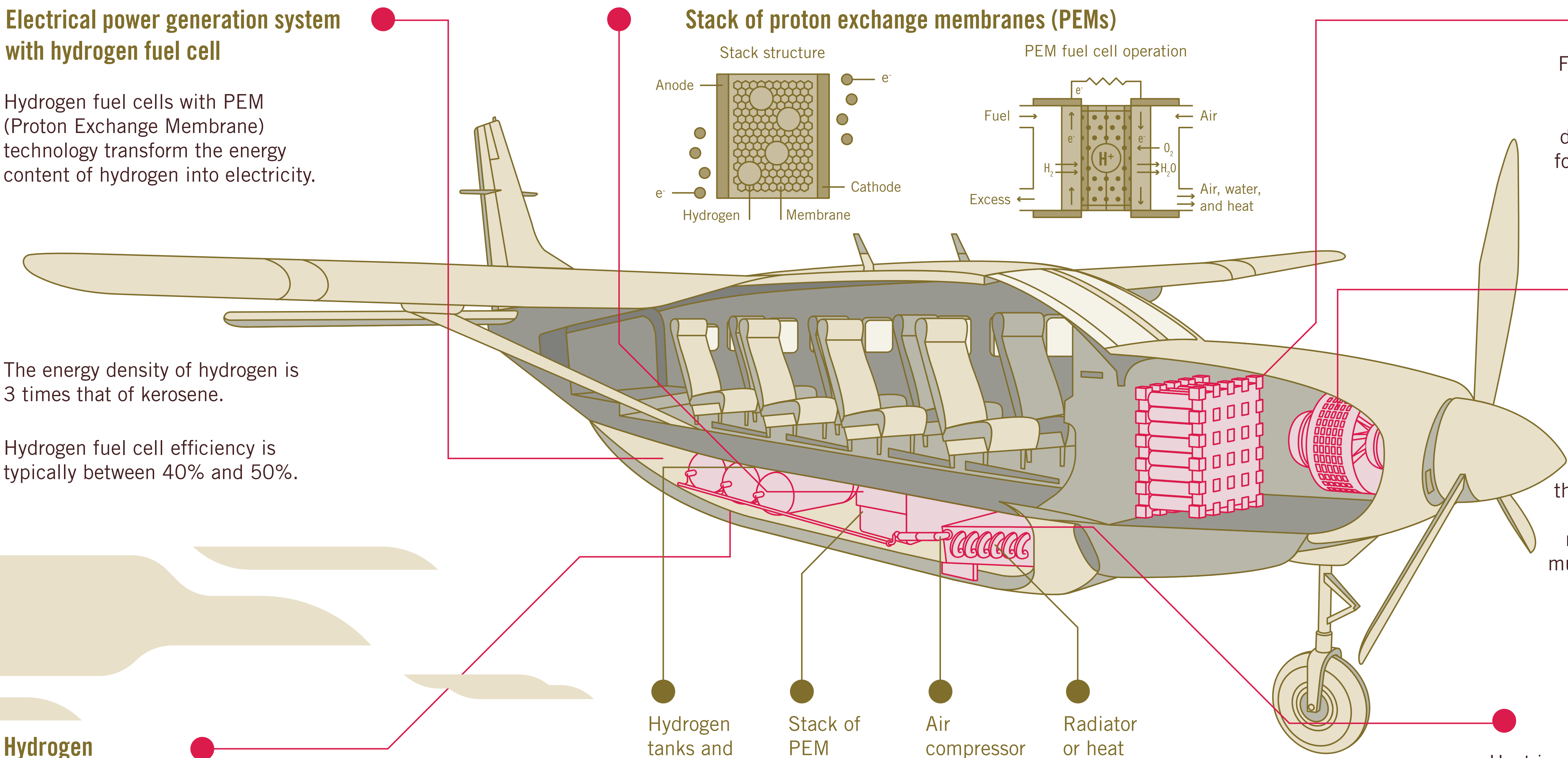
Electrical power generation system with hydrogen fuel cell

Hydrogen fuel cells with PEM (Proton Exchange Membrane) technology transform the energy content of hydrogen into electricity.

Stack of proton exchange membranes (PEMs)



Battery module

For power peaks at take-off and climbing. The cells selected allow for high discharge levels, necessary for phases such as take-off.

Electric motor

Efficiency > 90%

Electric motors are much more efficient (>90%) than internal combustion engines (less than 40%). Additionally, as they have practically no moving parts, they require much less maintenance and have a much longer life.

The energy density of hydrogen is 3 times that of kerosene.

Hydrogen fuel cell efficiency is typically between 40% and 50%.

Hydrogen storage system

Hydrogen is stored as a gas in high-pressure vesel (700 bars) to reduce the required volume.

These tanks need to be very resistant to withstand the high hydrogen pressures.

The weight in hydrogen typically does not go over 6-8% of the total system weight.

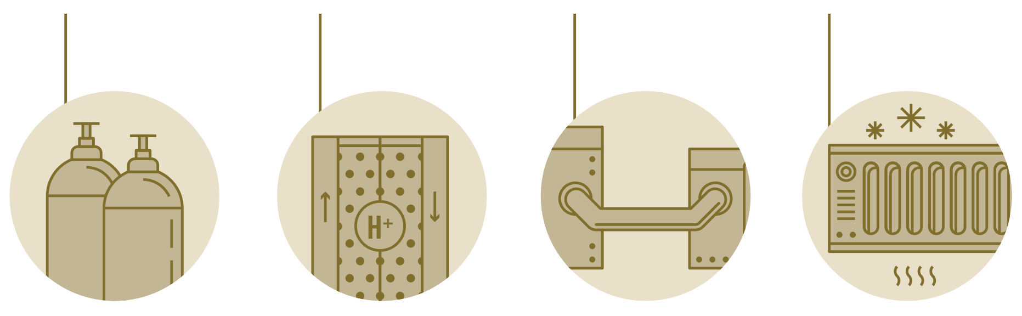
6-8%
Weight of hydrogen

Hydrogen tanks and supply system

Stack of PEM membranes

Air compressor

Radiator or heat exchanger



● Electric power plant with hybrid system

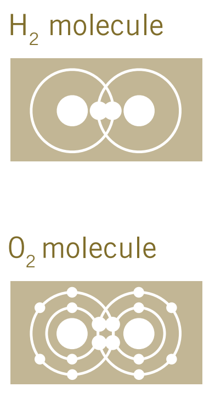
● Energy generating system

Cooling system

Heat is a byproduct of the reaction between H_2 and O_2 that generates electricity and produces water.

An active cooling system may be required, using a closed-loop liquid circuit, typically water with some additive that dissipates the heat generated in the PEM stacks.

Excess heat is released to the atmosphere through a radiator or heat exchanger.



Sustainable aircraft

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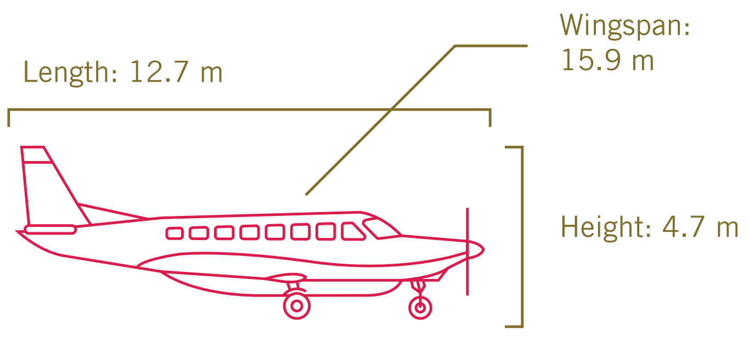
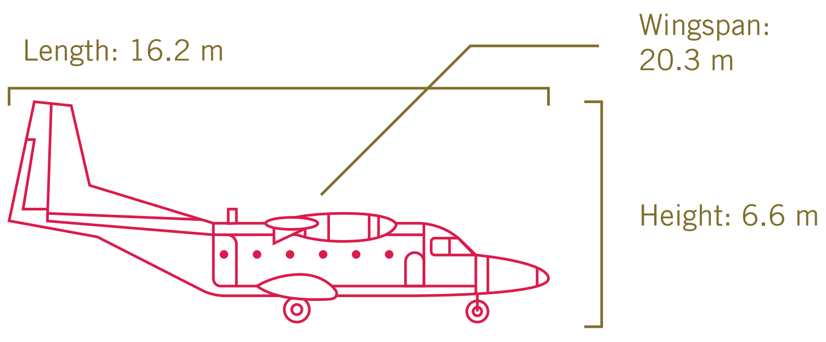
01. Retrofit of 9-seat aircraft

Conversion of short- and medium-range commercial aircraft to 100% electric.



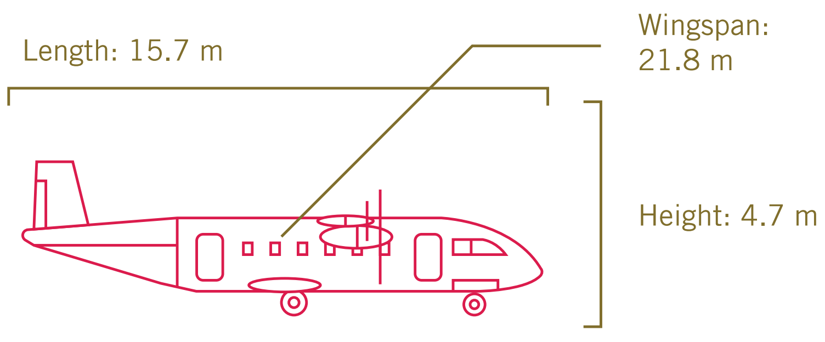
02. Retrofit of 19-seat aircraft

Conversion of short- and medium-range commercial aircraft to 100% electric.



03. 19-Passenger concept aircraft

DAX19 hybrid regional aeroplane design. Parallel project started in 2018.

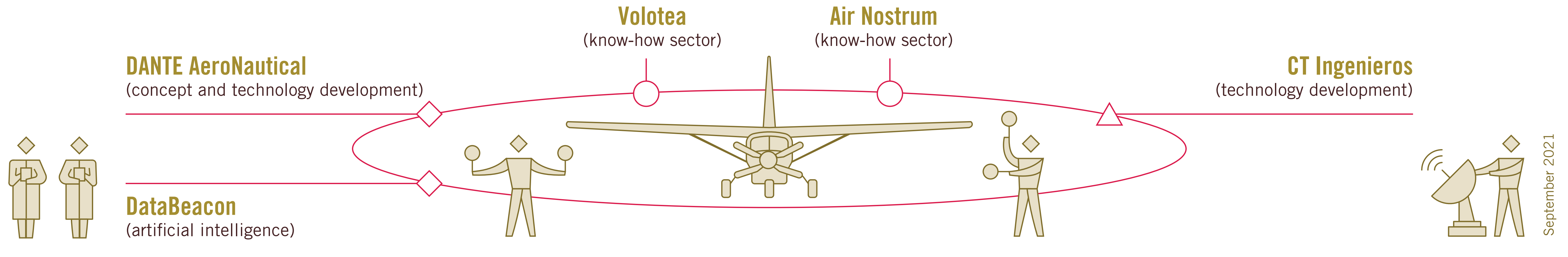


Development plan

The consortium

Partnership of five organizations joining efforts to develop a first prototype of a small regional aircraft retrofitted into 100% electric.

◇ SMEs ○ Airlines △ Major companies



Volotea
(know-how sector)

Air Nostrum
(know-how sector)

DANTE AeroNautical
(concept and technology development)

CT Ingenieros
(technology development)

DataBeacon
(artificial intelligence)

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