





SIXTH FRAMEWORK PROGRAMME

Thematic Priority: 1.4: Aeronautics and

ENF  CA ^{FC} 

ENFICA-FC: ENvironmentally Friendly Inter-City Aircraft powered by Fuel Cells.

Proposal/Contract no.: *AST5-CT-2006-030779*

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EUROPEAN AERONAUTICS: A VISION FOR 2020



Meeting society's
needs and winning
global leadership

A Vision for 2020

- The ENFICA-FC proposal is in response to the FP6 3rd call and will address Thematic Priority 1.4 AERONAUTICS & SPACE, according to the top level objectives in the Strategic Research Agenda and Vision 2020 Report:
- To meet society's needs for a more efficient, safer and environmental friendly transport
- To win global leadership for European aeronautics, with competitive supply chain, including small and medium size enterprises

The ENFICA-FC project is proposing an alternative innovative aircraft; one, which is more silent and less polluting aircraft that will be able to takeoff and land from congested urban areas using short airfields.

All the main objectives that are being dealt with the ENFICA-FC project respond to the major challenges identified in the Strategic Research Agenda for European aeronautics:

- ❑ Research for strengthening the competitiveness of the aeronautical industry in the global market, responding to the challenge of delivering more economical, high performance and better quality products and services.
- ❑ Research for improving the environmental impact with regard to emissions and noise, responding to the challenge of meeting the society's demand for sustainable transport.
- ❑ The project offers opportunities for new operational concepts resulting in the following:
 - Noise abatement friendly
 - Low or zero pollutants
 - Takeoff and landing from short airfields under 2000 feet.

1. POLITECNICO TORINO (Coordinator)	POLITO	Italy
2. METEC (Adm. Management)	METEC	Italy
3. ISRAEL AIRCRAFT INDUSTRY	IAI	Israel
4. EVEKTOR	EVE	Czech Rep.
5. JIHLAVAN Airplanes	JA	Czech Rep.
6. BRNO UNIV. of TECH	BUT	Czech Rep.
7. INTELLIGENT ENERGY	IE	United Kingdom
8. AIR PRODUCTS	APL	United Kingdom
9. UNIV. LIBRE de BRUXELLES	ULB	Belgium
10. ENIGMATEC	ENIG	United Kingdom
11. INFOCOSMOS	INFO	Greece

To develop and validate the use of a fuel cell based power system for propulsion of more/all electric aircraft. ENFICA-FC will directly target the massive reduction of noise and emission developing a new environmental friendly aircraft concept. This great effect will have a strong direct positive impact on the quality of life and health of the European Citizens.

ENFICA-FC Short History and Future

- July 2005: Submission of Proposal
- December 2005: 1st Communication of Positive Evaluation
- February 2006: Proposal Retained for Negotiation
- April 2006: Final Proposal Submission
- July 2006: Agreement for starting the project
- 1st October 2006: ENFICA-FC Starting Date
- 4th October 2006: Received Contract for Signature
- 10-11th October 2006: Kick-off Meeting
- end October: Contract Signature
- end October: Consortium Agreement Approval

Total Cost: 4.445.400€- EC Funding: 2.918.600€

Project Main innovative aspects

- ❑ **First European flight test** of an aircraft powered by fuel cells;
- ❑ **First European feasibility and reliability study** of high efficiency fuel cells energy propulsion system & brushless electric motors for transport aircraft.
- ❑ **Development of Fuel Cells technology** and its application in aviation leading to enhancements in the European industry.
- ❑ **Low noise and low emissions aircraft.** In the case of using pure Hydrogen fuel, the result is zero emissions. The low noise and low emissions advantages are particularly important for small transport airplanes that usually takeoff and land from urban areas.
- ❑ The more/all electric aircraft has **advantages in reliability, maintainability** and in some aspects of the performance- only slight reduction in engine performance due to altitude.
- ❑ **NO OTHER PROJECT FUNDED BY European Commission** will give such ambitious results and it will be presented on ground and in flight in a public event within the scheduled time

BACKGROUND

Rapidly emerging hydrogen and fuel cell power based technologies can now be exploited to initiate a new era of propulsion systems for light aircraft and small commuter aircraft. In addition, these technologies can also be developed for the future replacement of on-board electrical systems in larger 'more-electric' or 'all-electric' aircraft.

The feasibility of this project is dependent on several key-enabling technologies including fuel cell stacks and integrated systems, hydrogen fuel storage and a safe airport based hydrogen-refuelling infrastructure. Another important consideration is that it should demonstrate the path to future economic viability.

The primary advantages of deploying these technologies are low noise and low emissions – features which are particularly important for commuter airplanes that usually takeoff and land from urban areas. The possibility to takeoff and land within the noise abatement regulations set for small airfields, in urban areas and near population centres, will allow the use of these airfields during the late night hours when the noise abatement regulations are even more stringent.

PROJECT OBJECTIVES

The main objective of the ENFICA-FC project is to develop and validate the use of a fuel cell based power system for propulsion of more/all electric aircraft. The fuel cell system will be installed in a selected aircraft which will be flight and performance tested as a proof of functionality and future applicability for inter city aircraft. It will also demonstrate that noise levels and pollutant emissions can be significantly reduced, or even eliminated, by more/all electric aircraft in the air and on the ground.

NO OTHER PROJECT FUNDED BY The European Commission will give such ambitious results and it will be presented at both an on-ground public event and at in-flight public event within the scheduled time.

A feasibility study will be carried out to define new aircraft propulsion systems that can be achieved by fuel cell technologies, together with other aircraft based applications. The feasibility study of the Inter-city aircraft would be carried out taking into account the future generation of fuel-cells with much higher performances as expected within the next 10-15 years.

This will all be achieved within in a 36 month project duration.

DESCRIPTION OF THE WORK

- 1) A feasibility study will be carried out to provide a preliminary definition of new forms of aircraft propulsion systems that can be obtained by fuel cell technologies; the following items shall be pursued:
 - ❑ Identification and requirements of specific applications for regional transport aircraft (APU, primary electrical generation supply, emergency electrical power supply, landing gear, etc).
 - ❑ Propulsion system preliminary definition including: Fuel stack (comparison between PEM, SOFC, MCFC, etc), hydrogen storage or direct on-board production, fuel cell system, electric motor and power management system.
 - ❑ Preliminary relevant systems and subsystem definition; integration of Fuel Cell Systems in pressurised structure of aircraft; operational behaviour.
 - ❑ Safety, certification, maintenance and installation.
 - ❑ Reliability and maintainability concept definition. Life Cycle Cost evaluation.

DESCRIPTION OF THE WORK

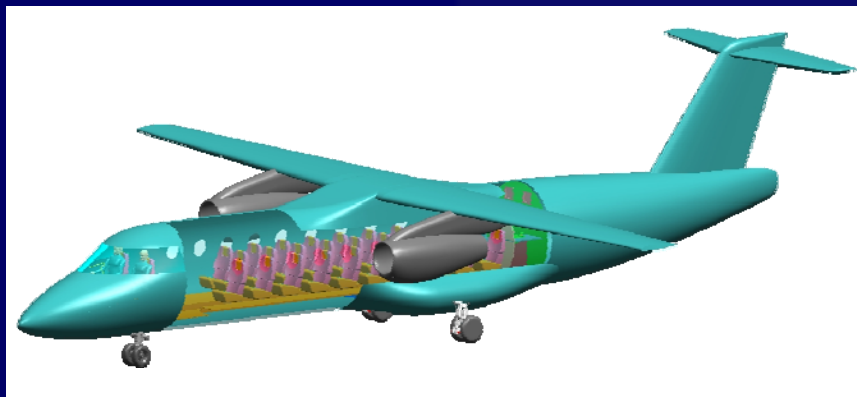
2) A scaled size electric-motor-driven airplane powered by fuel cells will be developed and validated by flight-test.

A high efficiency existing design of two-seat aircraft that is already certified will be used. The fuel cell system and the electric motor will be integrated on board; the flight control system would also be converted into an electric system. The following items shall be pursued:

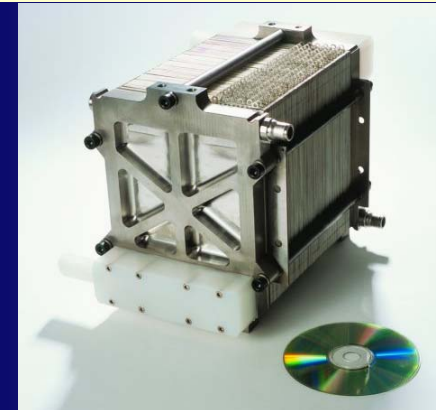
- A fuel cell unit shall be designed, built and tested in laboratory ready to be installed on board for flying
- A high efficiency brushless electric motors and power electronics apparatus for their control shall be designed and manufactured ready to be installed on board for flying
- Efficiency greater than 90% would be obtained by an optimised aerodynamic propeller design.
- A study of the flight mechanics of the new aircraft will be carried to verify the new flight performance.
- Flight test bed of the aircraft capable of remaining aloft for one hour will be the main goal of the project to validate the overall high performance of an all electric aircraft system.

Environmentally Friendly Inter City Aircraft
powered by Fuel Cells.

IAI
(Small Commuter Jet - 20 PAX)



INTELLIGENT ENERGY
20kW Stack



EVEKTOR

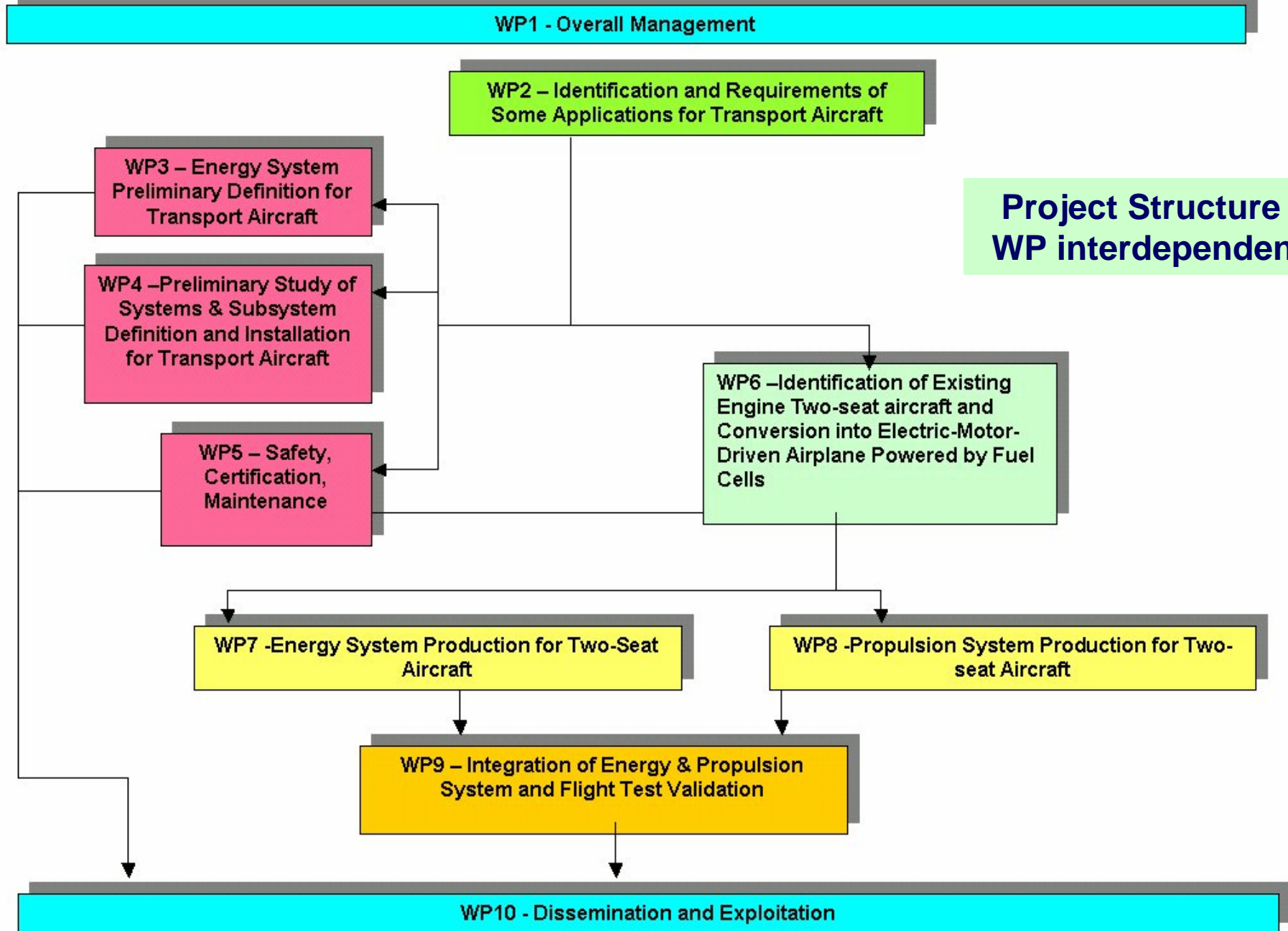


JIHLAVAN Airplanes



- WP1 - Overall Management**
- WP2 – Identification and Requirements of Some Applications for Transport Aircraft**
- WP3 – Energy System Preliminary Definition for Transport Aircraft**
- WP4 - Preliminary Study of Systems & Subsystem Definition and Installation for Transport Aircraft**
- WP5 – Safety, Certification, Maintenance**
- WP6 – Identification of Existing Engine Two-seat aircraft and Conversion into Electric-Motor-Driven Airplane Powered by Fuel Cells**
- WP7 - Energy System Production for Two-seat Aircraft**
- WP8 – Propulsion System Production for Two-seat Aircraft**
- WP9– Integration of Energy & Propulsion System and Flight Test Validation**
- WP10 – Dissemination & Exploitation**

Project Structure and WP interdependencies



Gantt Chart

Environmentally Friendly Inter City Aircraft
 powered by **Fuel Cells**

