



HYCARUS

Hydrogen cells for airborne usage

Panel 1 — Technology validation in transport applications

Acronym:	HYCARUS
Project ID:	325342
Title:	Hydrogen cells for airborne usage
Call Topic:	SP1-JTI-FCH.2012.1.6
Project total costs (€):	€ 12,0 million
FCH JU maximum contribution (€):	€ 5,2 million
Project start/end:	01 May 2013 - 30 Apr 2018
Coordinator:	Zodiac Aerotechnics, France
Beneficiaries:	Air Liquide Advanced Technol., Dassault Aviation, Zodiac Cabin Controls, Arttic, Commissariat à l'Energie Atomique et aux Energies Alternatives CEA, Driessen Aerospace, Inst. Nacional de Tecnica Aeroespacial, JRC -Joint Research Centre, European Commission, Zodiac ECE
Website:	http://hycarus.eu/

Project and objectives

HYCARUS develops a Generic Fuel Cell System (GFCS) in order to power non-essential aircraft applications such as a galley in a commercial aircraft or to be used as a secondary power source on-board business jets. Demonstration of GFCS performances in relevant and representative cabin environment (TRL 6) will be achieved through flight tests on-board a Dassault Falcon aircraft. Moreover, HYCARUS will assess how to valorise the by-products (especially heat and Oxygen Depleted Air - ODA) produced by the fuel cell system to increase its global efficiency.

Major project achievements

- ▶ Completion of the verification tests of the whole GFCS
- ▶ Completion of the design and the tests of the different components and sub-systems of the GFCS
- ▶ Completion of the functional Hazard Assessment & Preliminary System Safety Assessment

Future steps

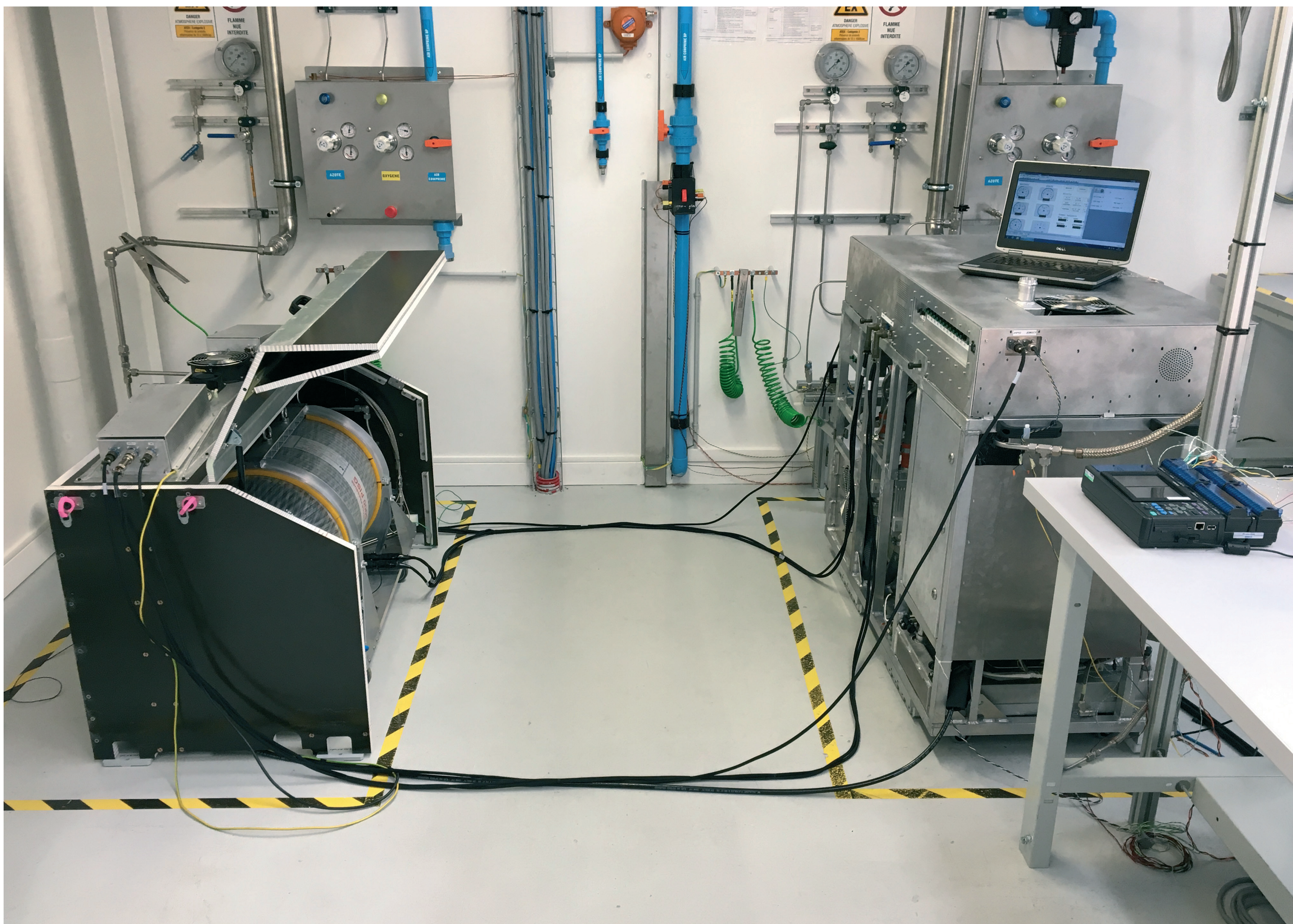
- ▶ Completion of the verification tests of the whole GFCS
- ▶ System Safety Assessment completion
- ▶ Flight Readiness Process completion
- ▶ Environmental tests of the GFCS for the flight test configuration

Non-quantitative objectives and status

- ▶ Proof of concept of H₂ storage and supply on-board an aircraft
- ▶ Gaseous 350 bars H₂ storage and supply system developed. H₂ leakage and safety management strategy approved. Demonstration planned for 2017
- ▶ Demonstrate operational capacity for such systems in aircrafts
- ▶ Fuel Cell system specification and qualification plan completed. Environmental and Flight tests planned for 2017

Quantitative targets and status

Target Source	Parameter	Unit	Starting point	Target for project	Achieved to date in project	Best est. of final project result	Target: status on May 1 st 2017	Description
AIP 2011	Demonstrator TRL	TRL	3	6	4	6	Due later	FC sub-systems tested, Functional FC system tests ongoing for flight tests configuration
AIP 2011	Power range	kW		20.00	12.5	20.00	Due later	FC sub-systems tested, Functional fc system tests for flight tests configuration ongoing (galley configuration tests are planned late on.
AIP 2011	Durability	Hrs		2500	2000	2000	Achieved	Only FC stack durability tests performed (2000 hrs, under flight representative load profiles)
AIP 2011	FC system efficiency (LHV) @ 25% of rated power	%		55	45	45	Not achieved	based on simulation results, tests to be performed in 2018
AIP 2011	FC system power density (End of life – EoL)	kW/L		0.40	0.02	0.02	Not achieved	H ₂ storage excluded. Initial target very ambitious in the timeframe of the project, for an aerospace 20kWe FC system.
AIP 2011	FC system specific power (EoL)	kW/kg		0.65	0.10	0.10	Not achieved	H ₂ storage excluded. Initial target very ambitious in the timeframe of the project, for an aerospace 20kWe FC system.





HYLIFT-EUROPE

Large scale demonstration of fuel cell powered material handling vehicles

Panel 1 — Technology validation in transport applications

Acronym:	HYLIFT-EUROPE
Project ID:	303451
Title:	Large scale demonstration of fuel cell powered material handling vehicles
Call Topic:	SP1-JTI-FCH.2011.4.1
Project total costs (€):	€ 22,0 million
FCH JU maximum contribution (€):	€ 9,3 million
Project start/end:	01 Jan 2013 - 31 Dec 2017
Coordinator:	Ludwig-Boelkow-Systemtechnik, Germany
Beneficiaries:	Air Products, Copenhagen Hydrogen Network, Dantherm Power, Fast - Federazione delle Associazioni Scientifiche e Tecniche, Air Liquide Advanced Business, Element Energy Ltd, H2 Logic, Mulag Fahrzeugwerk Heinz Wössner, Heathrow Airport Ltd, Still, JRC -Joint Research Centre, European Commission, Prelocentre
Website:	http://www.hylift-europe.eu/

Project and objectives

The aim of HyLIFT-EUROPE is to demonstrate more than 200 fuel cell (FC) material handling vehicles and associated refuelling infrastructure at more than 2 sites across Europe (the initial plan foresaw 5-20 sites), making it the largest European trial of hydrogen fuel cell material handling vehicles to date. This continues efforts of the previous FCH JU supported project HyLIFT-DEMO. In the HyLIFT-EUROPE project, the partners demonstrate FC systems in material handling vehicles from the partner STILL and from non-participating OEMs.

Major project achievements

- Demonstration in real-world operation of 49 materials handling vehicles at the Prelocentre site
- Demonstration in real-world operation of an indoor hydrogen refuelling station including hydrogen supply at the Prelocente site
- Identification of a further customer to install also a fleet of FC forklifts enabling the project to achieve the 200 vehicles target

Future steps

- Extension of the project beyond current end date to demonstrate the new forklifts
- Start-up of second demonstration fleet at second site (137 FC materials handling vehicles in total)
- Large opening ceremony foreseen in second half of 2017



Quantitative targets and status

Target Source	Parameter	Unit	Starting point	Target for project	Achieved to date in project	Best est. of final project result	Target: status on May 1 st 2017	Description
MAIP 2008-2013	Nr vehicles	[-]	11	200	49	201	Due later	11 vehicles ex HyLIFT-DEMO, 49 at Prelocentre. Contracts signed for achieving target
AIP 2011	Nr FC systems	[-]	11	200	49	201	Due later	
AIP 2011	FC system efficiency	[%]	45	45-50	>45	>45	Achieved	Target already reached with past generation FC systems
AIP 2011	Refuelling time	[min]	n.a.	~3	2.5	2.5	Achieved	Application of most advanced refuelling technology
AIP 2011	HRS availability	[%]	98	>98	>99	>99	Achieved	Application of most advanced refuelling technology
Project's own	Nr HRS	[-]	0	≥ 2	2	2	Achieved	

Non-quantitative objectives and status

- Validation of Total Cost of Ownership (TCO) & path towards commercial target
Validation of TCO and development of the path towards commercial targets are taking place
- Plan and ensure initiation of supported market deployment beyond 2018
The project and demonstration volume in itself provide first step towards commercialisation by selling the vehicles at commercially competitive prices
- Best practice guide for hydrogen refuelling station installation
A best practice guide documents in detail the lessons learned from obtaining safety approval for an airport HRS
- European dissemination and supporting of the European industry
The European dissemination and supporting of the European industry is a still ongoing task to be finished only at the end of the project

Relevant to FCH JU overarching objectives

- Reduce the production cost of fuel cell systems to be used in transport applications, while increasing their lifetime to levels which can compete with conventional technologies

