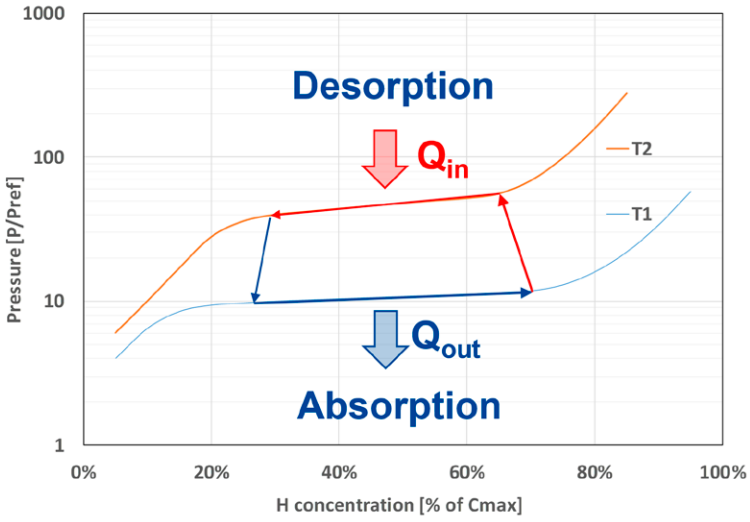
COSMHYC

COMBINED HYBRID SOLUTION OF MULTIPLE HYDROGEN COMPRESSORS FOR DECENTRALISED ENERGY STORAGE AND REFUELLING STATIONS

Project ID:	**736122**
Call topic:	**FCH-01-8-2016** - Development of innovative hydrogen compressor technology for small-scale decentralised applications for hydrogen refuelling or storage
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€2 496 830**
FCH JU max. contribution:	**€2 496 830**
Project start - end:	01/01/2017 - 30/09/2020
Coordinator:	**EIFER EUROPAISCHES INSTITUT FUR ENERGIEFORSCHUNG EDF KIT EWIV, DE**
Website:	**www.cosmhyc.eu**



BENEFICIARIES: STEINBEIS INNOVATION GGMBH, LUDWIG-BOELKOW-SYSTEMTECHNIK GMBH, NEL HYDROGEN AS, MAHYTEC SARL, STEINBEIS 2I GMBH

PROJECT AND OBJECTIVES

COSMHYC is developing a hybrid compression solution for hydrogen refuelling stations by combining an innovative metal hydride and mechanical compressor, for a compression from 1 to 1 000 bar. The objectives are to decrease investment and operational costs, reduce noise level, increase the availability of stations, and thus to increase the efficiency of hydrogen delivery. MAHYTEC, EIFER and NEL are currently focusing on the integration of both technologies, which are being comprehensively tested. A techno-economic assessment is being performed to ensure the competitiveness of the solution.

NON-QUANTITATIVE OBJECTIVES

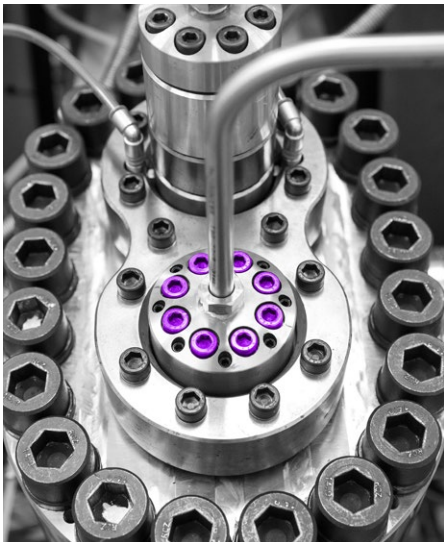
- Modularly scalable
- Design is intrinsically scalable
- Increased reliability
- No moving part in the innovative compressor
- Perform a cost-of-ownership assessment
- Ongoing dedicated activities in the project.

PROGRESS AND MAIN ACHIEVEMENTS

- Production of over 1 000 kg of metal alloys without rare earth for the innovative metal hydride compressor, which has been commissioned
- Design and testing of a new mechanical compressor prototype with validated improved endurance, lower energy consumption and significant noise reduction
- Site commissioned for long-term tests of the metal hydride compressor following test protocol for validation of the hybrid compression concept.

FUTURE STEPS AND PLANS

- Long-time testing of the COSMHYC compression solution as a virtual compressor following joint test programs and protocols of the complete system
- Collection of operative and performance data and technical economic evaluation comparing processor concepts for selected applications
- Final economic feasibility study and costumer value proposition analysis
- Finalisation of a roadmap for market deployment of the different compression solutions developed in COSMHYC.



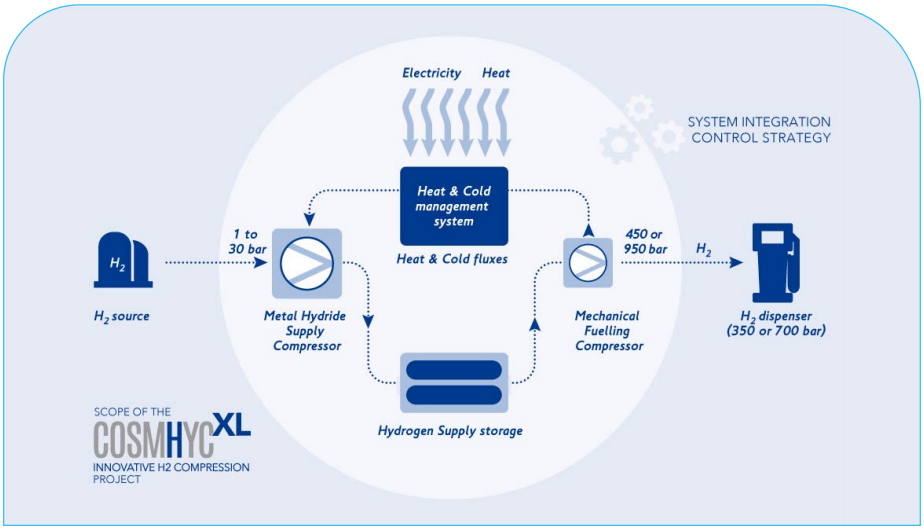
QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
HRS							
Project's own objectives	Energy consumption	kWh/kg	6	6	✓	N/A	N/A
	Degradation	%/9 month	10	5	✓	N/A	N/A
	Specific costs	k€/kg*day	N/A	3.7		5-12	2015
	Electricity consumption	kWh/kg	N/A	<1.5	✗	3	2017
	Noise	DB	N/A	<60		85	2017

COSMHYC XL

COMBINED HYBRID SOLUTION OF MULTIPLE HYDROGEN COMPRESSORS FOR DECENTRALISED ENERGY STORAGE AND REFUELLING STATIONS

Project ID:	**826182**
Call topic:	**FCH-01-7-2018** - Improvement of innovative compression concepts for large-scale transport applications
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€2 749 613.75**
FCH JU max. contribution:	**€2 749 613.75**
Project start - end:	01/01/2019 - 31/12/2021
Coordinator:	**EIFER EUROPAISCHES INSTITUT FUR ENERGIEFORSCHUNG EDF KIT EWIV, DE**
Website:	**cosmhyc.eu/cosmhyc-xl-project**



BENEFICIARIES: STEINBEIS 2I GMBH, MAHYTEC SARL, NEL HYDROGEN AS, LUDWIG-BOELKOW-SYSTEMTECHNIK GMBH

PROJECT AND OBJECTIVES

Hydrogen is one of the most promising solutions for sustainable large-scale transport (heavy-duty vehicles or fleets of light duty vehicles). COSMHYC XL is developing an innovative compression solution for extra-large hydrogen refuelling stations for these applications, by integrating a baseload metal hydride compressor (high level of reliability) and a new mechanical compressor (for large flow rates). The consortium is currently optimising both technologies, which will be comprehensively tested. LBST analysed requirements to ensure economic optimisation of the hydride compression solution.

NON-QUANTITATIVE OBJECTIVES

- Hybrid system allowing different configurations
- Economic optimisation from LBST demonstrates that different refuelling applications will require only very slight adapted configurations and intermediate storage capacities to minimise total costs
- Increased reliability
- No moving parts in the innovative compressor
- Cost-of-ownership assessment
- Ongoing dedicated project activities.

PROGRESS AND MAIN ACHIEVEMENTS

- Economic analysis shows that the hybrid system allows different configurations (e.g. intermediate pressure levels or intermediate storage sizes)
- Metal hydrides with required performance are developed. Analysis of degradation processes shows pollutants have no impact (e.g. N_2, O_2, H_2O)
- Modelling and draft designs are available for the new mechanical compression and for large-scale oriented system integration.

FUTURE STEPS AND PLANS

- Production of roughly 1 800 kg of metal hydrides, without critical materials. Production of reactors with improved heat exchanger
- Iterative testing and development of a first-stage compression head and of dual heads for improved mechanical compression for LDV and HDV configurations
- Development of the system integration of the hybrid compressor, including thermal, control and monitoring systems as well as needed auxiliaries
- Long-term testing of the large-scale hybrid compression solution and preparation of the next steps for successful market deployment.

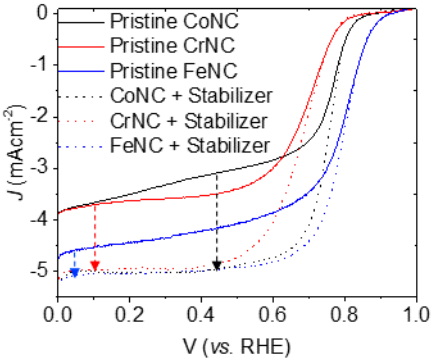
QUANTITATIVE TARGETS AND STATUS

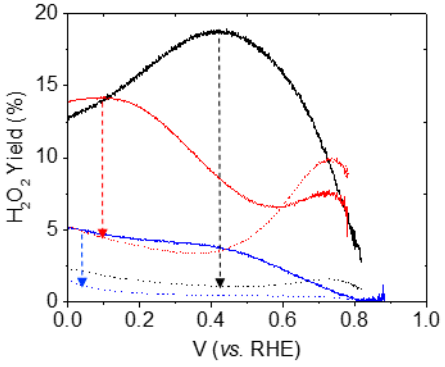
TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
HRS							
Project's own objectives	Energy consumption	kWh/kg	6	6	✓	8	N/A
	Degradation	%/1 000 h	10	0.8		N/A	
	Specific costs	k€/kg*day	N/A	1.47		3.7	2019
	Electricity consumption	kWh/kg	N/A	1.1	✗	1.5	
	Noise	DB	N/A	<60		85	2017

CRESCENDO

CRITICAL RAW MATERIAL ELECTROCATALYSTS REPLACEMENT ENABLING DESIGNED POST-2020 PEMFC2

Project ID:	**779366**
Call topic:	**FCH-01-2-2017** - Towards next generation of PEMFC: Non-PGM catalysts
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€3 068 199.05**
FCH JU max. contribution:	**€2 739 602.50**
Project start - end:	01/01/2018 - 31/12/2020
Coordinator:	**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS, FR**
Website:	**www.crescendo-fuelcell.eu/**





BENEFICIARIES: UNIVERSITE DE MONTPELLIER, JOHNSON MATTHEY FUEL CELLS LIMITED, PRETEXO, BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, JOHNSON MATTHEY PLC, TECHNISCHE UNIVERSITAT BERLIN, COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE, UNIVERSITA DEGLI STUDI DI PADOVA

PROJECT AND OBJECTIVES

CRESCENDO aims to progress research on PGM-free fuel cell cathode catalysts, develop diagnostic methods to characterise their active site density and turnover frequency and realise successful approaches for their stabilisation in operation, as well as advance research on non-PGM and ultra-low PGM hydrogen oxidation catalysts. The reasons for high losses with current PGM-free cathode catalyst layers have been analysed, and the learning used to redesign the catalyst layer, with the objective of achieving 0.42 W/cm² at 0.7 V on air, and 1 000 h operation with the finally configured MEA.

NON-QUANTITATIVE OBJECTIVES

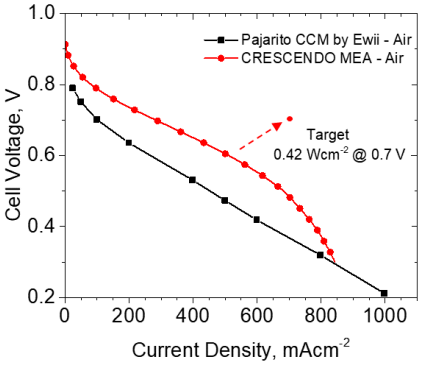
- International collaboration with IPHE countries
- Several meetings have been held with collaborators in IPHE (mainly US) countries
- International conference 'Towards catalysts free from critical raw materials for fuel cells and electrolysers', held in September 2019, with 160 participants.

PROGRESS AND MAIN ACHIEVEMENTS

- Achieved 7 wt % atomically dispersed iron in an Fe-NC catalyst, more than twice that in previously published catalysts
- Developed catalyst stabilisation additive that greatly reduces the by-production of H_2O_2 and improves M-NC catalyst stability in FC operation
- Demonstrated 60 mA/cm² at 0.1 V with Ni-based bioinspired anode catalyst anchored to functionalised carbon nanotubes.

FUTURE STEPS AND PLANS

- Pursue cathode catalyst development to improve intrinsic activity and catalyst morphology
- Upscale down-selected catalyst to amounts sufficient for full automotive-size fuel cell testing
- Optimise cathode catalyst layer with down-selected catalyst
- Perform fuel cell testing with full automotive size active cell area
- Demonstrate performance of an MEA with PGM-free anode and PGM-free cathode.

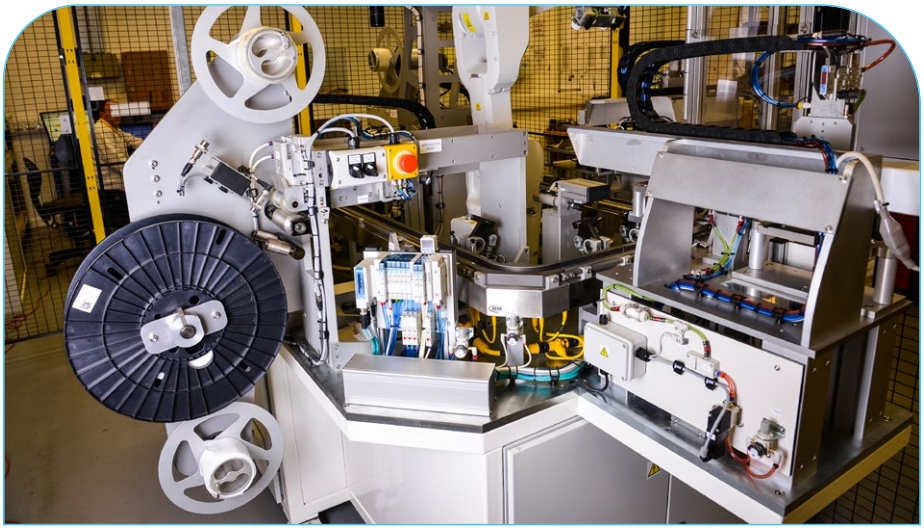


QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
AWP 2018 for non-PGM cathode catalyst	Cell voltage at 600 mA/cm², on H_2/air	A	0.7	0.55		0.55	2020
AWP 2018 ex situ ORR performance	IR-free current density at 0.9 V	mA/cm²	75	16		28	2019
Project's own objectives for PGM-free anode catalyst	Current density at 0.1 V	mA/cm²	75	60		6	2016

DIGIMAN
DIGITAL MATERIALS CHARACTERISATION PROOF-OF-PROCESS AUTO ASSEMBLY

Project ID:	**736290**
Call topic:	**FCH-01-1-2016** - Manufacturing technologies for PEMFC stack components and stacks
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€3 486 965**
FCH JU max. contribution:	**€3 486 965**
Project start - end:	01/01/2017 - 30/06/2020
Coordinator:	**COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR**
Website:	**digiman.eu/**



BENEFICIARIES: INTELLIGENT ENERGY LIMITED, PRETEXO, FREUDENBERG PERFORMANCE MATERIALS SE & CO KG, TOYOTA MOTOR EUROPE NV, THE UNIVERSITY OF WARWICK

PROJECT AND OBJECTIVES

The project advances (MRL4 > MRL6) the critical steps of the PEM fuel cell assembly processes and associated in-line QC and demonstrates a route to automated volume process production capability within an automotive best practice context. This includes characterisation and digital codification of physical attributes of key materials (e.g. GDLs) to establish yield-impacting digital cause and effect relationships within the value chain Industry 4.0 standards. Main outputs are a proof-of-process and a blueprint for beyond current state automotive PEM fuel cell manufacturing in Europe.

NON-QUANTITATIVE OBJECTIVES

- Inline digital detection and marking of surface non-uniformities via Vision line
- Process setup and in operation. Automated surface assessment shows meaningful results and sufficient resolution
- Integration of in-line non-destructive quality control tools
- Digital optical QC has already been installed with Freudenberg Performance Materials' production processes
- Development of beyond-state technologies, specific to PEMFC stack production
- Innovative flotation methods for pick and place handling and mechanical prealignment of non-rigid and porous GDL materials have been developed
- Improvement, modification and adaptation of component production steps
- Development of digital boundary limits to empirically derived homogeneity data
- Development of QA strategies for the transport sector compatible with IATF 16949
- Characterisation of structural anomalies (heterogeneities) and detection techniques has been completed.

PROGRESS AND MAIN ACHIEVEMENTS

- Proof-of-process demonstrator equipment for the uplifted cell assembly automation has been manufactured and validated (MRL6)
- On-line automated characterisation of GDL defects has been set up and validated to fill a database for QC of GDL during production
- The influence of GDL defects on performance depends on cell design and operating conditions.

FUTURE STEPS AND PLANS

- The project has finished.

QUANTITATIVE TARGETS AND STATUS

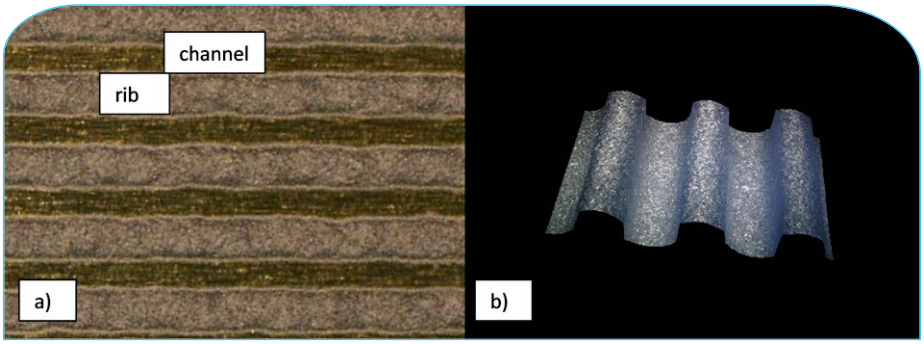
TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?
Project's own objectives aligned with AWP 2015/MAWP Addendum (2018-2020)	**Stack weight**	**kg**	**2.9**	**2.9**	✓
	Stack volume	**l**	**2.85**	**2.85**	
	Stack capacity	**t**	**2.1**	**2.1**	

DOLPHIN

DISRUPTIVE PEMFC STACK WITH NOVEL MATERIALS, PROCESSES, ARCHITECTURE AND OPTIMIZED INTERFACES

Disruptive pemfc stack with nOvel materiaLs, Processes, arcHitecture and optimized INterfaces

Project ID:	**826204**
Call topic:	**FCH-01-6-2018** - Game changer fuel cell stack for automotive applications
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€2 962 681**
FCH JU max. contribution:	**€2 962 681**
Project start - end:	01/01/2019 - 31/12/2022
Coordinator:	**COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR**



BENEFICIARIES: CHEMOURS FRANCE SAS, CHEMOURS BELGIUM, CHEMOURS INTERNATIONAL OPERATIONS SARL, HEXCEL COMPOSITES GMBH & CO KG, REALIZER GMBH, FAURECIA SYSTEMES D'ECHAPPEMENT SAS, ZENTRUM FUR SONNENENERGIE- UND WASSERSTOFF-FORSCHUNG BADEN-WURTTEMBERG, THE UNIVERSITY OF MANCHESTER

PROJECT AND OBJECTIVES

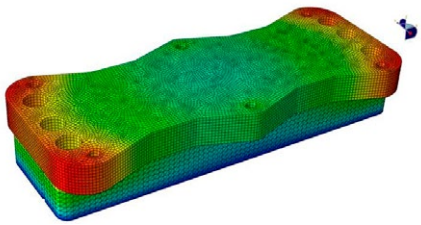
The overall aim of the project is to validate disruptive technologies for 100 kW lightweight and compact fuel cell stack designs, reaching outstanding (specific and volumetric) power density, while simultaneously featuring enhanced durability (under automotive application conditions) compared with the state of the art and compatible with large-scale/mass produced full-power stacks.
Validation of the DOLPHIN technologies will be supported by the design and fabrication of an automotive stack of 5 kW, representative of 100 kW power stacks.

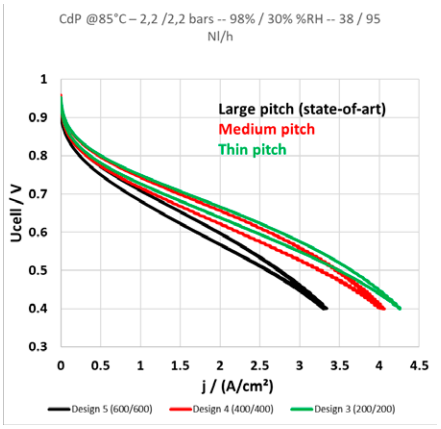
PROGRESS AND MAIN ACHIEVEMENTS

- Printing of ultrathin rib/channel pitch (down to 200 µm) has been successfully performed on various thin metallic and carbon sheets
- Increase of single-cell performance thanks to rib/channel pitch reduction
- Single-layer graphene coating has been applied to high-performance membrane.

FUTURE STEPS AND PLANS

- Selection of most promising components to be tested in short stack and 5 kW stack (2020, 2021)
- Performance and durability tests of 5 kW stack (2022)
- Validation of the interest of developments to increase performance and durability
- Analysis of manufacturing processes according to performance/durability results and life cost analysis.





QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
AWP 2018	Weight-specific power density	kW/kg	4	N/A	3.4	2017
	Volumic-specific power density	kW/l	5		4.1	
	Area-specific power density	W/cm²	2	1.3	1.13	
	Durability	Hours	6 000	N/A	3 500	
	Stack cost	€/kW	20		36.8	

FIT-4-AMANDA

FUTURE EUROPEAN FUEL CELL TECHNOLOGY: FIT FOR AUTOMATIC MANUFACTURING AND ASSEMBLY

FIT-4-AMANDA

Project ID:	**735606**
Call topic:	**FCH-01-1-2016** - Manufacturing technologies for PEMFC stack components and stacks
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€2 999 185**
FCH JU max. contribution:	**€2 999 185**
Project start - end:	01/03/2017 - 29/11/2020
Coordinator:	**UNIRESEARCH BV, NL**
Website:	**www.fit-4-amanda.eu**

BENEFICIARIES: FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG EV, TECHNISCHE UNIVERSITAET CHEMNITZ, IRD FUEL CELLS A/S, PROTON MOTOR FUEL CELL GMBH, UPS EUROPE SA, AUMANN LIMBACH-OBERFROHNA GMBH

PROJECT AND OBJECTIVES

Fit-4-AMandA's ambition is to modify the current design of PEMFC stacks and stack components and build new equipment to facilitate automation of the stack assembly process (including in-line non-destructive tests). Furthermore, it will demonstrate the resulting mass-produced stacks in a real environment – by integrating the output into a light- (and medium-sized) commercial vehicle. The project will offer the mass production machine innovative solutions, which affect process, product and tools to bring the MRL from 5 to 7.

NON-QUANTITATIVE OBJECTIVES

- Conduct a feasibility study for commercial fuel cell electric vehicle
- Summarise the conditions under which the fuel cell technology, especially the newly created stack, fits into for a LCV from UPS (see D6.1)
- Elaborate performance requirements from the vehicle
- Consolidate the technical requirements in detail for standard fuel cell operation and need for special-demands UPS automotive fleet small-package city operation, find ways of seamlessly integrating to reduce costs (D6.3).

PROGRESS AND MAIN ACHIEVEMENTS

- FAT acceptance test of the mass-manufacturing machine for automatic fuel cell stack assembling
- BPP design for moulding verified
- Method for removal of casting skin from moulded plates verified.

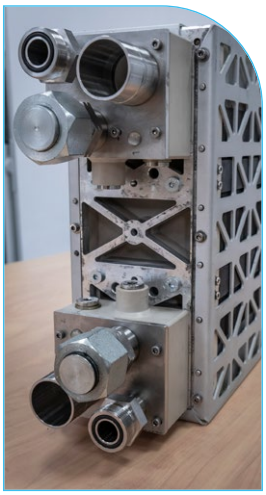
FUTURE STEPS AND PLANS

- Statistical analysis and optimisation of the in-line QC of the bipolar plates fed into the MMM
- Statistical analysis and optimisation of the in-line testing methods and validation of the in-line testing methods
- Continue to see suppliers of relevant hydrogen storage tanks and evaluate proposed solutions, including ensuring availability of specification update and engineering.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	TARGET ACHIEVED?
Project's own objectives	Project process: energy per MW	Kwh/MW	200	✓
	FC system lifetime	Hours	6 000	✗
	Specific FC system cost	€/kW	100	

FLHYSAFE
FUEL CELL HYDROGEN SYSTEM FOR AIRCRAFT EMERGENCY OPERATION



Project ID:	**779576**
Call topic:	**FCH-01-1-2017**: Development of fuel cell system technologies for achieving competitive solutions for aeronautical applications
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€7 354 868.75**
FCH JU max. contribution:	**€5 063 023**
Project start - end:	01/01/2018 - 31/12/2020
Coordinator:	**SAFRAN POWER UNITS, FR**
Website:	**www.flhysafe.eu**

BENEFICIARIES: COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, UNIVERSITAET ULM, ARTTIC, INSTITUTO NACIONAL DE TECNICA AEROESPACIAL ESTEBAN TERRADAS, ZODIAC AEROTECHNICS SAS

PROJECT AND OBJECTIVES

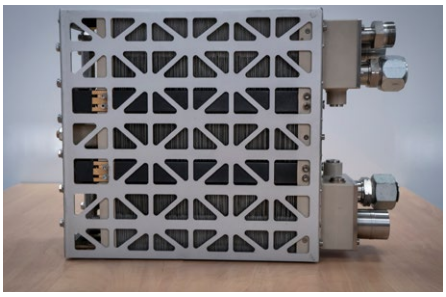
The main objective of FLHYSAFE is to demonstrate that a cost-efficient modular fuel cell system can replace critical safety systems and serve as an emergency power unit aboard a commercial airplane to provide enhanced safety functionalities. Additionally, the project will virtually demonstrate that the system can be integrated into current aircraft designs, respecting both installation volumes and maintenance constraints.

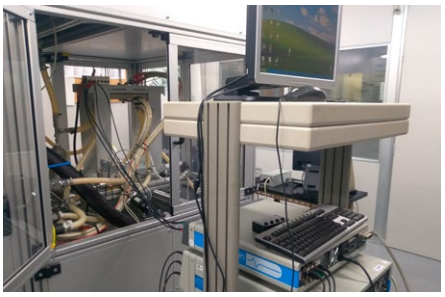
PROGRESS AND MAIN ACHIEVEMENTS

- The system architecture is known, derived from safety and functional analyses
- A reduced model of the fuel cell stack is available for designing tools.

FUTURE STEPS AND PLANS

- Finalise the design of the EPU demonstrator
- Finalise the manufacturing and assembly of the EPU demonstrator
- Proceed to partial, functional and environmental tests.



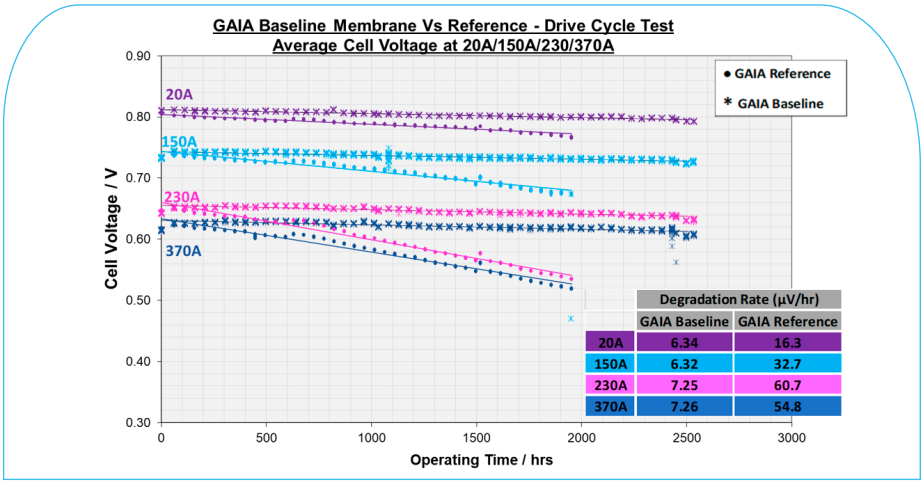


QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	TARGET ACHIEVED?
Project's own objectives	EPU weight	kg	150	
	EPU volume	L	200	
	Power density	W/kg	100	
	EPU efficiency at rated power	%	40	
	Lifetime (flight hours)	Hours	4 000	

GAIA
NEXT GENERATION AUTOMOTIVE MEMBRANE ELECTRODE ASSEMBLIES

Project ID:	**826097**
Call topic:	**FCH-01-5-2018** - Next generation automotive MEA development
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€4 493 025**
FCH JU max. contribution:	**€4 493 025**
Project start - end:	01/01/2019 - 31/12/2021
Coordinator:	**UNIVERSITE DE MONTPELLIER**
Website:	**www.gaia-fuelcell.eu**



BENEFICIARIES: DYNEON GMBH, JOHNSON MATTHEY FUEL CELLS LIMITED, PRETEXO, FREUDENBERG PERFORMANCE MATERIALS SE & CO KG, 3M DEUTSCHLAND GMBH, ELMARCO SRO, BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, ZENTRUM FUR SONNENENERGIE- UND WASSERSTOFF-FORSCHUNG BADEN-WURTTEMBERG, JOHNSON MATTHEY PLC, TECHNISCHE UNIVERSITAT MUENCHEN, TECHNISCHE UNIVERSITAT BERLIN, CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS

PROJECT AND OBJECTIVES

GAIA aims to develop next-generation automotive MEAs delivering 1.8 W/cm² at 0.6 V. The project intends to validate the MEA performance and durability of full-size cell short stacks, demonstrate the possibility of 6 000 hours lifetime, and provide a cost assessment that establishes that the MEAs can achieve the cost target of 6 €/kW for a production rate of 1 million m²/year. Currently at ML7, GAIA has validated its stack hardware and testing protocols, developed new carbon, catalyst, ionomer, membrane, gas diffusion and microporous layer components, and reached the two milestones due to date.

NON-QUANTITATIVE OBJECTIVES

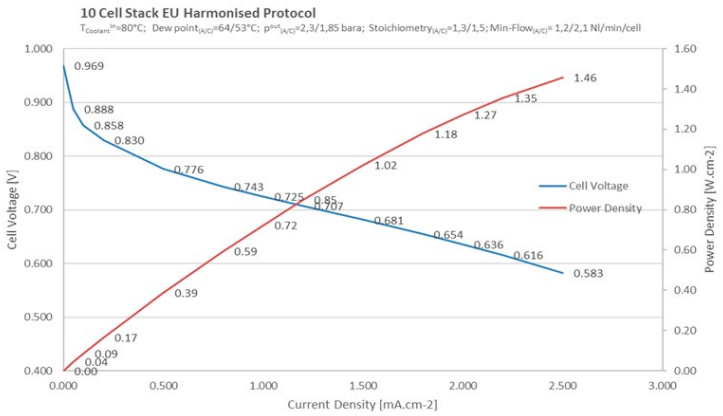
- Training
- GAIA partners TUB and TUM have produced a training video on RDE testing, MEA fabrication and FC testing.

PROGRESS AND MAIN ACHIEVEMENTS

- Project reference MEA tested to 3 A/cm² over call conditions up to 105 °C, in 50 cm² and full-size single cells, and short stacks
- Power density of 1.46 W/cm² at 2.5 A/cm² achieved in European harmonised reference conditions
- Significantly lower (up to 9x) voltage decay rate in ADC of MEA with GAIA nanofiber-reinforced membrane compared with equivalent MEA with ePTFE reinforcement.

FUTURE STEPS AND PLANS

- Supported catalyst preparation with down-selected GAIA modified carbons and GAIA high mass activity catalysts, catalyst layer development
- Implement further improved membrane chemical and mechanical stabilisation components
- Short testing iterations with new GAIA (membrane, catalyst layers, MPL-GDL) components
- Implement alternative CCM constructions and coating methods
- Costs analysis.



QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
AWP 2019	Power density at 3 A/cm²	W/cm²	1.8	1.6		No public data at 3 A/cm² under call conditions	N/A
	Durability (voltage decay)	%	<10 % after 6 000 hours (1 000 hours of actual testing, extrapolated to 6 000 hours)	<3 % after 2 500 hours automotive drive cycle testing		10 % after 500 hours automotive drive cycle testing	2019
	MEA cost	€/kW	6	Planned year 3		12.9	2017

GIANTLEAP

GIANTLEAP IMPROVES AUTOMATION OF NON-POLLUTING TRANSPORTATION WITH LIFETIME EXTENSION OF AUTOMOTIVE PEM FUEL CELLS

Project ID:	**700101**
Call topic:	**FCH-01.2-2015** - Diagnostics and control for increased fuel cell system lifetime in automotive applications
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€3 260 297.50**
FCH JU max. contribution:	**€3 260 297.50**
Project start - end:	01/05/2016 - 31/10/2019
Coordinator:	**SINTEF AS, NO**
Website:	**www.giantleap.eu**

BENEFICIARIES: VDL ENABLING TRANSPORT SOLUTIONS BV, VDL BUS CHASSIS BV, VDL BUS ROESELARE, VDL BUS & COACH BV, INSTITUT FRANCAIS DES SCIENCES ET TECHNOLOGIES DES TRANSPORTS, DE L'AMENAGEMENT ET DES RESEAUX, ELRINGKLINGER AG, ECOLE NATIONALE SUPERIEURE DE MECANIQUE ET DES MICROTECHNIQUES, BOSCH ENGINEERING GMBH, SVEUCILISTE U SPLITU, FAKULTET ELEKTROTEHNIKE, STROJARSTVA I BRODOGRADNJE, UNIVERSITE DE FRANCHE-COMTE, STIFTELSEN SINTEF

PROJECT AND OBJECTIVES

The project aimed to increase the reliability and availability of fuel cell buses, which was achieved with definition of diagnostic and prognostic algorithms, for both the stack and several balance-of-plant components, and a range-extender design with a system mounted on a trailer.
Data on long-term tests has been published on public repositories.
The project has been completed and an evolution of the prototype is currently in regular operation in the Netherlands.

PROGRESS AND MAIN ACHIEVEMENTS

- Published extensive data sets for fuel cell and BoP component testing
- Implemented and tested multiple diagnostic and prognostic algorithms
- Demonstrated the operation of a hydrogen range extender for battery-powered buses, now in regular operation.

FUTURE STEPS AND PLANS

- The project has finished.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
Project's own objectives	Stack lifetime	Hours	12 000	15 200	✓	30 000	2020
MAWP 2014-2020	FC bus cost	€	650 000	540 000	✓	N/A	N/A
	Fuel consumption	$kgH_2/100\ km$	8	7			

H2REF

DEVELOPMENT OF A COST EFFECTIVE AND RELIABLE HYDROGEN FUEL CELL VEHICLE REFUELLING SYSTEM

Project ID:	**671463**
Call topic:	**FCH-01.5-2014** - Development of cost effective and reliable hydrogen refuelling station components and systems for fuel cell vehicles
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€7 127 941.25**
FCH JU max. contribution:	**€5 968 554**
Project start - end:	01/09/2015- 31/12/2019
Coordinator:	**CENTRE TECHNIQUE DES INDUSTRIES MECANIQUES, FR**
Website:	**www.h2ref.eu**

BENEFICIARIES: UNIVERSITE DE TECHNOLOGIE DE COMPIEGNE, LUDWIG-BOELKOW-SYSTEMTECHNIK GMBH, THE CCS GLOBAL GROUP LIMITED, HEXAGON RAUFOSS AS, H2NOVA, HASKEL FRANCE, HASKEL EUROPE LTD

PROJECT AND OBJECTIVES

The H2REF project, completed in 2019, addressed hydrogen compression and buffering for the refuelling of fuel cell electric light-duty vehicles. It encompassed the activities for advancing a novel cost-effective and reliable hydraulics-based compression and buffering system from TRL3 to 5.
The overall goal was to demonstrate a bladder accumulator technology applied to hydrogen refuelling, providing significant performance levels as currently achieved with existing solutions for 70 MPa refuelling at a significantly lower cost, and establish the knowledge base required for taking this innovation to the market.

NON-QUANTITATIVE OBJECTIVES

- Techno-economic analysis based on project result
- Completed cost comparison of CBM with benchmark
- Have the technology covered by the RCS framework
- CEN TC 54 has agreed to cover accumulators in composite materials and is developing a plan on how to proceed.

PROGRESS AND MAIN ACHIEVEMENTS

- CBM process developed, full-scale prototype system built, and 70 MPa hydrogen dispensing cycle successfully operated and evaluated (including H_2 purity)
- Suitable bladder material identified and accumulator developed and qualified for functional and endurance testing in CBM
- New hydrogen test area set up on Haskel's premises.

FUTURE STEPS AND PLANS

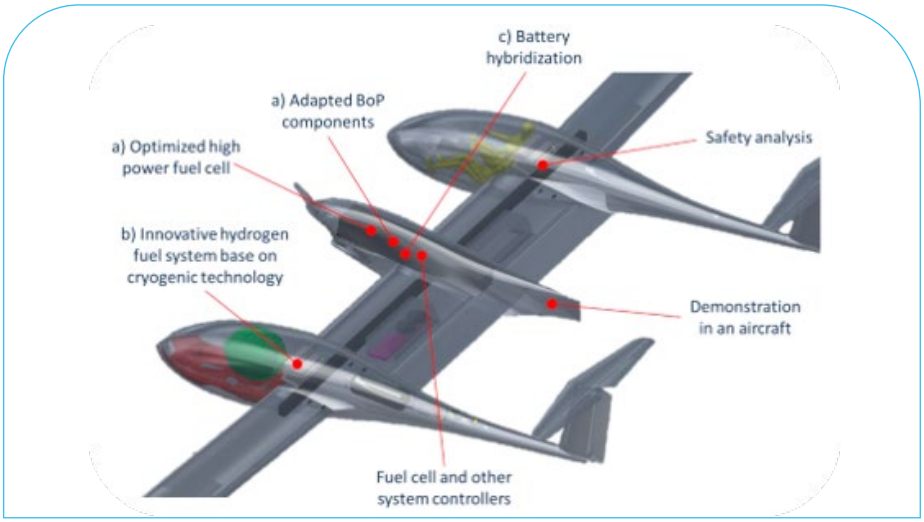
- The project has finished.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	COMMENTS
Project's own objectives	TRL	N/A	6	5		N/A
	Unit cost	k€	300	440		For 50 units
	Capacity	kg/hour	30	15.9		With 75 kW motor, from 7 MPa
	Consumption	kWh/kg	1.5	5.1		Sources of energy losses identified

HEAVEN

Project ID:	**826247**
Call topic:	**FCH-01-4-2018:** Fuel cell systems for the propulsion of aerial passenger vehicle
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€4 600 881.68**
FCH JU max. contribution:	**€3 995 305**
Project start - end:	01/01/2019 - 31/12/2022
Coordinator:	**FUNDACION AYESA**
Website:	**https://heaven-fch-project.eu/**



BENEFICIARIES: PIPISTREL VERTICAL SOLUTIONS DOO PODJETJE ZA NAPREDNE LETALSKE RESITVE, H2FLY GMBH, AIR LIQUIDE ADVANCED TECHNOLOGIES SA, ELRINGKLINGER AG, L AIR LIQUIDE SA, DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV

PROJECT AND OBJECTIVES

The goal of HEAVEN is to design, develop and integrate the world's first aircraft powertrain based on a high-power density fuel cell system and high-energy density liquid hydrogen fuel system into an existing two to four seater aircraft for testing in flight operation. HEAVEN will focus on demonstrating the airworthiness and economic viability of a fuel cell and cryogenic hydrogen-based solution for the propulsion of passenger aircraft. In addition, the project will provide reliability figures for future certification and introduce relevant data for developments towards a ZE hydrogen-powered aircraft.

NON-QUANTITATIVE OBJECTIVES

- Increase the credibility for the propulsion of passenger aircraft and UAVs
- Advance towards a zero-emission hydrogen-powered regional commuter airliner.

PROGRESS AND MAIN ACHIEVEMENTS

- Conceptual design of the overall powertrain
- Safe cryogenic liquid hydrogen storage design which meets main aircraft requirements.

FUTURE STEPS AND PLANS

- Qualification and delivery: 2021
- Ground/flight tests: 2022.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?
HRS					
Project's own objectives - AWP 2018	FC stack power density in weight	kW/kg	2 kW/kg	2.7 kW/kg (stack incl. endplates)	✓
	FC power density in volume	kW/l	3.5 kW/l	4.1 kW/l (stack incl. endplates)	
	Air subsystem	%	>50 %	Preliminary results are compliant with this value	
	Power converter	kW/kg	8 kW/kg	Preliminary results are compliant with this value	
	Liquid hydrogen storage system	wt%		Preliminary design is compliant with this value	
	System lifetime	Hours	5 000 h (stack)	N/A	

INLINE

DESIGN OF A FLEXIBLE, SCALABLE, HIGH-QUALITY PRODUCTION LINE FOR PEMFC MANUFACTURING

Project ID:	**735367**
Call topic:	**FCH-01-3-2016** - PEMFC system manufacturing technologies and quality assurance
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€3 286 068.75**
FCH JU max. contribution:	**€3 286 068.75**
Project start - end:	01/02/2017 - 31/01/2020
Coordinator:	**PROFACTOR GMBH, AT**
Website:	**www.inline-project.eu**

BENEFICIARIES: ELRINGKLINGER AG, FRONIUS INTERNATIONAL GMBH, KARLSRUHER INSTITUT FUER TECHNOLOGIE, OMB SALERI SPA

PROJECT AND OBJECTIVES

The project INLINE aimed to design a flexible, scalable, high-quality production line for PEMFC manufacturing. The three objectives were:

- redesign the media supply unit
- develop automated quality inspection methods to improve the end-of-line test
- ensure the scalability of the manufacturing process.

The project finished in January 2020. The final demonstration, including demonstration 3, was held in November 2019.

NON-QUANTITATIVE OBJECTIVES

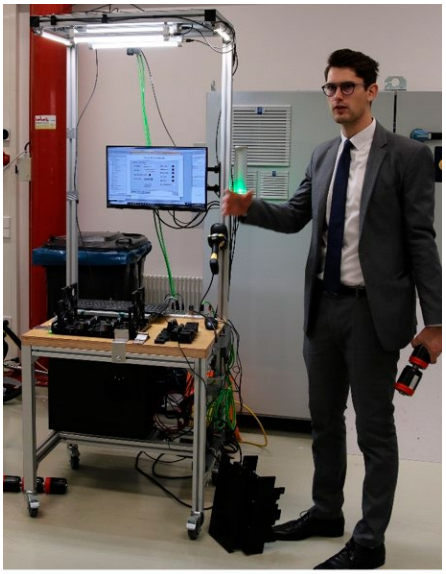
- Smart camera system
- The system enhances workers' safety in preventing short-circuits during mounting of the batteries in the accu pack
- Assisted assembly system
- The projection-based assembly instructions shorten workers' training time
- Semi-automated end-of-line test
- The built chamber and installed semi-automation provides a safety enhancement for the worker who executes the end-of-line test.

PROGRESS AND MAIN ACHIEVEMENTS

- Redesigned and integrated media supply unit
- Simulation of the full manufacturing process, including the newly developed systems and components, evaluated under different scenarios
- Final demonstrations of assisted assembly station and quality control sensors (endoscope sensor, smart camera sensor).

FUTURE STEPS AND PLANS

- The project has finished.



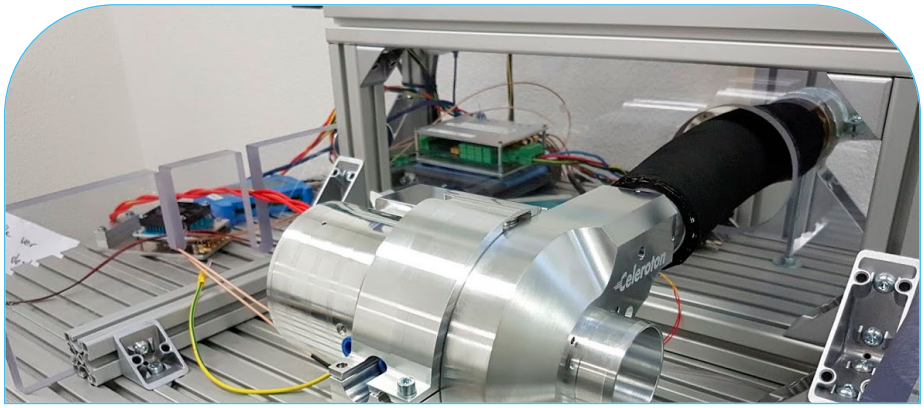
QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?
Project's own objectives	Smart camera: detection rate	%	99	99	✓
	Simulation model: scalability factor		100	100	
	Endoscope sensor: detection rate				
	Screwing time	seconds	5	5	

INN-BALANCE

INNOVATIVE COST IMPROVEMENTS FOR BALANCE OF PLANT COMPONENTS OF AUTOMOTIVE PEMFC SYSTEMS

Project ID:	**735969**
Call topic:	**FCH-01-4-2016** - Development of Industrialisation-ready PEMFC systems and system components
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€6 156 288.75**
FCH JU max. contribution:	**€4 994 538.75**
Project start - end:	01/01/2017- 31/01/2021
Coordinator:	**FUNDACION AYESA, ES**
Website:	**www.innbalance-fch-project.eu**



BENEFICIARIES: DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, UNIVERSITAT POLITECNICA DE CATALUNYA, AVL LIST GMBH, VOLVO PERSONVAGNAR AB, STEINBEIS INNOVATION GGMBH, POWERCELL SWEDEN AB, CELEROTON AG, BROSE FAHRZEUGTEILE GMBH & CO. KOMMANDITGESELLSCHAFT WURZBURG, STEINBEIS 2I GMBH, CHINA-EURO VEHICLE TECHNOLOGY AKTIEBOLAG

PROJECT AND OBJECTIVES

INN-BALANCE aims to establish a novel and integrated framework for balance of plant (BoP) components for fuel cell based electric vehicles (FCEVs). The goal is to generate a pervasive and competitive system based on innovative technologies that directly tackles components performance improvement, durability and cost reduction of current auxiliary systems in FCEVs. INN-BALANCE supports the FCH2 JU New Industry Grouping in the 'Financial and Technology outlook on the European sector ambition 2014-2020', particularly in its strategy to accelerate market entry and widespread adoption.

NON-QUANTITATIVE OBJECTIVES

- Develop a BoP control unit integrated by advanced control and diagnosis strategies and low-cost platform – under commissioning and on-board testing for validation
- Test the fuel cell system in a vehicle powertrain – under commissioning for testing.

PROGRESS AND MAIN ACHIEVEMENTS

- Compressor
- Passive recirculation of hydrogen
- Anti-freezing solution to prevent ice formation during cold storage.

FUTURE STEPS AND PLANS

- Testing on test bed
- Testing on vehicle.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
Project's own objectives	Cold start	°C	-40		-30	2015 (Toyota) 2019 (Hyundai)
	Peak energy efficiency[1]	%	N/A		60	2010
	Durability in automotive drive cycle	Hours			3 900	2015
	Input power at full flow b (with/ without expander)[2]	kWe			11/17.3	2016
	Compressor volume[3]	L	6 .5 L (converter) ~4.5 L (compressor) = 11 L	✂	15	
	Compressor weight[3]	Kg	12 kg (converter) 10 kg (compressor) = 22 kg		22	
	Compressor cost[4]	$	N/A		750	2015
	Combined motor and motor controller efficiency at full flow[5]	%	aero = 82 % (isentropic) motor = 83 % converter = 95.3 % total (isentropic) = 65 % motor + converter: 79 %		80	2016

1: Ratio of DC output energy to the lower heating value of the input fuel (hydrogen). Peak efficiency occurs at less than 25 % rated power.

2 Electrical input power to motor controller when bench testing fully integrated system. Fully integrated system includes control system electronics, air filter, and any additional air flow that may be used for cooling. b Compressor: 92 g /s flow rate, 2.5 bar (absolute) discharge pressure; 40 °C, 25 % RH inlet conditions. Expander: 88 g/s flow rate, 2.2 bar (absolute) inlet pressure, 70 °C, 100 % RH inlet conditions.

3 Weight and volume include the motor and motor controller.

4 Includes cost of compressor, expander, and motor controller manufactured at a volume of 500 000 systems per year.

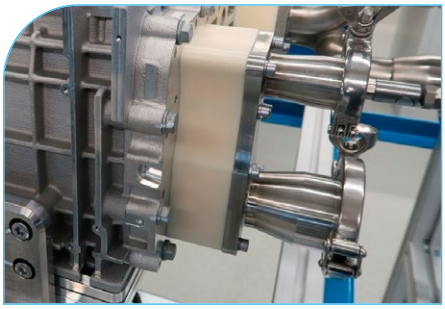
5 Compressor: 92 g /s flow rate, 2.5 bar (absolute) discharge pressure; 40 °C, 25 % RH inlet conditions. Expander: 88 g/s flow rate, 2.2 bar (absolute) inlet pressure, 70 °C, 100 % RH inlet conditions.

INSPIRE

INTEGRATION OF NOVEL STACK COMPONENTS FOR PERFORMANCE, IMPROVED DURABILITY AND LOWER COST

Integration of Novel Stack Components for Performance, Improved DuRability and LowEr Cost

Project ID:	**700127**
Call topic:	**FCH-01.1-2015** - Low cost and durable PEMFCs for transport applications
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€6 878 070.01**
FCH JU max. contribution:	**€6 877 869.75**
Project start - end:	01/05/2016 - 31/10/2019
Coordinator:	**JOHNSON MATTHEY PLC, UK**
Website:	**www.inspire-fuelcell.eu/**



BENEFICIARIES: CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS, TECHNISCHE UNIVERSITAT BERLIN, TECHNISCHE UNIVERSITAT MUENCHEN, REINZ-DICHTUNGS GMBH, ALBERT-LUDWIGS-UNIVERSITAT FREIBURG, SGL CARBON GMBH, BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, PRETEXO, JOHNSON MATTHEY FUEL CELLS LIMITED, UNIVERSITE DE MONTPELLIER, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY

PROJECT AND OBJECTIVES

The objectives of INSPIRE were to develop and integrate the most advanced MEA components (electrocatalysts, membranes, GDLs and bipolar plates) into three generations of automotive stacks. The project developed and validated its third and final generation stack in 2019. The project met all its technical targets (including world-leading power and volumetric densities of 1.5 W/cm^2 and 4.8 kW/l respectively, and predicted durability >6 000 hours with <10 % power degradation), and was within 10 % of its cost target (below 50 €/kW for an annual production rate of 50 000 units).

NON-QUANTITATIVE OBJECTIVES

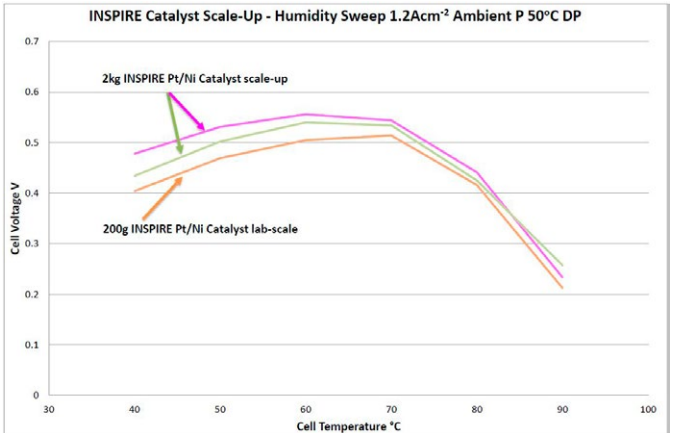
- Scale-up best performing catalyst for stack MEAs
- New catalysts met the project performance and durability targets and were scaled up for MEA optimisation and testing
- Develop two new generations of BPP for automotive stacks
- Final generation BPP and stack validated and still undergoing full durability assessment
- Dissemination of project results
- INSPIRE workshop held in 2019, bringing together several FCH JU H2020 projects focused on PEM fuel cell components.

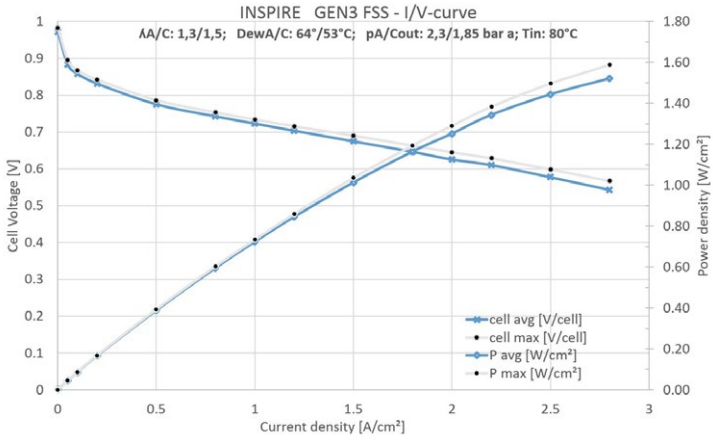
PROGRESS AND MAIN ACHIEVEMENTS

- Areal power density of 1.5 W/cm^2
- Cell volumetric power density of 4.8 kW/l
- Predicted durability of >6 000 hrs.

FUTURE STEPS AND PLANS

- The project has finished.





QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
AWP 2015	Areal power density	W/cm^2	1.5	1.5	✓	1.3 (50 cm^2 cell, 250 kPaabs, outlet, 94 °C, 65 % RH)	2018
Project's own objectives	Catalyst	A/mg	0.6	0.6		0.6 (GM)	2016
MAWP 2014-2020	Performance loss over 6 000 hrs	%	10	10		5 605 hrs (NREL)	2015

MARANDA

MARINE APPLICATION OF A NEW FUEL CELL POWERTRAIN VALIDATED IN DEMANDING ARCTIC CONDITIONS

Project ID:	**735717**
Call topic:	**FCH-01-5-2016** - Develop new complementary technologies for achieving competitive solutions for marine applications at an economic scale of implementation
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€3 704 757.50**
FCH JU max. contribution:	**€2 939 457.50**
Project start - end:	01/03/2017- 28/02/2021
Coordinator:	**TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, FI**
Website:	**www.vtt.fi/sites/maranda/**

BENEFICIARIES: SUOMEN YMPARISTOKESKUS, ABB OY, POWERCELL SWEDEN AB, OMB SALERI SPA, PERSEE, SWISS HYDROGEN SA

PROJECT AND OBJECTIVES

The MARANDA project is developing emission-free, hydrogen-fuelled PEMFC-based hybrid powertrain systems (3 x 82.5 kW AC) for marine applications. These will be validated both in test benches and onboard the research vessel Aranda, including full-scale freeze-start testing.
The project will increase the market potential of hydrogen fuel cells in the marine sector. General business cases for different actors in the marine and harbour or fuel cell business will be drawn up.
The project is in the system integration phase and the validation phase is being prepared.

NON-QUANTITATIVE OBJECTIVES

- The impact related to the development of RCS
- MARANDA has already had a significant impact on RCS development
- Fuel cell systems should be able to withstand the shocks, vibrations, saline environment and motions commonly encountered by ships on water, as well as meeting other marine-application relevant requirements
- Fuel cell systems and hydrogen storage are designed to withstand these conditions
- Evaluation of the economic and environmental impact for prospective customers
- Report on business analysis of hydrogen fuel cells for marine applications has been prepared
- The formulation of an initial go-to-market strategy
- Report on business analysis includes this
- Mapping opportunities for future demonstration actions
- The work will be done in the fourth project year.

PROGRESS AND MAIN ACHIEVEMENTS

- Three fuel cell systems from Swiss Hydrogen have been assembled and two have been delivered for final integration to VTT
- First fuel cells system has been characterised and integrated into a container for durability testing
- Significant improvement in stack durability has been shown by Powercell Sweden.

FUTURE STEPS AND PLANS

- Commissioning of the first fuel cell system at durability test site (M43, September 2020)
- Acceptance from Finnish Transport Safety Agency (Trafi) for the installation of fuel cell system and hydrogen storage on board Aranda (M43, September 2020)
- Field trial start in target vessel (M44, October 2020)
- First fuel cell system testing completed (M48, February 2021)
- Field trial start in target vessel completed (M48, February 2021).

QUANTITATIVE TARGETS AND STATUS

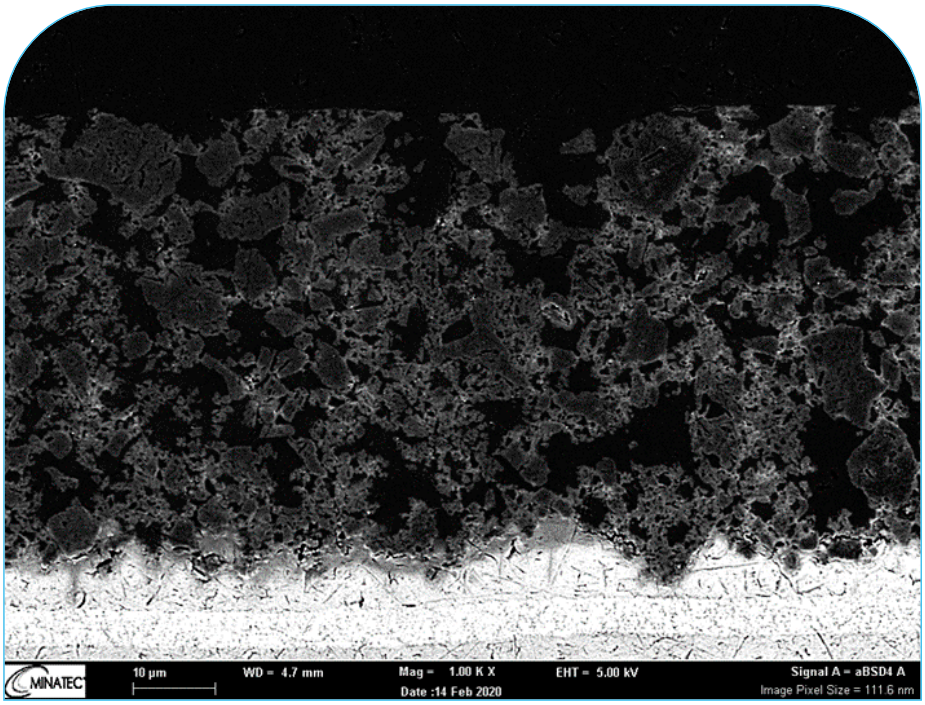
TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	COMMENTS
AWP 2016	Fuel cell system effect	kW	75	82.5	✓	Design value AC power
	Freeze start capability	°C	-35	N/A	✂	To be tested
	Stack durability	mV/1 000 h	4.6	1.7	✓	No data available with comparable conditions
	Fuel-to-electric efficiency (AC)	%	48	45	✂	AC efficiency is an estimate based on DC efficiency data (FAT test). No data available with comparable conditions

PEGASUS
PEMFC BASED ON PLATINUM GROUP METAL FREE STRUCTURED CATHODES

PEGASUS
PGM Free Catalyst

Project ID:	**779550**
Call topic:	**FCH-01-2-2017 -** Towards next generation of PEMFC: Non-PGM catalysts
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€2 829 016.88**
FCH JU max. contribution:	**€2 829 016.88**
Project start - end:	01/02/2018 - 31/01/2021
Coordinator:	**COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR**
Website:	**www.pegasus-pemfc.eu/**

BENEFICIARIES: AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS, DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPPEMENT DES METHODES ET PROCESSUS INDUSTRIELS, TECHNISCHE UNIVERSITAET MUENCHEN, ECOLE NATIONALE SUPERIEURE DES MINES DE PARIS, IRD FUEL CELLS A/S, TOYOTA MOTOR EUROPE NV, HERAEUS FUEL CELLS GMBH.



PROJECT AND OBJECTIVES

PEGASUS is exploring a promising method of removing Pt and other critical raw materials (CRM) from PEMFC, and replacing them with non-critical elements and structures enabling efficient and stable electro-catalysis conditions for an appropriate use as Pt-alternative competitive cathodic catalysts. The overall aim of this project is to bring up the experimental proof-of-concept for novel catalysts materials and structures.

NON-QUANTITATIVE OBJECTIVES

- Implementation of new techniques to characterise PGM-free catalysts for ORR in PEMFC
- Use of AFM combined SECM to quantify the ORR activity of PGM catalyst at the agglomerate level: achieved.
- Diagnosis to quantify the O_2, H+ and e- transport in PGM-free based cathode: achieved
- Benchmark PGM catalysts integrating catalyst from other research groups (Us-DoE, NEDO).

PROGRESS AND MAIN ACHIEVEMENTS

- The best catalyst synthesised in 2019 and tested in a single cell is two times more active (mass activity) than the commercial reference material under air
- The active site density for the best catalyst is 2.4 (10^20), which is three times greater than the best-reported in literature (ACS catal. 2018)
- Upscale: production per milligram batches and MEA fabrication using high-speed fabrication techniques.

FUTURE STEPS AND PLANS

- Improvement of MEA performance by integrating second generation of catalysts developed in the project
- TCA and LCA conclusions available in S1 2021
- Degradation study using single cell setup to be conducted
- Shift of the workshop organised by PEGASUS from Q2 2020 to a later date.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)
AWP 2017	Catalyst activity igeo @ 0.9 V under air	mA/cm^2	44	6.5	✗	N/A
	Catalyst activity igeo @ 0.7 V under O_2	mA/cm^2	600	280		300
	Catalyst activity @ 0.9 V (iR free) under O_2	mA/cm^2	75	17.5		21
	Diagnosis and in situ characterisation of PGM-free based cathode, H+ resistance, e- resistance, O_2 diffusion	N/A			✓	N/A
Project's own objectives	Milligram production of catalyst for 1 batch	g	5	Achieved	✓	N/A
	Implementation of SECM	N/A	Benchmark of catalyst from project and AB			
	Insight into degradation mechanisms		Understanding the degradation mechanism of Fe/N/C catalyst			

TAHYA
TANK HYDROGEN AUTOMOTIVE

Project ID:	**779644**
Call topic:	**FCH-01-3-2017**: Improvement of compressed storage systems in the perspective of high volume automotive application
PRD 2020 Panel:	2 - Next Generation of Products - Transport
Project total costs:	**€3 996 943.75**
FCH JU max. contribution:	**€3 996 943.75**
Project start - end:	01/01/2018 - 31/12/2020
Coordinator:	**OPTIMUM CPV, BE**
Website:	**tahya.eu/**

BENEFICIARIES: VOLKSWAGEN AG, TECHNISCHE UNIVERSITAET CHEMNITZ, BUNDESANSTALT FUER MATERIALFORSCHUNG UND -PRUEFUNG, RAIGI SAS, ANLEG GMBH, POLARIXPARTNER GMBH, ABSISKEY

PROJECT AND OBJECTIVES

- Preparatory work to provide a compatible, high-performance H_2 storage system that meets health, safety and environmental standards
- Provide a compatible H_2 storage system that can be mass-produced and is cost competitive
- Regulation codes and standards (RCS) activities to propose updates on GRT13 and EC79, according to test results obtained over the duration of the project.

NON-QUANTITATIVE OBJECTIVES

- Contribution to RCS
- Important contribution regarding safety assessment of tanks
- Reliability and safety
- Development of gas handling unit
- Orbital winding process
- Increased tank manufacturing productivity.

PROGRESS AND MAIN ACHIEVEMENTS

- Development of efficient hydrogen tank according to OEM specification
- Active participation in, and contribution to, GTR13 meetings to revise the text for the R134 certification standard
- Significant cost reduction for on-board hydrogen storage.

FUTURE STEPS AND PLANS

- Validation of fire resistance
- Concept for integrated structural health monitoring
- Optimised filling nozzle to reduce thermal hot spots.

QUANTITATIVE TARGETS AND STATUS

TARGET SOURCE	PARAMETER	UNIT	TARGET	ACHIEVED TO DATE BY THE PROJECT	TARGET ACHIEVED?	SOA RESULT ACHIEVED TO DATE (BY OTHERS)	YEAR FOR SOA TARGET
MAWP addendum (2018-2020)	Gravimetric efficiency	%	6	6.5	✓	5.5	2016
	Costs	€/kg H_2	500	508		1 000	
RCS	Burst pressure	bar	1 750	1 750		1 750	