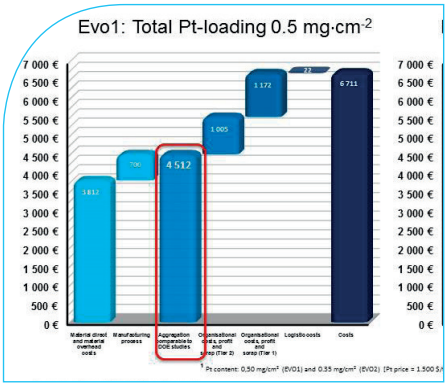
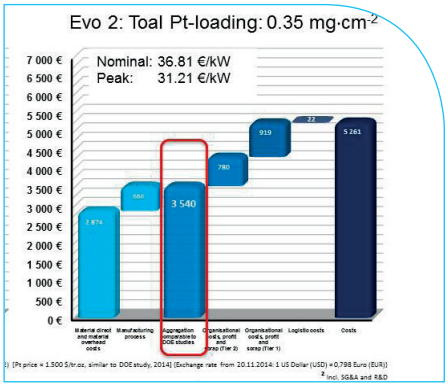
Auto-Stack CORE

AUTOMOTIVE FUEL CELL STACK CLUSTER INITIATIVE FOR EUROPE II

Project ID:	**325335**
Call topic:	**SP1-JTI-FCH.2012.1.2** - Next Generation European Automotive Stack
Project total costs:	**€ 14,673,625.27**
FCH JU max. Contribution:	**€ 7,757,273**
Project start - end:	01/05/2013 - 31/07/2017
Coordinator:	**ZENTRUM FUER SONNENENERGIE- UND WASSERSTOFF-FORSCHUNG, BADEN-WUERTEMBERG, DE**
Website:	**www.autostack.zsw-bw.de/index.php?id=1&L=1**





BENEFICIARIES: BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, BELENOS CLEAN POWER HOLDING AG, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, FREUDENBERG FCCT SE & CO. KG, FREUDENBERG VLIESSTOFFE KG, GREENERITY GMBH, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION, PAUL SCHERRER INSTITUT, POWERCELL SWEDEN AB, REINZ-DICHTUNGS GMBH, SOLVICORE GMBH & CO KG, SWISS HYDROGEN SA, SYMBIOFCELL SA, VOLKSWAGEN AG, VOLVO TECHNOLOGY AB

PROJECT AND OBJECTIVES

"AutoStack Core" establishes a coalition with the objective to develop best-of-its-class automotive stack hardware with superior power density and performance while meeting commercial target cost. The project consortium combines the collective expertise of automotive OEMs, component suppliers, system integrators and research institutes and thus removes critical disconnects between stakeholders. Within the project two stack evolutions were designed and tested. The second evolution achieved a peak power density of 4 kW/l. A third evolution was designed. The project finished July 31st 2017.

PROGRESS & MAIN ACHIEVEMENTS

- Peak power density under operating conditions agreed upon in DoW 4 kW/l
- Endurance testing for more than 3,000 h under dynamic load cycling
- Specific cost according to DoE model 36.81 €/kW

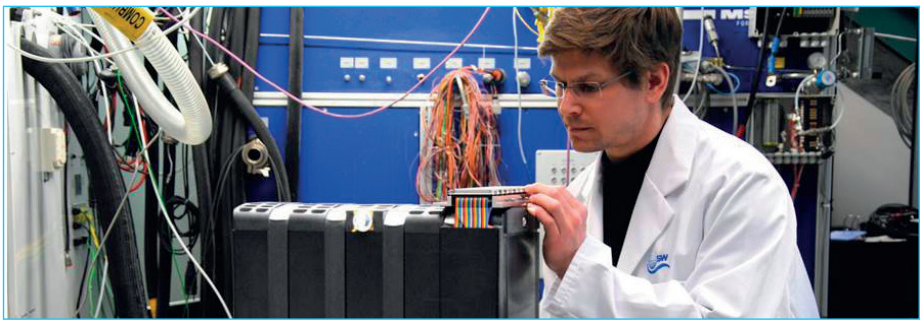
FUTURE STEPS & PLANS

- Project is finished
- The stack is offered as a prototype through Powercell and was selected as one stack to be used by Nikol-motors for truck application
- A German national follow-up project (AutoStack -Industry) in two phases involving 4 OEMs was started with a total budget of 60 M€

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

ReReduce the use of the EU defined 'Critical raw materials

Minimum Pt contents was found to 30 µgcm-2



QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

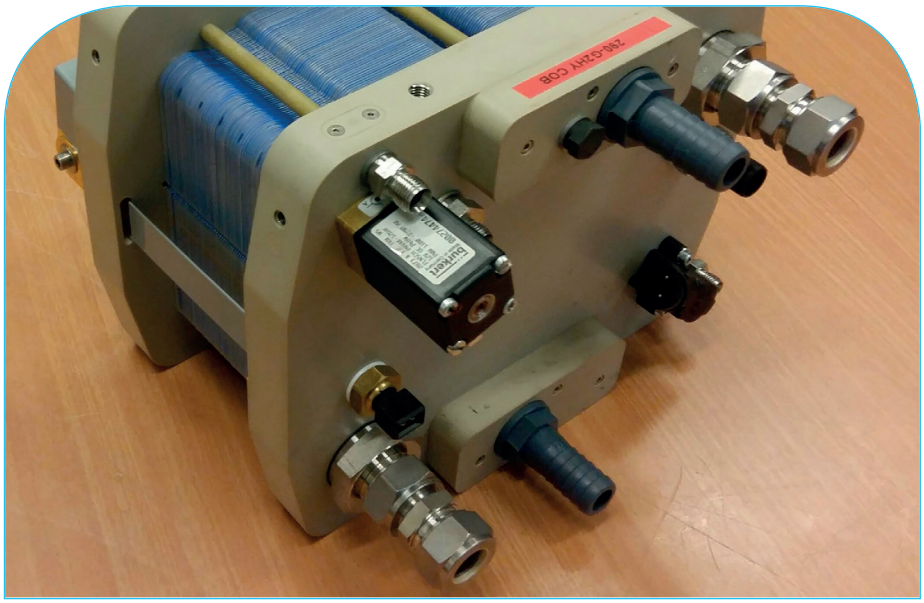
PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	SoA result achieved to date by other group/project (SoA Year)	DESCRIPTION
Est. stack CAPEX (per kW) @ mass production	€/kW	36.81	50	✓ @ mass production	27.56 (2017)	Based on nominal power from a design specific cost study subcontracted to an independent party assuming a production level of 30 000 units per year using the boundary conditions of the DoE cost studies.
Areal power density	W/cm2	0.992	≈1	✓	N/A	Begin of life
Cell Volumetric power density	kW/l	4.05	2	✓	> 3.1 (2015)	Based on peak load under reference operating conditions as described in DoW

*As identified in AIP 2012, Target Year 2017

COBRA
COATINGS FOR BIPOLAR PLATES

Project ID:	621193
Call topic:	SP1-JTI-FCH.2013.1.2 - Research & Development on Bipolar Plates for PEM fuel cells
Project total costs:	€ 3,803,697.6
FCH JU max. Contribution:	€ 2,339,595
Project start - end:	01/04/2014- 31/12/2017
Coordinator:	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR
Website:	www.cobra-fuelcell.eu

BENEFICIARIES: BORIT NV, FUNDACION CIDETEC, IMPACT COATINGS AB, INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE LYON, SYMBIOFCELL SA



PROJECT AND OBJECTIVES

COBRA aims at developing and improving the PEMFC stack components and especially metallic bipolar plates. For automotive fuel cell stacks most of the OEMs have already chosen metallic bipolar plates as technological solutions for cost and process ability concerns. Thus, the COBRA focuses on two main topics to reach the performances, durability and cost objectives: the improvements of manufacturing process and the development of new coatings as alternative to expensive state-of-art gold coating. The project ended in December 2017.

NON QUANTITATIVE OBJECTIVES

PROGRESS & MAIN ACHIEVEMENTS

- Development of new coating for PEMFC bipolar plate (MaxPhase)
- Cost analysis of complete manufacturing process for COBRA technology
- Real field testing for a 5 kW COBRA stack in Hy-Kangoo vehicle (9300 kms)

FUTURE STEPS & PLANS

- Project is finished
- Long-term real field testing could be very useful to complete the project results (lack of time)

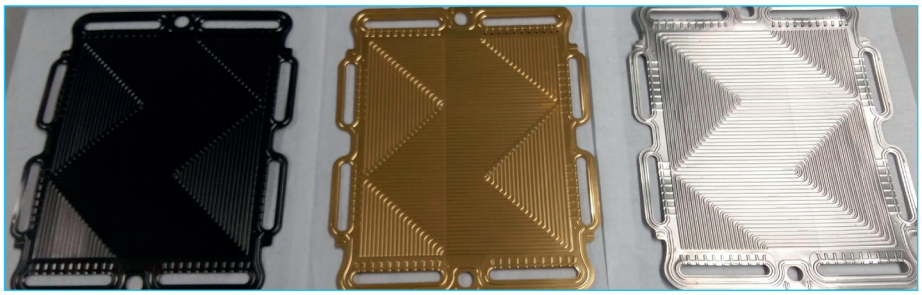
RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

Development of low cost manufacturing process and coating material for bipolar plate

Reduce the use of the EU defined 'Critical raw materials'

Replacement of gold coatings by low cost alternative solutions.



QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TAR-GET	TARGET ACHIEVED?	SoA result achieved to date by other group/project (SoA Year)	DESCRIPTION
Corrosion anode	µA/cm²	-0.1	<10	✓	0 (target : 1) (2020-DOE Target year)	Bipolar plate corrosion resistance
Corrosion cathode	µA/cm²	1.07	<10	✓	< 1 (target : <1) (2020-DOE Target year)	Bipolar plate corrosion resistance
Area specific resistance	mohm.cm²	5	<10	✓	6 (target : < 10) (2020-DOE Target year)	Bipolar plate specifications
Cost	euro/kW	9.8	2.5	✗	7 (target : 3 for 500000 stack per year) (2020-DOE Target year)	Bipolar plate specifications
Rated stack total efficiency (LHV)	%	46	55	✗	N/A	FC stack
Cell Volumetric power density	kW/l	1.5	7.3	✗	N/A	FC stack

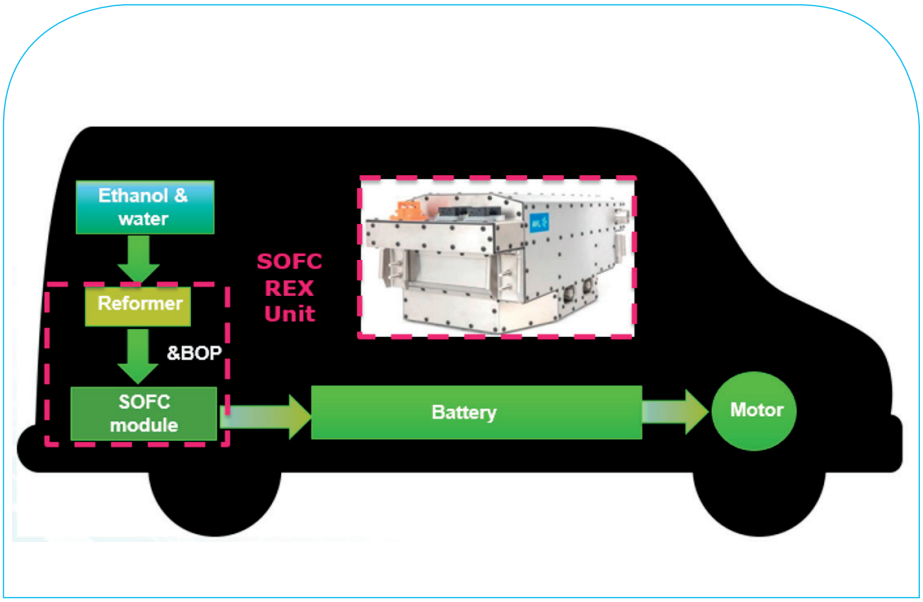
* As identified in MAWP Addendum 2018-2020 and AIPs 2012-2013, Target Years 2017-2020

COMPASS

COMPETITIVE AUXILIARY POWER UNITS FOR VEHICLES BASED ON METAL SUPPORTED STACK TECHNOLOGY

Project ID:	700200
Call topic:	**FCH-01.5-2015** - Develop technologies for achieving competitive solutions for APU transport applications based on existing technology
Project total costs:	€ 3,920,302.5
FCH JU max. Contribution:	€ 3,920,302.5
Project start - end:	01/10/2016 - 30/09/2019
Coordinator:	AVL LIST GMBH, AT
Website:	www.h2020-compass.eu

BENEFICIARIES: FORSCHUNGSZENTRUM JULICH GMBH, Nissan Motor Manufacturing (UK) Limited, PLANSEE SE



PROJECT AND OBJECTIVES

This project is worldwide the first (publically known) approach to integrate SOFC based APUs (Auxiliary Power Units) into electrical powertrains. With this innovative approach, the attractiveness of Battery electric vehicles can be increased due to significant improvements in vehicle range and recharging times. Within the COMPASS project an advanced APU system will be developed, to convert chemical energy stored in a high energy density fuel tank (hydrocarbon, e.g. ethanol) into electricity, to recharge the vehicle HV battery for electrical driving.

PROGRESS & MAIN ACHIEVEMENTS

- Specification documents, DVP & APU to vehicle integration framework complete
- Advanced component for APU developed
- Advanced Simulation tool for Rapid starting developed

FUTURE STEPS & PLANS

A stack supplier and OEM partner are now actively recruited to join the consortium by AVL.

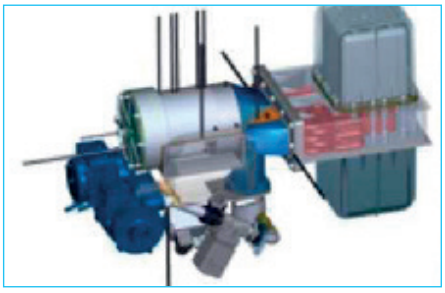
RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

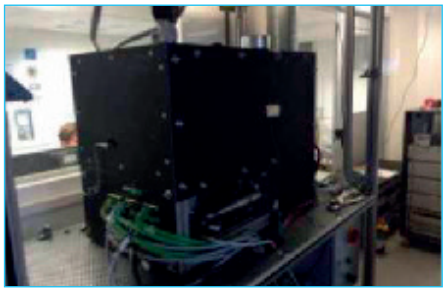
Reduce the production cost of fuel cell systems to be used in transport applications

A work package is devoted to this task.

Increase the electrical efficiency and the durability of the different fuel cells

A work package is devoted to this task.





QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	TARGET	TARGET ACHIEVED?
Fuel Cell system durability	hours	5000	✓
Rated system total efficiency (LHV)	%	55	✓
APU CAPEX	€/kW	<2000	✗
Est. APU CAPEX @ mass production	€/kW	<2000	✓ (projection)

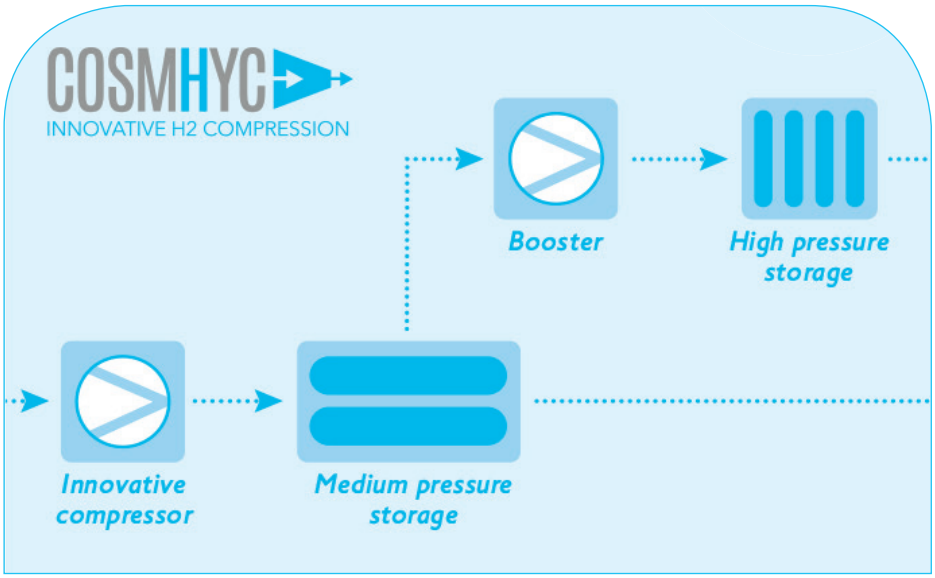
*** As identified in MAWP Addendum 2018-2020 and AIPs/MAIPs, Target Years 2016-2020**

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 decentralized applications for hydrogen refuelling or storage
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: Ludwig-Boelkow-Systemtechnik GmbH, MAHYTEC SARL, NEL HYDROGEN AS, STEINBEIS 2I GMBH, STEINBEIS INNOVATION GGMBH



PROJECT AND OBJECTIVES

COSMHYC develops and test a hybrid compression solution for hydrogen refuelling stations by combining an innovative compressor with a booster and optimizing both technologies for a compression from 1 to 1000bar. The objectives are to lower investment and operational costs, to reduce the noise level related to the booster, to increase the availability of stations, and thus to increase the efficiency of hydrogen delivery. MAHYTEC, EIFER and NEL are currently developing the compressors and focusing on the integration of both technologies, which will be tested in a comprehensive way.

NON QUANTITATIVE OBJECTIVES

- Modular and scalable
- Increase reliability
- Perform a cost of ownership assessment

PROGRESS & MAIN ACHIEVEMENTS

- Definition of technical requirements for the compression solution for selected applications (refuelling of FC cars, buses and trains...)
- Preliminary design of the innovative compressor along with the definition of the specification of the monitoring and control system
- Design of a mechanical compressor with major improvements in terms of efficiency and life time

FUTURE STEPS & PLANS

- Construction and tests of the mechanical compressor, integrating innovative features, advanced materials and noise reduction packaging
- Construction and tests of the innovative compressor along with safety analysis and pre-certification process
- Long-time testing of the COSMHYC compression solution as a virtual compressor following joint test programs and protocols
- Collection of operative and performance data and technical economic evaluation comparing processor concepts for selected applications
- Definition of a roadmap towards exploitation of the different compression solutions developed in COSMHYC for preparing their market deployment

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Increase the energy efficiency of production of hydrogen mainly from water electrolysis and renewable sources while reducing operating and capital costs

- Possibility to use waste heat (no electricity consumption)
- Optimized compression system designed to minimize energy consumption below 6 kWh/kg
- Strong focus on technical-economic assessment

Reduce the use of the EU defined 'Critical raw materials'

- No platinum intrinsically
- No rare earths

QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	SoA result achieved to date by other group/project (SoA year)
Energy consumption	kWh/kg	6	6	✓	3 (2017)
Degradation	%/9 months	5	10	✓	N/A
Specific costs	k€/kg*day	3.7	N/A	✗	5-12

*** Project's own objectives**

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
Project total costs:	**€ 3,486,965**
FCH JU max. Contribution:	**€ 3,486,965**
Project start - end:	01/01/2017 - 31/12/2019
Coordinator:	**COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR**
Website:	**www.digiman.eu**

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

PROJECT AND OBJECTIVES

The project aims at advancing to MRL6 the critical steps of the PEM fuel cell assembly processes and in-line QC/end-of-line test and to demonstrate a route to automated volume process production capability within automotive best practices (cycle time optimization, cost reduction and quality control). The project will include digital codification of properties of GDL to establish yield impacting causes and effects relationships within the value chain (Industry 4.0 standards). The outcome will be a blueprint for beyond current state automotive PEM fuel cell manufacturing capability in Europe.

NON QUANTITATIVE OBJECTIVES

- Analyse the influence of GDL defects on performance
- Develop a scanning method for roll-stock GDL to identify defects
- On-line characterization of GDL properties
- Develop a Proof of Process and a blue print design for the stack automated manufacturing process

PROGRESS & MAIN ACHIEVEMENTS

- KPIs for i) fully automated stack assembly / test via automotive best practice and ii) stack performance at handover into an automotive production lin
- Proof-of-process demonstrator equipment for the uplifted cell assembly automation has been specified and designed (and is currently in manufacture)
- Deep characterization of GDL properties has enabled the development of meaningful automatic scanning techniques for digital QC and upstream/downstream

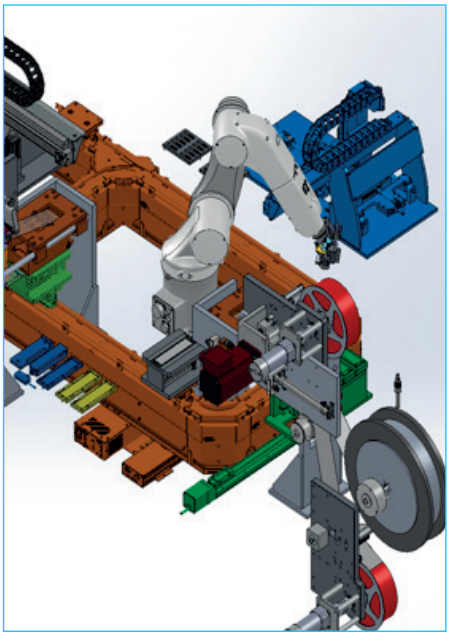
FUTURE STEPS & PLANS

- Finalize the validation of the Vision System for scanning roll-stock GDL
- Finalize the PoP and the blue print design
- Analyse the influence of some GDL defects on performance: propose a methodology to do so
- Virtual engineering and the development of the 'Digital Twin' plus a validation programme for stacks assembled via the PoP demonstrator

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

The PoP of automated assembly of stack will allow the development of a Blueprint design for automated assembly of cells will reduce stack manufacture Capex and operational costs reducing cost.



QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET
Cycle time cell assembly	seconds	1st year project	<5
Component yield	%		>95
Material utilization	%		>99
Cost reduction (stack manufacturing)	%		>15
Increase AC64 stack process technology from TRL4 to TRL6	TRL		6

* Project's own objectives

Fit-4-AMandA

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

Project ID:	**735606**
Call topic:	**FCH-01-1-2016** - Manufacturing technologies for PEMFC stack components and stacks
Project total costs:	**€ 2,999,185**
FCH JU max. Contribution:	**€ 2,999,185**
Project start - end:	01/03/2017- 29/02/2020
Coordinator:	**UNIRESEARCH BV, NL**
Website:	**www.fit-4-amanda.eu**

BENEFICIARIES: EWII FUEL CELLS A/S, FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Proton Motor Fuel Cell GmbH, TECHNISCHE UNIVERSITAET CHEMNITZ, UPS EUROPE SA, USK KARL UTZ SONDERMASCHINEN GMBH

PROJECT AND OBJECTIVES

Fit-4-AMandA's ambition is to modify the current design of PEMFC stacks and stack components, and build an entirely new equipment facilitating automation of the stack assembly process (including inline non-destructive tests). Furthermore, it will demonstrate the resulting mass-produced stacks in real environment – by integration the output into a Light-Commercial-Vehicle. The project will offer the mass production machine innovative solutions, which effect process, product and tools with the objective to bring the MRL from 5 to 7.

NON QUANTITATIVE OBJECTIVES

- Development of fast inline non-destructive quality assurance (NDT-QA) test methods for automated production of MEAs and stack assembly
- FC Market study

PROGRESS & MAIN ACHIEVEMENTS

- Stack design optimized for automatic manufacturing: design, tolerances, material and surfaces; assembly drawings with the relevant parameters
- Design of machine system for automatic fuel cell stack assembling, consisting of mechanical design, pneumatic and electrical design and control system
- Fast in-line tests of fuel cell components and sub-assemblies, addressing integrity, quality, tightness and post-process control.

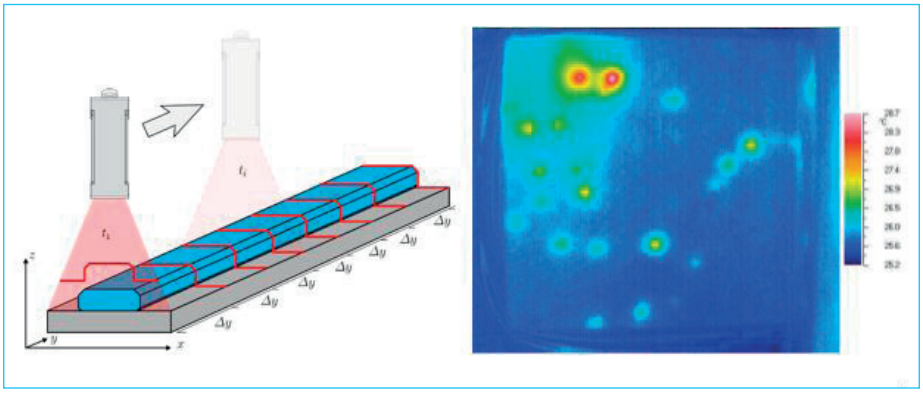
FUTURE STEPS & PLANS

- Develop a new bonding technique for the BPP to ensure it meets the technical and performance requirements
- Negotiate with suppliers to ensure that materials and equipment relevant for the building of the mass manufacturing machine is delivered on time
- Delays due to the procurement of materials and equipment. Come up with out of the box solutions to ensure that the project is completed on time
- To minimize delay, system can be equipped with a PM SoA stack first which can be replaced when the machine stack is available

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

Develop a mass manufacturing machine that enables high volume production of fuel cell stacks in a cost effective way. Thus eventually lowering the production cost of fuel cell systems to be used in transport applications.



QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

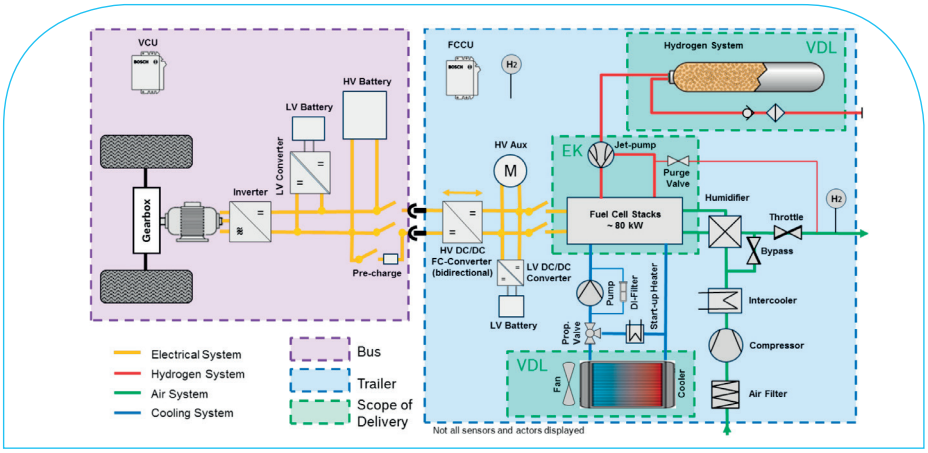
PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?
Stack electrical efficiency (LHV) - observed	%	51	55	
Cell Volumetric power density	kW/l	1.42	7.3	

*** As identified in MAWP Addendum 2018-2020, Target Year 2020**

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
Project total costs:	**€ 3,260,297.5**
FCH JU max. Contribution:	**€ 3,260,297.5**
Project start - end:	01/05/2016 - 30/04/2019
Coordinator:	**SINTEF AS, NO**
Website:	**www.giantleap.eu**



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

PROJECT AND OBJECTIVES

Giantleap aims to develop new diagnostic, prognostic and control approaches to improve the availability and reliability of fuel-cell electric buses (FCEBs). FCEB demonstrations have reported multiple issues, often not related to the fuel cells but more with the balance-of-plant (BoP), especially compressors. Giantleap shall demonstrate the operation of a FCEB system with new algorithms and analyse the produced data to validate the approach. To further increase reliability and availability, the FCEB is actually a battery bus with a detachable fuel-cell range extender.

NON QUANTITATIVE OBJECTIVES

- Flexible conversion of battery buses into hydrogen buses, flexibility for operators
- Better understanding of rejuvenation techniques in fuel cells
- Provide publicly available data for BoP

PROGRESS & MAIN ACHIEVEMENTS

- Development of relay-based, inexpensive sensing technique for low-frequency resistance in fuel cells
- Development of comprehensive prognostic software for fuel cells and balance-of-plant units in FC systems
- Development and testing of passive, highly reliable, stack-integrated hydrogen recirculation system.

FUTURE STEPS & PLANS

- Implementation of control & PHM system
- Demonstration activities
- Validation of approaches with experimental data
- Exploitation plan and business case for end users
- Public data collection

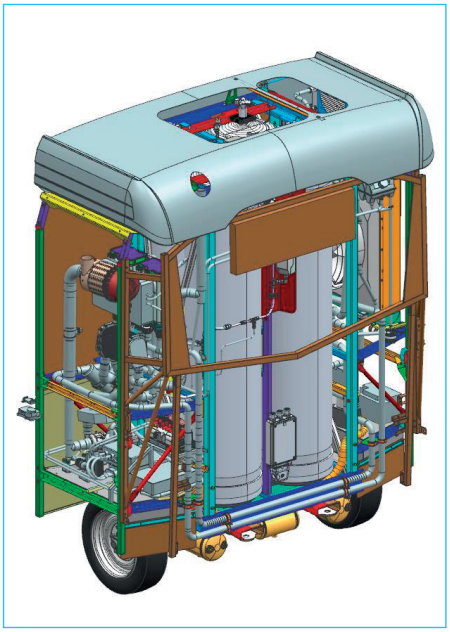
RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

Focus on increasing system and stack lifetimes, which directly contribute to a lower TCO.

Increase the electrical efficiency and the durability of the different fuel cells

Focus on increasing durability of fuel cells (also systems) with multiple innovative control and PHM approaches.



QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	SoA result achieved to date by other group/project (SoA year)	DESCRIPTION
FC Bus Cost	k€	565	625	✓	N/A	Estimate by VDL for production at scale
Availability	%	85	90	✗	85 (2017)	Demonstration not started yet.
Stack lifetime for buses	hours	10,000	20,000	✓	25,000 (2017)	N/A

*As identified in MAWP Addendum 2018-2020, Target Year 2020

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 applications
Project total costs:	**€ 7,127,941.25**
FCH JU max. Contribution:	**€ 5,968,554**
Project start - end:	01/09/2015- 31/05/2019
Coordinator:	**CENTRE TECHNIQUE DES INDUSTRIES MECANIQUES, FR**

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

PROJECT AND OBJECTIVES

H2REF addresses compression and buffering of H2 for refuelling of 70 MPa vehicles and aims to bring a novel cost effective, high-performance, and reliable hydraulics-based system, from TRL 3 to 6. Following design of the process and of the core compression device, a full scale prototype compression and buffering module (CBM) was built in a test area. Following compression device testing, the full CBM including the number of compression devices for the complete compression and dispensing cycle will be tested in closed loop operation. The CBM will be interfaced with a vehicles dispenser for demo.

NON QUANTITATIVE OBJECTIVES

- Techno-economic analysis based on project results
- Have the technology covered by the RCS framework

PROGRESS & MAIN ACHIEVEMENTS

- CBM process developed, full scale prototype system built, and compression device hydraulic actuation successfully tested
- Suitable bladder material identified and accumulator developed and successfully qualified for functional testing in CBM
- New hydrogen test area set up within consortium partner (Haskel) premises for testing of system in hydrogen service

FUTURE STEPS & PLANS

- Functional testing of the bladder accumulator in hydrogen service
- Closed-loop functional testing of the CBM process with a complete set of accumulators
- Interfacing of CBM with a dispenser and demonstration of vehicle refuelling using this process

QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

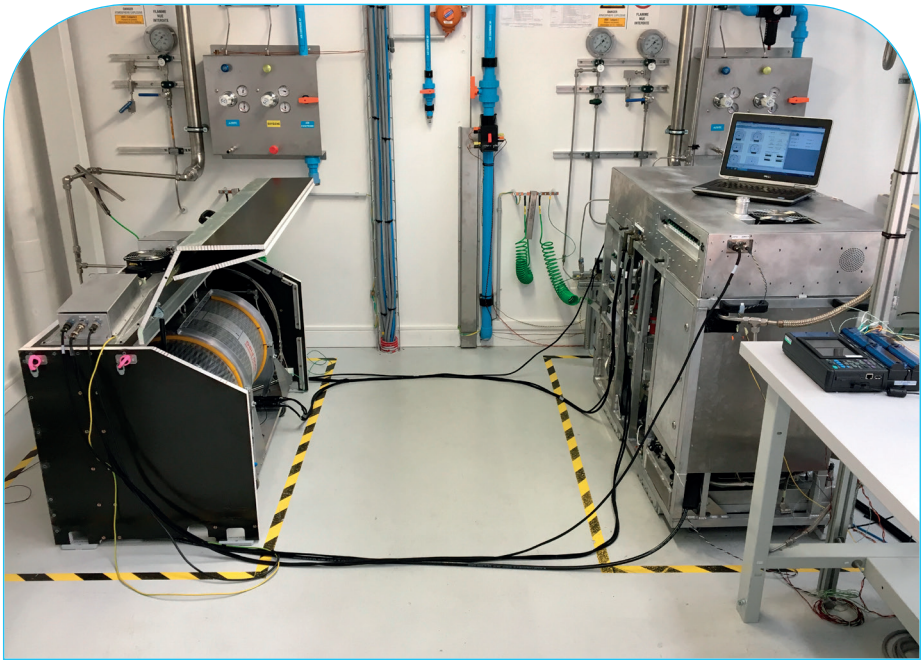
PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?
TRL	N/A	3.00	Bring from TRL3 to TRL6 a technical solution providing a step change	(due later) Through an extensive component and system testing programme
CBM manufacturing cost	K€	0.00	300 assuming 50 units/yr	(due later) Through the novel implementation of mature technologies (hydraulics and composite pressure vessels)
Throughput	kg/d	0.00	Throughput of 720 kg/d from 7 MPa with a pumping power of 75 kW	(due later) No long recharge of buffers needed, allowing a throughput of 30 kg/h 24h/d from 7 MPa with a pumping power of 75 kW
Average consumption	kWh/kg	0.00	1.5	(due later) Thanks to the conservation of source storage pressure

* As identified in AWP 2014 and Projects own objectives, Target Years 2018-2019

HYCARUS
HYDROGEN CELLS FOR AIRBORNE USAGE

Project ID:	**325342**
Call topic:	**SP1-JTI-FCH.2012.1.6** - Fuel cell systems for airborne application
Project total costs:	**€ 12,064,473.93**
FCH JU max. Contribution:	**€ 5,219,265**
Project start - end:	01/05/2013 - 31/12/2018
Coordinator:	**ZODIAC AEROTECHNICS SAS, FR**
Website:	**www.hycarus.eu**

BENEFICIARIES: AIR LIQUIDE ADVANCED TECHNOLOGIES SA, ARTTIC, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, DASSAULT AVIATION SA, DRIESSEN AEROSPACE CZ SRO, INSTITUTO NACIONAL DE TECNICA AEROESPACIAL, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION, ZODIAC CABIN CONTROLS GMBH, Zodiac ECE



PROJECT AND OBJECTIVES

The main objective of HYCARUS is to develop 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 sources 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. In addition, 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.

PROGRESS & MAIN ACHIEVEMENTS

- All System verification tests completed including dysfunctional tests defined in accordance with the System Safety Analysis (SSA) made
- EMI qualification tests (D0160 Section19, 20, 21, 25) have been performed successfully on the Fuel Cell System
- Completion of the Fuel Cell system prototype which will be used for the Flight tests campaign

FUTURE STEPS & PLANS

- End of Qualification tests (Climatic and vibration tests) according to the D0160 standard at Fuel Cell system level
- Flight tests clearance (permit to fly)
- Flight tests campaign (3 flights are planned)

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Demonstrate on a large scale the feasibility of using hydrogen to support integration of renewable energy sources into the energy systems

The main objectives of HYCARUS is to develop 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 sources 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.

QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

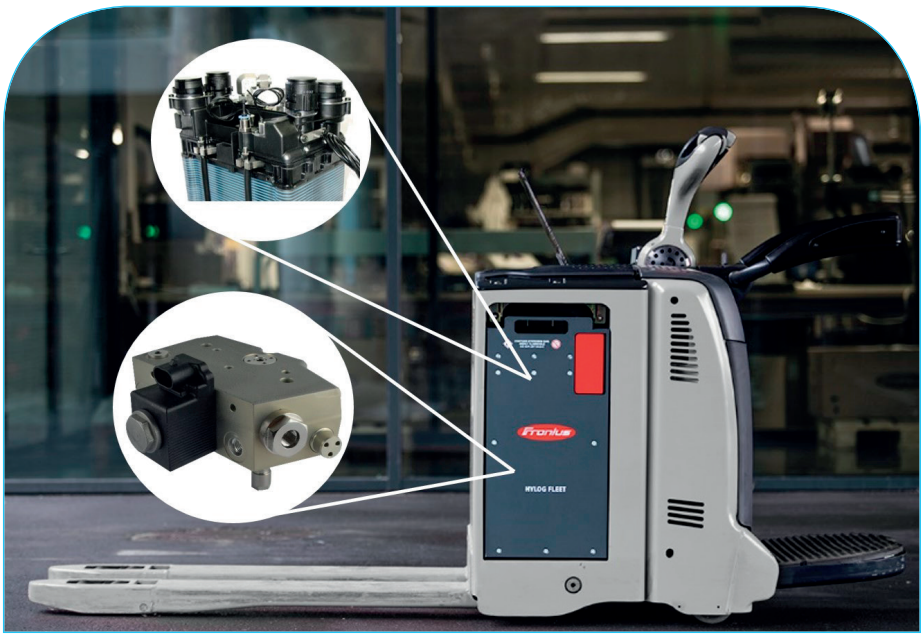
PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	SoA result achieved to date by other group/ project (SoA year)	DESCRIPTION
KPI - System total efficiency (LHV), observed	%	45	25	✓	55	Fuel cell system efficiency (LHV) at 25% of rated power: 55%
Durability	hours	[-]	3,500/10,000	✂	N/A	N/A

*** As identified in MAWP Addendum 2018-2020 and AIP 2012, Target Years 2018-2020**

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
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:	**http://inline-project.eu/**

BENEFICIARIES: ELRINGKLINGER AG, FRONIUS INTERNATIONAL GMBH, Karlsruher Institut fuer Technologie, OMB SALERI SPA



PROJECT AND OBJECTIVES

The Project aims on a development of a design for a high qualitative manufacturing of Proton Exchange Membrane fuel cells. The objectives include the redesign of the media supply unit, the development of automated Quality inspection methods and the scalability of the manufacturing process. Currently the original manufacturing process has been successfully simulated, and the first Demonstrators for inline Quality Control are built up. Also some Engineering samples of the redesigned media supply unit and the new manufactured tank Valve are available.

PROGRESS & MAIN ACHIEVEMENTS

- Redesigned media supply unit
- Simulation of the full manufacturing process at it is currently run at Project Partners
- First Demonstrators of assisted assembly Station and inline quality Control

FUTURE STEPS & PLANS

- Manufacturing of each 10 Engineering samples of Media Supply Unit and Tank valve
- Manufacturing of 20 Hylog Fleet PEMFC Systems
- Fully operational assisted assembly station
- 2 functional non-destructive inline quality control methods
- Full Simulation of the new design of the manufacturing process

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

The Addition of assisted assembly and automated inline Quality Control to reach Scalability in the production process will reduce production costs and lower cycle time and increase the quantity at the same time.

QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

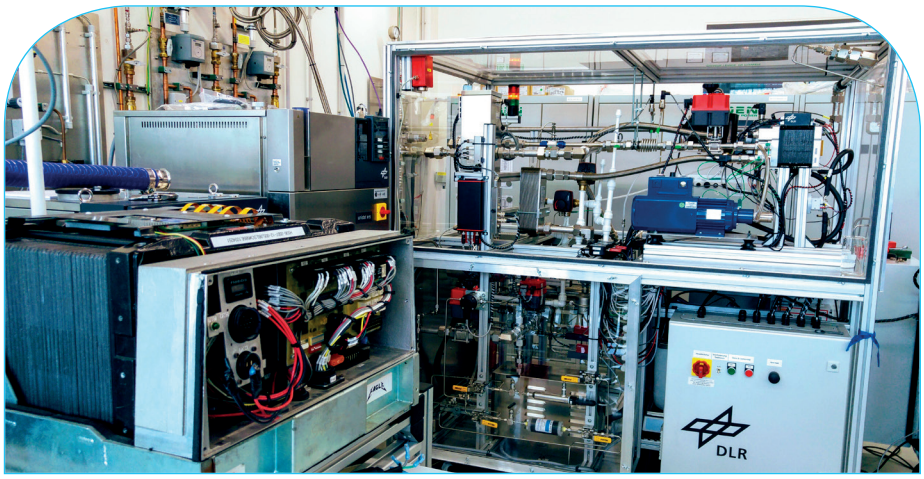
PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	TARGET YEAR	TARGET SOURCE
Project process: Production Rate	(stacks/yr)	100	100-50,000	✓	2016	AWP 2016
Rated FC system durability	hours	20,000	5000	✓	2020	MAWP Addendum 2018-2020
System availability	%	100	98	✓		

*** As identified in MAWP Addendum 2018-2020 and AWP 2016, Target Year 2020**

INN-BALANCE

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

INN·BALANCE
AUTOMOTIVE FUEL CELL



Project ID:	**735969**
Call topic:	**FCH-01-4-2016** - Development of Industrialization-ready PEMFC systems and system components
Project total costs:	**€ 6,156,288.75**
FCH JU max. Contribution:	**€ 4,994,538.75**
Project start - end:	01/01/2017- 31/12/2019
Coordinator:	**FUNDACION AYESA, ES**
Website:	**www.innbalance-fch-project.eu**

BENEFICIARIES: AVL LIST GMBH, Brose Fahrzeugteile GmbH & Co. Kommanditgesellschaft, Wurzburg, CELEROTON AG, DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, Powercell Sweden AB, STEINBEIS 2I GMBH, STEINBEIS INNOVATION GGMBH, UNIVERSITAT POLITECNICA DE CATALUNYA, VOLVO PERSONVAGNAR AB

PROJECT AND OBJECTIVES

INN-BALANCE project aims to design, develop and test balance of plant components for automotive fuel cells in order to increase their efficiency and reliability and to reduce costs. Specifically, the main technical objectives are to improve and tailor development tools for design, modelling and testing innovative components in fuel cell based vehicles and to achieve high technology readiness levels (TRL7 or higher) in all the tackled developments. The project is currently in the middle of the execution and the BoP components are under development.

NON QUANTITATIVE OBJECTIVES

- Develop different types of system models
- Advanced supervisory control strategies
- Test the fuel cell system into a vehicle powertrain
- To develop a technology plan
- To elaborate an exploitation, communication and dissemination plan

PROGRESS & MAIN ACHIEVEMENTS

- Overall fuel cell system layout defined
- 100 kw fuel cell stack prototype already manufactured.
- Air turbo-compressor prototype sample A available in Celeroton's facilities and under testing

FUTURE STEPS & PLANS

- On-board diagnostics software
- Anode module prototype
- Air turbo-compressor prototype sample B
- Cathode module prototype
- Thermal management prototype

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

One of the activities of the project is to develop a tool to optimize the design of the prototypes considering the impact on the mass production. To that end, the design of the components is not only focused on the performance but also on the manufacturing implications.

QUANTITATIVE TARGETS AND STATUS

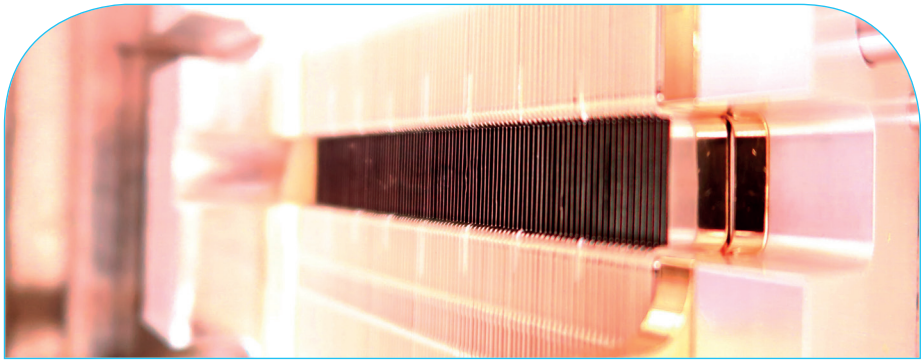
FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	DESCRIPTION
Cold start	Celsius degree	Under development	-40	✗	The temperature able to start up and shut down.
Air compressor power	kW	Under development	10-12	✗	The power of the turbo compressor
Manufacturing cost of the air compressor	€/unit	Under development	250	✗	The estimated manufacturing cost per unit at 50.000 units/year production
Manufacturing cost of the anode	€/unit	Under development	220	✗	The estimated manufacturing cost per unit at 50.000 units/year production
Manufacturing cost of BoP	€/kW	Under development	100	✗	The estimated manufacturing cost of BoP at 50.000 unit/year
Rated stack electrical efficiency (LHV)	%	53	> 55%	✗	N/A
Areal power density	W/cm2	0.975	1.5	✗	Maximum continuous, up to 1.2 possible for limited time

*As identified in MAWP Addendum 2018-2020, AIP 2012 and project's own objectives, Target Years 2019-2020

INSPIRE

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
Project total costs:	**€ 6,878,070.01**
FCH JU max. Contribution:	**€ 6,877,869.75**
Project start - end:	01/05/2016 - 30/04/2019
Coordinator:	**JOHNSON MATTHEY PLC, UK**
Website:	**www.inspire-fuelcell.eu**

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

PROJECT AND OBJECTIVES

The overall aim of INSPIRE is to develop and integrate together the most advanced MEA components (electro catalysts, membranes, gas diffusion layers and bipolar plates) into 3 generations of automotive stacks meeting a beginning-of-life power density of 1.5 W/cm2 at 0.6 V, durability of over 6,000 hours operation with less than 10% power degradation, and a stack assessment showing production costs below 50 €/kW for an annual production rate of 50,000 units. The first generation, 140kW, 395 cell stack is now in operation and 3 new catalysts meeting the 0.44 A/mgPt target have moved to scale-up.

NON QUANTITATIVE OBJECTIVES

- Scale-up best performing catalyst for stack MEAs
- Develop two new generations of BPP for automotive stacks
- Dissemination of project results

PROGRESS & MAIN ACHIEVEMENTS

- 4 new catalysts have met the project mass activity and stability requirements (>0.44 A/mg Pt), with 3 of those catalysts having now moved to scale-up
- The Milestone 2 target of 1.2 W/cm2 @ 0.6V was achieved with the GEN 1.0 MEA design in the INSPIRE GEN 1.0 hardware at BMW
- The 1st generation 395 cell stack has been manufactured and validated, demonstrating 140 kW, 2.8 kW/l with prototype housing, 5.4 kW/l without housing

FUTURE STEPS & PLANS

- Testing with the second generation (GEN 2.0) stack due to start June 2018; third generation (GEN 3.0) earmarked for February 2019
- 1.2 W/cm2 MEA mid-term performance achievement to be fully demonstrated in full stack; plus MEA development towards 1.5 W/cm2 target
- Following successful scale-up of the three new catalysts from WP3, further catalyst layer optimization will take place to be implemented in GEN 3.0
- New high performing, durable membrane to be scaled-up and implemented in GEN 3.0.
- Six-month project extension to be agreed by the beneficiaries and Grant Amendment request submitted

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

Main project target to reduce production cost of overall stack to below 50€/kW.

Reduce the use of the EU defined 'Critical raw materials'

Project target is to reduce loading to 0.2 mgpt/cm2 and assess recycling potential.

QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	DESCRIPTION
1.5 W/cm2 at 0.6V	W/cm2	1.14	1.5	✗	Demonstrated in 395 cell stack
10% performance loss over 6,000 hours	%	N/A	10%	✗	Not yet assessed
MA >0.6 A/mg	A/mg	0.6	0.6	✓	N/A
Loading <0.125 mg/cm2	Mg/cm2	0.3	0.12	✗	GEN 2.0 design demonstrated in screener and large single cell at 0.25 mg/cm2 but not in stack.
50€/kW @ 50,000 units/year	€/kW	N/A	50	✗	Not yet assessed
Areal power density	W/cm2	1.13	1.5	✗ But SoA 2017 achieved	N/A
PGM catalyst loading - Anode	g/kW	0.073	0.17	✗	N/A
PGM catalyst loading - Cathode	g/kW	0.244			

*As identified in MAWP Addendum 2018-2020 and AWP 2015, Target Year 2019-2020

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
Project total costs:	**€ 3,704,757.5**
FCH JU max. Contribution:	**€ 2,939,457.5**
Project start - end:	01/03/2017- 28/02/2021
Coordinator:	**Teknologian tutkimuskeskus VTT Oy, FI**
Website:	**www.vtt.fi/sites/maranda**

BENEFICIARIES: ABB OY, OMB SALERI SPA, PERSEE, Powercell Sweden AB, SUOMEN YMPARISTOKESKUS, SWISS HYDROGEN SA, VERTIGO GAMES BV

PROJECT AND OBJECTIVES

In MARANDA project an emission-free hydrogen fuelled PEMFC based hybrid powertrain systems (3 x 82.5 kW AC) are developed for marine applications and validated both in test benches and on board the research vessel Aranda, including full scale freeze start testing of the system. The project will increase the market potential of hydrogen fuel cells in marine sector. General business cases for different actors in the marine and harbour or fuel cell business will be created.

NON QUANTITATIVE OBJECTIVES

- The impact related to the development of RCS
- Fuel cell systems should be able to withstand the shocks, vibrations, saline environment and ship motions
- The evaluation of the economic and environmental impact for a prospective customer
- The formulation of an initial go-to market strategy with support from stakeholders.
- The mapping of opportunities for future demonstration 'innovation' actions.

PROGRESS & MAIN ACHIEVEMENTS

- Regulations, codes and standards for fuel cells in marine applications has been reviewed and gaps identified
- First 100 kW S3 stack has been assembled and delivered for the use in fuel cell system
- Environmental assessment of hydrogen for research vessel use has been completed

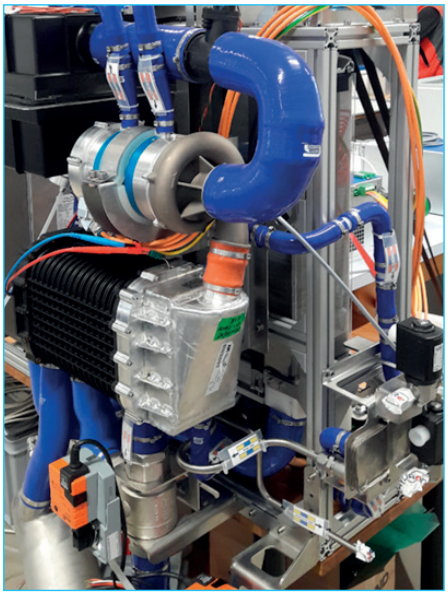
FUTURE STEPS & PLANS

- Commissioning of the first fuel cell system at durability test site (M19)
- Acceptance from Finnish Transport Safety Agency (Trafi) for the installation of FC system and hydrogen storage in Aranda (M22)
- Field trial start in target vessel (M27)
- 1st FC system complete 4380 testing (M36)
- Field trial start in target vessel completed (M45)

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Increase the electrical efficiency and the durability of the different fuel cells

The experimental results of the project will help to understand the durability issues of fuel cells in marine applications.



QUANTITATIVE TARGETS AND STATUS

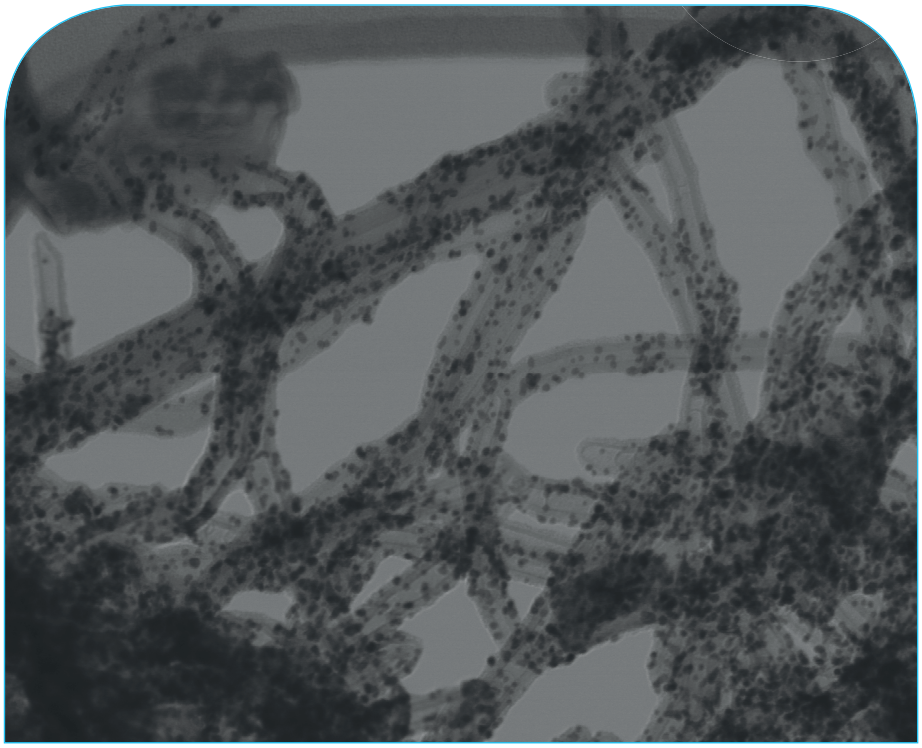
FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	DESCRIPTION
Fuel cell system effect	kW	82.5	75	✓	Design value AC power
Freeze start capability	C	N/A	-35	✗	To be tested
Rated system electrical efficiency (LHV)	%	48	42	✓	The fuel to electric efficiency (AC) objective in the project (BoL).
Rated stack durability	Hours	15,000	15,000	✓	Fuel cell system durability has been estimated to be the same as stack durability. Different BoP components will have different life-times.
FC system CAPEX	€/kW	4000	<6000	✓	Including hydrogen storage for 8 hours operation.

*As identified in AWP 2016, Target Year 2020-2021

Nano-CAT

DEVELOPMENT OF ADVANCED CATALYSTS FOR PEMFC AUTOMOTIVE APPLICATIONS



Project ID:	**325239**
Call topic:	**SP1-JTI-FCH.2012.1.5** - New catalyst structures and concepts for automotive PEMFCs
Project total costs:	**€ 4,394,331**
FCH JU max. Contribution:	**€ 2,418,439**
Project start - end:	01/05/2013 - 31/01/2017
Coordinator:	**COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR**
Website:	**www.nanocat-project.eu**

BENEFICIARIES: ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPPEMENT DES METHODES ET PROCESSUS INDUSTRIELS – ARMINES, C-TECH INNOVATION LIMITED, DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV, FUNDACION TECNALIA RESEARCH & INNOVATION, JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION, NANOCYL SA, VOLVO TECHNOLOGY AB

PROJECT AND OBJECTIVES

The objectives of Nano-CAT were the synthesis on new catalyst concept to reduce the loading of platinum in PEMFC and increase durability. The consortium synthesized innovative support (highly resistance carbon nanotubes and metal oxide aerogel) and did there functionalization with platinum nanoparticles. Those new catalysts showed good performances and durability against commercial reference (Pt/C). Finally, those materials were integrated in full 25 cm2 MEA and advantages in some specific accelerated stressed tests.

NON QUANTITATIVE OBJECTIVES

- Contribution to testing protocol harmonization
- Contribution to determination of ageing mechanism

PROGRESS & MAIN ACHIEVEMENTS

- Functional of carbon nanotube as catalyst support for PEMFC and set up of the adapted catalyst deposition procedure
- Optimization of metal oxide aerogel as catalyst support for PEMFC: optimization of the porous structure, electrical conductivity and Pt deposition
- Low loaded MEA performance

FUTURE STEPS & PLANS

Project is finished

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

Reduction of Pt loading in electrodes. Development of robust support.

Increase the electrical efficiency and the durability of the different fuel cells

Development of new catalyst structure and support to stabilized active layer and catalytic activity.

Reduce the use of the EU defined 'Critical raw materials'

Reduction of Pt loading. Development of PGM free catalysts (both for anode and cathode).

QUANTITATIVE TARGETS AND STATUS

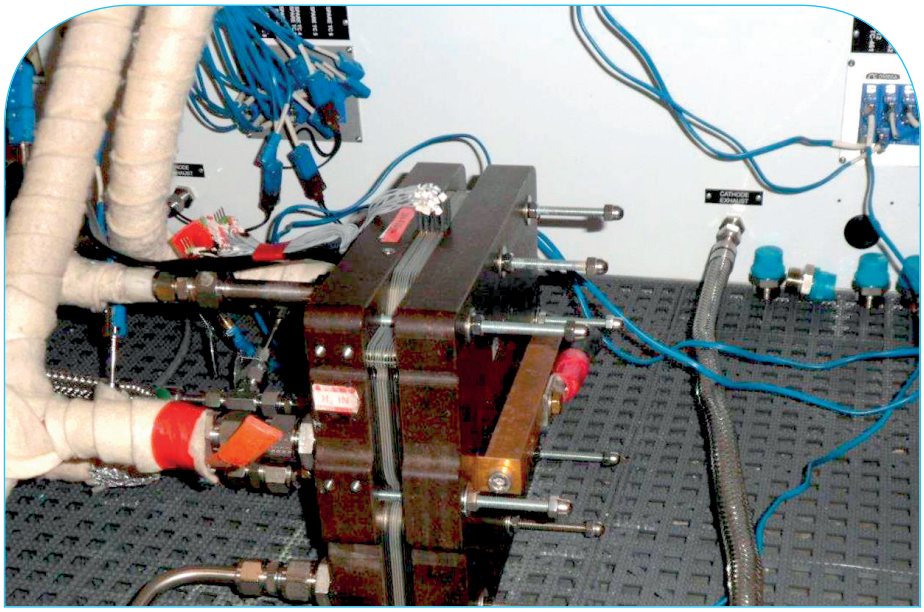
FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?
MEA power density	mW/cm2	1000	1000	✓
degradation, loss of performance	%	10	10	✓
catalyst stability-residual ECSA	%	100	70	✓
conductivity of metal oxyde aerogel	S/cm	0.95	0.4	✓

*As identified in AIP 2012 and project's own objectives, Target Year 2017

SMARTCat

SYSTEMATIC, MATERIAL-ORIENTED APPROACH USING RATIONAL DESIGN TO DEVELOP BREAK-THROUGH CATALYSTS FOR COMMERCIAL AUTOMOTIVE PEMFC STACKS



Project ID:	**325327**
Call topic:	**SP1-JTI-FCH.2012.1.5** - New catalyst structures and concepts for automotive PEMFCs
Project total costs:	**€ 4,768,172.6**
FCH JU max. Contribution:	**€ 2,501,998**
Project start - end:	01/06/2013 - 31/05/2017
Coordinator:	**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, FR**
Website:	**www.smartcat.cnrs.fr**

BENEFICIARIES: BASIC MEMBRANES BV, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, DANMARKS TEKNISKE UNIVERSITET, MXPOLYMERS BV, STIFTELSEN SINTEF

PROJECT AND OBJECTIVES

The present consortium will build a new concept of electrodes based on new catalyst design (ternary alloys/core shell clusters) deposited on a new high temperature operation efficient support. In order to enhance the fundamental understanding and determine the optimal composition and geometry of the clusters, advanced computational techniques will be used in direct combination with electrochemical analysis of the prepared catalysts. SMARTCat will thus enable to automate the MEA production and build efficient short-stack required for competitive automotive fuel cell operation.

NON QUANTITATIVE OBJECTIVES

- Stability of ternary PtMeAu/C catalysts upon potential cycling
- Atomic arrangement of ternary catalysts using Molecular Dynamics
- PhD candidate training

PROGRESS & MAIN ACHIEVEMENTS

- Development of ternary catalysts and supports with either higher activity or higher stability than Pt/C catalyst
- Stack 10 cells 220cm2 active area loaded with 0.18 mg/cm^2 Pt3NiAu 5Wcm-2 / 1.1 kW = performance of same stack loaded with 0.42 mg/cm^2 pure Pt
- Achievement of automated 70 MEA/day with membrane size = electrode size + 5%

FUTURE STEPS & PLANS

Project is finished

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the use of the EU defined 'Critical raw materials'

Minimum Pt contents was found to 30 µgcm-2

QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	DESCRIPTION
Stack availability	%	100	98	✓	N/A
Areal power density	W/cm2	0.137	1.5	✗	
PGM catalyst loading - Anode	g/kW	0.015	0.17	✓	
PGM catalyst loading - Cathode		0.015			
Stack Durability	hours	5000	5000	✓	Estimated using PVD coating technology developed in SMART-Cat with 1W/cm2

*As identified in MAWP Addendum 2018-2020, Target Year 2020

VOLUMETRIQ

VOLUME MANUFACTURING OF PEM FC STACKS FOR TRANSPORTATION AND IN-LINE QUALITY ASSURANCE

Project ID:	**671465**
Call topic:	**FCH-01.2-2014** - Cell and stack components, stack and system manufacturing technologies and quality assurance
Project total costs:	**€ 4,988,450.25**
FCH JU max. Contribution:	**€ 4,961,950**
Project start - end:	01/09/2015 - 28/02/2019
Coordinator:	**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS, FR**
Website:	**www.volumetriq.eu**

BENEFICIARIES: BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, ELRINGKLINGER AG, INTELLIGENT ENERGY LIMITED, JOHNSON MATTHEY FUEL CELLS LIMITED, JOHNSON MATTHEY PLC, PRETEXO, SOLVAY SPECIALTY POLYMERS ITALY SPA, UNIVERSITE DE MONTPELLIER


Automated Stack Assembly Line (ASAL)

PROJECT AND OBJECTIVES

VOLUMETRIQ provides the entire European supply chain for an optimized stack design to enable validation of performance, lifetime and manufacturability, with analysis of each process capability and efficiency, including costs, while developing the appropriate quality assurance methodologies for at-scale fuel cell manufacturing. At M35 of the 42 month duration, VOLUMETRIQ currently achieves 2.2 A/cm2 at 0.6 V with project materials and hardware, and uses manufacturing and assembly processes compatible with high volume production.

PROGRESS & MAIN ACHIEVEMENTS

- Achieved 2.2 A/cm2 at 0.6 V in VOLUMETRIQ hardware
- Improved MEA assembly process leading to a cycle time reduction of ca. 72 %
- New membrane design with lower H2 crossover, improved mechanical properties, and similar/lower proton resistance than ePTFE-reinforced membranes

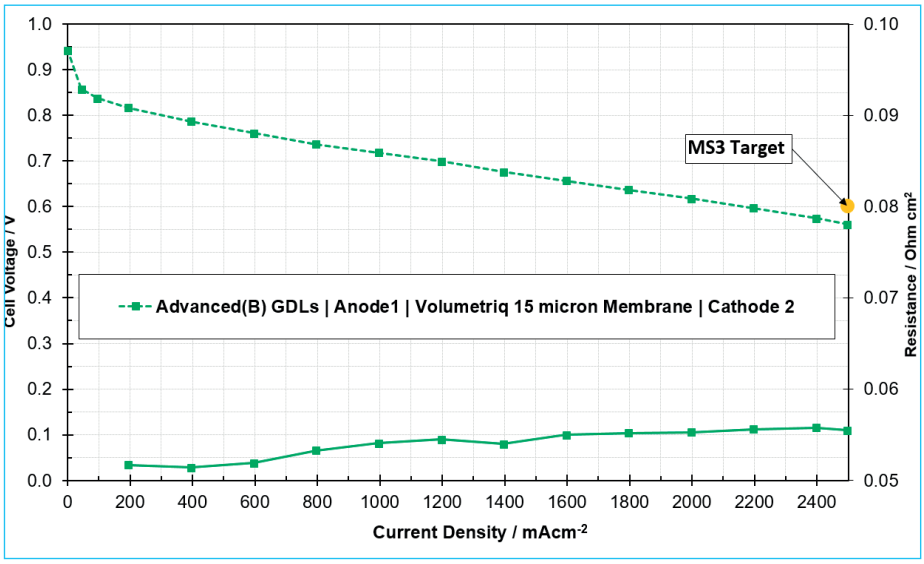
FUTURE STEPS & PLANS

- Manufacture of membrane with electro spun reinforcement
- Finalize tooling, BPP stamping and production
- CCM production for stack
- Stack test
- Costs analysis

RELEVANCE TO FCH JU OVERARCHING OBJECTIVES

Reduce the production cost of fuel cell systems to be used in transport applications

.dvanced handling technologies for CCM processing, with potential cycle time reduction of ca. 61 % and increased yield.
Improvements on the MEA assembly process developed, leading to a cycle time reduction of ca. 72 %.



QUANTITATIVE TARGETS AND STATUS

FCH JU Programme Targets*

PARAMETER	UNIT	RESULT ACHIEVED TO DATE	TARGET	TARGET ACHIEVED?	SoA result achieved to date by other group/project (SoA year)
stack volumetric power density	kW/l	4.1-5.01 kW/L (excluding housing) expected for NM12 stack	7.3		3.5 kW/L (2017)

*As identified in MAWP Addendum 2018-2020, Target Year 2020