VOLUMETRIQ
Volume manufacturing of PEMFC stacks for transportation and in-line quality assurance

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Programme Review Days 2016
Brussels, 21-22 November

PROJECT OVERVIEW

VOLUMETRIQ

Project Information	
Call topic	FCH-01.2-2014 - Cell and stack components, stack and system manufacturing technologies and quality assurance
Grant agreement number	671465
Pillar (Horizon 2020)	Transport
Start date	01/09/2015
End date	28/02/2019
Total budget (€)	5,163,450
FCH JU contribution (€)	4,961,950
Other contribution (€, source)	201,500 (Daimler self-funded, BMW 20% self-funded)
Stage of implementation	33% project months elapsed at 01/11/2016
Partners	CNRS, Johnson Matthey Fuel Cells, Solvay Speciality Polymers, Intelligent Energy (to Nov 2016), ElringKlinger, BMW, Pretexo. Associate Partner: Daimler

PROJECT SUMMARY

VOLUMETRIQ

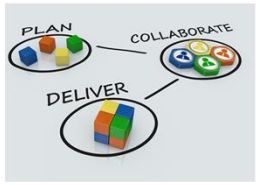
- VOLUMETRIQ is developing a European supply chain for PEM fuel cell components and stacks with volume manufacturing capability and embedded quality control, with validation of performance, lifetime and manufacturability
- The stack and components are based on automotive PEM fuel cell technology which is presently TRL5 for component manufacturing approach and concepts.
- The project will deliver a TRL7 stack and component design, at TRL7 manufacturing maturity, utilising a verified EU supply base.
- *Global positioning vs international state-of the art:*
  - *Innovation in MEA components development*
  - *Innovation in moving from hand-built stacks to high volume capability throughout the supply chain – from sub-component through to stack assembly, while developing the appropriate quality assurance methodologies for "at scale" fuel cell manufacturing*
- Transport Application – Automotive

Project Summary

VOLUMETRIQ

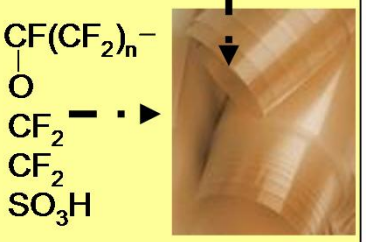
CNRS

WP1 Project Management



Solvay, CNRS, JMFC

WP3 Reinforcement

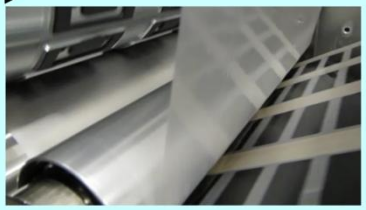


JMFC, Solvay, CNRS

WP4

CCMs & MEAs

Single Cell MEA testing

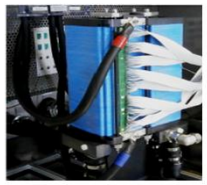


High volume CCM production

All partners

WP7 Dissemination and knowledge management

WP2

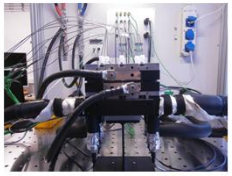


200 cell existing stack (45 kW) component specification and testing

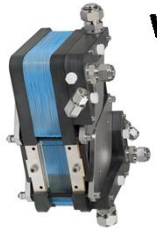
BMW, Daimler, EK, JMFC, Solvay, CNRS

EK, JMFC

WP6

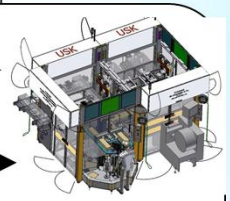


Single cell new MEA & plate testing



20 cell testing

Production Processes Study



Full size cell stack assembly (90 kW)

Bipolar Plate optimisation

Plate Manufacturing Process & QC

High volume bipolar plate production

EK, JMFC

WP5

Project objectives

MAWP	
Reduce the production cost of fuel cell systems to be used in transport applications, while increasing their lifetime to levels competitive with conventional technologies	Cost reduction: target €100/kW (2020) Durability: demonstrate capability to achieve target 5,000 hours
AWP 2014 Cell and stack components, stack and system manufacturing technologies and quality assurance	
Cell and stack design improvements that have been validated and meet or exceed the TRL 5 level	Optimise existing component detail designs to achieve automotive power density of 2.5 A/cm^2 at 0.6 V. Advance cell component and stack manufacturing technology level to TRL 7
Validation and improvement of existing manufacturing methods to increase robustness, manufacturing yield and reduce product variation and manufacturing cost (QA strategies)	Develop volume manufacturing capability and quality controls at component and sub-component level
Testing and validation of critical manufacturing sub-processes (low yield/high cost)	Investigate the parameters of the key cell components influencing durability, yield, cost
Identification of manufacturing failure modes and implementation of manufacturing control plans	Review of processes and identification of failure modes with resulting control plans

Year 1 achievements

- completed definition of automotive fuel cell stack requirements
- agreed and validated test protocols that will be used to generate membrane, MEA and stack performance data
- produced and supplied reinforcement and ionomer dispersion materials for baseline membrane and MEA development
- fabricated and tested the VOLUMETRIQ baseline MEA using materials representing the state-of the-art at the beginning of the project.
- completed cross-checking of test results between single cell hardware at 2 partners
- developed and supplied new improved reinforcement and ionomer dispersion materials for first generation improved membranes and MEAs
- Achieved higher performance with first generation improved membranes compared with the baseline
- introduced a new pilot level continuous membrane casting line to produce VOLUMETRIQ membranes by volume manufacturable processes
- communicated on VOLUMETRIQ through a press release (September 2015), project web-site (December 2015), brochure and newsletter (November 2016)

PROJECT PROGRESS:
membrane mechanical properties

Achievement to-date
33% stage of implement.

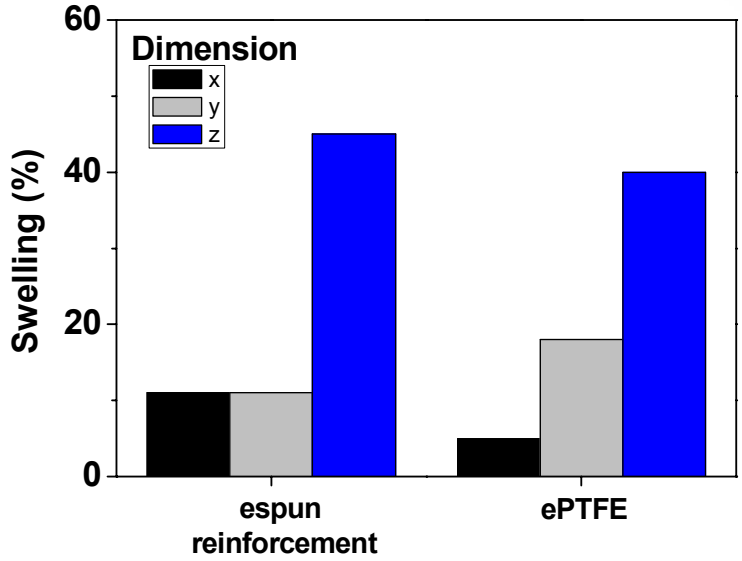
Membrane toughness

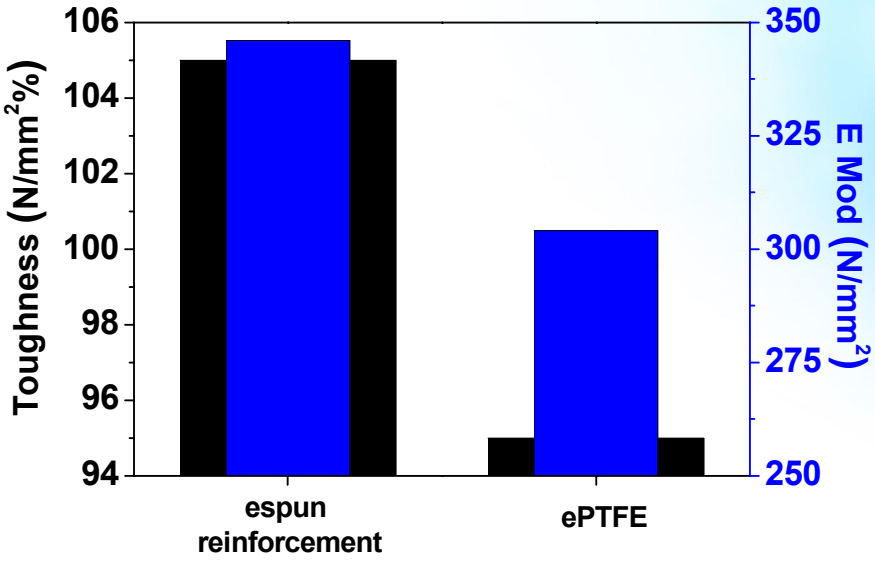
90 at 10% deformation (standard reinforcement)

120 at 10% deformation (novel reinforcement)

150 at 10% deformation novel reinforcement

25% 50% 75%





Future steps:

Scale-up reinforcements

Transfer optimised membrane processing procedures to pilot-scale continuous membrane casting line at JMFC

PROJECT PROGRESS:
membrane mechanical properties

VOLUMETRIQ

Achievement to-date
33% stage of implement.

Membrane toughness

120 at 10% deformation (novel reinforcement)

90 at 10% deformation (standard reinforcement)

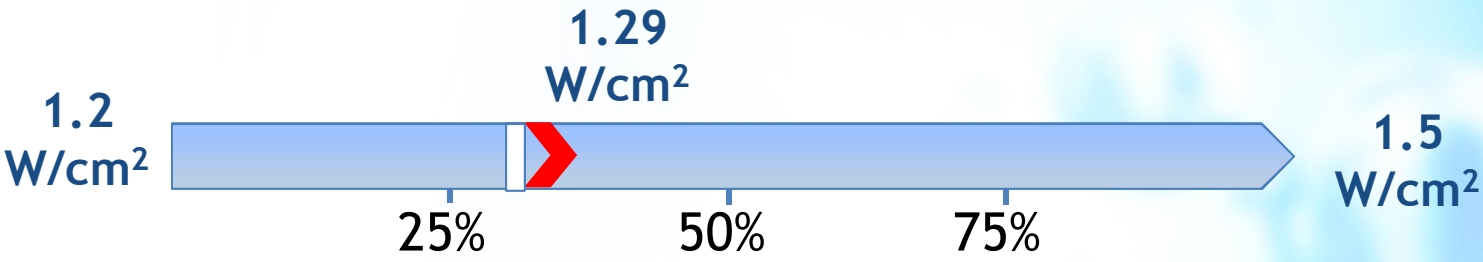
25% 50% 75%

150 at 10% deformation novel reinforcement

- Commissioning of a new pilot-scale continuous membrane casting line at JMFC for use in VOLUMETRIQ
- Line will enable the manufacture of a few linear metres of new reinforced membranes from 1 litre samples of ionomer dispersions

PROJECT PROGRESS: MEA power density

Achievement to-date
33% stage of implement.



Cell at 80 ºC, 150 kPag, Cathode λ 1.8 100% RH, Anode λ 1.4, 30% RH. 50 cm²

Aspect addressed	Parameter (KPI)	Unit	SoA 2016	FCH JU Targets		
				Call topic	2017	2020
Power density	Power density at 0.6 V	W/cm²	1.29	1.5	1.5	1.5

Future steps:

Optimise membrane processing

Implement generation 2 catalyst layers with optimised membrane

PROJECT PROGRESS: MEA current density

VOLUMETRIC

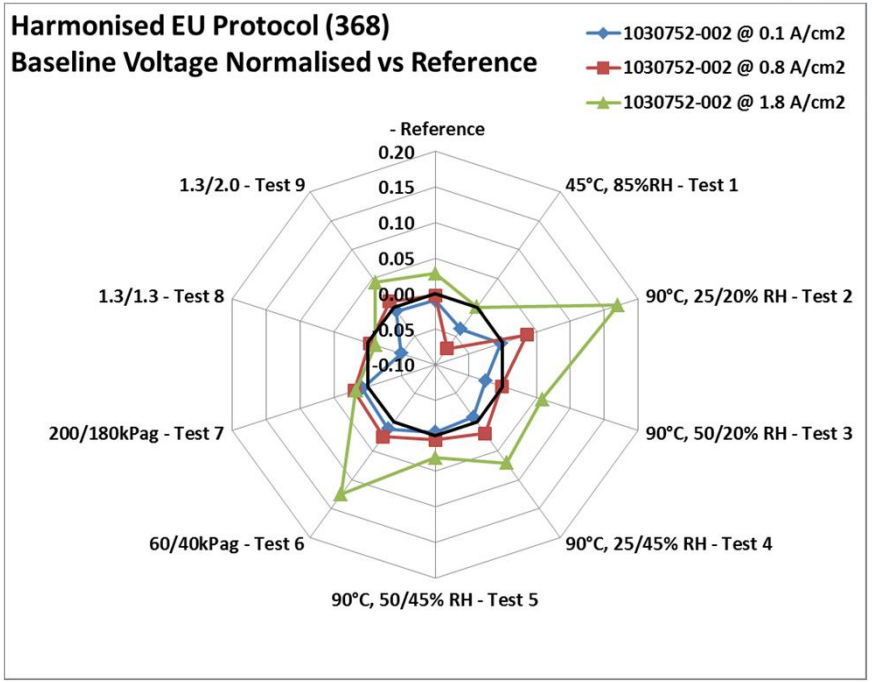
Achievement to-date
33% stage of implement.

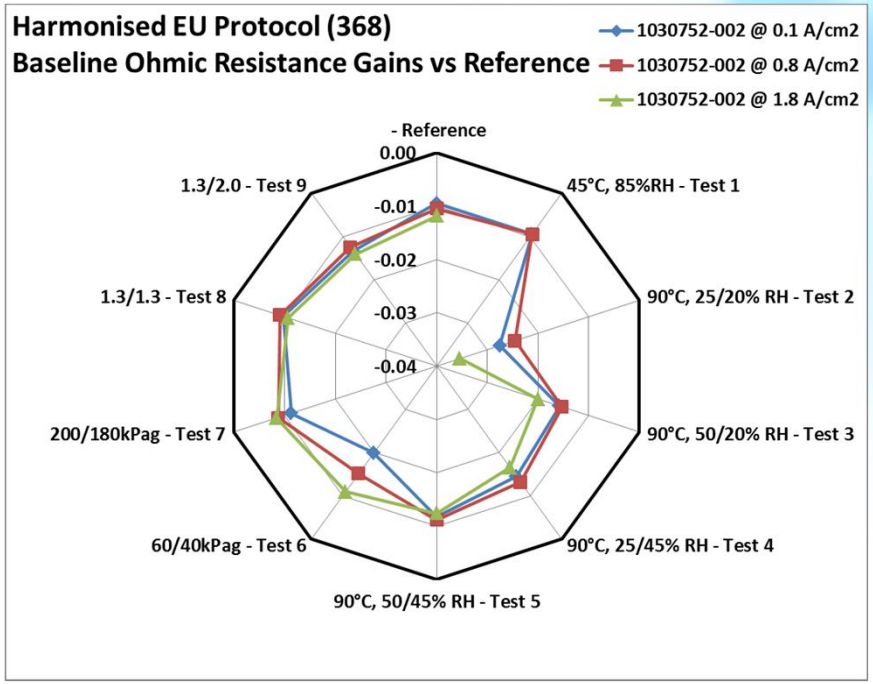
2.0 A/cm² at 0.6 V

2.15 A/cm² at 0.6 V

2.5 A/cm² a 0.6 V

25% 50% 75%





- MEA with baseline membrane using electrospun reinforcement and low EW Aquivion ionomer has demonstrated improved performance versus the project Reference MEA with conventional reinforcement, especially in hot dry conditions, and has also shown lower ohmic resistance.

Stack development

- 90 kW stacks on fully automated production line at an industrial rate
- ElringKlinger’s NM5 stack platform
- On display at VOLUMETRIQ poster

SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes	
From… MAESTRO	Electrospun reinforcements and cross-linked low EW PFSA ionomers
From…IMPACT	Development of ultrathin reinforced membranes (Solvay)
To….INSPIRE	VOLUMETRIQ membrane reinforcement transferred to INSPIRE (CNRS). Ultimately, VOLUMETRIQ membranes to be transferred to INSPIRE (JMFC, CNRS)
From …Autostack Core	Stack component specification (BMW)
From…STAMPEM	Stamping tool design know-how (EK)
Interactions with national and international-level projects and initiatives	
Montabs Programme (DE)	Automotive stack manufacture (EK)
BMWI-ELAAN	Development of a 20 kW fuel cell system and integration into a commercial vehicle based on NM5 stack technology (EK)

DISSEMINATION ACTIVITIES

Public deliverables

- D1.2 Project shared workspace implemented and operational (M2)
- D2.1 Stack requirements provided for further component analysis (M3)
- D2.2 Stack component requirements derived and agreed (M6)
- D2.3 Stack component test scope and procedures (M6)

Conferences/Workshops

- *Electrospinning for Energy* organised by project partner CNRS
- Presentation of VOLUMETRIQ results at above conference

Social media

Publications:

- *None to date*
-

Patents:

- *None to date*
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Thank You!

Coordinator: Deborah.Jones@umontpellier.fr

Project Summary

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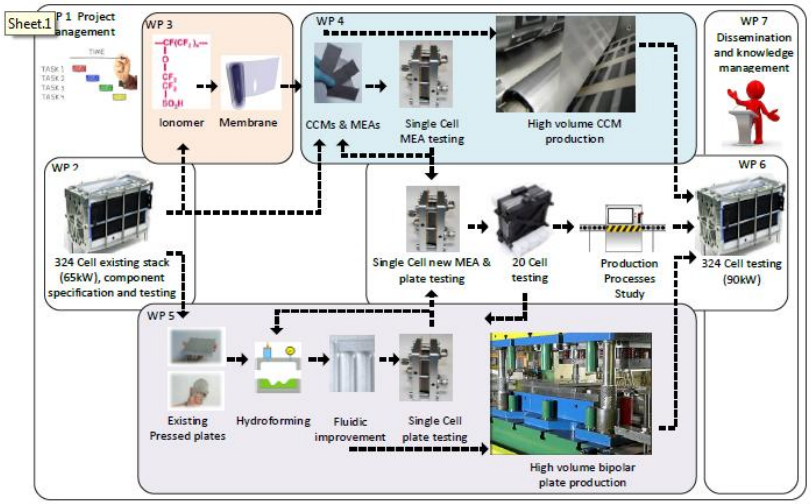

09/2015 – 07/2016

WP1: Coordinator Intelligent Energy

WP6: Intelligent Energy responsible for stack activities and manufacture

08/2016 – 02/2019

WP1: Coordinator CNRS

WP6: ElringKlinger responsible for stack activities and manufacture

-No impact on final expected output

-Extended project duration to enable catch-up on WP5 and WP6