Fit-4-AMandA

Future European Fuel Cell technology: Fit for Automatic Manufacturing and Assembly

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Programme Review Days 2019

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PROJECT OVERVIEW

- Call year: 2016
- Call topic: FCH-01-1-2016 Manufacturing technologies for PEMFC stack components and stacks
- Project dates: 1st March 2017 – 29th February 2020
- % stage of implementation 01/11/2019: ~80%
- Total project budget: 2,999,185 €
- FCH JU max. contribution: 2,999,185 €
- Other financial contribution: None
- Partners: Uniresearch BV, Proton Motor Fuel Cell GmbH, IRD Fuel Cell A/s, Aumann GmbH, Fraunhofer IWU, Technische Universitaet Chemnitz, UPS Europe SA

PROJECT SUMMARY – Project Objectives

- **Project Acronym:** Fit-4-AMandA

- **Project Full Title:** Future European Fuel Cell technology: Fit for Automatic Manufacturing and Assembly

- **Project Main Objective:** develop, validate and demonstrate step changes in term of cycle time, manufacturing cost, yield and reliability in two critical steps in the production PEMFC systems, i.e. the production of the MEAs and the assembly of the stacks.

Machine is READY and delivered at PM!

PROJECT SUMMARY – Project Objectives

Project technical objectives:

1. Establish the **technological roadmap** to scale up from less than hundred stacks/year **to 50,000 stacks per year.**
2. Redesign (adaptation) of current MEA and stack design to optimise the designs for manufacturability.
3. Development of an alternative concept to graphitic BPP based on a metallic BPP technology.
4. Development of fast inline non-destructive quality assurance (NDT-QA) test methods for automated production of MEAs and stack assembly.
5. **Design and development of an automated processing** unit/system for the manufacturing of key/critical stack components, i.e. MEAs.
6. Development, manufacturing and testing of technology and machine system for the automatic assembly of PEMFC stacks.
7. Validation of the developed designs, hardware, tools and software for the automated production of MEAs and automated stack assembly and the fast-inline NDT-QA test methods.
8. Integration and field testing using one of the first prototype stacks manufactured by the automated processes into a light commercial vehicle

PROJECT SUMMARY – Positioning vs State-of-the-art

- **Global positioning vs international state-of the art**

Characteristics and Key performance indicators (KPIs)	Fit4AMandA targets	Baseline
Production time for one stack (throughput time)	<0.5 Hours	40 hours
Automated production process steps	90% automation grade per stack	10% automation grade per stack
Testing time (automated and manually)	1 hour	1 day
Costs per stack	>50%	100%
Reduction of scrap (e.g. broken Bipolar Plates per Stack during production)	0	10 per stack
Non accepted tests: Rework and unbundling of stack	0	Every 10th stack needs to be reworked
Tightness and leakage of the stack	0	Every 10th stack needs to be reworked

- **Application and market area**

The project targets will result in strong reduction of the cost of the PEMFC stacks.
The achievement of the CAPEX targets will **allow the introduction and roll out of PEMFC technology in specific automotive** applications (e.g. urban delivery van, city buses and regional buses).

PROJECT PROGRESS/ACTIONS - Redesign Stack Design

Achievement to-date

Previous PM Stack Design

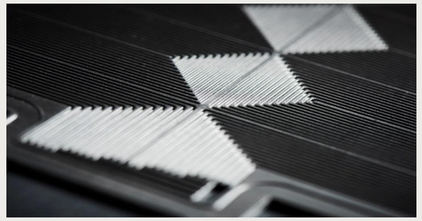
25% 50% 75%

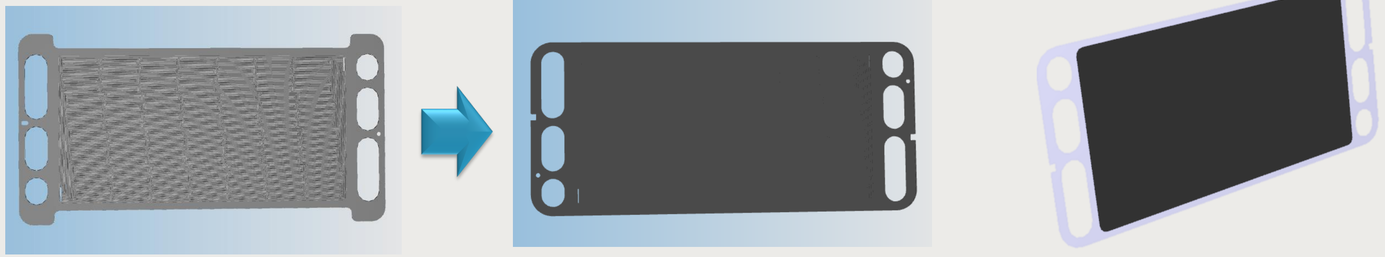
New F4A stack design is ready
Extended tests are on-going

Status at month 32 of a 36 months project at date 01/11/2019

- Bipolar plate design (footprint) and flow field structures have been optimised → finished 100 %
- Redesign of sealing concept for implementation of the new MEA → finished 100 %
- Development of two concepts (7-layer MEA and seal-on GDL+CCM) → finished 100 %
- Design implementation of an advanced restrain concept → finished 100 %
- New stack design is currently being tested → ~ 50 %

➢ Without the results of the current tests, no statements can be made about the stack performance (KPI)!
➢ First indications are promising…





PROJECT PROGRESS/ACTIONS – Mass manufacturing machine (MMM)

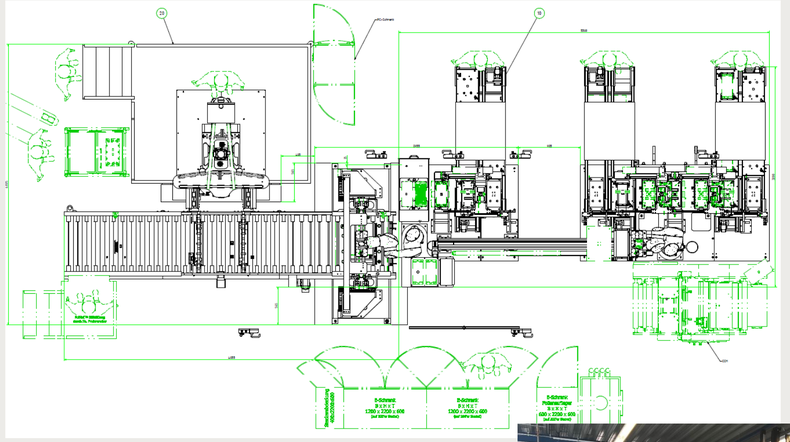
Achievement to-date

Manually stacking

25% 50% 75%

MMM is designed, built, commissioned and in operation

Status at month 32 of a 36 months project at date 01/11/2019



- Machine is now at the final location at PM
- Currently commissioning is being carried out
- **Final approval and proof of KPI is still pending**

PROJECT PROGRESS/ACTIONS – Fast inline test methods

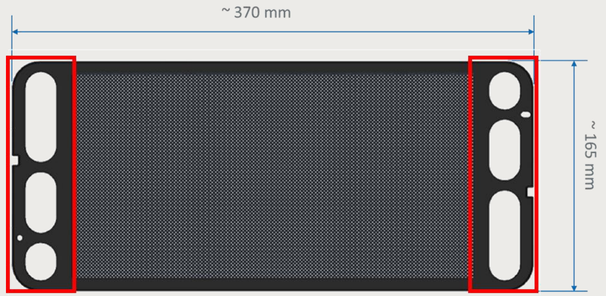
Achievement to-date

In-person visual inspection of components

25% 50% 75%

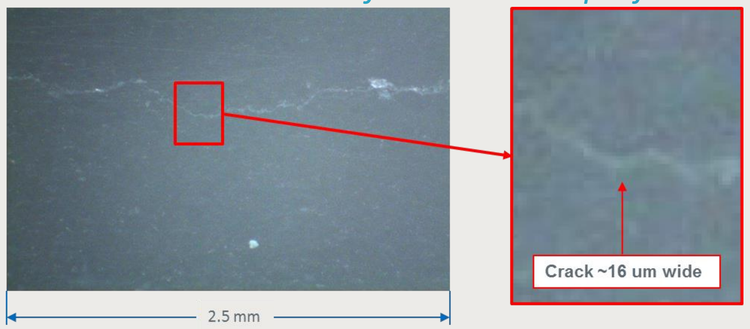
In-line NDT-QC testing conceptualised, candidates selected and implemented in MMM

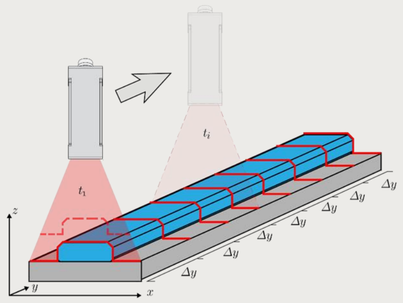
Status at month 32 of a 36 months project at date 01/11/2019

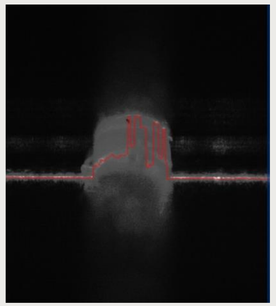


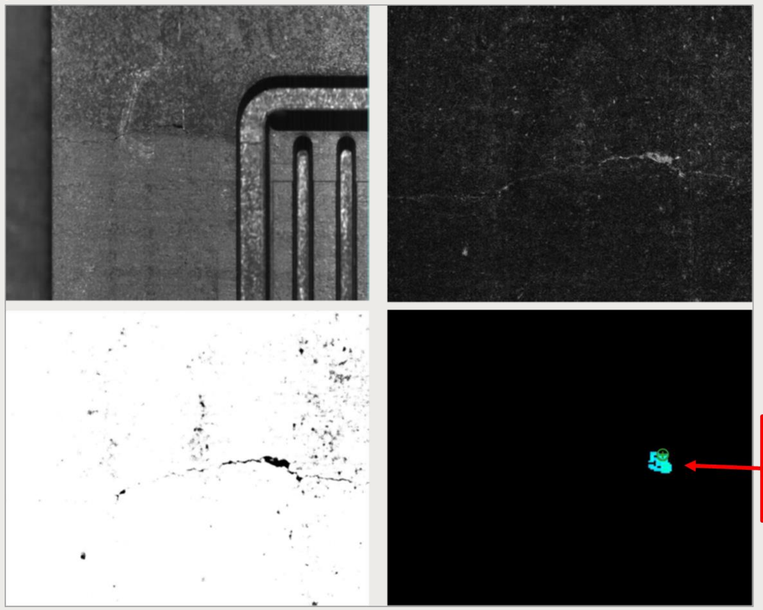
- Measurement area: ~600 cm²
- Defects: length few mm, width 10's of µm
- Time: >10 s/plate

→ **Compromise necessary**









Feasibility tests*) (integrity and seal test)

Successful result of a pass/fail in-line test

*) Top: offline detection; bottom: unsuccessful in-line profile measurement of sealing bead

Risks and Challenges

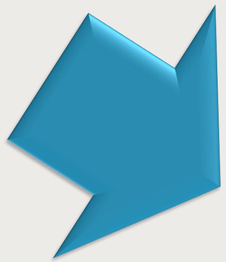
Risks have been identified during the proposal definition and During the project lifetime others unforeseen risks materialized:

FORESEEN RISKS (examples):

- **Failure in bringing the BPP and the MEA production from MRL6/7 to MRL8/9.**
- **Technical risk of tolerance summation when stacking >100 components**

UNFORESEEN RISKS (examples):

- **Higher costs of the vehicle**
- **Strong delay due to insufficient core component supply**

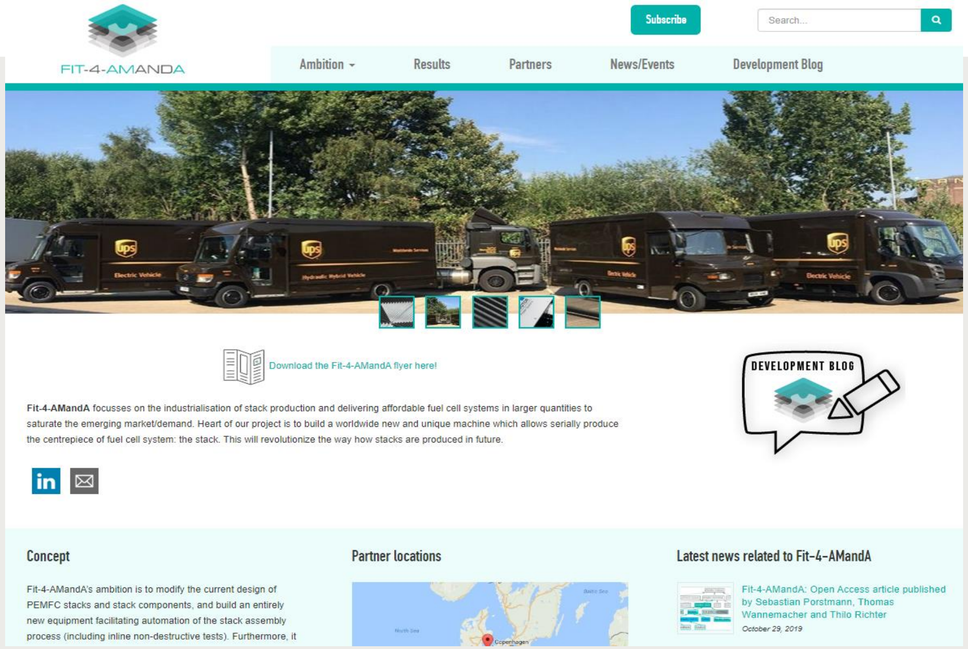


MEASURES to MITIGATE:

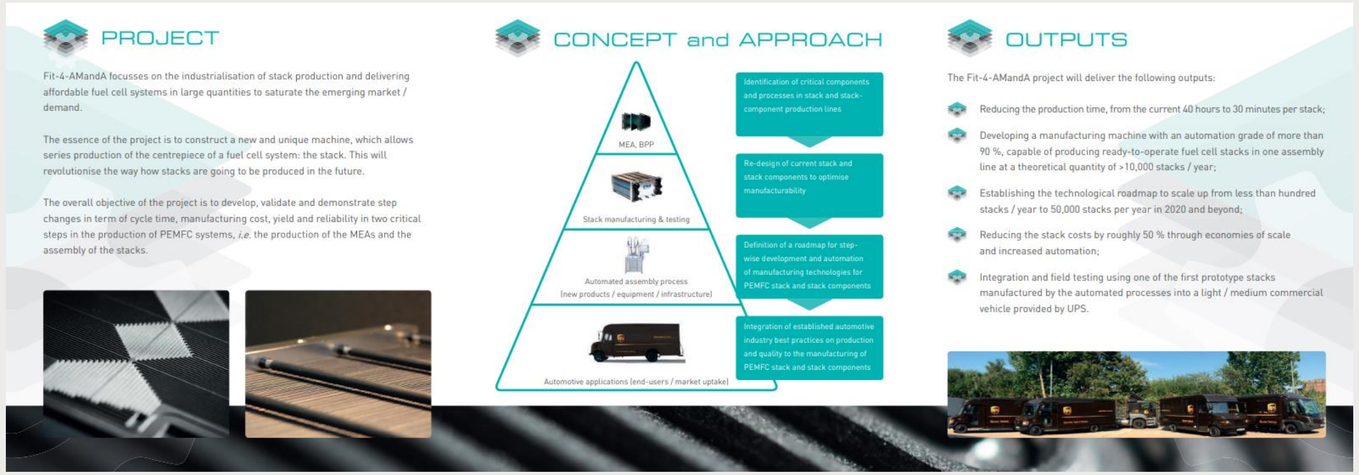
- **Strategies for alternative solutions**
- **Reorganisation of the sequence of WP tasks**
- **Flexible MMM design for easy adoption of different concepts (fall back options)**

Communications Activities

Project Website



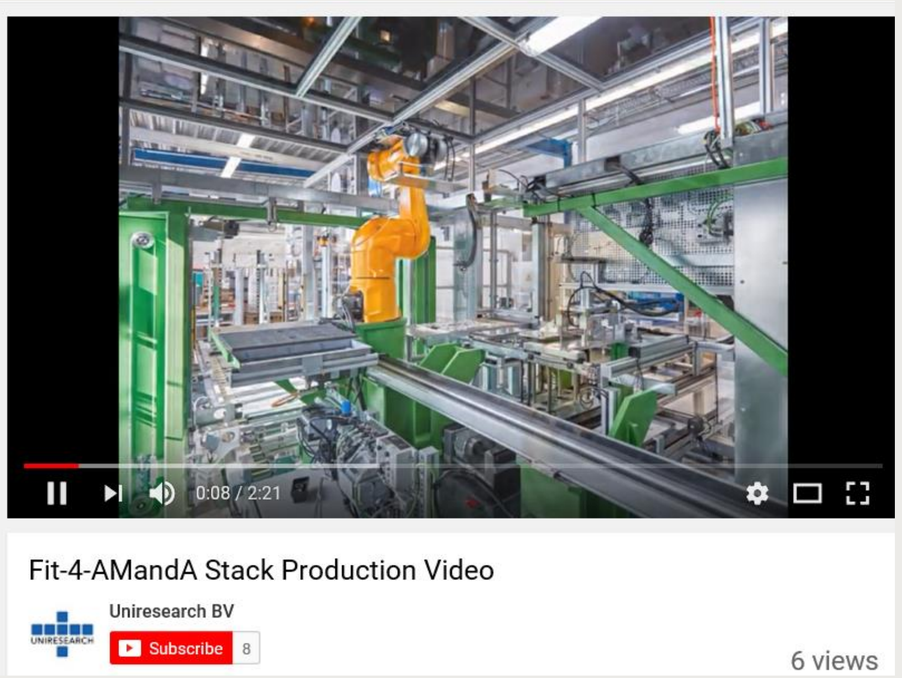
Flyer



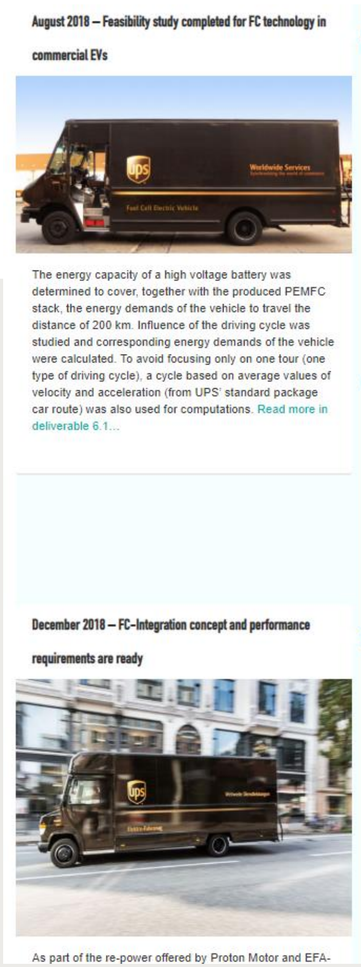
Newsletters

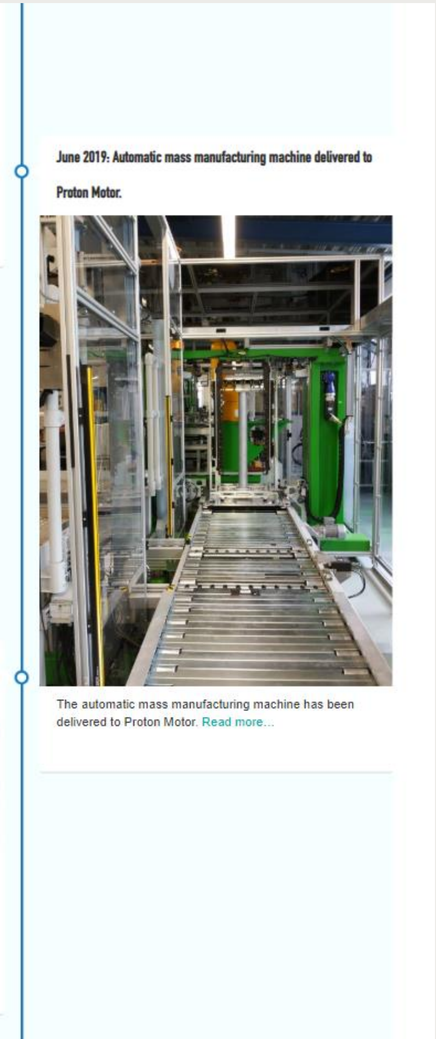
Communications Activities

Development blog: since the start of the project, all major achievements and milestones have been reported and are easy to check on the website



Promotional Video





Dissemination Activities

Conferences / workshops

- 6 Presentation at conferences
- 4 workshops

Publications in international peer-reviewed scientific Journals

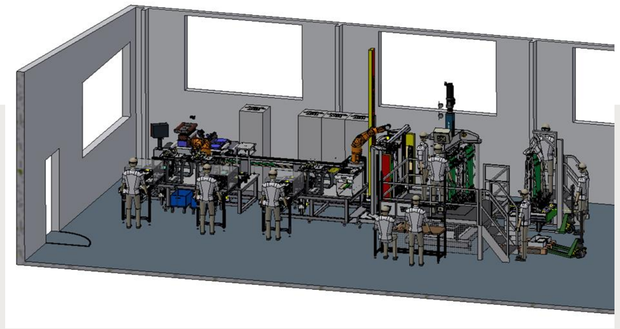
- One published and more are currently under preparation

Public deliverables

- 3 Deliverables published in the project web-site:

https://fit-4-amanda.eu/downloads/

Project Results (Timeline)



The Mass Manufacturing Machine is built up at Proton Motor and currently in the commissioning phase

2020

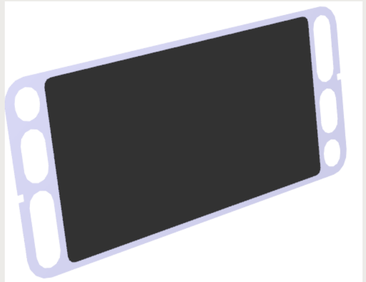
Validation in a test vehicle

>2020

Future application in transport

2019

Mass Manufacturing Machine

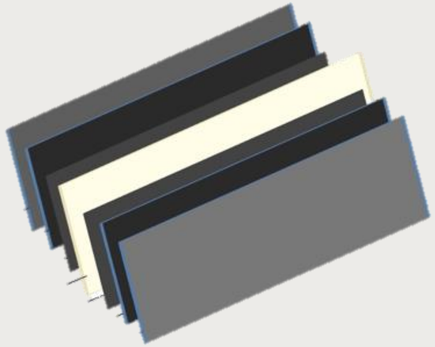


A new stack design is developed and capable of being processed automatically

2018

New stacks design

Stack components and concept optimization have been successfully carried out



EXPLOITATION PLAN/EXPECTED IMPACT

Preparative activities
- Orient the partners (during the GA and EB meetings) towards exploitation actions, including informing them about what are exploitable results and which results and activities will have an impact on the broader industry and society. Use the dissemination and exploitation plan as presented in the proposal as a platform.

GA Workshop
- Group workshop to identify exploitable results for the technical WPs and routes to exploitation

Preliminary Exploitation Plan
- Compile all the findings into an integrated document, as a D7.3 (Preliminary exploitation Plan)

Feedback incorporation
- Preliminary exploitation plan will be shared with the Sounding Board members – requesting their inputs, and incorporating them within the document. This will be facilitated during future GAs, and channelled through interactive exploitation workshops.

Finalize Exploitation Plan
- All the findings and updates will be incorporated in the D7.4 (Updated dissemination and exploitation plan).

	Innovation	Partner bringing them to the Market
1	Automatic assembly machine for PEMFC-stacks	Aumann
2	PEMFC components, MEA and BPP, for mass manufacturing	IRD Fuel cells
3	Scalable PEMFC stacks in high batch sizes	Proton Motor
4	Protocols, Turn-key services	TUC

SYNERGIES WITH OTHER PROJECTS AND PROGRAMMES

Interactions with projects funded under EU programmes

- MAMA-MEA : Exchange of ideas regarding QC techniques; characterisation of MAMA-MEA functional layers during demonstrations of QC hardware; co-development of *zero-loads*
- INSPIRE: Templates; Exchange of ideas during INSPIRE's *FCH JU PEMFC development workshop*
- TAHYA: Hydrogen tank hardware recommendation
- *Not realised yet: → REVIVE: Exchange of experiences in real life operation of mobile applications*