



# FIT-4-AMANDA

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

**EUROPEAN COMMISSION**

**Horizon 2020 | FCH-01-1-2016 | Manufacturing technologies for PEMFC stack components and stacks  
GA # 735606**

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## 2 Summary

Deliverable 7.5 – Evaluation of dissemination, activities and related impact contains a comprehensive collection of electronic newsletters throughout the project time-line, and all other dissemination activities, including the targeted audience.



### 3 Introduction

The overall aim of the dissemination activities within the Fit-4-AMandA project was to maximize the dissemination of results and to express them in terms that are readily understandable not only to experts in the field of Fuel cells, but also to policy makers, industry and suppliers - in order to accelerate the implementation of the research findings.

The secondary aim is to promote the project findings through presentations at workshops, scientific publications etc. Furthermore, dissemination involves preparing information for the project website and facilitating the technology transfer of the research into product and process.

The Fit-4-AMandA project is funded by public EU money, and the results and output should therefore benefit the EU as a whole. Several goals are defined to make the work in Fit-4-AMandA known to widest possible group of potential users and maximize the impact of the work in this project.

The description of action of the Fit-4-AMandA project comprised of an extensive dissemination plan. This deliverable will set out an evaluation of the taken activities and the related impact. The introduction will provide an overview of what was originally planned, and the following chapters will give a more detailed summary of the activities that have been executed as well as include the impact of these activities by providing statistics.

#### 3.1 Project Identity



A project identity was created, composed of visual elements aimed to represent the project. The identity includes a logo, fonts, colors as well as templates for the presentations, posters and text documents. This identity was considered crucial as it created a consistent and recognizable communication and dissemination.

Figure 3-1 Project Identity Logo

#### 3.2 Website

A website was created to promote the project activities and included the project objectives, partner backgrounds, public deliverables, and other project news. Uniresearch has designed and managed the website. Partners have provided extensive input to keep the website up to date.

#### 3.3 Project Flyer and Newsletter

Next to the website and the identity a few general dissemination items were created to be distributed to the contacts of the partners and stakeholders. These contacts have been assembled in the Dissemination Database. A project flyer has been created to be distributed on external events and exhibitions visited by our partners. A total of five newsletters has been sent out to our contacts.

#### 3.4 External activities

Other dissemination activities planned in the description of actions were: workshops with target groups and the Stakeholder group, final event, technical publications and project presentations, newsletters, inclusion in reports and documents, involvement in networks, journal papers, open access publications, press release, professional contacts, project website, seminars/presentations, trade fairs, tutoring at workshops.

## 4 Project Website

The public website has been designed to act as a contact point for third parties who are interested in the progress and/or outcomes of the Fit-4-AMandA project. It has an ‘easy to navigate’ menu structure and provides all basic information as well as a brief summary of the project. The partners involved in Fit-4-AMandA are presented on the website, with their logo, a short description of the organisation and a link to their website.

The objective of the website is to inform the general public, as well as interested stakeholders/end users of ongoing and finalised activities through flyers, newsletters and technical project publications. All the information displayed on the project website is updated and maintained on a regular basis. The public website was available within the second month of the project.

Special icons are inserted which allow to share and follow the project website and updates via Social Media (LinkedIn, Facebook, Twitter, etc.)

### 4.1 Project website statistics

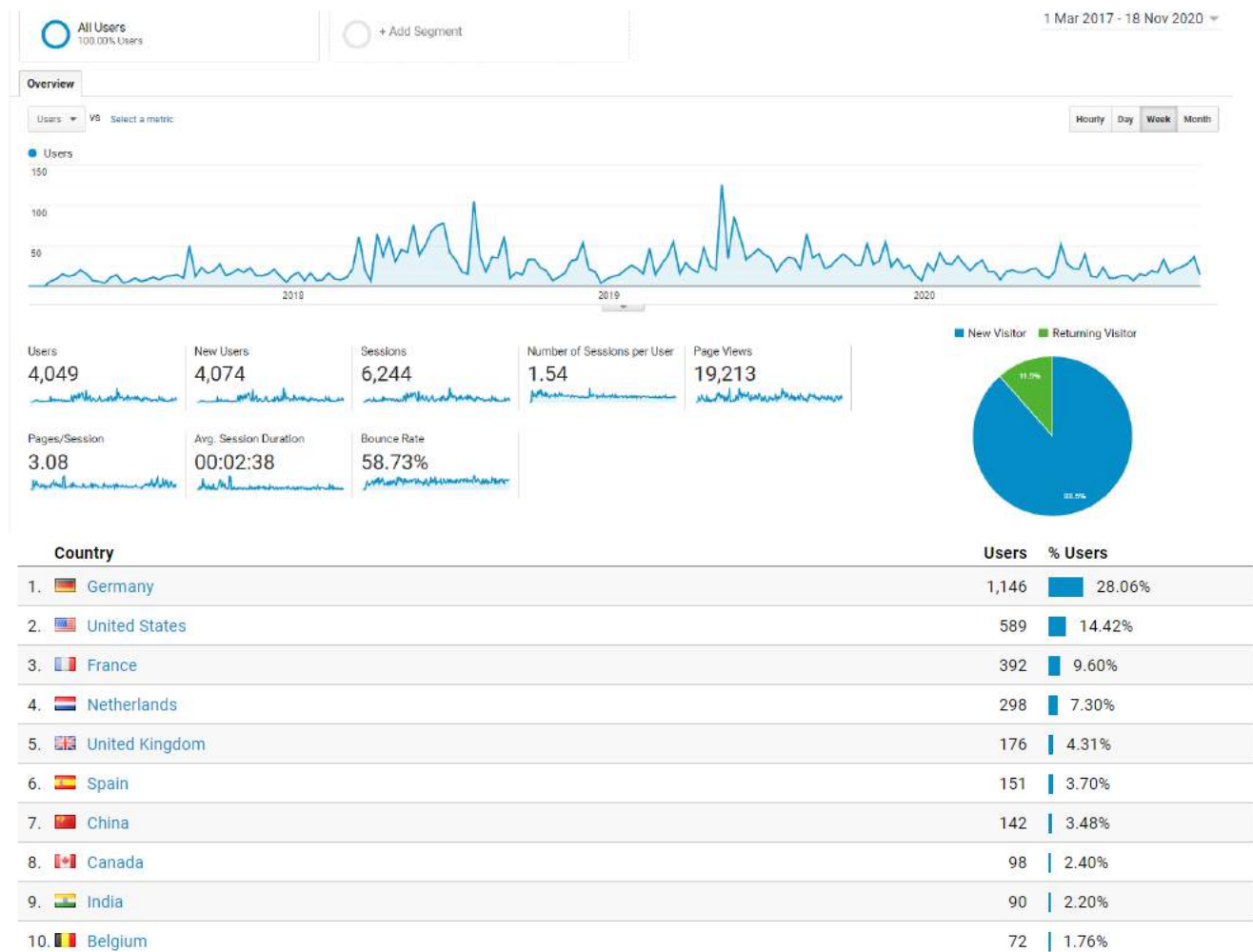


Figure 4-1 Project Website Statistics



## 5 Project Flyer

Fit-4-AMandA: A one-page document providing basic information about the project's main goals, the technical approach, the expected achievements, and a list of project participants in the consortium was planned. This target was also been achieved, by setting up, in Period 1, the general flyer and by updating this flyer during Period 2. In total two updates have been made. The flyers were distributed during many external events.

### 5.1 Project Flyer – version 1

**CONSORTIUM**

- Uniresearch BV  
The Netherlands  
[www.uniresearch.com](http://www.uniresearch.com)
- Proton Motor Fuel Cell GmbH  
Germany  
[www.proton-motor.com](http://www.proton-motor.com)
- EWI Fuel Cells A/S  
Denmark  
[www.ewi.com](http://www.ewi.com)
- USK Karl Utz Sondermaschinen GmbH  
Germany  
[www.usk-utz.de](http://www.usk-utz.de)
- Franshofer – Institut für Werkzeugmaschinen und Umformtechnik IWU  
Germany  
[www.iwu-franhofer.de](http://www.iwu-franhofer.de)
- Technische Universität Chemnitz  
Germany  
[www.tu-chemnitz.de](http://www.tu-chemnitz.de)
- United Parcel Service  
Belgium  
[www.upsl.com](http://www.upsl.com)

**FACTS and FIGURES**

Full name: Future European Fuel Cell Technology: Fit for Automatic Manufacturing and Assembly  
 Acronym: Fit-4-AMandA  
 Start date: 1 March 2017  
 Duration: 36 months  
 Total budget: 2.9 M€  
 EC funding: 2.9 M€

**CONTACTS**

Project Coordinator: Uniresearch BV - Dr. Anna Molinari  
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[m.fleum@proton-motor.de](mailto:m.fleum@proton-motor.de)  
 Project Manager: Uniresearch BV - Dr. Anish Patel  
[a.patel@uniresearch.com](mailto:a.patel@uniresearch.com)

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 732604. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and NEREPH.

**PROJECT**

Fit-4-AMandA focuses on the industrialization of stack production and delivering affordable fuel cell systems in large quantities to saturate the emerging market / demand.

The essence of the project is to construct a new and unique machine, which allows series production of the centerpiece of a fuel cell system: the stack. This will revolutionise the way how stacks are going to be produced in the future.

The overall objective of the project is to develop, validate and demonstrate step changes in term of cycle time, manufacturing cost, yield and reliability in two critical steps in the production of PEMFC systems, i.e. the production of the MEAs and the assembly of the stacks.

**CONCEPT and APPROACH**

MEAs EPP  
 Stack manufacturing & testing  
 Automated assembly process: few products / equipment / HR required  
 Automotive applications (end-users / market uptake)

- Identification of key constraints and priorities to reach cost-effective production lines
- Re-design of current stack and stack components to optimize manufacturability
- Definition of a roadmap for innovative design and automation of manufacturing techniques for PEMFC stack production
- Integration of innovative automotive industry level production and assembly to the manufacturing of PEMFC stack production components

**OUTPUTS**

The Fit-4-AMandA project will deliver the following outputs:

- Reducing the production time, from the current 60 hours to 30 minutes per stack;
- Developing a manufacturing machine with an automation grade of more than 90 %, capable of producing ready-to-operate fuel cell stacks in one assembly line at a theoretical quantity of >10,000 stacks / year;
- Establishing the technological roadmap to scale up from less than hundred stacks / year to 50,000 stacks per year in 2020 and beyond;
- Reducing the stack costs by roughly 50 % through economies of scale and increased automation;
- Integration and field testing using one of the first prototype stacks manufactured by the automated processes into a light / medium commercial vehicle provided by UPS.

Figure 5-1 Project Flyer - Version 1



## 5.2 Project Flyer – Version II



**CONSORTIUM**

- Uniresearch BV, The Netherlands ([www.uniresearch.com](http://www.uniresearch.com))
- Proton Motor Fuel Cells GmbH, Germany ([www.proton-motor.com](http://www.proton-motor.com))
- IRD Fuel Cells A/S, Denmark ([www.irdfuelcells.com](http://www.irdfuelcells.com))
- Aamann Limbach-Oberfröning GmbH, Germany ([www.aamann.com](http://www.aamann.com))
- Fraunhofer - Institut für Werkzeugmaschinen und Unternehmerristik IWU, Germany ([www.iwu.fraunhofer.de](http://www.iwu.fraunhofer.de))
- Technische Universität Chemnitz, Germany ([www.tu-chemnitz.de](http://www.tu-chemnitz.de))
- United Parcel Service, Belgium ([www.ups.com](http://www.ups.com))

**FACTS and FIGURES**

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 Acronym: FIT-4-AMANDA  
 Start date: 1 March 2017  
 Duration: 36 months  
 Total budget: 2.9 M€  
 EC funding: 2.9 M€

**CONTACTS**

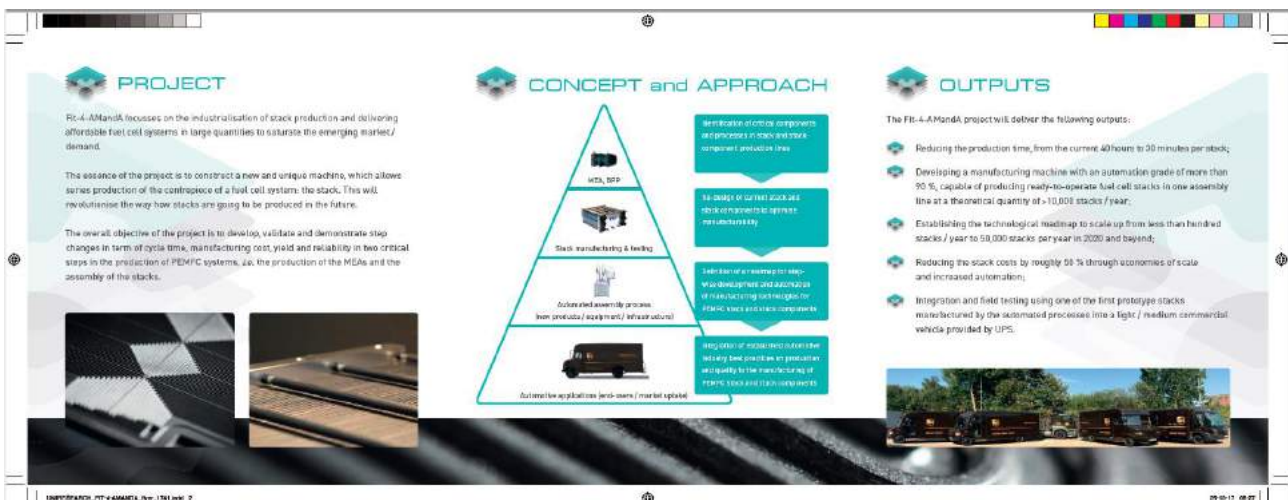
Project Coordinator: Uniresearch BV - Dr. Anja Midtman ([ajmidtman@uniresearch.com](mailto:ajmidtman@uniresearch.com))  
 Technical Coordinator: Proton Motor - Thomas Wannmacher ([twannmacher@proton-motor.com](mailto:twannmacher@proton-motor.com))  
 Project Manager: Uniresearch BV - Dr. Anish Patel ([apatel@uniresearch.com](mailto:apatel@uniresearch.com))

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska Curie Grant agreement No 770851. The content of this flyer is only for information. It does not constitute an offer or a contract. The content of this flyer is only for information. It does not constitute an offer or a contract.

**FIT-4-AMANDA**

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

[www.fit-4-amanda.eu](http://www.fit-4-amanda.eu)



**PROJECT**

Fit-4-AMANDA focuses on the industrialization of stack production and delivering affordable fuel cell systems in large quantities to saturate the emerging market/demand.

The essence of the project is to construct a new and unique machine, which allows series production of the corepiece of a fuel cell system, the stack. This will revolutionise the way how stacks are going to be produced in the future.

The overall objective of the project is to develop, validate and demonstrate step changes in terms of cycle time, manufacturing cost, yield and reliability in two critical steps in the production of PEMFC systems, i.e. the production of the MEAs and the assembly of the stacks.

**CONCEPT and APPROACH**

MEAs, BPP

Stack manufacturing & testing

Automated assembly process (new production equipment) without manual

Automotive applications (bus, train, marine, etc.)

Identification of critical components and processes in new and more compact production lines

to design of fuel cell stacks with enhanced efficiency

Development of a new and unique machine for the production of PEMFC stacks and stack components

Key data of the machine will be used to generate a digital twin for the manufacturing of PEMFC stacks and stack components

**OUTPUTS**

The FIT-4-AMANDA project will deliver the following outputs:

- Reducing the production time, from the current 40 hours to 30 minutes per stack;
- Developing a manufacturing machine with an automation grade of more than 90 %, capable of producing ready-to-operate fuel cell stacks in one assembly line at a theoretical quantity of ~10,000 stacks/year;
- Establishing the technological roadmap to scale up from less than ten thousand stacks/year to 50,000 stacks per year in 2020 and beyond;
- Reducing the stack costs by roughly 50 % through economies of scale and increased automation;
- Integration and field testing using one of the first prototype stacks manufactured by the automated processes into a light / medium commercial vehicle provided by UPS.

Figure 5-2 Project Flyer - Version 2



## 6 Project Newsletter

The newsletters were a way of communicating the results from the project towards the target group. As described earlier, the target group was set-up and the contacts used to share the newsletter with them. The database was accessible via the Fit-4-AMandA project partner internal website and was maintained by the project management team (Uniresearch).

### 6.1 Newsletter I

The newsletter was sent out on October-2017. The statistics can be found below.

#### 6.1.1 Newsletter I – Statistics

No statistics available.

#### 6.1.2 Newsletter I – Content

##### Facts & Figures

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

**Acronym:** Fit-4-AMandA

**Duration:** 36 months

**Start date:** 1 March 2017

**Total budget:** 2,9 M€

**EC Funding:** 2,9 M€

**Website:** [www.fit-4-amanda.eu](http://www.fit-4-amanda.eu)

##### Fit-4-AMandA Dissemination

[Newsletter #1](#)

[Flyer](#)



##### Fit-4-AMandA - Consortium

The consortium consists of [7 partners](#).

##### Consortium

Uniresearch BV, Proton Motor, EWII, USK, Fraunhofer, Technische Universität Chemnitz, UPS.

##### 2nd General Assembly Meeting

5-6 September 2017 - FhG - Chemnitz



##### FCH 2 JU

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.



### Introduction by Proton Motor (PM), coordinator

The kick-off meeting of the EU-funded project Fit-4-Amanda took place, on March 15th 2017, at Proton Motor (PM) Fuel Cell’s Puchheim location.



The scope of this project is to **design, develop** and **construct a machine capable of automatically producing fuel cell stacks** and testing with in-line quality assurance methods in a mass manufacturing process, ready for use in automotive application.

[Read more](#)



### Bringing fuel cells to mass market

During the project new manufacturing technologies specific to the PEMFC stack production processes, advancing beyond state-of-the-art equipment and tools, will be developed. Established industry best practices on production and quality will be analyzed and transposed to the manufacturing of PEMFC components and stacks. New QA strategies relevant for the transport sector will be proposed and assessed.

[Read more](#)



### “Paving the road for fuel cell vehicles – A customer’s perspective”

UPS has a long history of developing, deploying, and promoting the use of alternative fuels and advanced technology to operate more sustainable. Since its inception in 2000, UPS’s alternative fuel fleet has driven more than 1 billion miles globally, saving more than 60 million gallons of conventional fuel. UPS has invested more than \$750 million in alternative fuel and advanced technology vehicles and fueling stations globally since 2009 and we deploy more than 8,500 low-emission vehicles: pedal power, electric-assisted bicycles, electric and hybrid electric vehicles, natural gas, renewable natural gas and propane. UPS puts sustainability innovation into action, all over the world. [Read more](#)



## 6.2 Newsletter II

The newsletter was sent out on Thu, 19 Apr 2018 11:29 am. The statistics can be found below.

### 6.2.1 Newsletter II – Statistics

Newsletter II was sent to 65 recipients

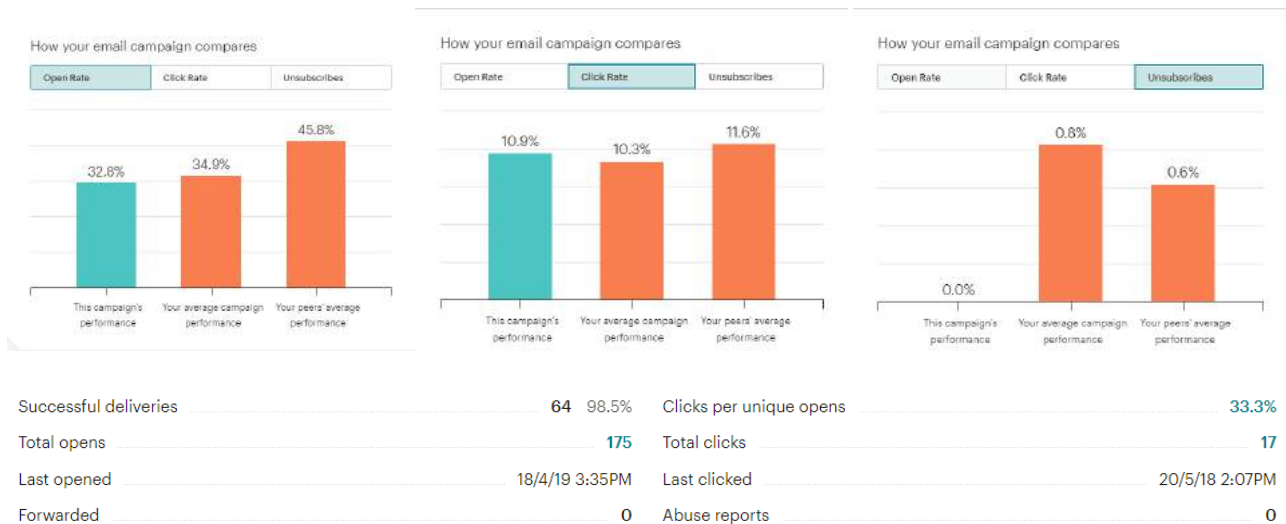


Figure 6-1 Newsletter II - Statistics

### 6.2.2 Newsletter II – Content

#### Facts & Figures

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

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**Duration:** 36 months

**Start date:** 1 March 2017

**Total budget:** 2,9 M€

**EC Funding:** 2,9 M€

**Website:** [www.fit-4-amanda.eu](http://www.fit-4-amanda.eu)

#### Fit-4-AMandA - Consortium

The consortium consists

of [7 partners](#).

#### Consortium

Uniresearch BV, Proton Motor, EWII, USK, Fraunhofer, Technische Universität Chemnitz, UPS.

#### 3rd General Assembly Meeting

13-14 March 2018 - EWII - Kolding



## FCH 2 JU

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.



### Adapting the stacks for automated manufacturing and stacking

In order to adapt Proton Motor's (PM's) fuel cell stack (FCS) for automated manufacturing/stacking with a mass manufacturing machine several changes to the basic stack components were necessary. Within the scope of the project these changes are targeted not only to ensure machine handling but also to improve the overall performance of the PM Fuel cells by using state-of-the-art (SoA) components and technologies.

[Read more](#)

For enabling an easier automated handling the general BPP footprint was revised, and additional alignment features were implemented. (see fig.1)

Figure 1: Redesign of the BPP for automated machine handling



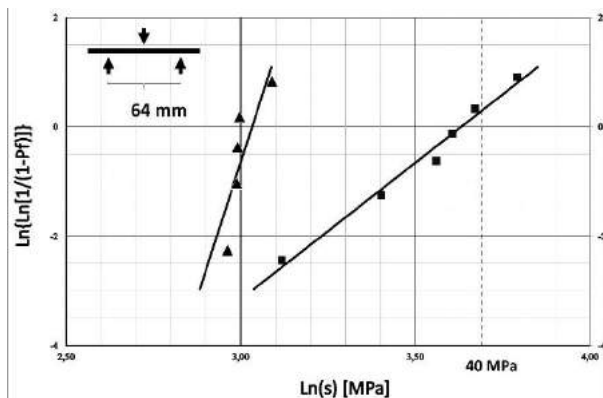
### Encouraging results with bonding of graphite-composite bipolar plates (BPPs)

EWII has developed a process to bond BPPs. Bonded BPPs are advantageous, as one step of the fuel-cell stack assembly is eliminated for the customer, and as quality assurance of the bonding process remains with the supplier to secure a performance to the customers satisfaction.

[Read more](#)

Caption to Figure

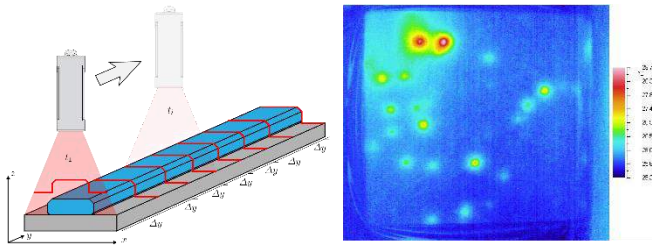
3-point compression test results of bonded and non-bonded material. Triangles: Two non-bonded plate placed on top of each other; indicative of the performance of the bulk material. Squares: One pair of bonded plates with milled groove for adhesive application. The bonding area equals ca. 10% of the total area. The compression strength shows significantly better performance than the bulk material.



### Non-destructive quality control and testing tools

The role of TUC in Fit-4-AMandA project is the development of non-destructive quality control (NDT-QC) tools for the stack-assembly machine to increase yield and reliability of the produced fuel cell stack. Low throughputs together with high number of faulty produced stacks – every tenth stack is faulty and needs to be reworked – are among the main technical barriers in the

fuel cell stack manufacturing. Additionally, fast quality-testing techniques are lacking. The goal of Fit-4-AMandA project is to elevate these constraints, and fast NDT-QC methods are necessary to do so.. [Read more](#)



*On the left, an illustration of the scanning process of a sealing; on the right, an IR thermograph of the hot-pressed MEA with GDL fibres protruding into the membrane.*

## 6.3 Newsletter III

The newsletter was sent out on Fri, 19 Oct 2018 3:50 pm. The statistics can be found below.

### 6.3.1 Newsletter III – Statistics



Figure 6-2 Newsletter III - Statistics

### 6.3.2 Newsletter III - Content

#### Facts & Figures

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

**Acronym:** Fit-4-AMandA

**Duration:** 36 months

**Start date:** 1 March 2017

**Total budget:** 2,9 M€

**EC Funding:** 2,9 M€

**Website:** [www.fit-4-amanda.eu](http://www.fit-4-amanda.eu)

#### Fit-4-AMandA - Consortium

The consortium consists of [7 partners](#).

#### Consortium

Uniresearch BV, Proton Motor, EWII, USK, Fraunhofer, Technische Universität Chemnitz, UPS.

#### Fit-4-AMandA - 4th General Assembly



The fourth General Assembly of the Fit-4-AMandA consortium took place in September 2018. The meeting was hosted by the Technische Universität Chemnitz

## FCH 2 JU



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.

### Fit-4-AMandA Experimental machine system is ready

In the result of a simultaneous engineering process of fuel cell stack design, stack manufacturing technology and machine system now is arisen an automatic assembly system for fuel cell and stack assembly.



The assembly process starts with (1) the component supply of GDL bottom, CCM and GDL top. These parts are assembled via robot to the membrane electrode assembly. The MEA is transported via shuttle axis (2) to the robot in the stacking area (3). For the stacking process the work piece carrier is loaded manually with the lower endplate. The carrier moves via transfer system to the stacking



station. [Read more...](#)

### Lighthouse family projects

The projects under the Horizon2020 and FP7 umbrella involve institutions active in the research and development of fuel cells. Some of these institutions take part in more than one project, which quite naturally brings forth the idea of sharing resources to boost efficiency and or productivity. The information shared does not necessarily relate only to the non-confidential scientific data, but extends to lessons learnt, administrative tools, coordination strategies, etc.

During the "[Workshop on PEMFC stack and MEA manufacturing: is the EU industry ready for the challenges?](#)" organised by the FCH2 JU on October 11, Fit-4-AMandA representatives have discussed the possibility of joining the currently crystallising network of European projects such as, Volumetriq (GA# 671465), Inspire (GA# 700127), Grasshopper (GA# 779430), DEMCOPEM-2MW (GA# 621256) and MAMA-MEA (GA# 779591). Taking care to neither cause conflict of interest nor breach of confidentiality, the network could unify the interface between the individual projects, the communication with the FCH2 JU and possibly also align the efforts of the participating consortia towards the common goal of bringing affordable fuel cell technology at scale to market and provide the means for clean and sustainable energy production in the future.

After a discussion with Dr. Buche from Johnson Matthey Fuel Cells, it was concluded that the project [VOLUMETRIQ](#) could be a good match to cooperate with. During the workshop Fit-4-AMandA was discussed and presented by multiple parties. The Fit-4-AMandA representatives were also invited by Dr. Buche to a workshop organized by JMFC in March 2019.





## 6.4 Newsletter IV

The newsletter was sent out on Wed, 24 Apr 2019 12:58 pm. The statistics can be found below.

### 6.4.1 Newsletter IV – Statistics

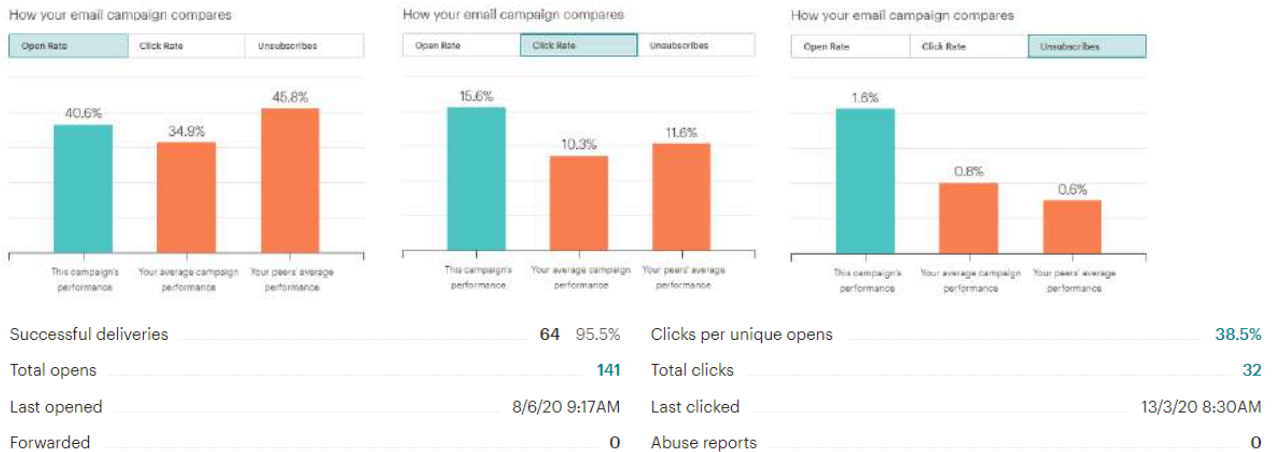


Figure 6-3 Newsletter IV - Statistics

### 6.4.2 Newsletter IV - Content

#### Facts & Figures

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

**Acronym:** Fit-4-AMandA

**Duration:** 36 months

**Start date:** 1 March 2017

**Total budget:** 2,9 M€

**EC Funding:** 2,9 M€

**Website:** [www.fit-4-amanda.eu](http://www.fit-4-amanda.eu)

#### Fit-4-AMandA - Consortium

The consortium consists of [7 partners](#).

#### Consortium

Uniresearch BV, Proton Motor, IRD, Aumann, Fraunhofer, Technische Universität Chemnitz, UPS.

#### Fit-4-AMandA - 5th General Assembly



The fifth General Assembly of the Fit-4-AMandA consortium took place in February 2019. The meeting was hosted by Uniresearch in Delft, The Netherlands.

#### FCH 2 JU



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.

## Fit-4-AMandA Experimental machine system ready for shipment to Proton Motor



After several weeks of intensive commissioning and functional testing, the experimental machine system for fuel cell stack assembly is now ready for relocation from the plant manufacturer Aumann Limbach-Oberfrohna GmbH to the stack manufacturer Proton Motor Fuel Cell GmbH.

The focus of the work done during the recent past was the testing of all functional assemblies and thus technologies for the assembly of the seal-on MEAs and the fuel cell stacks. A special challenge was the system for the automatic provision of components. These are supplied on a carrier in a type-specific stackbox.



The highly adhesive GDLs need intermediate non adhesive layers. In the machine the GDLs have separated. The GDL is handled under the camera for position measurement. The separating layer is dropped. The result of the optimization is an improved intermediate layer in terms of rigidity and flatness. [Read more...](#)

### Are we chasing the right horse?

Following the presentation of Thomas Wannemacher (Proton Motor) during the Manufacturing workshop organised by the INSPIRE team in Marseille, a debate started on the topic of the usefulness of graphite-polymer bipolar plates. According to some, metallic bipolar plates are a clear winner due to their superior electric conductivity, mechanical properties, ease of mass manufacture and the smaller cell pitch. Furthermore, due to the fast processes the capability of producing very high volumes in appropriate short time is given, combined with a potential of moderate production costs. Others refer to the still developing coating systems needed to keep the corrosion processes under wraps. Certainly, Proton Motor has to have a good reason to stay with the graphite-polymer alternative.

To provide some perspective, there are two obvious routes in the exploitation of fuel cells: low current density operation leveraging the high efficiency and ensuring endurance when compared to conventional power sources and high current and power density capability requested by the automotive industry to sever the umbilical cord to oil and meet the stringent yet sorely needed targets imposed on CO<sub>2</sub> emissions. While the entire fuel cell industry will surely benefit from the pursuit of ever higher power densities at lower catalyst loading, there are many areas with more conservative needs.

In the Fit-4-AMandA project, UPS expect that the delivery vans will last considerably longer than the 6000-hour mark requested in the recent Horizon 2020 calls. Given the nature of operation, light-commercial vehicles post a much higher mileage than their passenger counterpart. A UPS package logistics van can reach up to 50.000km per year and remains much longer in service. Operating as a range extender, the dynamic load shifts and start-stop cycles are covered by the battery packs, which are kept at the optimum state of charge by the fuel cell, [Read more...](#)

## 6.5 Newsletter V

The newsletter was sent out on Wed, 24 Apr 2019 12:58 pm. The statistics can be found below.

### 6.5.1 Newsletter V – Statistics

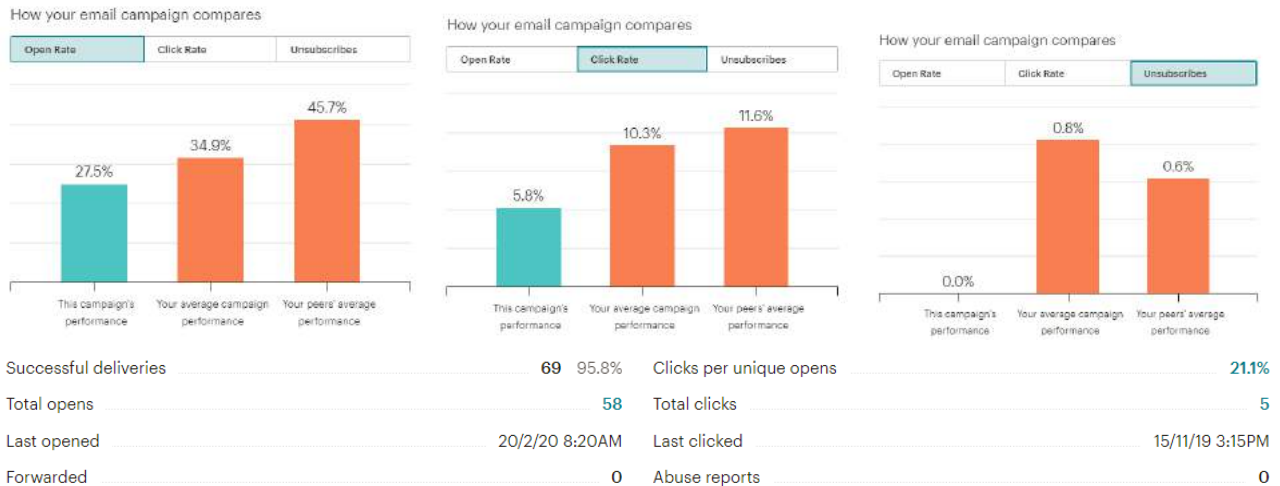


Figure 6-4 Newsletter V - Statistics

### 6.5.2 Newsletter V - Content

#### Facts & Figures

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

**Acronym:** Fit-4-AMandA

**Duration:** 36 months

**Start date:** 1 March 2017

**Total budget:** 2,9 M€

**EC Funding:** 2,9 M€

**Website:** [www.fit-4-amanda.eu](http://www.fit-4-amanda.eu)

#### Fit-4-AMandA - Consortium

The consortium consists of [7 partners](#).

#### Consortium

Uniresearch BV, Proton Motor, IRD, Aumann, Fraunhofer, Technische Universität Chemnitz, UPS.

#### Fit-4-AMandA - 6th General Assembly



The sixth General Assembly of the Fit-4-AMandA consortium took place in September 2019. The meeting was hosted by Proton Motor in Munich, Germany.

#### FCH 2 JU



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735606. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.

#### Message from the Fit-4-AMandA Sounding Board!

By 2019, PEM fuel cells represent a stage of development where key parameters as performance and longevity have reached



the status of being ready for everyday use, in a line with conventional energy converters. However, Cost is a topic where fuel cells lack to keep up with the established technologies. Reason for this – and at the same time consequence – is the small footprint on the market, associated with low volumes.

The question is - why did fuel cells not emerge from the niche at the time their technological parameters became competitive? The crux herein lies not only in the time needed for market penetration, but also in the capacities and the cost of manufacturing. Indeed, the problem of ramping up volumes closes the circle of the high cost problem. This is a vicious circle eventually to be solved by automated manufacturing.

Nowadays, whenever the role of fuel cells is discussed, consensus is reached that the most important issue is not to wring the last percent of efficiency with disproportionate development effort [read more...](#)

*By Mathias Reum - Schaeffler*

### **Fit-4-AMandA bipolar plates – the closed sealing design for automated stack assembly**



A long process of iterative development of the graphitic BPPs (g-BPP) design to support the automated assembly process is now near completion. Most important is the design of a closed concept BPP in which the cathode and anode flowplates are supplied in a pre-sealed unit. Furthermore, alignment features were included to assist accurate plate positioning during stacking.

The resulting Fit-4-AMandA design represents the limit of what is possible with complex BPP geometries in terms of molding. It took its time, but the challenges have been resolved and the outcome is a state-of-the-art g-BPP. Manufacture of bipolar plates in the Fit-4-AMandA design is now at a stage where only trials to optimize the molding process followed by final validation is required before mass manufacture of g-BPPs can commence.



In parallel Fit-4-AMandA work on improving the conductivity of g-BPPs by removing the casting skin on the surface of the molded BPPs. Tentative results indicate that we can double [read more...](#)

### **Fit-4-AMandA Open Access Article published!**

Our Fit-4-AMandA colleagues have published the open access article: "Overcoming the Challenges for a Mass Manufacturing Machine for the Assembly of PEMFC Stacks" in the Journal 'Machines'. You can find the links to the open access article on [our website!](#)

Authors: Sebastian Porstmann (Fraunhofer IWU), Thomas Wannemacher (Proton Motor), Thilo Richter (Aumann).


## 7 External Activities

### 7.1 Workshops information and presentations

The table below is a duplicate from table 2-3 in **Deliverable 1.4 'Report on optimized strategies for market and production based on customer feedback'**. It provides an overview of the participations of the Fit-4-AMAndA project partners at selected important events and congresses.

Table 7-1 List of important presentations and related publications in the context of Fit-4-AMAndA relevant workshops

Title	Date	Place
<b>Fit-4-AMAndA Workshop no. 1</b>	<b>2018/04/17</b>	<b>Chemnitz, Germany</b>
Presentation by Sebastian Porstmann (FhG-IWU)		
<b>INSPIRE Workshop: MEA Workshop / FCH-JU Projects synergies</b>	<b>2019/03/ 05-06</b>	<b>Marseille, France</b>
Dr. Jiri Hrdlicka (TUC), Dr. Anna Molinari (UNR), Thomas Wannemacher (PM) Sharing technical information and networking within EU projects EU projects VOLUMETRIQ, CRESCENDO, GRASSHOPPER, GAIA, <a href="#">Fit-4-AMAndA</a> , HYDRAITE and ID-FAST the MAMA-MEA		
<b>Conference "f-cell + HFC"</b>	<b>2019/03/22-23</b>	<b>Vancouver, Canada</b>
Presentation by Prof. Dr.-Ing. Thomas von Unwerth (TUC)		
<b>10th International Conference Hydrogen Days 2019</b>	<b>2019/03/27-29</b>	<b>Prague, Czech Rep.</b>
Presentation by Dr. Martin Biák (TUC) Title: Future European Fuel Cell Technology: Fit for Automatic Manufacturing and Assembly		
<b>FCH JU Workshop on regulation codes and standards (RCS)</b>	<b>2019/06/25</b>	<b>Brussels, Belgium</b>
Presentation by Thomas Wannemacher (PM) Title: Future European Fuel Cell Technology: Fit for Automatic Manufacturing and Assembly - Barriers and challenges within the FCH technologies		
<b>VDMA Fuel Cell Workshop I</b> Quality assurance of repeat parts in membrane fuel cells	<b>2019/06/03-04</b>	<b>Duisburg, Germany</b>
Co-Organisation and chair of the workshop Thomas Wannemacher (PM) Discussion and group work (Thomas Wannemacher (PM), Dr. Martin Biak (TUC), Alexander Pritzl (PM), Robert Csaky (PM)		
		
<b>ECFC 2019 – Low-Temperature Fuel Cells, Electrolysers &amp; H2 Processing – Fundamentals &amp; Engineering Design</b>	<b>2019/07/03-05</b>	<b>Lucerne, Switzerland</b>

<p>Presentation by Dr. Martin Biák (TUC)          Title: Future European Fuel Cell Technology: Fit for Automatic Manufacturing and Assembly</p>		
<p><b>VDMA Fuel Cell Workshop II</b>          Automated stack stacking of membrane fuel cells</p>	<p><b>2020/01/28-29</b></p>	<p><b>Duisburg, Germany</b></p>
<p>Co-Organisation and chair of the workshop Thomas Wannemacher (PM)          Discussion and group work (Thomas Wannemacher (PM), Dr. Martin Biak (TUC), Dr. Thilo Richter (Aumann)  <b>Presentation by Dr. Richter (Aumann)</b>          Title: <b>Requirements and challenges in stack stacking</b>          Presentation by Thomas Wannemacher (PM)          Title: Requirements and challenges in stack stacking from the fuel cell manufacturer's point of view</p>		
		
<p><b>8th Electric Vehicle Production Days (EPT)</b></p>	<p><b>2020/10/05-08</b></p>	<p><b>RWTH Aachen, Germany and online</b></p>
<p>Online Discussion and Presentation by Thomas Wannemacher (PM)          Title: Industrialisation of the production of NT-PEM stacks - from the hand manufacture to serial production</p>		
<p><b>Journal on hydrogen and fuel cells</b></p>	<p>2019/10/01</p>	<p>H2-international 04</p>
<p>Article by Sebastian Porstmann and Dr. Martin Biák          Title: FIT-4-AMANDA – STACK ROBOT DELIVERED – Automatic production line for PEM stacks          Link: <a href="https://www.h2-international.com/wp-content/uploads/2019/11/H2-international-October-2019.pdf">https://www.h2-international.com/wp-content/uploads/2019/11/H2-international-October-2019.pdf</a></p>		
<p><b>Open access publication by a peer-reviewed journal</b></p>	<p><b>2019/10/18</b></p>	<p><b>MDPI machines</b></p>
<p>Article by Sebastian Porstmann, Thomas Wannemacher and Thilo Richter          Title: <b>Overcoming the Challenges for a Mass Manufacturing Machine for the Assembly of PEMFC Stacks</b>          Link: <a href="https://doi.org/10.3390/machines7040066">https://doi.org/10.3390/machines7040066</a></p>		



### MDPI and ACS Style

Porstmann, S.; Wannemacher, T.; Richter, T. Overcoming the Challenges for a Mass Manufacturing Machine for the Assembly of PEMFC Stacks. *Machines* **2019**, *7*, 66.

### Show more citation formats

ⓘ Note that from the first issue of 2016, MDPI journals use article numbers instead of page numbers. See further details [here](#).

## Article Metrics

### Citations

Crossref



3

Scopus



1

Google Scholar

[click to view]

### Article Access Statistics

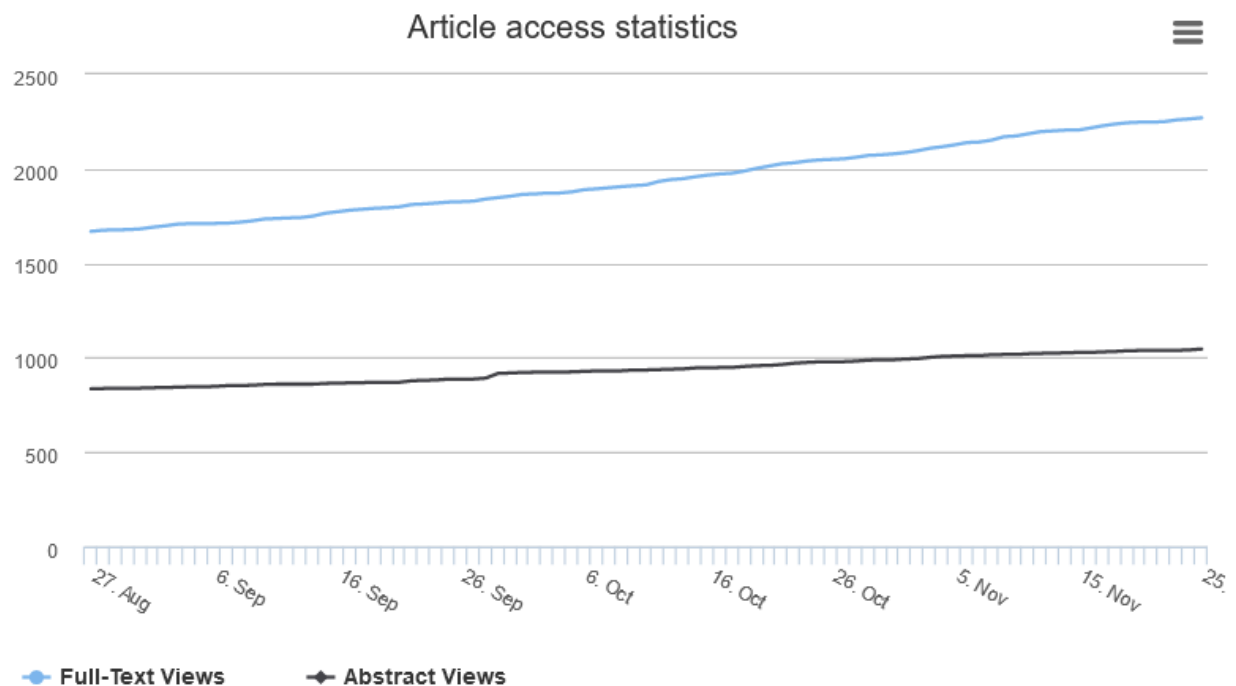


Figure 7-1 MDPI Article Statistics

Fit-4-AManda Workshop no. 2 (FC3 Conference)

2019/11/26-27

Chemnitz, Germany

Presentation by Dr. Martin Biák (TUC)

Title: FIT-4-AMANDA – AUTOMATION OF PEMFC-STACK MANUFACTURE



Article by Dr. Martin Biák* and Prof. Dr.-Ing. Thomas von Unwerth Title: FIT-4-AMANDA – AUTOMATION OF PEMFC-STACK MANUFACTURE Link: <a href="https://monarch.qucosa.de/api/qucosa%3A36264/attachment/ATT-0/">https://monarch.qucosa.de/api/qucosa%3A36264/attachment/ATT-0/</a>		
Presentation by Thomas Wannemacher (PM) Title: CHALLENGES OF AN SME IN THE MARKET RAMP-UP OF FUEL CELLS IN TERMS OF QUANTITY & QUALITY		
Article by Thomas Wannemacher Title: CHALLENGES OF AN SME IN THE MARKET RAMP-UP OF FUEL CELLS IN TERMS OF QUANTITY & QUALITY Link: <a href="https://monarch.qucosa.de/api/qucosa%3A36198/attachment/ATT-0/">https://monarch.qucosa.de/api/qucosa%3A36198/attachment/ATT-0/</a>		
Presentation by Sebastian Porstmann (FhG-IWU) ANALYSIS OF MANUFACTURING PROCESSES FOR METALLIC AND COMPOSITE BIPOLAR PLATES		
Article by Sebastian Porstmann*, Allan Christian Petersen and Thomas Wannemacher Title: ANALYSIS OF MANUFACTURING PROCESSES FOR METALLIC AND COMPOSITE BIPOLAR PLATES Link: <a href="https://monarch.qucosa.de/api/qucosa%3A36248/attachment/ATT-0/">https://monarch.qucosa.de/api/qucosa%3A36248/attachment/ATT-0/</a>		
Presentation by Dr. Thilo Richter (Aumann GmbH) Title: Automated Fuel Cell Stack Assembly - A Experience Report		
<b>Open access publication by a peer-reviewed journal</b>	<b>2020/11/02</b>	<b>Journal of Manufacturing Processes</b>
Article by Sebastian Porstmann, Thomas Wannemacher and Prof. Dr.-Ing. Welf-Guntram Drossel Title: <b>A comprehensive comparison of state-of-the-art manufacturing methods for fuel cell bipolar plates including anticipated future industry trends</b> Link: <a href="https://doi.org/10.1016/j.jmapro.2020.10.041">https://doi.org/10.1016/j.jmapro.2020.10.041</a>		

## 7.2 Regular reports of activities

A development blog was developed with regular updates on the progress of the project. The partners from Fit-4-Amanda also regularly presented the project during conference and exhibitions. They wrote reports and made pictures of the events. A few reports have been highlighted below. All the blogs/reports can be found on the [project website](#).



### 7.2.1 Fit-4-AMANDA workshop IWU in Chemnitz

**April 17 2018**

On April 17th, 2018, a Fit-4-AMANDA workshop took place at the Fraunhofer IWU in Chemnitz. In addition to the project consortium, the initial situation, the objective and the proposed solution path as well as the current status of the project was presented. The audience included automotive manufacturers, component suppliers for automotive application, materials manufacturer and a representative of the innovation network "Forschungsvereinigung Antriebstechnik".



Figure 7-2 Fit-4-AMANDA workshop IWU in Chemnitz

## 7.2.2 Exhibition Blechexpo 2019 at Stuttgart

### Fit-4-AMandA presented at the Exhibition Blechexpo 2019 at Stuttgart

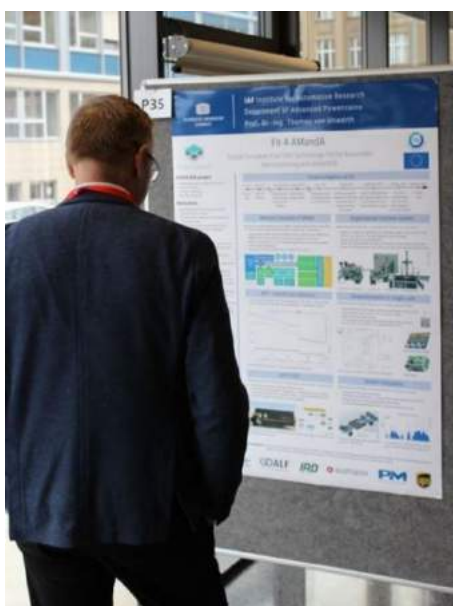
Exhibition Blechexpo 2019 at Stuttgart  
International trade fair for sheet metal working

At the Blechexpo 2019 in Stuttgart, the Fraunhofer IWU presented the EU project Fit-4-AMandA and the results obtained so far. The aim was to inform about the project, to disseminate the achieved results and to promote the project consortium with the acquired or expanded Know-how.



Figure 7-3 Exhibition Blechexpo 2019 at Stuttgart: Fit-4-AMandA Poster

## 7.2.3 10<sup>th</sup> International Conference Hydrogen Days 2019



### Date/Time

Date(s) – 27/03/2019 – 29/03/2019

### Location

The National Library of Technology  
Technická 6/2710  
Prague  
Czech Republic

Delegates from the Consortium: Prof. Dr.-Ing. Thomas von Unwerth (TUC), Dr. Martin Biák (TUC)

The annual international conference Hydrogen Days was organised by Czech Hydrogen Technology Platform (HYTEP). The main motto of the conference was “Through collaboration to the deployment of H<sub>2</sub> technologies”. The audience consisted of 120 delegates from 21

Figure 7-4 10<sup>th</sup> International Conference Hydrogen Days 2019: Fit-4-AMandA Poster

countries. Participants came mainly from research institutions (SINTEF, Fraunhofer IFAM) and industry (Hydrogenics, Daimler, Siemens), but there were representatives from banking and policy makers, too. Participants gave 28 lectures and presented 37 posters. At the beginning, a speaker from Fuel Cell & Hydrogen 2 Joint Undertaking gave the talk summarising the situation in Europe. Other topics included:

- Development and deployment in the energy sector (hydrogen production, hydrogen storage, energy storage, infrastructure, co-generation systems, fuel cells, reversible fuel cells, business cases, market implementation, etc.)
- Development and deployment in transportation (fuel cells as an energy source for mobile application, hydrogen storage and distribution, hydrogen infrastructure, etc.)
- Cross-cutting and overarching issues (education & information, legislation & safety, reliability, grid integration, etc.)

The project Fit-4-AMandA was presented in the form of an oral lecture and as a poster. More info: [www.hydrogendays.cz/2019](http://www.hydrogendays.cz/2019)

**Figure 7-5 10th International Conference Hydrogen Days 2019: Fit-4-AMandA presentation**



Figure 2: The conference hall in the National Library of Technology in Prague, was almost full.



Figure 3: To the conference venue in Prague, 120 participants came from 21 countries from all around the world.

**Figure 7-6 10th International Conference Hydrogen Days 2019: 120 participants from 21 countries were present at the conference in Prague**

#### 7.2.4 World Smart Energy Week 2019 / FC EXPO 2019



**Figure 7-7 Fit-4-AMandA was promoted at the World Smart Energy Week 2019 and flyers were distributed**

**Date/Time**

Date(s) – 27/02/2019 – 01/03/2019

**Location**

Tokyo Big Sight  
3 Chome-11-1 Ariake  
Kyoto City  
Tokyo 135-0063  
Japan

Delegates from the Consortium: Dr. Jiří Hrdlička (TUC)

The most interesting take-home message from the World Smart Energy Week was the obvious maturity of the production lines for the manufacture of batteries, which could probably be transposed to the production of fuel cells. Both technologies consist of electrochemically active layers and the

inclusion of techniques already maturing in the battery industry could help accelerate the ramping up of the fuel cell production volume.

The event quite obviously caters to the Asian market, a fact underscored by most of the talks being given in Japanese and simultaneously translated to English and Chinese. Same applies to the flyers distributed at the booths.

Technical conference did not go far beyond publicly available facts and only the discussion with the speakers provided more useful information. The Expo itself is certainly worthwhile and facilitates bilateral talks with the reps of the involved companies and research institutions.

Technical sections FC-5 through FC-9 were attended to gain information on the current state of the fuel cell market and ongoing activities. Fuel cell expo has been scouted to gain information about already existing fuel cell manufacturing technology. Contact has been made to several companies in the Fuel cell and battery sections, mostly in the direction of mass production ready equipment, distributing Fit-4-AMandA flyers in the process.

## 8 Risk Register

Risk No.	What is the risk	Probability of risk occurrence <sup>1</sup>	Effect of risk <sup>2</sup>	Solutions to overcome the risk
<b>WP7</b>	Limited project visibility due to lack of face-to-face events	medium	low	Extra online activities and one-to-one business promotions
	Due to technical problems, delay in achieving project targets. Limited dissemination chances	medium	low	Commitment from partners to continue promoting project results (beyond project lifetime)

<sup>1</sup> Probability risk will occur: 1 = high, 2 = medium, 3 = Low

<sup>2</sup> Effect when risk occurs: 1 = high, 2 = medium, 3 = Low

## 9 Acknowledgement

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

### Project partners:

#	Partner	Partner Full Name
1	UNR	Uniresearch BV
2	PM	Proton Motor Fuel Cell GmbH
3	IRD	IRD Fuel Cells A/S
4	Aumann	Aumann Limbach-Oberfrohna GmbH
5	Fraunhofer	Fraunhofer gesellschaft zur foerderung der angewandten forschung E.V.
6	TUC	Technische Universitaet Chemnitz
7	UPS	UPS Europe SA



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