



PEMBeyond

PEMFC system and low-grade bioethanol processor unit development for back-up and off-grid power applications

Grant Agreement no: 621218

Deliverable 9.2

Dissemination Plan

Due date of deliverable:	30.6.2016
Actual submission date:	4.7.2016
Lead beneficiary:	VTT
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Confidentiality:	Public
Revision:	Version 2.0



Deliverable title D9.2 Dissemination Plan	
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Project name PEMFC system and low-grade bioethanol processor unit development for back-up and off-grid power applications	Project short name PEMBeyond
Author(s) Pauli Koski, VTT	Pages 18
<p>Summary</p> <p>This document defines the work to be performed within WP9 Dissemination of PEMBeyond project, by defining a framework for dissemination of the project results, including definition of objectives and message, identification of target audience, and definition of dissemination strategy.</p> <p>Following the first version of the dissemination plan, this second version reviews the implementation of dissemination actions to date, while also providing a draft of the forthcoming actions for the remainder of the project.</p> <p>The progress already made in identifying and engaging relevant companies for the first industry workshops has been promising and a lot of potential is seen in continuing these workshops annually for the project duration. The project has been successfully promoted in international conferences, and will be presented in two more this year. One journal paper has been published and more are currently under work.</p>	
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1. Overview

1.1 PEMBeyond project overview

This project aims to develop a cost-competitive, energy-efficient and durable, low-grade (crude) bioethanol fuelled integrated PEMFC power system for back-up and off-grid power generation. Wireless communication systems are rapidly expanding globally, and the need for reliable, cost-competitive and environmentally sound back-up and off-grid power is growing, especially in developing countries.

Cost-competitive PEMFC power system compatible with crude bioethanol would allow direct use of easily transported and stored, locally produced sustainable and low-emission fuel also in developing countries, further adding value and increasing the number of potential applications and end users for fuel cell and hydrogen technology.

1.2 WP9 Dissemination

Objective of WP9 Dissemination is to create awareness of the project and promote the project results throughout Europe and beyond, both industry and research communities, and due to the possible applications in developing countries and arctic regions, for a wider public as well.

1.3 Purpose and scope of this deliverable

This deliverable, *D9.2 Dissemination Plan* defines a framework for dissemination of the project results, including definition of objectives and message, identification of target audience, and definition of dissemination strategy.

Following the first version of the dissemination plan, submitted after 6th project month, this second version also reviews the implementation of dissemination actions to date, while also providing a draft of the forthcoming actions for the remainder of the project.

2. Dissemination objectives

In short, the main dissemination objectives are to identify the correct audience consisting of different stakeholder groups, engage the key stakeholders for bi-directional information exchange and deliver the project message to all the relevant stakeholders.

Informing scientific and technical audience with the unique characteristics of this system, including the most advantageous applications and comparison to other solutions with their strengths and weaknesses is very important.

Reaching the project targets in terms of cost, lifetime, efficiency and emissions need to be proven to stakeholders; hence it is essential to disseminate the experimental results from testing and field trials.

The most important objectives are:

- Identifying and engaging industrial stakeholders to ensure that the project outcome meets their demands and expectations

- Promotion and information exchange within the scientific community in order to receive feedback on the project results and share our contribution with the community
- Raising awareness of the general public on fuel cell based crude bioethanol fuelled power generation technologies

In addition to the external dissemination, effective information exchange within the project consortium is important. Internal dissemination is described briefly where applicable, but main focus is kept on external dissemination activities.

3. Key messages and expected results

The back-up and off-grid power generation is currently handled with battery and internal combustion engine based systems, with also fuel cell based solutions slowly entering the market. The Reformed Ethanol Fuel Cell System (REFCS) developed in this project features on-site hydrogen generation from crude bioethanol via steam reforming.

However, the produced hydrogen rich reformat gas needs further treatment as it contains a fraction of CO – a compound that sticks to the PEMFC anode catalyst reducing the power generation capacity. To reduce the CO content, the product gas first runs through a Water Gas Shift (WGS) reactor followed by final polishing step via pressure swing adsorption (PSA). The CO level in the purified hydrogen should stay below 20 ppm, even with the state-of-the-art reformat MEAs used in the stacks.

To downsize the fuel processing and purification stage for back-up applications, the system is equipped with a hydrogen buffer tank, which allows fast start-up of the fuel cell system (FCS) at full power. Once the buffer is empty, FCS shifts to partial load, continuing operation for several days without the need of refuelling.

The concept of the REFCS differs somewhat from its competitors, mainly due to the chosen fuel, crude bioethanol. The four themes given below summarize the main advantages.

1. Crude bioethanol - Sustainable fuel with diverse feedstock options

Crude bioethanol is an unpurified, undenatured fuel produced from biomass with an ethanol content ranging from 80-95 w-%. Compared to pure ethanol, the production does not require sophisticated fuel processing and purification equipment – the fermentation and distillation can be done locally, reducing the amount of transport needed. The production can be started with fairly low investment costs, a clear advantage for communities in developing countries.

Bioethanol can be produced sustainably from various feedstocks ranging from agricultural or wood biomass to communal waste. However, care should be taken that the production chain has sufficiently high energy return on energy invested (EROEI), which may not be the case with all biofuels. Thus, the feedstock should be based on biomass from plants cultivated on soil not able to sustain food production, from leftover material streams and other waste that would otherwise be left to decay, etc. In addition, all other energy inputs in the production process, often based on fossil fuels, should be kept as low as possible.

In the intermediate future, the availability of fossil fuel feedstock is also questionable, so alternative routes to produce and transform liquid hydrocarbons to electricity have high societal importance. This also helps to reduce the risk of increase in fuel costs.

2. Low fuel logistics costs and other operation expenditure

Compared to other currently available energy storage methods, liquid hydrocarbons fuels are still unparalleled by energy density. Moreover, ethanol can be transported and stored in

inexpensive containers, opposed to cryo or high pressure equipment needed with hydrogen. As the REFCS runs on ethanol diluted to 30 w-% with water, a very broad range of ethanol grades may be used, allowing the use of the cheapest locally available fuel option. In principle, the system is also self-sufficient with water.

Compared to diesel generators, the fuel processing system and fuel cells integrated in the REFCS can reach much longer operation times without maintenance. As capital expenditure is estimated to reach level comparable to other competing technologies, the REFCS is a very attractive alternative for power generation in remote and hard to access locations.

3. Low environmental impacts during operation

Compared to diesel generators, the REFCS has low noise emissions and no particle/NO_x emissions. As part of the fuel processing, CO₂ is produced, but due to higher efficiency, these emissions are lower than in diesel or gasoline generators. With a lifetime of 20 000 hours, the life cycle emissions of REFCS system are also expected to be lower, taken that the catalysts can be recycled.

Fuel cell systems with on-site fuel processors may also use other fuels, such as diesel or methanol. However, ethanol has clear advantage to these as it does not pose large risks to the environment in case of a spill. Depending on soil or water oxygen content, ethanol is decomposed by bacteria to CO₂ or methane.

These facts combined make the REFCS very attractive for applications in vulnerable natural environments, for instance in nature conservation areas or in research expeditions wishing to have minimal impact on the surrounding habitat.

4. Capability for operation in the arctic environment

Starting a power generator from freezing temperatures is still a huge challenge for conventional technologies. In the REFCS concept, the fuel cell stack has shown capability of unassisted start-up from -25 °C. This ability relates to the automotive type metal bipolar plate design used in the stacks. The fuel processor uses a 30 w-% ethanol water mixture having a freezing point of -19 °C, so the system can in principle start from complete hibernation at that temperature. With the hydrogen buffer tank and fuel cell by-product heat distribution to ethanol vessel heat-up, the system will be able to start-up from -25 °C. The possibility for cold operation is a major advantage to conventional diesel generators and opens completely new markets for off-grid arctic regions.

As a summary, the best opportunities for the REFCS lie in applications where noise and particle/NO_x emissions are not tolerated, fuel logistics plays a large role in the overall costs, and a renewable/sustainable fuel is preferred.

4. Stakeholder mapping

Potential stakeholders for the project results can be found from all parts of the value chain throughout the lifecycle of the REFCS. From operation perspective, these range from fuel feedstock suppliers to the customers using the produced electricity. Taking into account the system manufacturing, an even broader scope is established, starting from raw material extraction to system integrators and recycling of the components.

The following sections describe the potential stakeholders, divided by industrial and other economic sectors. In addition, the geographical division of the potential stakeholder types is presented.

4.1 Fuel processing and distribution

Biomass feedstock suppliers provide raw materials for fuel processing industry. The possibility to use low grade bioethanol for electricity production may provoke feedstock sector to develop local bioethanol production for added value, instead of shipping the raw materials to be processed elsewhere.

Biofuel distilleries and refineries, part of fuel processing industry, process the biomass to chemicals and fuels that may be used by energy or transport sectors as well as food or chemical industry. This sector is expected to be very interested in the fuel processing technology and catalysts developed in this project.

As most of the fuel processing plants are designed for production of very pure bioethanol, upscaling of the crude bioethanol production, yielding lower retail prices, may not be in direct interest of the distilleries. However, with the fractional distillation process, for a portion of high quality pure bioethanol, a portion of low quality bioethanol is also produced. As markets for low quality bioethanol are currently very limited, fuel processing industry will benefit of the increased sales of this fraction.

Bioethanol suppliers and distributors handle the logistics of fuel distribution, buying in large quantities of fuel from the markets or directly from the manufacturer, handling fuel storage and dispensing through larger regions. It is in the interest of these companies to know about the potential of increase in demand of their supplies.

Hydrogen suppliers and distributors take care of hydrogen logistics for end users. A large part of the hydrogen supply is now handled directly by large gas companies, which also produce the hydrogen themselves. The reformat gas purification methods developed in this project, including WGS and PSA, are in the interest of these companies.

Another sector, slowly emerging, includes companies establishing hydrogen distribution networks based on hydrogen refuelling stations (HRS), mainly for dispensing hydrogen for use as fuel in transport applications. This sector will be very interested on the possibility on-site production of hydrogen from bioethanol. Exchanging information on hydrogen buffer tank solutions and end user requirements within the project also serves these stakeholders.

4.2 Electricity supply and security, industrial end users

Back-up system operators include companies that provide electricity supply security as a service for critical applications. As the system developed under this project aims to reduce the overall operation costs, this has clear benefits for the system operators. This is especially true for remote locations, where REFCS system provides ease of fuel logistics and low maintenance requirements.

Back-up power end users take the back-up capacity in to use at their application site. These companies include telecom service providers, electricity distribution grid operators, and other end users (e.g. industrial sites, hospitals, green houses), which in some cases may operate the back-up system themselves. The end users will benefit from long operation time and low environmental impact of the REFCS back-up system. Being able to promote the use of a more sustainable power generation option is also a clear benefit on acquiring new environmentally conscious customers and investors for the business.

Off-grid system operators and end users generate and use the power directly at their application site, located outside electricity grid. In this type of applications, the ease of fuel supply logistics plays a crucial role. Even though the prototype REFCS is more designed for the back-up application, with small modifications the system may be altered for off-grid power generation by downsizing the hydrogen buffer tank and upscaling the fuel processing line. Potential end-users can be found from mining and other material extraction fields, as well as

marine applications. It is also still common for construction companies to use diesel generators at their sites, even in the middle of cities. Future emission restrictions in densely populated areas may force construction industry to seek other alternatives.

The low noise signature, absence of particle/NO_x emissions, and non-hazardous fuel are clear advantage for both back-up and off-grid application sites located in a vulnerable natural environment. Parties requiring kilowatt scale power generators for their expedition equipment have a clear interest for this type of technology.

4.3 System manufacturing

Raw material suppliers, providing metals and minerals for the component manufacturing and noble metals for catalyst manufacturers, can also be seen as stakeholders of this project. One very important aspect is also **material recycling**, which can reduce the life-cycle emissions of the REFCS system drastically, especially by recycling noble metals and other rare minerals used in the catalysts.

Specialty chemicals industry, supplying many essential catalysts and adsorbents to the REFCS, may expect the demand of their products to increase with commercialisation of the system. On the other hand, the suppliers have large interest on the catalysts and adsorbents developed within the project. Suppliers of reformat compatible membrane electrode assemblies (MEAs) may also benefit from potential increase in their product demand.

Component manufacturers provide most of the hardware integrated to the REFCS. Increased demand of specialized components, such as fuel cell stacks, catalytic reactors and burners, batteries, power electronics, hydrogen buffer tanks, balance of plant (BoP) components, etc. is expected as a result of this project. Also automotive fuel cell component manufacturers may wish to extend their market to stationary applications.

System integrators are the developers and suppliers of telecom hardware, complete back-up power solutions or subsystems, such as the fuel processor, gas purification systems, fuel cell systems, battery units etc. Also automotive fuel cell system integrators may find new markets for their hardware in stationary applications.

4.4 Non-government organisations

Industrial and trade associations participate in public affairs representing their member companies. Such associations exist for most parts of the value chain, bridging together industry from regional perspective or even worldwide. Industry associations will play an important role in promoting the project results within their own list of stakeholders, while they also have a lot of influence among government organizations and other policymakers.

Other associations include independent, non-profit organizations or inter-governmental organizations that participate in public affairs for direct humanitarian aid or increasing human wellbeing worldwide.

Associations with common interest with the PEMBeyond project include:

- European renewable ethanol association ([ePURE](#))
- World Bioenergy Association ([WBA](#))
- European Catalyst Manufacturers Association ([ECMA](#))
- The Fuel Cell and Hydrogen Energy Association ([FCHEA](#))
- Hydrogen Europe (<http://hydrogeneurope.eu/>)

- European Telecommunications Network Operators' association ([ETNO](#))
- World Energy Council ([WEC](#))
- Arctic Council (<http://www.arctic-council.org/>)
- World Alliance for Decentralized Energy ([WADE](#))
- Alliance for Rural Electrification ([ARE](#))
- Global Off-Grid Lighting Association ([GOGLA](#))

In addition, a lot of national and regional associations will be targeted in countries of project partners, for instance in Finland the [Finnish Energy Industries](#) and [WEC Finland](#).

4.5 Scientific community

Universities and research institutes are the main driving force on developing new technologies for the advantage of mankind. To ensure the best possible societal impact of this project, the results should be disseminated to these institutions as openly as possible. The dissemination activities to the research organisations will be carried out mainly by publishing articles on peer-reviewed journals and conference proceedings, which these institutions typically have access to. In addition, the results can be disseminated to member institutes in events organized by inter-organisational associations.

Professional associations that may distribute information to their member individuals will also be considered for dissemination of PEMBeyond project. These associations include for instance Institute of Electrical and Electronics Engineers (IEEE) and The Electrochemical Society (ECS). Commonly, the dissemination will be carried out through conferences and seminars arranged by the associations.

4.6 Geographical division of stakeholders

In addition to the value chain from feedstock to end users, a geographical division on the stakeholder interest is evident. The areas may be divided into five sectors based on their interests:

1. *Africa*: Developing countries have scarce grid and telecom connections available. Establishment of local fuel production from biomass would help to develop independent energy solutions. This is in the interest of local government as well as development and humanitarian aid organizations.
2. *Southern America*: With strong bioethanol production industry, bioethanol fuelled back-up systems are seen as a compelling solution with short range fuel logistics, and without the need to purchase resources outside the continent.
3. *Arctic regions*: Research stations and research expeditions to fragile ecosystems wish to have as little impact to their surroundings as possible, and also want to demonstrate the use of environmentally sound solutions for their electricity generation needs. Freeze tolerance and start-up capability is also required.
4. *Western countries*: Societal push for companies to deploy environmentally sound solutions is increasing. Biofuels seen as one of the key alternatives for transport sector and near future fuel logistic costs for bioethanol fuel is expected to remain at moderate level, whereas as fossil fuel prices may increase due to implementation of emissions taxes.

5. *Asia*: Densely populated developing areas in Asia with unreliable electricity grids require back-up power for telecommunications and other critical applications, such as hospitals. The use of non-polluting alternatives in these areas help to reduce deaths related to air pollution.

5. Dissemination strategy

5.1 Responsibilities

VTT as project coordinator is responsible for dissemination of the project results and representing project in different events, but other partners are also encouraged to promote project results in conferences, seminars and other events. In these brief description of PEMBeyond should be included (slide or two in the presentation). In general, the research institutions will take care of writing the scientific publications, whereas industrial partners will focus on representing the consortium in media and trade fairs. Planned and completed dissemination activities are communicated within the project consortium as a part of the project meetings taking place every 6 months.

5.2 Dissemination purposes and timing

The purpose of the dissemination actions can be divided in four categories:

- Raising awareness: Telling the audience what the project is about and what are the expected outcomes
- Engagement: Getting input and feedback from the audience to the project
- Promotion: Selling your ideas and results to the audience
- Informing: Educating the audience, contributing to the community

In the first half of the project, while no concrete results are yet available, the dissemination actions should focus on raising awareness of the project through all possible channels. Another important task is to engage the relevant stakeholders, which will be done through establishing an Industrial Advisory Group (IAG) and arranging annual IAG workshops. These actions are planned to take place from the very start of the project.

Once the project has started to accumulate interesting results, these should be promoted to the key stakeholders. At this point, dissemination should also focus to raise the awareness of audience outside the key stakeholders. The scientific community should be informed through publications in scientific journals and by participation in scientific conferences and seminars.

During the last year of the project, the results should be presented in high impact international conferences. It is also essential to get the key stakeholders committed to future plans to ensure proper exploitation of the project results.

5.3 Dissemination channels

The different dissemination channels and their expected target audiences are described below. A more detailed list of the already completed and planned activities is given in Chapter 6.

5.3.1 Stakeholder identification and direct engagement

Stakeholder identification within the industrial target groups continues throughout the project. Existing knowledge and contacts within the consortium will be used, and new relevant companies and contacts will be searched for e.g. using search engines and networking in different events (workshops, fairs, seminars and conferences). Once identified, the companies and other stakeholders will be contacted and meetings arranged for presentation of the project and communication of the possible benefits for the stakeholder in question. In addition to direct meetings with the stakeholders, the most important tool for engaging these companies are the Industrial Advisory Group workshops described more in detail below.

For the dissemination purposes, we wish concentrate our efforts on the key stakeholders. Based on the stakeholder mapping in Chapter 4, the most relevant industrial parties for dissemination in short term are the back-up power end users, system integrators and bioethanol producers. Towards the end of the project, the scope should be widened to off-grid applications, especially in developing countries.

5.3.2 IAG workshops

Industrial Advisory Group (IAG) workshops are an important tool for establishing mutual trust and engaging the industry for committed cooperation. Currently, the IAG consists of invited companies mainly from the telecom and energy sector. The IAG is invited to annual IAG workshops, with the objective to reach bilateral exchange of information:

- Promotion and dissemination project results directly to a key audience, and
- Receiving feedback to ensure attractiveness of the technology developed.

Participation of companies to the annual workshops is fully non-binding, and IAG acts as a discussion forum within a list of relevant companies and their contact persons.

Forming an IAG was not originally planned in the project plan, but a need for such a forum was discovered soon in the beginning of the project. There is a relevant need from both sides (the project consortium and the industry) to understand the requirements and projections of back-up power and fuel cell technology for the future. The approach to market is complex for technologies developed in PEMBeyond and it will require variety of competences. Back-up and off-grid solutions should be tailored for each application case by case. Also the installation and maintenance requires expertise. Gaining knowledge on these aspects is very important in order to develop solutions that are truly competitive.

5.3.3 Conferences, seminars, trade fairs, professional networks

The project will be promoted and the results presented in selected scientific and industrial conferences throughout the project duration. Main focus will be on major events related to fuel cells and hydrogen technology and telecommunication technology, especially telecom power systems.

Goal is to a presentation on an international conference at least once per year. Oral presentation is preferred over poster presentation for each conference participated. Current plans for conference participation are given in Chapter 6.

Within PEMBeyond scope, the following conferences seem the most interesting:

- International Telecommunications Energy Conference ([INTELEC](#))
- World Hydrogen Energy Conference ([WHEC](#))
- European PEFC and H2 Forum ([EFCE](#))

- World Hydrogen Technology Conference ([WHTC](#))
- Baltic Electrochemistry Conference
- International Conference on Hydrogen Production (ICH2P)

The industrial partners will concentrate on presenting the project on trade fairs with one of the prime targets being Hannover Messe, with Hydrogen + Fuel Cells + Batteries Group Exhibit (<http://www.h2fc-fair.com/>).

In addition to the above, PEMBeyond project is presented annually in Fuel Cells and Hydrogen Joint Undertaking (FCH JU) Review Days. This will offer a well-focused tool for dissemination within both the industrial and scientific stakeholders of the European fuel cell community, also being a good forum to receive feedback, share experiences and discuss common issues with other similar projects to PEMBeyond.

The project results are also be promoted through networks of other projects currently ongoing, such as HyCoRA.

5.3.4 Publications

Scientific journal articles are a very important and broad-based dissemination tool with a long-lasting impact especially within the scientific community. Every chance on publishing results in peer-reviewed journals will be exploited, also to the benefit the number of Ph.D. students working within the PEMBeyond project. Publishing key project results will be carried out by the research and university partners within the PEMBeyond consortium (VTT, Fraunhofer-IMM, UPorto).

Relevant journals for PEMBeyond research scope include: *International Journal of Hydrogen Energy, Journal of Power Sources, Fuel Cells, International Journal of Electrical Power & Energy Systems, Industrial & Engineering Chemistry Research, Chemical Engineering and Processing, Fuel Processing Technology, IEEE Transactions on Energy Conversion, IEEE Transactions on Power Systems, Applied Energy, Energy Conversion and Management, Energy Research and Social Science, Fuel, Energy and Fuels, ...*

The list is not exhaustive, but aims to communicate variety of relevant journals in the field. Naturally, other potential journals will be also sourced and evaluated once publishing is at hand.

5.3.5 Media exposure

Partners are encouraged to exploit any chances to get the PEMBeyond project featured in local news. Official press release, distributed through the partner institutions, is planned to be released on system commissioning/field trial start. This is a good way to make the project known also outside the typical audience, to possibly reach a broader sector of applications and end-users through individuals interested in the subject.

5.3.6 Public website

The project website is the most versatile dissemination tool, providing information on the project plan, activities, progress and outcome to a wide audience. A public project website was launched shortly after project kick-off in May 2014. It is available at <http://pembeyond.eu/> and contains the following parts:

- *Home / Front page*: General description of the project, its background, project plan objectives and expected outcomes. Coordinator contact details for further information. Recent updates part.

- *Deliverables*: All public and accepted project deliverables.
- *Partners*: List of all project partners with their logos and partner descriptions.
- *Downloads*: Short presentations and other promotional material.

The website will be maintained and updated throughout the project.

5.3.7 Project promotional material

The necessary project promotional material has been set up to facilitate promotion of the project and its results by all partners. Further material (e.g. leaflets, handouts, posters) will be developed later in the project, when needed.

A project logo and PowerPoint template have been designed in line with the graphical appearance of the project website. They are used in all project related presentations and other materials by all partners. The project logo can be found e.g. on the front page of this document.

Standard project presentation with the key information (background, objectives, consortium, key numbers, and general project plan) is available in project workspace for all partners. Partners may add these slides (either all of them or separate slides) into their own presentations.

5.3.8 Internal communication

Project internal communication will be carried out via e-mail, bi-monthly progress meetings (teleconference), semi-annual face-to-face meetings, and annual workshops (also being an important tool for external dissemination).

A restricted project workspace was set up before the project kick-off on MS Sharepoint with the purpose to offer all project partners access to project documentation (agreements, meeting materials, presentations, deliverables, etc.). User accounts have been given to all relevant persons from all partners in order to facilitate project internal dissemination. All partners can upload, edit and download files at all times.

5.4 Evaluation

Evaluation of the dissemination activities during the project may be accomplished in a few ways. The coordinator can keep track of contacts acquired based on a dissemination action and the project website logs can be used to track changes in visitor frequency and geographic location.

For the events organised by the project consortium, a feedback survey is given for participants, asking them to review the quality and usefulness of the event.

The impact of publications can be tracked by number of citations, however this has limited information during the project implementation phase, as the impact of a certain publication can be assessed only couple of years after the publication date.

6. Implementation

This chapter reviews the dissemination actions carried out so far, and provides plans for actions planned in the near future. The planned activities act as a guideline and the consortium reserves the right to alter the dissemination actions as they see fit based on

information coming to light after the submission of this plan. However, the level or quality of dissemination should be kept at sufficient level.

Table 1 gives a list of publication completed and planned within PEMBeyond. Writing of articles based on the subsystem and component development is already progressing, with one article published on ejector testing. At least one paper is planned to be written on each subsystem being developed and published in journals specific to the field.

A conference or journal paper is targeted based on complete system description and hydrogen quality studies. Another broader paper will also be written based on the commissioning and field trial experiences.

Table 2 shows the conference exposure of the project. The project has been so far presented in three conferences, with two more coming this year. With the current plan, the project will be promoted in around six international conferences in addition to the FCH JU Review Days.

As shown in Table 3, the first two IAG workshops were held in Finland (Q3/2014) and Italy (Q2/2015). The original plan was to organize each workshop in different country to reach a broad geographical variety of companies. An option currently under consideration is to arrange one of the remaining workshops at a trade fair, to reach maximal impact. The last workshop is again considered to be held in Finland, at the vicinity of the system trial site.

The project consortium has also carried out other types of dissemination activities (Table 4), mainly promotion in technical seminars and trade fairs and direct engagement of stakeholders.

Table 1: List of completed, on-going and planned publications.

Partner	Type	Working title	Name of publication	Status
VTT	Conference Paper	Development of bioethanol fuelled fuel cell system for backup applications - PEMBeyond project	Proceedings of the 5 th European PEFC and H2 Forum	Published Q3/2015
VTT	Journal Paper	Designing a hydrogen gas ejector for 5 kW stationary PEMFC system - CFD-modeling and experimental validation	International Journal of Hydrogen Energy	Accepted for publishing Q2/2016
VTT	Conference Paper	Development of Reformed Ethanol Fuel Cell System for Backup and Off-Grid Applications - System Design and Integration	Proceedings of the 38 th International Telecommunications Energy Conference	Abstract accepted, writing in progress
VTT	Journal Paper	Development of PEMFC systems for fuel impurity dynamics studies with anode hydrogen recirculation	-	Writing in progress
UPorto	Journal Paper	Development of low temperature water gas shift catalyst based on non-noble metals	-	Planned for Q4/2016
UPorto	Journal Paper	Development and validation of a computational model for pressure swing adsorption unit	-	Planned for Q1/2017
IMM	Journal Paper	Bioethanol steam reforming reactor development for elevated pressure applications	-	Planned for Q1/2017

VTT	Conference/ Journal Paper	Unassisted freeze start-up of a 0.7 kW short stack with metal bipolar plates from -25 °C	-	Planned for Q1/2017
VTT	Journal Paper	Design and experimental validation of a discrete throttle control system for ejectors in stationary fuel cell applications	-	Planned for Q2/2017
VTT	Conference/ Journal Paper	Development of Reformed Ethanol Fuel Cell System for Backup and Off-Grid Applications – Commissioning and Field Trials	-	Planned for Q4/2017

Table 2: Attended and planned scientific conferences and seminars with presentation of the project.

Partner	Type	Working title	Venue	Status
VTT	Poster presentation	PEMBeyond - PEMFC system and low-grade bioethanol processor unit development for back-up and off-grid power applications	20 th World Hydrogen Energy Conference, Gwangju, South Korea, 2014	Completed Q2/2014
VTT	Poster presentation	PEMBeyond project	FCH JU Review Days, Brussels, Belgium, 2014	Completed Q4/2014
VTT	Oral presentation	Development of bioethanol fuelled fuel cell system for backup applications - PEMBeyond project	5 th European PEFC and H2 Forum, Lucerne, Switzerland, 2015	Completed Q3/2015
VTT	Poster presentation	PEMBeyond project	FCH JU Review Days, Brussels, Belgium, 2015	Completed Q4/2015
IMM	Poster presentation	Study of methane formation under conditions of bioethanol steam reforming at elevated pressure	49 th Annual Meeting of German Catalysis, Weimar, Germany, 2016	Completed Q1/2016
VTT	Oral presentation	Development of Reformed Ethanol Fuel Cell System for Backup and Off-Grid Applications - System Design and Integration	38 th International Telecommunications Energy Conference, Austin, Texas USA, 2016	Accepted for lecture presentation
VTT	Oral presentation	Development of Reformed Ethanol Fuel Cell System for Backup and Off-grid Applications - PEMBeyond project	6 th HFC Nordic Conference, Sandviken, Sweden, 2016	Abstract sent
VTT	Poster presentation	PEMBeyond project	FCH JU Review Days, Brussels, Belgium, 2016	Planned for Q4/2016
VTT	Oral/Poster presentation	PEMBeyond – Commissioning and field trial of crude bioethanol fuelled PEMFC based back-up and	7 th World Hydrogen Technology Convention, Czech	Planned for Q2-3/2017

		off-grid power system	Republic, Prague, 2017	
		AND/OR		
VTT	Oral/Poster presentation	Development of Reformed Ethanol Fuel Cell System for Backup and Off-Grid Applications – Commissioning and Field Trials	6 th European PEFC and H2 Forum, Lucerne, Switzerland, 2017	Planned for Q2-3/2017
VTT	Oral/Poster presentation	PEMBeyond project	FCH JU Review Days, Brussels, Belgium, 2017	Planned for Q4/2017

Table 3: Events organized by the project consortium.

Partner	Type	Event title	Venue	Status
VTT	Workshop	1 st Industrial Advisory Group Workshop	VTT, Espoo, Finland, 2014	Completed Q3/2014
Genport	Workshop	2 nd Industrial Advisory Group Workshop	Genport, Vimercate, Italy, 2015	Completed Q2/2015
VTT	Workshop	3 rd Industrial Advisory Group Workshop	VTT, Espoo, Finland, 2016	Planned Q4/2016-
		OR		
All	Workshop	3 rd Industrial Advisory Group Workshop <i>at Trade fair</i>	Hannover Fair FC Expo 2017	Planned Q2/2017
VTT	Workshop	4 th Industrial Advisory Group Workshop	VTT, Espoo, Finland, 2017	Planned Q3-4/2017
VTT	Public tour	Open doors day at trial site. Invitation of local politicians etc.	VTT, Espoo, Finland, 2017	Planned Q3-4/2017

Table 4: Other types of dissemination actions, including direct meetings, trade fairs, technical seminars, etc.

Partner	Type	Description	Status
Genport	Workshop presentation	Presentation of PEMBeyond Technology at Battery & Fuel Cell Seminar	Completed Q1/2014
Genport	Workshop presentation	Presentation of PEMBeyond at the 4 th Israeli conference for Power Sources	Completed Q1/2014
VTT	Web page	PEMBeyond project public web pages. The contents and layout of the pages are updated as the project progresses.	On-going Q2/2014
All	Web page	Brief project presentation and/or link to the above project web pages	Completed Q2/2014
VTT Genport	Direct engagement	Face to face meetings with telecom and energy sector companies were employed for mapping end user/system integrator requirements, specifications for fuel cell back-up power (WP6) and collection back-up and off-grid power market data (WP8).	Completed Q2-3/2014

VTT Genport	Direct promotion	Presentation of the PEMBeyond project to telecom and energy sector companies	Completed Q2-3/2014
VTT Genport	Direct engagement	Sharing of invitations to telecom and energy sector companies to participate in the IAG and the annual workshops	Completed Q2-3/2014
Genport	Workshop presentation	Presentation of PEMBeyond Technology at Battery & Fuel Cell Seminar	Completed Q2/2015
Genport	Trade fair presentation	Hannover Fair FC Expo 2015 presentation of PEMBeyond Concept at a Technical Seminar	Completed Q2/2015
Genport	Media exposure	Video material of PEMBeyond System in public Italian national TV channel (RAI)	Completed Q2/2016
VTT IMM UPorto	Direct engagement	Negotiations with bioethanol producers in Finland, Germany, Portugal and Spain	On-going
Genport	Direct promotion	Presentation of PEMBeyond to various Telecom customers during visits at Genport	On-going
VTT	Public deliverables	The project public deliverables are made available in the web page to distribute information of the already completed tasks	On-going
VTT	Public status reports	Public status reports of the project are made available in the web-page, to report progress to general public	On-going
Genport	Workshop presentation	Presentation of PEMBeyond Technology at Battery & Fuel Cell Seminar	Planned Q3/2016
UPorto VTT	Leaflet/flyer	Printable leaflets with graphic representation of the PEMBeyond concept. Also translated to Portuguese and Spanish for Southern American audience.	Planned Q3/2016
VTT	Poster	General project poster for all partners to use based on the leaflet/flyer.	Planned Q3/2016
All	Trade fair presentation	Booth, video, poster or technical presentation PEMBeyond concept at Hannover Fair FC Expo 2017	Planned Q2/2017
VTT	Press release	Official VTT press release at system commissioning, distributed to local press. International press release in collaboration with FCH JU. Distribution also through project partners' web page news feed.	Planned Q2/2017

7. Summary and conclusions

Following the first dissemination plan delivered in the 6th project month, this updated version establishes a more thorough picture of project stakeholders, while also providing a clear list of planned dissemination actions.

The progress already made in identifying and engaging relevant companies for the first industry workshops has been promising and a lot of potential is seen in continuing these workshops annually for the project duration. The project has been successfully promoted in international conferences, and will be presented in two more this year. One journal paper has been published and more are currently under work.

The most critical task at the moment is to secure the buy-in of key stakeholders for ensuring that the project results will be properly exploited and receives enough backers for future funding. Based on the experience gained during the first half of the project, it is evident that dissemination should focus more on applications in developing countries. This will require identification of new kinds of dissemination channels, outside the established community in Europe.