



Pathway to a Competitive European
Fuel Cell micro-CHP Market

REPORT

D1.10 Report on status of installer training and certification

MAIN AUTHOR:

Isobel Kaul – Element Energy, an ERM group company

CONTRIBUTOR(S):

Lisa Ruf – Element Energy, an ERM group company

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1. Executive Summary

PACE is a seven-year, FCH JU funded project that is currently deploying over 2800 next generation Fuel Cell micro-Combined Heat and Power (FC mCHP) units in 10 countries across Europe. This project is helping to further Fuel Cell micro-Cogeneration technology and increase awareness of the sector across the continent.

Task 1.4 concerns how installers and technicians working with these units are being trained, and how best to advance this training to further progress the sector. The proposed method for this task was to establish a working group within which information regarding FC mCHP training could be shared by the Original Equipment Manufacturers (OEM) involved in the PACE project, and to investigate the benefits of standardised training practices and the possibility of formal certification.

This task has been undertaken in two phases. The first phase has focused on creating and sharing updated training materials around the working group and with the wider public¹, and the second collected data regarding current training practices and general opinions on formal certification. A combination of online surveys and interviews were used to collect qualitative primary data.

The results of these data have shown that OEMs that currently engage with FC mCHP installer training are content with their own, well developed training facilities and do not see a lack of standardised training as a significant obstacle. However, it has also been noted that the standardisation of some introductory materials may allow installers and manufacturers that do not currently engage in this sector to begin to.

In this early stage of market development, it is recommended that standardised efforts focus on broader regulated materials to support the promotion of the technologies with key audiences. Alongside other important steps, such as raising awareness of the technology and improving access to funding schemes, this may help to progress the commercialisation of fuel cell technology with specialised audiences.

¹ The training materials developed are available on the website of the PACE project under the report section and identified as “specialised trade”: <https://pace-energy.eu/pace-reports/>



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2. Introduction

2.1 Introduction to PACE

PACE is a €90 million project funded by the Fuel Cells and Hydrogen 2 Joint Undertaking (FCH JU) that is deploying over 2800 next generation Fuel Cell micro-Combined Head and Power (FC mCHP) units in 10 countries across Europe. This project focuses on deploying these units to small businesses and customer homes.

PACE has brought together six European Original Equipment Manufacturers (OEM) for sales and installations of these units (BDR Thermea, Bosch, SOLIDPower, Sunfire, Viessmann and Hexis). They have deployed several generations of FC mCHP during the course of the project and in some cases, several FC mCHP products.

They are supported by four partner organisations (COGEN Europe, Danish Technical University, Element Energy and Lucerne University of Applied Sciences and Arts).

This project will create significant benefits that will allow the Fuel Cell micro-Cogeneration sector to develop further and move towards mass market uptake, with the aim to:

1. Reduce costs and improving competitiveness
2. Improve performances
3. Establish FC mCHP as a standard technology
4. Raise awareness of Fuel Cell micro-Cogeneration

Figure 1 below presents an overview of the project, the partners involved, and the location of the PACE field trial.

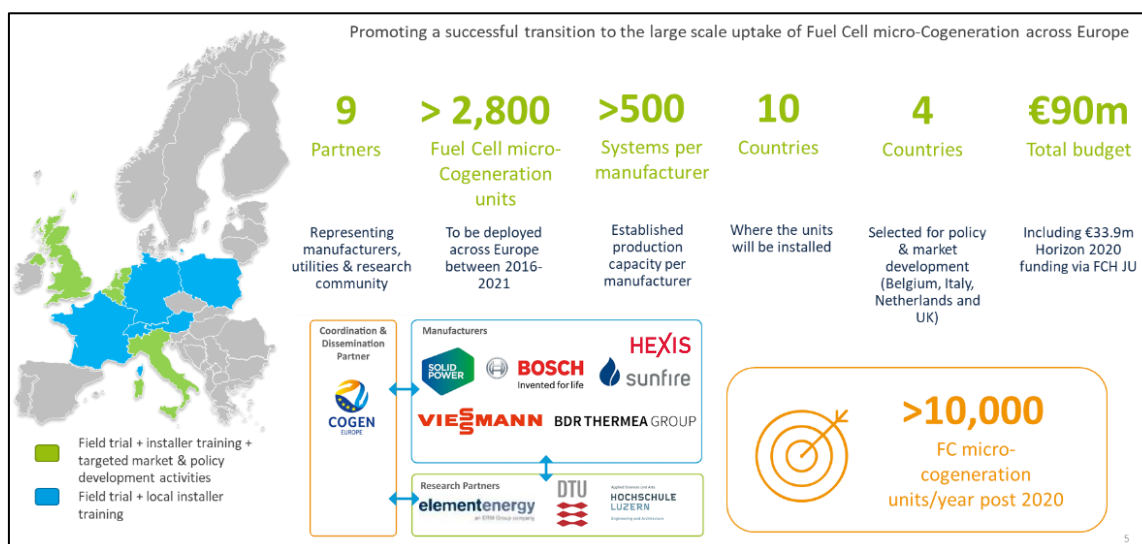


Figure 1: Overview of the PACE project

2.2 Working Group on Training and Certification

Work package 1 concerns Product Innovation and Field Demonstration, and is responsible for the deployment of all FC mCHP units within the project time frame. This includes building routes to market for FC mCHP through installer training, marketing and sales development. In addition to the progression of sales and installations of the units, work package 1 also involves the exchange of information among the consortium regarding lesson learnt and best practices arising in the trials.

Task 1.4 in particular aims to share materials used to train installers and technicians within the project, as well as understanding the need or demand for a common approach to certification and, if required, developing this approach. The specific aims of this task are as follows:

- Establish a working group to facilitate the exchange of information between project partners on progress of the trials
- Share information on successful approaches to training technicians and installers
- Discuss options for developing more standardised third party training so that installers could be trained once and be eligible to install units from different manufacturers

- Discuss options for certification programmes to verify the credentials of installers and create trust in the installer base

This report is the outcome of the work undertaken by the working group for Task 1.4 to discuss and consider options for developing standardised third party training materials and formal certification programmes.

2.3 Training and Certification in the Heating Sector

2.3.1 Established and Less Established Heating Technologies

In order to understand the future of training and certification for fuel cell technology, it is important to consider how similar efforts are conducted for already established heating technologies.

Boilers are a very established form of heating technology in Europe, and the schemes in which installers and technicians are trained are therefore also well set up in each country and sometimes internationally. This is for example the case in the UK where the Health and Safety Executive (HSE), a UK government agency, requires all operators to be trained to a high level of competence, which resulted in the Boiler Operations Accreditation Scheme (BOAS) being created. This scheme was developed by the Combustion Engineering Association (CEA) in consultation with the HSE and provides a comprehensive qualification for operators and managers of industrial and commercial boiler plant². The qualification is based on the former City & Guilds syllabus, but was updated and expanded to include energy efficiency, environmental control, and the latest developments in automatic and remote control. Similar schemes and approaches are followed across Europe.

The BOAS qualification can be obtained either by attendance on an approved training course or by application for assessment. In addition to this, an International BOAS can also be awarded for operators outside of the UK and across Europe. IBOAS is not focused on the specific legal requirements of any one country so can apply across the world.

² Combustion Engineering Association website

Heat pumps are a less established form of heating technology than boilers, but the training and certification schemes for their operations are still well developed. The 2009 EU Renewable Energy Sources Directive stated that “Member States shall ensure that certification schemes or equivalent qualification schemes become or are available by 31 December 2012 for installers”. The creation of a formal training and certification scheme was therefore a high priority established in the regulatory framework.

Following this statement, a scheme called EUCert was developed by the EU Heat Pump Association (HPA) which was aimed at initiating a European training and quality campaign for installers. Since then, calls for such a program to be wider developed resulted in the HPA working with its partners in several EU Member States to improve the schemes. Today organisations from several European countries, in addition to the original partners involved in the development of the scheme, are actively using and supporting this system³

2.32 Stakeholders involved in training and certification

Within the heating sector, unaccredited training schemes are often developed and run by manufacturers themselves. This makes up a significant portion of the training courses across the sector, demonstrating the role that manufacturers play in the training of installers. Accredited schemes are often developed by universities and awarding bodies.

The 2015 study by the UK Department of Energy and Climate change report into heat pump standards and training outlined a breakdown of the key stakeholders in heat pump training schemes⁴.

The report revealed that 60% of the 192 courses identified across the UK were accredited, by 28 different awarding bodies and 15 different universities. A wide variety of training is available from several sources. Of the 40% of training schemes that were not accredited, 28% were provided by manufacturers themselves, including Baxi, Euroheat, Worcester Bosch and Daikin. This emphasises the significant role played by manufacturers in the training of installers.

³ EHPA Website

⁴ UK Department of Energy and Climate Change - Renewable Heat: Standards and Training Report

3. Methods

Task 1.4 has been split into two phases; the first of which involved the creation of new training materials and the second focused on collecting data from organisations about their approaches to training and certification.

3.1 Phase 1

In Phase 1, work package 1 leaders Element Energy established a working group within the project consortium to facilitate the exchange of information between project partners and created new and updated training materials for technicians and installers.

Element energy created six PowerPoint based training modules for installers using training materials originally from the Callux project developed in German, in which over 1,000 residential FC mCHP units were installed across Europe. The materials developed by Callux were already extensive and provided detailed information for target groups such as installers, planners and architects. In order to build upon this, these materials were translated from German to English and then updated to create new, more in depth training resources for installers.

This training has centralised information on installations and sales, and explains how to become a trained installer. Upon completion, the resources were shared with other project partners and manufacturers in the working group.

The training materials developed are available on the website of the PACE project under the report section and identified as “specialised trade”⁵ as well as of the FCH Observatory website under the education and material section⁶.

⁵ PACE Website

⁶ FCH Observatory Website

3.2 Phase 2

Phase 2 is comprised of a wider interrogation into stakeholder engagement on which training materials are currently needed. Element Energy aimed to understand training methods used by manufacturers in the PACE project and to discuss possible benefits of starting to establish a formal certification scheme for installers.

To do this, primary data was collected from manufacturers in the working group, in addition to other training schools and national COGEN associations, in order to understand general opinion regarding current training resources and certifications.

3.21 Online Survey

Data was collected using an online survey that was created and distributed by Element Energy. Contacts for this survey were provided by COGEN Europe and included training schools, certification bodies and COGEN associations. The survey was sent to approximately 15 different relevant organisations.

The aim of this survey was to collect data about the awareness of FC mCHP and prevalence of existing training schemes amongst training and certification stakeholders. It was comprised of the following five sections: Overview of current FC mCHP awareness and training offering, Overview of existing training activities, Usefulness of FC mCHP training materials, Future plans regarding FC mCHP training and Future plans regarding FC mCHP certification.

3.22 Interviews with manufacturers

The second way in which primary data was collected was through a series of interviews conducted with training instructors from each of the manufacturers in the PACE consortium. These interviews were carried out remotely in a combination of English and German.

The aim of these interviews was to discuss options for developing standardised third party training so that installers could be trained once and be eligible to install units from different manufacturers. They also aimed to understand whether there is a demand from manufacturers for certification programmes to verify the credentials of installers. To do this, the interview was split into the following five sections: A brief overview of installer training process, Understanding installer base, Wider outreach, Certification and Broad opinions.

Questions in the first three categories discussed current training practices in the manufacturing organisation, including what methods are used and how installers were created. The purpose of these sections was to understand how manufacturers currently conduct their installer training and to identify any issues they have with these methods, including whether a more standardised set of training materials would be beneficial. In the fourth category of the interview, the possibility of a formal certification was discussed. The aim of this section was to identify any demand for formal certification among manufacturers and to understand what this might look like should it be introduced. The final section discussed broader opinions, including the manufacturers' overall appreciation with current methods. This section gave the interviewees an opportunity to highlight any further problems or ideas for the future of FC mCHP installer training.

4. Evaluation of Current Training and Certification Practices

4.1 Online Survey Results

There were three responses to the online survey, two of which were by representatives from associations working with Heat, Ventilation and Air Conditioning (HVAC) professionals and one from a private organisation working with HVAC professionals. There were no responses from any certification bodies or training entities, so the results from the survey are only able to give an indication of the views of certain organisations.

Although all organisations responding had heard of FC mCHP technology, and one was familiar with it, no organisation had produced or regularly used training or certification material on FC mCHP or other types of fuel cell technology in the past.

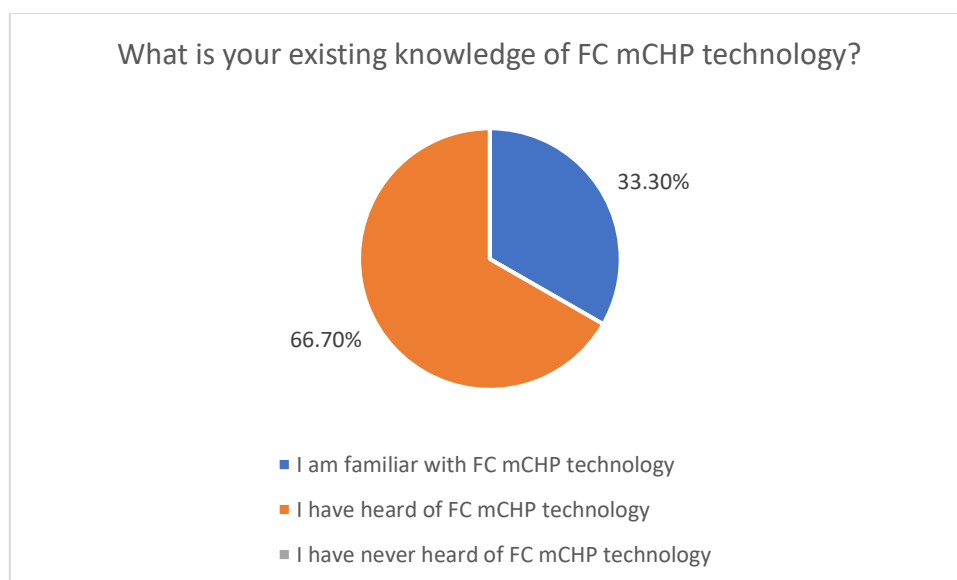


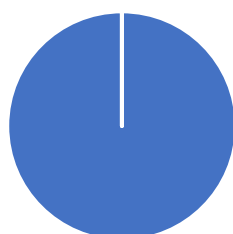
Figure 2: Survey response to the question “what is your existing knowledge of FC mCHP technology?”

However, all three of the organisations do provide some form of training or certification for HVAC professionals in general. These training resources include: certified and non-certified

courses, webinars, face to face training days and materials such as books and manuals. All offer some form of certification, but also options without certification requirements.

Despite not currently offering fuel cell related training, all responses reported that this is something they would consider conducting in the future, and that they would be interested in receiving training materials from the PACE project to help with this. Resources including lessons and guides for trainers, as well as materials that can be presented to political decisionmakers were all mentioned as being useful. Responses mentioned that a combination of both printed and digital formats would be preferred.

If you do not already conduct training related to FC mCHP, is this something you would be interested in?



100%
■ Yes ■ No

Would you be interested in receiving materials from the PACE project to improve installer knowledge of the basics of FC mCHP technology and installation?



100%
■ Yes ■ No

Figures 3 and 4: Survey responses to questions about future plans for FC mCHP training

Furthermore, all organisations declared that they would consider a formal certification for FC mCHP installer training to be of use in the future. Opinions varied on whether this should be a new and independent certification or incorporated into one that exists currently. One response stated a new certification would be preferable, one was unsure and one believed that in the short term a new certification would be beneficial but that it should eventually be incorporated into existing certifications. All were, however, in agreement that

certification of any kind for installers of FC mCHP would be useful going forward in this sector.

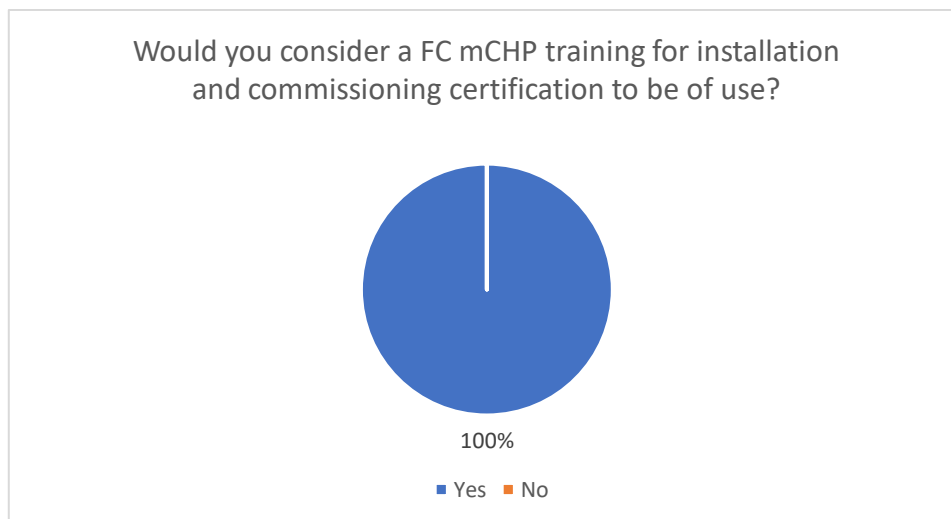


Figure 5: Survey response regarding a new certification for FC mCHP installer training

All organisations also stated that they would be interested in attending a PACE webinar in order to hear and learn more about FC mCHP technology. It is clear from these responses that, although these organisations do not currently engage in this sector, they would all be interested in doing so in the future and developing their own training courses for installers. It is also clear that these organisations would find it easier to make this transition into the fuel cell sector with help from external training materials being provided to them, and a formal certification to work towards. This therefore highlights some the benefits of standardised training materials and formal certification, as it may help new organisations to become involved in the sector, thereby helping it to grow further.

4.2 Analysis of Manufacturer Interviews

4.2.1 Understanding the Current Installer Base and Current approaches to training

All OEMs interviewed currently offer their own training programmes for installers of FC mCHP. The majority of these programmes and the accompanying training materials are developed internally and are a combination of online webinars and resources, and in person training sessions. All manufacturers have had to diversify their training over the past year due to the impacts of COVID-19 restrictions, and now offer a mixture of resources as shown in figure 6.

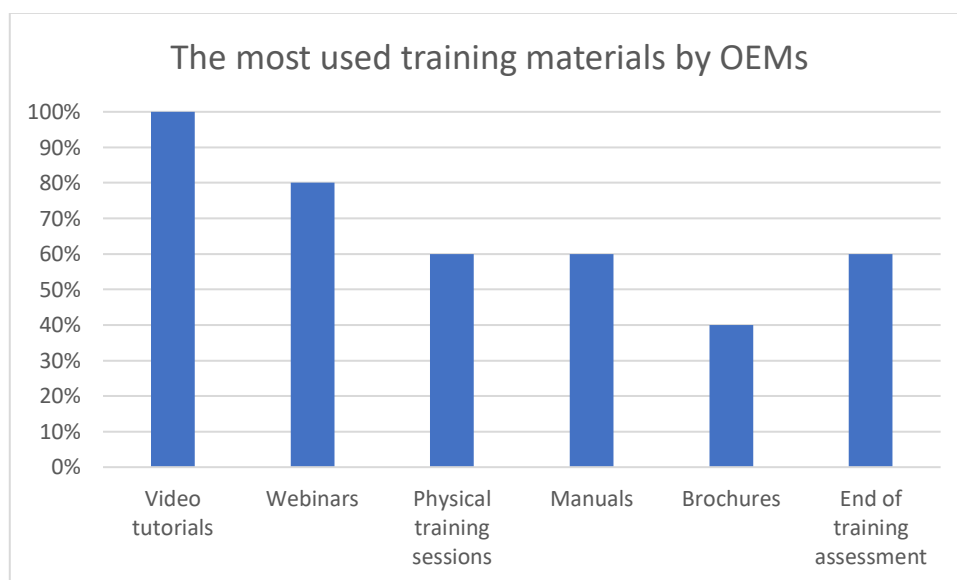


Figure 6: The most listed training materials used by OEMs

At the time of writing the OEMs involved in the PACE project had trained over 1400 installers across 6 countries since the beginning of the project.

Despite there being a significant range in the number of installers each manufacturer has, all engage in direct contact with their installers. The OEMs reported that this was an important factor in recruiting new installers and building a successfully working relationship with them. The recruitment of installers is carried out by an internal sales network within each of the

OEMs that engages with potential installers through marketing channels and sales representatives.

The current approach to installer training is therefore largely internally managed within the OEMs, with direct contact between potential installers and OEMs being an important basis of the approach.

The effects of COVID-19 have also greatly impacted the training carried out by OEMs for FC mCHP installers. Over the course of the COVID-19 pandemic, OEMs have had to adapt to online training methods and diversify their resources. These adaptations have been carried out largely internally within the organisations, and several OEMs reported it as having been beneficial in allowing them the opportunity to try online methods. A digital approach to training can be more accessible to installers and therefore broaden the installer base. Solely online training does, however, have limitations as physical training sessions are an important part of the installer training. A hybrid approach has been found to be successful by many OEMs interviewed.

OEMs reported that they have some limited engagement with training associations and technical schools, such as the German LPG Association. Little interest was shown in collaboration with other organisations in regards to installer training, with the reason being given that this was not currently needed. It was noted that an increase in collaboration with other manufacturers could be beneficial in order to increase co-operation between competitors, but not that this was a necessity.

4.22 Standardised Training and Certification as a Barrier for the Uptake of Fuel Cell Technology

The results of the interviews conducted have revealed that the majority of manufacturers within the PACE project do not prioritise the development of any form of standardised training or certification and do not feel that this is a primary area to focus on in the first instance to help increase the uptake of fuel cell technology across Europe.



Figure 7: OEM responses regarding their internal development of training materials

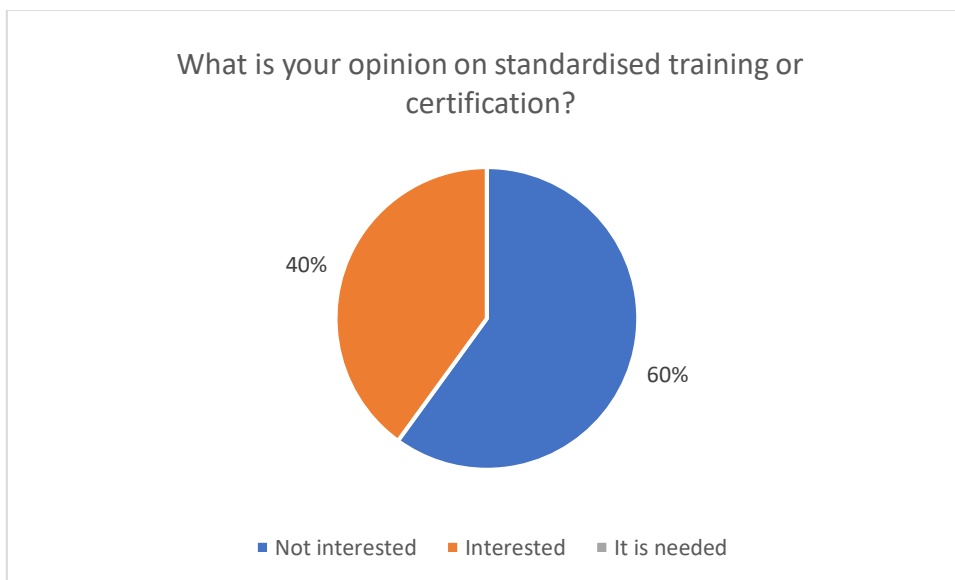


Figure 8: OEM responses regarding a new certification or standardised training for FC mCHP installer training

On the reasons listed when OEMs showed no interest on a formal certification were:

- The specific and ever changing nature of the sector prevents standardised certifications from being of use, as they can quickly become outdated.
- OEMs were content with the training and certification that they themselves provide and feel that the required content for training changes too often for standardised materials to remain relevant and useful.
- Installers would therefore still be required to undergo OEM specific training, rendering any standardised training programmes of little use. The fuel cell products currently available on the market vary too greatly between manufacturers for a standardised certification to be helpful. Any material developed would be too general to suffice as training alone.

The following possible positive impacts of establishing a formal certification were identified:

- New technologies such as fuel cells are often overlooked and a standardised certification may therefore help with uptake. It was noted however that a formal certification may result in an initial increase in sales, but this would not outweigh the increase in mistakes that would also likely arise due to the training being too broad.
- A certification could include clarifications on regulations in different Member States or federal state in Germany. Installers were reportedly confused due to the different regulations in Germany. As installers are unlikely to install FC mCHP outside of their country of work, this is primarily an issue for the German market.
- Certification may be useful to installers who are not directly affiliated with any manufacturers. However, as these are a minority, this is not expected to largely increase the pool of installers.
- A national or even EU-wide certification programme for general training could allow manufacturers to reduce and shorten their own training process. It was reported that they would still require installers to undergo OEM specific training for their specific product, but that this would be able to be greatly shortened if standardised training was introduced.

In conclusion, all OEM either stated a preference to conduct training directly or acknowledge that they have the capability to manage this themselves, and did not consider

this to be a significant obstacle to overcome as there are several larger issues to the uptake of FC mCHP today.

4.22 Barriers and Opportunities for the Development of Fuel Cell Technology

Several challenges and issues were identified by manufacturers during the interviews; many of which the trainers considered were holding back FC mCHP technology significantly more than a lack of formal certification.

One notable barrier is that installers are currently unable to specialise in fuel cell technology and often work on a variety of different systems which causes the complexity to increase. This prevents installers from being able to understand all systems to an adequate depth. A solution to this would be more digitalisation of training resources. It was identified by manufacturers that better access to digital training resources would allow installers to easily look for answers while conducting installations in the field and would be less likely to make mistakes due to misremembering information. In order for this to be possible, it firstly requires these materials to exist on a digital platform, and then needs installers to have access to these platforms while in the field. A move towards more digitalised training resources could therefore help greatly. Furthermore, allowing technicians to specialise would mean that installers could focus all attention onto fuel cell technology and not be forced to manage multiple systems at one time.

A lack of new installers was another major challenge discussed by manufacturers in the interviews. Many installers across Europe are nearing retirement age and are closing down their businesses. Combined with a lack of young people entering the industry as technicians and installers, this means the numbers of installers in Europe are falling. A possible solution to this is promoting becoming a technician as a viable career path in schools and colleges. Raising awareness of this as a future career for young adults will help to encourage new installation businesses and increase numbers of technicians. This can be done through online resources and careers fairs. This is a broader challenge for the heating sector and would require regulatory support at the European and National level.

For many of the trainers interviewed, one of the largest challenges responsible for holding back FC mCHP technology is a general lack of awareness among policy makers and the general public. Many reported that there is a perception across Europe that fuel cell technology is in its early stages and is not yet widely developed. This therefore has a knock-



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on effect of reducing governmental support for the technology and limiting sales. Despite the fact that fuel cell technology is now highly developed and ready for commercial deployment, this perception is limiting its success across the continent. More promotion and awareness of the technology is therefore needed to change this.

This misguided perception of the technology has also led to manufacturers reporting that funding is a challenge. The interviews revealed that trainers found governmental funding limited and, in cases where it was available, hard to access. For smaller OEMs who don't have dedicated departments or partners to help with this, accessing public or private funding can be very difficult. In order for the technology to become more widespread, smaller companies need to be able to engage in the industry as easily as larger ones. Therefore, the accessibility of funding is a large issue as it is preventing some smaller companies from succeeding in the industry.

5. Recommendations

The results of the phase 2 have led to the following recommendations being identified:

- A formal, standardised certification is not currently recommended due to the fast changing and specific nature of the sector. OEMs would continue to require installers to undertake their own certification programmes to ensure that installers were adequately trained for their products.
- The digitalisation of training material developed by OEMs on their own products is recommended, in order to support installers in the field.
- The digitalisation of standard introductory training materials is also recommended. This should ideally be a generalist training to be used as introductory material to create interest in the technology and in anticipation of OEMs specific training materials. This should preferably be developed jointly with universities or certification bodies for this to be recognised and distributed more widely to installers not currently engaging with FC mCHP OEMs and to the wider public.
- Some standardisation of training materials for FC mCHP installers may help companies and installers that don't currently engage in this sector to begin to. This will allow smaller companies to join the sector and contribute to the commercialisation of fuel cell technology.
- Engagement with professionals' associations and associations representing the heating sector should continue and training materials developed shared with them as has been the case for the material developed in PACE. A combination of both printed and digital formats would be suitable.
- The continued and enhanced promotion of fuel cell technology in technical schools and colleges is needed to bring forward a new generation of installers.

In conclusion, there is currently no immediate need for comprehensive standardised third party training so that installers could be trained once and be eligible to install units from

different manufacturers. Manufacturers within the PACE project are of the opinion, that no third party training would be thorough enough for installers to be able to begin work without further training from the manufacturer themselves. The significant variation in FC mCHP products between manufacturers and the fast changing nature of the products means that, presently, standardised training would not be able to provide comprehensive training for this work.

It was noted, however, that the standardisation of some introductory training materials would allow manufacturers to simplify and shorten their own training requirements. This would also enable smaller companies to join the sector and increase awareness for potential new installers. Therefore, although a comprehensive third party training is unlikely to replace manufacturers' training schemes, it may still be beneficial to a certain extent. To make this possible engagement with professionals' associations and associations representing the heating sector should continue in and outside of the PACE project to raise the profile of the technology in Europe. These associations may in the future develop their own training material and certification schemes but would initially require access to generalist training material. The PACE project can continue to facilitate this by engaging with these associations through news updates and events such as webinars as well as by making training material available publicly.

6. Conclusions

A lack of standardised training materials and formal certification do not appear to be a significant issue holding back fuel cell technology from more widespread uptake across Europe. Manufacturers in the PACE project have largely developed their own training materials and certification programmes and have currently no need for a more standardised set of materials. Manufacturers reported several other barriers as being more significant in regards to the status of fuel cell technology in Europe.

Therefore, it is noted that more important steps could be taken to boost the success of FC technology in the near future, including: raising awareness with policy makers about the technology, creating new and easier access routes to funding, the digitalisation of resources and encouraging young adults to become technicians. It is important that fuel cell



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technology continues to be actively promoted going forward, to ensure that both policy makers and the general public are aware of it as a strong and viable technology option.

Although not a complete solution in itself, an increase in accessible training materials and continuing to explore the possibility of formal certification, alongside these other changes, may also be helpful. This would also support the development of training materials and training and certification schemes by professionals' associations and associations representing the heating sector.

7. Appendix

A copy of the interview questions used can be found below. All interviewed manufacturers gave informed consent for their responses to be used for the purpose of this report.

Interview Questions (English):

- **Section 1:** Brief overview of installer training process (incl. methods used)
 1. What is your existing training offering for FC mCHP installers?
 2. What training materials do you use?
 3. How were those training materials developed?
 4. Do you use any external training materials, or were they all developed internally?
 5. Are you happy to share any materials you do use with us?
- **Section 2:** Understanding installer base
 1. How many installers do you have?
 2. Do you have direct contact with them, or are they accessed through other groups (eg. training associations, installer companies).
 3. How do you conduct installer recruitment?
- **Section 3:** Wider outreach
 1. Do you ever engage with training associations? If so which ones, and how useful are they?
 2. Do you ever engage with technical schools? If so which ones, and how useful are they?
 3. Which other types of organisation would you like to collaborate with to facilitate FC mCHP installer training?
- **Section 4:** Certification
 1. Do you think a certification for FC mCHP installation would be beneficial?
 2. If so, who do you think this certification would have to come from?
 3. If there was a certification, would you still require installers to undertake your own training?
- **Section 5:** Broad opinions
 1. What changes do you think are needed to improve the training of FC mCHP installers?
 2. Are you happy with how things operate at the moment? Do you see installation and trainer certification as a barrier to uptake of the technology?

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