Learning points from demonstration of 1000 fuel cell based micro-CHP units - Summary of analyses from the ene.field project - DTU Orbit (28/09/2019)

Learning points from demonstration of 1000 fuel cell based micro-CHP units - Summary of analyses from the ene.field project

The ene.field project (European-wide field trials for residential fuel cell micro-CHP) has been Europe's (to date) largest demonstration project for FC micro-CHP (fuel cell based micro combined heat and power) systems. The project has demonstrated more than 1000 small stationary fuel cell systems for residential and commercial applications in 10 countries.

This report highlights learning points from the European demonstration project ene.field. It gives a brief introduction to the FC micro-CHP technology as well as the current status of the technology capability and potential, including barriers yet to overcome to reach a mass market.

Fuel cells can efficiently produce electricity and heat from natural gas. Large-scale roll-out of FC micro-CHP units can help the EU fulfill energy policy aims and climate commitments. An environmental life cycle assessment (LCA) of FC micro-CHP unit has been carried out as part of the project. This LCA concluded that in general the greenhouse gas (GHG) emissions of a FC micro-CHP are lower than those of a gas condensing boiler or a heat pump in all the investigated scenarios. Furthermore, the FC micro-CHP generally leads to lower air pollutant emissions compared with the alternative systems. From a technical point of view, the FC micro-CHP is ready for a large market penetration. In the best 6-month period of the field trial, the availability of the units to the end-user has been above 99%. Of the total failures observed, only 1-2% were due to the fuel cell stack itself.

End-users participating in the ene.field project were very positive to the FC micro-CHP technology. In general, they were very satisfied with all aspects of their micro-CHP systems, especially the environmental profile of the technology. Based on the end-users’ perception, the following two areas with some room for improvement have been identified: running costs and ease of use of the technology.

At today’s capital and maintenance costs, FC micro-CHPs are significantly more expensive than traditional heating technologies. However, as serial production begins, economies of scale will cause the costs to drop substantially. The conducted life cycle cost analysis (LCC) showed that the FC micro-CHP can become economically competitive with volume manufacture. Increased sales encouraged by for example subsidies could therefore improve the near-term economics of micro-CHP units, and may be crucial for the technology to reach the mass market and hence for the EU to harvest the environmental and system benefits.

A number of aspects of the field trial turned out to be more challenging than originally anticipated. These aspects were routes to market, site selection, good business case for all involved partners, supply of components for the manufacturing, installation process and administrative procedures. These caused a delay in the deployment of units compared to the original plan. However, by the end of the project a total number of 1046 units have been installed which exceeds the target of 1000 units. The expected main route to market via utilities proved to be very difficult as less funding was available for demonstration projects than previously (e.g. for the German demonstration project Callux). The most successful approach for selling micro-CHP systems has been via installers through the heating market channels. A key element for a generally successful field trial is to establish good communication channels with end-users and installers beyond the basic technical discussion. The training of installers to ensure a smooth and faultless installation process is also key to successful deployment. During the project approximately 600 installers have been trained.

Germany has been the most successful market for ene.field in terms of deployment numbers. More than 750 of the 1000 units have been installed in Germany. Funding from the national support schemes helps decrease the investment costs, and therefore favours the ramping up of the installation numbers. Moreover, high electricity prices make the technology more attractive in Germany than in other European countries.

The installers of FC micro-CHP units find the systems easy to install. However, the time required for completing the installation is longer than desirable. The installation times are likely to decrease significantly as installers become more experienced with the technology. In addition, further standardisation of components and training of installers are also expected to reduce the installation time.

Lack of a common framework for European standards is seen as a large hindrance to further market uptake. Countries use international and European standards, but supplement these with national versions. This mix of standards leads to problems for manufacturers who want to commercialise products throughout Europe. Furthermore, the forms for approval of installation lack standardisation and are partly complex and lengthy. A systematic and simple approach is required for the registration of new technologies.

The FC micro-CHP technology is well suited for integration into smart grids. A smart grid is a power grid where information and communication technology is used to manage generation, consumption and distribution of electricity, typically to compensate fluctuations in power generation from renewable energy sources (grid-balancing and peak-shaving). The micro-CHP units can be remotely controlled and can adjust to external heat and power demands at seconds’ notice when at operating temperature. In order for micro-CHP units to contribute to grid stability, an estimated minimum of 1000 units need to be aggregated into a virtual power plant (1 MW).

The German support programme KFW433 will facilitate the commercialisation of the FC micro-CHP technology in the coming years. As a follow-up on the ene.field project, field demonstration of FC micro-CHP systems in Europe continues with the EU funded project PACE.