



## VIRTUAL FC POWER PLANT

### Objectives

Developing Fuel Cell Heating Appliances as decentralized CHP systems in multi-family houses and small industrial companies requires intensive and thoroughly executed testing in the field. As the major European manufacturer of heating appliances, Vaillant GmbH in co-operation with 9 other European project partners from academia and industry started a project for installation and testing of a Virtual Fuel Cell Power Plant in November 2001.

The objective of the project is to install and demonstrate a Virtual Fuel Cell Power Plant as an application of the innovative Fuel Cell technology, i.e. to transform laboratory technology into everyday technology. The parties expect important findings for the technical realization of the Virtual Power Plant, the definition and testing of the different load profiles and the behaviour under continuous duty of the Fuel Cell system.

# Europe's first Virtual Fuel Cell Power Plant

### Challenges

The international agreements for climatic protection, such as the Kyoto protocol, constitute major stages on the way to reduce emissions contributing to the greenhouse effect, such as CO<sub>2</sub>, for example. However, implementing these targeted reductions also requires product development in particular on CO<sub>2</sub>-efficient technologies. In this connection, the coupling of heat and power is becoming more and more important in the future energy mix even on the European level. If we combine Fuel Cell technology, in particular in micro-CHPs to a system of networked installations, we will be able to profit from all the advantages of decentralized energy generation with Virtual Power Plants without affecting the energy management desired by the power generators. The Virtual Power Plant is an "Internet of Energy".

The Virtual Fuel Cell Power Plant is a group of interconnected decentralized residential micro-CHPs, using Fuel Cell technology, installed in multi-family houses, small enterprises, public facilities etc., for individual heating, cooling and electricity production. Centrally controlled and grid-connected, these elements contribute to meet peaking energy demand in the public electricity grid and act as Virtual Power Plants.

The objective of the project is to install and demonstrate a Virtual Fuel Cell Power Plant as an application of innovative Fuel Cell technology, i.e. to transform laboratory technology into everyday technology.

Simultaneously this application is a fast door-opener for a broad market entrance of Fuel Cells with their environmental and economic benefits. Severe testing in different environments including requirements involving techniques, users, standards and utilities is necessary. The 40-

months project is co-funded by the European Commission under the 5th R&D Framework Programme.

### Project structure

Project partners are Vaillant GmbH, Europe's leading manufacturer of heating and hot water appliances. Vaillant is the Project co-ordinator and is in particular responsible for the production of the Fuel Cell Heating Appliances; Plug Power Holland, a partner of Vaillant GmbH in developing a Fuel Cell Heating Appliance; COGEN Europe, which is engaged in all aspects of co-generation, in particular data acquisition, thorough market analysis and dissemination; Instituto Superior Tecnico (IST), c/o University of Lisbon is the biggest and best known Engineering College in Portugal; TEE, Technology of Energy Supply and Energy Systems, a department of the University of Essen, and responsible for the development of the Central Control System and measurement evaluation; DLR, Germany's Aerospace Research Centre. DLR participates in the European Solar Test Centre Plataforma Solar de Almeria, and co-ordinates the installations in the Southern European applications; Sistemas De Calor, a regional supplier and installer of energy-related equipment for co-generation, heating and cooling purposes, water supply, and a producer of solar collectors; N. V. Nederlandse Gasunie, one of the leading Dutch gas suppliers. Gasunie's principal activities are producing, transporting and selling natural gas. Gasunie is responsible for the field test equipment in The Netherlands; Ruhrgas AG, the leading German gas supplier, and its local partner EAM EnergiePlus Kassel and EWR Remscheid and E.ON Energie AG and its local Partner EWE (a well established subsidiary of E.ON Energie AG).



Field Test System  
in Baunatal near  
Kassel.

## Expected impact

Developing and demonstrating the so-called Virtual Power Plants with decentralized Fuel Cell Heating Appliances is a major step on the way to the European energy market of the future. This system will play a major role in decentralizing energy management able to succeed in the future and it offers at the same time numerous synergy effects: high availability rate thanks to systems which are operated independently, the opening of new business fields, minimization of line drops even to the integration of regenerative energies. Progress expected will probably be the minimization of traditional contaminants and pollutants and in particular the reduction of greenhouse gases. Thus, Virtual Fuel Cell Power Plants significantly contribute to achieve the European target reductions set within the scope of the Kyoto protocol to combat the greenhouse effect.

## Progress to date

In the first project phase at the end of 2002 and the beginning of 2003, the first 6 Fuel Cell Heating Appliances have been installed mainly in multi-family houses in Germany and The Netherlands. Overall it is planned to install several dozen appliances. In the first months of this European field test, these field test appliances developed by Vaillant GmbH and Plug-Power have proven to work really reliably and since the installation in December 2002, they have fed about 43 MWh (status: April 2003) of electric power into the public grid, generated in about 13.000 running hours.

The first field test systems are operated in multi-family houses in the Oldenburg region (partner E.ON and EWE), Kassel (partner Ruhrgas and EAM EnergiePlus) and Remscheid (partner

Ruhrgas and EWR) as well as by Gasunie Research in the Dutch city of Groningen. In the course of the year, further systems shall be installed in Germany, The Netherlands, Spain and Portugal. The Fuel Cells are operated via a defined load profile and are heat- as well as power-controlled. Based on weather data, decentralized energy management systems will forecast the amount of energy of regenerative energy plants for the following day and will derive and set load profiles for the Virtual Power Plant. The next step will be to test the systems' behaviour with different defined load profiles. Furthermore the parties expect to get important information on the systems' behaviour under continuous duty with increasing field test duration.



Design of the  
Vaillant Fuel  
Cell Heating  
Appliance.

## INFORMATION

References: NNE5-2000-208

Programme:

**FP5** - Energy, Environment and Sustainable Development

Title:

System development, build, field installation and European demonstration of a Virtual Fuel Cell Power Plant consisting of residential micro-CHPs (VIRTUAL FC POWER PLANT)

Duration: 40 months

Partners:

- Vaillant (D)
- Plug Power Holland (NL)
- CoGEN Europe (B)
- Instituto Superior Tecnico (P)
- Technology of Energy Supply and Energy Systems (D)
- Deutsches Zentrum für Luft- und Raumfahrt (D)
- Sistemas de Calor (E)
- Gasunie (NL)
- Ruhrgas (D)
- EON Energie (D)

Contact point:

Alexander Dauensteiner

Tel: +49-2191-18-2506

Fax: +49 2191-18-72506

alexander.dauensteiner@vaillant.de

EC Scientific Officer:

Jean-Marie Bemtgen

Tel: +32-2-2962071

Fax: +32-2-2966016

jean-marie.bemtgen@cec.eu.int

Status: Ongoing