Demonstration of Fuel Cell Based µCHP Systems

SOFC Technology for Combined Heat & Power

Small-scale co-generation systems provide reductions in carbon emissions and costs by generating both heat and electricity locally with efficient fuel use and by offsetting the use of centrally-generated electricity from the grid.

The major benefits of distributed generation systems are heat usage, savings in losses in transmission of electricity, lower installation costs and ability to add a small unit instead of a larger one during peak load-conditions. High efficiencies the µCHP SOFC will lead to direct reduction of fuel consumption.

SOFC technology has the potential of very high electrical efficiencies and lowest costs compared to alternative fuel cell types.

System Characteristics

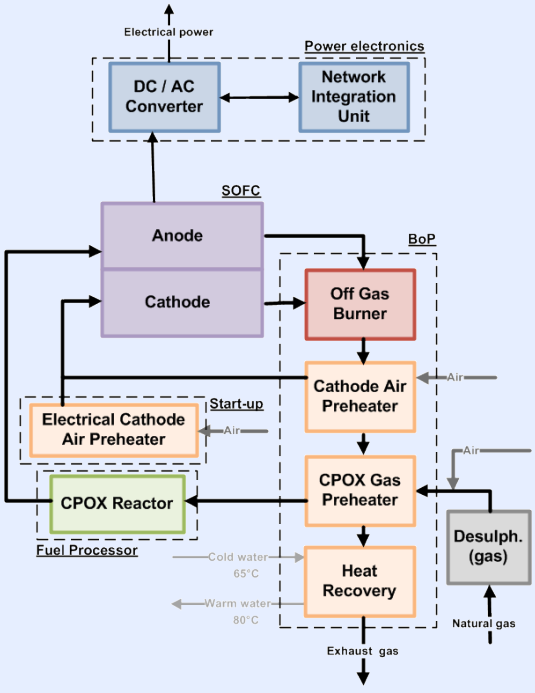
The system will be operated on natural gas that is processed via catalytic partial oxidation (CPOX) to a hydrogen-rich reformate. Advantage of a CPOX based system is the simple layout with lowest initial and operational costs.

The SOFC based µCHP units are designed to deliver up to 2 kW electric power and 6-8 kW thermal power, with an electrical efficiency of up to 35 % and an overall efficiency of 90%, allowing trigenerative use (power/heating/cooling) at building level, inter-connection with a district heat distribution system and an electrical micro-grid.

The system is developed in the framework of the FP7 project FC-DISTRICT. Main partners are the Energy research Centre of the Netherlands, TU Bergakademie Freiberg in Germany, Fagor Electrodomesticos and IKERLAN from Spain as well as the SOFC system integrator EBZ from Germany.

Specification of SOFC based co-generation system	
General	Gas appliance for single-family homes and district heating environments for providing demand-flexible electricity and heat
Fuel input	Natural gas (H-gas and L-gas), biogas
Nom. max capacity	1.5 kW_{el} / 2.75 kW_{th} at 30% net electrical efficiency
Modulation	1:2
Emissions	NOx < 60 mg/kWh, CO < 50 mg/kWh at 0% O_2 (Blue Angel)
Dimensions	L x W x H: 1000 x 800 x 1800 mm³

CPOX based SOFC µCHP unit



System layout

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New µCHP Network Technologies for Efficient and Sustainable Districts

Summary & Objectives

FC-DISTRICT targets at an innovative energy production and distribution concept for sustainable and energy efficient districts, exploiting decentralized co-generation. The concept is based on dynamic heat exchange between the buildings equipped with Solid Oxide Fuel Cell based µCHP units for energy production collaborating with improved thermal storage and insulation building systems, the distribution system for electricity as well as heat and the consumer, aiming to achieve energy balance at district level.

The project team is investigating innovative co-generation concepts, where fuel flexibility is one main objective. Small-scale biogas production and utilization in a fuel cell is used to reach a CO_2 neutral power and heat production at district level.

µCHP based on High Temperature Fuel Cells

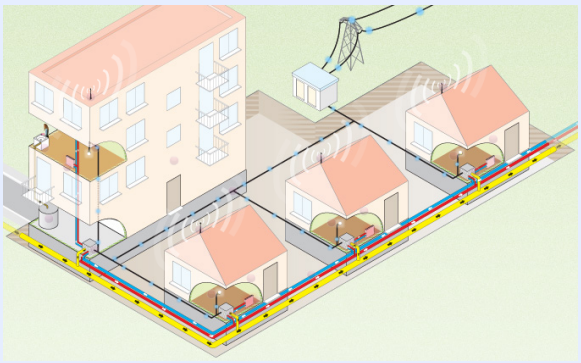
Distributed generation systems offer a considerable carbon saving capability, where the SOFC technology is most promising due to its high electrical efficiency. A coupling of smaller-scale units in a local network coupled with central heat storage capabilities is expected to be the most economic energy distribution system.

District Wide Distribution Networks

Electrical integration at district level can be met using the Virtual Power Plant (VPP), a collection of smaller electricity generating units able to replace a conventional power plant in terms of power output. The concept of thermal integration at district level with a dynamic load exchange between neighboring buildings and/or with a central hub is an extension of the VPP concept. This totally innovative approach will be investigated in the framework of FC-DISTRICT.

Biogas Production from Food Waste

Food waste, which is the most efficient fraction of municipal solid waste for the production of biogas, is collected in a Food Waste Disposer coupled with settler tanks. This saves time for the citizens and provides a source of biogas production, creating the base for a win-win business model.



FC-DISTRICT integration concept

Project partners	
Large industrial	Mostostal (PL) – project coordinator, Acciona (ES), Knauf (DE/GR), Fagor (ES), Powerpipe (SE), D'Appolonia (IT)
Technological specialized SMEs	EBZ (DE), Rinicom (UK), Solintel (ES), Ecofast (IT)
Research organisations	NTUA (GR) – scientific coordinator, IEN (PL), ECN (NL), TU-BAF (DE), IKERLAN (ES), OvM (RO), SP (SE), Vito (BE), Chalmers (SE), IST (PT)
Financial sector	IntesaSanpaolo

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Realization of FC-DISTRICT is co-financed based on grant agreement no. 260105, signed between the project consortium and European Commission.

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