Asterix3
a FCH JU Project

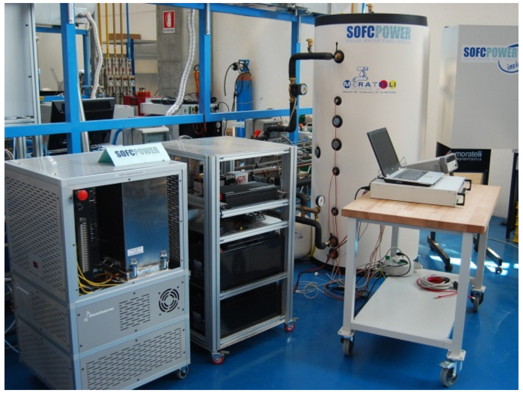
ASTERIX III
256764

ASsessment of SOFC CHP systems build on the Technology of htceRamIX 3

January 2011 to December 2012

Per Balslev
Dantherm Power A/S
peb@dantherm.com

ASTERIX III



Asterix3

a FCH JU Project

Project: **Micro Combined Heat and Power based on SOFC technology**

R&D to achieve proof - of - concept of µCHP fuel cell systems

Budget: **Total: 3096 k€** **Funding: 1361 k€** **2011 – ~~2012~~ 2013**

Partners:

Dantherm Power, DK: Fuel cell system integrator

HTCeramix, CH and I: SOFC cell, stack and HoTbox™ producer

EIFER, D: Energy research and relation to large energy company

CNR-ITAE, I: National research center on energy

Target specification for the µCHP unit

Simulate, specify, optimize, design, build and test a fuel cell µCHP units with target specifications:

- Power density of 0.375 W/cm^2 at nominal power
- Degradation and lifetime: 1%/1000h in system conditions
- Electrical efficiency (Peak) 50% net AC efficiency
- Electrical efficiency (Nominal avg.) 45% net AC efficiency
- Total efficiency of the system reached values up to 90%
- Modulation range demonstrated of 4:1 in terms of gas input
- 5000 hours of operation
- 10 thermal cycles
- Ability to start-up and shut-down without forming gas

ASTERIX III
Project Objectives

Proof of feasibility of integrated SOFC µCHP unit

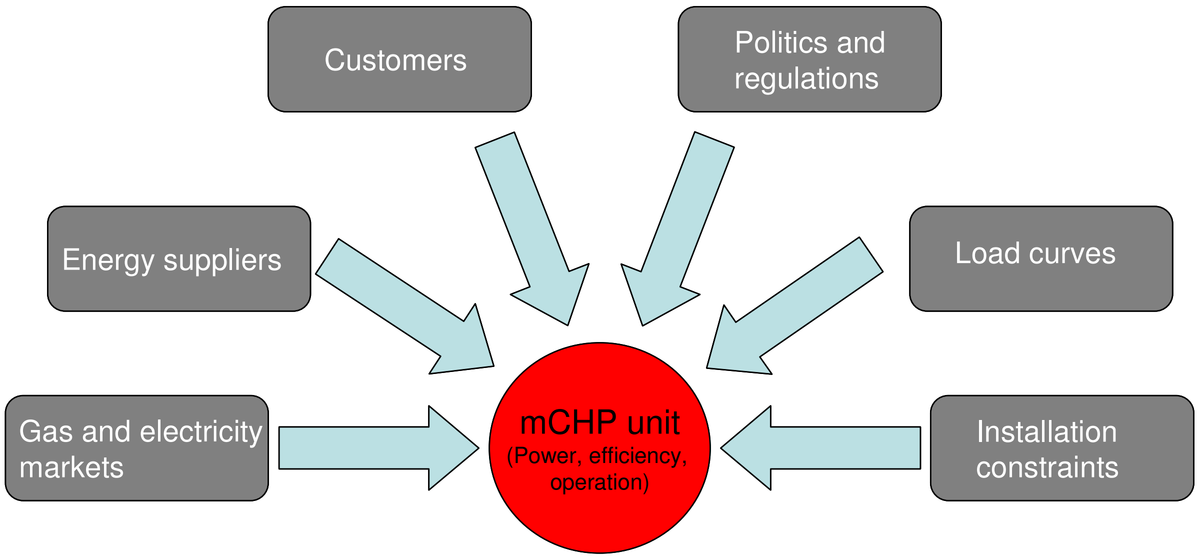
- WP1 Coordination and management — Dantherm Power
- WP2 Simulate and specify SOFC µCHP — EIFER, eDF
- WP3 Build and optimize SOFC HoTbox™ — HTceramix
- WP4 Design and develop SOFC µCHP — Dantherm Power
- WP5 Test and validate SOFC µCHP unit — EIFER, eDF
- WP6 Dissemination

ASTERIX III

Simulate and specify SOFC µCHP

1. Initial proof of concept
2. Final system simulations
3. Final system specifications

µCHP: a complicated environment, a multi parameter function, a lot of stakeholders



Too many constraints ⇒A small potential for market development

Main conclusions from available studies

Economic aspects:

- high el power required for economic sustainability
- high el efficiency required to reduce starts/stops
- optimum value for thermal production to be found

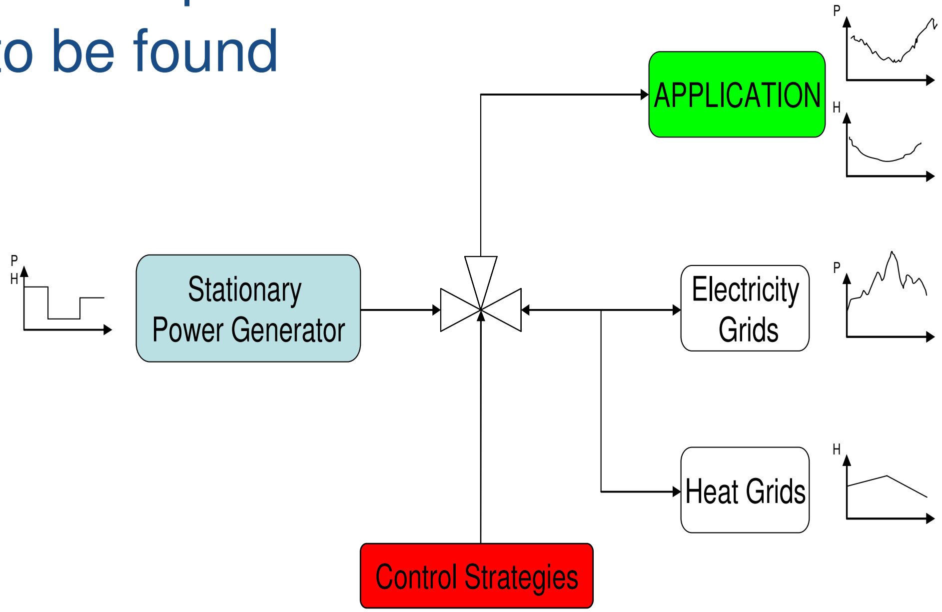
Environmental aspect (CO^2 /PE savings):

- main issue: grid mix (gCO^2/kWh)
- high total efficiency required
- optimum value for heat production

Importance of the hydraulic integration:

- heat management
- system control

Ideal system? Depends on need (P and H) and location

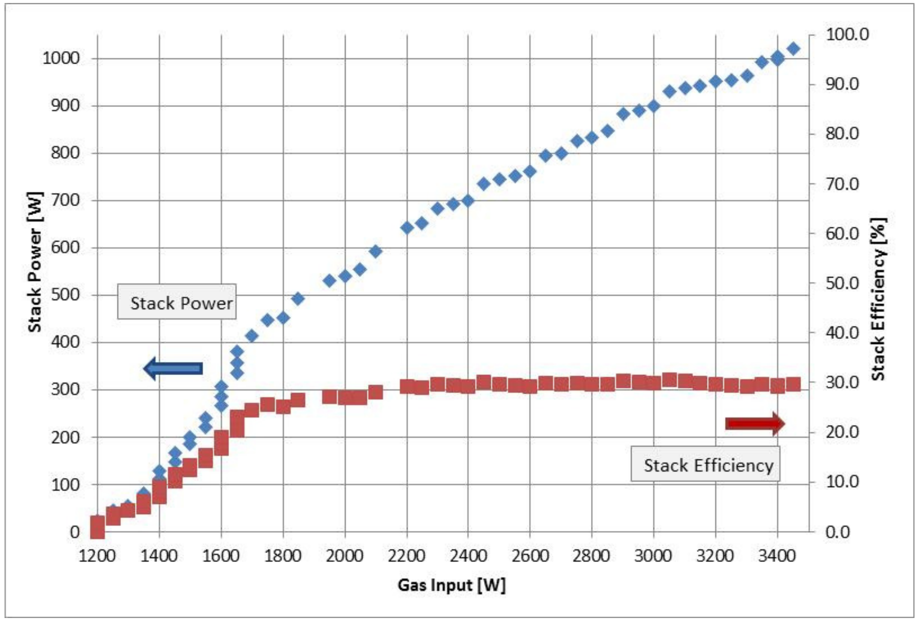


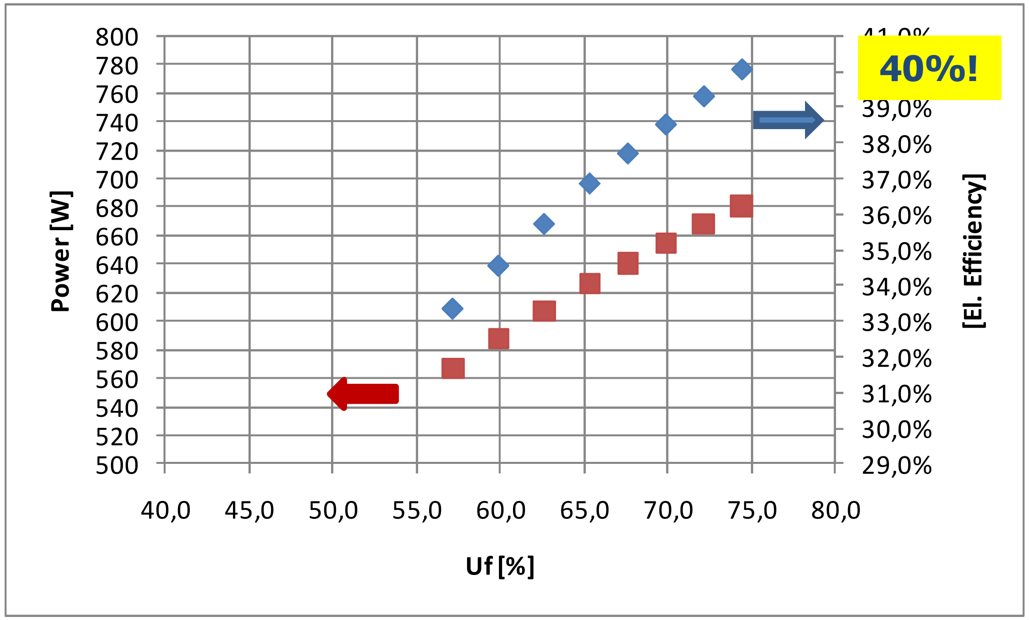
ASTERIX III

Build and optimize SOFC HoTbox

Optimizing SOFC HoTbox™

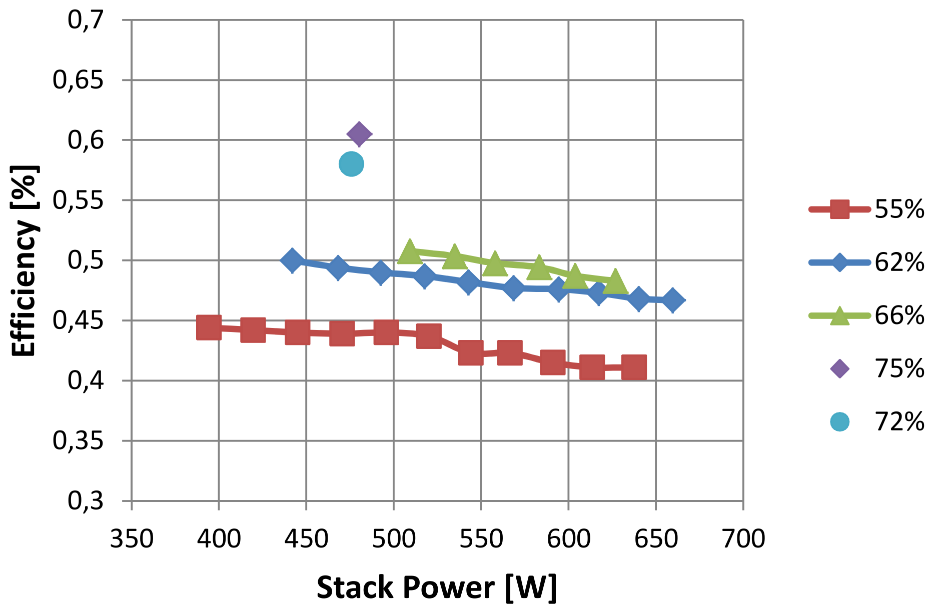
- **Catalytic partial oxidation (CPOx)**
- Steam reforming (SR)
- System size 1 to 2 kW

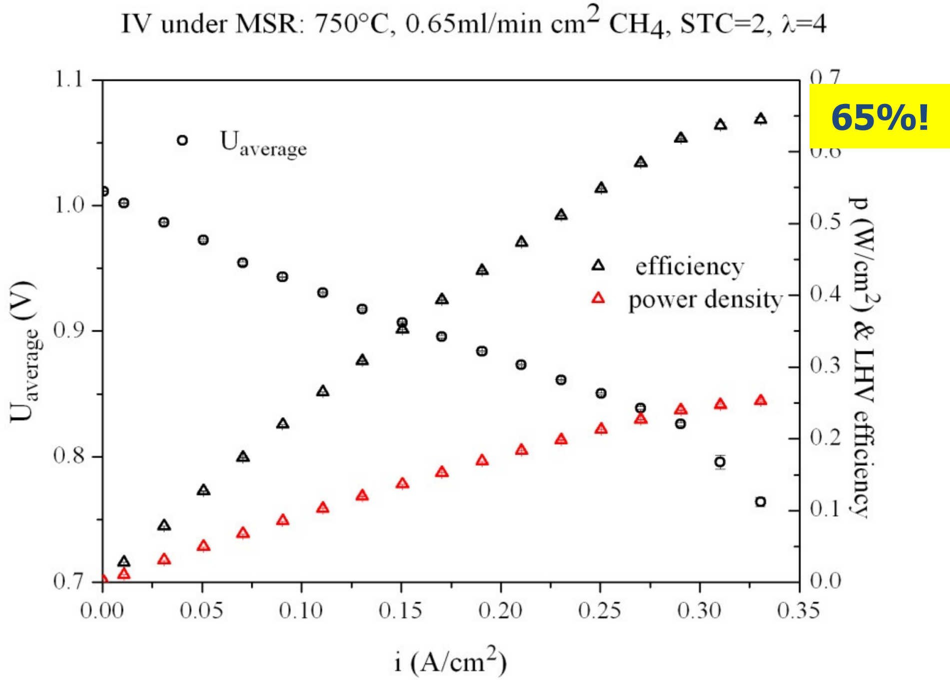




Optimizing SOFC HoTbox™

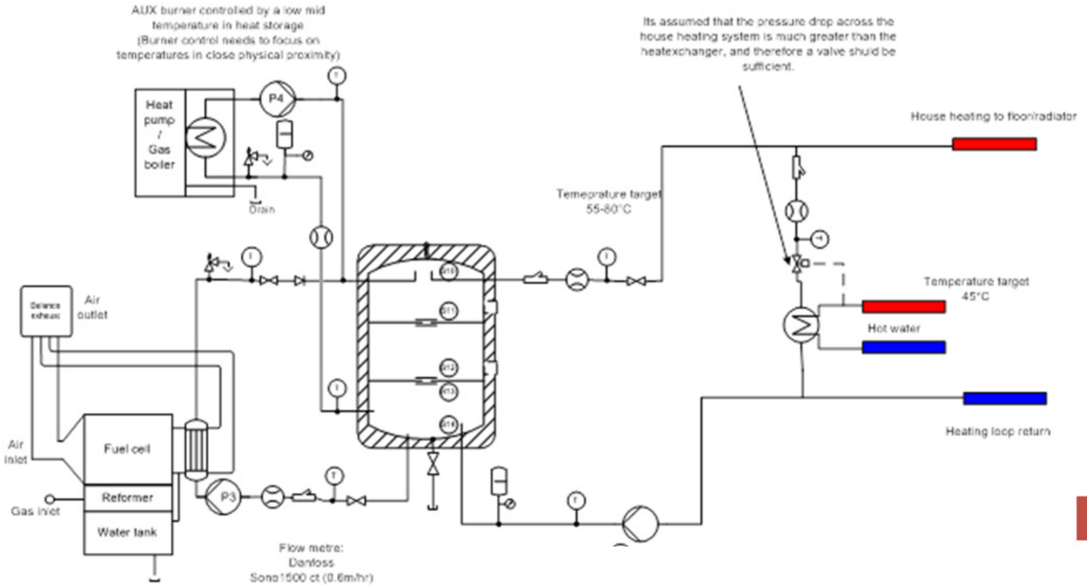
- Catalytic partial oxidation (CPOx)
- **Steam reforming (SR)**
- System size 1 to 2 kW



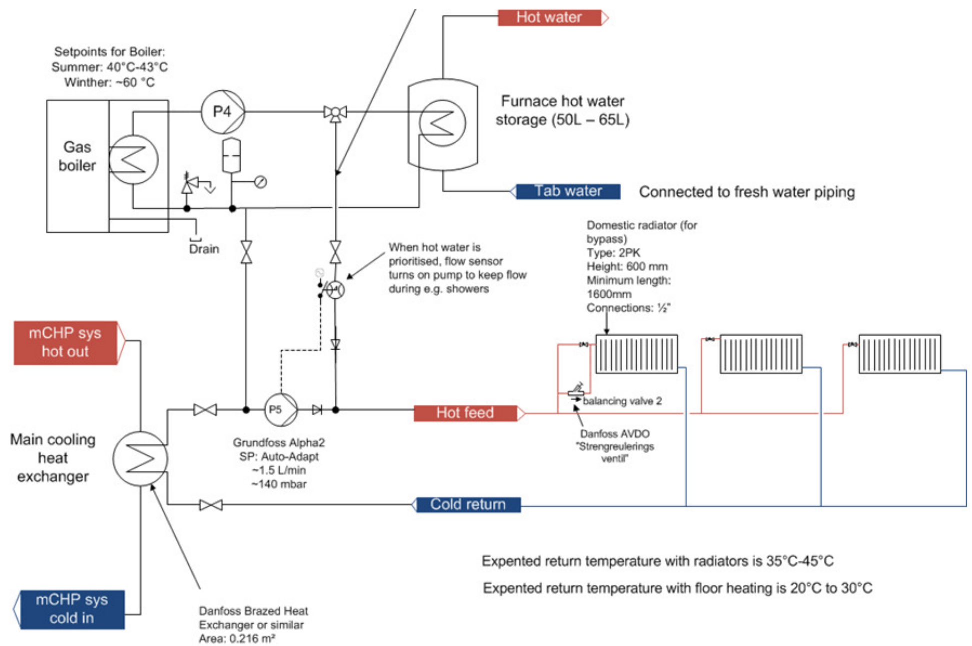


Strategies for thermal management

Operating with heat storage

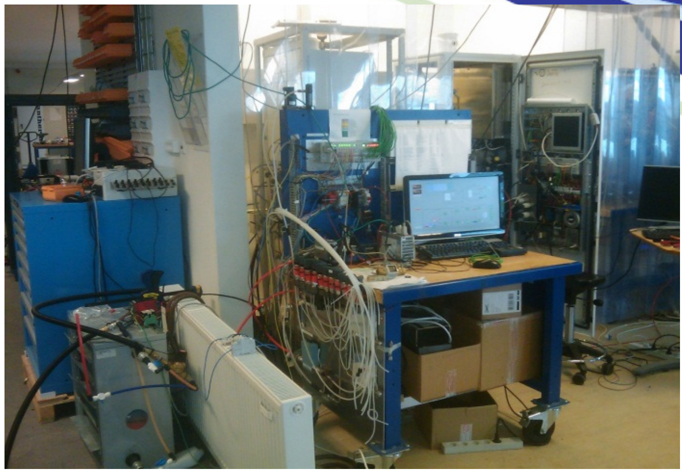


Operating without heat storage

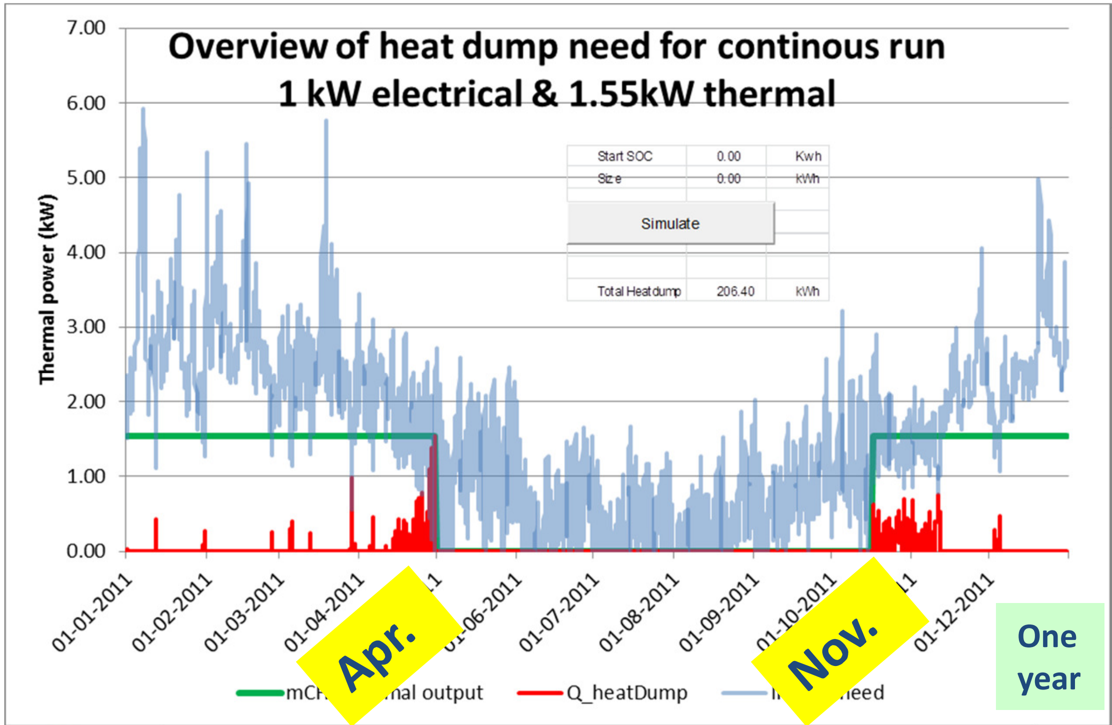


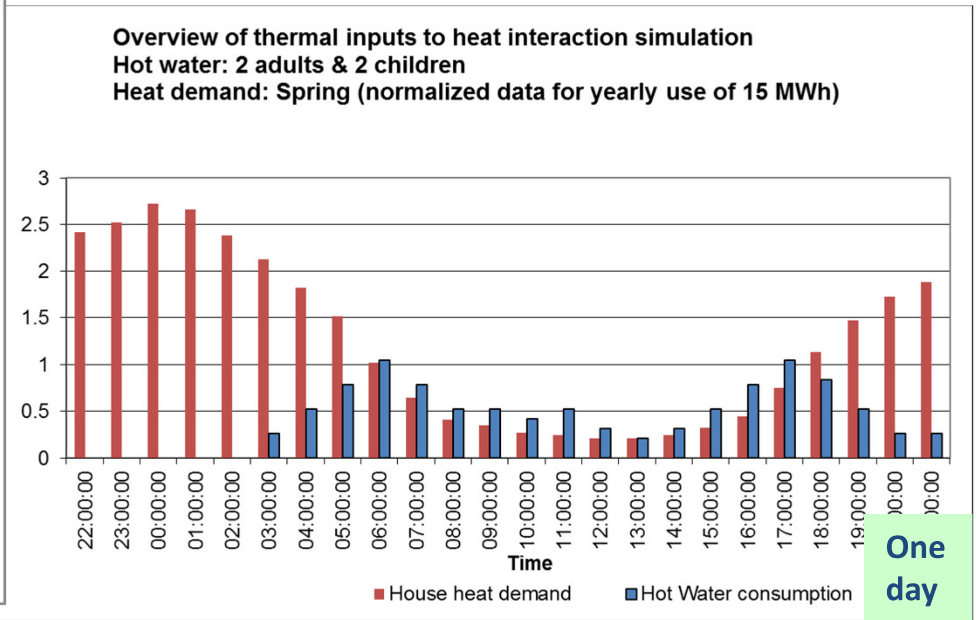
Dantherm Power

Verification by test



Simulation of consequence of operating without heat storage





ASTERIX III

Test and validate SOFC µCHP unit

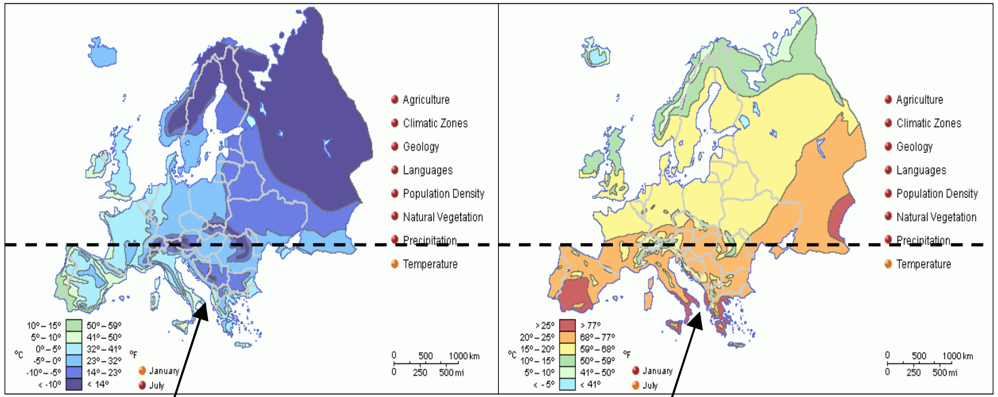
- A tests procedure will be written
- Tests carried out in EIFER facilities and at CNR-ITAE

Test program will be defined according to testing procedures drafted in the upcoming international standard IEC 62282-3-2, test methods for stationary fuel cell systems.

Hybrid heating solution using a heat pump to be investigated

Lab test of SOFC µCHP and Geothermal HP Preliminary test shows better efficiency in the heat generation process can be achieved compared to traditional auxiliary burner.

Different climatic zones with different needs
Reversible Heat Pump is a solution



To Increase Heat Pump COP

Cooling is required

THE WEB SITE

Domain: asterix3.eu

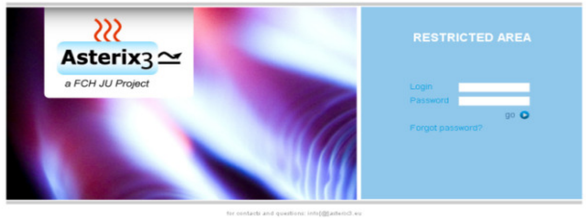
asterix3.eu
(Public dissemination area)

TO PROVIDE GENERAL PUBLIC WITH AN OVERVIEW OF THE PROJECT

3 sections

- Work in progress: *Details about the project*
- Beneficiaries: *Parteners' presentation*
- Members: *Links to contact partners*

blog.asterix3.eu
(reserved area)



MEMBERS AND AUTHORISED COLLABORATORS CAN SAFELY SHARE INFORMATION

3 sections

- Leave your message: *Bulletin board for partners*
- Archive upload: *File sharing space*
- Members: *Administrative area to manage partners' accounts*

ASTERIX III
Correlation with MAIP/AIP

AIP 2009: Stationary Power Generation & CHP

Primarily: Proof-of- concept fuel cell systems

Development of proof-of- concept prototype fuel cell systems for any stationary application, potential feature and technology. The aim is to demonstrate feasibility of proposed systems. The aim is to show interaction between the PoC FC systems with other devices required for delivering power, heat and cooling to end users.

- µCHP based on SOFC technology proof-of-concept by simulation, specification, building, optimization, design, develop and test
- µCHP interaction with heat storage
- µCHP interaction with a standard installation
- µCHP interaction with a heat pump solution

Correlation with MAIP/AIP

AIP 2009: Stationary Power Generation & CHP

Secondary: Validation of integrated fuel cell systems readiness

Development to show system readiness of integrated fuel cell systems in simulated application environments for typical lead applications. Economic manufacturing solutions need also to be addressed, ensuring that quality and cost targets are met.

- Understanding system level failure modes leading to more robust systems
- Maintenance and repair strategies for robust and reliable systems
- Automatic control, control strategy. heat, electricity ratio, grid connected
- Safety issues, legislation, CE marking, market requirements, legislative issues, feed in tariffs etc.

ASTERIX III

Cooperation and perspective

ASTERIX I
ASTERIX II
ASTERIX III
ASTERIX IV

- **The cooperation in the ASTERIX III project is a continuation of 5 years R&D relationship between partners**
- **The consortium includes more elements in the value chain:**
  - **R&D and test lab. - *CNR-ITAE and EIFER***
  - **Fuel Cell Stack and HoTbox company – *HTCeramix***
  - **System integrator - *Dantherm Power***
  - **Energy company - *EDF through EIFER***
- **The partners plan a larger demonstration as a continuation of ASTERIX III**
- **The partners are involved in a number of other national and European project related to SOFC technology and µCHP**

ASTERIX III

Asterix3
a FCH JU Project

Thank you for your attention!

www.asterix3.eu
www.dantherm-power.com
peb@dantherm.com