Programme Review Day
Brussels, 11/12 Nov 2013

Evaluating the Performance of Fuel Cells in European Energy Supply Grids

FC-EuroGrid

Contract number FCH JU 256810

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Project data

- duration 01.10.2010 – 31.12.2012
- total budget 805.931 €, funding 588.982 € (73%)

The consortium consisted of 9 partners:

University of Birmingham (UK) (coordinator)

Forschungszentrum Jülich (DE)

European Institute for Energy Research EIfER (FR/DE)

E.ON Ruhrgas/E.ON NBT (DE)

Teknologian tutkimuskeskus VTT (FI)

Institute of Power Engineering IEn (PL)

Grontmij AB (SE)

ENEA (IT)

EBZ GmbH (DE)

Problem addressed

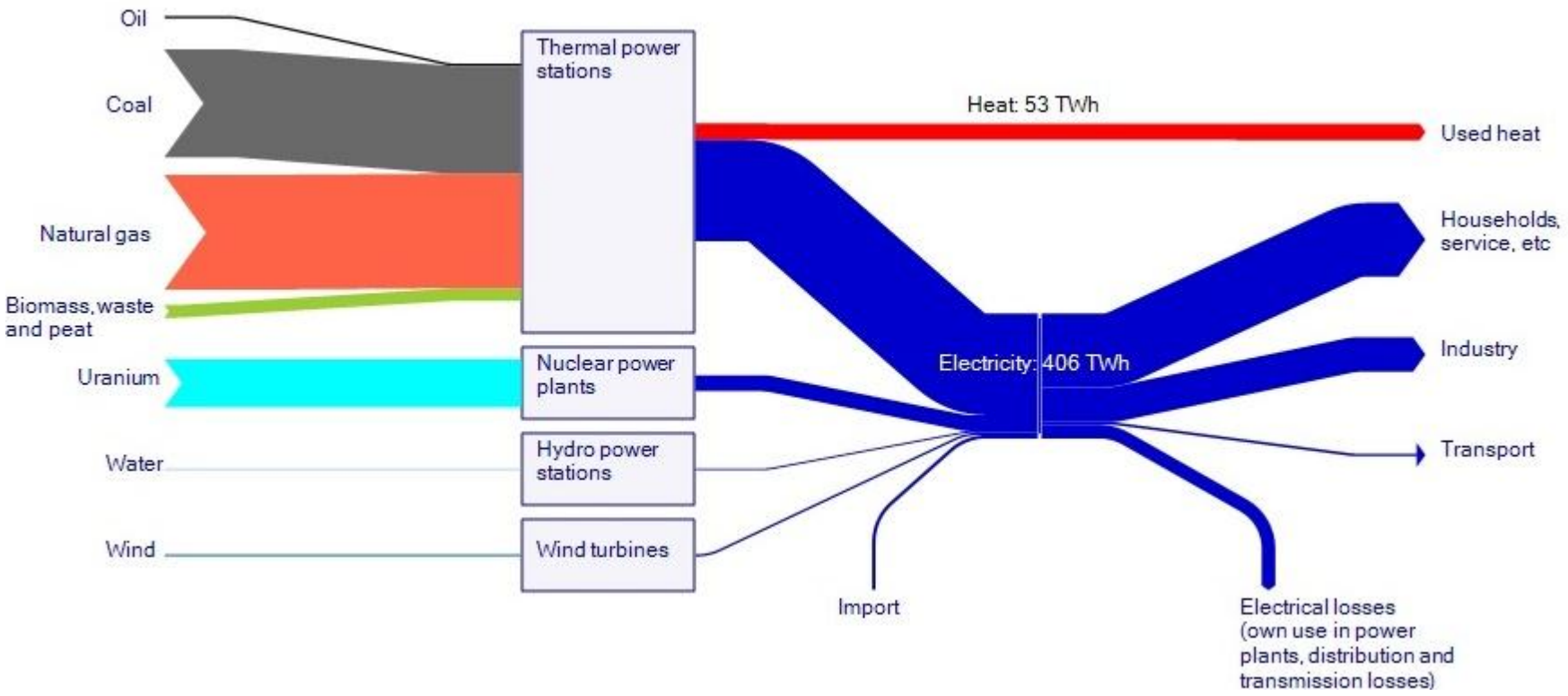
- MAIP builds on contributing to the 20-20-20 goals of the EU
- nevertheless, MAIP (and AIP) give no indications in AA 3 as to the minimum performance stationary fuel cells have to deliver in order to support the EU goals of increasing energy efficiency and reducing GHG emissions
- minimum KPI achievement should be required to achieve funding
- stationary fuel cell performance has to match and surpass CHP requirements

Project Goals

- establish a methodology of assessment of stationary fuel cell environmental benefits in various electricity grid surroundings
- identify useful indicators, such as
  - amount of CO_2 avoided
  - amount of fossil energy avoided or substituted
  - total and electrical efficiency
- map the environmental benefits according to the electricity grid the installation is situated in
- identify gaps in the current development status and assess status in comparison with competing technologies

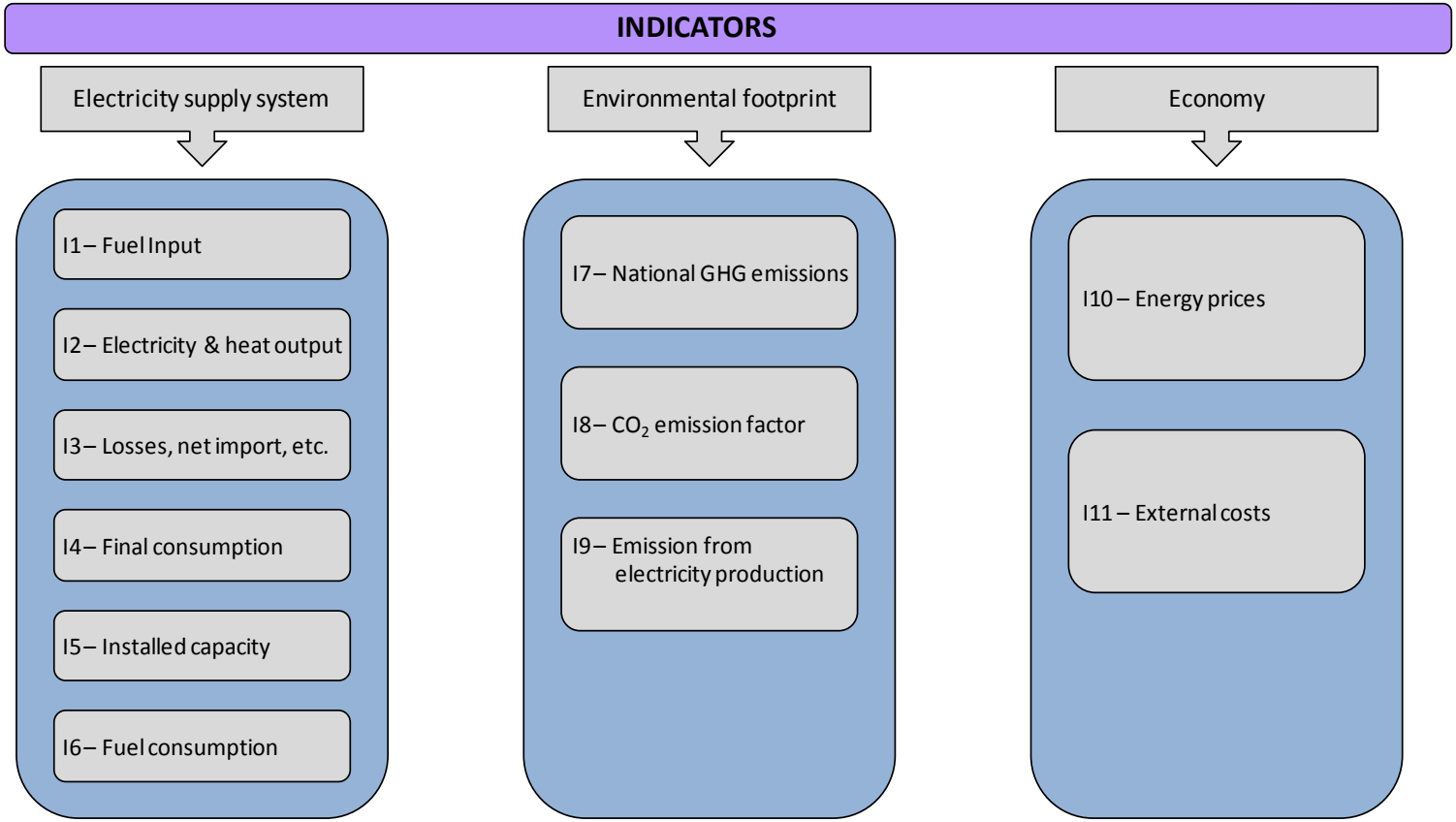
Input Data: Power Generation

- Database of system data



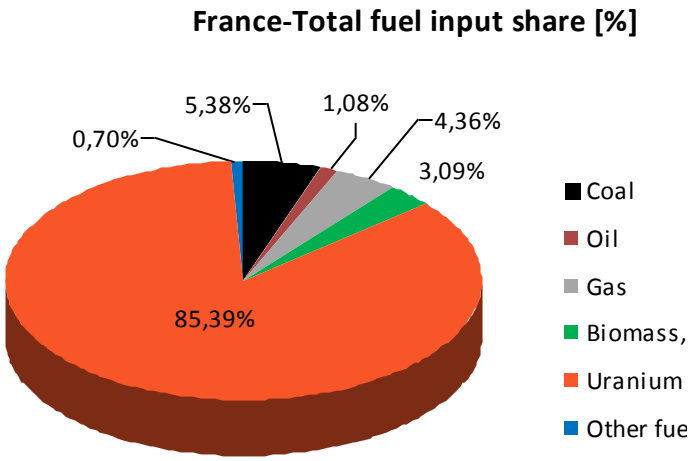
Input Data: Indicators

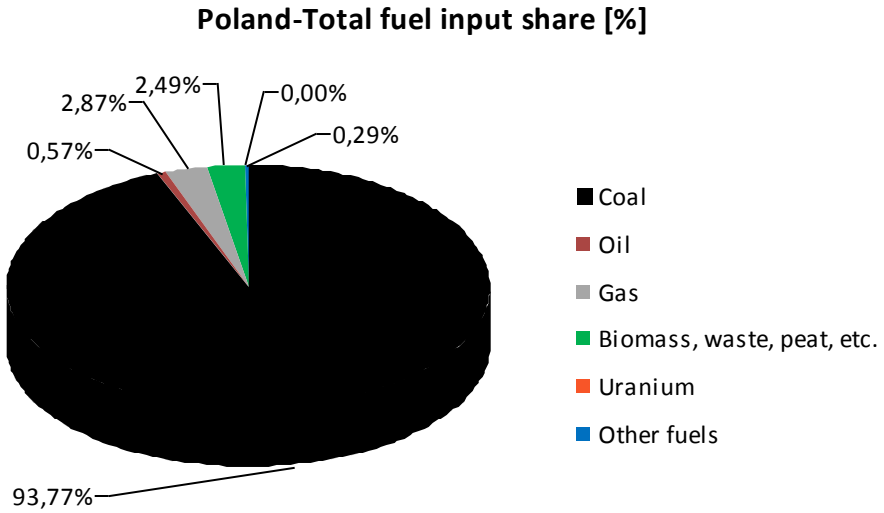
- Database of indicators: Structure



Input Data: Fuel Use in Power Generation

- Database of indicators: fuels in electricity generation





Benchmarking Approach

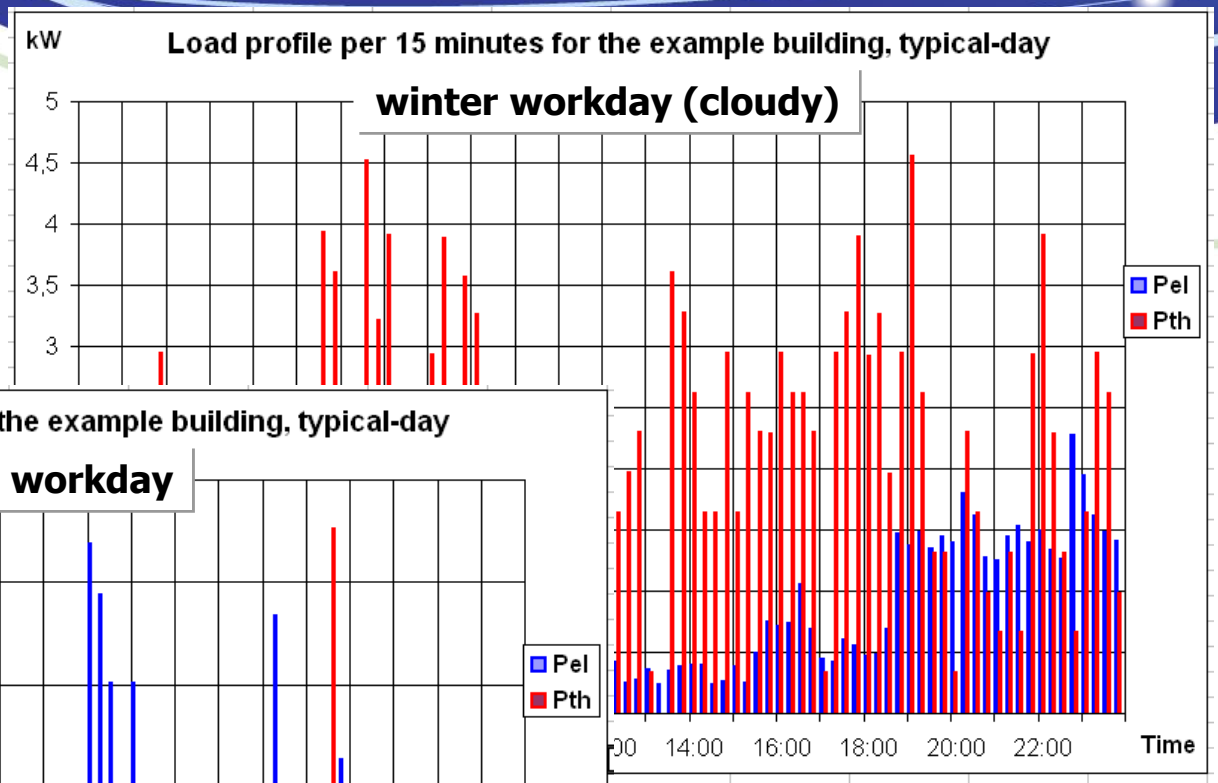
reference systems:

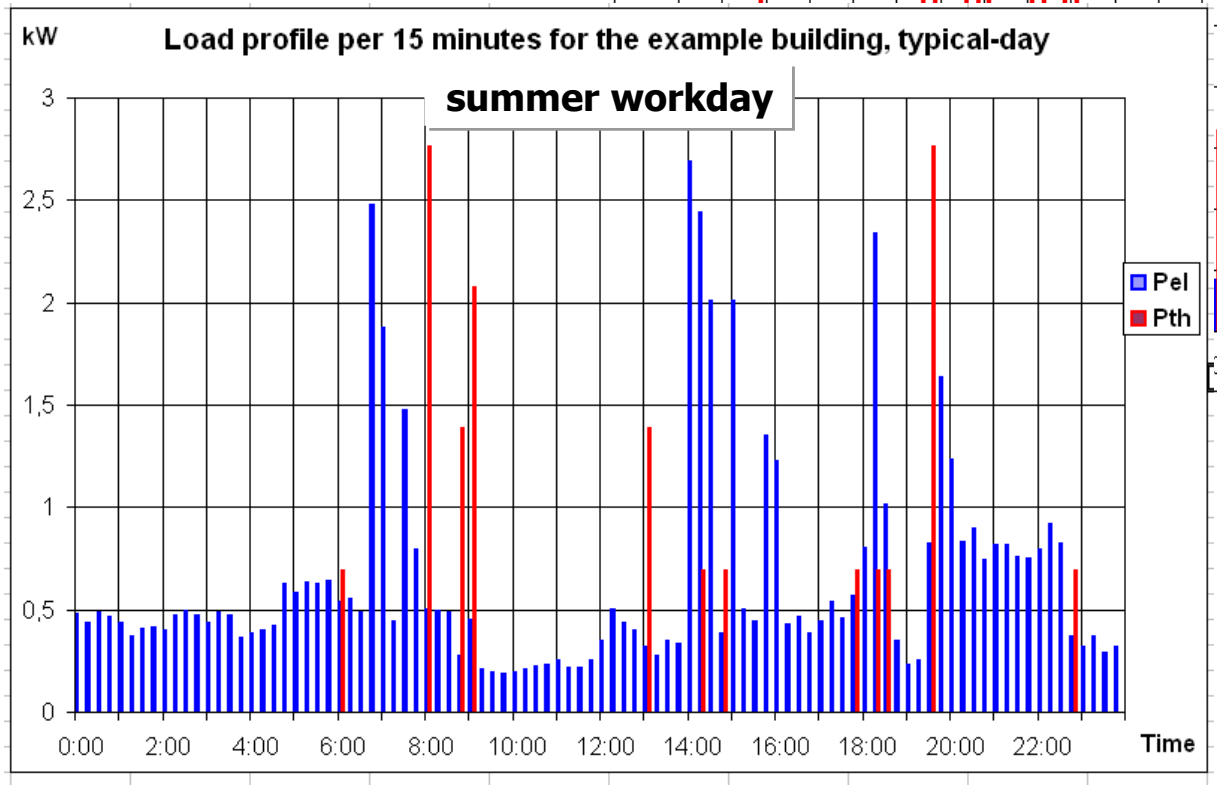
1. Single Family Home (SFH)
2. Multi Family Home (MFH)

- Calculation of system performance with 1-hour time steps
- Comparison of key figures of merit
  * system CO_2 emission
  * primary energy use
  * electrical and total efficiency
- different operating strategies: (1) heat & (2) electricity following, (3) economic optimisation
- different CHP technologies: Stirling, ICE, PEFC, SOFC

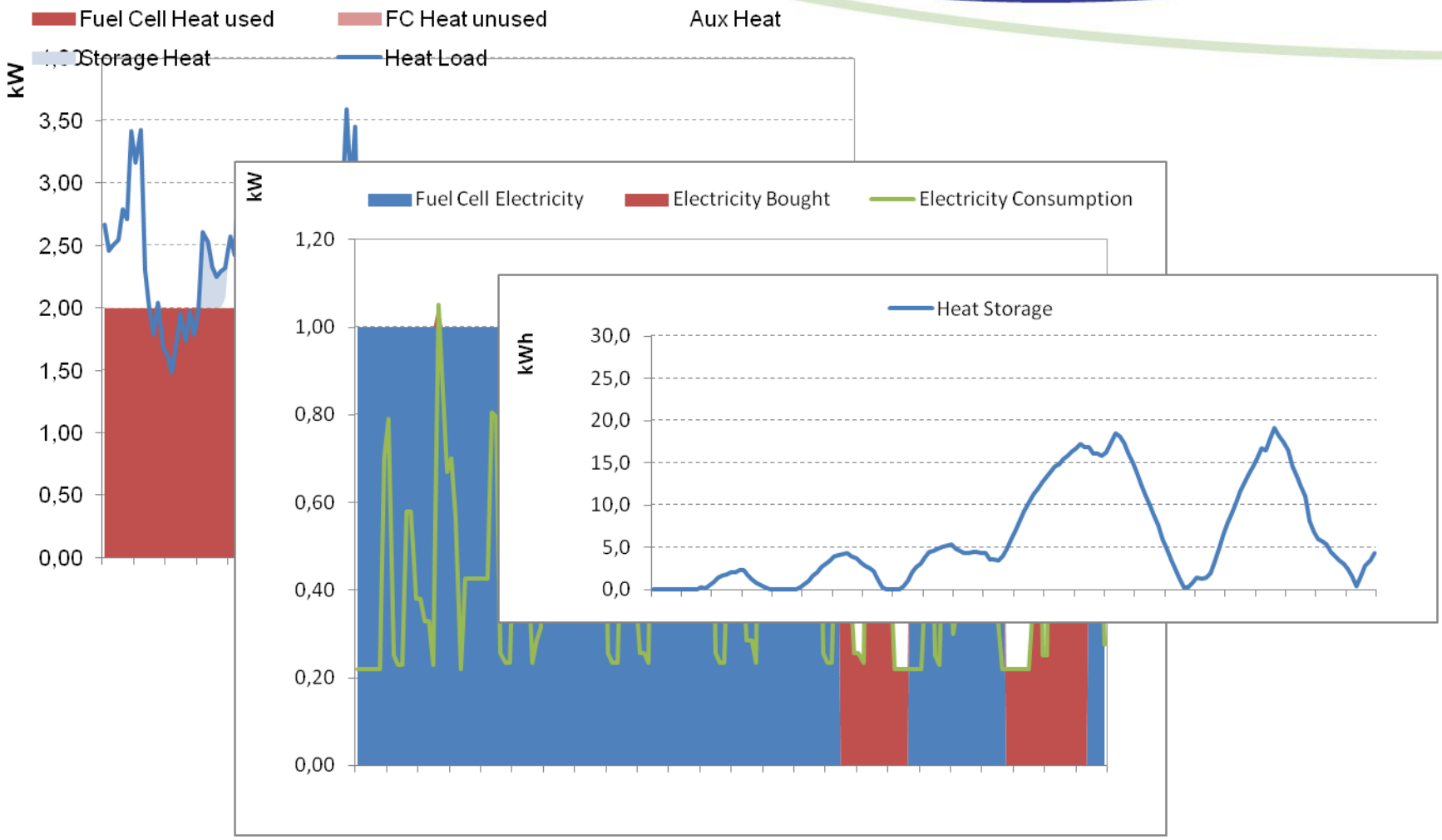
Simulation Calculations

- calculation of FC performance under ‘real’ operating conditions

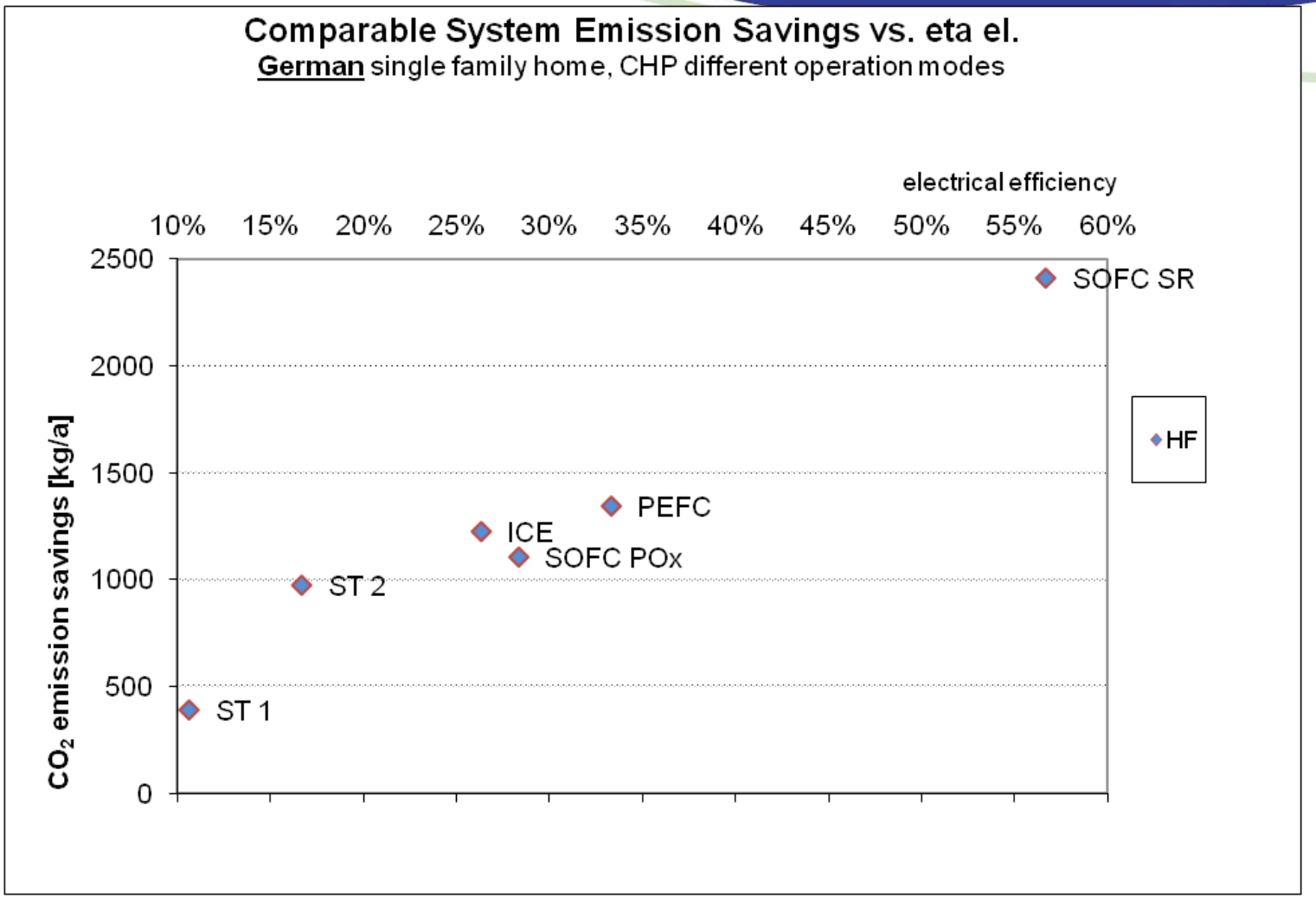




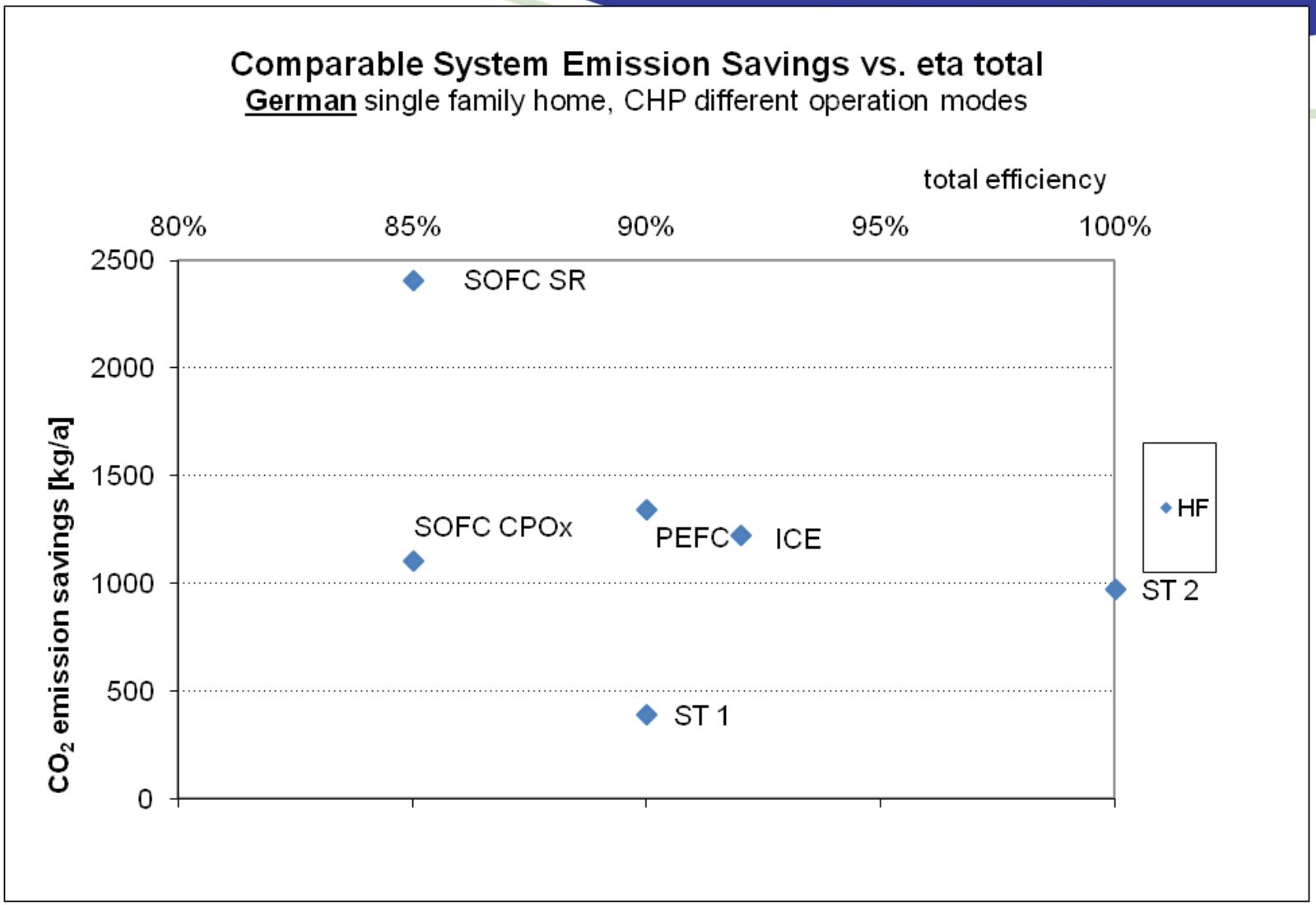
Simulation Examples



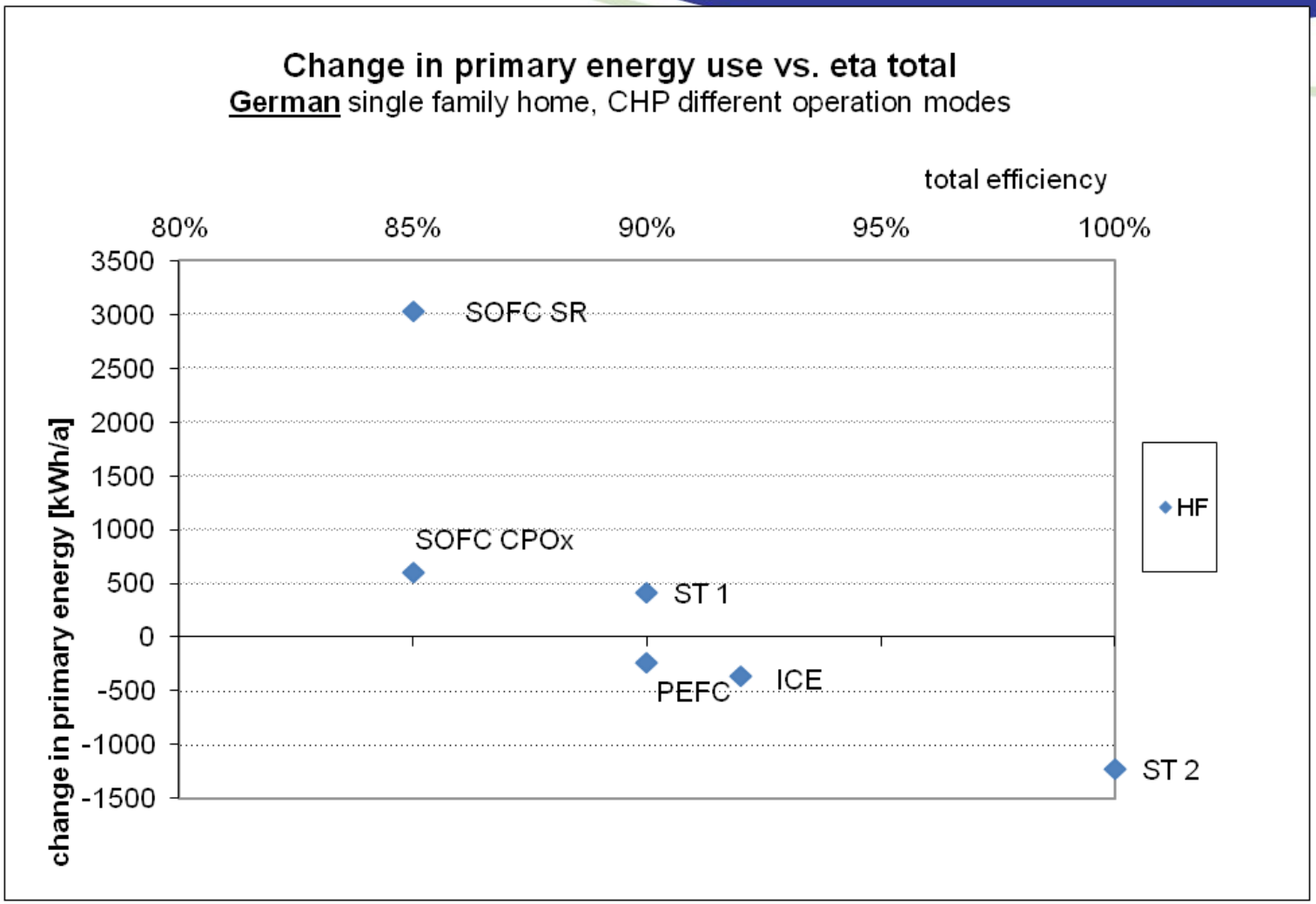
Project results



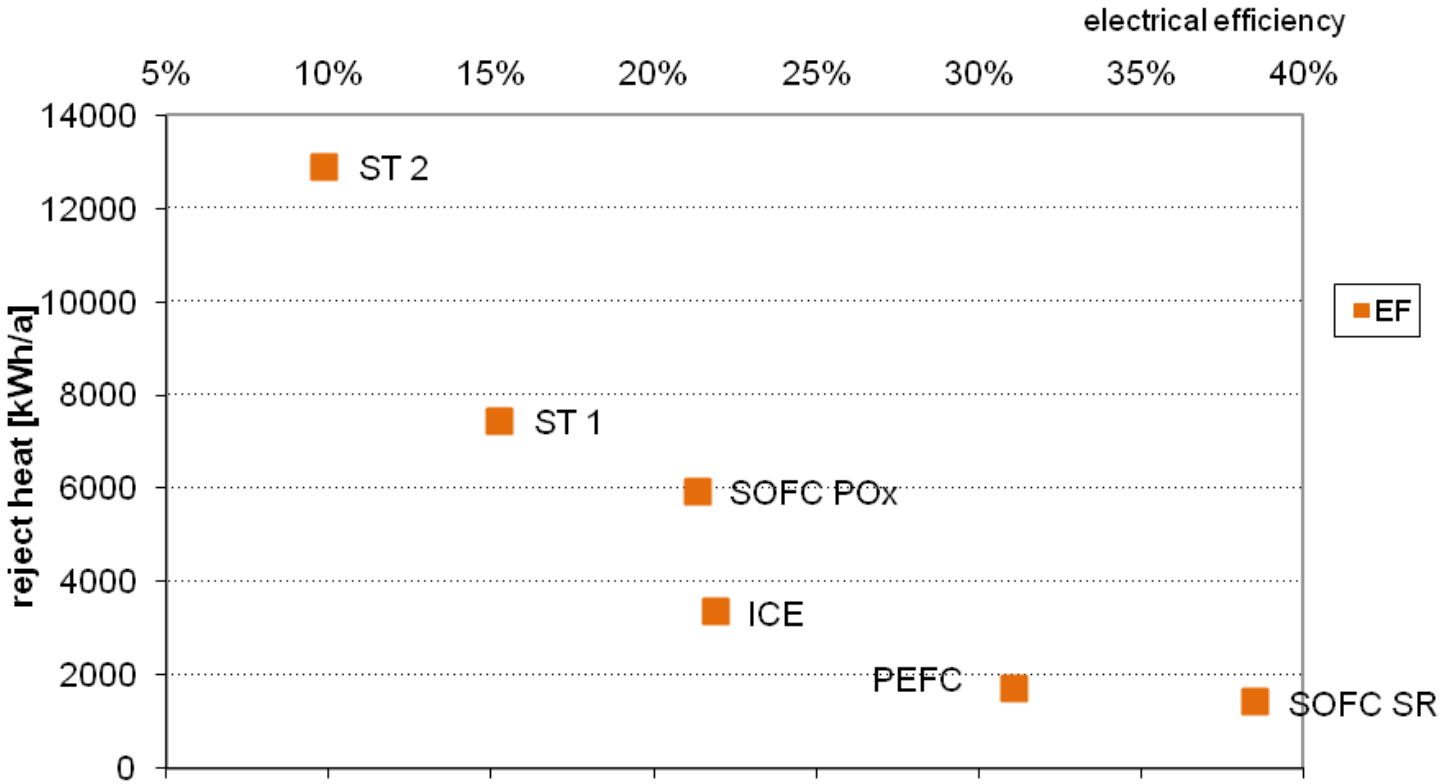
Project results (5)



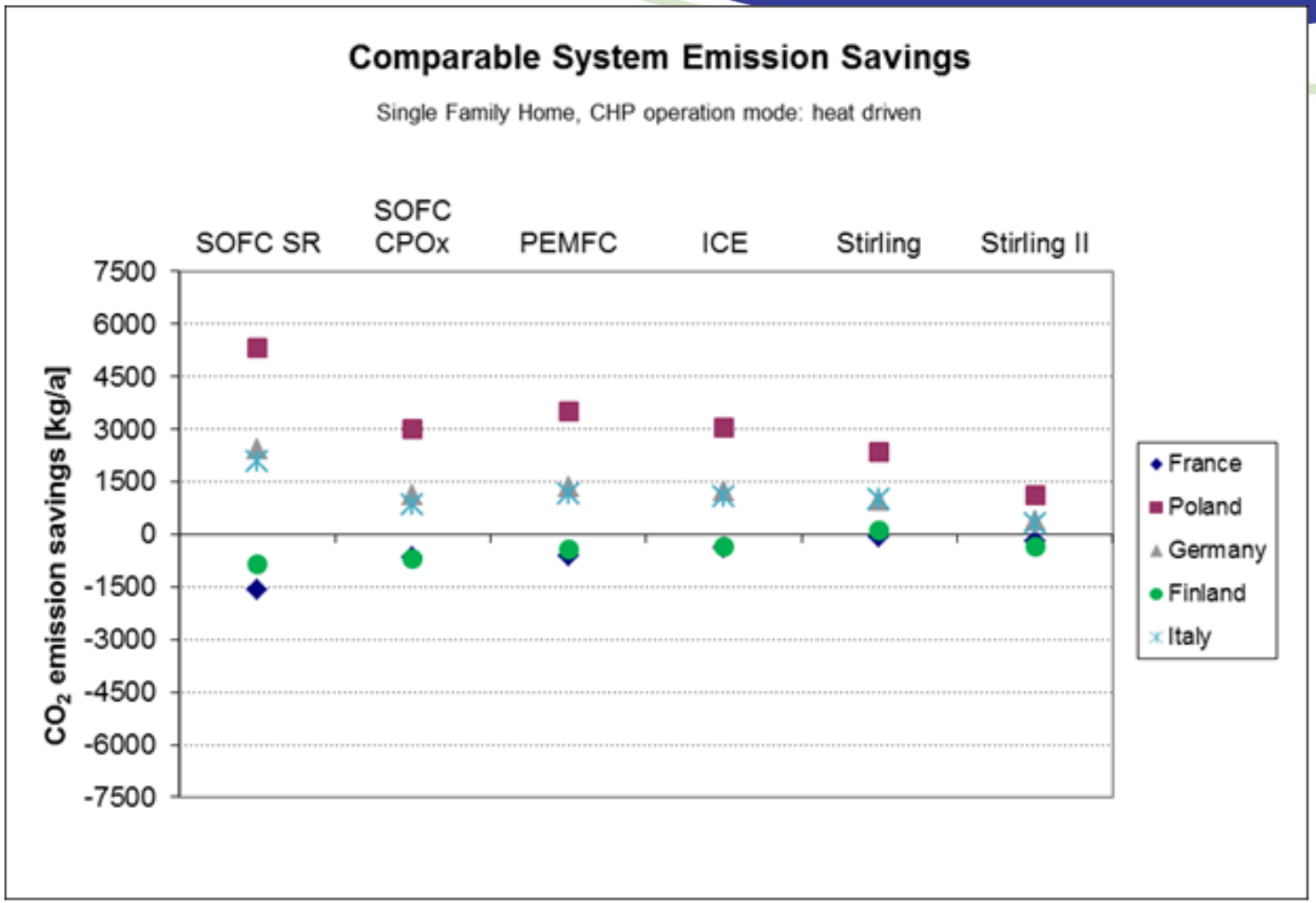
Project results (2)



Project results (3)



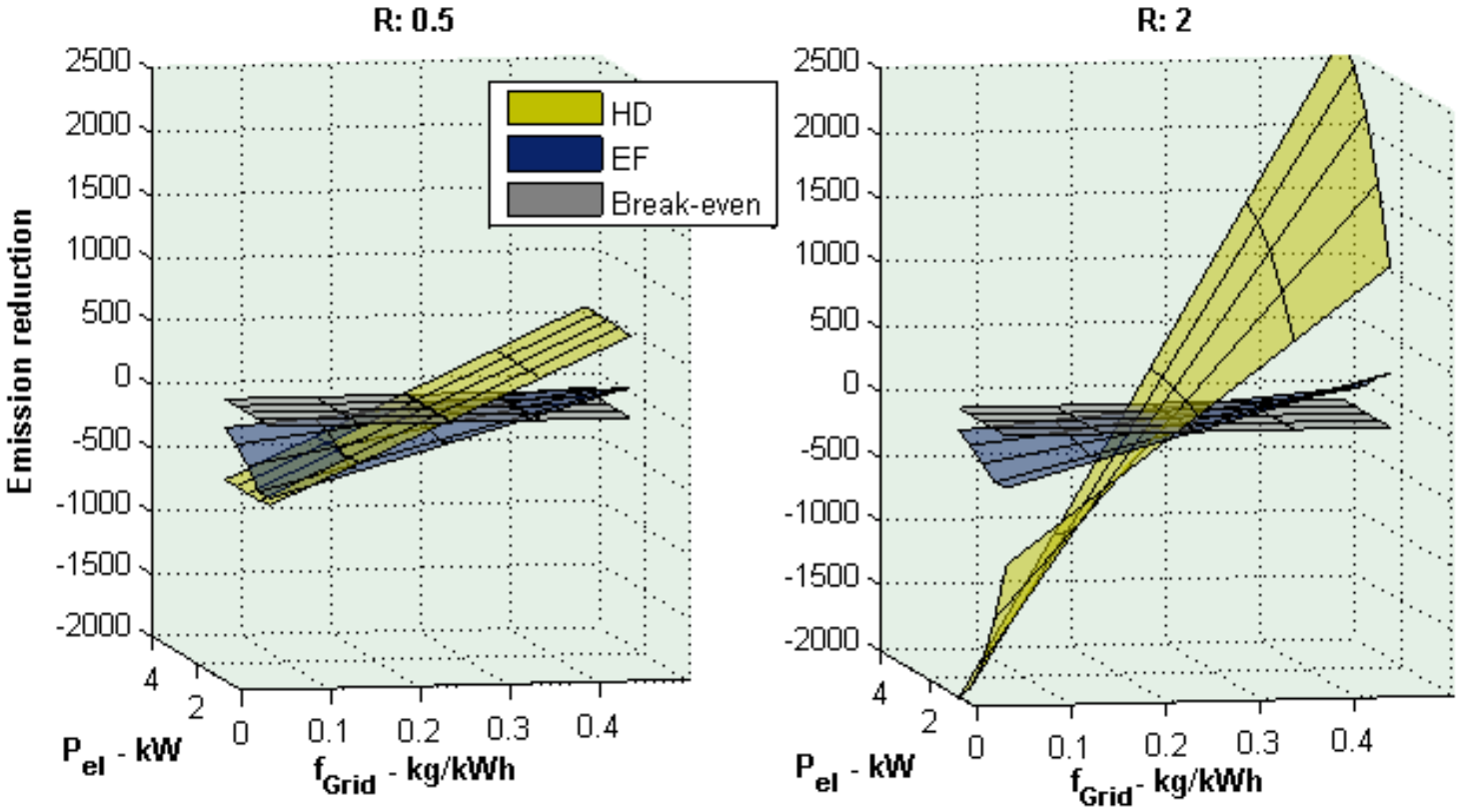
Project results (4)



g/kWh
90
730
563
176
448

Sensitivity Analysis

$R = E_{el} / Q$



Project status

- complex simulation and evaluation system established
- reporting being completed, including public documents
- tool could be installed on a web page
- funding for web page implementation being sought

Summary

- fuel cells can deliver emission reduction, primary energy savings and operating cost reduction in most European countries
- in most cases, heat following mode will be preferred – unless virtual power plants are considered
- high total and electrical efficiencies, power-to-heat and turn-down ratio are required
- sensitivity analysis provides the break-even points where microCHP improves the emission and energy balance and how to prioritise technical development, depending on application

Thank You for your Attention !