ADEL – ADvanced ELectrolysers
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Topic SP1-JTI-FCH.2009.2.3:
New generation of high temperature electrolyser

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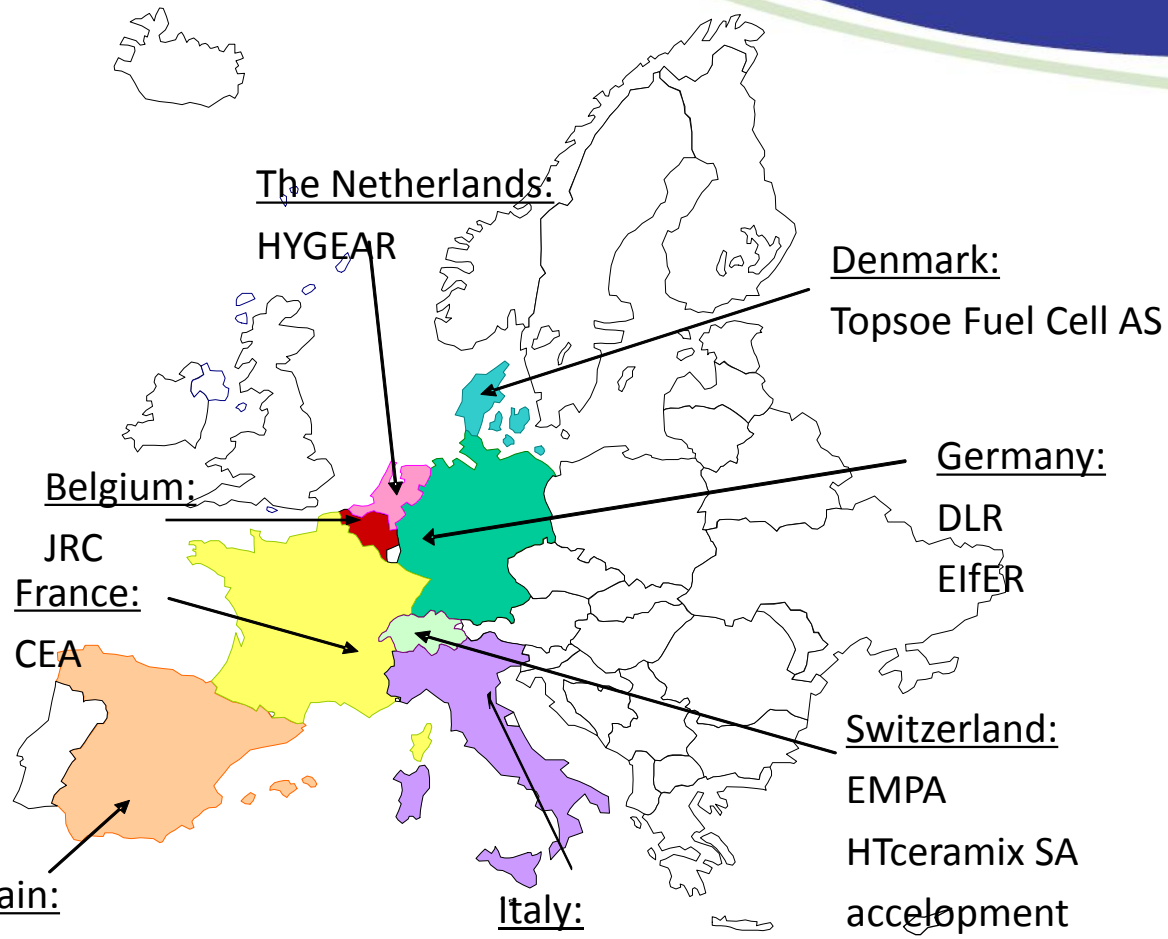
HTceramix-SOFCpower

Consortium



Overview

13 members

8 countries

7 industrial (5 SME)

6 R&D centers

Hi2H2
(CEA, Eifer, EMPA, DLR)

SOFC600$_2$
(CEA, HTceramix, TOFC, EMPA)

REL-HY
(CEA, Eifer, TOFC, EMPA)

Objective

The ADEL project targets hydrogen production that is

- cost-competitive
- high energy efficient and sustainable
- based on renewable energy sources or nuclear

Intermediate Temperature Steam Electrolysis (ITSE)

- optimize electrolyser life time and cost by
  - decreasing operating temperature
  - maintain satisfactory performance level
- achieve high energy efficiency at the levels of
  - the electrolyser unit itself and its operating window
  - the energy system composed by heat and power sources and the device

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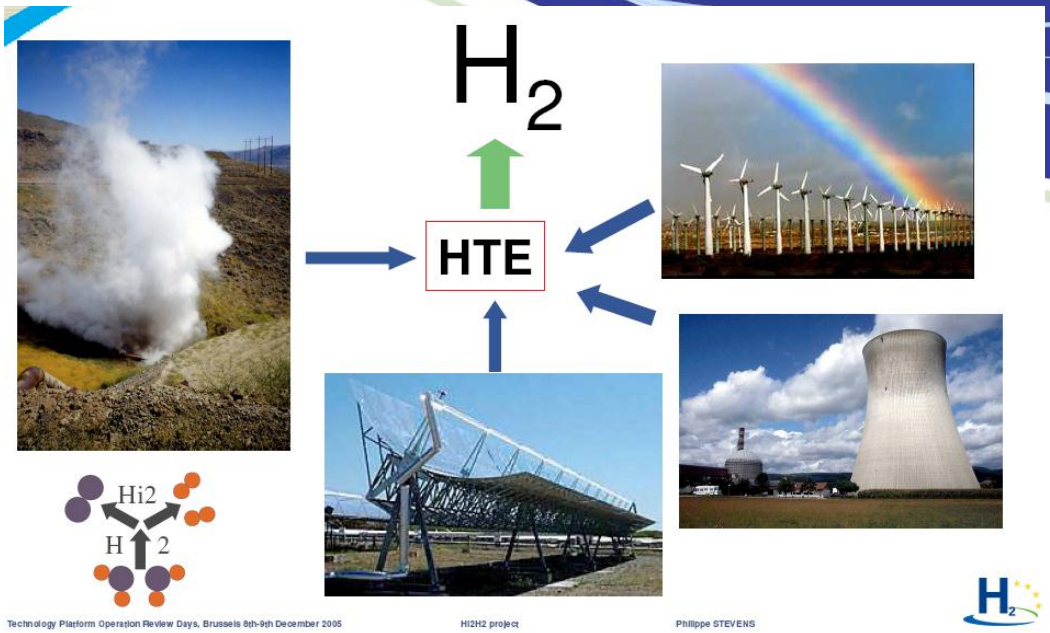
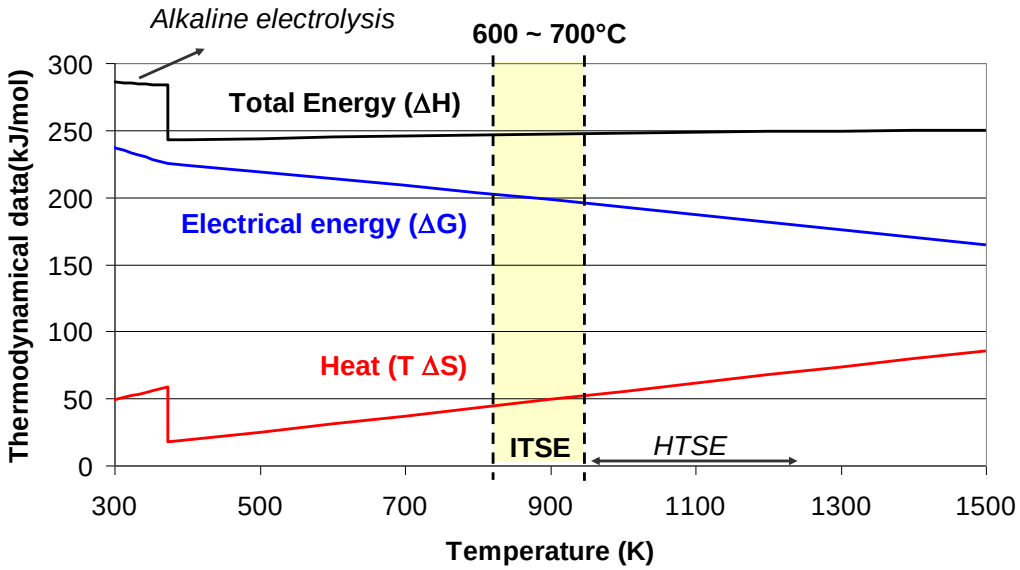
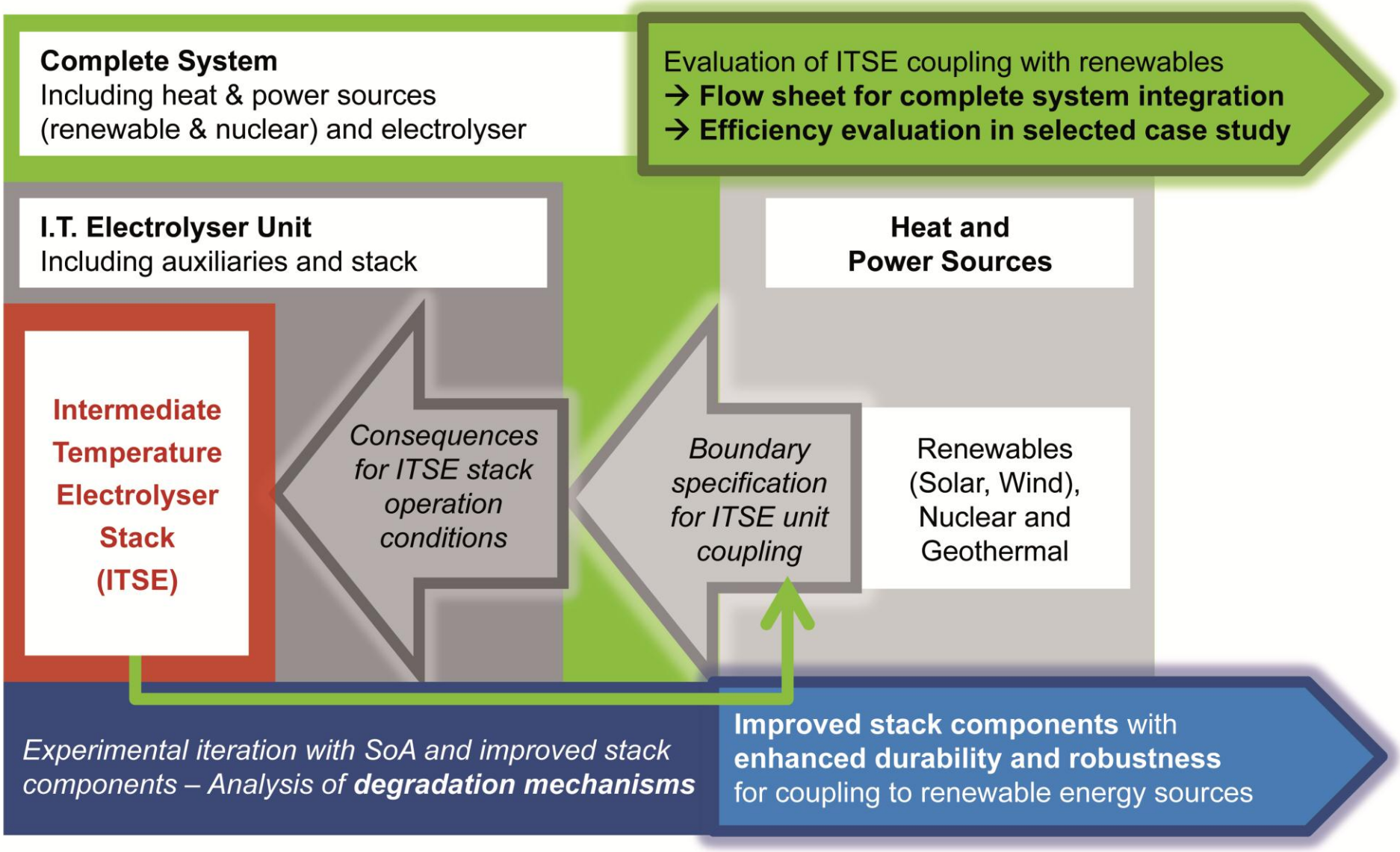
Various heat sources with specific caracteristics





Optimal coupling of sources and device for efficient hydrogen production by ITSE

Heat required for high efficiency



The **most energy efficient coupling solutions** will be used as basis to specify a proof of concept demonstrator including a ITSE stack.

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Expected outcome

Improved cells and small stacks with better performance and improved durability:

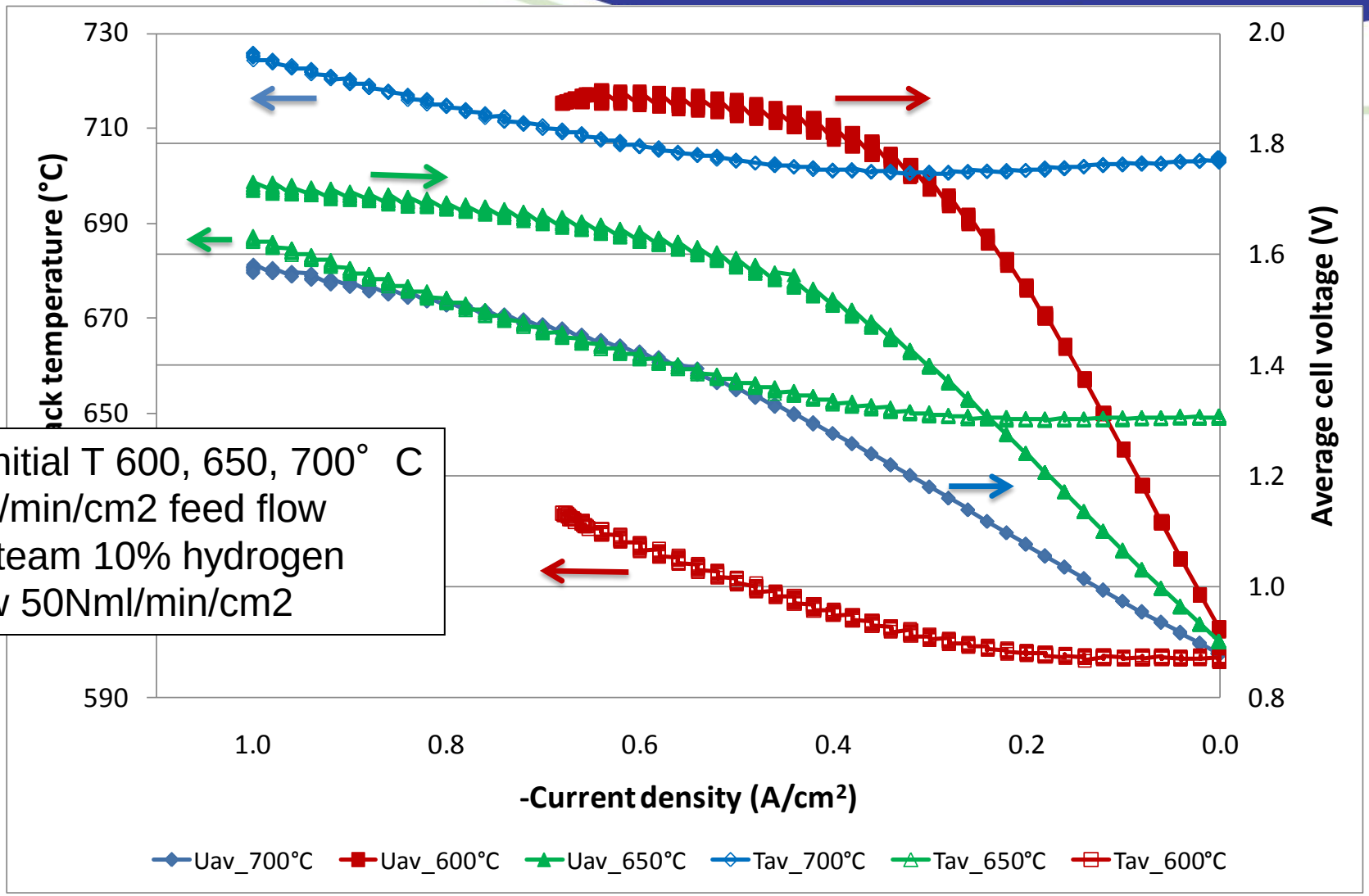
- Cell degradation < 0.5% /1000 hours (relevant conditions)
- Improved interconnects and coatings
- Current density of 2 A/cm2
- Improved sealants
- Stack degradation < 1% /1000 hours under relevant conditions

Flow sheet with adjustable parameters to assist the development of systems

Based on SOFC600 rsults, materials development aims to achieve all objectives in a temperature window of 600 to 700° C.

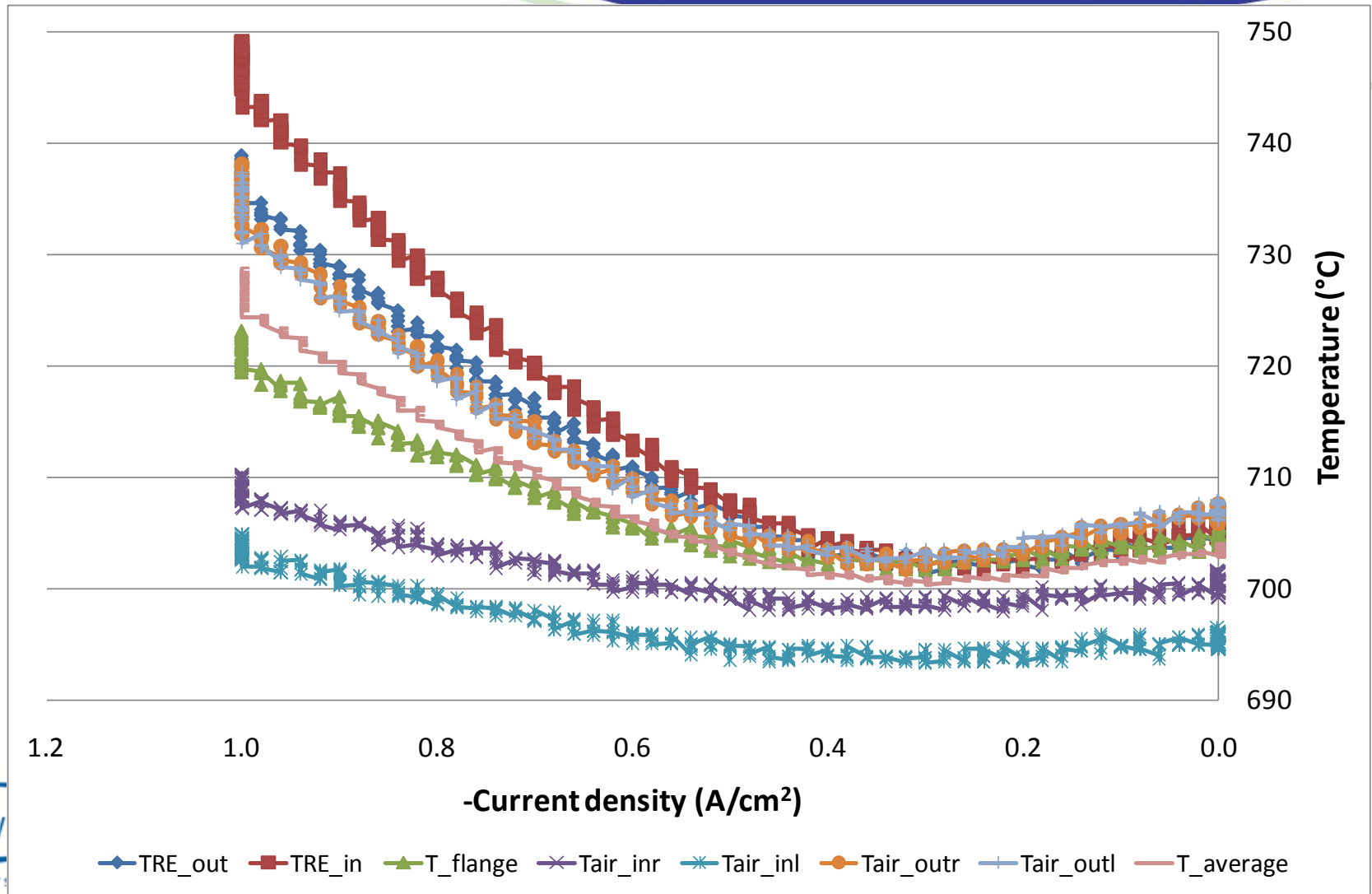
Flow sheets will allow to determine the influence of the temperature of the heat source

stack heating during



OCV initial T 600, 650, 700° C
12Nml/min/cm2 feed flow
90% steam 10% hydrogen
air flow 50Nml/min/cm2

temperature change during U-i according to position in stack



MAIP targets

Hydrogen Production & Distribution

- Appropriate H2 supply chain (including fuel purity) ✔ ☐
- to match Transport, Stationary and Early Markets requirements. For 2015 10 - 20% of general H2 -
- demand produced via carbon free/carbon lean processes ✔ ☐
- Cost of H2 delivered at refuelling station < €5/kg (€0.15/kWh) ?

Generally well aligned project with mid to longterm orientation

Initial results & open SOE questions .

- Project started Jan 2011
- Challenge to integrate the different levels
  - Electrochemistry, device, energy system
- Thermal effects and flows in focus
- Materials research progressing as expected
  - (learning curve Real-SOFC, SOFC600)

Dissemination

- Web-Site: adel-energy.eu
- Publications in reviewed papers
- 2 Public Workshops
  - Sevilla, Spain, October 2011
  - Grenoble, France, autumn 2012
- Participation in conferences such as the European Fuel Cell Forum in Lucerne (efcf.com)

Electrolysis statements

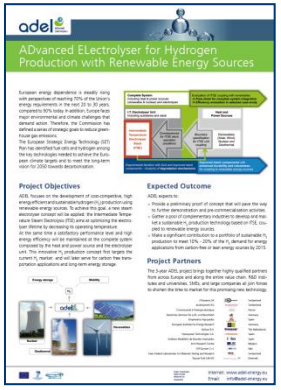
- Hydrogen production from excess electricity is key
  - Intermittant/dispatchable operation is required
  - Grid balancing has an economic value
  - Intermode energy switch from electricity to mobility and/or heat reduces generally the carbon footprint
- Excess electricity to fuel by electrochemistry is of strong interest
- Electrolysis is a bridging technology and hydrogen is one energy vector towards low-carbon energy generation
  - Enabling more renewable and nuclear generation

SOE statements

- Electrolysis simulation and flow sheeting allow to orient materials search towards relevant objectives (T, p, I, durability)
- Simulation tools need to be validated against experimental performance
- Intermediate temperature stack operation (SOE@600° C) might not be required from a system point of view
- Pressurised SOE operation seems to be relevant from system side
  - kinetically increased stack performance and reduced BoP costs
  - does it affect degradation?

Corprate Identity

- CI Manual
- Website
- Poster
- Factsheet



Next steps .

The project will establish the preliminary design of an ITSE demonstrator taking into account

- the performances of the materials, cells and stacks,
- the integration of the unit in a thermally couples system
- the availability of heat sources

This outcome is the intended basis for a demonstration project for this new exciting technology!

A link to fueling infra-structure up-build is appreciated to adjust project system evaluation and design concepts to evolving market needs.

Thank you for your attention

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