Fuel cells and hydrogen

Joint undertaking

Program Review Days 2013

Introduction to portfolio of System development, Components, Materials and Operation Diagnostics projects – Energy R&D

New Energy World JU

fuel cells & hydrogen for sustainability

http://www.fch-ju.eu/

Nikolaos Lymperopoulos, Project Manager

Agenda Day 2 Morning

09:00 – 09:45	**Introduction to portfolio of System development, Components, Materials and Operation Diagnostics projects**	
• ***Energy:***	**Nikolaos Lymperopoulos,** FCH JU Project Manager	
• ***Transport:***	**Carlos Navas,** FCH JU Project Manager	
Q&A session		
09:45 – 10:15	**Coffee break & networking**	
10:15 – 12:15	**PARALLEL SESSIONS on Systems, Components and Materials Development projects for Energy and Transport applications**	
	SESSION 1 **Degradation Analysis and Materials Development for CHP** *Moderators: Florence Lefebvre-Joud, Alan Atkinson*	**SESSION 2** **Materials Development for Hydrogen Storage and Portable applications** *Moderators: Andreas Dorda, Nikos Lymberopoulos*
0:15-10:45	**KEEPEMALIVE** 'Knowledge to enhance the endurance of PEM fuel cells by accelerated lifetime verification experiments' *Steffen Moller-Holst, SINTEF*	**HYCOMP** 'Enhanced design requirements and testing procedures for composite cylinders intended for the safe storage of hydrogen' *Clemence De Villers, Air Liquide*
0:45-11:15	**SOFC-LIFE** 'Solid-Oxide Fuel Cells – Integrating degradation effects into lifetime prediction models' *L.G.J de Haart, Forschungszentrum Juelich*	**SSH2S** 'Fuel Cell Coupled Solid State Hydrogen Storage Tank' *Marcello Barricco, University of Torino*
1:15-11:45	**MAESTRO** 'Membranes for stationary application with robust mechanical properties' *Deborah Jones, Université de Montpellier II*	**HYPER** 'Integrated hydrogen power packs for portable and other autonomous applications' *Juliet Kauffmann, Orion Innovations*
1:45-12:15	**METSAPP** 'Metal supported SOFC technology for stationary and mobile applications' *Niels Christiansen, Topsoe Fuel Cell A/S*	**DURAMET** 'Improved durability and cost-effective components for new generation solid polymer electrolyte direct methanol fuel cells' *Antonino Arico, CNR-ITAE*
12:15 – 13:30	**Lunch (Poster session)**	

Agenda Day 2 Afternoon

13:30 – 14:30 **PARALLEL SESSIONS on Systems, Components and Materials Development projects for Energy and Transport applications**

	SESSION 1 **Sustainable Hydrogen Production** *Moderators: Eden Mamut, Jean-Luc Delplancke*	**SESSION 2** **Materials Development for Transport** *Moderators: Daria Vladikova, Joerg Wind*
13:30-14:00	**COMETHY** 'Compact multifuel-energy to hydrogen converter' *Alberto Giaconia, ENEA*	**PEMICAN** 'PEM with innovative low cost core for automotive application' *Joel Pauchet, CEA*
14:00-14:30	**RESELYSER** 'Hydrogen from RES: pressurised alkaline electrolyser with high efficiency and wide operating range' *Regine Reissner, DLR*	**STAMPEM** 'Stable and low cost manufactured bipolar plates for PEM fuel cells' *Anders ØDEGÅRD, SINTEF*

14:30 – 15:00 **Coffee break & networking**

15:00 – 15:30 **Introduction to portfolio of Cross-Cutting projects**

Cross-Cutting Issues: **Guillaume Leduc,** FCH JU Project Manager

15:30 – 17:00 **SESSION on Cross-Cutting projects**

Moderators: Guillaume Leduc, Carlos Navas

15:30-16:00 **HYINDOOR** 'Pre-normative research on safe indoor use of fuel cells and hydrogen systems'
Béatrice L'Hostis, Air Liquide

16:00-16:30 **FC-EUROGRID** 'Evaluating the Performance of Fuel Cells in European Energy Supply Grids'
Robert Steinberger-Wilckens, University of Birmingham

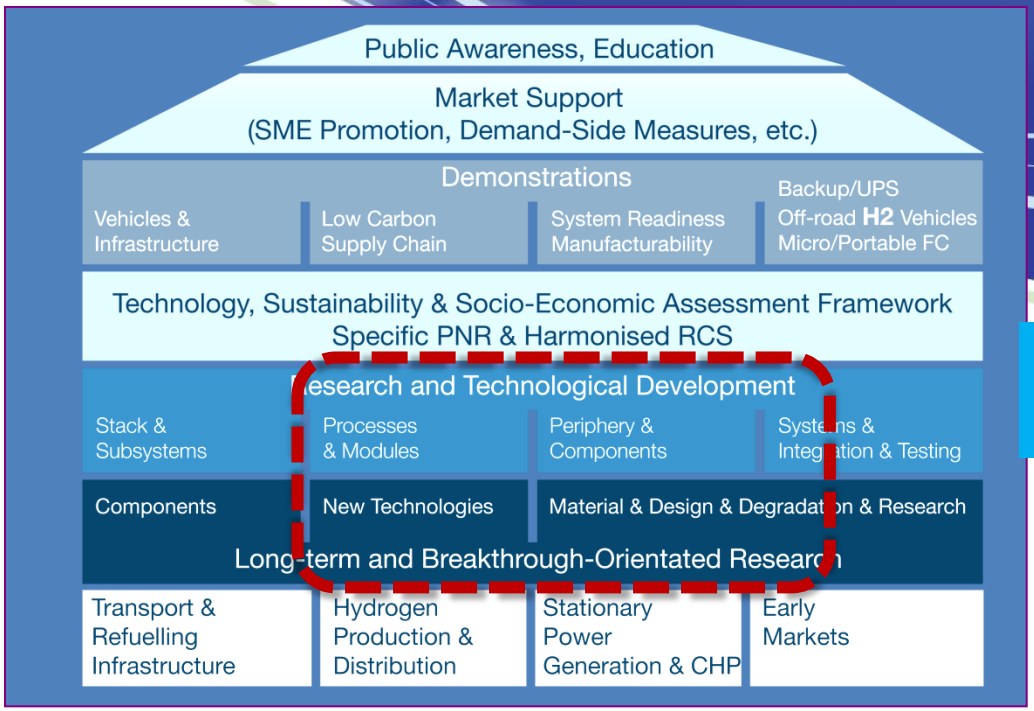
16:30-17:00 **TEMONAS** 'Technology monitoring and assessment'
Peter Claassen, CLIMT

17:00 – 17:30 **Concluding remarks - Scientific Committee members**

17:30 – 18:00 **Closure speech**
Bert de Colvenaer, FCH JU Executive Director

18:30 – 21:00 **Cocktail dinner**

FCH for ENERGY: 89 projects



RTD: 62 projects

DEMO: 27 projects

Field demonstration
7 projects

Validation of integrated ***systems readiness***
5 projects

Proof-of- concept Systems
4 projects

Materials development *for cells, stacks and BoP*
21 projects

Portable
7 projects

Operation ***diagnostics*** and control
5 projects

Fundamentals of Degradation
9 projects

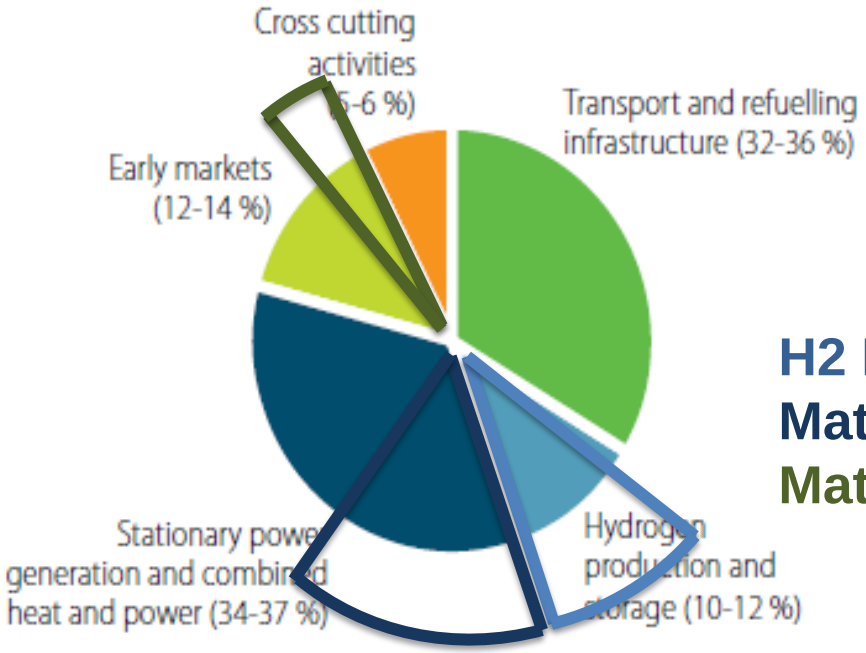
H2 storage
3 projects

Components Improvement
6 projects

Sustainable H2 production
22 projects

Technology Readiness Level, TRL

470 M€ FCH JU Budget distribution



FCH JU Support

H2 Production & Storage 10.4% (50.9M€)

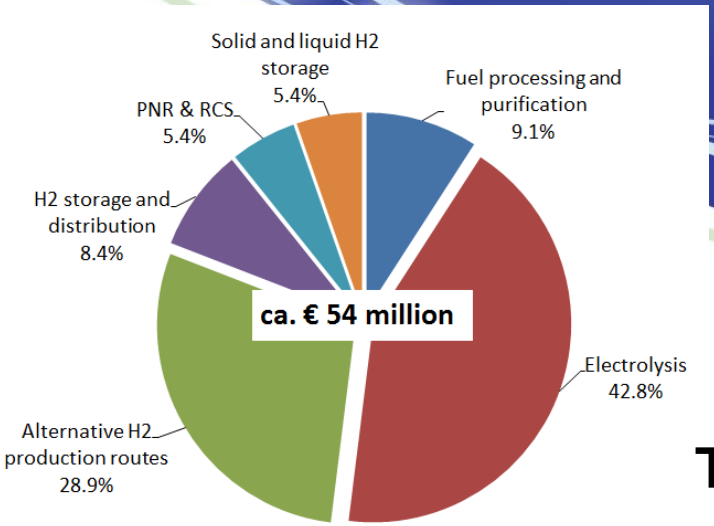
Materials for CHP 15% (70.6M€)

Materials for portable 3% (13.6M€)

AA2 Sustainable H2 Production
MAIP objectives

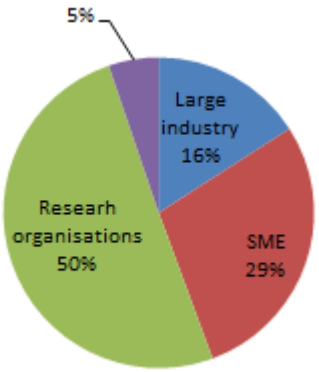
- Develop cost-competitive, energy efficient, sustainable H2 production processes
- Various feedstocks
- Centralised (large scale) or distributed (small scale)
- Short-term: meet demand with mature technologies
- Longer-term: variety of technologies exploiting mainly renewable energy sources
- Hydrogen storage in gaseous, liquid and solid form

AA2 Sustainable H2 Production MAIP Coverage



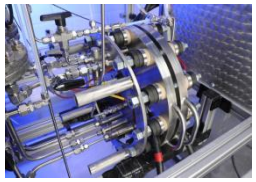
Total R&D: 28 projects, 50.9M€

Low Cost, low Temp electrolysis: 4 projects, 6 M€
High temp electrolysers: 4 projects, 10.1 M€
Materials for PEM electrolysers: 2 projects, 4 M€
Biomass to H2: 1 project 2.2 M€
High Temp thermochemical water decomposition: 3 projects, 5.3 M€
Low temp H2 prod. processes: 4 projects, 8.1 M€
H2 Storage & Distribution: 3 projects, 4.5 M €
PNR & RCS: 2 projects, 2.9M €
Solid and Liquid Storage: 2 projects, 2.9 M €
Fuel processing, and gas purification: 3 projects, 4.9 M€

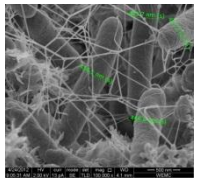


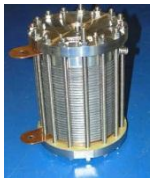
AA2 Sustainable H2 Production
Main Technical Achievements

- Alkaline electrolysers with advanced membranes, η>80%, 1000 on/off cycles, 3,000€/(Nm3/hr)
- Development of large scale PEM electrolysers aiming for MW scale commercial units
- SOE electrodes operating at 700ºC, 15% increased performance @ 0.9A/cm2
- Advanced catalysts for steam reforming at 400-550ºC
- Thermochemical water splitting using solar energy: simulations - pilot-scale demonstration
- 1-10kg/day H2 production from thermophilic fermentation of 2nd gen biomass
- 50% reduction of energy consumption for the liquefaction of hydrogen through up-scaling and optimisation.
- Improved designs and testing procedures for pressurised hydrogen tanks
- Hydrogen delivery with 400bar composite tanks
- 5 wt% H2 in MH tanks capable of 20Nl/min for 2h, integrated with FC


RESelyser


SSH2S


HYTIME


PRIMOLYSER


DELIVERHY


SOL2H2

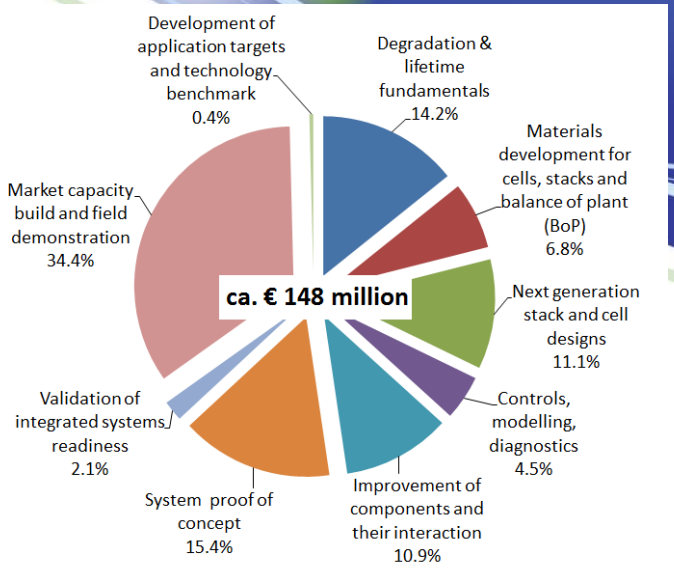

UNIfHY

AA3 Stationary CHP
Degradation & Materials MAIP objectives

- Improve FC stack and BoP components
- R&D on:
  - Degradation and lifetime fundamentals
  - New and improved materials
  - Control and diagnostic tools
  - Components and sub-systems
  - Novel cell & stack architectures

Step change in endurance, robustness, durability, cost

AA3 Stationary CHP
Degradation & Materials
MAIP Coverage



Degradation: 11 projects, 21.1 M€

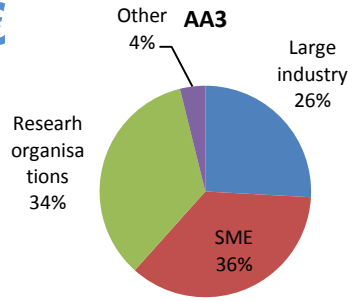
Materials development for cells, stacks and BoP: 5 projects, 10.1 M€

Next generation stack and cell design: 7 projects, 16.5 M€

Control and diagnostics: 4 projects, 6.7 M€

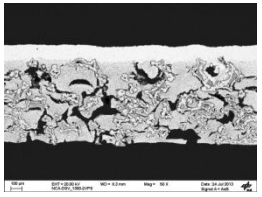
Improvement of components, 7 projects, 16.2 M€

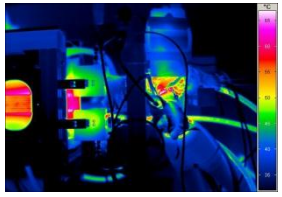
Total for R&D: 34 projects, 70.6 M€

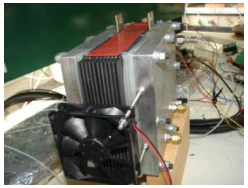


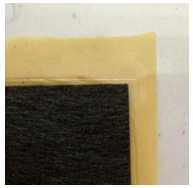
AA3 Stationary CHP Degradation & Materials Achievements

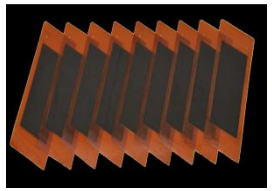
- 160-200ºC PEM stacks with >20,000 h lifetime and η>45%
- Metal supported tubular SOFC with >40,000 h lifetime
- Triode architecture of SOFCs for x10 power factor and η>55%
- AFCs with advanced stack design –> estimated 100MW @ 1,500-2,000 €/kW
- Ammonia fuelled 5kW AFCs for remote power
- Membranes and MEAs with improved mechanical properties
- Improving durability through accelerated testing procedures

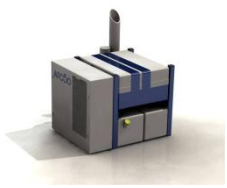

EVOLVE


EUREKA


DeMStack


MAESTRO

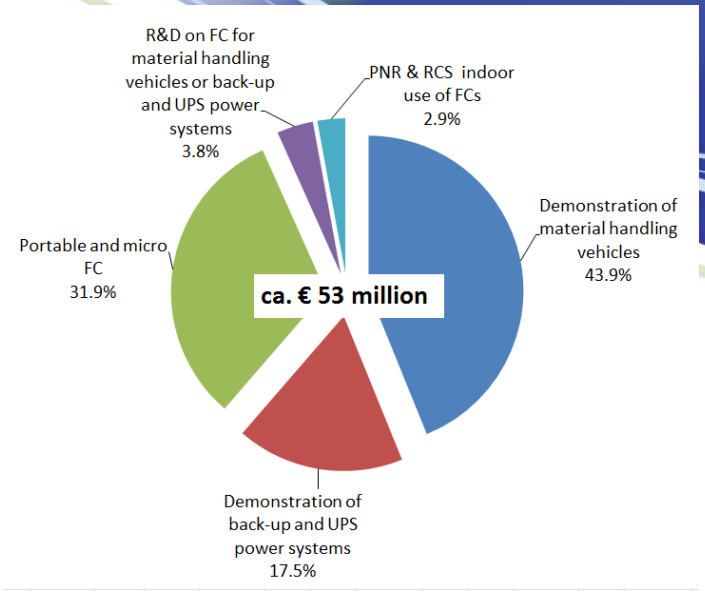

CISTEM


ALKAMONIA

AA4 Early Markets
Portable Apps MAIP objectives

- Show the technology readiness of portable and micro FCs
- R&D on:
  - Reduced cost of FC
  - Improved efficiency & lifetime
  - Enhanced fuel supply, reduced H2 delivery costs (supply concepts, on-board reforming)

AA4 Early Markets
Portable Apps MAIP Coverage



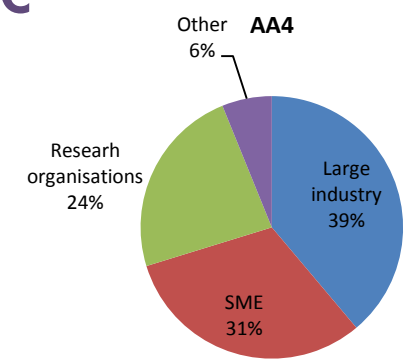
Fuel supply concepts for portables: 2 projects, 2.4 M€

Durability of micro FCs: 1 project, 1.5 M€

R&D of new portable FC systems: 4 projects, 7.7 M€

R&D of 1-10kW FC systems: 1 project, 2 M€

Total for R&D: 8 projects, 13.6 M€



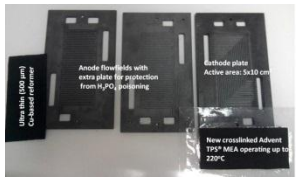
AA4 Early Markets Portable Apps Achievements

- Optimised DMFC componenents with reduced cross-over and 2x<degradation, PGM <0.5 mg cm2
- Miniaturised SOFCs & BoP for UAVs, resulting to doubling of flight times
- H2 based power packs (20kg/kW, 20l/kW))for portable apps
- Portable internal reforming methanol high temperature PEM

DURAMET

SUAV

HYPER



IRMFC

Conclusions: R&D in Energy

Comprehensive level of MAIP coverage

- **Conventional and innovative H2 production concepts supported**
- **All FC technologies covered in CHP applications**
- **PEM, DMFC, SOFC in portables**

The Future
FCH 2 JU Objectives

- FCs for power production: η increase, cost reduction to levels competitive with conventional technologies
- H2 production: η increase, reduce capital cost
- Demonstrate the feasibility of using H2 to support the integration of RES into the energy systems

Thank you for your attention!

Further info:

- **FCH JU: http://fch-ju.eu**
- **NEW-IG: http://www.new-ig.eu**
- **N.ERGHY: http://www.nerghy.eu**