# Fuel cells and hydrogen Joint undertaking

### **Program Review Days 2013**

Introduction to portfolio of Energy Demonstration projects



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## FCH for ENERGY: 89 projects



Technology Readiness Level, TRL

### MAIP objectives (1) Planned Budget

Currently distributed in 3 different application areas:

- Hydrogen Production and Storage
- Stationary applications and Micro-CHP
- Early markets Back-up power and off-grid systems

More than 50% of initial budget to be allocated to ENERGY oriented projects









**Cross-Cutting** 

Transportation & Refuelling infrastructure (32-36%)



Hydrogen Production & Distribution (10-12%)



## MAIP objectives (2) *Technical targets*

#### Price of H2 delivered to station: 5€/kg

H2 production by electrolysis					
Increase capacity to 3,0 t/d decentralised	and				
50 t/d centralised					
Increase efficiency to 68-70%			Volume & cost		
Decrease price to 1,5-1,9 M€/(t/d)	Application	Market	2010	2015	2020
	Area	application	baseline	mid-term	long-term
		Hydrogen delivered to retail station	-	5€/kg	5 €/kg
H2 production by biogas reformin Increase capacity to 3,0 t/d	Ig	Distributed production of hydrogen by water electrolysis	1.5 t/d cap.   65% eff.   3.1 M€/(t/d)	1.5 t/d cap.   68% eff.   2.8 M€/(t/d)	3.0 t/d cap.   70% eff.   1.9 M€/(t/d)
Increase efficiency to 67% Decrease price to 2,5 M€/(t/d)		Distributed production by reforming of biogas SMR (incl. purification)	1.5 t/d cap.   64% eff.   4.2 M€/(t/d)	1.5 t/d cap.   64% eff.   3.8 M€/(t/d)	3.0 t/d cap.   67% eff.   2.5 M€/(t/d)
		Total installed production capacity from renewables	-	-	103 t/d
Installed storage capacity H2 from grid: 129 t	Hydrogen	Centralized production of			50 t/d cap.
	Production	hydrogen by water	-	-	70% eff.   1 5 M£/(t/d)
	and Storage	Centralized underground storage of hydrogen	-	-	4000 t cap.   0.006 M€/t
		Distributed storage of	0.8 t cap.	5 t cap.	10 t cap.
H2 storage		gaseous hydrogen	0.5 M€/t	0.45 M€/t	0.4 M€/t
Increase capacity while decreasing price:		storage of hydrogen in	3 t cap.   5 M€/t	5 t cap.   1 5 M£/t	10  t cap.   0.85 M£/t
<ul> <li>Underground: 4000 t and 0,006M€/t</li> <li>Gaseous H2: 10 t and 0,4M€/t</li> <li>Solid materials: 10 t and 0,85€/t</li> </ul>		Total installed storage capacity of H2 produced from grid	-	-	129 t
		High capacity compressed	0.6 t cap.   0.55 M€/+	1.3 t cap.   0 55 M€/+	1.6 t cap.
<ul> <li>Compressed H2: 1,6 t and 0,4 M€/t</li> </ul>					0,4 1116/1

# MAIP objectives (3) Technical targets

Volume & cost

#### **Micro-CHP:**

Demonstrate at least 1,000 units Decrease cost to 10,000 €/kWe by 2015 Increase durability to 40,000 h Total efficiency > 80% Electrical efficiencies >45% for power only units

			volume & cost		
	Application Area	Market application	<b>2010</b> baseline	<b>2015</b> mid-term	<b>2020</b> long-term
Large CHP: Demonstrate at least 5 MW Decrease cost to 3,000-4,000 €/kW by 2015 Increase durability to 40,000 h On-stream availability of 95% or higher	Stationary applications and CHP	Micro-CHP (residential), natural gas based		1,000 units / 10,000 € per system (1kWe + household heat) Assuming supported deployment from 2013+	50,000 units / 5,000 € per system (1kWe + household heat) Anticipating commercial introduction beyond 2020
		Industrial/commerci al, H2 based	1 MW / 4,500 €/kW	>5 MW / 3,000 €/kW Assuming supported deployment from 2013+	>50 MW / 1,500 €/kW Anticipating commercial introduction beyond 2018
		Industrial/commerci al, natural gas based		>5 MW / 4,000 €/kW Assuming supported deployment from 2013+	>100 MW / 2,000 €/kW Anticipating commercial introduction beyond 2018
	Early Markets	Back-up power systems	150 units   5,000€/kW fuel cell system	9.000 units   <1.500€/kW fuel cell system	20.000 units   <800€/kW fuel cell system



#### FCH contribution to ENERGY <u>DEMONSTRATION</u> Projects (incl validation/proof-of-concept/components): <u>98,8 mill EUR</u>







ASSENT: development of <u>fuel and water</u> <u>management</u> for SOFC systems

**CATION:** optimal process and mechanical **solutions for the cathode** and stacks subsystems



MAIP Coverage

Technology/Activities

**Projects examples** 

tcom

FCH-JU project

and power) prototype



new <u>multi-fuel membrane reformer</u> for pure hydrogen production (5 Nm3/h) based on Catalytic Membrane Reactors

CHP system based on ASC technology, at reduced stack-temperature of 650C and high electrical efficiency (min. 45%)

**SAPPHIRE:** System Automation of PEMFCs with <u>Prognostics and</u> <u>Health management</u>



**<u>new DC/DC converter</u>** to use on-line electrochemical impedance spectroscopy (EIS) as <u>**diagnostic tool**</u> for back-up power and CHP applications



**proof-of-concept CCHP plants** based on SOFC fed by different typologies of biogenous primary fuels (locally produced), integrated by a process for the CO2 recovery





### **Future expectation** Proposal for a COUNCIL REGULATION on the Fuel Cells and Hydrogen 2 Joint Undertaking

The general **objective of the FCH 2 Joint Undertaking for the period of 2014-2024** is to develop a strong, sustainable and globally competitive fuel cells and hydrogen sector in the Union, in particular to:

- <u>reduce the production cost of fuel cell systems to be used in transport applications</u>, while increasing their lifetime to levels competitive with conventional technologies
- increase the electrical efficiency and the durability of the different <u>fuel cells used for power</u>
   production, while <u>reducing costs</u>, to levels competitive with conventional technologies
- <u>increase the energy efficiency of production of hydrogen from water electrolysis</u> while <u>reducing</u> <u>capital costs</u>, so that the combination of the hydrogen and the fuel cell system is competitive with the alternatives available in the marketplace
- demonstrate on a large scale the <u>feasibility of using hydrogen as a competitive energy storage</u> medium <u>for electricity produced from renewable energy sources</u>

#### FCH studies Additional 2-3 mill EUR to support programme planning/strategy

Studies on the commercialization of fuel cells and hydrogen technologies and competing technologies – ENERGY related studies:

**Electrolysers** techno-economic assessement – <u>on-going study</u> by E4tech

**Distributed Generation** technologies and role of Fuel Cells – industry coalition building stage !!!

**Energy Storage** and role of Hydrogen – <u>industry coalition building stage !!!</u>

Recommendations to help stimulate the policy and investment climate – <u>what needs to happen to</u> <u>achieve the cost and volume targets required for commercialisation</u> - as input to the next FCH2 programming !!!

<u>For industry</u>, next steps will include focus on tackling the remaining technical and cost-related barriers to achieve full commercialisation of mass market technologies.



# Thank you for your attention !

Further info :

- FCH JU (Programme Office) <u>http://fch-ju.eu</u>
- NEW-IG <u>http://www.new-ig.eu</u>
- N.ERGHY <u>http://www.nerghy.eu</u>