

INNOVATION IN ACTION

JOINT
TECHNOLOGY
INITIATIVES



fuel cells & hydrogen for sustainability



Innovative Medicines Initiative



Joint Exhibition
30 September - 4 October 2013

Fuel Cells and Hydrogen technologies can contribute to:

Sustainability

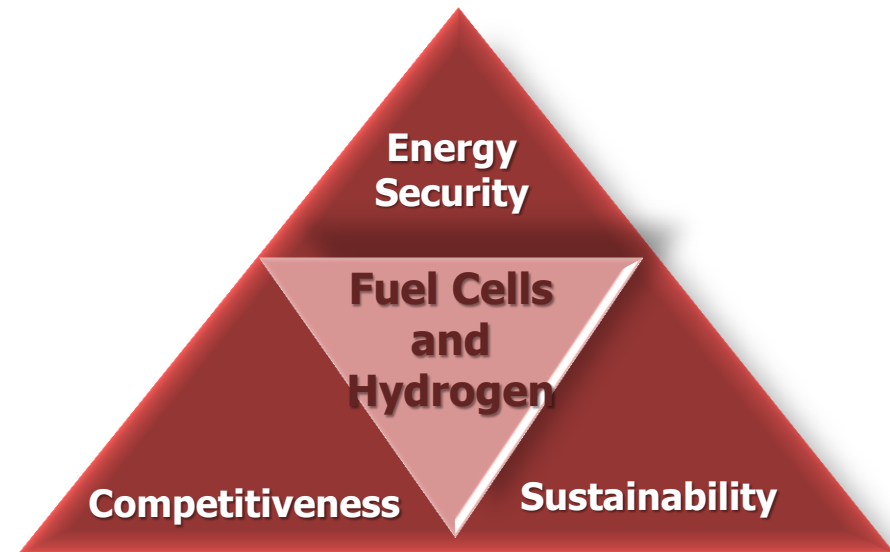
- H2 is a clean carrier of energy
- Transport and stationary applications, generate electricity and heat
- Storage of renewable energy sources
- Reduction of CO2 emissions

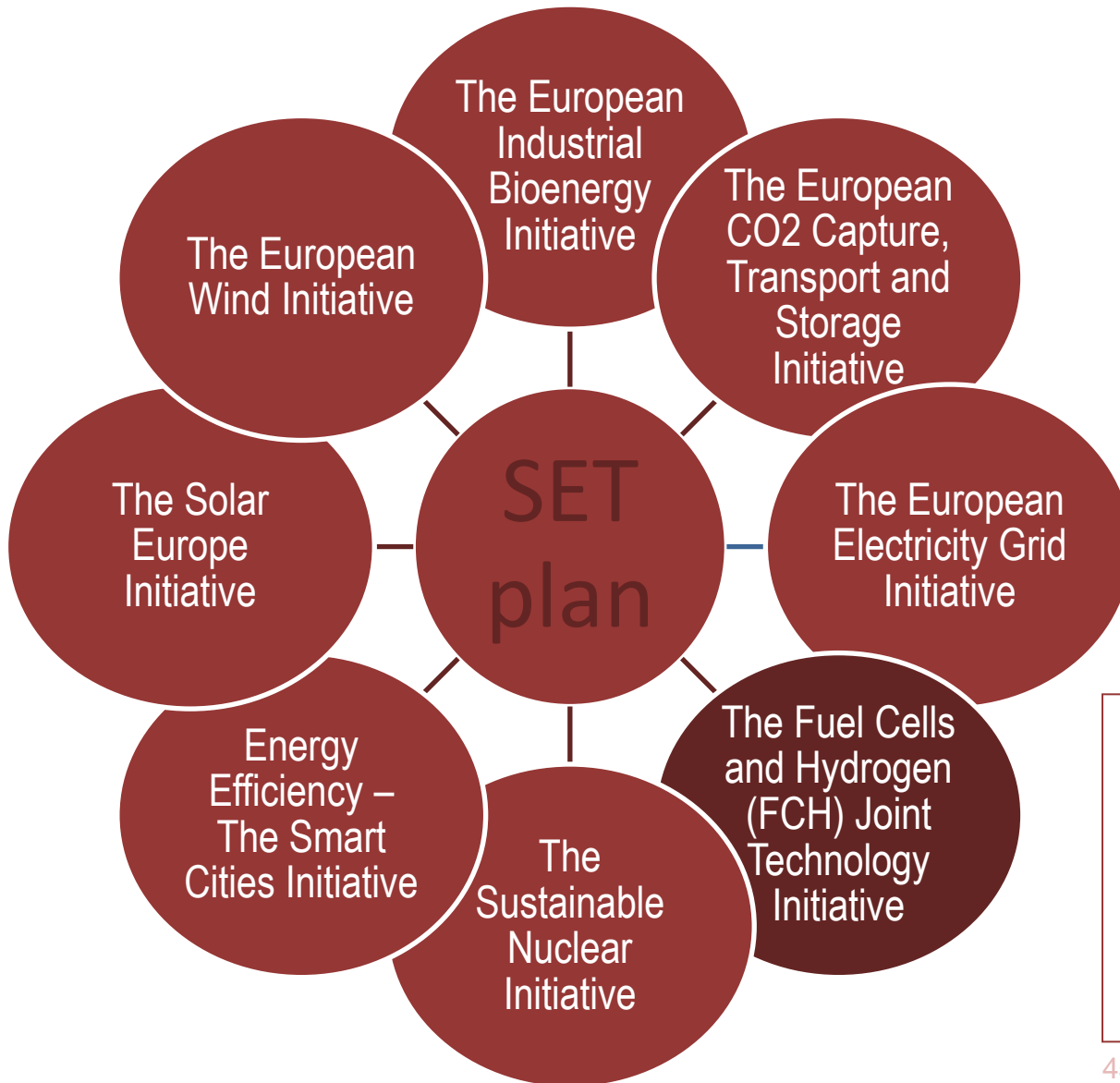
Energy Security

- Increase independence from unstable outside regions

Competitiveness

- research excellence leading to industry innovation and growth





EU targets :

- 20 % increase in renewables
- 20 % increase in efficiency
- 20 % decrease in emissions

Fuel Cell and Hydrogen Joint Undertaking as PPP

- FCH JU : community body
- Budget : 940 M € : 50/50
- FCH JU Programme Office

INNOVATION IN ACTION

JOINT
TECHNOLOGY
INITIATIVES

Fuel Cells & Hydrogen Joint Undertaking



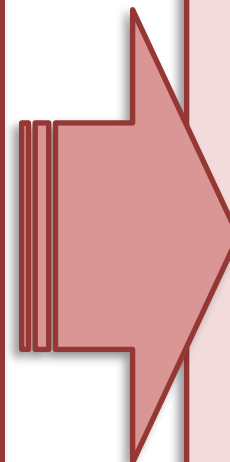
Industry Grouping
Over 60 members



European Union
represented by the
European Commission



Research Grouping
Over 60 members



To accelerate the
development of
technology base
towards **market**
deployment
of FCH
technologies
from 2015 onwards

Both the Industry Grouping and the Research Grouping are non-profit organisations with open membership

Main achievements of FCH 1 JU :

- Strong community in Europe, increased FCH visibility,
- Consensus strategy (MAIP/AIP)
- Pre-competitive collaboration
- 430 participants in 127 projects
- SME participation 23%

- **Transport:**
 - 49 buses, 37 passenger cars, 95 mini cars
 - Bus H2 consumption halved
 - 13 new refuelling stations
 - H2 cost < 10€/kg

- **Stationary:**
 - 1000 domestic Combined Heat & Power generators
 - Cost - 50%, efficiency 90%, lifetime up to 8 years

- **Early markets:**
 - 9 fork lifts, 1 tow truck
 - 19 back up power units



INNOVATION IN ACTION

JOINT
TECHNOLOGY
INITIATIVES

10%

average increase of annual **turnover** (on a 2012 total of €0.5 billion)

8%

average increase of **R&D expenditures** (2012 total €1.8 billion)

6%

average increase of **market deployment expenditures** (2012 total €0.6 billion)

6%

growth in **jobs** per year (~4,000 FTE in 2012) while average EU job market has contracted

16%

annual increase in **patents** granted in the EU to European companies (average 1.5% for all European industries)

INNOVATION IN ACTION

JOINT
TECHNOLOGY
INITIATIVES

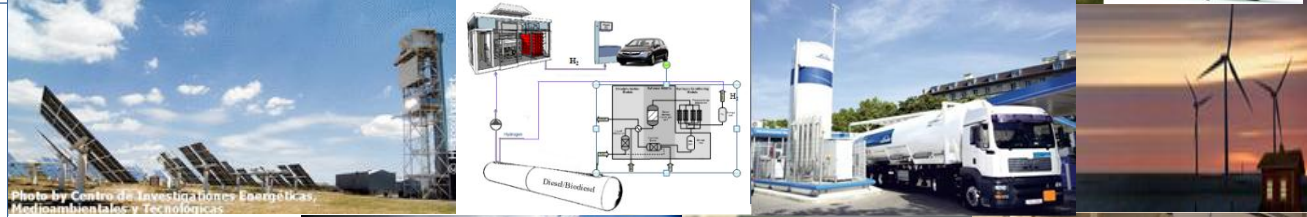
TRANSPORTATION & REFUELLING INFRASTRUCTURE

25 projects
8 demo
14 research
3 CSA



HYDROGEN PRODUCTION & DISTRIBUTION

28 projects
4 demo
24 research



STATIONARY POWER GENERATION & CHP

36 projects
9 demo
26 research
1 CSA



EARLY MARKETS

21 project
13 demo
8 research



CROSS - CUTTING

17 project

RCS, Safety, Education, PNR, ...



**26 Buses in 5 cities,
50% reduction of
fuel consumption**

- Operation of **26 fuel cell buses** in 5 cities in Europe (**Bolzano, London, Milano, Oslo**) and the respective infrastructure for a period of 5 years
- Transfer of learning from cities with experience in operating buses and infrastructure (Hamburg, Berlin, Cologne, Whistler; ~ 30 fuel cell buses) to the 5 cities
- Assessment of the technology with focus on environment, economy and society
- Dissemination to the general public and to cities preparing for the technology in the next step
- 2 filling stations per city
- Demonstration phase 2010-2016
- **Cost 82 M€, 26 M€ funding**
- <http://chic-project.eu/>



Next-Generation PEM Electrolyser For Sustainable Hydrogen Production

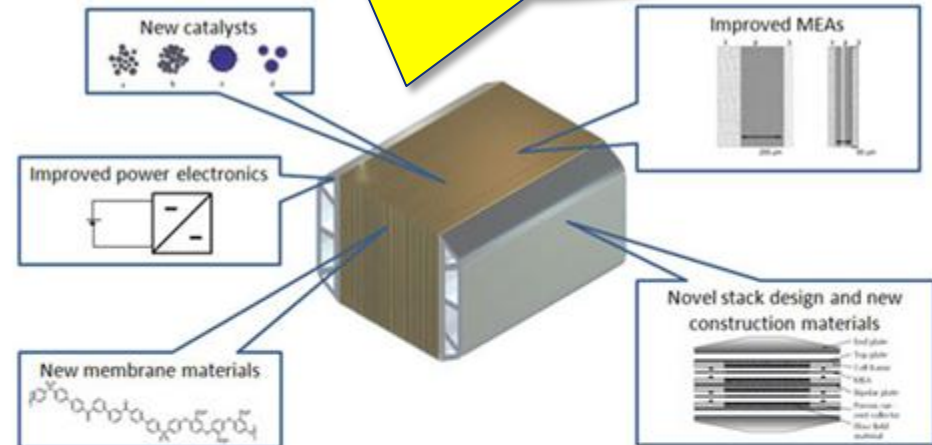
Construction and demo of an efficient PEM electrolyser integrated with Renewable Energy Sources (RES)

Goals: improvement of components, reduce cost and improve stability.

Advanced stack design using components suitable for mass production and highly efficient power electronics.

<http://www.sintef.no/Projectweb/nexpel/>

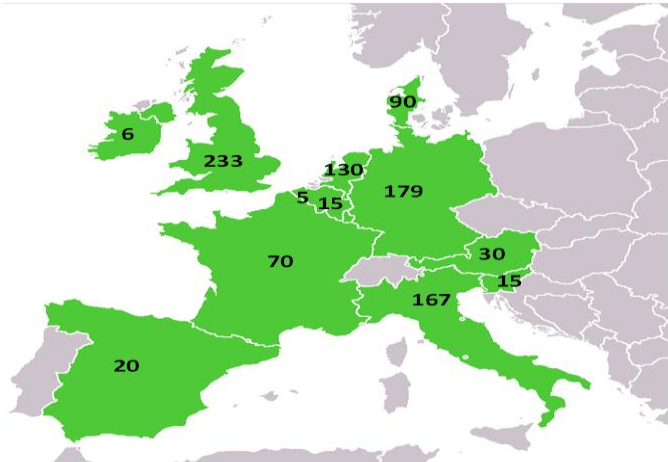
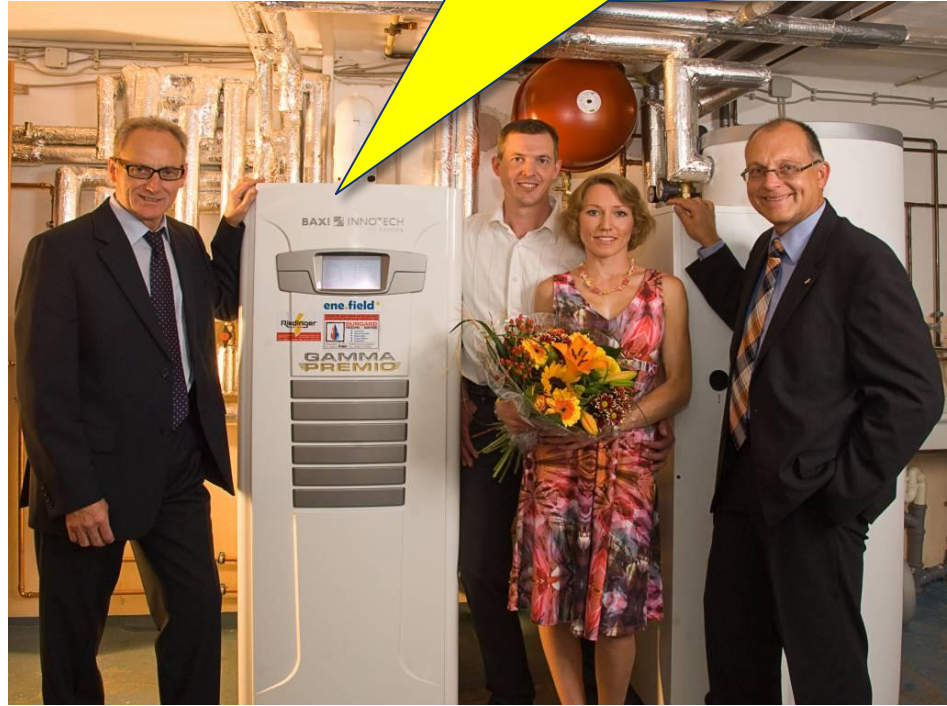
**Electrolyser Targets:
75% efficiency,
lifetime of 40000 h**



INNOVATION IN ACTION

Target: 1000 high-efficiency domestic units installed

- Demonstration of up to 1000 residential fuel cell μ CHP (1-5 kW) units from 9 manufacturers in 12 EU member states
- Establish supply chains, validate new routes to market, stimulate cost reduction for commercial deployment
- <http://www.enefield.eu>







FCH JU Target	State of the Art	Expected performance
Electrical efficiency (min) 35%	30 %	35 % – 50 %
Overall efficiency > 85% (LHV)	70 % – 85 %	Up to 90 %
Lifetime : of 8 - 10 years	3 years	Up to 8 years



**Target:
30 FC fork lifts
demonstrated**

European demonstration of fuel cell powered materials handling vehicles including infrastructure

-  demonstration of 30 fuel cell forklifts
-  demonstration of hydrogen refuelling infrastructure
-  performance of accelerated durability tests
-  <http://www.hylift-demo.eu/>



INNOVATION IN ACTION

JOINT
TECHNOLOGY
INITIATIVES

A portfolio of power-trains for Europe:
a fact-based analysis



The role of Battery Electric Vehicles, Plug-in Hybrids and Fuel Cell Electric Vehicles

Industry participants

Car OEMs	DAIMLER HONDA The Power of Dreams	HYUNDAI KIA MOTORS GM	KIA NISSAN Ford	RENAULT VW TOYOTA	BMW
Oil and gas	Eni	OMV OMV	Shell	TOTAL	galp energia
Utilities	EnBW	VATTENFALL			
Industrial gas companies	AIR PRODUCTS	AIR LIQUIDE			Linde
Equipment OEMs	INTELLIGENT ENERGY Clean fuel and power			Powertech	
Wind	NORDEX				
Electrolyser companies	HYDROGENICS Advanced Hydrogen Solutions	PROTON ENERGY SYSTEMS	ELT Elektrolyse Technik		Hydrogen Technology
NGOs, GOs	European Climate Foundation	NOW Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie			Clean Energy World

Publication: 8 November 2010

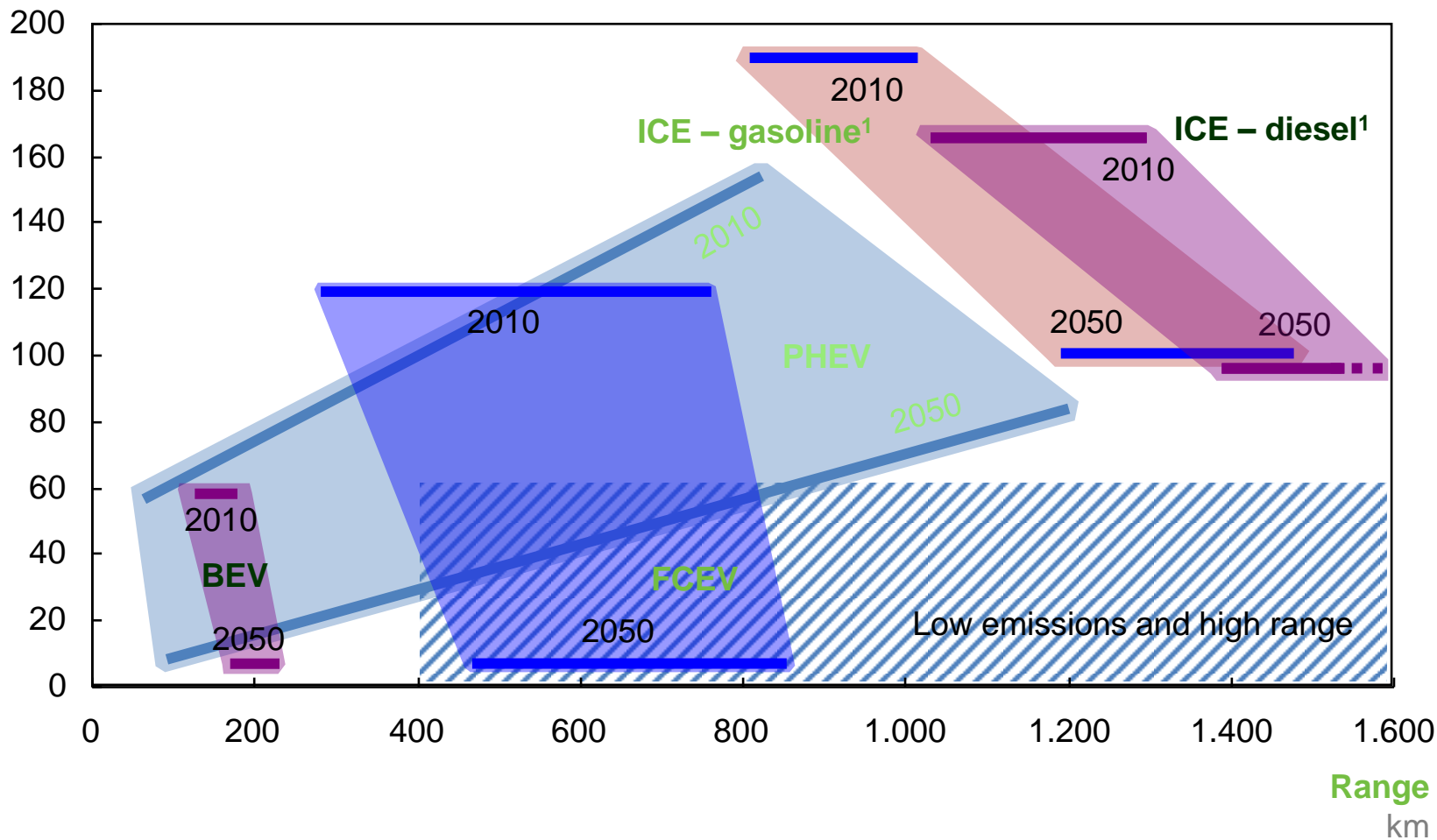
Available on <http://fch-ju.eu>

Battery and fuel cell vehicles can achieve low emissions

C/D SEGMENT

CO₂ emissions

gCO₂/km



H2 Mobility in Germany



H₂ Mobility initiative

Leading industrial companies agree on an action plan for the construction of a hydrogen refuelling network in Germany

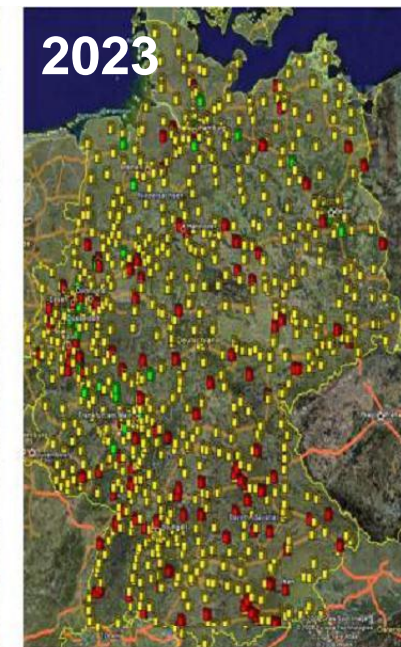
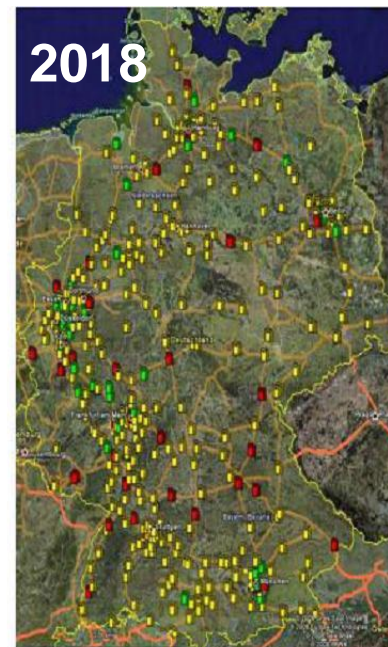
- Hydrogen refuelling network to grow to about 400 filling stations by 2023
- Precondition for the market success of fuel cell powered electric vehicles initiated
- Overall investment of around €350 million planned
- Development plan represents the benchmark at international level

Stuttgart, 30 September 2013 – The six partners in the "H₂ Mobility" initiative - Air Liquide, Daimler, Linde, OMV, Shell and Total – have set up upon a specific action plan for the construction of a nationwide hydrogen refuelling network for fuel cell powered electric vehicles. By the year 2023 the current network of 15 filling stations in Germany's public hydrogen infrastructure shall be expanded to about 400 H₂ filling stations. As a first step the deployment of 100 hydrogen stations in Germany over the next 4 years is intended. This would ensure a need-related supply for fuel cell powered electric vehicles to be introduced into the market in the next years. An agreement in principle has been signed by representatives of all the partners involved.

In addition to plans for a nationwide filling station network, the agreement includes the principles for the procurement and distribution of the necessary hydrogen and a request for support to the German Federal Government. Following the foundation of a joint venture (subject to necessary regulatory approvals), gradual expansion of the national filling station network will commence next year. This means that an H₂ supply suitable for everyday use shall be created not only for densely populated areas and main traffic arteries, but also for rural areas. The objective is to offer an H₂ station at least every 90 kilometres of motorway between densely populated areas. According to this plan in metropolitan areas, drivers of fuel cell powered vehicles will have at least 10 hydrogen refuelling stations available each from 2023. Thus zero tailpipe emission H₂-mobility is becoming increasingly attractive for customers. The "H₂ Mobility" initiative expects that a total investment of around €350 million will be required for this future-oriented infrastructure project.

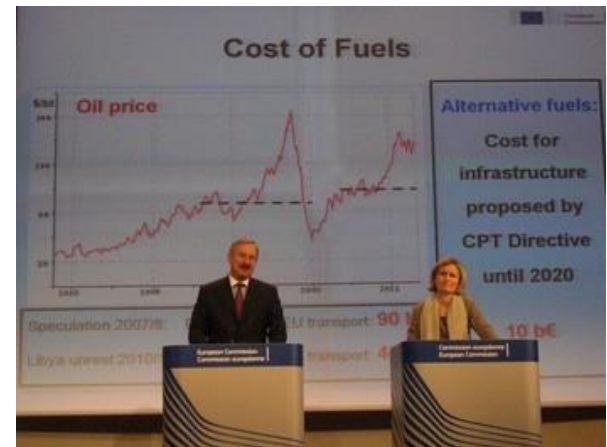
The launch of fuel cell powered production vehicles on the German market has been announced by first manufacturers for 2015. In addition to attractive procurement and

- Initiative gathering the German government and 6 major industrial companies
- 400 hydrogen stations by 2023
- Investment of € 350 million
- Benchmark at international level



Clean Power for Transport Package

- Proposal for Directive on the deployment of alternative fuels infrastructure
 - Framework (minimum infrastructure)
 - Common EU standards
 - Consumer information
- Associated costs:
 - Electricity = 8 M charging points = 8 B€
 - LNG Waterborne = 139 refuelling points * 15 M€ = 2,1 B€
 - LNG trucks = 144 refuelling points * 0.4 M€ = 58 M€
 - CNG road = 654 refuelling points * 0.25 M€ = 164 M€
 - **Hydrogen = 77 refuelling stations * 1.6 M€ = 123 M€**



Fuel Cells and Hydrogen 2 Joint Undertaking

extension under Horizon 2020

General objectives

- Contribute to the objectives of the Joint Technology Initiative on FCH
- Development of a strong, sustainable and competitive FCH sector

Specific Objectives

- Reduce **cost** of fuel cell systems for **transport** applications, while increasing their **lifetime**
- Increase the electrical **efficiency** and the **durability** for **power** production, while reducing costs
- Increase the energy **efficiency** of production of hydrogen from **electrolysis** while reducing capital **costs**
- Demonstrate **integration** of renewable energy sources through **H2 storage**

➔ **Adopted by the Commission on 10 July 2013
as part of the Innovation Investment Package**

Comparison with FCH 1 JU :

Unchanged :

- Members
- PPP structure
- Implementation mainly through calls for proposals

New :

- Emphasis on storage of hydrogen for integration of renewable energy sources into grid
- More demonstration and market uptake (60%)
- Two areas of activity only
- Increased EU contribution (700M €)
- In-kind contributions only from members (or constituent entities)

Transport

- Road vehicles
- Non-road vehicles and machinery
- Refuelling infrastructure
- Maritime, rail and aviation applications

Energy

- Hydrogen production and distribution
- **Hydrogen storage** for renewable energy integration
- Fuel cells for power and combined heat & power generation

Cross-cutting Issues

(e.g. standards, consumer awareness, manufacturing methods, ...)

- Implemented mainly through calls for proposals
- Follow H2020 Rules for Participation, **no derogations**

FCH 2 JU activities are fully in line with EU policy:

- Linked to Energy and Transport Challenges of H2020
- Contributing to Climate Challenges, Resource Efficient Europe, Low-Carbon Economy 2050, ...
- Enabling Smart, Sustainable and Inclusive Growth

Strong relations with transport and energy-related initiatives at European level, such as:

- SET-Plan Industrial Initiatives (wind, solar, grids)
- Strategic Transport Technology Plan (STTP)
- European Green Vehicle Initiative (EGVI) contractual PPP
- Clean Power for Transport Package
- Smart Cities and Communities EIP

Fuel Cells and Hydrogen Joint Undertaking

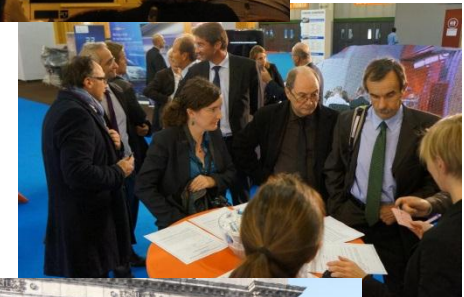


6th Stakeholder General Assembly of the European Partnership for Fuel Cells and Hydrogen

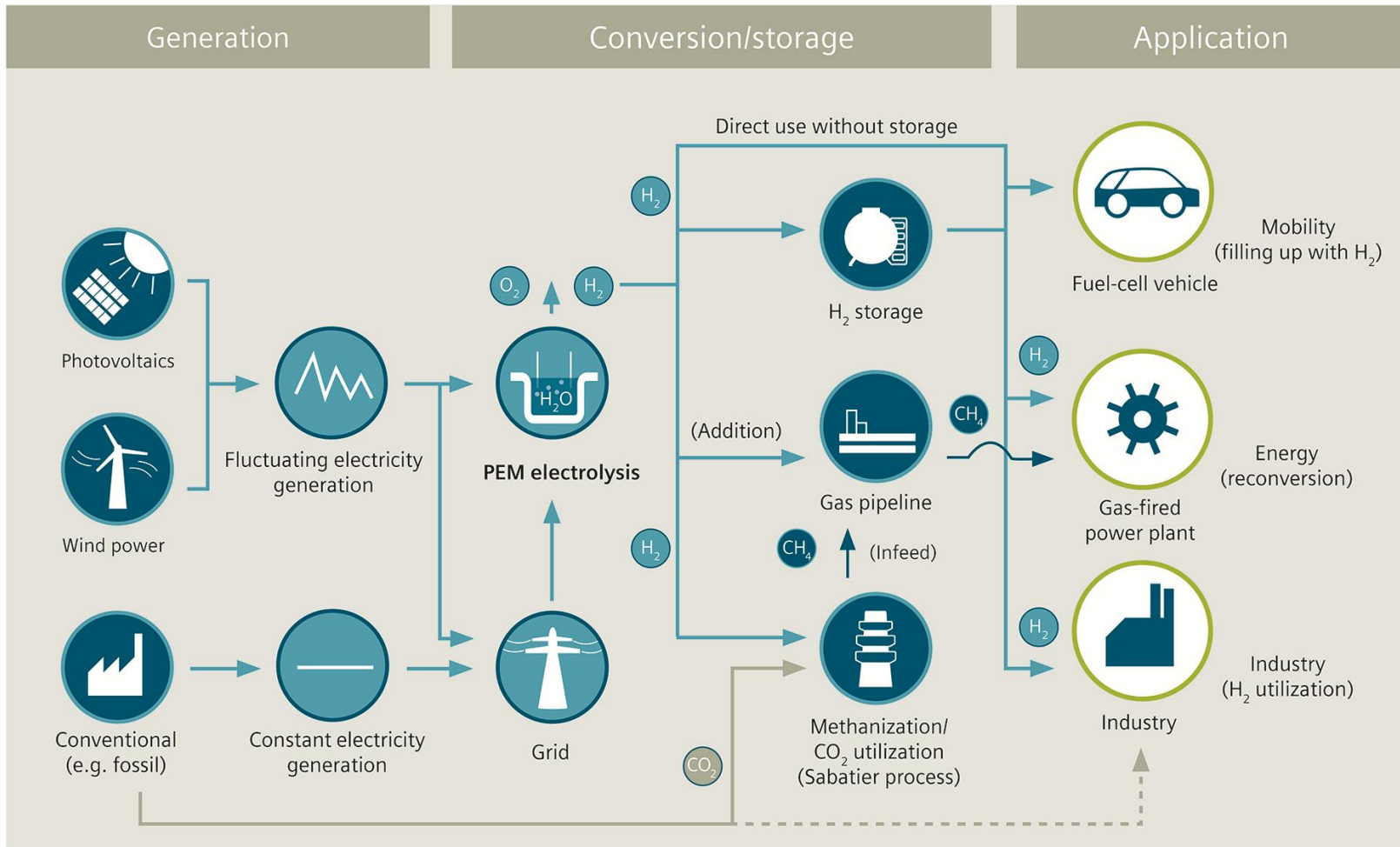
*"Fuel Cells and Hydrogen:
Towards a competitive, sustainable Europe"*

13 November 2013 / Brussel, Belgium

Leading speakers from the fuel cell and hydrogen community will meet on the occasion of the 2013 Stakeholder General Assembly of the Fuel Cells and Hydrogen Joint Undertaking. This high-level forum will mark the 10th anniversary of a European FCH strategy and take stock of exciting new developments in the sector. Importantly, it will set out the strategic vision of how fuel cells and hydrogen can help achieve EU 2020 targets.



Hydrogen as “smart link” for Renewable Energy



Applications and examples of use of hydrogen electrolysis



INNOVATION IN *ACTION*

Joint Exhibition
30 September - 4 October 2013

JOINT
TECHNOLOGY
INITIATIVES



fuel cells & hydrogen for sustainability



Innovative Medicines Initiative