



# Fuel Cell & Hydrogen Technology in Transportation Applications

An overview about activities in the FCH JTI

## Scope & Objectives

- Accelerate market introduction of fuel cell & hydrogen technology in the transportation sector in Europe
- Join forces and create synergies between different transportation sectors (road, air, rail, maritime)
- Create a European fuel cell & hydrogen supply chain to provide competitive products and economic growth.
- Achieve excellent exploitable research results as basis for successful FC&H<sub>2</sub> products

## H<sub>2</sub> & Fuel Cell Demonstration Roadmap for Road Vehicles

### Phase I

**Anticipated car numbers**

up to 25 vehicles per OEM  
up to 100 vehicles in total

**Anticipated number of car demo sites**

1 EU region

**Anticipated bus numbers**

ca. 10-20 buses per OEM  
up to 100 buses in total

**Anticipated number of bus demo sites**

3 EU regions

### Phase IIa

**Anticipated car numbers**

up to 100 vehicles per OEM  
up to 500 vehicles in total

**Anticipated number of car demo sites**

1 + x (up to 3) EU regions

**Anticipated bus numbers:**

ca. 100 buses per OEM  
up to 500 buses in total

**Anticipated number of bus demo sites**

3 + x (up to 10) EU regions

**Regions shall ensure  
sufficient technical  
infrastructure and  
provide additional  
public funding**

### Phase IIb

**Snapshot  
2020:**

0.4 - 1.8  
million vehicles

**Phase IIb shall show  
further progress  
towards  
Snapshot 2020**

2008

2009

2010

2011

2012

2013

2014

2015

7th Framework Program

## H<sub>2</sub> & Fuel Cell Demonstration Roadmap for Rail Vehicles

### Phase I

#### Anticipated train numbers

1 train per OEM – 2 types  
2 trains in total

#### Anticipated number of train demo sites

Prepare 2 EU regions  
using a transportable  
H<sub>2</sub> filling infrastructure

### Phase IIa

#### Anticipated train numbers

1 train per OEM- 2 types  
2 trains in total

#### Anticipated number of train demo sites

Prepare 2 different EU regions  
using a transportable H<sub>2</sub> filling infrastructure

### Phase IIb

#### Anticipated train numbers

3-4 trains per OEM project  
6-10 trains in total  
At least 3 OEMS

#### Anticipated number of train demo sites

2 + x EU regions

Design, Manufacture & Test

Demonstration

Sites shall assure  
sufficient technical  
infrastructure and  
provide additional  
public funding

2008

2009

2010

2011

2012

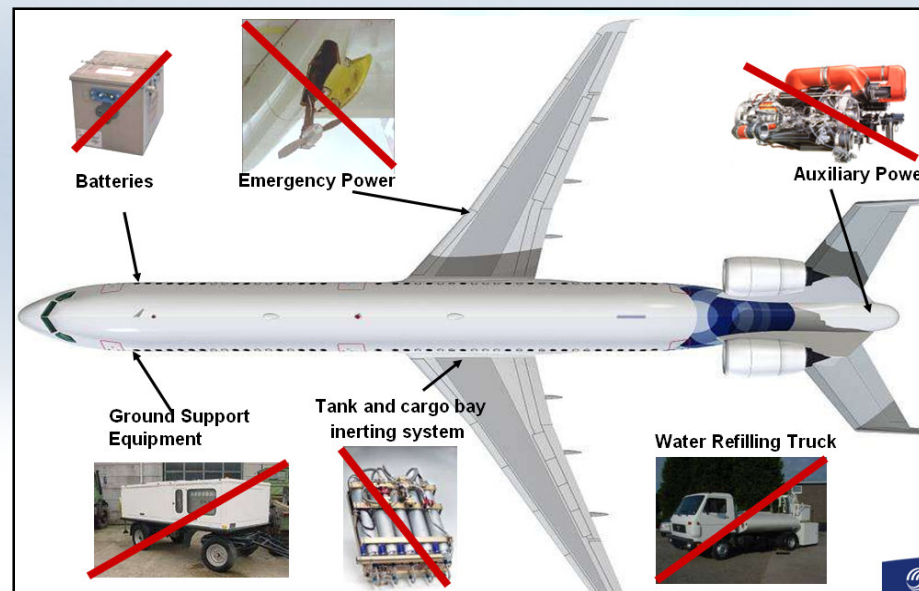
2013

2014

2015

7th Framework Program

## H2 & FC Demonstration Roadmap of the Aerospace Industry



## FCH Transportation Topics (Draft)

### T - Transportation & Refuelling Infrastructure

No.	Activity	Cat	Rationale
T01	Road vehicle large scale demonstration including refuelling infrastructure	D	Large-scale demonstration of second-generation fuel cell vehicles fleets with improved duration, robustness, reliability and efficiency to prove application readiness of the technology; demonstrate feasibility of infrastructure for daily use; provide extended operating experience and awareness to customers and the public; provide a data base for the assessment of environmental benefits associated with the commercial introduction of fc vehicles and infrastructure.
T02	European fuel cell stack including concerted action	AR	Develop a European cluster of excellence for research for the establishment of a European transportation stack based on a joined technology road map and combined basic and applied research activities to close the competitive gap with Japan and the US.
T03	Storage compressed gaseous H <sub>2</sub>	AR	Applied research on hydrogen onboard storage technology to allow for the application readiness of storage technology and address associated functional performance as a pre-condition of Activity No. T01.
T04	Periphery air supply	AR	Applied research on air supply systems as a critical system module to further improve system performance, efficiency and robustness; also assess improved architectures and alternative concepts.
T05	PEM-FC catalyst	BR AR	Long-term basic and applied research on PEM-FC-catalysts to further reduce the relative use of platinum in MEAs; further increase performance and electro-chemical stability of the catalyst; identify potential, alternative low-cost catalysts.

## FCH Transportation Topics (Draft)

### T - Transportation & Refuelling Infrastructure

No.	Activity	Cat	Rationale
T06	PEM-FC membrane including HT-membrane & transport process	BR AR	Long-term basic and applied research on PEM-FC-membranes to reduce humidification requirements, improve mechanical stability and increase operating temperature, thereby further enhancing robustness and life time and allowing for the further simplification of system architectures.
T07	Investigation of degradation phenomena	BR AR	Basic and applied research on critical operating conditions and parameter of fuel cell systems in order to establish a solid methodology and tools for life-time assessments and to help improve the fuel cell system and vehicle operating strategies.
T08	PEM-FC bipolar plates	BR	Long-term basic and applied research on PEM fuel cell bipolar plates in order to increase corrosion resistance, improve manufacturability and reduce weight, volume and cost, thereby promoting the ultimate power density for automotive application.
T09	HRS components	AR	Applied research on key components of hydrogen refuelling station components in order to ensure application readiness for large-scale, real-use market introduction.
T10	Fuel cell systems for H <sub>2</sub> -fuelled airborne platforms	D	Demonstrate proof of concept for onboard power generation in aeroplanes by addressing critical application needs, e.g. increased efficiency of onboard power generation, onboard water production and ground taxiing to reduce local CO <sub>2</sub> emissions and substantially lower fuel consumption.
T11	Storage cryogenic H <sub>2</sub>	AR	Applied research on cryogenic storage as an alternative technology to store ≥10 kg hydrogen (70 MPa CGH <sub>2</sub> is the benchmark technology to be surpassed).

## FCH Transportation Topics (Draft)

### T - Transportation & Refuelling Infrastructure

No.	Activity	Cat	Rationale
T12	Rail propulsion	D	Demonstrate proof of concept for fuel cell propulsion systems based on automotive technology in commuter trains, rail cars and city trains in order to reduce local emissions, drastically cut the cost of infrastructure for new trails and increase the flexibility of the commuter system.
T13	Periphery H2 tank system & conditioning components	AR	Applied research on hydrogen storage and conditioning components of refuelling stations to further improve robustness, functionality and safety.
T14	Periphery H2 loop	AR	Applied research on on-board hydrogen loop architectures in order to further improve and mature robustness, performance, and simplify system architecture.
T15	PEMFC APU for rail and maritime application	AR D	Demonstrate proof of concept for onboard power generation APU in rail and maritime applications using PEM fuel cell in order to enhance efficiency substantially, reduce fuel consumption and local CO2 emissions; prepare for extended demonstration with next-generation technology, including 20% R&D on dedicated systems and components with focus on fuel processes
T16	H2-ICE	AR	Applied research on hydrogen ICE to reduce local emissions and support the establishment of a hydrogen infrastructure.

**DRAFT**



## Topics called in first FCH JTI call (published Oct 8, 2008)

Area/ Topics called	Funding Schemes	Indicative FCH JU Funding Mill. €
<b>Area SP1-JTI-FCH.1: Transportation &amp; Refuelling Infrastructure</b>		<b>8.9</b>
SP1-JTI-FCH.1.1 Demonstration of hydrogen fuelled road vehicles and refuelling infrastructure	Collaborative Project	
SP1-JTI-FCH.1.2 Preparation for large-scale vehicle demonstrations in Europe	Coordination and Support Actions (Supporting Action)	
SP1-JTI-FCH.1.3 European fuel cell stack cluster	Coordination and Support Actions (Supporting Action)	
SP1-JTI-FCH.1.4 Compressed hydrogen onboard storage	Collaborative Project	

## Outlook and challenges

- First demonstration projects for FCH road vehicles (including H<sub>2</sub>-infrastructure) will be started in 2009
- Due to limited budgets the number of vehicles will still be low
- It is necessary to align further activities in order to achieve a continuous and coherent build up of demonstration sites
- Studies on further demonstration projects and a European stackcluster will provide a sound base for further planning of demonstration projects and research on fuel cell technology
- Demonstration in road transportation as lead application will be followed by the other transportation sectors

## **Outlook and challenges**

- Basic research is paramount for further improvements of the technology
- Concentration and focus on major topics as well as using synergies is necessary to make the most efficient use of available budgets
- The FCH JTI has to be completed by national activities to achieve significant impact
- In the end FCH technology shall be ready for market entry

## Outlook and challenges

- The transportation committee of the IG will further contribute to the finalisation of the MAIP and AIP2009
- A leading role of industry is a key element of the JTI
- Learnings from the first call will be implemented in the second call
- The contradiction of disconnected separate (and competitive) calls and the need of long time planning has to be solved, especially for large scale demonstration projects
- Exploitable results from basic research can only be achieved by research activities which target to application
- RCS and PNR issues have to be handled in a proper way to make the best use of the existing expertise