Call 2016: - Transport Pillar Topics

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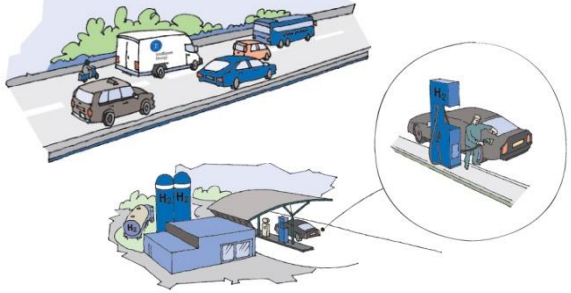
Enrique GIRÓN, Project Manager - Transport

FCH 2 JU objectives

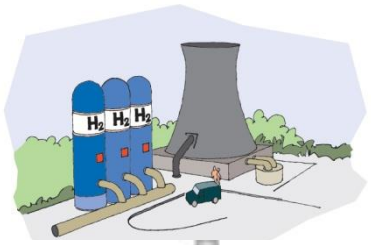
1. Reduction of production costs of long lifetime FC systems to be used in transport applications

2. Increase of the electrical efficiency and durability of low cost FCs used for power production

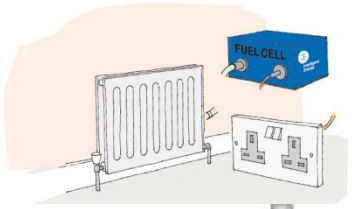
Transport



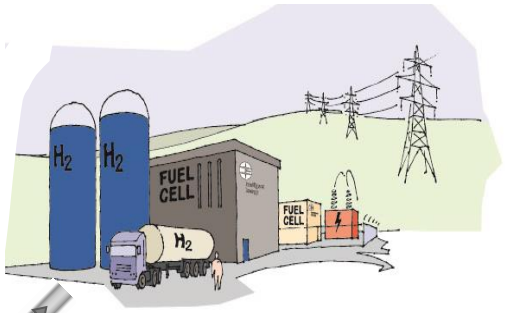
Industrial applications



Residential CHP



Feed to electricity grid

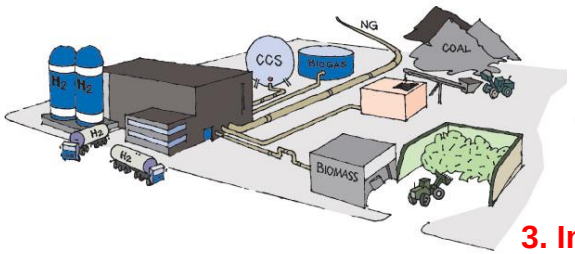


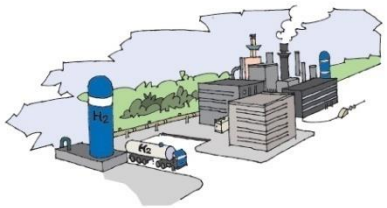
5. Reduce the use of critical raw materials

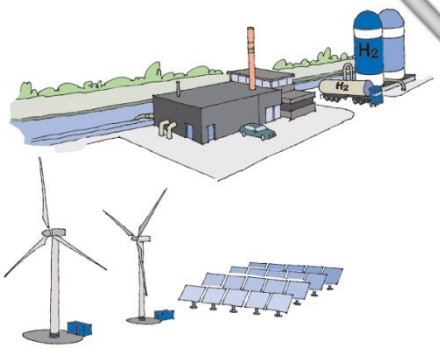
Existing natural gas, electricity and transport infrastructures

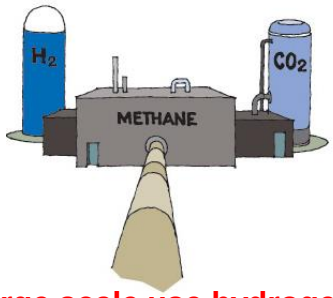
Methanisation feed to natural gas grid

By-product from Chemical Industry









Natural gas, biogas, coal, biomass

3. Increase the energy efficiency of low cost production of hydrogen from water electrolysis and renewable sources

Renewable generation, storage and 'buffering'

4 Large scale use hydrogen to support integration of renewable energy sources into the energy systems

Transport pillar
FCH-01 2016

Topic	Type of Action	Ind. Budget M EUR
FCH-01-1-2016: Manufacturing technologies for PEMFC stack components and stacks	Research & Innovation (RIA)	20
FCH-01-2-2016: Standardisation of components for cost-efficient fuel cell systems for automotive applications		
FCH-01-3-2016: PEMFC system manufacturing technologies and quality assurance		
FCH-01-4-2016: Development of industrialization-ready PEMFC systems and system components		
FCH-01-5-2016: Develop new complementary technologies for achieving competitive solutions for marine applications		
FCH-01-6-2016: Develop new complementary technologies for achieving competitive solutions for rail applications		
FCH-01-7-2016: Improvement of compressed storage systems and related manufacturing processes in the perspective of automotive mass production		
FCH-01-8-2016: Development of innovative hydrogen compressor technology for small scale decentralized applications for hydrogen refuelling or storage		
FCH-01-9-2016: Large scale validation of fuel cell bus fleets	Innovation (IA)	37
FCH-01-10-2016: Validation of fuel cell urban trucks and related infrastructure		

Topic 1.1: Manufacturing technologies for PEMFC stack components and stacks

Challenge

- **Enable a cost efficient production and thereby marketable products in the transport sector.**

Scope

- Develop manufacturing technologies
- Transpose established automotive industry best practices on production and quality
- Identification of bottleneck processes, improvement, modification, adaptation or even new development of at least two critical stack or stack component production steps
- Integration of inline non-destructive quality control tools and strategies compatible with ISO/TS16949
- Avoid duplication with VOLUMETRIQ
- Indicative Funding 3 MEuro; No. of projects: 2; Duration: 3-4 years
- MRL5 @ start, MRL6 @ end

Impact

- Demonstrate capability to increase from 100 stacks/year to 50,000 stack/year in 2020 for a total power of 5MW/year with a single line
- Produce engineering samples of the improved design for manufacturability of at least two relevant stack components, including their product validation
- Validate in hardware
- Achieve components yields> 95% for the improved stack component production steps

Topic 1.2: Standardisation of components for cost-efficient fuel cell systems for automotive applications

Challenge

- **Standardization of interfaces and system components to reduce cost of automotive fuel cell technology.**
- **Development and qualification of a capable European supplier base**

Scope

- Components suitable: air supply, fuel supply, valves, sensors, cooling, water management, DC/DC converters, current connectors…
- Minimum three components or subsystems;
- Standardized verification, validation and qualification test protocols
- Develop and build the components and test them against the specifications
- Assess the cost impact upon standardization
- Indicative Funding 3 MEuro; No. of projects:1; Duration: 3years
- TRL4 @ start, TRL7 @ end

Impact

- Recommendations for aligned interfaces and specifications for key PEMFC system components
- At least three PEMFC system components or subsystems modified, adapted and built
- Standardize verification, validation and qualification test protocols (&White paper)

Topic 1.3: PEMFC system manufacturing technologies and quality assurance

Challenge

- **Cost reduction of fuel cell systems and their components though manufacturing and quality assurance technologies.**

Scope

- Development of manufacturing technologies
- Transpose established automotive industry best practices on production and quality
- Identification of bottleneck processes in production lines, improvement, modification, adaptation or even new development of at least two critical system or system component production steps
- Integration of inline non-destructive quality control tools compatible with ISO/TS 16949
- Indicative Funding 3 MEuro; No. of projects: 2; Duration: 3-4 years
- MRL5 @ start, MRL7 @ end

Impact

- Increase production from 100 stacks/year to 50,000 stack/year in 2020 for a total power of 5MW/year with a single line
- Produce and validate engineering samples of the improved design for manufacturability of at least one relevant component, including its product validation
- Validate in hardware
- Validate the performance of the full system production in an existing production line
- Achieve components yields > 95% for the improved system component production steps

Topic 1.4: Development of industrialization-ready PEMFC systems and system components

Challenge

- **Improvement of system components and configurations to prepare for mass production**

Scope

- Development of a new generation of systems using cost engineering
  - Novel system prototypes that eliminate or reduce voltage cycling, CU/SD corrosion
  - Freeze start design and system component layout to enable faster start up at sub-zero temperature
  - Air compressor prototypes with higher efficiency at max load meet automotive dynamic requirements (0-90% power in 0.5s) and improve flow vs. pressure operating window at low current densities
  - Optional: Turbine/expanders prototypes; humidification prototypes; intercoolers
- Indicative Funding 5 MEuro; No. of projects: 1; Duration: 3-4 years
- TRL4 @ start, TRL7 @ end

Impact

- FC system production cost: 100 €/kW at 50 000 units/year production rate
- Maximum power degradation of 10% after 6000 h for passenger cars
- Cold Start: Improved freeze start up performance and reliability closer to standard automotive conditions

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Transport RIA
Topic 1.5: Develop new complementary technologies for achieving competitive solutions for marine applications

Challenge

- **Adoption of fuel cell technologies as power trains for large ships**

Scope

- Identify components with specific marine application requirements
- Select highest impact for the marine application in cost and performance
- Develop improved, industrialisation-ready system components
- Validate the system performance on a powertrain test bench and in a target marine vessel for a period of minimum 6 months
- Indicative Funding 3 MEuro; No. of projects: 1; Duration: 3-4 years
- TRL4 @ start, TRL7 @ end

Impact

- Fuel to electric efficiency > 42 %; Freeze start capabilities from -35ºC; Top -30ºC to +45ºC
- Powertrain system cost below 6000€/kW; stack life of >15,000 hours
- Fuel cell system of at least 75kW
- Formulation of initial go-to market strategy with support from stakeholders from the marine industry
- Potential for future demonstration ‘innovation’ actions once the project is completed

Topic 1.6: Develop new complementary technologies for achieving competitive solutions for rail applications

Challenge

- **Adoption of fuel cell technologies as power trains for electrification of railway**

Scope

- Identify components with specific rail application requirements
- Select highest impact for the rail application in cost and performance
- Develop improved, industrialisation-ready system components
- Validate the system performance on a powertrain test bench and a target rail vehicle for a period of minimum 6 months
- Indicative Funding 4 MEuro; No. of projects: 1; Duration: 3-4 years
- TRL4 @ start, TRL7 @ end

Impact

- Fuel to electric efficiency > 42 %; Freeze start capabilities from -35ºC; Top -30ºC to +45ºC
- Powertrain system cost below 6000€/kW; stack life of >15,000 hours
- Fuel cell system of at least 200kW
- Formulation of initial go-to market strategy with support from stakeholders from the rail industry
- Potential for future demonstration ‘innovation’ actions once the project is completed

Topic 1.7: Improvement of compressed storage systems and related manufacturing processes in the perspective of automotive mass production

Challenge

- **Achievement of the automotive cost targets changing manufacturing processes**
- **Vessel and ancillary component (tank valve, pressure regulator) integration in the vehicle**
- **Extended temperature range of the COPV**
- **Increase the acceptance of COPVs in automobile applications by means of a higher safety level**

Scope

- New and/or optimized tank geometries, standardized interfaces, manufacturing processes
- Improve filling and venting tolerance of COPV; Design a leak-before-burst vessel
- Provide input to revised regulation codes and standards for storage tanks for compressed hydrogen.
- Indicative Funding 3 MEuro; No. of projects: 1; Duration: 3-4 years
- TRL4 @ start, TRL6 @ end

Impact

- Best trade-off weight/cost savings with conventional COPV and/or novel geometries/architecture strategies
- New automated and flexible manufacturing processes, equipment and tools: COPV manufacturing yield increase by a factor of 3 & Standard deviation of burst pressure reduced by 30%
- Improved filling/venting tolerance of storage systems (temperature range: -60°C to +100°C) to sustain fast-filling and unrestricted extraction.
- Produce whitepapers for RCS and/or maintenance guidance
- Volumetric capacity: 0.023Kg/l (2020)
- Gravimetric capacity: 5%

Topic 1.8: Development of innovative hydrogen compressor technology for small scale decentralized applications for hydrogen refuelling or storage

Challenge

- **Reduce the cost and noise generation and make compression systems sufficiently dynamic to follow the hydrogen production rates maintaining efficiency to pressurize hydrogen from 1 to 1000 bar**

Scope

- Development of a modularly scalable, low noise hydrogen compression technology capable of
  - < 6 kWh / kg H2 from 1 to 1000 bars (or equivalent)
  - installed system cost of < €2,000/ (kg H2/day) on the long term
- Long duration testing of a typical start-stop operational profile during 9 months with <10% performance decay
- Validation of the hydrogen compression technology in a relevant simulated environment
- Indicative Funding 2.5 MEuro; No. of projects: 1; Duration: 3years
- TRL3 @ start, TRL5 @ end

Impact

- Modular scalability and operation; Low noise level(<60 dB at 5 m); Low energy demand
- 6 kWh/kg H2 for 1 to 1000 bar compression
- Low cost:
  - CAPEX: < €4,000/ (kg H2/day) on a short term basis with a target of <€2,000/(kgH2/day) on a longer term.
  - OPEX: lower maintenance cost and lower down time compared to conventional technology

Topic 1.9: Large scale validation of fuel cell bus fleets

Challenge

- **Establish a committed coalition that can achieve the aggregate volume for a full commercialisation of fuel cell bus technology by 2020**

Scope

- Roll-out of a set of fleets amounting to at least 100 FC buses
  - at least 3 locations with minimum 20 buses per depot
  - minimum 10 buses per location/depot for additional locations
- Hydrogen refuelling station for large bus fleets based on previous engineering research projects (min. > 20 buses and 400 kg refuelling capacity per day)
- MAXIMUM Funding 32 MEuro; No. of projects: 1; Duration: 4-6 years
- TRL7 @ start buses, TRL7 @ start HRS

Impact

- Further cost reduction of FC-buses; uptake of FC-buses by European cities
- Higher public awareness
- Increase the confidence of bus operators
- Deliver lessons learnt from implementing and operating large hydrogen bus fleets

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Topic 1.10: Validation of fuel cell urban trucks and related infrastructure

Challenge

- **Increase air quality in cities by reducing emissions of urban logistic vehicles**

Scope

- Deployment and demonstration of Fuel Cell urban truck fleets (3.5 - 20 tons)
  - Lifetime 25,000h; MTBF >2,500h; Efficiency >42%; Availability >90%
  - Funding lesser of 1,500€/kW or 3000,000€; minimum demo 24 months
- At least 10 urban trucks and the related infrastructure
- At least two major European cities with minimum 5 trucks each
- HRS: minimum 5 vehicles; availability 98%; potential to scale up; at the pump < 9 €/kg excl. taxes
- MAXIMUM Funding 5 MEuro; No. of projects: 1; Duration: 4-5 years
- TRL6 @ start for trucks; TRL7 @ start for HRS

Impact

- Significant step towards successful market introduction of FC trucks
- Increase the confidence of fleet operators in reliable fuel supply and demonstrate the viability of fuel cells for trucks
- Identify and disseminate lessons learnt from implementing and urban trucks for early adopters

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Call 2016: - Overarching projects Topics

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Enrique GIRON, Project Manager - Transport

Overarching projects
FCH-03 2016

Topic	Type of Action	Ind. Budget M EUR
FCH-03.1-2016: Development of innovative hydrogen purification technology based on membrane systems	Research & Innovation (RIA)	2

Overarching projects RIA
Topic 3.1: Development of innovative hydrogen purification technology based on membrane systems

Challenge

- **Develop innovative membrane based hydrogen purification methods fit for dynamic hydrogen demand at lower scale and high hydrogen purity requirements**

Scope

- Proof-of-concept and optimization of stand alone hydrogen purification technologies for small-scale clean-up steps of H2 produced from new production methods with:
  - low overall energy consumption
  - low investment cost
- Design and validation in relevant simulated environment of stand-alone hydrogen purification system
- Cost assessment and benchmarking with the conventional PSA
- Indicative Funding 2 MEuro; No. of projects: 1; Duration: 3 years
- TRL3 @ start; TRL5 @ end

Impact

- A step change in membrane based, small scale stand-alone hydrogen purification system
- Hydrogen recovery >90%; Hydrogen purity min 5N (SAE2719 or ISO 14687-2/3)
- Output capacity 2-5 kgH2/day; Energy consumption 5 kWh/kg H2
- Reduction of CAPEX compared to state of art (e.g. PSA purification) to 1,500€/kg H2/day