FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

FCH2 JU Appel à projets 2019

Lionel BOILLOT

4 Février 2019

Strong public-private partnership with a focused objective

EU Institutional Public-Private Partnership (IPPP)

Fuel Cells & Hydrogen Joint Undertaking (FCH 2 JU)

Hydrogen Europe

Industry grouping
About 130 companies
50% SME

European Commission

Hydrogen Europe Research

Research grouping
About 70 institutions

To implement an *optimal research and innovation programme* to bring FCH technologies to the point of market readiness by 2020

FCH 2 JU Programme structure

ENERGY

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

TRANSPORT

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

CROSS-CUTTING

(e.g. standards, safety, education, consumer awareness, …)

FCH 2 JU:

Total Budget: at least 1.3 bill.€

EU contribution: 665 mill.€

FCH JU programme implementation (2008-2018)

Energy

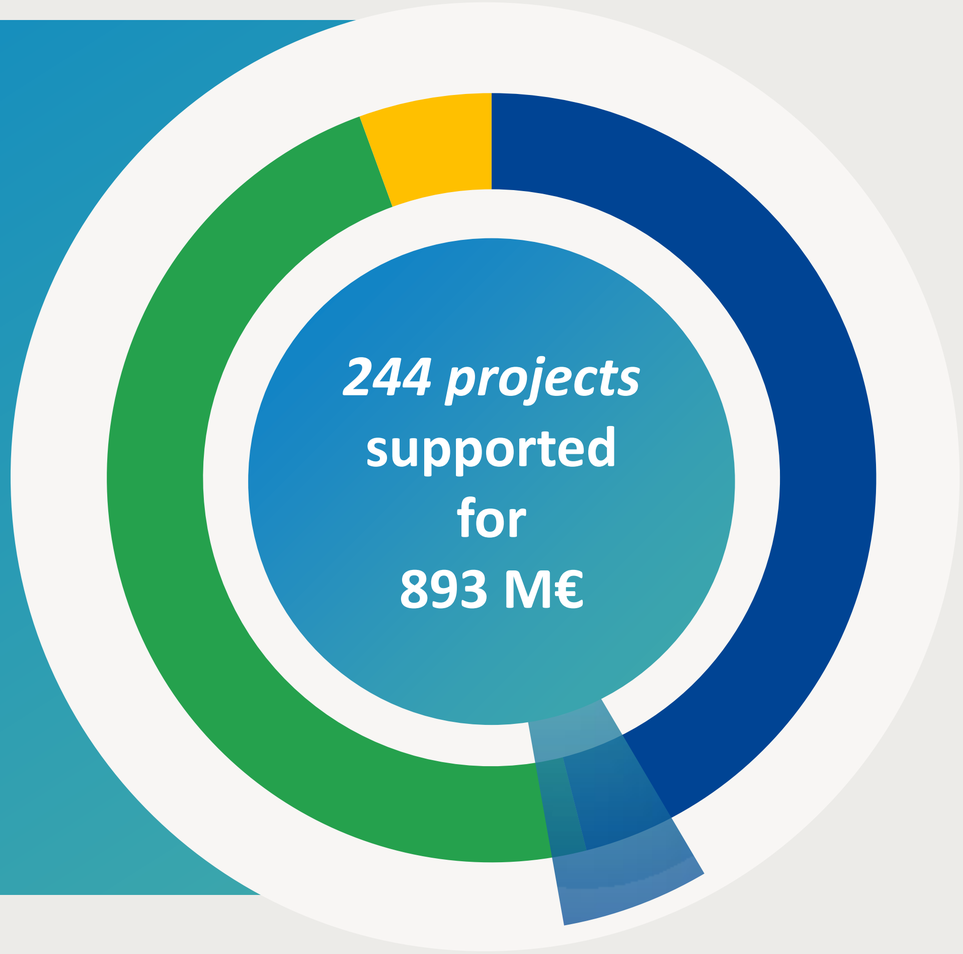
- Hydrogen production and distribution
- Hydrogen storage for renewable energy integration
- Fuel cells for power & combined heat & power generation

Transport

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

Cross-cutting

- E.g. standards, safety, education, consumer awareness …



47 %

418 million euros

135 projects

42 %

376 million euros

65 projects

6 %

53 million euros

40 projects

5 %

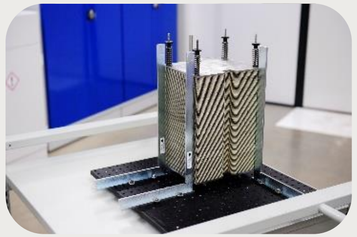
46 million euros

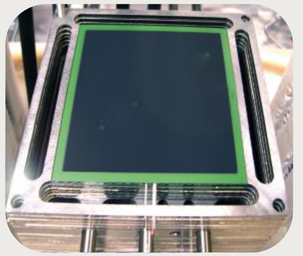
4 projects

Similar leverage of other sources of funding: 892 m€

Appel à projet 2019 - Aperçu

Reflects the industry and research partners' assessment of the state of the technological maturity of the applications and their estimated importance to achieve critical objectives of the FCH 2 JU





Appel: H2020-JTI-FCH-2019-1

Total budget: EUR 80.8 million

Ouverture: 15 Janvier 2019

Clotûre: 23 Avril 2019

Contenu = 17 sujets (topics

- Transport : 3 IA et 2 RIA pour EUR 27.3 million
- Energy: 3 IA et 5 RIA pour EUR 28.5 million
- Overarching : 1 IA pour EUR 20 million
- Cross-cutting : 2 RIA et 1 CSA pour EUR 5 million

International cooperation

Renewable and Clean Hydrogen Challenge under Mission Innovation

H2020 is open to the world - All topics are opened to international cooperation

In particular **international cooperation is strongly encouraged** with Mission Innovation countries and for the 6 topics identified with this logo 

Mission Innovation

- ➔ Launched in May 2018
- ➔ 16 countries
- ➔ Objective: *"To accelerate the development of a global hydrogen market by identifying & overcoming key technology barriers to the production, distribution, storage, and use of hydrogen at GW scale"*
- ➔ Scope:
  - focused multinational research & large scale demonstration efforts
  - from both public & private sectors
  - industry-directed breakthroughs within the next 3 years
  - renewable & clean hydrogen
  - 4 activity streams: making, sharing, using hydrogen & cross-cutting issues
- ➔ Australia, EU & Germany as co-lead countries

Types of Actions – Annex D

RIA - Research and Innovation Actions

Actions primarily consisting of activities aiming to establish new knowledge and/or to explore the **feasibility of a new or improved technology**, product, process, service or solution. For this purpose they may include **basic and applied research**, technology development and integration, testing and validation on a **small-scale** prototype in a laboratory or simulated environment.

*funding rate max.**100%***

IA- Innovation Actions

Actions primarily consisting of activities directly aiming at producing plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose they may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication.

*funding rate max.70%**

*Funding 100% for non-profit legal entities

CSA - Coordination and Support Action

Actions consisting primarily of accompanying measures such as standardization, dissemination, awareness-raising and communication, networking, coordination or support services, policy dialogues and mutual learning exercises and studies, including design studies for new infrastructure and may also include complementary activities of strategic planning, networking and coordination between programs in different countries.

*funding rate max.**100%***

Technology readiness levels (TRL) – Annex G

TRL 1 – basic principles observed

TRL 2 – technology concept formulated

TRL 3 – experimental proof of concept

TRL 4 – technology validated in lab

TRL 5 – technology validated in relevant environment

TRL 6 – technology demonstrated in relevant environment

TRL 7 – system prototype demonstration in operational environment

TRL 8 – system complete and qualified

TRL 9 – actual system proven in operational environment

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Transport

EUR 27.3 million

3 IA et 2 RIA

Transport Pillar Overview

Demonstration and research

Main Focus

- Consolidating **non-road application**:
  - Scaling up on **maritime** applications
  - Full industrial ecosystem for **logistic vehicles**
- **Research** for improve use of PEM fuel cells in transport applications:
  - Breakthroughs in **MEA**
  - **Hybrid drivetrain** optimization
- Improve HRS: **footprint** reduction

What is new

- Hybrid system **platform**
- Large industrial ecosystem with **multiple fuel cell vehicle types**
- **Underground storage**

Transport Pillar

Topics and type of action

Topic	Type of Action	Ind. Budget (M€)
FCH-01-1-2019: Demonstrating the blueprint for a zero-emission logistics ecosystem	*IA*	*10**
FCH-01-2-2019: Scaling up and demonstration of a multi-MW Fuel Cell system for shipping	*IA*	*10**
FCH-01-3-2019: Cyber-physical platform for hybrid Fuel Cell systems	*RIA*	*1.8***
FCH-01-4-2019: Towards a better understanding of charge, mass and heat transports in new generation PEMFC MEA for automotive applications	*RIA*	*2*
FCH-01-5-2019: Underground storage HRS	*RIA*	*1.5***

** Eligibility criteria: maximum funding*

***Maximum 1 project to be funded*

Transport Pillar Overview

Innovation and Research topics

FCH-01-1-2019: Demonstrating the blueprint for a zero-emission logistics ecosystem

Demonstrate the **distinct operating advantages** of fuel cell logistic and production vehicles in **comparison to battery solutions**

- Demonstrate at least **250 fuel cell logistic vehicles** at one or two industrial or logistic end-user sites
- Minimum **10 trucks/tow tractors, 10 vans/small trucks, 10 new logistic vehicles and 30 forklifts**
- Adaptation might be included but **not powertrain component development**
- Minimum demonstration time/operation hours per vehicle to be taken into account
- Focus on a healthy and diversified **European value chains**

FCH-01-2-2019: Scaling up and demonstration of a multi-MW Fuel Cell system for shipping

Give a solution to the urgency of **introducing ultra-low and zero-emission solutions for shipping**

- Adapt, scale up and demonstrate a fuel cell system for shipping with a total **minimum nominal power output of 2 MW**
- Open to **all types of FC technologies** and **all types of fuels** but must **reach >70% CO2 reductions**
- Minimum power: **500 kW/fuel cell unit** ; Adapted for **maritime conditions** ; Assessment of **scalability to 20 MW**
- If H2 is the fuel: study on a **bunkering concept** with the potential **for scaling** up to the requirements for 20 MW
- Special focus con relevant **regulation and codes ongoing activities**, promoting **international collaboration** beyond EU
- Minimum 12 months and 3,000 h of operation

Transport Pillar Overview

Research topics

FCH-01-3-2019: Cyber-physical platform for hybrid Fuel Cell systems

Increase the competitiveness of fuel cell systems for automotive through **optimization of the hybridization**

- Develop a validated **fuel cell system model and its hybridization** (both modelling tool and physical platform)
- Offer an **open, seamless and highly integrated** development platform for **fast prototyping** (XiL) for software or hardware models and create a common simulation, experimental and validation platform
- The XiL platform should be **open** regarding the interfaces **to other third party simulation and testing modules and tools**
- Several **end-users or vehicle manufacturers** to be part of the consortium

FCH-01-4-2019: Towards a better understanding of charge, mass and heat transports in new generation PEMFC MEA for automotive applications

Reduce the cost of fuel cells for transport application

- Reach understanding of promising **MEAs and MEAs components** to meet the target of **high-power density** PEMFC single repeat unit
- MEA targeting: **ultra-low Pt loading** (< 0.08 mg/cm^2), **high power density** (> 1.8 W/cm^2) and **compact design** (two to three-times thinner than today)
- Understanding of durability issues is **not part of the topic but it should be tested**
- At least **one OEM partner** should take part in the technical work

TRL 2 to 3-4

Transport Pillar Overview

Research topics

FCH-01-5-2019: Underground storage HRS

Allow the display of HRS were space is a constrain by **reducing footprint**

- Design, certify, build and operate for at least **6 months** a hydrogen retail station with **underground storage of hydrogen**
- Should be integrated into a **multi-fuel refueling station** that dispenses gasoline, diesel, and preferably also LPG and/or CNG
- Should develop recommended procedures for **safety assessment** and **permitting process** steps
- Include a minimum of one hydrogen dispenser capable of refueling **350 and 700 bar** FCEV
- **Equipment not related to storage are not eligible costs**
- "**CertifHy Green H2**" guarantees of origin should be used

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Energie

EUR 28.5 million

3 IA and 5 RIA

Energy Pillar Overview

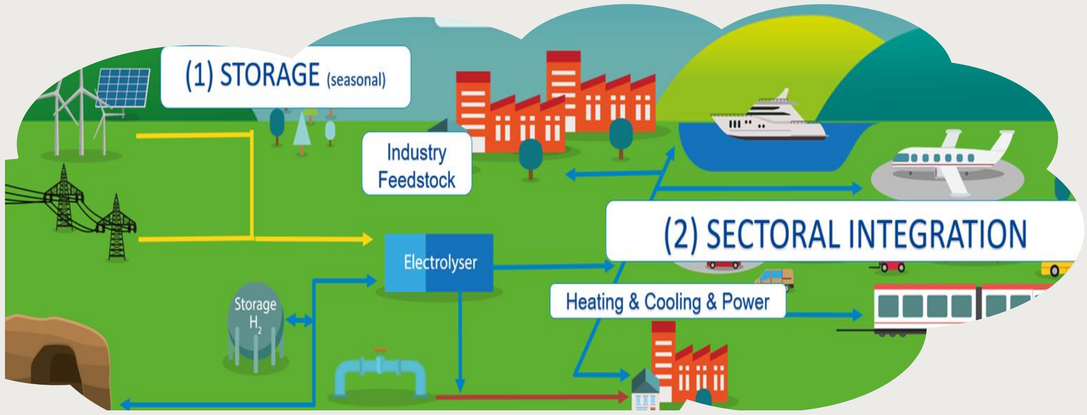
Electrolysers and Hydrogen injection in gas grid

Main Focus

- Greening of NG grid through **injection of electrolytic H_2** @ transmission and distribution NG grids
- Efficient electrolysers

What is new

- Injection of H_2 @ transmission and distribution lines of NG, facilitating HRS
- **Largest SOC** electrolyser (1.5t/d)
- Anion exchange electrolyser



Energy Pillar

Electrolysers and Hydrogen injection in gas grid

Topic	*Type of Action*	*Ind. Budget (MEUR)*
FCH-2-1-2019: Combined electrolyser-HRS and Power-to-Gas system	*IA*	*5*,****
FCH-2-2-2019: Multi megawatt high-temperature electrolyser for valorisation as energy vector in energy intensive industry	*IA*	*7*,****
FCH-2-4-2019: New Anion Exchange Membrane Electrolysers	*RIA*	*2*
FCH-2-5-2019: Systematic validation of the ability to inject hydrogen at various admixture level into high-pressure gas networks in operational conditions	*RIA*	*2***

** Eligibility criteria: maximum funding*

***Maximum 1 project to be funded*

Energy Pillar Overview

Innovation Actions

FCH-02-1-2019: Combined electrolyser-HRS and Power-to-Gas system

Reduce financial risk of HRS through NG injection and grid services

- Any transport client; Flexible electrolyser >600kg/d; **Injection @ low pressure** NG distribution grid
- **Co-location of HRS with gas distribution network**, ensuring downstream compatibility of devices with level of admixture
- Liaise with topics 02-5 and 04-3

TRL 6 to 8

FCH-02-2-2019: Multi megawatt high-temperature electrolyser for valorisation as energy vector in Energy Intensive Industry (EII)

Scale HTE to a level that has relevance to EII, demonstrating targets on η, durability & cost

- Focus not only on HTE but also on auxiliary equipment (steam supply, H_2 purification, compression)
- **2 separate stacks to be benchmarked @ 10kW** before upscaling
- 1.4t/d operated for 3 years with η degradation < 0.5%/1000h and stack production loss <1.2%/1000h
- Strategies for addressing constant demand with intermittent production based on renewables

TRL 7 to 8

Energy Pillar Overview

Research and Innovation actions

FCH-02-4-2019: New Anion Exchange Membrane Electrolysers

Material and design breakthroughs needed for AEME to fulfil their potential

- Develop new components (membranes, ionomers, PGM-free electrodes
- **1kW stack** with > 5 cells, 2V @ 1 A/cm^2
- Include industrial partner capable of scaling-up; International Collaboration encouraged.

TRL 2 to 4

FCH-02-5-2019: Systematic validation of the ability to inject hydrogen at various admixture level into high-pressure gas networks in operational conditions

Develop a platform for testing components of a **high pressure network (40-80 bar) for various H_2/CH_4 mixtures (0-100%, >5kg/h)**

- Test gas network equipment, appliances and coatings
- Test separation systems for cases where H_2 < 15%
- Legal, regulatory aspects; Safety; Gas metering; Leakage detection

TRL 4 to 6

Energy Pillar Overview

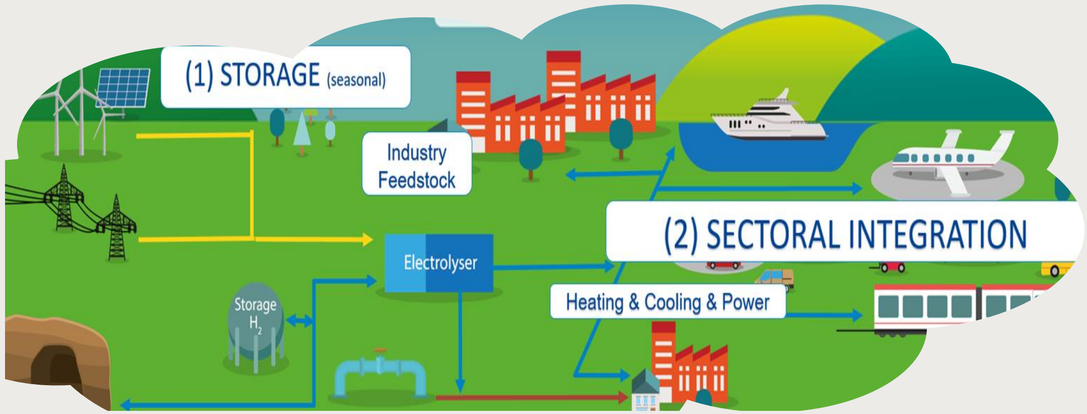
Fuel cells for Energy

Main Focus

- **Consolidating European leadership** on Solid Oxide based technologies and opening-up of new markets
- **Setting the basis for the commercialisation** of results emerging from research projects

What is new

- Innovative **poly-generation** systems using rSOCs
- **Optimised materials** and manufacturing process for SOCs under different operating modes
- Validation of **HTPEMFCs** for ~5kWe applications
- Demonstration of **advanced diagnostic and controls** tools for stationary FCs



Energy Pillar

Fuel Cells for Energy

Topic	Type of Action	Ind. Budget (M€)
FCH-02-3-2019: Continuous supply of green or low carbon H2 and CHP via Solid Oxide Cell based Polygeneration	*IA*	*3**
FCH-02-6-2019: New materials, architectures and manufacturing processes for Solid Oxide Cells *Maximum 1 project to be funded*	*RIA*	*5**
FCH-02-7-2019: Development of highly efficient and flexible mini CHP fuel cell system based on HTPEMFCs	*RIA*	*1.5**
FCH-02-8-2019: Enhancement of durability and reliability of stationary PEM and SOFC systems by implementation and integration of advanced diagnostic and control tools	*RIA*	*3*

*** Eligibility criteria: maximum funding**

For all topics: Maximum 1 project to be funded

Energy Pillar Overview

Innovation Action

FCH-02-3-2019: Continuous supply of green or low carbon H2 and CHP via Solid Oxide Cell based Polygeneration

Develop, engineer, **build** a SOC based **polygeneration** system :

- Electricity to hydrogen mode or
- Methane to hydrogen, electricity and heat mode

- Electrolysis **output** > 20 kg H2/day
- 5,000 hours **tests in real** industrial or mobility **environment**
- **Performance** criteria included in the AWP
- **New** operational and business **models**
- “CertifHy Green H2“ **guarantees of origin** should be used

TRL 4-5 to 6

Energy Pillar Overview

Research and Innovation actions

FCH-02-6-2019: New materials, architectures and manufacturing processes for SOCs

Optimisation of materials historically used for SOFCs for SOE, co-SOE and rSOC applicattions

TRL 2 to 4

- **Next generation** of cells and stacks for SOC applications
- New **materials**, architectures and **related manufacturing processes**
- Cell development -> short stack testing -> 5,000 hours **tests at stack level**
- At least **3 cell or stack manufacturers** involved in SOE, co-SOE or rSOC + research institutions / academic groups

FCH-02-7-2019: Development of highly efficient and flexible mini-CHP HTPEMFCs system

Develop, manufacture and validate a **mini-CHP device** using HTPEMFCs technology at **5 kWe**

- **Specific KPIs should be addressed** at proposal stage, e.g system elc eff of 50-55%
- **Validation** in relevant environment
- **At least two fuel cell system-core component** suppliers **and a system integrator** with clear perspectives and commitment to **exploit results commercially**

TRL 3 to 5-6

Energy Pillar Overview

Research and Innovation actions

FCH-02-8-2019: Enhancement of durability and reliability of stationary PEM and SOFC systems by implementation and integration of advanced diagnostic and control tools

Enhancement of durability and reliability of stationary PEMFC and SOFC systems

- Develop and demonstrate a **new generation of robust, general and cost-effective prognostic and control tools**
- Consider integration of **available monitoring and diagnostic** techniques
- At least **1 year testing** of MDPC tool (**prototype**) in **operational environment** for at least two PEM and two SOFC systems.
- **Cost** of the **FC systems** for the testing are **not in scope** of the topic
- Extended **lifetime , availability and reliability** / Specific KPIs in AWP 2019

TRL 4 to 7

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Overarching

EUR 20 million

1 IA

Overarching topics Overview

Focus: sector coupling through hydrogen

Topic	Type of Action	Ind. Budget (M€)
FCH-03-1-2019: H2 Valley	*IA*	*20**

** Eligibility criteria: maximum funding*

FCH-03-1-2019: H2 Valley

Developing, deploying and demonstrating replicable, balanced and integrated fuel cell and hydrogen-overarching solutions in both energy and transport fields

- At the end of the project hydrogen should be **100% green** (“**CertifHy Green H2**” should be used)
- At least **3 FCH applications** must be demonstrated from at least **two different sectors**: transport, energy and industrial
- At least **1,500 t H2 / year** should be used in the project, minimum 20% or **1 t H2/d per application**
- The **replicability** of the project is fundamental
- Secure additional **local/regional/national funding**
- Long-term vision (roadmap) how to **serve all energy needs from H2 and RES** based on a local/regional H2 economy **until 2050**

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Cross-Cutting

EUR 5 million

2 RIA and 1 CSA

Cross-cutting Activity Area Overview

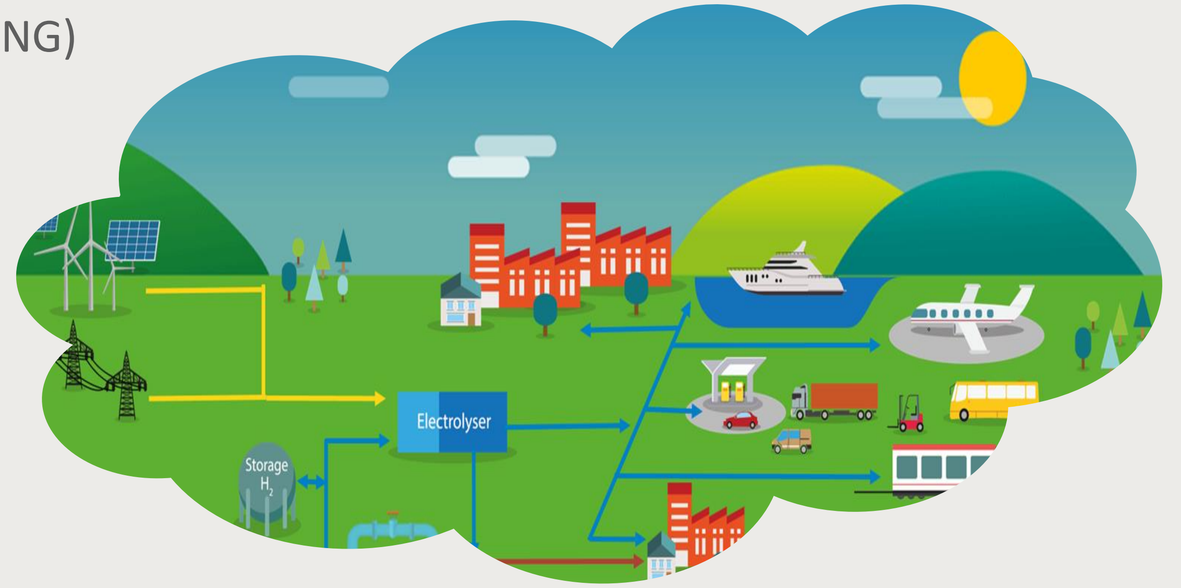
Activity Area facilitating the market uptake

Main Focus

- To guarantee an **effective response in Europe in case of emergency** related to hydrogen through education and training activities for first and second responders across Europe
- To provide knowledge-based information in **standards for upcoming FCH applications**
  - Medium and heavy-duty vehicles (M-HDV)
  - Hydrogen admixtures in the natural gas (H2NG)

What is new

- "**Train the trainers**" for first and second responders
- Development of **new refueling protocols** for M-HDV
- H2NG **impact assessment on NG appliances**



Cross-cutting Activity Area

3 Topics - 5 M€

Topic	*Type of Action*	*Ind. Budget (M€)*
FCH-4-1-2019: Training of Responders	**CSA**	**1****
FCH-4-2-2019: Refueling Protocols for Medium and Heavy-Duty Vehicles	**RIA**	**1.5****
FCH-4-3-2019: Hydrogen admixtures in natural gas domestic and commercial end uses	**RIA**	**2.5****

***** Maximum 1 project to be funded***

Cross-cutting Activity Area Topics Overview

Coordination and Support Action - CSA

FCH-04-1-2019: Training of Responders

Educate and train **tomorrow's first and second responder trainers** across Europe on hydrogen safety for a safe deployment of hydrogen technologies and its public acceptance

- **Further develop HYRESPONSE training program** to train first and second responders trainers
- **Establish a pan-European network of trainers** (≥10 countries) to replicate the training locally in their own country and language (≥ 7languages), integration in national training programs…
- **Establish an International Forum of First Responders in Hydrogen Safety Training**
- The consortium should include **fire service institution(s)**, **virtual reality for training**, **academic partner(s)**
- The project should establish **links with FCH 2 JU research and educational projects**

Cross-cutting Activity Area Topics Overview

Research and Innovation Action – RIA

FCH-04-2-2019: Refueling Protocols for Medium and Heavy-Duty Vehicles

Develop refueling protocol(s) for vehicles with CHSS >250litre, >10kg

Feasibility **study on future protocols needs and storage technologies** for vehicles with HSS >50kg

- **Fueling protocol(s)** should be developed **to fill any vehicle** with CHSS >250litre @ 350/ 700bar; -40°C ÷ +70°C,…
- **Identify factors** limiting the refueling rate in standards (120g/s) and **propose solutions** for larger flow rates
- **Technology review/ Benchmarking** on gaseous and liquefied H_2 dispensing to **identify most suitable storage technology/ boundary conditions for fueling**, ensuring the acceptability for all stakeholders
- **Hydrogen vehicle refuelling station(s)** should be made available at proposal stage
- **Findings and recommendations should be shared** with relevant sectors and standardization committees

Cross-cutting Activity Area Topics Overview

Research and Innovation Action – RIA

FCH-04-3-2019: Hydrogen admixtures in natural gas grid

Impact assessment on H2NG blends effects on NG end-user applications

- Assess the **effects of N2NG blends on combustion characteristics and performance of NG appliances**
- **Wide coverage**: appliances, %Vol H_2, NG compositions…(Previous results **should be included!)**
- The project should undertake **desk research supported by experimental program** to:
  - ✓ **Assess the sensitivity** to H2 concentration of existing end-use stock and new appliances
  - ✓ **Evaluate mitigation solutions** to widen the acceptance of higher H2 concentrations
  - ✓ **Identify new test methods/gases** for certification of domestic and commercial appliances
- Tests should cover the **impact on safety, efficiency, reliability, lifetime, and environmental performance**
- **Findings and recommendations should be shared** with relevant sectors and standardization committees