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HarmonHy (SES6- 513542)

Harmonization of Standards and Regulations for a Sustainable Hydrogen and Fuel Cell Technology

a "Specific Support Action" under the 6th Framework Programme of the European Commission

Areas for Additional Pre-normative Research for RCS

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on behalf of the HarmonHy Consortium

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Presentation Outline

1. Definitions
2. Summary of the work
3. Data collection
4. Inventory of public RDD Programs
5. Key findings
6. Needs for PNR to support RCS

1. Definition

What is Pre-Normative Research?

The meaning of pre-normative research used in the HarmonHy Project is:

the preliminary phase of experimental research aimed at better characterising the novel technologies and evaluating the related safety aspects by applying well established procedures and methodologies (whose development is part of the pre-normative activities).

2. Summary of the work

- World-wide Public RDD Projects/Programmes Inventory
- Pre-normative Research Project Selection
- Data Analysis Approach
  - Traffic Light Analysis
- Analysis of the Selected Projects
- PNR Gaps&Needs

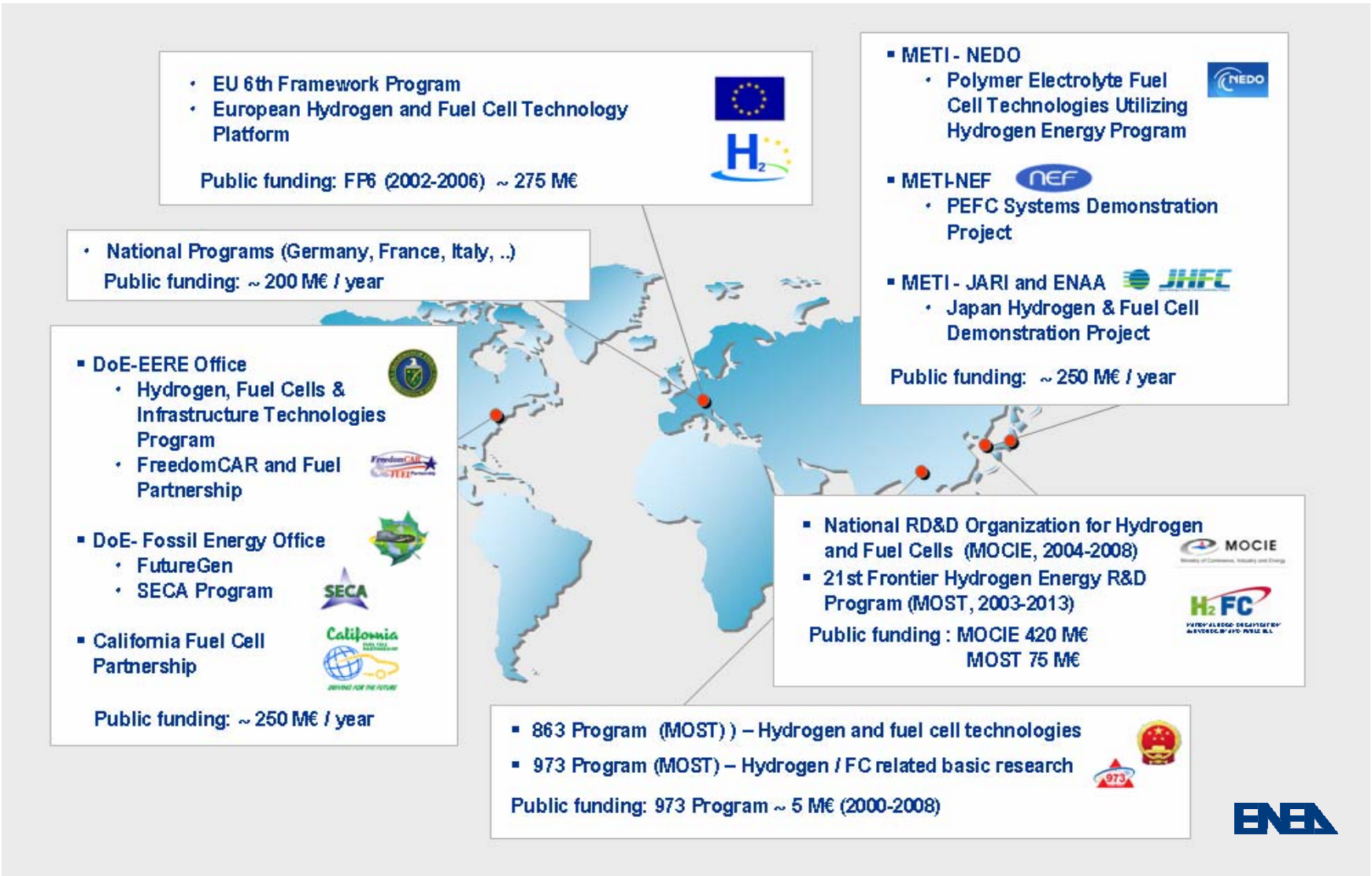
3. Worldwide Public RDD on H_2 and FC technologies

Selected Countries

1. Japan
2. USA
3. EU
4. Canada
5. China
6. France
7. Italy
8. Germany
9. South Korea

In 2005
More than 500 publicly-funded projects
More than € 1 Billion

3.1 Worldwide Public RDD on H_2 and FC technologies



RCS Needs-Categories for H_2

	Categories
General	***Fuel quality***
	H_2 sensors
	Materials compatibility*
	Safety (in all the phases)
H_2 Production	***Comparing production processes***
	Well-to-tank analysis
H_2 Distribution and Storage	***Materials design and test methods***
	Smart sensors
	Materials compatibility for pipelines*
	Testing procedures for characterization of storage systems
	Safety issues for storage systems (high pressure, liquid tanks)
H_2 end use	
	Fuel infrastructure
	Fuel-vehicle interface
	Refuelling Stations
	Parking areas, garages

RCS Needs-Categories for FC

	Categories
General	Fuel quality
	Safety (in all the phases)
FC components	Materials compatibility
	MEA characterization
FC stacks	Materials compatibility
	Characterization procedures
	Environmental tests: vibration and extreme conditions (e.g. saline atmosphere)
FC system	Balance of plant (electronics, thermal management) testing
	Fuel processor testing procedures
	Environmental tests: vibration and extreme conditions (e.g. saline atmosphere)
	EMC (EMI) tests
FC applications	Vehicle operations
	Emission measurements
	Fuel consumption measurements
	Materials compatibility
	Testing profiles
	Refuelling interface
	H_2 sensors
	EMC (EMI) tests

3.2 Data Collection

Program /Project Selection criteria

- **1st Priority: Direct RCS**
  - ✓ **Programs**
  - ✓ **Subprograms**
  - ✓ **Projects**

- **2st Priority: Explicit indication in the Project description of RCS activities**

- **3rd Priority**
  - ✓ **“Sample” Projects mainly Demonstrations and Hydrogen and Fuel Cell applications after “cross-linking” of various sources.**

3.3 Results of data collection

Pre-normative research projects

Application	Priority	EUROPE	JAPAN	USA	TOTAL
General (Both)	1st	5	1	4	10
	2nd				
	3rd				
Transport	1st	1		1	2
	2nd	6		1	7
	3rd	4	1	1	6
Stationary	1st	1	1	0	2
	2nd	7			7
	3rd		1		1
Geographical Total		24	4	7	35

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Traffic Light Analysis

Symbol	Meaning	Definition	Examples
	No RCS	The research work does not address any specific RCS activity.	No way to use project results for RCS.
	Indirect RCS	There are some activities potentially useful for RCS development	Test results in Demo Projects able to specify testing profiles for materials, components & systems
	Direct RCS	The project is a source of results and activities addressing RCS development	The specific characterization of materials & components, development of test procedures, risk and safety analysis of operating conditions, extreme condition testing.

Project Questionnaire

The Project Form/Questionnaire is divided in four parts.

1. Part 1 contains a short project description with starting date and duration, the major application, a short summary of the project contents and an approximate budget (with an indication of the public funding if any).
2. Part 2 regards the Traffic Light Analysis. Two sections, one for Hydrogen and the other for Fuel Cells, present a list of major items/issues of interest for RCS pre-normative research. One of the 3 lights has to be “switched on” for each item. Some free fields are made available for introducing new topics/items considered in the described project.
3. Part 3 requires some more details and a limited description (very few lines) on one or two topics on which the described project as specific pre-normative research (e.g. sensor development, experimental or mathematical analysis of safety aspects, testing methods and so on).
4. Part 4 contains references (mainly publicly available, such as, publications, presentations, website pages, papers) and the indications of the person filling in the Questionnaire and, possibly, contact persons involved in the presented project.

The survey was carried out with the HarmonHy website, www.harmonhy.com.

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4. Findings

Category analysis for Hydrogen technologies: research coverage

Categories	Project	Jap 1	Jap 2	Jap 3	Jap 4	USA 1	USA 2	USA 3	USA 4	USA 5	USA 6	USA 7	EU 1	EU 2	EU 3	EU 4	EU 5	EU 6	EU 7	EU 8	EU 9	EU 10	EU 11	EU 12	EU 13	EU 14	EU 15	EU 16	EU 17	EU 18	EU 19	EU 20	EU 21	EU22	EU 23	EU 24
	Application	T	B	S	S	B	B	T	B	B	T	T	B	B	T	B	T	T	T	S	T	B	S	T	T	T	S	S	T	B	S	S	T	T	T	S
General	Fuel quality	G	Y																																	
	H_2 sensors				R																															
	Materials compatibility																																			
	Safety (in all the phases)																																			
Production	Comp.production processes																																			
	Well-to-tank analysis																																			
H_2 Distribution and Storage	Materials design and test methods																																			
	Smart sensors																																			
	Materials compatibility for pipelines																																			
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	Safety issues for storage systems																																			
H_2 end use	Fuel infrastructure																																			
	Fuel-vehicle interface																																			
	Refuelling Stations																																			
	Parking areas, garages																																			
	H_2 ICE Engine/ Vehicle																																			

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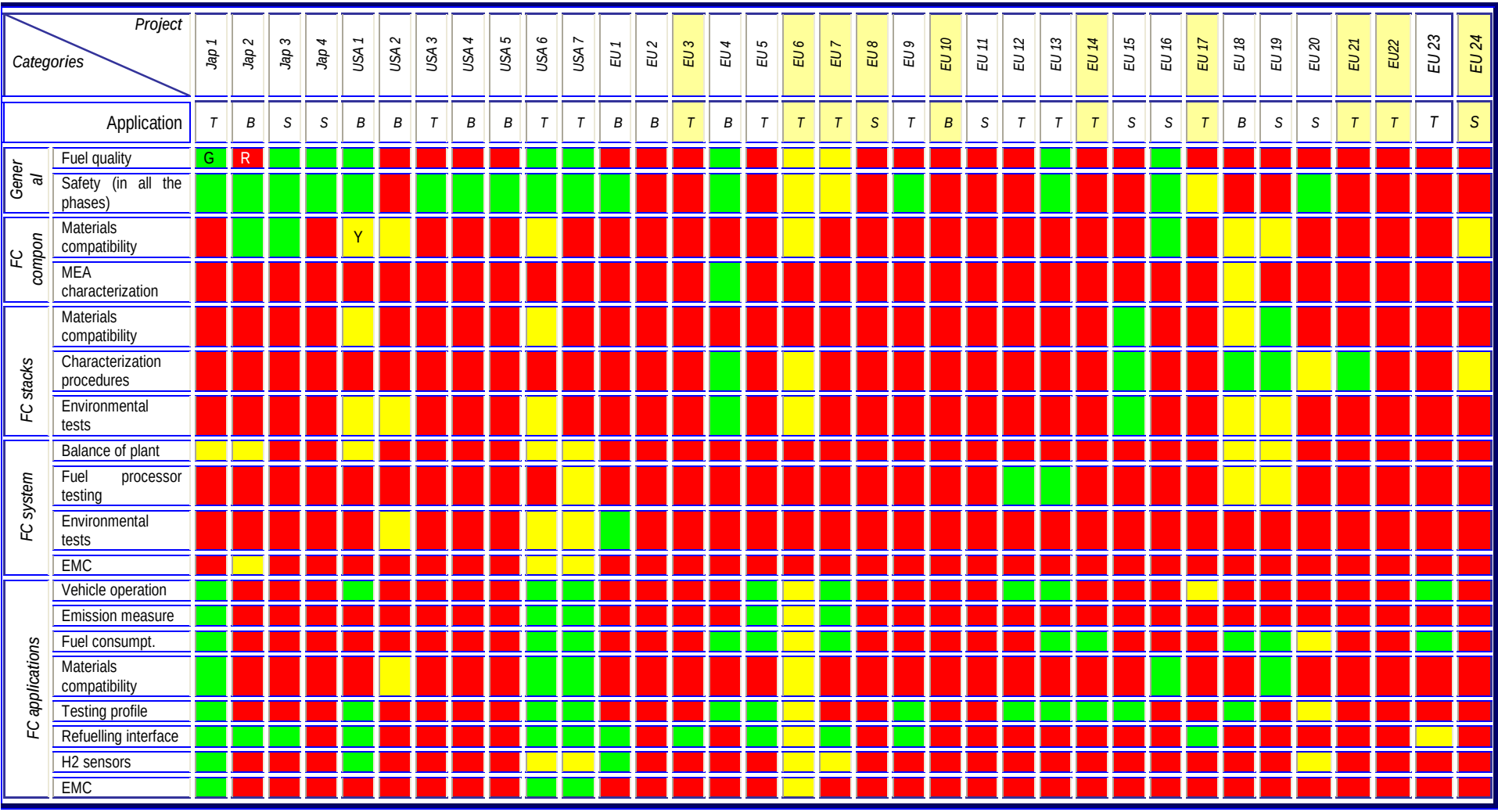
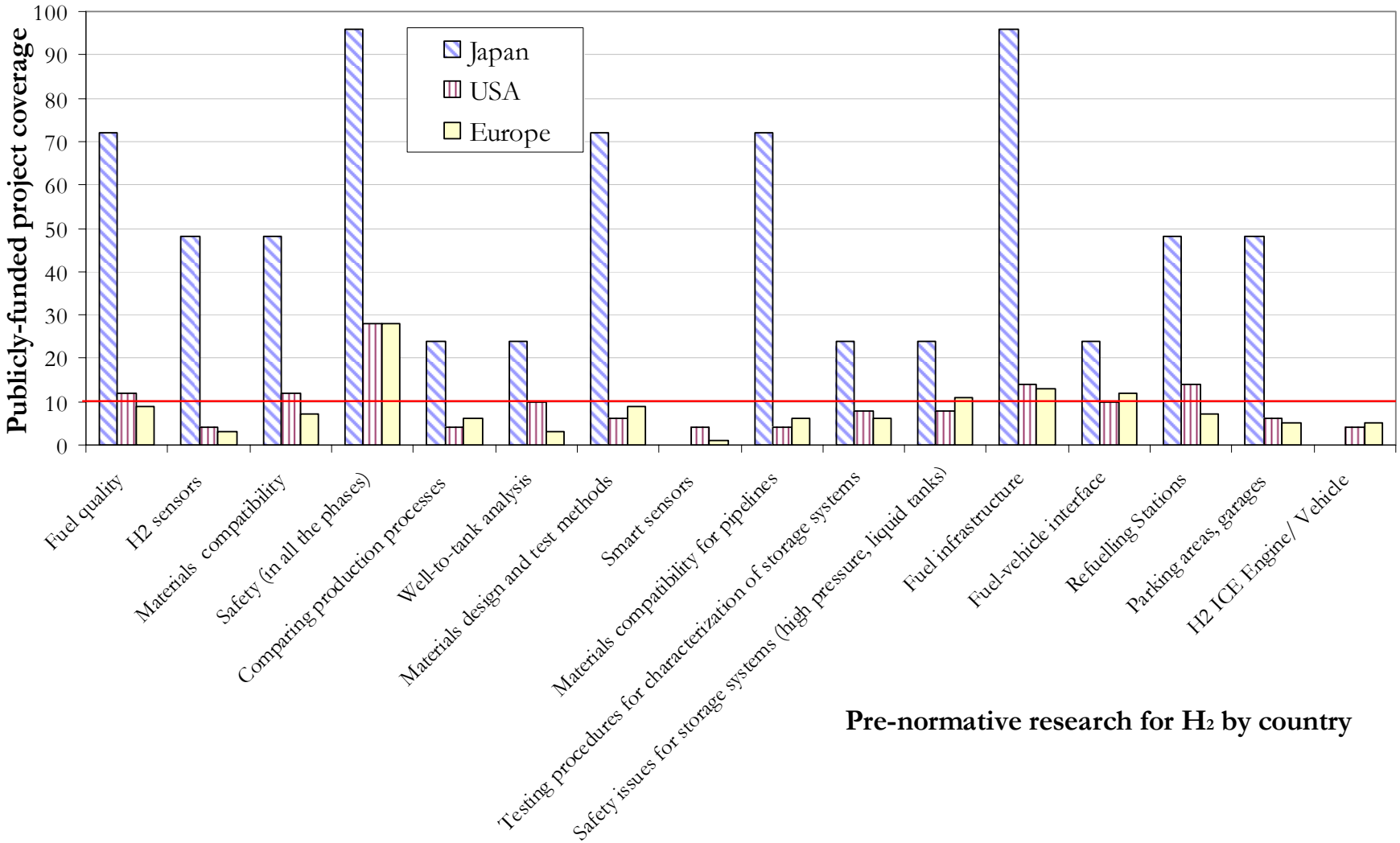
4. Findings

Category analysis for FC technologies: research coverage



4. Findings

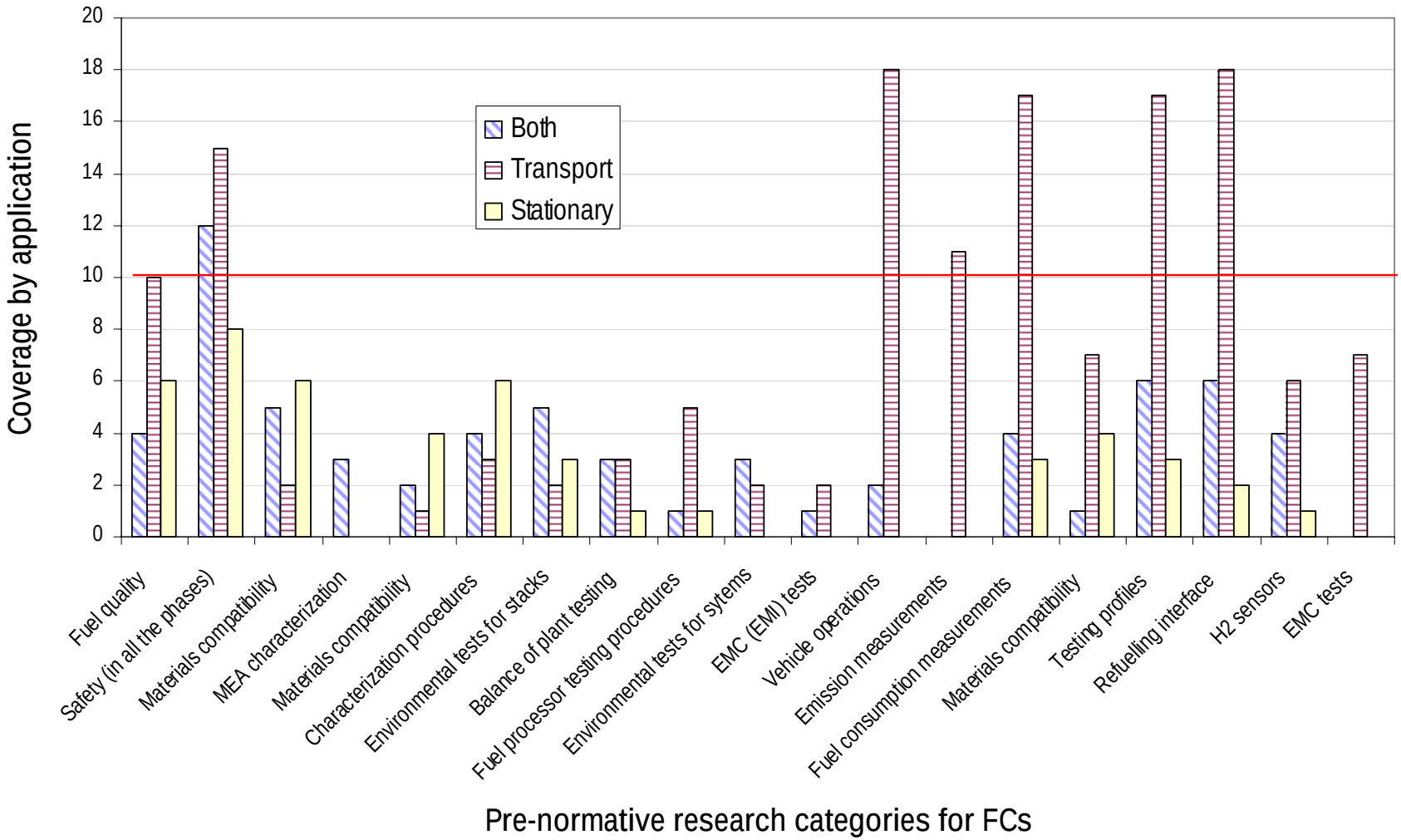
Category analysis for H_2 technologies: coverage by country



Pre-normative research for H_2 by country

4. Findings

Category analysis for FC technologies: coverage by category



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4. Findings

Pre-normative Research Gaps and Needs for H_2

	Categories	Gaps and Needs for RCS prenormative research		
		USA	Japan	EU
General	Fuel Quality			
	H2 Sensors			
	Materials compatibility			
	Safety (in all the phases)			
H2 Production	Comparing production processes			
	Well-to-tank analysis			
H2 distribution and storage	Materials design and test methods			
	Smart sensors			
	Materials compatibility for pipelines			
	Testing procedures for characterization of storage systems			
	Safety issues for storage systems (high pressure, liquid tanks)			
H2 end use	Fuel infrastructure			
	Fuel-vehicle interface			
	Refuelling Stations			
	Parking areas, garages			
	H2 ICE Engine/ Vehicle			

Red means no prenormative research

Yellow means limited prenormative research to reduce Gaps and Needs

Green means existing prenormative research

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4. Findings

Pre-normative Research Gaps and Needs for H_2

		Gaps and Needs for RCS prenormative research		
	Categories	Both	Transport	Stationar
General	Fuel Quality			
General	H2 Sensors			
General	Materials compatibility			
General	Safety (in all the phases)			
H2 Production	Comparing production processes			
H2 Production	Well-to-tank analysis			
H2 distribution and storage	Materials design and test methods			
H2 distribution and storage	Smart sensors			
H2 distribution and storage	Materials compatibility for pipelines			
H2 distribution and storage	Testing procedures for characterization of storage systems			
H2 distribution and storage	Safety issues for storage systems (high pressure, liquid tanks)			
H2 end use	Fuel infrastructure			
H2 end use	Fuel-vehicle interface			
H2 end use	Refuelling Stations			
H2 end use	Parking areas, garages			
H2 end use	H2 ICE Engine/ Vehicle			

Red means no prenormative research

Yellow means limited prenormative research to reduce Gaps and Needs

Green means existing prenormative research

Key PNR Needs

Identified PNR research topics for hydrogen technologies and recommendation for further steps

Category	Recommendations	
	Pre-normative Research	**Description**
Fuel specification	*Standardized test for fuel quality and composition measurements and specifications*	Fuel specification is fundamental in the use of FCs. There is a need for integration of efforts to agree upon international rules for measuring fuel composition and accepting defined specifications. EU needs to increase the effort to complement and integrate projects underway in USA and Japan
Materials compatibility	*Test protocols*	Basic definition of ways to characterize materials
Safety	*Safety/ CFD/ Handbook heat and mass transfer correlations*	Joint efforts to reach global consensus using demo results
Materials compatibility for pipelines	*Comparison and verification of protocols and materials*	Common selection of materials must be done by using long-term endurance tests on a variety of materials
Testing procedures per storage systems	*Test protocols for different storage systems*	There is the need to verify and develop specific test protocols for various storage systems
Refuelling stations	*Common approval procedures*	
Parking areas	*Safety studies*	Analysis of leakage and accidents
Tunnels	*Safety studies*	Analysis of leakage and accidents
User interface	*Studies for new/ innovative HRS layout and related safety studies*	Inherently safe HRS layout and user-friendly human/ machine interface

Key PNR Needs

Identified PNR research topics for fuel cell technologies and recommendation for further steps

Category	Recommendations	
	Pre-normative Research	**Description**
FC MEA	*Identify relationships between physical and performance properties of MEAs*	FC MEA and related materials must be analysed according to common, comparable procedures.
FC stacks	*Test protocols*	Basic definition of ways to characterize materials
Environment tests	*Definition of common environmental conditions*	Joint efforts to reach demonstration results
Testing protocols	*Harmonized procedures*	Testing protocols and procedures for transportation and stationary applications must be verified and standardised.

Key PNR Strategic Considerations

- There is a significant difference in the strategic approach on RCS activities between countries.
- Specific RCS subprograms and projects are more directed toward the regulatory aspects instead of pre-normative research.
- Ongoing pre-normative research mainly covers safety aspects in all the applications.
- Multilateral collaborations for a common analysis of case studies.
- Round-robin experimental activities at international level to compare results on safety tests and materials/components/systems characterization.
- Expand the already international experience and lessons learned of demonstration projects.
- Some pre-normative research activities are of a comparative level in Japan, USA and EU and can be part of international collaborations, such as IPHE, IEA and international projects.