D7.2–Proposal of modifications of normative framework

WP 7 – Normative Framework

Task 7.2 – Propose Modifications of Normative Framework

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Partner	Contribution
CNH2	Preparation of the deliverable and gaps analysis related to HRS
CAF	Review of the deliverable
DLR	Review of the deliverable
ADIF	Review of the deliverable
RENFE	Review of the deliverable
IP	Review of the deliverable
STT	Review of the deliverable

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Executive Summary

This document is Deliverable D7.2: "Proposal for modification of normative framework", for the project 'FCH2RAIL: Fuel cell hybrid power pack for rail applications', under Grant Agreement No. 101006633 [1].

The aim of this deliverable is to propose a strategy to modify the current regulatory framework with regards to fuel cell hybrid trains, hydrogen refuelling stations, and all the railway infrastructure around it. This has been carried out based on the following:

- Deliverable 7.1 "Gaps in regulatory framework prior to the demonstrator train test" [5]
- Deliverable 7.4 "Complementary gaps in analysis framework" [6]
- *Roadmap on hydrogen standardisation* [3] published by the European Clean Hydrogen Alliance (ECH2A)
- *Hydrogen propulsion in the European railway sector* [4] published by the Community of European Railway and Infrastructure Companies (CER)
- Liaison with a broad range of stakeholders.
- *Standardisation HSBooster.eu expert contribution to FCH2RAIL*, a report obtained after consulting *HSBooster.eu*, an European initiative that aims at supporting research and development EU projects in standardization activities (Annex 1).

To ensure that the outcomes of this work on the regulatory gaps in the railway sector reaches the right people, meetings and webinars are taking place with entities such as: the European Union Agency for Railways (ERA), the Spanish railway authority for safety (AESF), Spanish government departments for industry and environment, working groups for European standardisation, the German Centre for Railway Traffic Research (DZSF) and Deutsche Bahn (DB), among others. All these activities are registered in Task 7.3 "Networking activities".

Finally, as a result of these activities, some general recommendations have been given for the development of future standards.

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Glossary of Terms

Abbreviations	Description
ATEX	Explosive Atmospheres
AUWP	Annual Union Work Programme
CER	Community of European Railway and Infrastructure Companies
ECH2A	European Clean Hydrogen Alliance
EN	European Standard
EuroSpecs	European Specification for Railway Vehicles
FCS	Fuel Cell System
FCHPP	Fuel Cell Hybrid PowerPack
FCH2RAIL	Fuel Cell Hybrid PowerPack for Rail Applications
H2	Hydrogen
HRS	Hydrogen Refuelling Station
ICE	Internal Combustion Engines
IM	Infrastructure Manager
IRS/UIC	International Railway Solutions
PED	Pressure Equipment Directive
RU´s	Railway Undertakings
TSI	Technical Specification for Interoperability
WP	Work Package

Acronyms	Description
CA	Consortium Agreement
GA	Grant Agreement
RSSB	Railway Safety & Standards Board

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1. Background information

The diagnosis made in Task 7.1, is the basis to propose a new collaborative framework in the use of fuel-cell based propulsion systems in the railway sector between the relevant stakeholders in order to:

- become aware of the existing gaps in legislation, and
- set up collaborative schemes and initiatives leading to specify and coordinate the modifications to the appropriate level of detail.

Relevant conclusions over the compatibility among member countries, resulting from the introduction of the fuel-cell based propulsion system in those territories, has to be shared with the relevant stakeholders in order to make visible the interfaces between them. Figure 1 shows how to identify and handle the agreement on relevant application conditions and ease the harmonization of future authorization processes with stakeholders' participation.Figure 1 shows how to identify and handle the agreement on relevant application conditions and ease the harmonization of future authorization processes with stakeholders' participation.

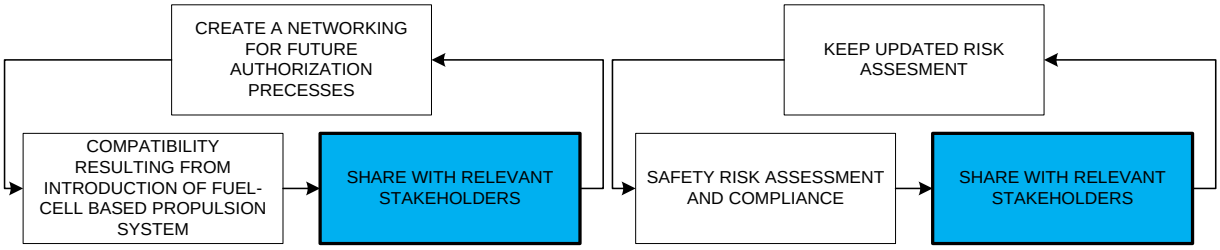

Figure 1. Stakeholders' participation

Regulatory changes in the European Standards (EN) and the Technical Specification for Interoperability (TSIs) of standardisation working groups and regulatory bodies due to the issue concerning FCHPP bi-modes have been provided from different points of view by the project partners:

- Adif and IP as infrastructure manager
- CAF as railway vehicle manufacturer
- STT as expert in aspects related to the pantograph
- TME contributes with its experience and knowledge in the automotive sector
- CNH2 contributes with its experience and specific knowledge in Hydrogen
- DLR provides systemic view of the railway system

Agents involved in the modification of standards that affect the FCH2RAIL project are shown in Figure 2.

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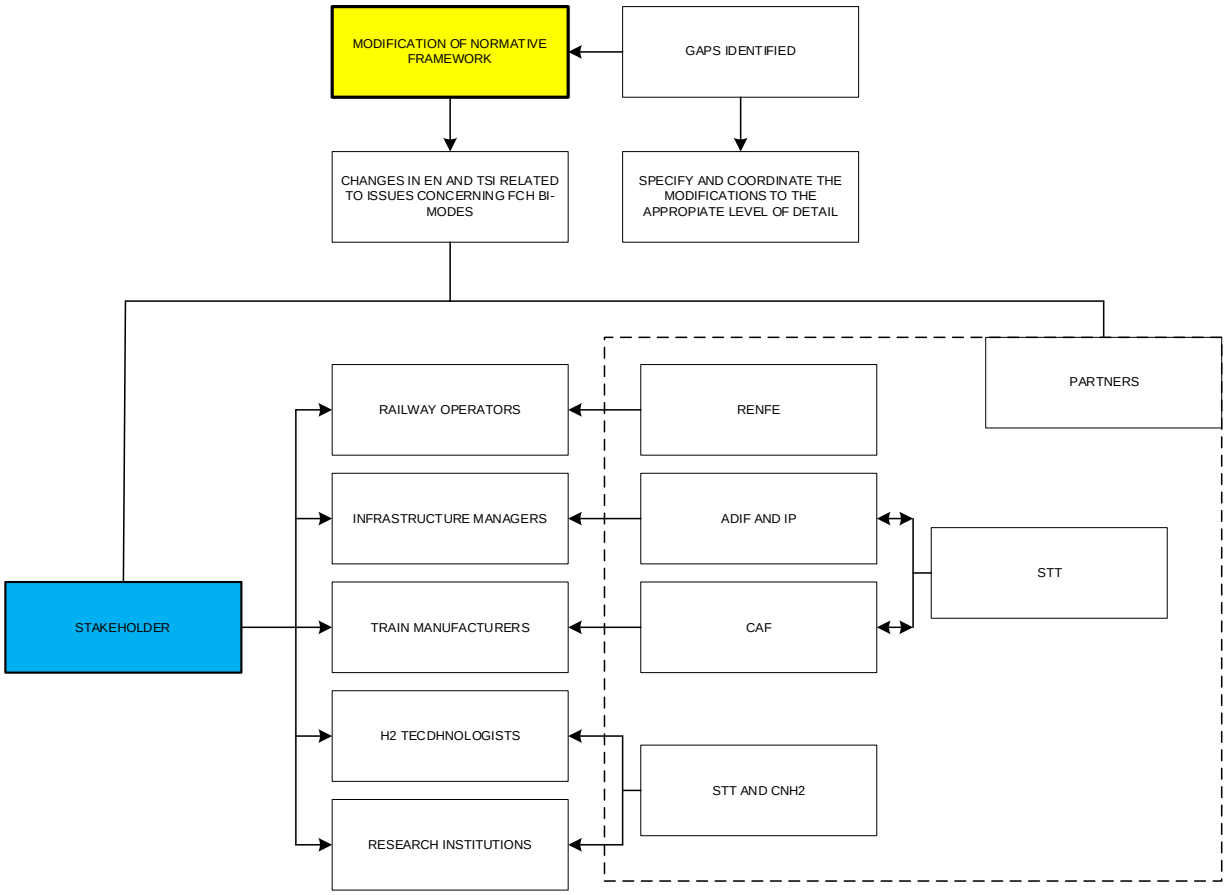

Figure 2. Agents involved in normative modification related to FCH2RAIL

2. Objective

This document proposes a strategy to modify the current regulatory framework related to hydrogen technology in the railway sector. For this, a wide level of support and consensus across the sector is being considered, given by the wide variety of types of stakeholders involved in the consortium representing the views of the different communities involved: railway operators, infrastructure managers, train manufacturers, hydrogen technologists and research institutions with relevant experience.

To ensure that the outcomes of this work on the regulatory gaps in the railway sector reaches the right people, meetings and webinars are taking place with entities such as: the European Union Agency for Railways (ERA), the Spanish railway authority for safety (AESF), Spanish government departments for industry and environment, working groups for European standardisation, the German Centre for Railway Traffic Research (DZSF) and Deutsche Bahn (DB), among others. All these activities are registered in Task 7.3 “Networking activities”.

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3. Scope

The scope of this work is to provide recommendations of regulatory changes in the EN and TSI to the standardisation, norming working groups and regulatory bodies. The aim is to propose a strategy to modify the current regulatory framework with regards to fuel cell hybrid trains, hydrogen refuelling stations, and all the railway infrastructure around it. This has been carried out based on the following:

- Deliverable 7.1 "Gaps in regulatory framework prior to the demonstrator train test" [5]
- Deliverable 7.4 "Complementary gaps in analysis framework" [6]
- *Roadmap on hydrogen standardisation* [3] published by the European Clean Hydrogen Alliance (ECH2A)
- *Hydrogen propulsion in the European railway sector* [4] published by the Community of European Railway and Infrastructure Companies (CER)
- Liaison with a broad range of stakeholders.
- A report obtained after consulting *HBooster.eu*, an European initiative that aims at supporting research and development EU projects in standardisation activities.

4. Roadmap on hydrogen standardisation

The European Clean Hydrogen Alliance (ECH2A) aims to strengthen the deployment of hydrogen technologies by 2030 in the areas of renewable or low-carbon hydrogen production, transportation, storage, demand in industry, mobility and other sectors. It encourages promoting investments and stimulating the implementation of the use and production of clean hydrogen.

In March 2023 the European Clean Hydrogen Alliance published the "*Roadmap on Hydrogen Standardisation*" [3] to support this large-scale deployment. The Alliance identified the need for a robust and harmonised regulatory framework for standardisation and created a dedicated working group to identify issues, gaps and priorities for the entire hydrogen value chain.

This working group is divided in 7 subgroups or clusters (**¡Error! No se encuentra el origen de la referencia.**), one of which is dedicated to mobility (including railway, and another one to cross-cutting aspects (including safety). Both are covered later in this section.

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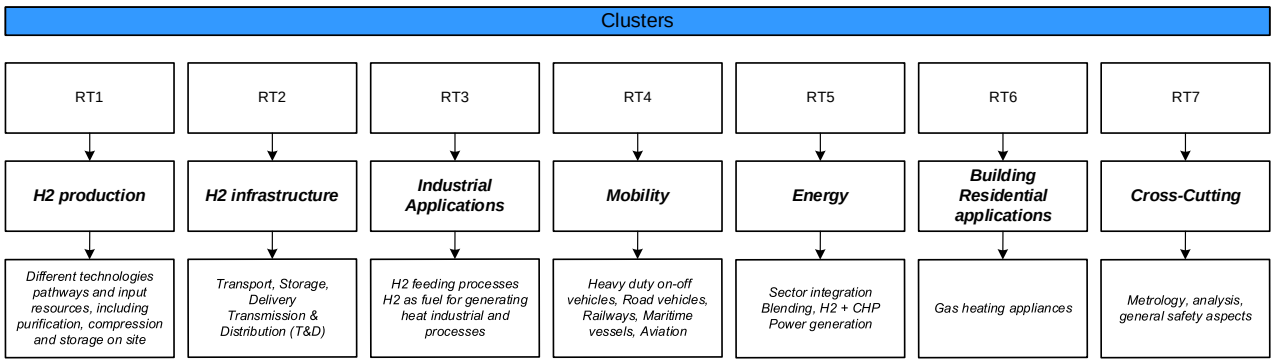

Figure 3. Clusters by specific fields of H2 applications

The *Roadmap on Hydrogen Standardisation* identifies a set of key actions to accelerate the deployment of large-scale hydrogen solutions,, some of which are:

- Integration of identified standardisation topics listed in standard setting processes at European (CEN-CENELEC) and international level (ISO-IEC).
- Prioritise topics that are not yet directly addressed in specific standardisation committees.

Expand the commitment of stakeholders in the standardisation process.

Several European and international standardisation committees are responsible for hydrogen standardisation topics along the entire hydrogen value chain. Figure 4 shows a graphic summary of these Technical Committees at a European and international level as well as their relationship.

As for the railway sector, the subgroup or cluster which is involved directly is the one corresponding to mobility. Nevertheless, the cross-cutting cluster partly covers the rest of them. In this way, it is appropriate to include it in this document, especially with regard to safety aspects.

The European standardisation process, including the main actors who participate in it, is shown in Figure 5. This process generally lasts between 2.5 and 3 years.

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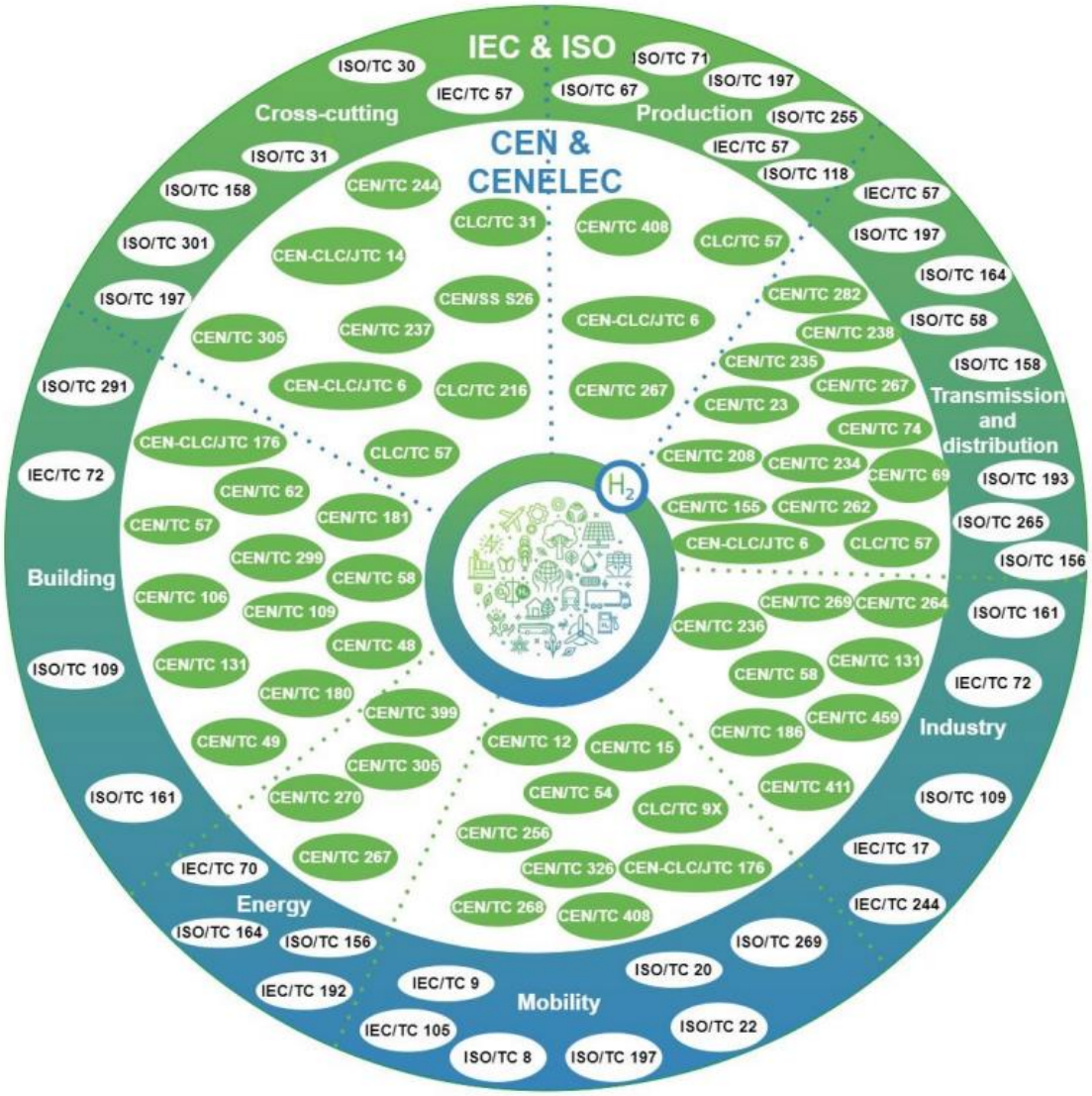

Figure 4. European and international standardisation landscape for hydrogen topics [3]

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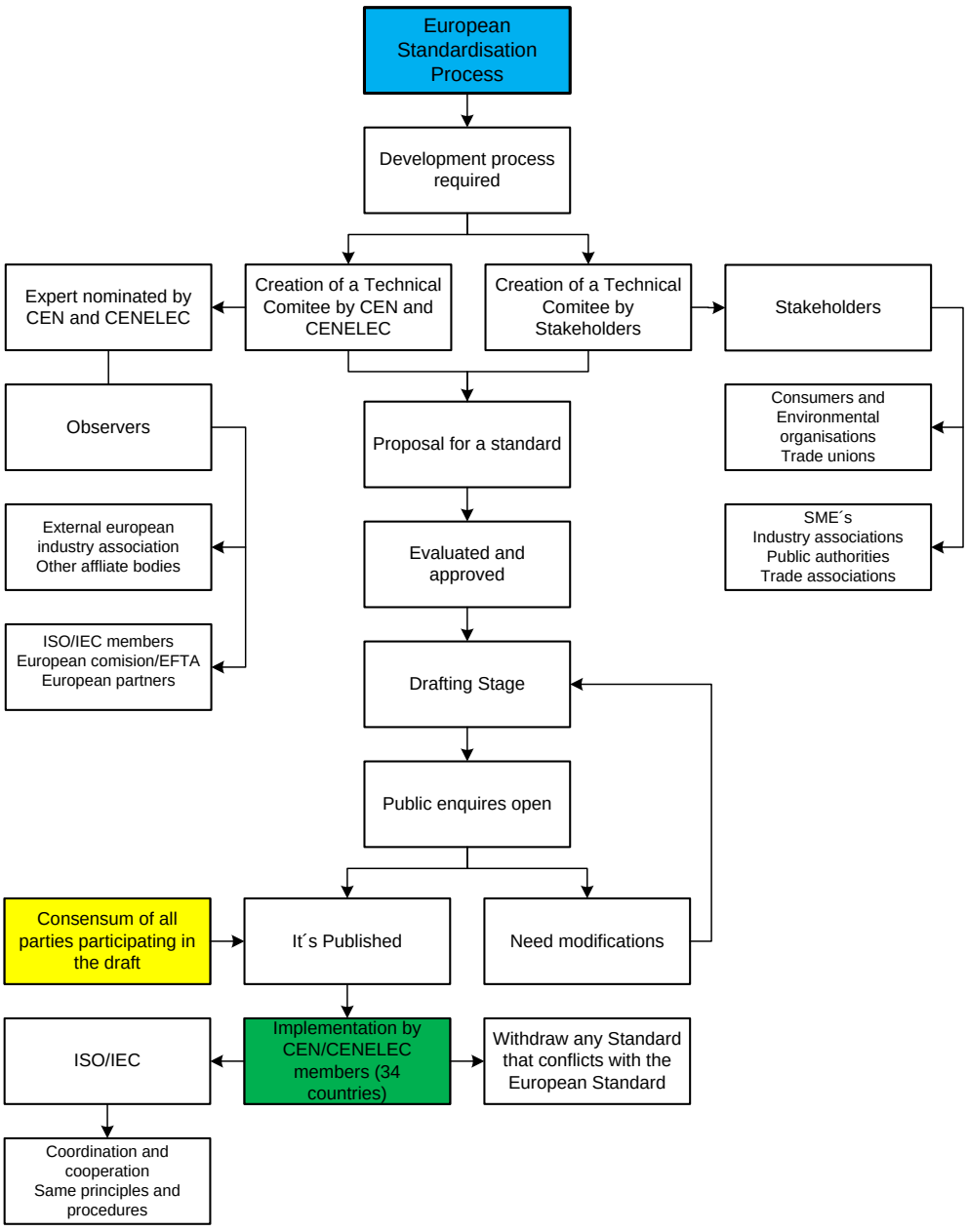

Figure 5. European standardisation process

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4.1 Cluster RT4. Mobility: railways

4.1.1 Legal and regulatory framework

The general European regulatory framework for the authorisation of rolling stock is based on the *Directive on the Interoperability of the Rail System within the EU* (2016/797) and the *Directive on Railway Safety* (2016/798). The use of hydrogen propulsion systems in railway is managed through:

- *The Rolling Stock - Locomotive and Passenger TSI*, established in accordance with Chapter 2 of the Interoperability Directive, and specifically its Article 10 on innovative solutions.
- *The Common Safety Methods*, established in accordance with Article 6 of the Railway Safety Directive.

4.1.2 Standardisation framework

European actors are leading international standardisation activities at CEN, CENELEC, ISO and IEC in the relevant railway committees (CEN/TC 256, CLC/TC 9X, ISO/TC 269 and IEC/TC 9), with the aim to provide a mature and proven-in-use input for future EU regulations. With regard to the on-board hydrogen propulsion subsystem, work is being carried out at the ISO and IEC levels through the IEC 63341 series:

- Part 1 for fuel cells
- Part 2 for compressed hydrogen storage system
- Part 3 for fuel cell testing

All these documents are developed in active cooperation between IEC/TC 9, IEC/TC 105 and ISO/TC 197 and benefit from the strong involvement of European experts through CLC/TC 9X, as this standard is a parallel development under the Frankfurt Agreement.

With regard to the infrastructure subsystem, work is taking place within ISO/TC 269.

Figure 6 summarises the main technical committees involved in standardisation related to the railway sector, including the outline of the scope, specific application fields as well as those exceptions where the standard does not apply.

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Technical Committee	Scope	Applications Field	Restrictions
CEN/TC 256	Rail vehicles and fix installations, including urban transport	Infrastructure design, installation and maintanance	Electrical and electronic subjects
CLC/TC 9X	Rail vehicles and fix installations, including urban transport	Electrical and electronics systems, equipment and associated software	
ISO/TC 269	Systems, products and services´ railway sector	Design, manufacture, construction, operation, and maintenance. Infrastructure, vehicles, environment interfaces	Electrical and electronic subjects
IEC/TC 9	Electrical equipment and systems for rolling stock, fixed installations	Systems, components and software (electrical, electronic and mechanical aspects)	
IEC 63341	Rolling stock	Fuel cells, compresed hydrogen storage and fuel cell testing	
IEC/TC 105	Railway sector and others	Fuel cells technologies and associated systems	Road vehicles
IEC/TC 197	H2 technologies	Systems and devices for the production, storage, transport, measurement and use of H2	
CEN/TC 268	Cryogenic Vessels	Insulated vessels	

Figure 6. Main TC involved in standardisation related to railway sector

4.1.3 Technical needs and timeline

In the framework of the standardisation request M/581, CEN/TC 268 is entrusted with developing two standards for heavy duty vehicles.

- European standard containing technical specifications with the unified solution for hydrogen refuelling points dispensing compressed **gaseous** hydrogen for heavy duty vehicles.
- European standard containing technical specifications with the unified solution for hydrogen refuelling points dispensing **liquefied** hydrogen for heavy duty vehicles.

In the railway domain, the main challenge is to adapt the regulatory framework for the authorisation of rolling stock to trains with hydrogen propulsion subsystem. The development of international standards in the following areas will be crucial:

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- vehicles on-board hydrogen storage (350 bar, 500 bar, 700 bars, liquid, LOHC)
- safe integration of on-board H2 storage
- hydrogen propulsion system
- refuelling infrastructure and processes

However, all this requires a comprehensive, mature and proven regulatory reference framework, and the adaptation of other relevant standards (e.g. fire and smoke) that do not consider this type of propulsion technology.

It is only once this normative framework is fully available, that the sector will be able to propose the relevant modification of the European regulatory framework for train authorisation. From the European Clean Hydrogen Alliance, it is expected that a first set of complete standards should be available by 2025 and updated on the basis of experience returned from the project by 2028. Prescriptive regulatory changes before the availability of such a mature standardised framework would be counterproductive. Progress on the standardisation of hydrogen refuelling infrastructure for all mobility applications is also important to reduce the investment risk and costs. Standardisation of hydrogen refuelling systems´ design and interface and building standards for certifying HRS should be envisaged for developing a cross-European network.

4.2 Cluster RT7. Cross-cutting: safety

The European regulatory framework already in place is able to cover the current need related to public safety, for example with the Explosive Atmospheres Directive (ATEX), the Pressurised Equipment Directive (PED), and their related set of harmonised standards. The ongoing work at the international standardisation bodies ISO and IEC is also translating the general safety principles and rules into hydrogen-specific requirements. However, the existing framework needs to be extended and adapted to new hydrogen applications. This effort must occur in parallel with the improvement of general approaches and methodologies, in particular in the areas of risk assessment and mitigation, and risk-informed design.

4.2.1 Key actions

The *Roadmap on hydrogen standardisation* gives a comprehensive overview of ongoing and missing standardisation topics along the whole hydrogen value chain, sets priorities, puts the topics in a timeline and clusters the main segments involved. Each roundtable follows a number of key actions, shown in Figure 7, and should be considered after the diagnosis made in Task 7.1. These key actions are:

***Key action 1*. Integration** of the standardisation topics **at EU level and international level** (CEN-CENELEC and ISO-IEC, respectively)

***Key action 2*. Prioritisation.** To ensure that all topics are actively dealt with in standardisation, coordinating activities, with specific focus on areas where:

- Topics are not yet directly addressed in a specific TC.
- Topics need further technical understanding and identification of standardisation needs

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- Topics are horizontal and therefore relevant for different segments of the H2 value chain
- Topics need additional pre-normative research

***Key action 3*. Stakeholder engagement.** To ensure the correct integration of stakeholders and associated committees that bring support to TC by knowledge and experience.

***Key action 4*. Call on the European Commission to support the H2 standardisation process**.

- Reflecting these needs in the AUWP for European standardisation
- Issuing one or more standardisation request covering the whole supply and value chain.
- Providing funding standardisation, its coordination and especially pre-normative research in the segment of the chain value that are at the beginning of the process but also in those sectors for which standardisation is already ongoing.

***Key action 5*. Continuous support** of the standardisation process, through:

- Identification of further needs for the pre-normative research and standardisation topics and communicating to the standardisation bodies.
- Motive of ECH2A member to participate actively in technical standardisation committees.
- Inform about the progress completed.
- Update the Standardisation Roadmap.

***Key action 6*. Strengthen the coordination** of the overall process, including relevant Horizon Europe Partnerships.

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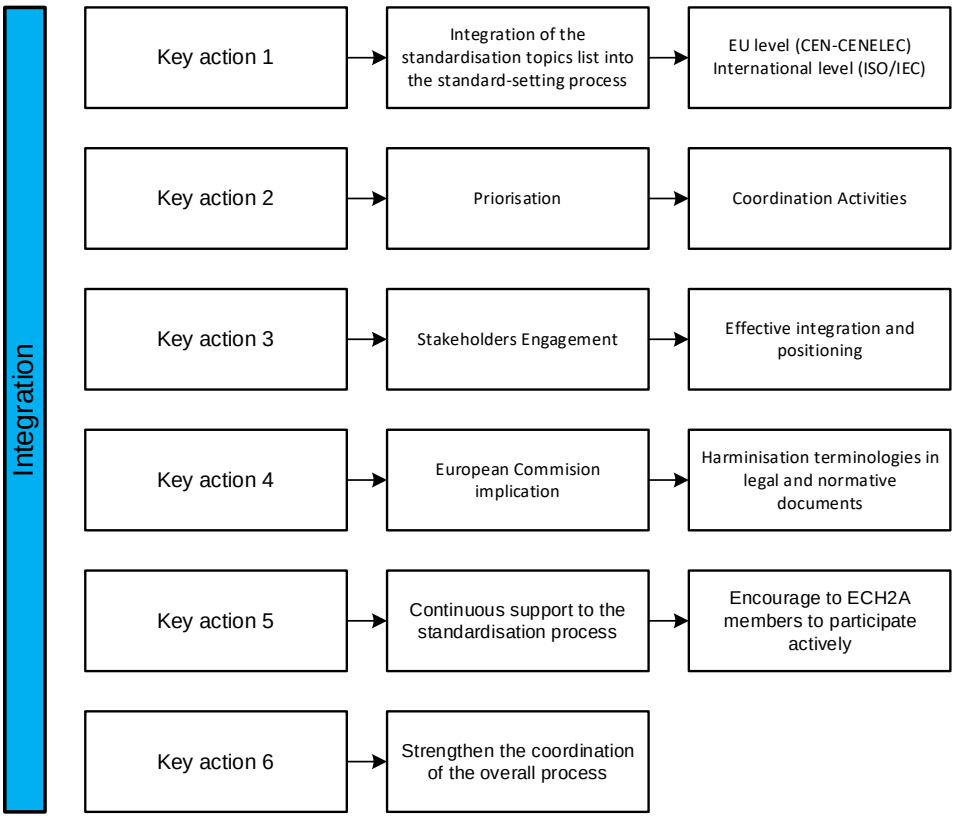

Figure 7. Integration schedule to standardisation process

5. Hydrogen propulsion in the European railway sector

The Community of European Railway and Infrastructure Companies (CER) was created in Brussels in 1988 and its role is to represent the interests of its members on the EU policy-making scene, in particular to support an improved business and regulatory environment for European railway operators and railway infrastructure companies. In a recent publication, CER formulates the needs of the railway operating community for hydrogen propulsion in terms of regulation and standardisation in Position Paper *Hydrogen propulsion in the European railway sector* [4]. This paper outlines the major elements that shall be taken into account when elaborating TSI or EN.

CER supports that additional functional requirements, that are neither covered in TSIs nor ENs, shall be laid down by EuroSpecs. Specific guidance for the railway operating community concerning railway operations among other shall be harmonised at European level and laid down in International Railway Solutions (IRS).

The *Hydrogen propulsion in the European railway sector* paper addresses the rail system from a railway operator´s point of view and focusses on the needs of railway undertaking (both passengers and freight) and infrastructure managers.

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It contemplates possible hydrogen technologies of application on train, which includes fuel cells with batteries, ICE, hydrogen pressure storage on board, battery packs and ammonia, among other alternative options.

It also summarises those projects and activities ongoing where these possible technologies are being implemented.

5.1 Barriers to the introduction of hydrogen-powered trains

Due to the innovative character of this type of technologies, there are several key barriers that must be considered:

- Train Technical standards
- Safety requirements (rolling stock and infrastructure)
- Authorisation process
- Train performance
- Logistics regarding refuelling processes and installations
- Economic viability and financing
- Operational phase

Figure 8 summarises the main barriers found for the introduction of hydrogen powered trains, main issues related to them and specific key points to consider.

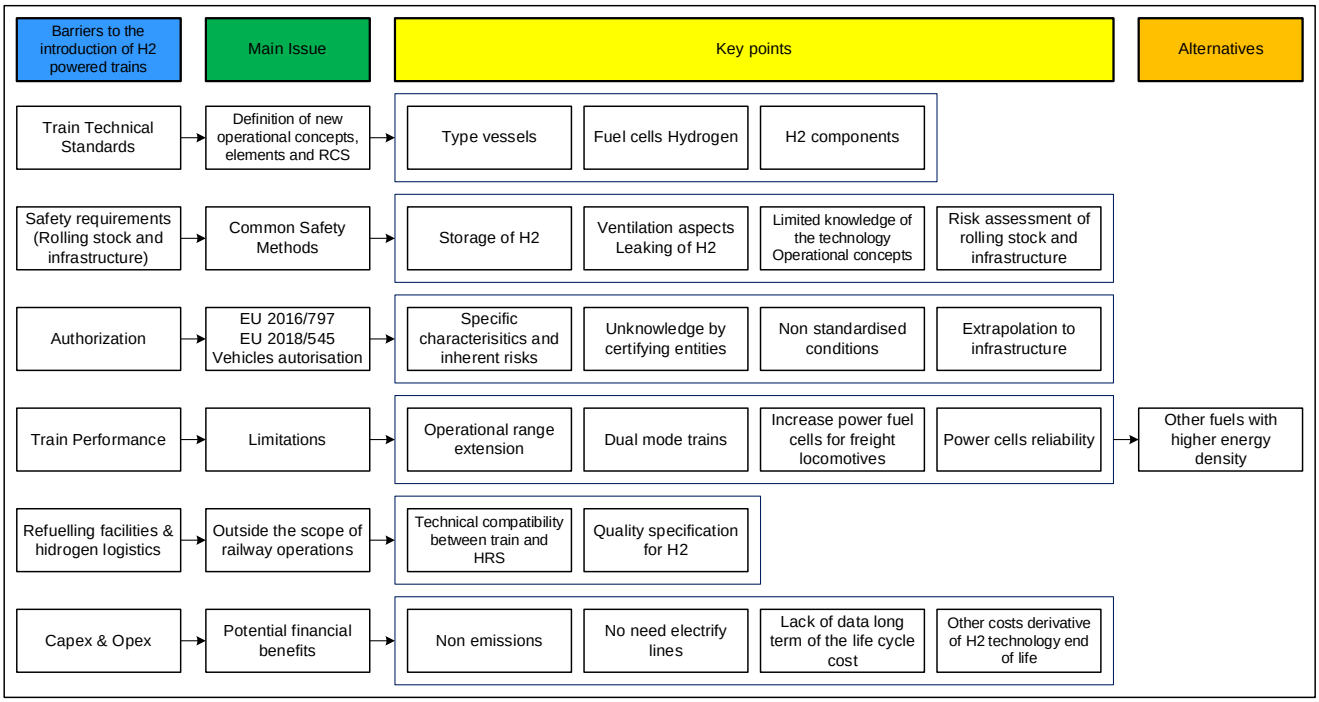

Figure 8. Barriers to the introduction of hydrogen powered trains

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5.2 Operational phase

In the use of a particular hydrogen technology, the operational costs over the whole life-cycle of the train shall be considered. This includes the handling of hydrogen, maintenances of the refuelling infrastructure and on-board components, among others. For example, the interaction between hydrogen and steel (embrittlement) must always be considered.

The railway sector needs a better understanding of the current hydrogen technological trends for rolling stock and infrastructure. Before a clear cost/benefit analysis can be made, and to demonstrate a positive case for the introduction of hydrogen in the railway industry, a comparison between the cost of hydrogen production and the classic line electrification must also be completed.

The choice of the best technological solution for hydrogen introduction should consider the overall advantages for the whole rail system and not those driven by particular interests of some parts of it (IM, RUs and suppliers).

Going further into the details, operations of hydrogen-powered trains introduce new requirements when compared to standards electric or diesel trains.

Currently, main key issues are:

- Safety aspects, strictly connected with the fire and explosion risk prevention.
- Maintenance costs
- Range
- Performance of HRS

5.3 Recommendations and conclusions

The railway sector must participate in the process of standardisation in the emerging field of hydrogen as soon as possible. In general, standardisation, along with other industries, will help to reduce costs in the entire supply chain, by using components under same standardisation processes.

Main standards from related sectors might apply if no specific railway regulations are available, including standards from IEC, ISO, etc. The International Railway Solutions are a structured framework of documents prepared and published by the International Union of Railways for use within the railway sector.

CER promotes that the International Railway Solutions should facilitate defining and compiling the railway operators basic needs beyond regulations and standardisation. It also supports that hydrogen propulsion topics are addressed by EuroSpec, a consortium of six European train operating companies.

To boost the development and evolution of hydrogen-based operations, some key recommendations can be drafted, for future integration into the full framework, with specific references to:

- Technical standards and safety requirements
- Authorisations
- Train performance, operations and refuelling

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As for authorisation, if not yet covered by European regulations and/or standardisation, hydrogen requirements shall be set at European level throughout TSIs or EN. This will be key to obtain a clear strategy of integration of hydrogen technologies at railway applications.

6. Interaction with other entities. Stakeholders

After having identified the gaps in the railway sector within the FCH2RAIL project in Task 7.1, the strategy is to ensure that the deliverable documents are provided to groups who are already planning to, or actually are, coordinating standards modifications for hydrogen in rail. These deliverables have been sent to critical actors at the highest level in terms of experience and knowledge, so that they can share them with the rest of stakeholders appropriately.

6.1 Procedure

The interaction with the different entities is collected in order to have an overview about where, when and who has disseminated the work carried out in Task 7.1. The procedure is the following:

- Before establishing the contact, the WP7 leader must be informed, to avoid more than one partner engaging the same company.
- WP7 members validate the contact.
- Each partner, after receiving the contact, provides the information included in table below in section 6.2, to register the activity.

The groups or entities that partners from WP7 consider interested were collected previously in an internal working excel table.

6.2 Template to collect the interaction with stakeholders

Table 1 is the template that was filled in by each partner to summaris the information of the interactions with other entities.

Table 1. Entities interaction

Entity	
Main contact of the entity	
Description of the entity	
Partner who has contacted	
Expected outcome	
Details of the interaction	
Link/Screenshot	
Result of the activity	

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6.3 Documented interactions

Throughout the project several stakeholder meetings have been held and recommendations for standardised framework changes can be made based on the outcome of those meetings in connection with the gaps found in Task 7.1.

The meetings held, include, among others:

- ***AESF – Agencia Española de Seguridad ferroviaria*** *(https://www.seguridadferroviaria.es/)*

AESF is a public organisation, responsible Authority of the railway safety, regulated by Spanish law 38/2015 of the railway sector. AESF will collaborate in the revision of the next WP7 work if necessary, monitoring the standardisation process that can be of benefit to the project. The work developed could be its basis for further development. With this interaction it is possible to get an expert partner that can review and expose their expertise in the field regarding the standardisation process.

- ***HSBooster - Standardisation Consultancy Services*** *(www.HSBooster.eu)*

HSBooster is a Standardisation Support for research and development projects. Several meetings among CNH2 and the assigned HSbooster expert (Mr. Ralph Muller) were carried out. Deliverable 7.1 was shared (public document) with this entity, and used as foundation to analyse and evaluate the path to get a consolidated method of proposal of modification of normative based on the existing gaps collected in the Deliverable.

- ***Regional governments: Aragón, Madrid, Galicia***

Authorisation was required for commissioning the HRS prototype in compliance with the regulations in force within the Spanish legal framework. A meeting between the different regional governments was carried out to discuss the issue in the Hydrogen Working Subgroup of the "Unidad de Mercado de la Conferencia Sectorial de Industria y Pyme". The aim of this meeting was to standardise criteria in terms of administrative procedures at national level, which means a big step for the standardisation and introduction of hydrogen technology in new sectors such as railway.

Other interactions, managed within Task 7.3. Networking activities, were also carried out. Those meetings will be documented in the D7.3. but the conclusions have also been considered to make a proposal for modification.

- **Hydrogen Technologies Standardisation Roadmap** - WG 3.4.3 - Rail Vehicles in Germany

Some WP7 partners are involved in this working group, where the first step is to determine the status and derive standardisation projects on the documents developed in Task 7.1.

- **WP7 network meetings**

At the beginning of the project a working group, WP7 network, was created, , consisting of the WP7 partners and normative experts of the Advisory Board organizations, with the following objectives:

- Join forces to improve standardisation and regulatory framework for hydrogen in railways

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- Create a collaboration with Spanish and Portuguese stakeholders -> New national rules to be analysed as there are currently no haydrogen trains running in these countries.

Some meetings have been organised to share and exchange information about the gaps in normative framework and how to solve them. These recommendations, together with the information reflected in this deliverable, form the basis of the conclusions set out in Chapter 8.

7. Proposal of modifications based on HSbooster recommendations

HSBooster is an EU-funded initiative that aims at supporting, either ongoing or closed, EU projects in standardisation activities. As a result of the collaboration between the FCH2RAIL project and the HSBooster initiative, some recommendations are given in Annex 1 and have been taken into consideration.

The introduction of hydrogen in the railway sector will follow other sectors such as the energy industry, so that, normatives have to be more developed and spread wider to other fields of application. The main specific Technical Committees engaged with the standardisation of the technology that get involved in the project are the following:

- IEC TC 105 – Fuel Cell Technologies (CEN ELEC SR 105), which is orientated to prepare international standards regarding fuel cell (FC) technologies for all FC types and various associated applications such as stationary FC power systems for distributed power generators and combined heat and power systems, FCs for transportation such as propulsion systems (see note below), range extenders, auxiliary power units, portable FC power systems, micro FC power systems, reverse operating FC power systems, and general electrochemical flow systems and processes.
- ISO TC 197 – Hydrogen technologies, which scope is the standardisation of large-scale hydrogen energy systems and applications, including aspects of testing, certification, sustainability and placement, and coordination with other relevant standardisation bodies and stakeholders.

As a remarkable point it is recommended to try and avoid railway specific standardisation as there would be a risk of disrupting industrial hydrogen development of standards covered by IEC EN and ISO EN.

Railway specific constraints and needs are discussed in IEC TC9[1] and ISO TC 269[2] (CEN TC 256). They bring in the joint recommendations for the rail specific clarifications in IEC TC 105 and ISO TC 197.

[1] To prepare international standards for the railways field which includes rolling stock, fixed installations, management systems (including supervision, information, communication, signalling and processing systems) for railway operation, their interfaces, and their ecological environment.

[2] Recently created to develop standards for products and services specifically related to the rail industry, including construction, operation and maintenance of parts and equipment, methods and technology, interfaces between infrastructure and vehicles and rail specific environmental aspects.

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Observe that EU-specific requirements can only be enforced by EU regulations. Standards should support the uptake of best practice and proven industrial solutions to meet regulatory requirements and foster competitive advantages of new and emerging technologies. Therefore, hydrogen technologies related to standardisation should be promoted in international industrial standards rather than existing railway specific standards for hydrogen applications.

Several detailed advices in the chapters above recommend launching research projects for broadening the industrial base towards TRL 7-9. Where existing standards are not comprehensive or their adaptation to railway needs is doubtful, research findings – including those from prototyping, lab and field testing – will help to grow confidence in inputs for the evolution of future Regulations, Codes and Standards.

As hydrogen technology is addressed in current and upcoming TSIs mandates, it is now time to support standardisation development with focused research. This objective can also be met and further exploited by exchanges with other industries using hydrogen in standardisation committees and joint research. Furthermore, user groups should be established to share best practices and ensure return of experiences to manufacturers, maintenance providers and authorities on regular basis.

8. Conclusions

Considering the analysis made based on the roadmap published by the European Clear Hydrogen Alliance, the CER position paper, the interaction with stakeholders and the HSBooster report, in relation to the deliverables which deal with gaps collected in WP7 (Deliverables D7.1 and D7.4), the followings conclusions can be released.

A complete *Roadmap on Hydrogen Standardisation,* related to the future hydrogen applications by 2030, was published by the European Clear Hydrogen Alliance [3]. It is aware of the need of a mature, robust and harmonised standardisation framework to ease the implementation and integration of the different technologies at European level. The cooperation between the main international standardisation bodies and CEN/CENELEC have been established through specific agreements, so that all these shall go along the same standardisation path. This document includes a schematic overview where all the steps of the European standardisation process are referenced, establishing a clear position where stakeholders hold in it.

In the roadmap, a specific cluster is orientated to mobility and covers railway applications. The general European regulatory framework for the authorisation of rolling stock is based on the *Directive on the Interoperability of the Rail System*, within the EU 2016/797, and the *Directive on Railway Safety* 2016/798. Main Technical Committees involved in the standardisation framework related to the railway sector are schematised, including the scope, specific application fields and those fields where the normative does not apply.

On the other hand, CER released the *Hydrogen propulsion in the European railway* paper [4], where barriers to the introduction of H2 powered trains are reflected. Most of these obstacles have been found as normative gaps or technical issues in the deliverables associated with the Task 7.1. [5] [6].

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Based on HSbooster recommendations, those standards with a wider scope are more convenient rather than those more oriented to a specific application field, to avoid taking the risk to disrupt from industrial hydrogen developments.

Considering Figure 5. European standardisation process, CEN/CENELEC and stakeholders technical committees are the only entities with capacity to propose a standard. So, it is hard to find a way in which regulatory gaps found in Task 7.1 can influence the standardisation process. Having a direct or indirect relationship with the stakeholders technical committee is the best way to impact the regulatory framework. Therefore, the steps that need to be followed to influence these committees at a regulatory level, and thus create a proposal for modification to be implemented in a standard, is shown in Figure 9. It is part of the planned *Task 7.3. Networking activities* and consists of:

- Establishing in which technical committee the gap found fits. (Classification)
- Establishing contact with those clusters, entities or organisations that are directly or indirectly involved in any of these technical committees (in fields of application as generic as possible). The contact should be at individual level (partner – entity) to maintain traceability as best as possible.
- Actively participating with the entity or organisation (feedback).

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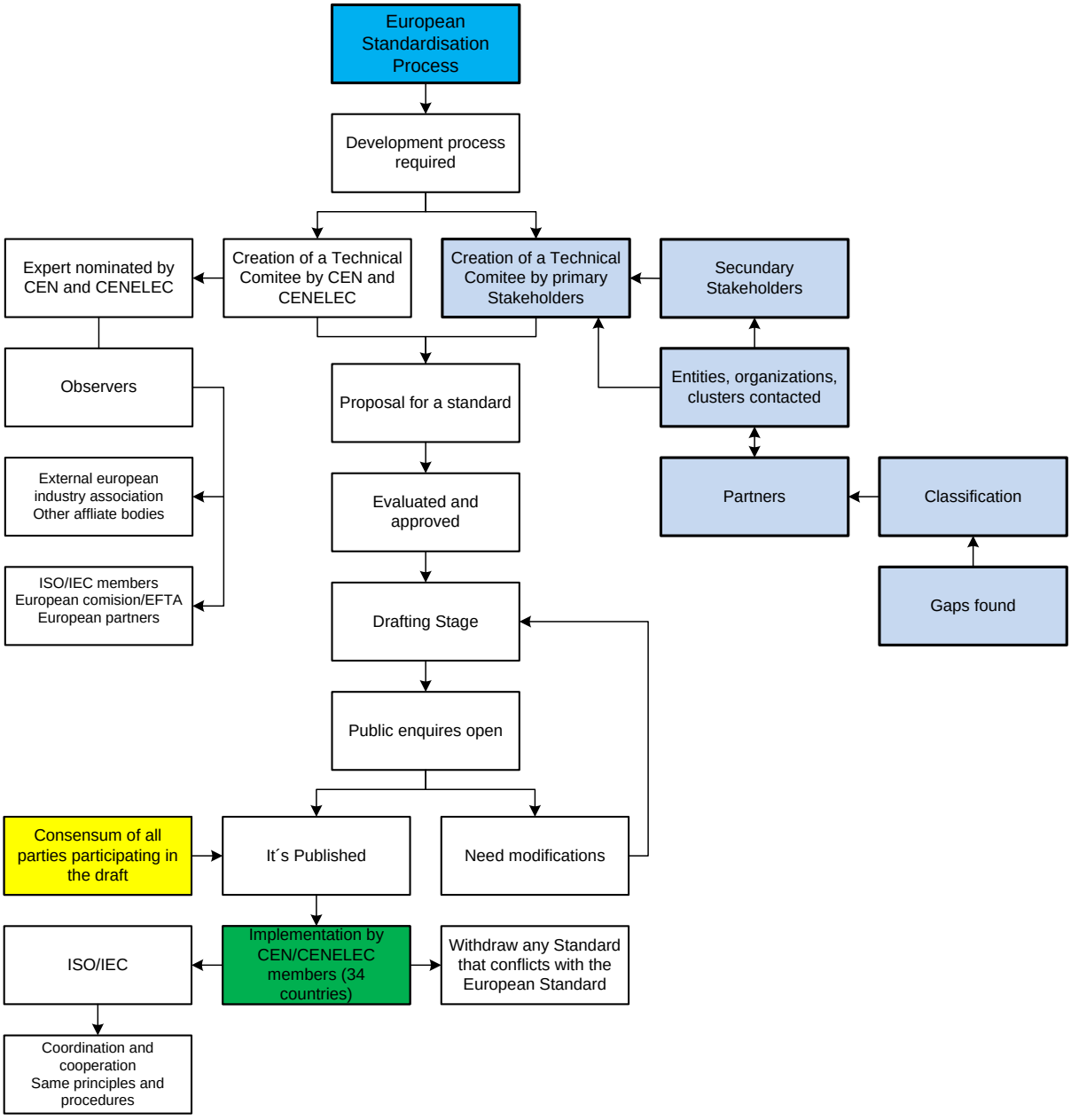

Figure 9. Influence on the standardisation chain related to propose a normative modification through stakeholder position by FCH2RAIL partners.

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9. List of Figures

10. List of Tables

11. References

[1] European Comission, "Grant Agreement Number- 101006633 - FCH2Rail," 2020.

[2] Consortium FCH2Rail Project, "Consortium Agreement FCH2Rail," 2020.

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