



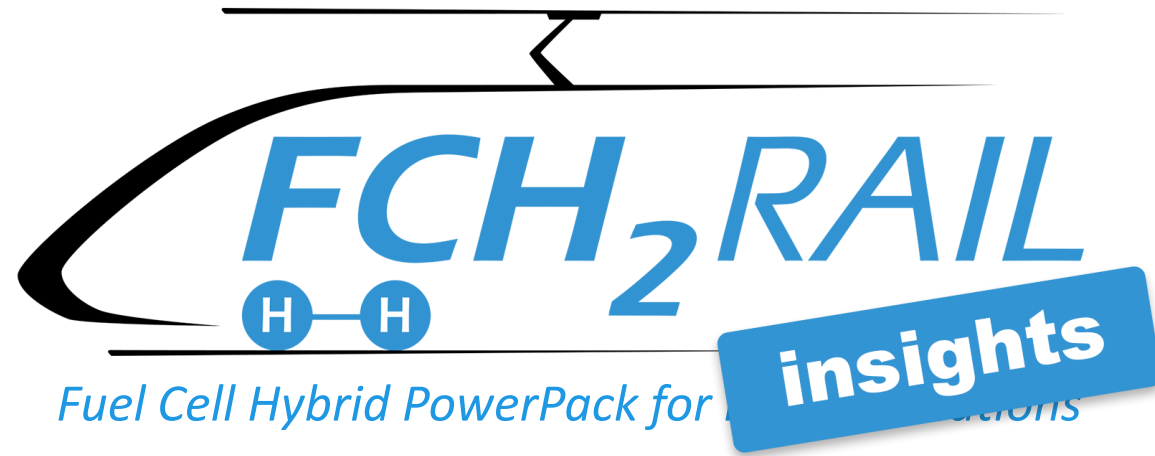
Demonstration of the Fuel Cell Hybrid PowerPack

Join us at InnoTrans 2022, Hall 7.2 A
22 September from 13.30 - 14.30
videostream via <https://plus.innotrans.de/>



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 101006633. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.





Demonstration of the Fuel Cell Hybrid PowerPack

22.09.2022, InnoTrans 2022, Berlin & Video Stream

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 101006633. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.

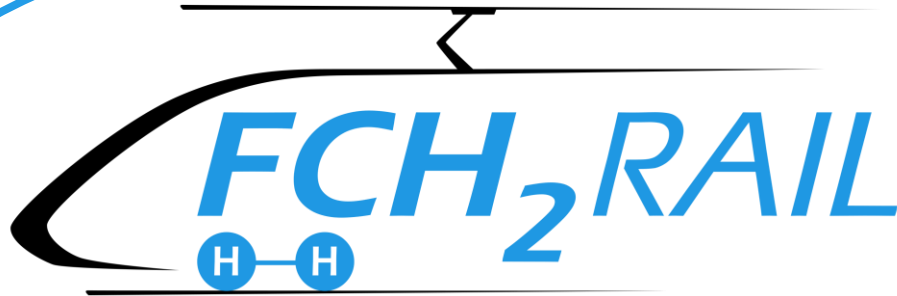


Project Partners



TOYOTA

renfe

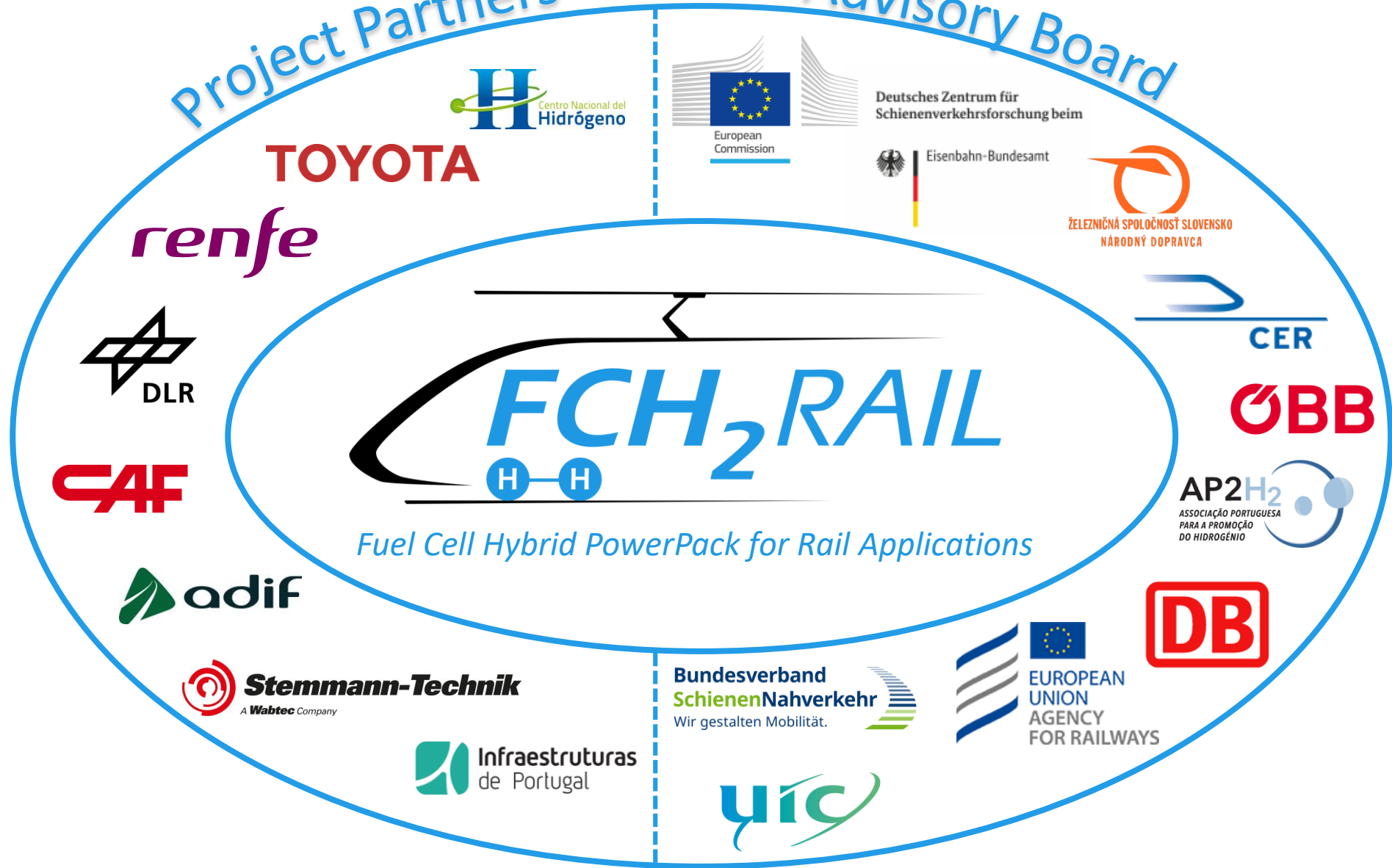


Fuel Cell Hybrid PowerPack for Rail Applications



Project Partners

Advisory Board



TOYOTA

renfe



CAF

adif

Stemmann-Technik
A Wabtec Company

Infraestruturas de Portugal



Deutsches Zentrum für Schienenverkehrsforschung beim Eisenbahn-Bundesamt



ŽELEZNIČNÁ SPOLOČNOSŤ SLOVENSKO
NÁRODNÝ DOPRAVCA



CER

OBB

AP2H2
ASSOCIAÇÃO PORTUGUESA
PARA A PROMOÇÃO
DO HIDROGÉNIO

DB

Bundesverband SchienenNahverkehr
Wir gestalten Mobilität.

UIC

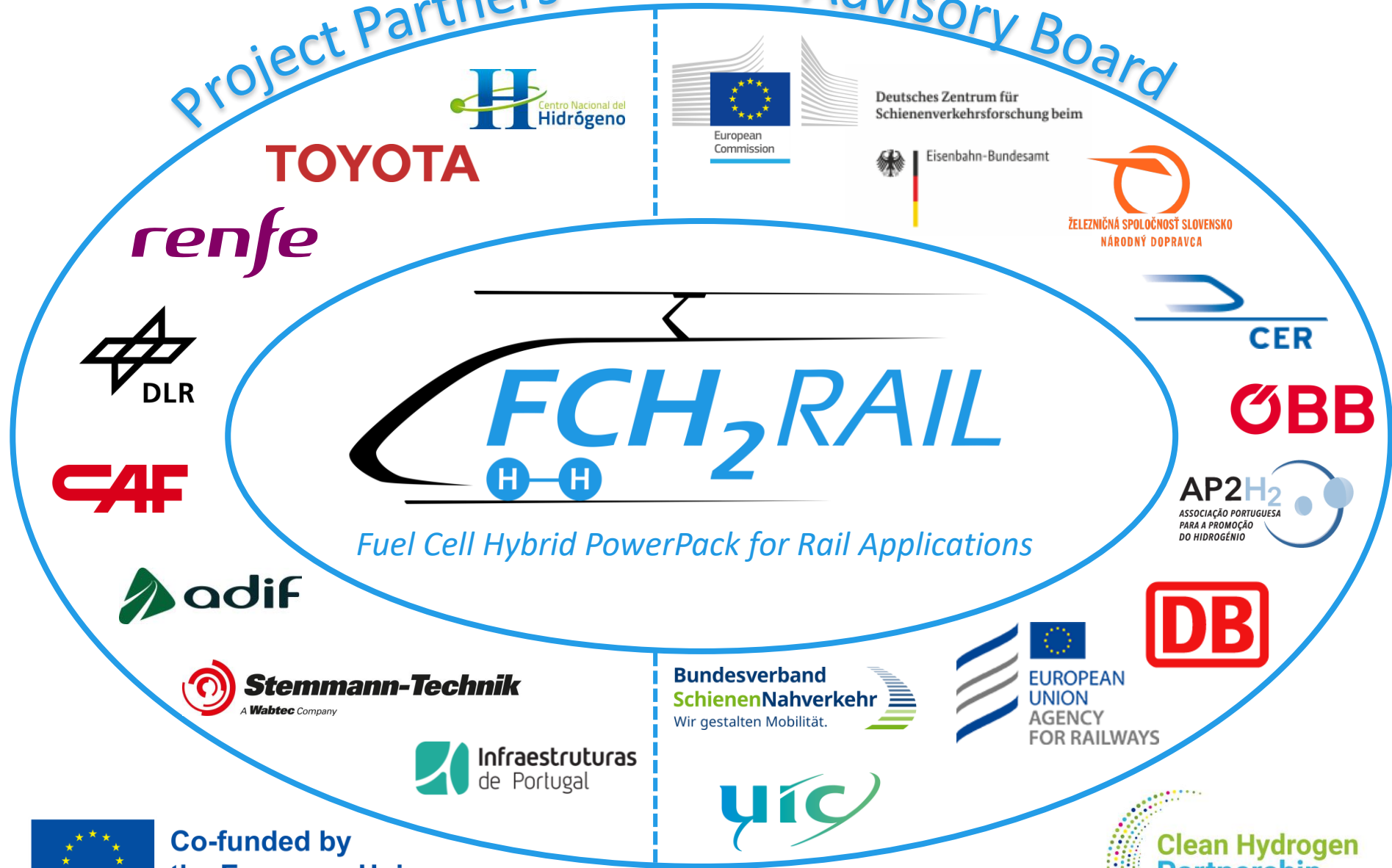
EUROPEAN UNION AGENCY FOR RAILWAYS

FCH₂RAIL

Fuel Cell Hybrid PowerPack for Rail Applications

Project Partners

Advisory Board



TOYOTA

renfe



CAF

adif

Stemmann-Technik
A Wabtec Company

Infraestruturas de Portugal



Deutsches Zentrum für Schienenverkehrsforschung beim Eisenbahn-Bundesamt



ŽELEZNIČNÁ SPOLOČNOSŤ SLOVENSKO
NÁRODNÝ DOPRAVCA



ÖBB



AP2H2
ASSOCIAÇÃO PORTUGUESA PARA A PROMOÇÃO DO HIDROGÉNIO

DB

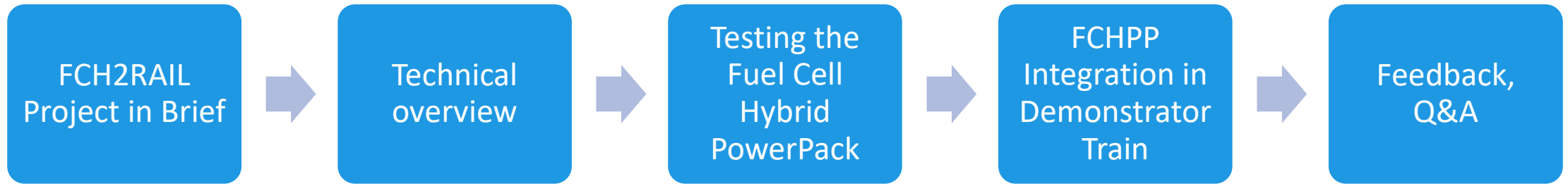
Bundesverband SchienenNahverkehr
Wir gestalten Mobilität.



Co-funded by the European Union



What do we do today?



Holger Dittus



Role in FCH2RAIL:
Project coordinator
Leader of dissemination activities



Eva Terron



Role in FCH2RAIL:
Technical coordinator



Jose Maria Olavarrieta



Role in FCH2RAIL:
Leader & Responsible for the FCHPP test bench

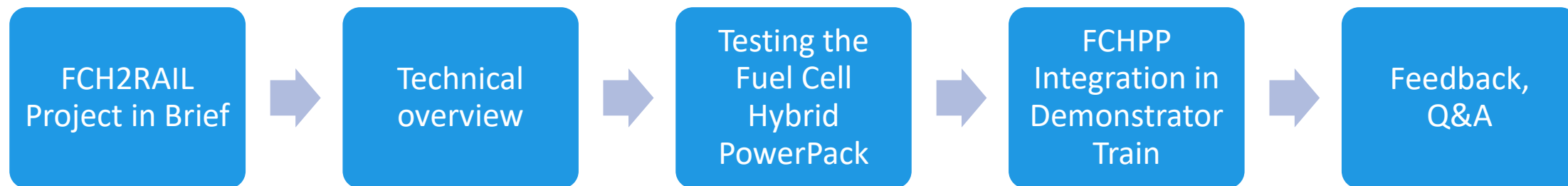


Fabien Bouyssou



Role in FCH2RAIL:
Responsible for the FCHPP Integration and Testing in Demonstrator Train





FCH2RAIL project in Brief

Holger Dittus, DLR

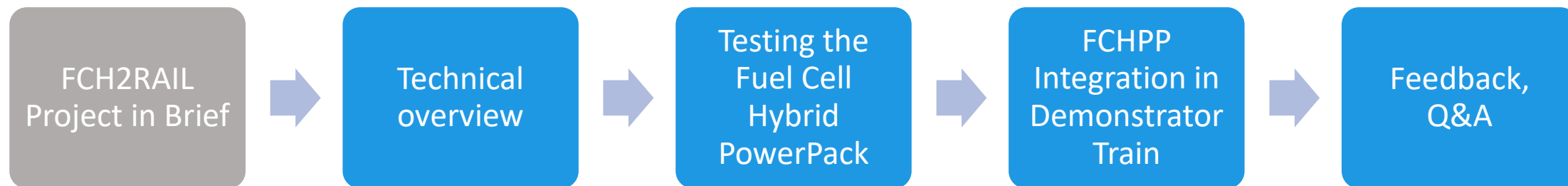
FCH2RAIL Project in Brief



- Start date: 01 January 2021
- Duration: 48 Months
- Total budget: **13.3 Mio €**
- H2020 Innovation Action funded by Clean Hydrogen Partnership
- 7 technical Work packages, 29 Milestones, 43 Deliverables
- **2 Demonstrators:** Fuel Cell Hybrid Power Pack and Bi-Mode Train

- 8 Beneficiaries from Belgium, Germany, Spain and Portugal:





Technical overview

Eva Terron, CAF

FCH2RAIL Objectives



To boost the development of the hydrogen technologies in railways, extending the use cases for FC trains

1. Develop, build, test and homologate a Fuel Cell Hybrid PowerPack (FCHPP)
2. Demonstrate the FCHPP in a Civia EMU
3. Evaluate the competitiveness of fuel cell traction against existing diesel solutions
4. Identify and benchmark innovative solutions to improve energy efficiency
5. Propose a normative framework for hydrogen in railway vehicles

FCH2RAIL Objectives

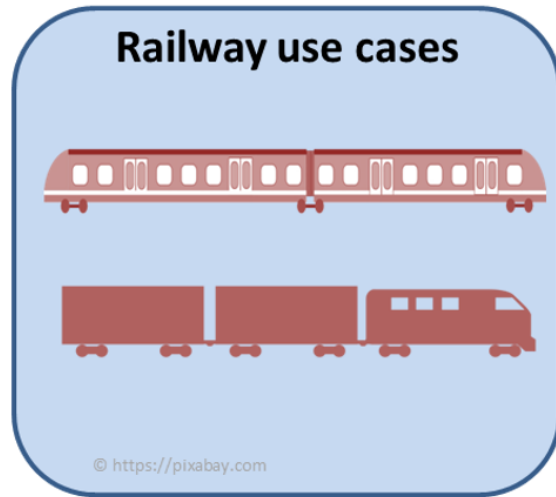


To boost the development of the hydrogen technologies in railways,
extending the use cases for FC trains

- 1. Develop, build, test and homologate a Fuel Cell Hybrid PowerPack (FCHPP)**
- 2. Demonstrate the FCHPP in a Civia EMU**
3. Evaluate the competitiveness of fuel cell traction against existing diesel solutions
4. Identify and benchmark innovative solutions to improve energy efficiency
5. Propose a normative framework for hydrogen in railway vehicles

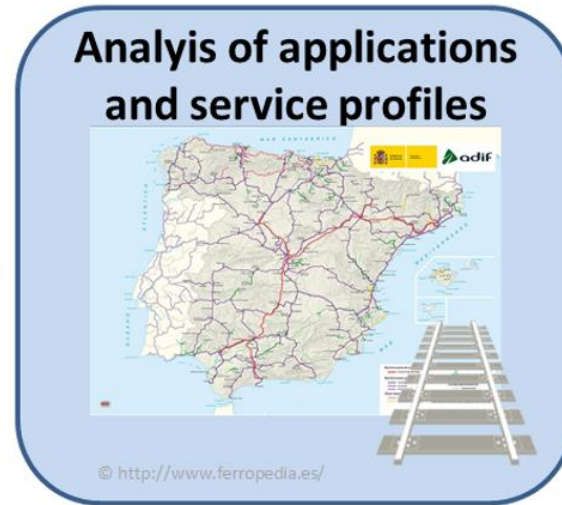
Developing the Fuel Cell Hybrid PowerPack

Step1- Definition of the requirements



Different use cases have been analysed in Spain, Portugal, Germany and Slovakia

- DMUs
- Mainline locomotives
- Shunting locomotives

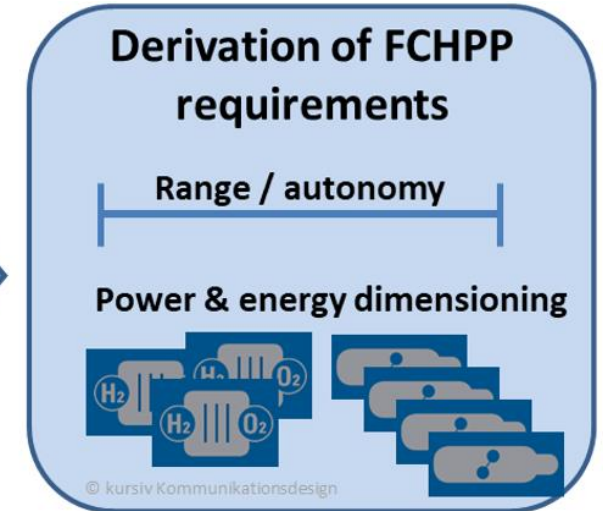


Many services have been analysed

- Spain and Portugal: 10 of 73 services
- Germany: 13 of 1417 services

Very different characteristics

	min	max
Non electrified section (Km)	80	730
Altitude (m)	20	1000
Av. Distance btw. Stations (Km)	2	25



Global requirements are defined:

- Power & energy
- Autonomy or range

Developing the Fuel Cell Hybrid PowerPack

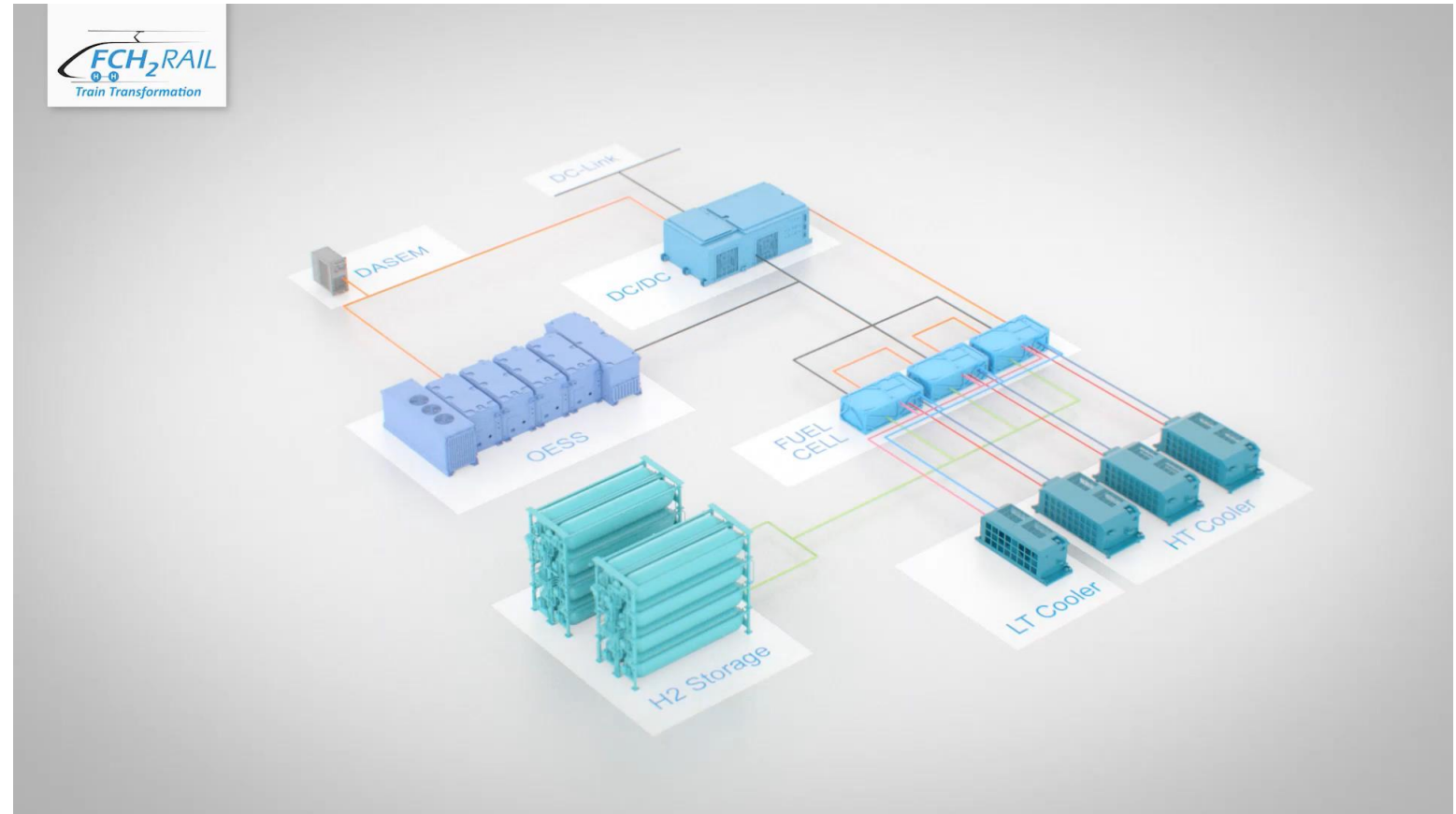
Step 2- Definition of the components and architecture

- Architecture

- Scalable and modular
- Applicable for different rail applications (Multiple Unit, Mainline and Shunting Loco)
- Suitable for retrofitting existing trains

- Components

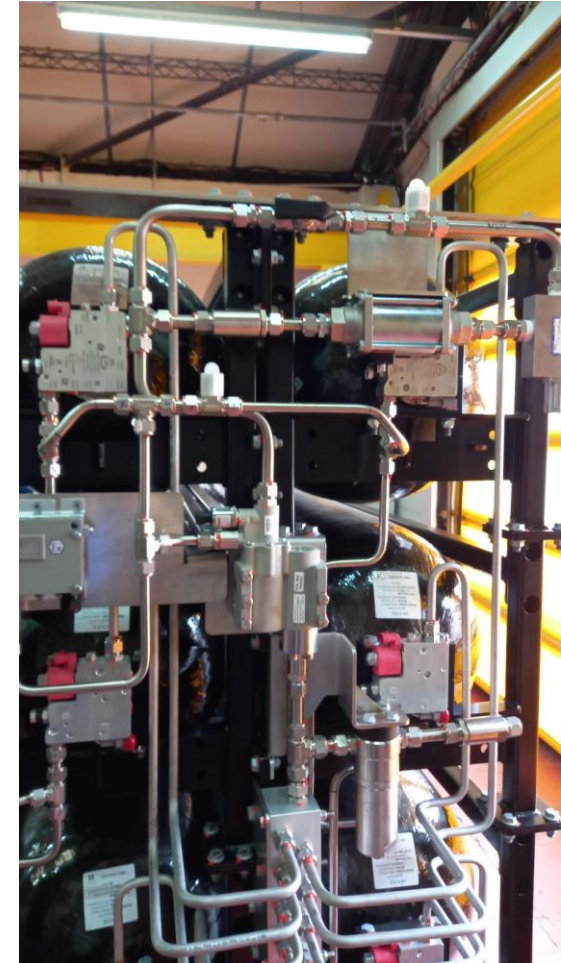
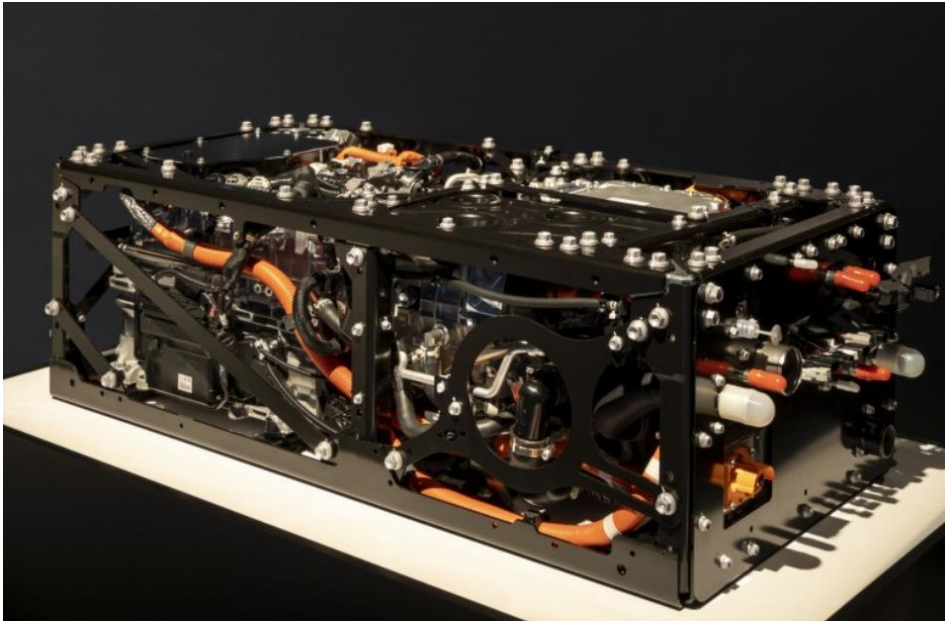
- Fuel Cells (TOYOTA)
- OESS (CAF)
- DC/DC converter (CAF)
- DASEM (CAF)
- Cooling system (Third Party)
- H2 Storage system (Third Party)



Developing the Fuel Cell Hybrid PowerPack

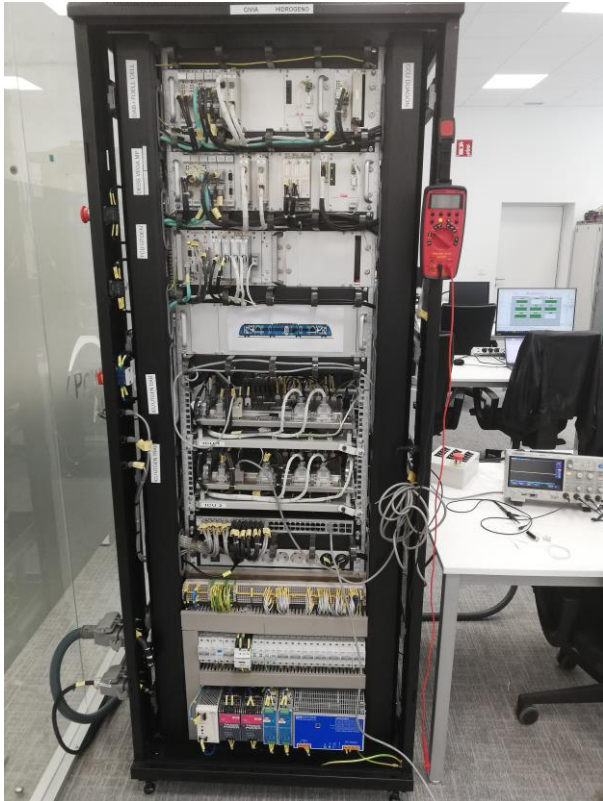
Step 3- Detailed design, manufacturing and testing the subsystems

- Components tested at origin and ready for installation



Developing the Fuel Cell Hybrid PowerPack

Step 4- Development of the HIL



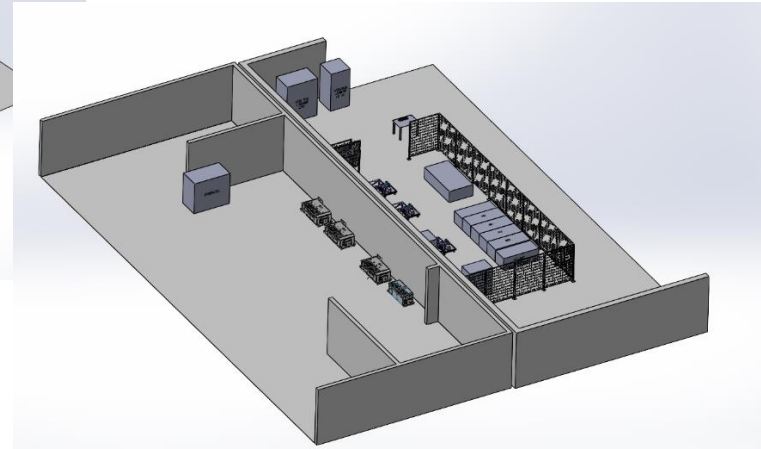
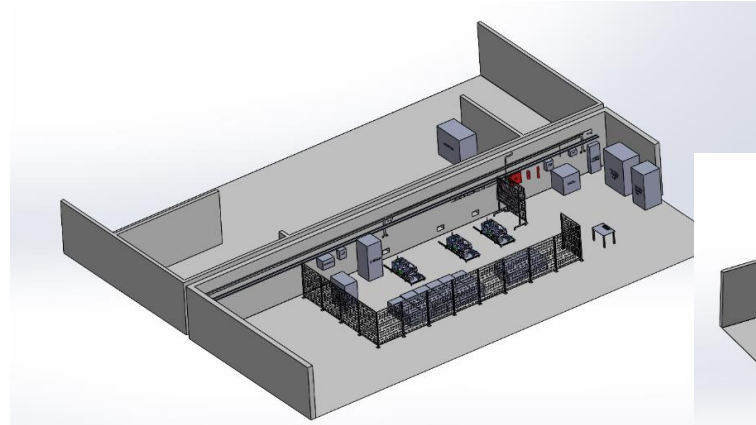
- HIL test bench developed in CAF, including
 - Electronic controllers of the subsystems of the Fuel Cell Hybrid PowerPack
 - New Train Control and Monitoring System (TCMS)
 - Traction control unit of the existing traction equipment in the CIVIA train
 - TCMS of the CIVIA train
- Functionality of the new FCHPP is extensively tested
- Integration of the new FCHPP with the existing traction equipment and the existing train control is also tested

Developing the Fuel Cell Hybrid PowerPack

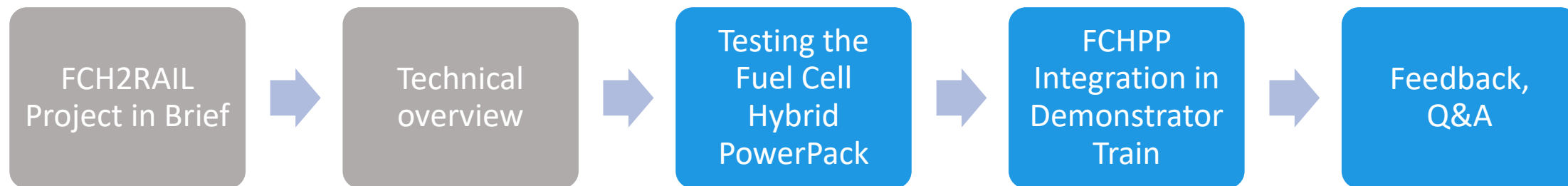
Step 5- Testing the real FCHPP

2 demonstrators have been developed

1. Full scale Test bench for the Fuel Cell Hybrid PowerPack (FCHPP)
2. Civia EMU converted into a Bi-Mode FCH train



Both demonstrators are running in parallel!

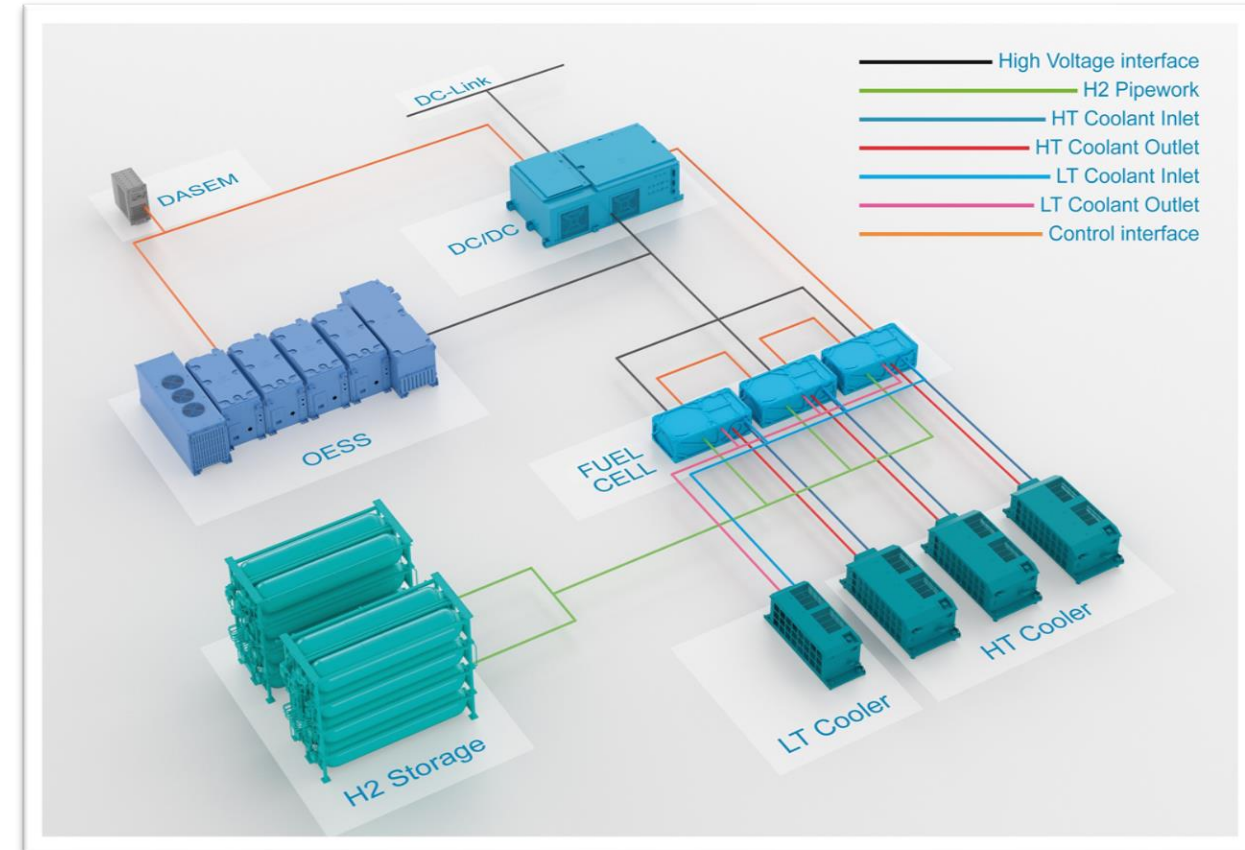


Testing the Fuel Cell Hybrid PowerPack

Jose Maria Olavarrieta, CNH2

MAJOR CHALLENGES

- How to test a H₂ train propulsion system without a train?
- How or where is this tested? Who has a test bench for this?
- Who is able to provide all the H₂ supply installations, main and auxiliary systems and subsystems, safety installations, etc?



MAIN OBJECTIVES



- To test a complete Fuel Cell Hybrid PowerPack.
- To demonstrate operation and performance of the Fuel Cell Hybrid PowerPack.
- To know how the individual equipment performs before the integration into the train.
- To optimize the controls and energy management system.

THE TEST BENCH IMPLEMENTATION PROCESS



**Week 0
(February '22)**

Facilities at CNH2
(prototypes area)

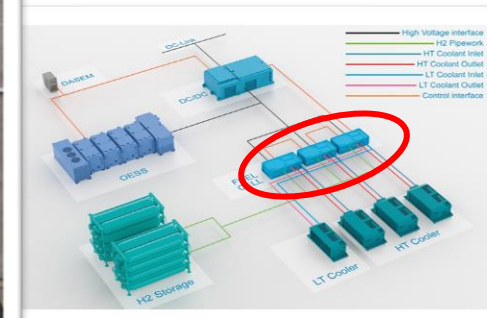
Clean and clear

Nothing
implemented

TME FUELCELL MODULES PLACING



Week 1





Week 02
Week 03

Safety barrier

H₂ SUPPLY PANEL PLACING

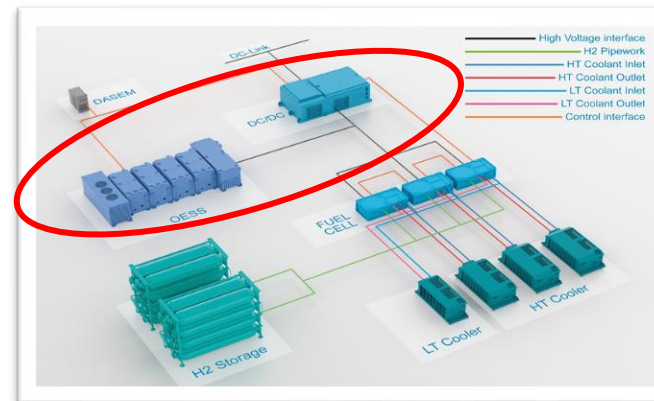


Week 03

Week 04

Mechanical
installation and
electrical connection
process of control
and monitoring
instruments

OESS & DC/DC INSTALLATION



Week 05

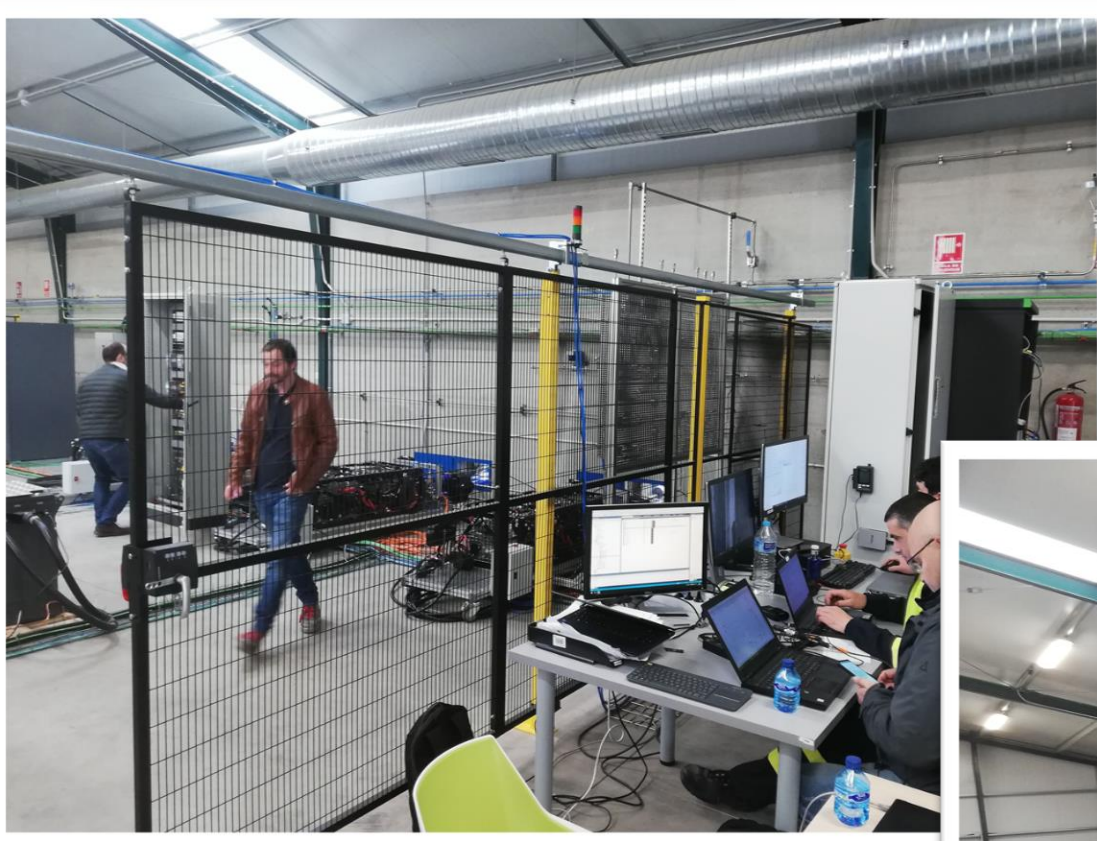


OESS and DC/DC placing, mechanical installation and electrical connection process



Cooling systems
mechanical
installation and
electrical connection

THE TEST BENCH COMMISSIONING PHASE



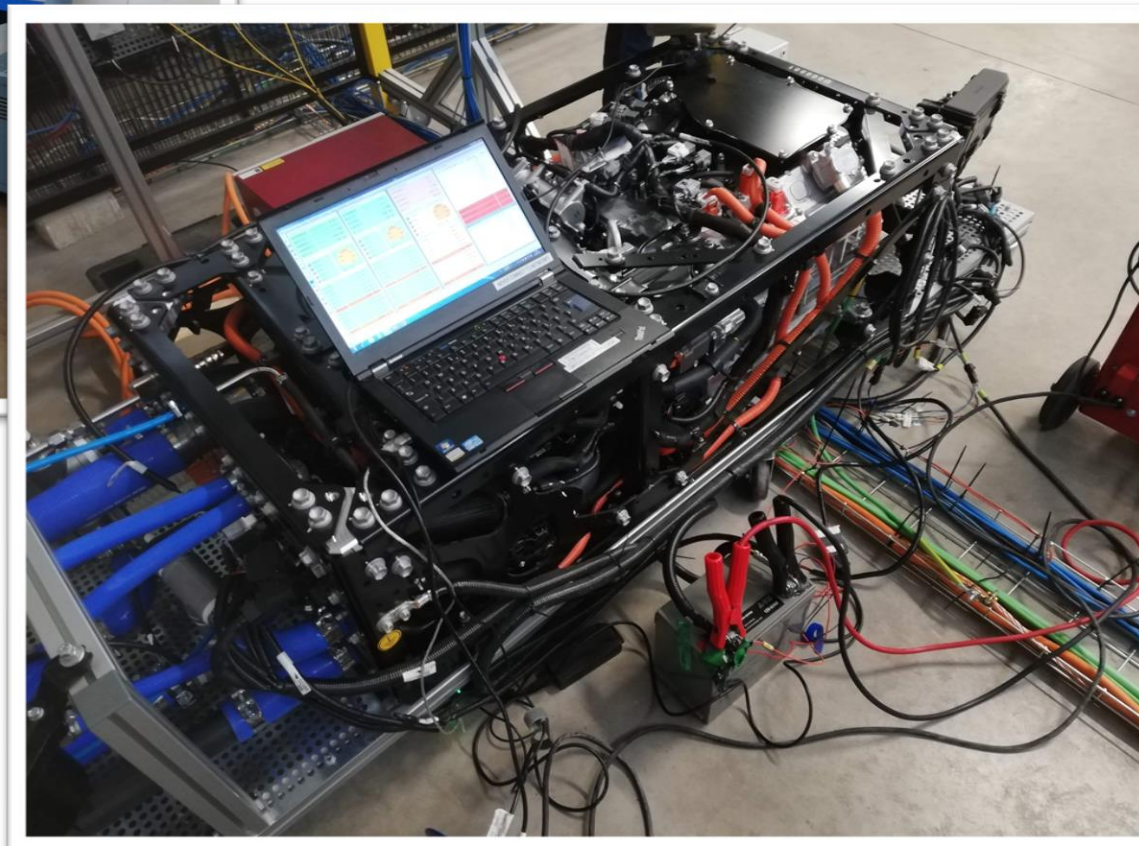
CNH2, CAF, CAF PA and TOYOTA crew in commissioning phase

Week 08





Cooling system connection/communication process (commissioning)



Fuel Cell Modules connection/communication process (commissioning)



Week 08

DC/DC converter
commissioning

THE TEST BENCH VIDEO DEMONSTRATOR



MAIN RESULTS



- Many tests on different system levels were performed:
 - Standard polarization curves for fuel cells, etc.
 - H₂ consumption test, driving cycle test, ramp-up test, etc.
 - Tests related especially to the specific use cases / service profiles / railway profiles, etc.

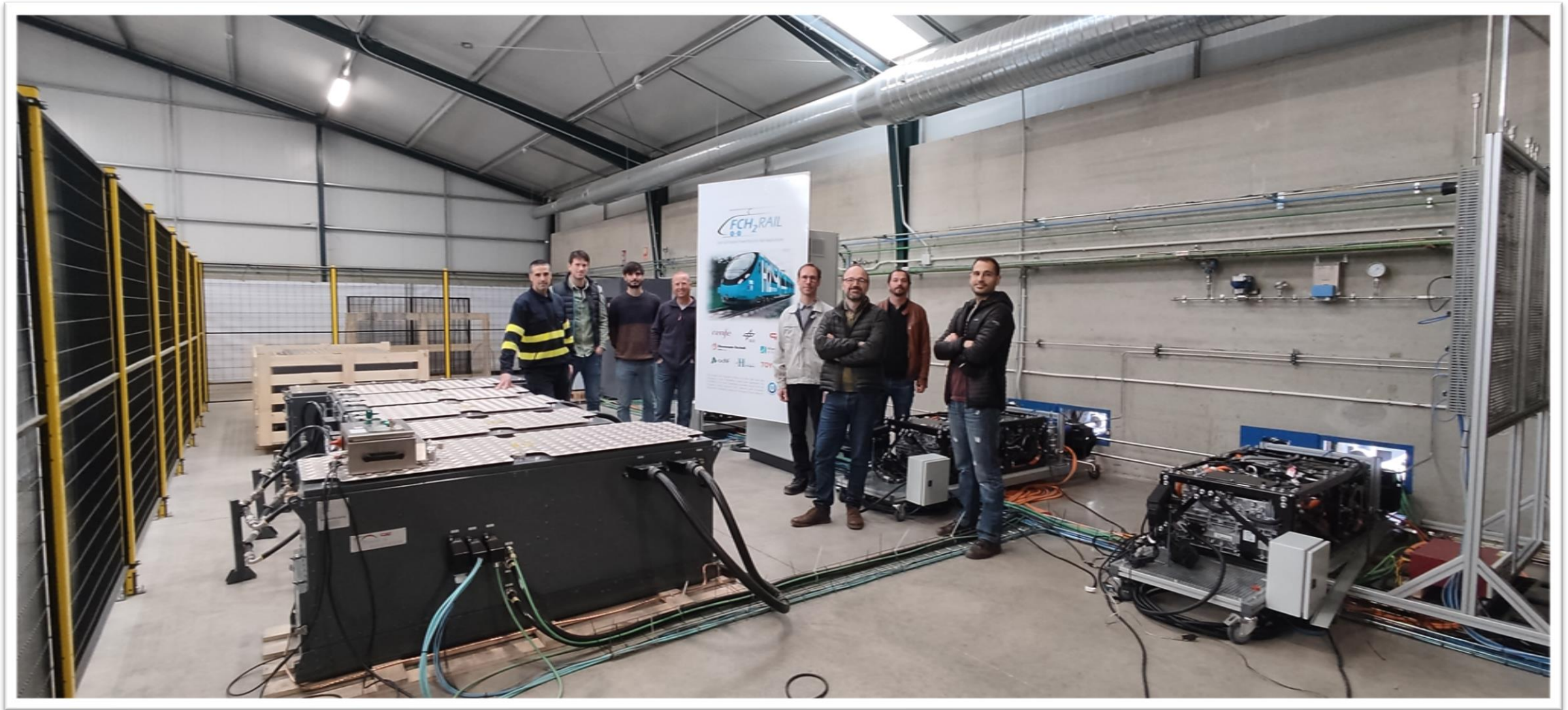
- 220 kg of green H₂ consumed so far.

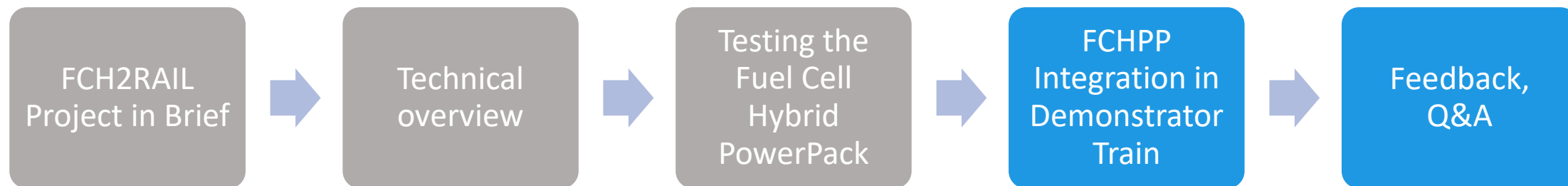
- Detailed knowledge of the systems and subsystems performance was obtained.

- Control and energy management system was optimized.

- Full functionality and requested performance of the Fuel Cell Hybrid PowerPack is achieved.

THANK YOU TO THE TEST BENCH CREW





FCHPP Integration in Demonstrator Train

Fabien Bouyssou, CAF

Train Demonstrator TimeLine

According to Grant Agreement objectives signed with JU:

- January 2023: Implementation and Integration in Demonstrator
- August 2023: Start of Track Testing



Thanks to one Power Pack not in use and available since M17:

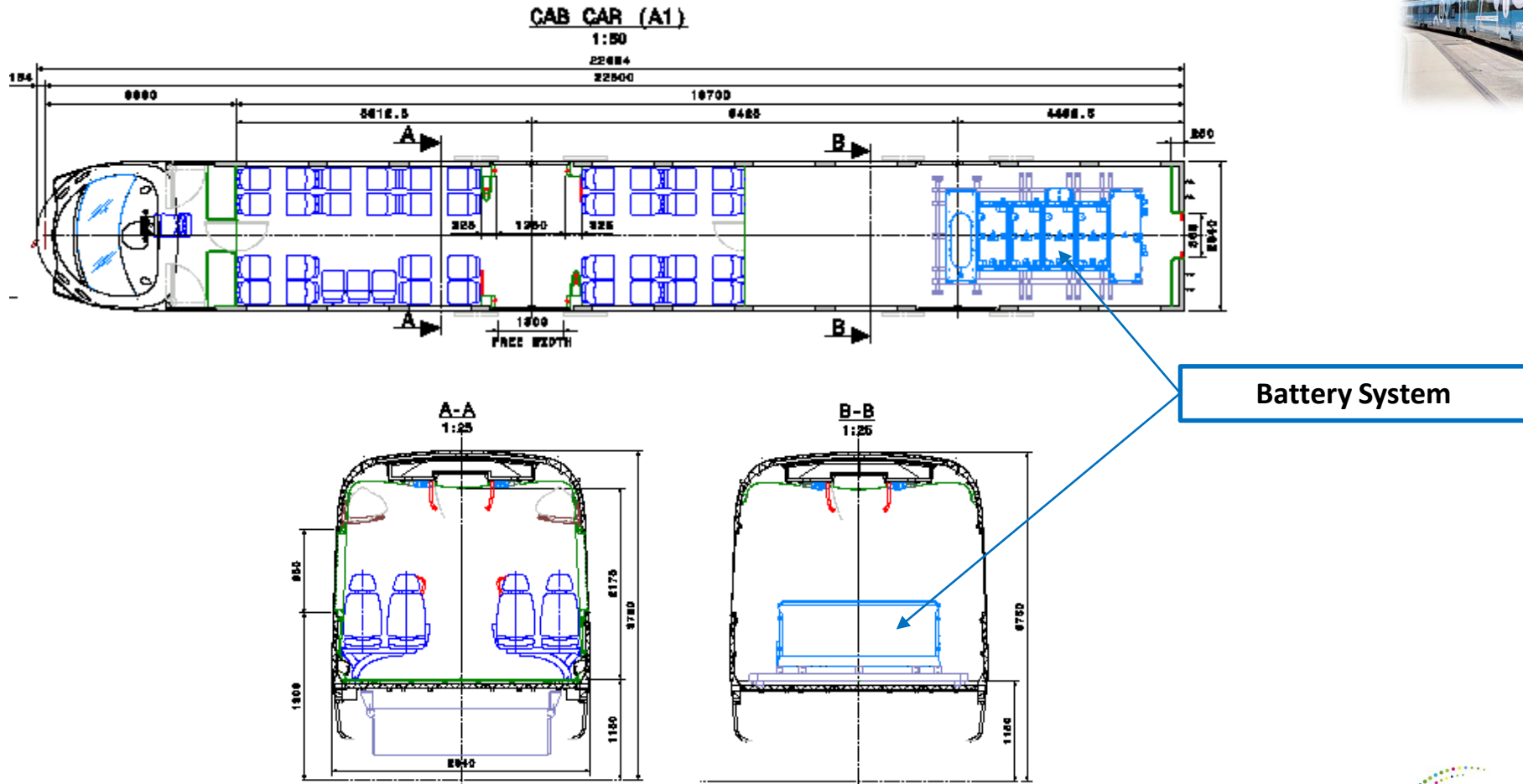
FCH2RAIL Results, as of today: Need of a Quick Implementation!

- **June 2022**: Implementation and Integration in Demonstrator of one PP
- **July 2022**: Start of Track Testing with one PP

High interest of getting both CNH Testing Bench and Train Demonstrator in use at the same time!

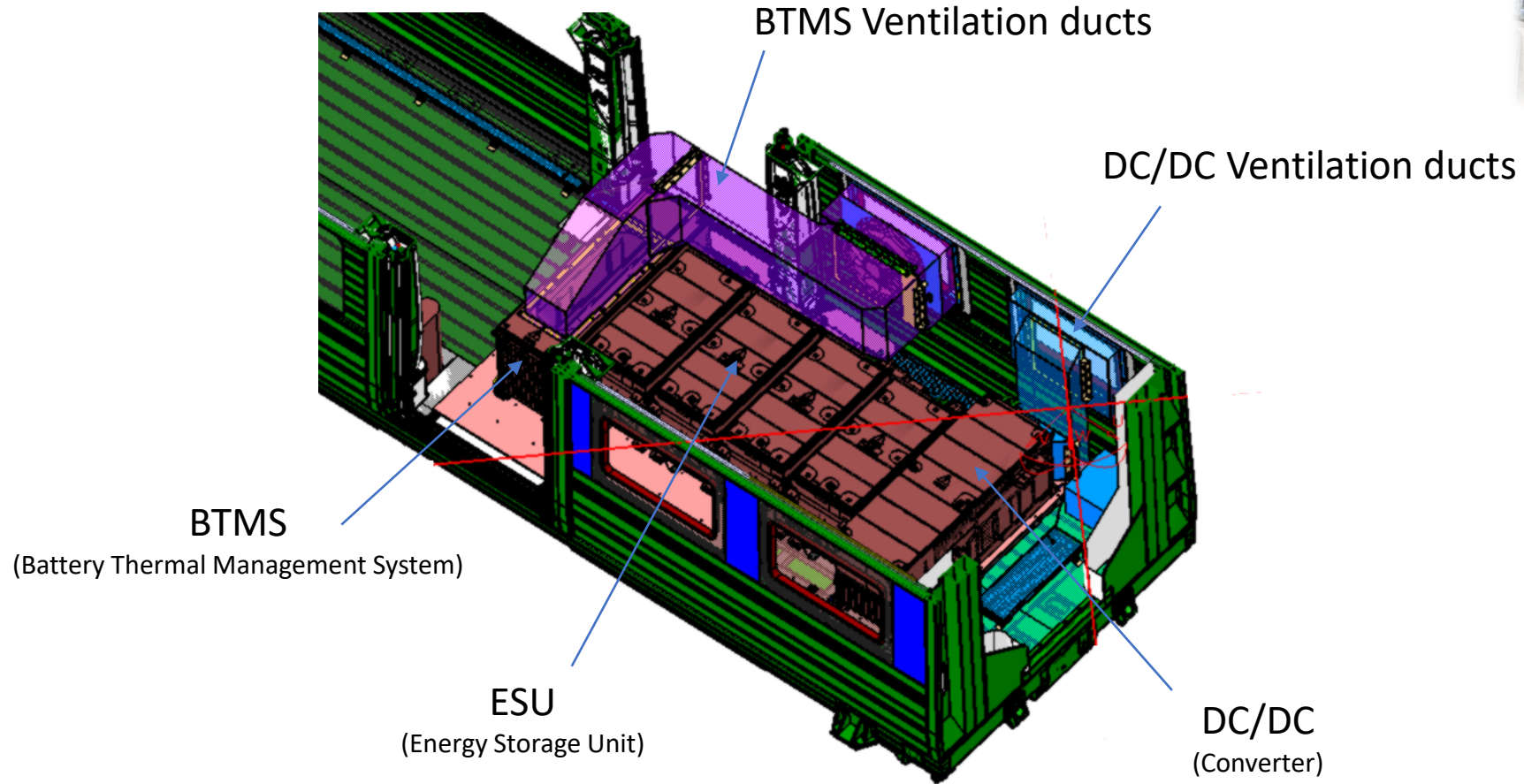
Train Demonstrator Modification Concept

FCHPP integration in Car A1/A2 (cab cars) due to battery weight!



Train Demonstrator Modification Concept

Battery System integration in rear end of A1/A2 cars



Train Demonstrator Modification Concept

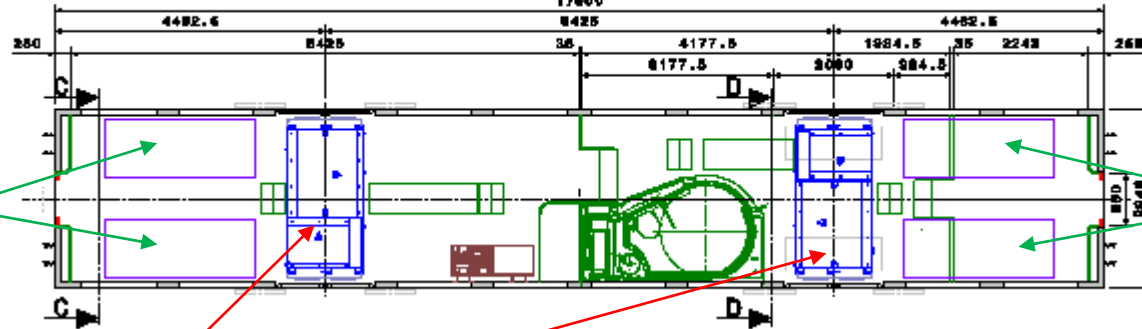
FCHPP Integration in Car A3 (intermediate car)



1/2 LOW FLOOR CAR (A3)

1:50

17800



H2 Storage System

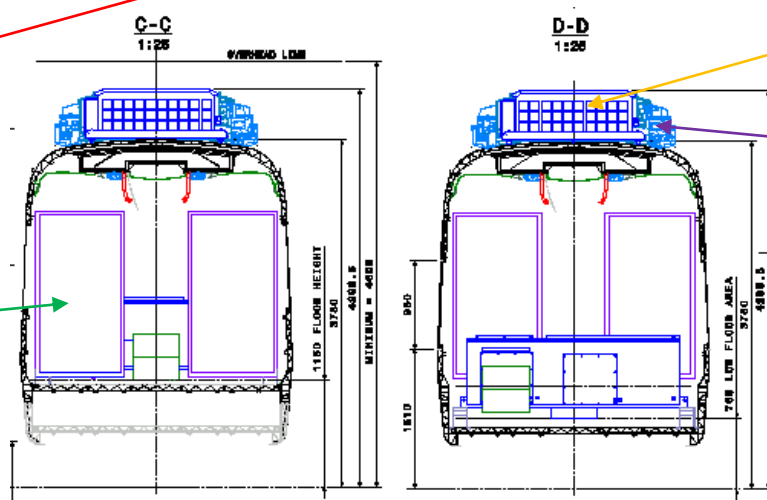
H2 Storage System

DC/DC 3000/750 Vdc

FC Cooling System

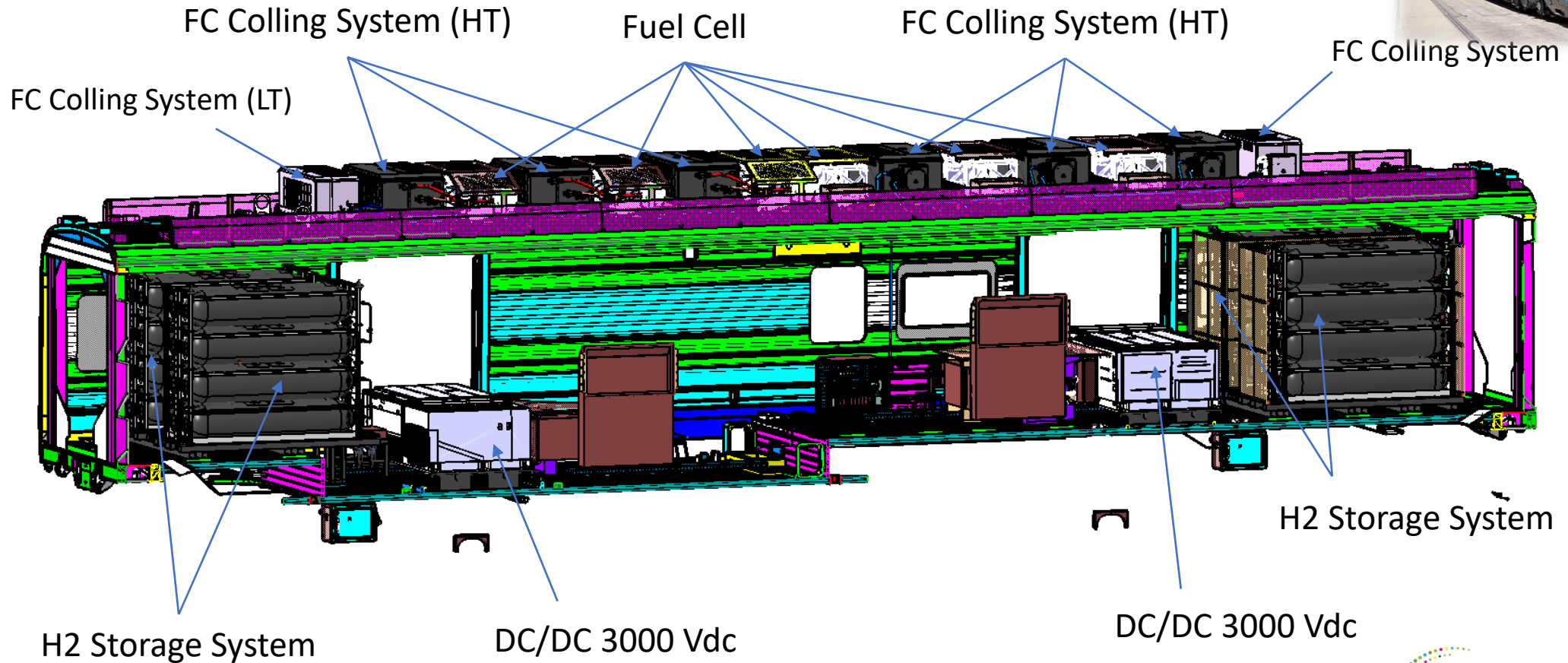
Fuel Cell

H2 Storage System



Train Demonstrator Modification Concept

A3 Intermediate Car



Train Demonstrator Modification Phases



3 Main steps:

1. Dismounting of former “RENFE” equipment and interiors
2. Preparation for PP installation
 1. Soldering operations on roof, brackets installation
 2. Mechanical supports and reinforcement inside the train
 3. Electrical wiring and protections
3. PP equipment installation and connection

Train Demonstrator Modification Video



Enjoying Concrete Results !

Train Demonstrator Modification Video



Train Demonstrator Modification Video



Train Demonstrator Modification Video



Train Demonstrator Lessons Learnt

Experience leads to lessons learnt:

H2 leaks! That's a fact!

Tightness test criterion is a challenge and experience is a key factor in successful test completion. Need of close involvement of H2 distribution and storage system sub suppliers.

Solaris help (CAF Group) has been fundamental in the 1st testing steps.

H2 dispensation is a new field of competence / knowledge to be developed as Rolling Stock supplier, to offer “turnkey” projects:

- Dispensation technology knowledge
- Need of optimizing refueling times, no “SAE Jx” protocol existing
- Safety related operation, monitoring and control of H2 max temp



Train Demonstrator Approval Process



Approval Process being started and undergoing.
ISA (Tüv-Süd) and DeBo (BelgoRail) competences involved.

First positive assessment results from Tüv-Süd Rail granted related to testing in San Gregorio external track with 1 PP.

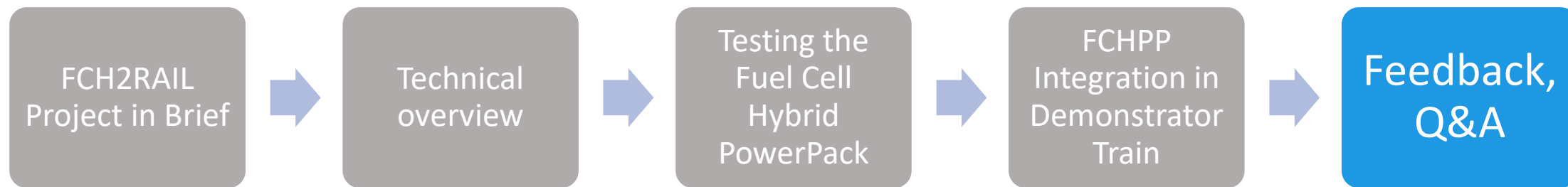
Relying on strong Tüv-Süd experience in H2 Rolling Stock field.

2023

TRL7 train homologation in Spain, Track Testing with 2 PP
Portable HRS in several locations

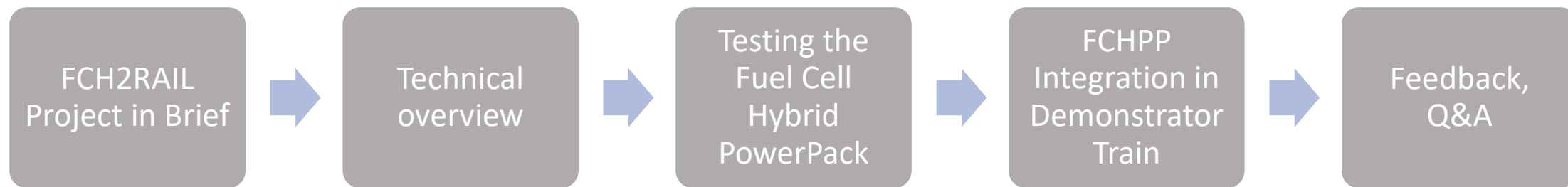
2024

TRL7 train homologation in Portugal, Track Testing with 2 PP
Train authorization study in Germany



Feedback, Q&A





Dissemination Activities



#wcr2022

World Congress on Railway Research 2022

Reshaping our railways post-pandemic: Research with an impact

6-10 JUNE 2022

International Convention Centre Birmingham, United Kingdom

EHEC 2022

HOME EHEC CONFERENCE PROGRAM TRADE FAIR MADRID MEDIA

EUROPEAN HYDROGEN ENERGY CONFERENCE 2022

18 - 20 MAY 2022

COMPLIJO DUQUES DE PASTRANA, MADRID (SPAIN)

TRA LISBON 2022

TRANSPORT RESEARCH ARENA

Conference dedicated to European Research in Transport

MOVING TOGETHER

14 - 17 November 2022 - Lisbon, Portugal

9th Transport Research Arena TRA Lisbon 2022, Portugal

The FCH2Rail Project: A Demonstration of a Modular Fuel Cell Hybrid Power Pack

Florian Kühnkamp*, Holger Dittus*, Sebastian Herwartz-Polster*, Johannes Pagenkopf*, Abraham Fernández Del Rey*, Maider Varela*

*DLR Institute of Vehicle Concepts, Pfaffenwaldring 38-40, Stuttgart 70568, Germany
*Rhein-Operatoren U.L.E., Zehn, P.O. Box 1000, 42699 Solingen, Germany
*Construções y Auxiliar de Ferrocarril S.A. - CAF, S.M. Barceos 26, Barceos 20060, Spain

Abstract (linked to sub-theme 2.1)

1. Overview and motivation
2. Project objectives, methodology and main contributions

The ongoing EU-project FCH2RAIL develops a novel fuel cell-based powertrain architecture by combining the advantages of an overhead electric traction and fuel cell hybrid powertrain. Therefore, the CO2 emission intensive diesel powertrain is replaced by a fuel cell hybrid power pack (FCHPP). The novel FCHPP incorporates two primary (FC & catenary) and a secondary power source (electric energy storage system), offering coverage of long non-electrified sections without the need to carry hydrogen for the whole trip. The application field for the novel FCHPP shall include multiple units, shunting as well as mainline operation. This imposes the necessity to dimension the bi-mode powertrain, especially the FCHPP, according to its use case specific demand profile. Hence, the investigation on a modular FCHPP is a core task of FCH2RAIL. This goal is achieved through a set of main objectives. The modular FCHPP will be developed, built, tested, homologated and implemented in an existing electrical multiple unit. The FCHPP's bi-mode operation is demonstrated and tested extensively on tracks with mixed operation modes: catenary (electrified) and fuel cell hybrid (non-electrified). Additionally, innovative solutions are identified and benchmarked to further improve the energy efficiency of the FCHPP. For these project objectives, eight project partners from Belgium, Germany, Spain and Portugal collaborate in the FCH2RAIL project, which started in January 2021 and is planned for a project duration of 48 months with a total budget of 13.3 Mio €. The project is part of the Horizon 2020 Innovation Action and funded by the Fuel Cells and Hydrogen 2 Joint Undertaking.

In the FCH2Rail project, an automated approach was developed to determine scalable component sizes whilst maintaining the FCHPP's modular character. The holistic energy management enables adaption to the application of specific requirements in terms of power and required range for non-electrified operation. Furthermore, it manages energy-efficient operation, thus reducing hydrogen consumption and improving operation cost of the

* Corresponding author. Tel.: +49 7141 662 2056; E-mail address: florian.kuehnkamp@dlr.de

WCR2022 BIRMINGHAM UK 2022

The EU Project FCH2RAIL - Fuel Cell Hybrid PowerPack for Rail Applications

Holger DITTUS¹, Eva TERRON², Thomas LANDTMETERS³, Abraham FERNANDEZ DEL REY⁴, Antonio MARTIN-CARRILLO⁵, Carlos DE LA CRUZ⁶, Francisco GANHAO⁷, Susanna KÜCK⁸

¹DLR Institute of Vehicle Concepts, Stuttgart, Germany
²Construções y Auxiliar de Ferrocarril S.A. (CAF), Beasain, Spain
³Toyota Motor Europe, Brussels, Belgium

WCR2022 BIRMINGHAM UK 2022

Bi-Mode Hydrogen Train Requirements Using Geospatial Line Assessment

Sebastian HERWARTZ¹, Florian KÜHLKAMP¹, Johannes PAGENKOPF², Abraham FERNANDEZ DEL REY³, Maider VARELA⁴, Antonio Martín CARRILLO DOMINGUEZ⁵, Francisco Manuel ROMA GANHÃO⁶

¹ German Aerospace Center (DLR), Institute of Vehicle Concepts, Berlin and Stuttgart, Germany
² Renfe Operadora (RENFE), Madrid, Spain
³ Construções y Auxiliar de Ferrocarril S.A. (CAF), Beasain, Spain
⁴ Administrador de Infraestructuras Ferroviarias (ADIF), Madrid, Spain
⁵ Infraestruturas de Portugal SA (IP), Lisboa, Portugal
Corresponding Author: Sebastian Herwartz-Polster (Sebastian.Herwartz@dlr.de)

Abstract

In this paper we analyse use-cases of bi-mode multiple units with a fuel cell hydrogen power pack to identify vehicle requirements arising from infrastructure and operation. For this, we develop a methodology combining a geospatial assessment on available open data (i.e. Open Street Map and a digital elevation model) and a longitudinal dynamic simulation model of rail vehicles. Open data railway networks are suitable in this manner, but elaborate measures to account for data gaps and data inconsistencies are needed. Therefore, we deploy a routing and a smoothing algorithm for elevation profiles integrated in a geospatial model. The modelled data is fed into a simulation tool, which simulates force and speed trajectories at wheel. From the resulting trajectories we determine the necessary traction power at wheel, which has to be subsequently covered by a traction system. From the defined power demand, we derive indicative values for a fuel cell system and resultant net usable battery capacity. We deploy our model on a collection of railway services in Spain, Portugal and Germany currently operated with diesel multiple units. We consider 23 use-cases with varying vehicles and operational configuration. Determined power rates vary strongly and are especially sensitive to operational issues such as very long or very short stopping times and to vehicle parameters such as vehicle mass. We determined net power at wheel capacities to be covered by fuel cell system between 82 kW and 674 kW. In relation we determined net usable battery capacities between 90 kWh and 274 kWh. Those demands cover demands for traction energy at wheel level, excluding auxiliary loads and efficiencies.

European Hydrogen Energy Conference 18-20 May, 2022, Madrid, Spain

Using Absorption Refrigerator and Metal Hydrides in Hydrogen Fuel Cell Trains: Draft Design Process and Feasibility

M. K. ...

HVAC installations on trains 15% to 20% and for regional use heating, ventilation and air conditioning (HVAC). For fuel cell trains with an end of 3.2 t-H₂ per year, if HVAC is feasible and benefits of Hydrogen technologies use the energy via tank, while the absorption AC is

European Hydrogen Energy Conference 18-20 May, 2022, Madrid, Spain

Hydrogen on-board storage options for rail vehicles

M. Boehm*

* German Aerospace Center - Institute of Vehicle Concepts (Institute for Life and Transport) | Pfaffenwaldring 38, 70568 Stuttgart, Germany
(*) 1boehm.boehm@dlr.de

This paper discusses hydrogen on-board storage options for rail vehicles, with a focus on the comparison for current implementation projects as hydrogen powered passenger trains. Within the framework of the EU project FCH2RAIL, data on pressurized hydrogen storage systems and other physical storage forms analyzed in terms of technical data.

Today, hydrogen storage manufacturers offer a variety of 35 MPa compressed gaseous hydrogen (CGH₂) type III and IV hydrogen storage cylinders for hydrogen trains. In 2016, the Coradia LINTE prototype, a fuel cell hybrid electric multiple unit, was equipped with Xplore's Type IV cylinders [1]. The current LINTE series trains attain mileage of up to 1,000 km with 24 roof-mounted 35 MPa Type IV cylinders from NPROXX [2]. Hexagon Pumps will deliver Type IV 35 MPa cylinders for Talgo's Virta-One and for Stadler's Flirt H2 multiple units [3]. The company announced that the cylinders are approved according to rail regulation codes and standards [4]. Linde's G-Store H2 Type III cylinders also have been used for railway applications. Linde indicates that every rail project is specifically approved case by case by the railway authority in charge as there is no standard regulation available [5], [6]. The Korea Railroad Research Institute announced that it will apply 70 MPa CGH₂ in its regional train prototype [7] and liquid hydrogen (LH₂) in its locomotive [8]. JR East, Hitachi and Toyota announced to use 70 MPa storage cylinders for the HYVARI Project [9].

Materials and Methods

Data on hydrogen storage systems of manufacturers active globally were evaluated using technical data provided by manufacturers, with a focus on available data for 35, 50 and 70 MPa CGH₂. If data was not available on their website, hydrogen storage manufacturers were directly contacted. Also, current standardization activities in the field of rail were researched. Moreover, alternative hydrogen storage technology candidates applied in other fuel cell powered transport modes (e.g. fortrac) were evaluated, which, due to the high hydrogen quantities stored on-board, are in principle also suitable for rail applications. Material based hydrogen storage technologies were not considered as the analysis since they are not available commercially today.

Results and Discussion

Based on requests and data specifications from worldwide CGH₂ storage manufacturers Hexagon Pumps, NPROXX, Quantum, Faenza, Linde, Worthington, Faber, Albarino, Swedish Composite, CLD and supplemented by literature findings as regard to LH₂ and CCH₄ system weight, system volume and hydrogen capacity of the different hydrogen storage systems are shown in Figure 1 and Figure 2. A large part of the cylinders exist for H₂ storage capacities below 10 kg. Larger quantities are mostly used for gas transportation vehicles. The higher weight of the 50 MPa cylinders results from higher safety requirements of gas transportation.

Table 1 compares CGH₂, LH₂ and CCH₄ storage systems in terms of pressure, density or substance level, volumetric and gravimetric capacity and TRL. When doubling the storage pressure from 35 to 70 MPa, it results only in 1.66 times increased energy density on substance level due to the isothermal properties of hydrogen. On vehicle storage system level that increase is lower (~1.25) because of the higher tank material requirement and thus there is a higher specific weight compared to 35 MPa CGH₂ storage systems. With LH₂ and CCH₄ storage systems, volumetric energy storage capacity could be doubled compared to CGH₂ systems. Both off and low-off losses may not be relevant for trucks and railway vehicles due to constant operating times, as opposed to passenger cars. Currently, no series LH₂ and CCH₄ storage tank systems are available on the market, but industry pushes forward development. Especially for heavy-duty truck applications, there are currently efforts to integrate LH₂ and CCH₄ storage systems. Development and validation of the first LH₂ heavy-duty truck prototype vehicle is expected to be completed in 2023.

Figure 1. System weight and H₂ capacity of H₂ storage systems

Figure 2. System volume and H₂ capacity of H₂ storage systems



Up-to-date information and results



Project overview Consortium Project results Project News

FCH2RAIL > Project News

Project News

Demonstration of the Fuel Cell Hybrid PowerPack
Join us at InnoTrans 2022, Hall 7.2 A
22 September from 13:30 - 14:30
#InnoTrans via <https://plus.innotrans.de/>

Visit us on InnoTrans 2022
31.08.2022

For more than 18 exciting months the FCH2RAIL partners have been working intensively on the development of the Fuel Cell Hybrid PowerPack for Rail Applications. Now the FCH2RAIL consortium shares recent highlights related to testing of the innovative power pack and the demonstrator train on InnoTrans 2022:

FCH2RAIL insights:
Demonstration of the Fuel Cell Hybrid PowerPack

The free of charge live presentation can be visited on 22 September from 13:30 - 14:30 in Hall 7.2a on the InnoTrans exhibition grounds in Berlin.

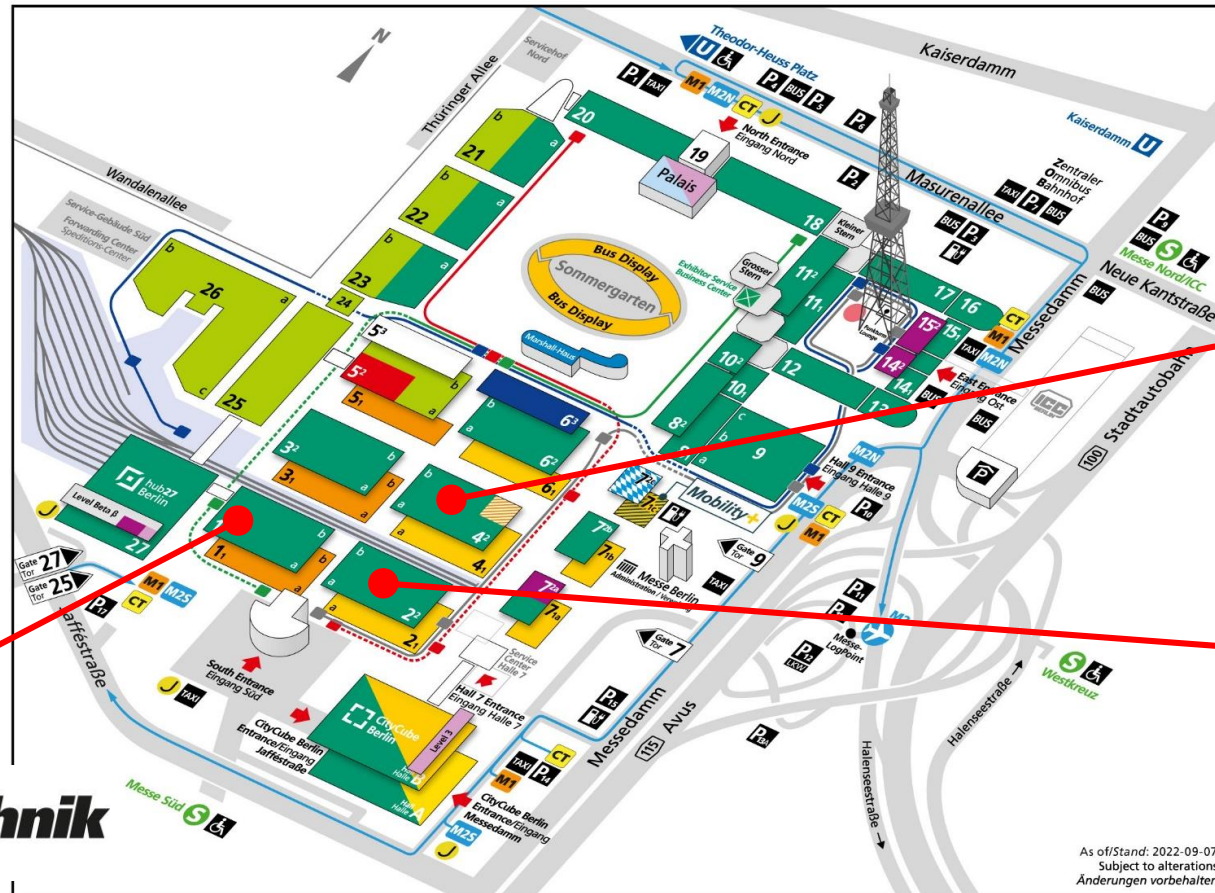
You are not at InnoTrans and cannot attend on site? No problem, our event will also be available online as a video stream via the InnoTrans website <https://plus.innotrans.de/>.

Contact
Holger Dittus
Institute of Vehicle Concepts (DLR)
+49 711 6862 581
holger.dittus@dlr.de



www.fch2rail.eu

FCH2RAIL partners on InnoTrans 2022



Stemmann-Technik

A **Wabtec** Company

Hall 1.2, Stand 210



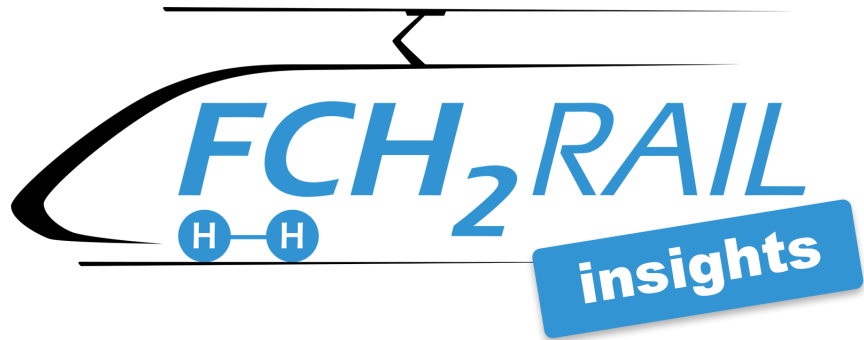
Hall 4.2, Stand 130



DLR

Hall 2.2, Stand 460

As of/Stand: 2022-09-07
Subject to alterations
Anderungen vorbehalten



Thank you for
joining!

Project Coordination

**German Aerospace Center (DLR)
Institute of Vehicle Concepts**

Pfaffenwaldring 38–40
70569 Stuttgart
Germany

Holger Dittus
holger.dittus@dlr.de

Technical Coordination

**Construcciones y Auxiliar
de Ferrocarriles (CAF)**

J.M. Iturrioz, 26
20200 Beasain
Spain

Eva Terron
eterron@caf.net



visit us
www.fch2rail.eu