Demonstration of the Fuel Cell Hybrid PowerPack

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Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

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Institute of Vehicle Concepts

Institut für
DLR Fahrzeugkonzepte

FCH2RAIL Project in Brief → Technical overview → Testing the Fuel Cell Hybrid PowerPack → FCHPP Integration in Demonstrator Train → Feedback, Q&A

FCH2RAIL project in Brief

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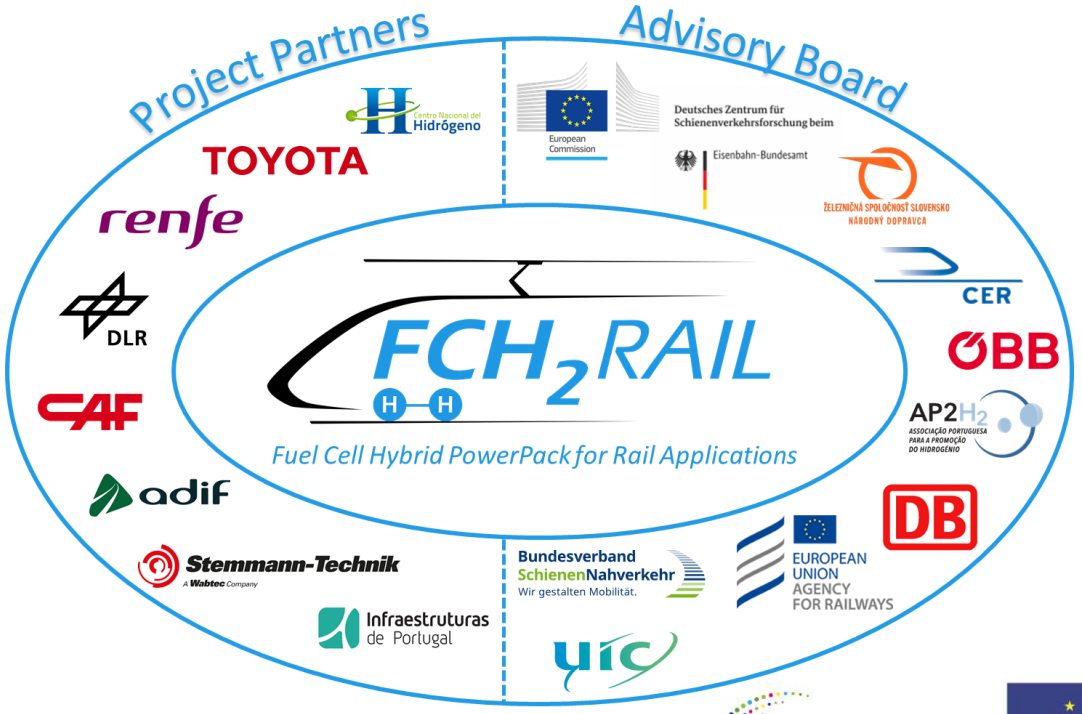
FCH2RAIL Project in Brief

- 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

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



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Technical overview

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FCH2RAIL Objectives

To boost t **ilways, extending**

1. **Develop** **Pack (FCHPP)**
2. **Demons**
3. Evaluate ng diesel solution
4. Identify y efficiency
5. Propose es

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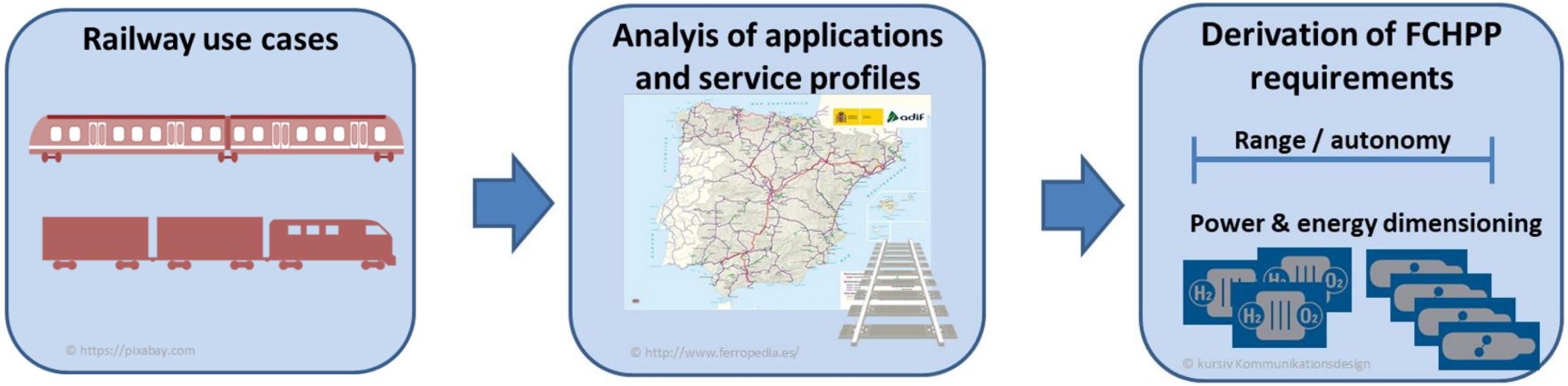
Developing the Fuel Cell Hybrid PowerPack

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

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Developing the Fuel Cell Hybrid PowerPack

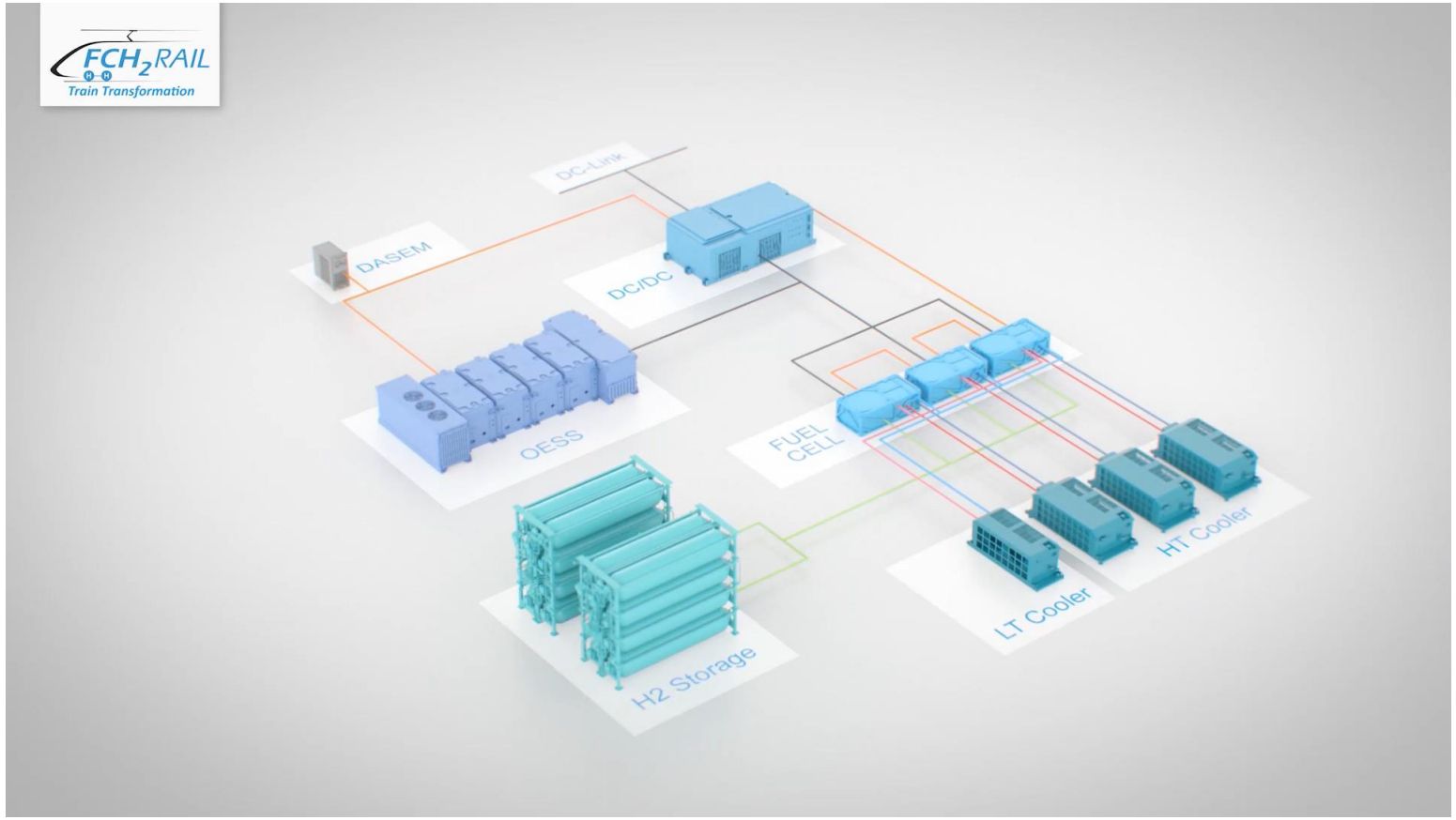
Definition of the components and architecture

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)



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Testing the Fuel Cell Hybrid PowerPack

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Testing the FCHPP

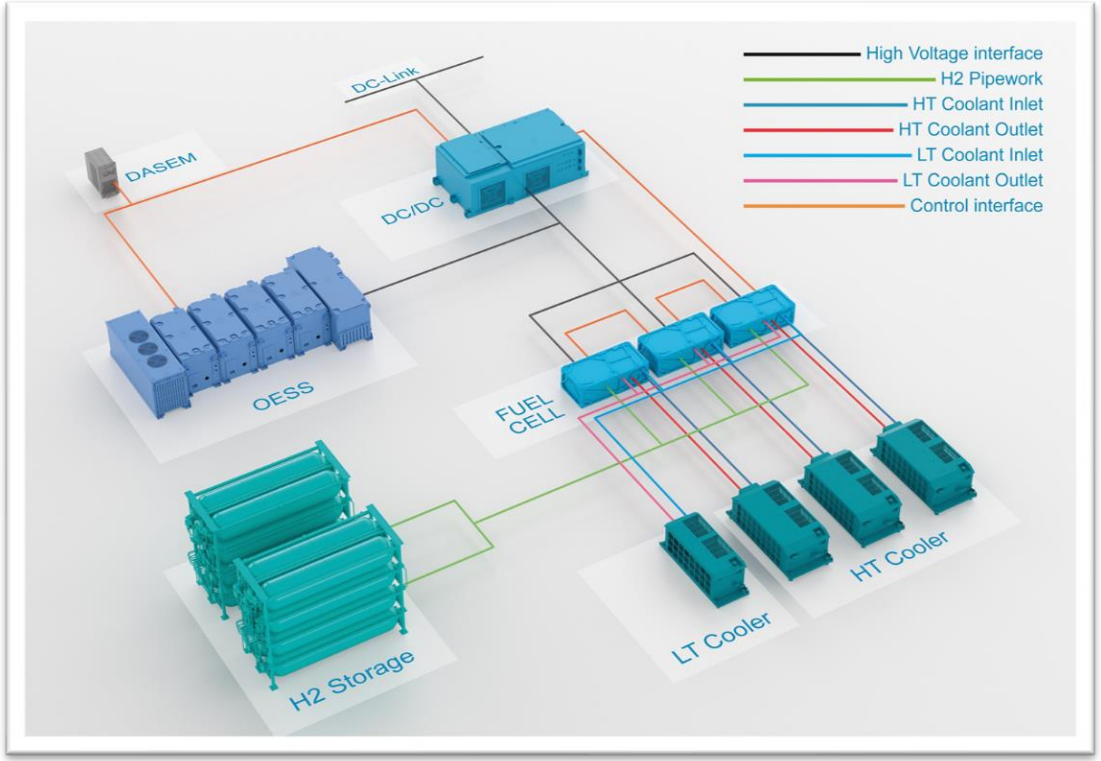
Objectives and Challenges

Objectives

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

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?



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Testing the FCHPP

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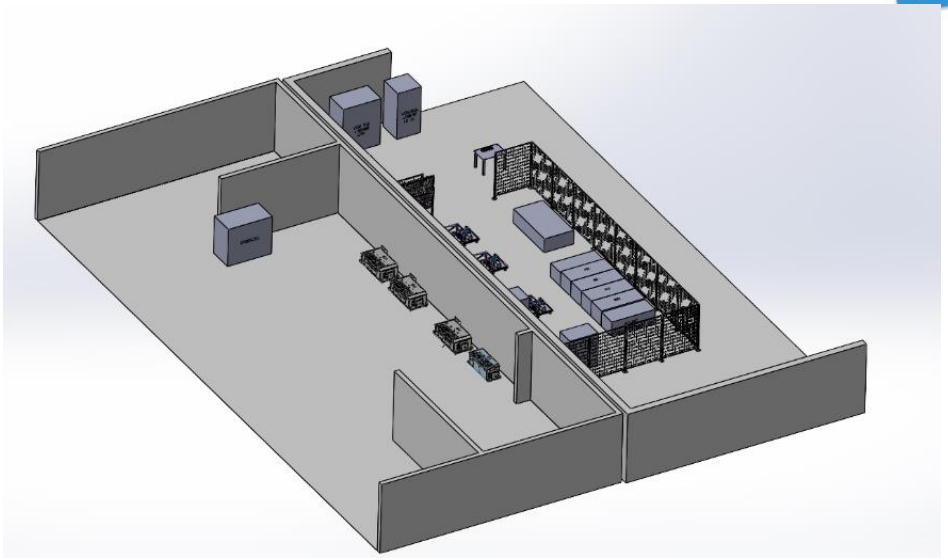
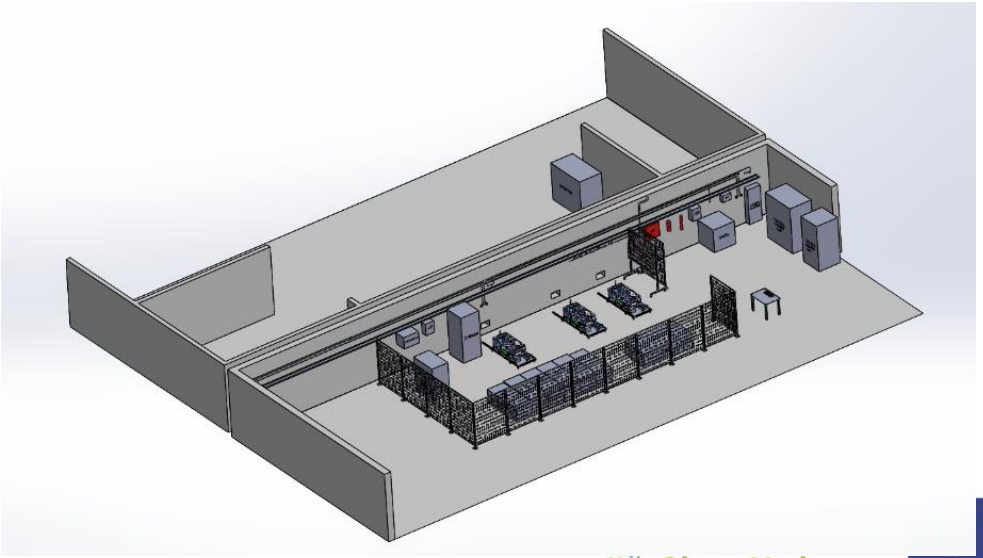
Testing the FCHPP





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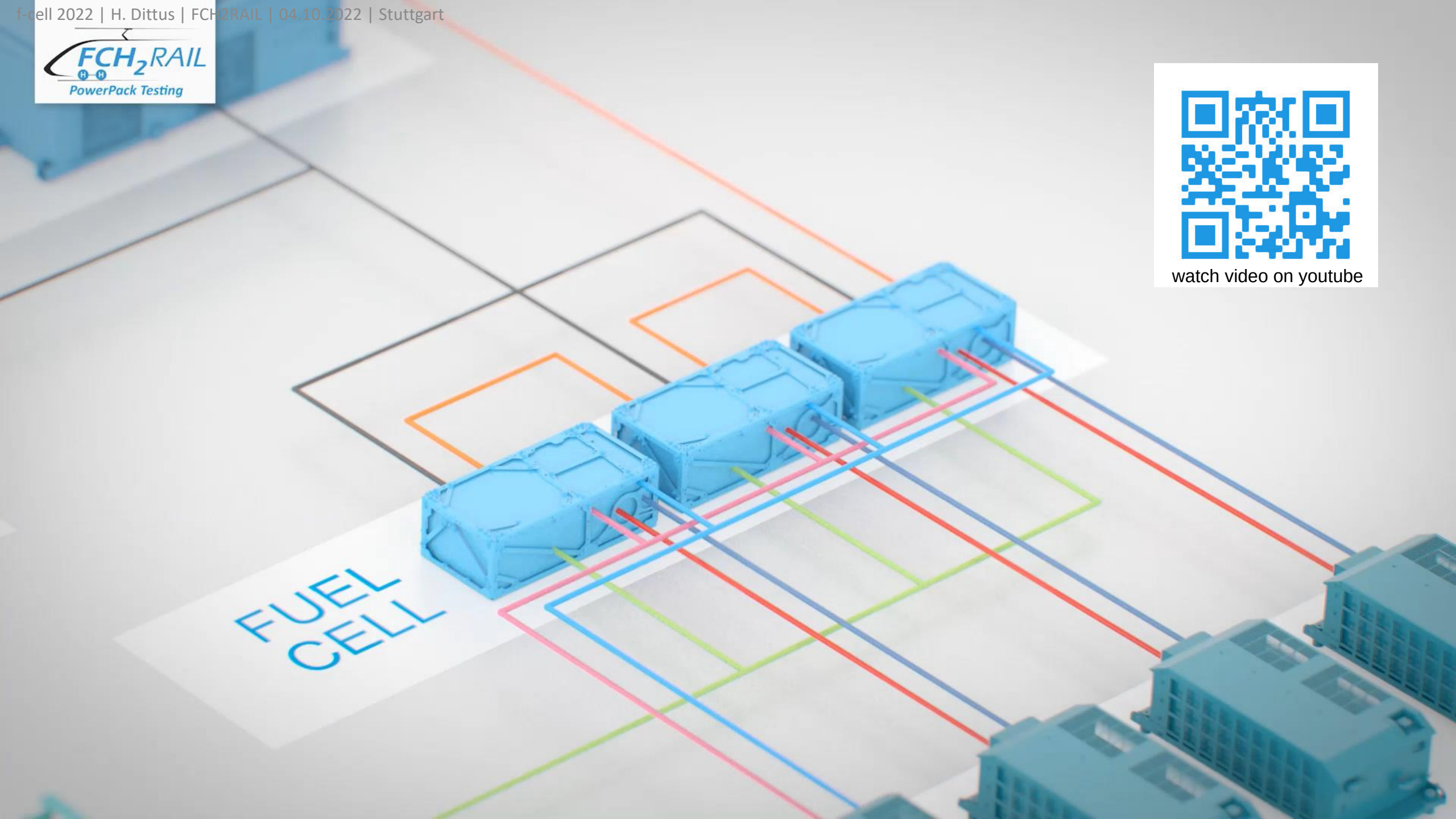
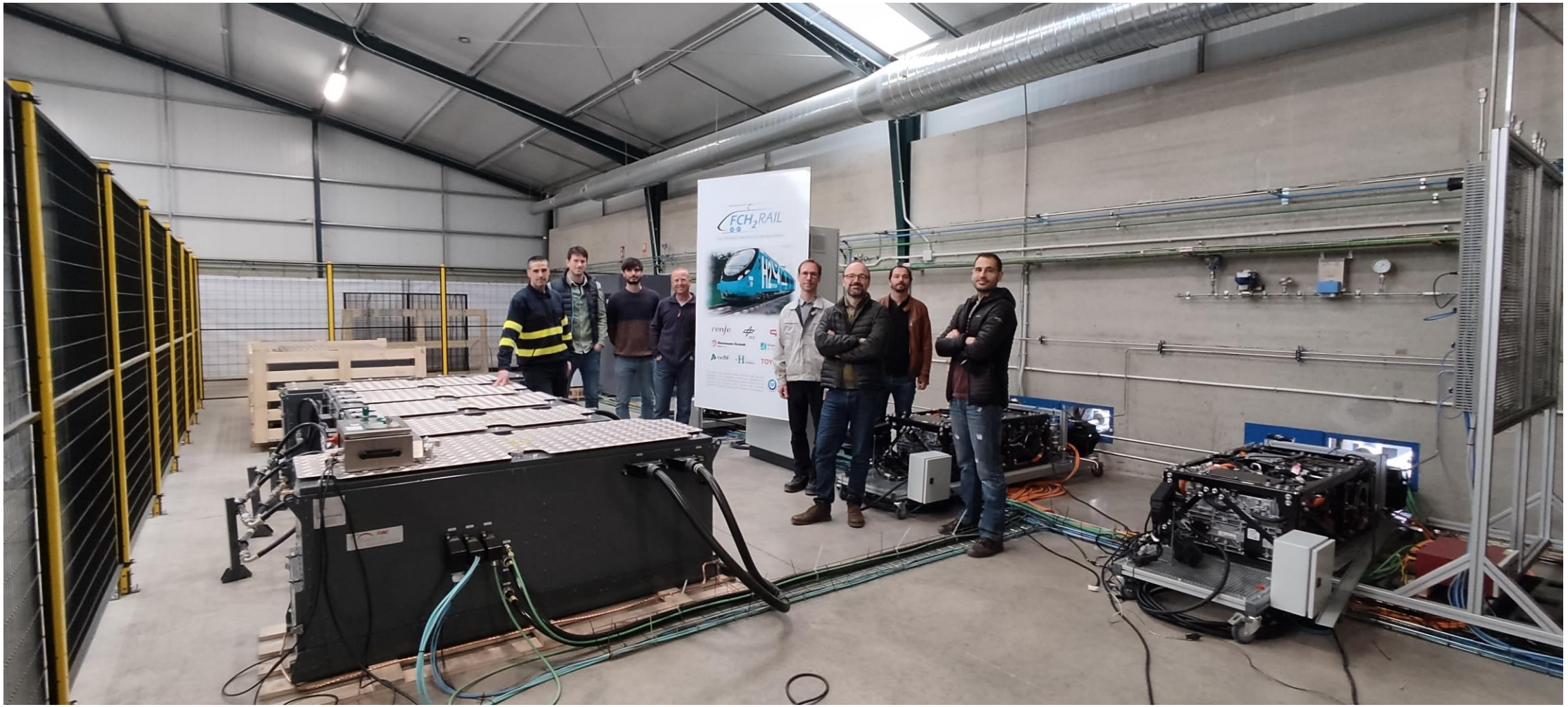
FCH2RAIL
PowerPack Testing

watch video on youtube



THE TEST BENCH CREW



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MAIN RESULTS

- Various tests on different system levels were perfomed:
  - Standard polarization curves for fuel cells, etc.
  - H_2 consumption test, driving cycle tests, ramp-up test, etc.
  - Tests related especially to the specific use cases / service profiles / railway profiles, etc.
- 220 kg of green H_2 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 FCHPP is achieved.**

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FCHPP Integration in Demonstrator Train

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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!

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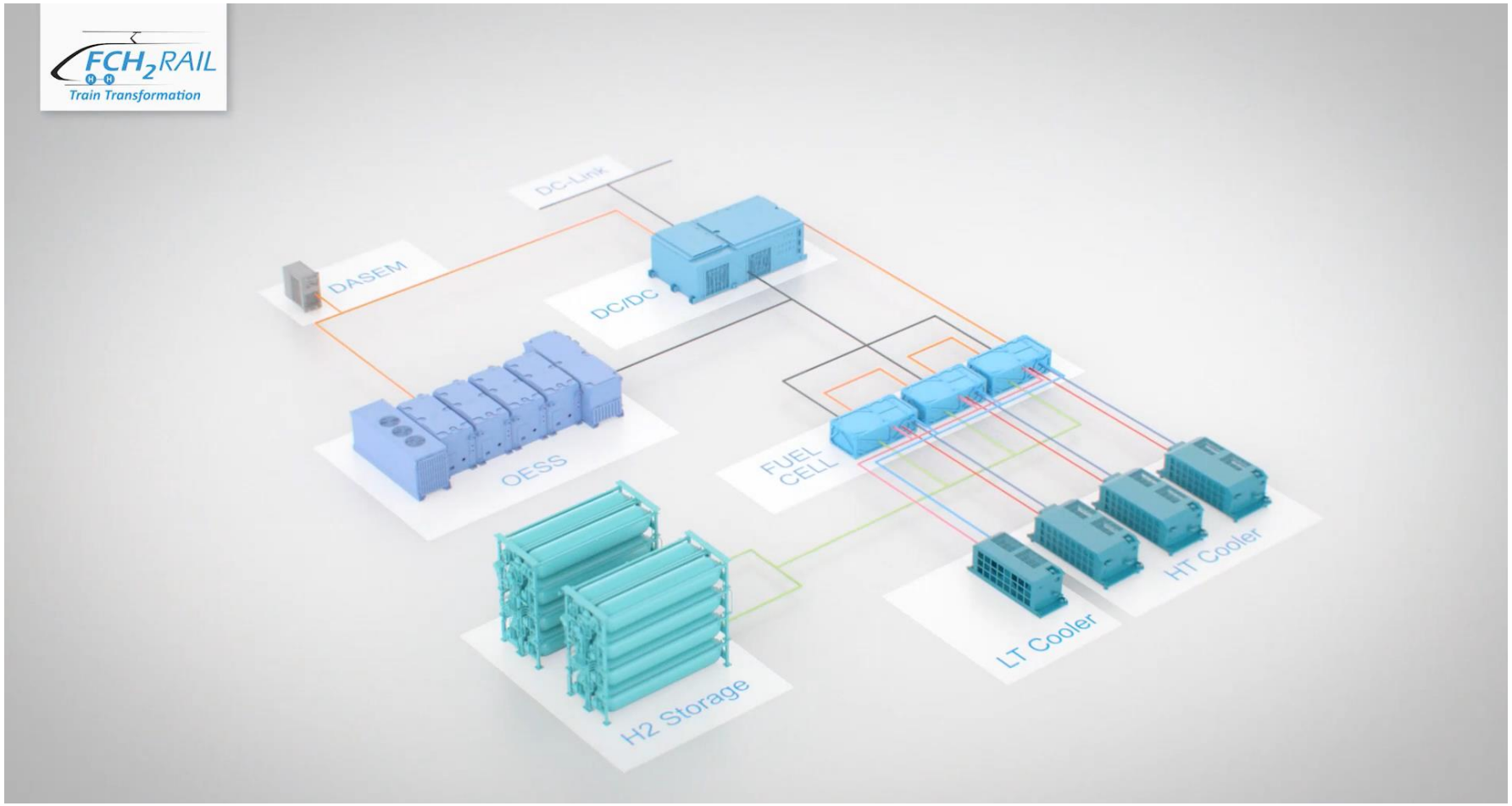

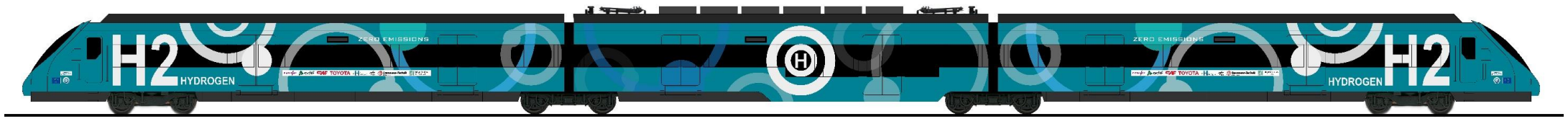

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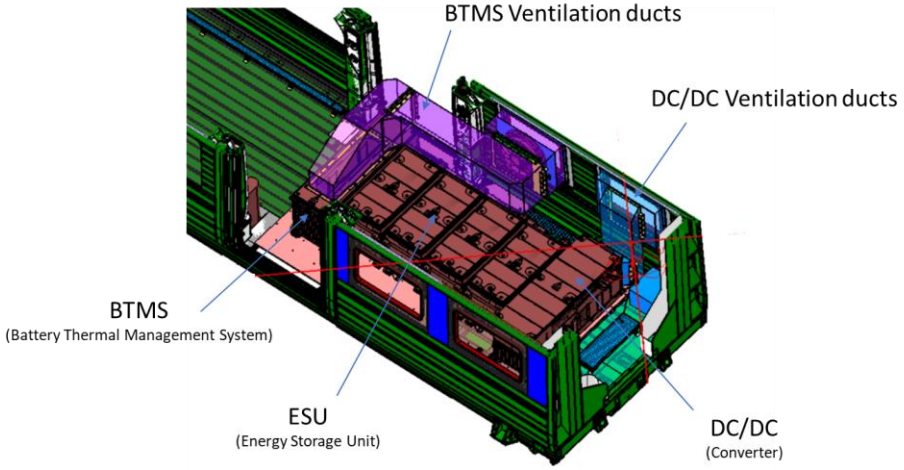
Train Demonstrator Modification Phases

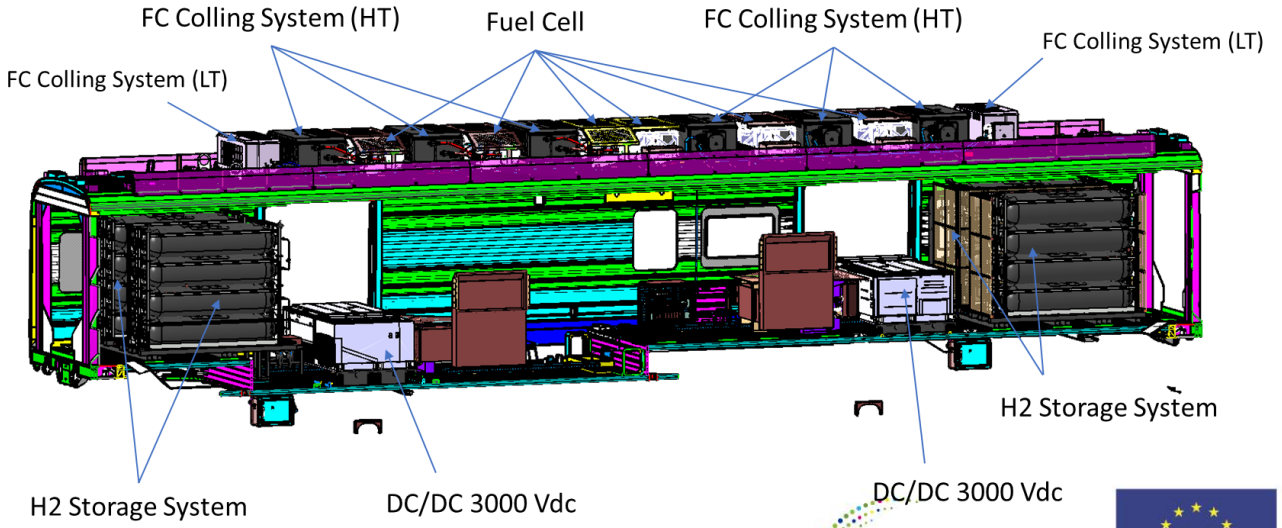
3 Main steps:

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





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Train Demonstrator Modification Video

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Current Highlight of the Project:

Train Demonstrator running on Hydrogen after just 21 Months!

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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

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Next Steps:
Train Demonstrator Approval Process

Approval Process being started and undergoing.

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 German

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Project News

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/.

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FCH2RAIL
Fuel Cell Hybrid PowerPack for Rail Applications

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Thank you for joining!

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