AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

UIC PROJECTS ON HYDROGEN; A GENERAL APPROACH TO THE RISK ANALYSIS

Francisco CABRERA – Deputy Head of Operations and Safety

17-21 Sept. 2024

Vienna, Austria
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UIC and alternative fuels

1. **Electrification**
2. **Partial electrification**
   - Hybridisation pantograph / combustion engine
   - Hybridisation pantograph / energy storage system (battery)
3. **Alternatives to fossil fuels (for combustion engines)**
   - Renewable fuels

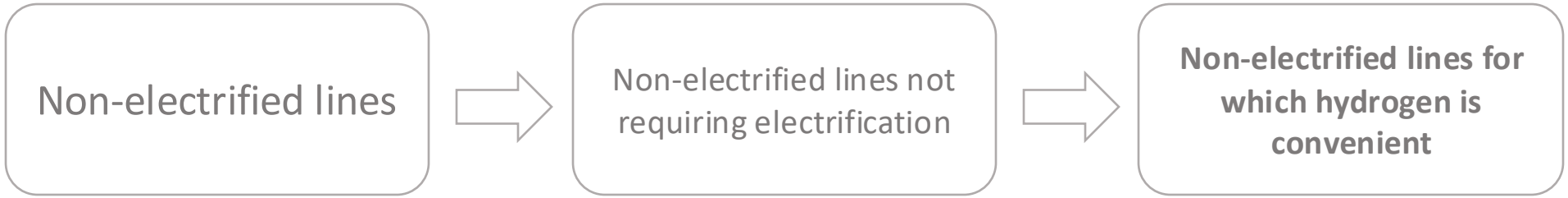
UIC and alternative fuels

1. **Biofuels (from biomass)**
2. **Renewable fuels from non-biological origin (RFNBO)**
   - Hydrogen from electrolysis powered by renewable energy
   - E-ethanol, e-methane, e-ammonia, etc. from hydrotreatment
3. **Recycled carbon fuels (RCF)**

UIC and alternative fuels: H_2

- **In an effort to innovate and make rail even more sustainable, the UIC has several initiatives to study alternative fuels to diesel and electrification.**

Nowadays non-electrified lines are generally the ones with a low-medium level-of-service (in terms of # trains/day), low network connectivity and are generally specialized for passenger transport.



UIC and alternative fuels: H

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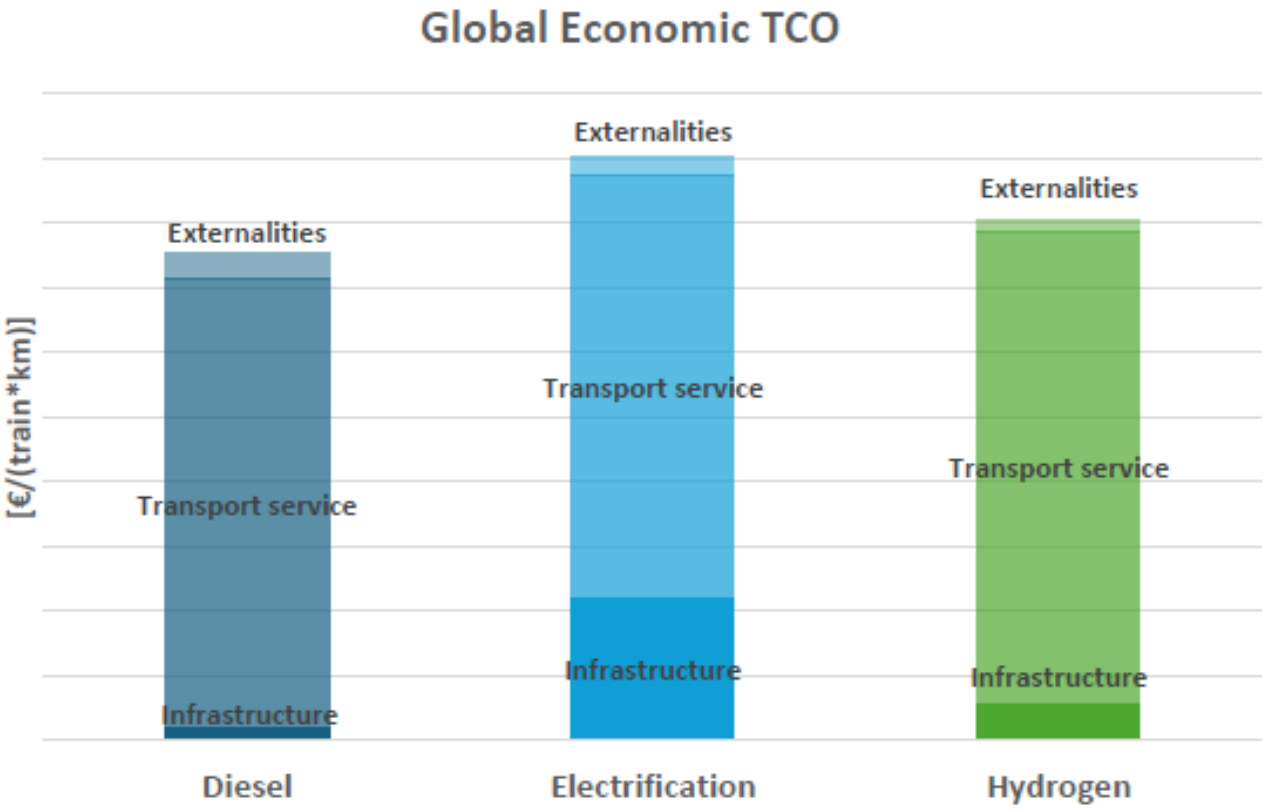


These are example charts, not referred to any specific business case and they are not in any specific scale.

UIC and alternative fuels: H_2 and Ammonia

- **Risks Analysis**

Therefore, hydrogen is a reality and the UIC launches this project to study the operational and safety part with an aim to provide more understandings on the risks and their mitigation measures to the UIC members when they plan to adopt this new technology into their railway context for their better decisions.

UIC and alternative fuels: H_2 and Ammonia

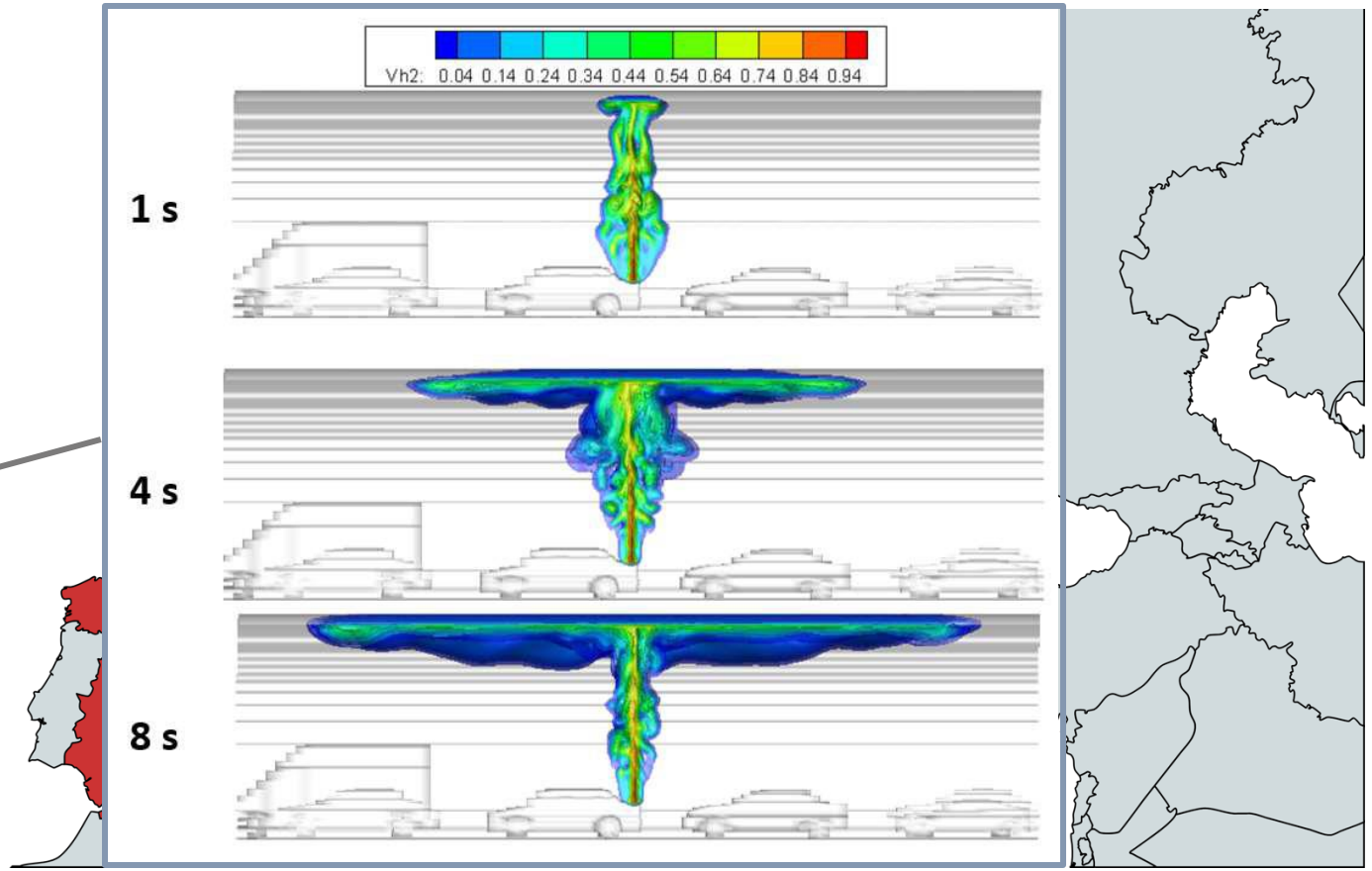
- **The starting point**

FCH2RAIL Fuel Cell Hybrid PowerPack for Rail Applications

UIC and alternative fuels: H_2 and Ammonia

- The starting point

Switzerland



UIC and alterna

- The starting point

Spain

UIC and alternative fuels: H_2 and Ammonia

- The starting point

Italy

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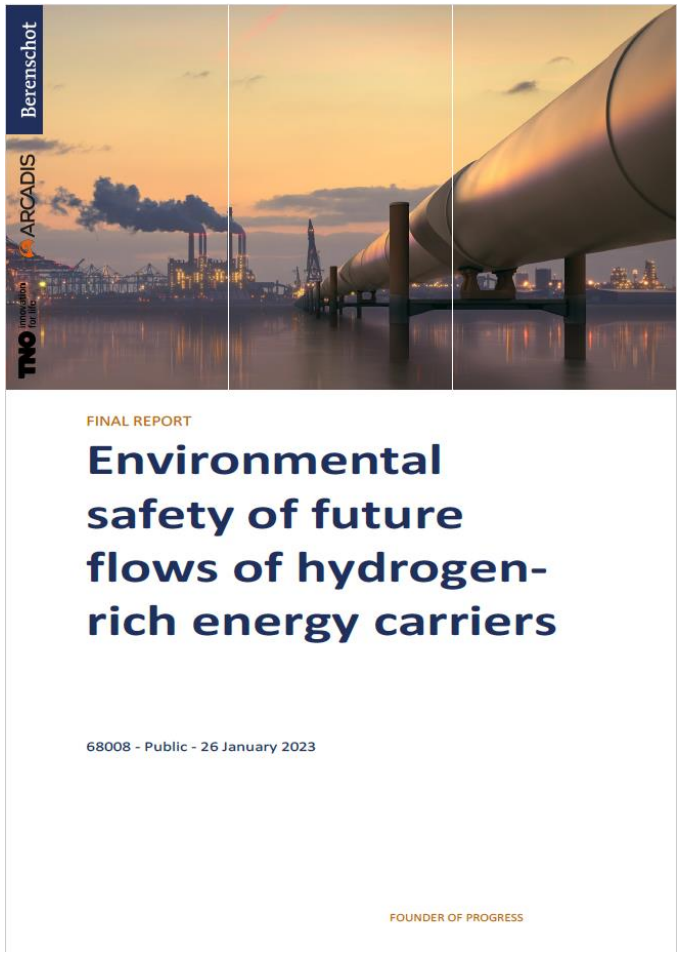
HYDROGEN RISKS

UIC and alternative fuels: H_2 and Ammonia

- The starting point

RAIL SAFETY AND STANDARDS BOARD



UIC and alternative fuels: H_2 and Ammonia

- **The Regulation framework**

RAILWAY REGULATIONS

Interoperability Technical Specifications (TSIs)

Railway Rolling Stock Instruction (IF MR - NTRs)

Technical specification of metric gauge rolling stock (ETM)

CENELEC SAFETY STANDARD EN 50126The Technical

Specifications set out RAMS safety requirements. The term RAMS represents a qualitative and quantitative indicator of the confidence that a system offers to behave safely and with high availability

LNG / H2 GAS REGULATIONS

- Regulation No. 79 Approval of H2-powered motor vehicles.- Regulation No. 134 Approval of motor vehicles and H2 safety components- Regulation No. 110 CNG/LNG Propulsion Components and Systems- Pressure equipment - Royal Decree 2060/2008- Transportable pressure equipment – Royal Decree 1388/2011- Directive 2014/34/EC on laws relating to appliances and systems of protection for use in potentially explosive ATEX atmospheres- Directive 1999/92/EC on minimum requirements for improving the protection of the health and safety of workers exposed to ATEX risks- Fire safety - Royal Decrees 2267/2004 and 513/2017- Serious accidents - Royal Decree 840/2015

REGULATION (EU) 402/2013 COMMON SECURITY METHOD

UIC and alternative fuels: H_2 and Ammonia

- **Hazard Identification & Risk Management**

The main stages of risk assessment and control are identified below:

1. Definition of the system under study. These are projects with a well-defined technical solution and a specific scope, both for new projects and modifications.
2. Systematic identification of threats or dangers. From the definition of the system, relevant safety analysis to identify all hazards or dangers.
3. Risk assessment and classification. Evaluation and classification, by expert personnel, of the risk associated with each hazard.
4. Demonstration of compliance with system safety requirements.

UIC and alternative fuels: H_2 and Ammonia

- **(Global) Hazard Management and safety measures (i)**

1. Systematic analysis is required to identify potential adverse conditions and hazards throughout the project's life cycle, affecting human, material, and environmental aspects.
2. Key Steps:
    - Analysis and Identification: Recognizing hazards or risks.
    - Risk Assessment and Classification: Evaluating the probability and severity of potential consequences.
    - Risk Reduction Measures: Defining new safety requirements.
    - Risk Level Acceptance: Determining acceptable levels of risk.

UIC and alternative fuels: H_2 and Ammonia

RISKS	CONSEQUENCES	MITIGATIONS
Impact and/or structural failure of tanks and components	Leaks with risk of explosion and fire	Side protection barriers and impact simulations
Variation of the center of gravity with an effect on vehicle dynamics	Modification of the center of gravity affecting vehicle dynamics Derailment	Mass balance study
Elements of the off-gauge propulsion system	Collision / Derailment	Gauge Study: Static & Dynamic
Extreme temperatures	Burns / Explosion / Fire	Leak Sensors & Cutting Systems
GN/H2 leaks in tanks or in the installation	Explosion / Fire	Line detection and cutting system
Electrical risk due to variation in dielectric strength	Electrocution / Explosion / Fire	Electrical tests of dielectric strength different concentrations
Overpressure in line and/or tanks	Explosion / Fire	Relief systems (venting) and safety valves

UIC and alternative fuels: H_2 and Ammonia

This project is possible thanks to our experts:

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- Eduardo del Rio (ERA) (guest)
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  - Lucie Anderton (Sustainability Unit)
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Thank you for your attention!