CER Compendium

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Alternative fuels and powertrains

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1. Background

Due to the high degree of electrification, railways, as the existing green mode of transport, are able to offer almost zero-carbon train operations in Europe. Railways are indeed key to EU transport decarbonisation, challenging themselves to maximise their contribution to the EU Green Deal, which requires a 90% reduction in transport greenhouse gas (GHG) emissions by 2050.

In order to achieve the vast decarbonisation and zero-pollution ambition envisaged in the EU Green Deal, European railways would exploit potential alternative fuels and powertrains. Today, diesel accounts for only around 20% of EU rail traction (specified in tonne-km and passenger-km). The European railways are committed to gradually phase out EU rail diesel traction by 2050.

2. Scope of this compendium

In order to support rail's decarbonisation commitment, the European railways request that the European Commission includes the railway sector when revising Directive 2014/04/EU on the deployment of alternative fuels infrastructure (AFID). Railways' decarbonisation efforts should be included in the EU strategies for energy system integration and hydrogen.

This paper summarises the sector's approach regarding alternative fuels and powertrains whilst underlining the sector's needs.

3. Alternative fuels for rail

- Hydrogen fuel cell trains have been suggested as potential alternative power train technology for rail transportation and are currently being tested. Synthetic and paraffinic fuels (HVO) on the other hand have not yet achieved technology readiness but if produced using renewable sources (i.e. E-fuels) they are interesting especially for the renewal of existing diesel vehicles. Biofuels such as B100 also have technical properties suitable for existing engines.
- When considering 'green' propulsion systems for railway applications there are more modes of propulsion to be considered other than just alternative fuels, for example battery powered trains are a very serious consideration in some countries.
- Railway undertakings need commercial availability of reasonably priced renewably produced green hydrogen (e.g. reduction of the price of electricity and of the components for hydrogen production via electrolysis).
- The Fuel Cells and Hydrogen Joint Undertaking (FJH JU) has a pivotal role to play in accelerating the production of hydrogen components. Special focus is needed for hydrogen applications in the railway and public transport sector. Furthermore the strategy has to be set to increase fuel cell production rates and harmonise the standards applicable to trains and buses at the EU level. This should be done through unified technology standards, unified vehicle interfaces for electricity supply and unified data protocols to support the transformation to carbon-free mobility solutions.
- Two major tasks need to be accomplished before investing in the construction of alternative fuels infrastructure for railways: firstly achieving wider technical standardisation and secondly a definition of safety-related requirements.
- Railway infrastructure managers need to provide hydrogen storage facilities, coupled with standardised refuelling interfaces with rolling stock to ensure the interoperability and safety requirements (hydrogen being a highly volatile fuel) of rail vehicles within the Single European Railway Area. EuroSpec is a key railway

sector initiative, where a consortium of European railway undertakings work on the definition of interfaces between electric vehicles and infrastructure. Another European project PRHYDE looks at the development of hydrogen for heavy-duty applications including rail. These projects should serve as a good basis for the future work on hydrogen propulsion, including the standardisation of interfaces between subsystems. The European Committee for Standardisation (CEN) is also working on topics related to hydrogen propulsion. CEN/TC256/WG 43 is working on respective standards that might be referenced in relevant TSIs in future. Therefore the European Commission should establish a master plan for the development of hydrogen infrastructure (e.g. fuelling and transport) across the EU. This master plan should incentivise the creation of demand-driven "hydrogen hotspots", which are situated strategically near switching stations, loading terminals or areas with bus stations, non-electrified railway tracks and highways.

- A European strategic approach needs to be defined for fuelling stations providing alternative fuels to be installed. Those stations must fulfil the requirements for interoperability and must be equally accessible to all actors. The sector proposes to work on the following tasks before building stations:
  - Define the geographical locations (positioning) in function of needs, stops, possible driving distances, etc.
  - Define the infrastructure including the logistics.

  This work should be discussed at biannual meetings between industry and operators in order to exchange experience and solve problems.

4. Research needs

- Railways request further research on the comparison of different types of alternative fuels with regard to an overall optimisation so that the EU avoids a patchwork of solutions where each one will require its own infrastructure for transport, storage, tanking, interfaces, hampering the interoperability of corresponding vehicles.
- Research should be targeted on hydrogen technology and also on batteries for railway applications to increase efficiency. This should include locomotives, infrastructure vehicles and yellow machines.
- Research is needed on HVO and E-fuels to get commercially available products.
- Research should also assist the sector in deciding on necessary operational measures for deploying alternative technologies, without hampering rail's competitiveness.
- EU legislation should not be used to steer industry down specific technological avenues but rather set the high-level requirements (e.g. reduce emissions by 90%) and provide the industry with strong guidance in order to work out the best and most effective way of achieving the goal. The EU guidance would help ensure international railway traffic of rolling stock with alternative propulsion systems.

5. Funding strategy

- Many applications of hydrogen technology (e.g. electrolysis for generating green hydrogen or hydrogen-powered vehicles) are not yet economically competitive compared to conventional fossil-based technologies. Hence, any successful integration of hydrogen technology into the railway and public transport sector requires a consistent funding strategy. This funding strategy has to be applied until a competitive market integration is achieved. It should cover the entire range of innovation processes including all Technology Readiness Levels (TRLs), especially

deployment projects. Successful projects would be an incentive for European companies to scale up their production of hydrogen equipment and vehicles.

- Revision of the Energy Taxation Directive 2003/96/EC provides an opportunity for incentivising the development of renewables-based green hydrogen.
- The existing cap on financial support for investments in hydrogen vehicles in the Guidelines on State Aid for Environmental Protection and Energy should be removed to allow Member States to provide adequate financial support for the entire additional costs of hydrogen vehicles. Furthermore, a framework for financial state aid for hydrogen production should be introduced in the Guidelines.
- Hydrogen technologies should be eligible to receive financial support from programs like Horizon Europe, the European Innovation Funds, as well as through subsidies (or facilitation of subsidies, e.g. Important Projects of Common European Interest).
- Consistent funding and support from future research and innovation (R&I) programmes (e.g. Shift2Rail-II and FCH-JU-II) should be ensured in order to reduce companies' first mover risk. Minimisation of the financial risks associated with research and implementation of pilot projects would lead to more R&I investments in developing hydrogen technologies.
- Public funding programmes should give a preferential treatment to projects that aim at achieving a fully integrated and sustainable hydrogen supply chain (starting from the generation of renewable energy, electrolysis, compression, transport, storage management, to final consumption).

6. The way forward for AFID

- The AFID could become a regulation to avoid or overcome, the current EU piecemeal situation.
- A common definition of targets and implementation indicators can be useful in order to guarantee the adequate level of alternative fuel deployment by Member States.
- Further electrification and deployment of alternative fuels such as hydrogen chargers should apply ideally for the whole transport network. The expansion of electrification should not be interfered with, especially for an arbitrary target of having to deploy a defined proportion of alternatively fuelled vehicles.
- In case the AFID was to cover alternative fuels for railways, then it would be very important to ensure compatibility with the EU Directive "A single railway network for Europe" (2012/34/EU) in order to avoid contradictions regarding the application of both directives by the Member States. Solutions that hamper interoperability should be avoided.
- The sector should be free to choose alternative propulsion technologies to fully decarbonise, with hydrogen trains as one of the innovative solutions for rail. The AFID and EU's hydrogen strategy should therefore avoid any technology lock-ins and prevent oligopolies in the rail supply industry.
- Decarbonisation of the transport sector requires large (public) investments, independently from the technologies selected. For this reason, it is necessary to develop extensive, sustainable supply chains as the backbone for an all-embracing, intermodal traffic system – including rail and maritime, as well as road. This is the only way to use synergetic effects in the best possible way and to reach the maximum green return on a given amount of money.
- Railway electrification (taking into account the operational model and the business case) must therefore continue in Europe because this is the primary means by which rail reduces its emissions. Alternative fuels are an option for other parts of

the network, where the production, storage and distribution of hydrogen are more convenient compared to other systems, considering also the operation of rail services and geographic allocations that are difficult to electrify. In this context the introduction of the hydrogen scenario as an alternative in cost/benefit analysis and transport analysis for the electrification of railway lines would help.

- As batteries will also be used in railways (even on hydrogen vehicles) their sustainability aspects (circularity and recycling) should play an important role from the very beginning when going for new solutions.
- The AFID should promote zero emission door-to-door mobility. Rail stations have a strategic role to play as multimodal hubs where passengers are not only connected to public transport or taxis but can also rent or park bikes, cars, scooters etc. In order to be in line with the EU Green Deal's ambition of climate neutrality, rail stations need to get priority attention for the deployment of alternative fuels infrastructure.
- The AFID should also cover technical, organisational and economic interfaces for the whole transport system. If, for example, the EU wants to pursue the objective to establish a comprehensive hydrogen filling station network, it makes sense to start implementation at intermodal nodes like intersections between road and rail or at container terminals (currently low priority in investments). Rail-specific solutions should be limited to the minimum. Whenever possible, available solutions from other sectors, e.g. from automotive, should be used.

7. Vision – Summary

There is no doubt that low-emission railways have a central role to play in mitigating the negative impact of climate change. The railway sector needs a veritable "cultural revolution" to remain a leading player guaranteeing a sustainable transport system in Europe. Hydrogen-powered fuel cell trains (hybrid as bridge technology - hydrogen & battery) have the potential to help the railways in the EU in achieving the EU's sustainability targets. As a matter of fact, whilst it is imperative that railways reduce costs and improve performance in the short run, it is of vital importance that we explore the possibilities in new technologies that in a longer term perspective can ensure that railways become increasingly cost-effective while retaining the lead as the most environmentally beneficial means of powered transport.