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Opinion
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Decarbonisation of Railways

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Opinion

Nature has deteriorated and climate change is inevitable. The environmental problems faced by the transport sector, especially the emissions of greenhouse gasses, are rising with shocking speed. The increasing global temperature could lead to damage, the equivalent of up to 23% of global GDP by 2100 [1]. In 2018, the transport sector produced more greenhouse gas emissions than any other sector in the UK. The transport sector was responsible for 33.6% of all CO_2 emissions in the UK. The railway is a relatively small contributor to emissions, as it made 1.4% of the total transport CO_2 emissions – while (pre-covid), passenger and freight usage was accordingly 10% of passenger-km and 9% of freight ton-km [2]. To keep an increase in the global temperature to under 2°C the decarbonisation of transport is necessary, and the railways must do their bit in decarbonisation of the transport industry. Improvements of existing trains and manufacture of new ones with higher safety, speed and comfort will make railways more attractive to users and will encourage them to shift from roads to railways.

It was predicted that transport demand will increase steadily and, to satisfy it, 25 million kilometers of road and 334,000 kilometers of railway track will be needed to be developed by 2050 [3]. Railway transport is becoming an important mode of transportation because it offers many advantages compared to other modes of transport and the role of railway transport will continue to increase. Developing a new railway infrastructure and improving existing ones will contribute to a reduction in use of fossil fuel by the transport sector. It was found that 1% increase in investments in railway infrastructure will generate a 0.045% decrease in fossil fuel use [4]. The railway transport provides access and mobility for society and supports economic growth, but railway transport also produces carbon emissions at all stages, from design and construction through operation and maintenance to recycling. To eliminate the negative impact from the railway industry there should be a substantial reduction in consumption of non-renewable natural resources. The railway transport produces carbon emissions at all stages, from design and construction through operation and maintenance to recycling. The major materials that are used in design and manufacturing of Rolling Stock (RS) are: metals, plastics, composite materials, and ceramics. Reducing the energy that is consumed by railways and reducing the volume of raw materials that is used by railways can sufficiently reduce the environmental impact of railways and improve its economical sustainability. 55% to 85% of the total CO_2 that trains accommodate over its life cycle are related to energy consumption whilst the rest is related to the use of raw materials [5]. One of the ways to reduce energy consumption of RS is to reduce the weight. The lighter RS will consume less energy and need fewer natural resources for construction. The energy consumption is closely correlated with economic performance. With decreasing the consumed energy, there will be improvements in economic performance and there will be a reduction in CO_2. If railway transport is powered by electricity and if it will use renewable energy, it can be almost at zero carbon level.

In 2013, the railway transport network in the UK consisted of 5710km electrified lines and 10485km non-electrified lines [6]. The length of electrified lines is increasing but at a very slow speed and the latest reports show that only 38% of railway lines is electrified, that leaves 9855 km of railway routes not electrified. The electrification of railways in the UK is an expensive business. One km of electrification varies in the range between £750,000 and £2m and more [7]. However, by 2040 all diesel only trains need to be removed from use within the railway industry in the UK [8]. It is a challenging task that requires a complex solution. There are many ways to achieve targets for sustainable mobility.

One of the ways to achieve this can be made through a greater accent on technological improvements. While focusing on technological changes to mitigate increasing CO_2 emissions, we have three options; reducing energy demand, improving energy efficiency, and shifting towards renewable energy [9], but a need to remain economically affordable for everybody. Improvements in energy efficiency for buildings and transport, electrification of railways, along with a wide application of fuel cell technologies can substantially reduce the carbon footprint from the railway industry. The rolling stock and maintenance machinery are manufactured for a substantial number of years to use. Therefore, it needs to take into consideration the future progress in development of new technologies and fuels at the design stage. The Life Cycle of any product consists of four stages: material acquisition, manufacturing, operation, and end of life. The biggest environmental impact from railway transport is in the operational and maintenance stages. This impact occurs because of the use of fossil fuels. The operational stage of all vehicles is distinguished by high energy consumption [10]. For operational stage to achieve decarbonisation there are three main approaches:

a. Reduction of resistance to movement (for example, reduce the weight of RS, improve aerodynamic drag etc.)

b. Reduction of dependency on diesel technologies

c. Switch to renewable energy resources (electrification, battery, hydrogen fuel cells etc.)

The maintenance of RS and infrastructure will also have a negative impact on the environment. To reduce this impact, the modern rolling stock is equipped with onboard diagnosis systems. These systems collect and analyze the data about the state of the train and infrastructure. This supports the introduction of condition-based maintenance. Condition based maintenance is to maintain before failure, and it is based on the monitoring of the real time condition of RS and infrastructure. Condition based maintenance improves reliability, availability, comfort, safety and supports the growth in transportation. This approach will reduce the level of down-time and reduce the life-cycle cost [11].

Technological innovations will promote faster and less costly transition to decarbonisation of the railways. When manufacturing a new rolling stock, it needs to introduce technologies that will contribute to energy efficiency, use lighter materials in construction, and avoid the use of hazardous substances. Rolling stock should be designed to be easily maintained, repaired, upgraded, and recycled. As we are going towards a circular economy, manufacturers need to work to increase durability and improve recyclability rate of rolling stock and railway equipment. In addition, to support decarbonisation of railways, there is a need to improve the operational strategies, optimize scheduling, and maximize the utilization of rolling stock and infrastructure.

References

1. Time (2019) https://time.com
2. Dataportal.orr.gov.uk (2020) Rail Emissions 2019-20.
3. Gossling S, Cohen S, Higham J, Peeters P, Eijgelaar E (2018) Desirable transport futures. Transportation Research Part D: Transport and Environment 61: 301-309.
4. Neves S, Marques A, Fuinhas J (2017) Is energy consumption in the transport sector hampering both economic growth and the reduction of CO 2 emissions? A disaggregated energy consumption analysis. Transport Policy 59: 64-70.
5. Andries V (2016) The Recyclable Train-By Véronique Andriès, Alstom. Railway News.
6. Watson I (2021) The advantages of electrified railways: an international summary PWI Journal 139: 36-37.
7. Dhesi T (2021) Harness rail's potential to tackle the climate emergency. Rail Technology Magazine pp: 90-93.
8. Networkrail.co.uk (2020) Traction Decarbonization Network Strategy.
9. Herrmann C, Dewulf W, Hauschild M, Kaluza A, Kara S et al. (2018) Life cycle engineering of lightweight structures. CIRP Annals 67(2): 651-672.
10. Delogu M, Del Pero F, Berzi L, Pierini M, Bonaffini D (2017) End-of-Life in the railway sector: Analysis of recyclability and recoverability for different vehicle case studies. Waste Management 60: 439-450.
11. Fortea P (2018) Using predictive maintenance to improve the safety and efficiency of railways. Global Railway Review.

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