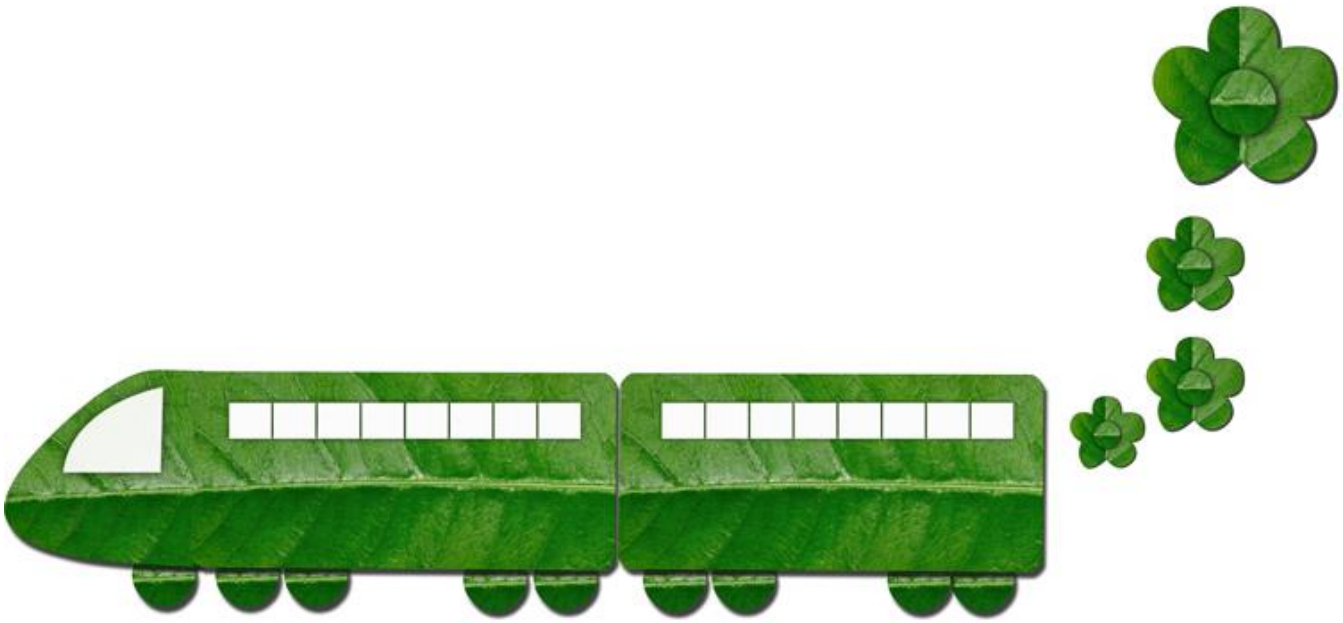
Enhancing shift towards Sustainable Freight Transport in Asia and the Pacific-

Opportunities through railway decarbonization



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Key Messages

1. The transport sector is responsible for around one third of global energy consumption and about a quarter of global greenhouse gas emissions. Left unchecked the environmental burden from the transport sector could increase substantially by 2050. Decarbonizing transport has become one of the main strategic responses to reduce carbon emissions that cause climate change.

2. There are two ways rail can contribute to decarbonize the transport, first by modal shift, as railways can carry approximately 40 times more passengers per square metre and consume only a third of fuel to carry a tonne-km of freight as compared to road transport thereby reducing overall emissions.

3. The second way, that is subject of this report, is to decarbonize the rail itself making it a practically zero emission transport mode.

4. Currently only one third of rail network in the ESCAP region is electrified -indicating substantial use of diesel for traction and non-traction purposes. And the diesel-powered trains emit at least twice as much CO_2 in the atmosphere than electric ones.

5. Railway decarbonize solutions entail (a) electrification of rail infrastructure (b) rolling stock that runs on alternative modes of traction such as hydrogen fuel cells, batteries and biodiesel.

6. The findings in the study highlight that some countries in the ESCAP region may not be able to afford or economically justify high investments required in electrification of rail infrastructure. Moreover, impact of rail electrification on carbon emissions is closely linked to energy source to generate electricity. Only use of renewable sources of energy can reduce emissions through rail electrification.

7. Electric battery and hybrid hydrogen fuel cell traction systems are gaining prominence as alternatives to the more costly traditional decarbonisation methods. There are still

barriers and challenges to the implementation of these alternatives that may not be entirely addressed by market forces and may need policy interventions.

8. The railway in ESCAP countries operate distinct traffic volumes over various levels of infrastructure highlighting the challenges of addressing the region with a single solution to decarbonize.

9. The study recommends clustering of countries according to a set of acceptable geo-political, economic, and operational criteria to develop decarbonization pathways that identify specific solutions and appropriate supporting policies to transform low-carbon railway freight into a reality.

10. For specific railway, the study provides a maturity assessment matrix as a strategic tool for railways to map their maturity levels and capabilities for railway decarbonization along the four parameters, namely, sources of electric supply, supporting infrastructure, financing availability and management priorities.

Executive summary

Decarbonisation has become one of the main topics within strategy and decision making across the globe due to heightened concerns on climate change. Forecasts highlight the urgency for drastic actions needed to avoid irreversible environmental damage and climate change, which include the change in the way that people and goods are moved within and between borders. There is extensive body of research that positively correlates the quality and robustness of transport infrastructure with economic growth and societal benefits.

On the other hand, the transport sector has been a prominent contributor to the climate emergency that requires urgent action, especially regarding the reduction of the carbon intensity of the sector, to prevent irreversible environmental damages at a global level. The main aim of this report is to explore not only the role of the railways in the efforts to decarbonise the transport sector, but also to investigate low-cost solutions to decarbonise rail transport in Asia and the Pacific.

To do so, this report includes a literature review of the current state of the freight railway sector in the region, together with a case study of the development of dedicated freight corridors in India and their impact on their national efforts to reduce greenhouse gas (GHG) emissions.

Building on the successful case study of the Indian Railways in railway electrification of new and existing routes, our main findings also highlights that some countries in the Asia and the Pacific region may not be able to afford or economically justify the high investments in that type of infrastructure. ESCAP countries operate distinct traffic volumes over various levels of infrastructure, which highlights the challenges of addressing the region with a single solution.

In light of recent technological developments, battery electric and hybrid hydrogen fuel cell traction systems have gained prominence as alternatives to the more costly traditional decarbonisation methods. The former, as the name suggests, uses large battery units, usually consisting of thousands of cells, to produce equivalent horsepower to diesel locomotives. The latter, which generates electricity from the chemical energy of hydrogen and oxygen, stands as one of the cleanest solutions available.

There are still a few barriers and challenges to the implementation of these alternatives that may not be entirely addressed by market forces. Batteries are made of non-renewable components and have end-of-life issues with disposal, and hydrogen fuel cell systems must be accompanied with the capability to produce and transport the fuel.

All in all, we identify that not only electrification but also new technologies have established a strong landscape that enables the decarbonisation of railway freight operations in Asia and

the Pacific. The continent enjoys abundant supply of energy sources that are crucial to the viability of the transition. Should countries be clustered according to a set of geo-political, economic, and operational criteria, roadmaps can identify specific solutions and appropriate supporting policies to transform low-carbon railway freight into a reality.

This report therefore aims to provide strategic advice for decarbonisation of freight railway services taking into consideration the particular developments in each country of the UNESCAP region. In order to do this, it has the following objectives:

- Analyse railways in the region to establish the context for decarbonised traction systems
- Analyse available decarbonised traction systems to establish their suitability
- Provide a maturity matrix as a strategic tool for policy makers
- Provide recommendations and relevant advice for countries looking to decarbonise their railways