

## DR. S K GUPTA

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# MAKING RAIL TRANSPORT MORE SUSTAINABLE

## The Perspective

There is no getting away from the fact that physical goods need transporting, whether it's the components or ingredients for a product across the supply chain which need to get to the finished product manufacturer, and from there to the distributor, retailer and ultimately to the end consumer. Logistics and transport have an essential role to play. People also need to travel whether it's to work, or for domestic, social or leisure reasons. In terms of commercial freight deliveries, the choices mainly centre around road, rail, air and boat.

The United Nation's 17 Sustainable Development Goals (SDGs) describe the major challenges humans will have to face to ensure a sustainable, peaceful, prosperous, and equitable life on earth for all, in the present and in the future. In this context, the role of rail transport becomes crucial in achieving the goals of decarbonisation and in emphasising its contribution to bringing people, territories, and relationships closer together for social and economic well-being.

Rail transport is a crucial component of sustainable transport systems worldwide, supporting sustainable cities and communities; SDG 11 acknowledges the importance of people having access to public transport including railways. Achieving SDG 11 will require building inclusive, resilient, resource-efficient urban development policies, while ensuring access to basic services including efficiently managed transport systems. The role of rail transport is crucial, both in achieving the goals of climate neutrality by 2050, and in bringing people, communities, and our customers closer together through an integrated and

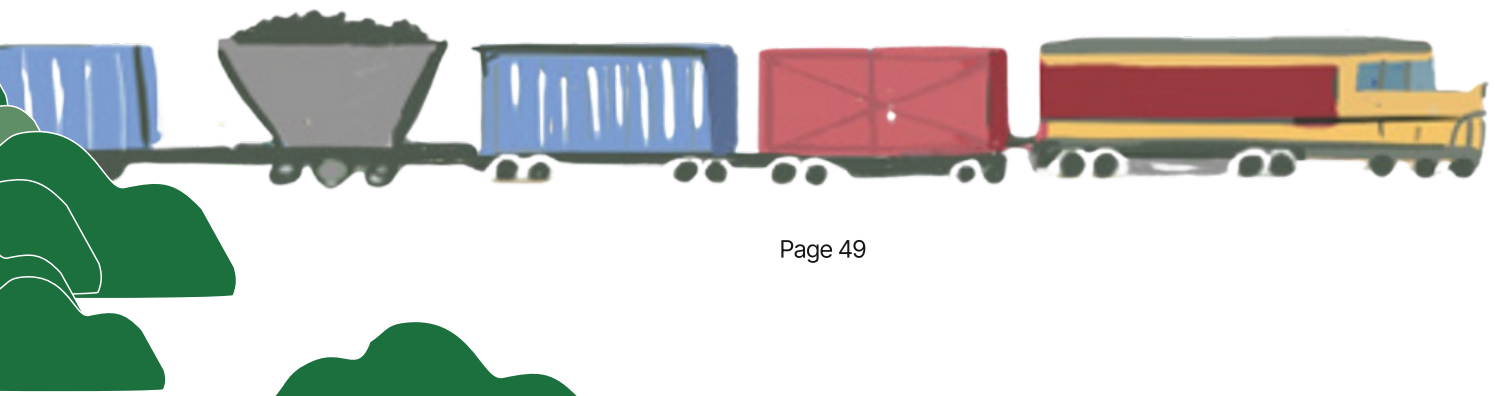
sustainable mobility ecosystem.

## Introduction

When looking at the progress made towards achieving the UN 2030 Agenda, it is clear that the world still has significant socioeconomic and environmental challenges to overcome. The global rail sector has been working diligently to ensure its maximum support to help advance all SDGs, including SDG 11, by helping to provide access to safe, affordable, accessible and sustainable transport systems for all. Around half of the world's population does not have easy access to public transport, all while rail is losing ground to more polluting forms of transport in terms of its market share and investment funds. Railways are the most sustainable form of motorised transport. They are inclusive, energy efficient, and land-use efficient, and they connect communities and support healthy and liveable cities. This fact has been proven by transparent and robust data and real-life examples, can help more people to understand the role that rail can play in a sustainable and connected mobility system of the future.

## Rail is environmentally friendlier

From an environmental perspective, railways have substantial advantages over road, air and maritime transport. Rail has a key role in decarbonizing transport. It is the cleanest and greenest high-volume transport mode and one of the most energy efficient. Rail accounts for 8% of global passenger and freight transport activity (in passenger km/tonne km), but railways produce only 2% of the transport sector's emissions. Global



Green House gas In cities, rail is unrivalled for mass transit of passengers, and it also reduces congestion, is safer and significantly less damaging to air quality than road transport. Freight rail for moving large volumes of goods over long distances is an environmentally friendly alternative to long-distance inland road freight transport and high-speed rail is a low-carbon alternative to aviation for intra-continental trips.

### **Rail networks are frugal by design**

- Frugality in energy consumption: whether in terms of energy per capita or globally, railways and public transport are extremely efficient: passenger rail transport requires less than 1/10th of the energy needed to move an individual by car or by aeroplane;
- Frugality in public space: whether in urban or rural areas, the occupation of public space is minimal, and the promotion of rail transport will once again give citizens the possibility of enjoying more public space with better air and soil quality with a greater level of safety emissions from transport are continuing to rise they accounted for 14% of all emissions in 2018, but rail was the only mode to reduce its emissions, down by 2% between 2000 and 2018. Indeed, trains are on average three to four times more fuel efficient than trucks - producing up to 75% fewer GHG emissions', while the EU found that European railways are up to 9 times less CO2 intensive than road for freight.
- Frugality in terms of life cycle: the lifetime of railways can be up to 50 years, minimising the need to reinvest regularly in non-renewable resources.

When deciding upon and allocating capital to railway projects, cash flow shouldn't be the only consideration, as social, economic and environmental factors should also be taken into account. For example, a commuter railway will reduce travel time, congestion, accidents, greenhouse gas emissions and noise pollution, while also creating employment, increasing social equality - everyone will use it regardless of status and contributing to urban regeneration. Using such a lens may also make it easier to raise funding from development finance institutions and even financiers, who are increasingly insisting

on social and environmental considerations to be cornerstones of projects.

### **The sustainability target**

The International Union of Railways (UIC) announced its Sustainability Pledge in 2021, which in addition to targeting a market share for rail of 25% by 2050, is also targeting carbon neutrality for African rail by 2050 through:

- Delivering innovative solutions to increase energy efficiency and phase out diesel services.
- Prioritizing renewable energy sources.
- Working together as a region to share best practice and common solutions.
- Embedding circular economy principles to help combat resource depletion and the impacts of material and waste production: recycling and reusing end-of-life products in all processes associated with railway activity and
- Integrating an eco-design approach during the study, design and development project phases of new infrastructure.

### **Sustainability considerations are imperative for Railways**

*In today's world, faced with climate emergency, the pursuit of sustainability isn't just a choice- it's a responsibility.*

The World Bank emphasises the considerable benefit of investing in rail infrastructure, particularly in developing countries, highlighting how such investments can offer mobility and connectivity solutions, alongside significantly reducing carbon emissions, while supporting the achievement of sustainable development goals (SDGs). Ensuring a continuous and sustainable movement of people and goods within and between cities is fundamental to building a sustainable future. the challenge lies in aligning traditional economic and financial objectives with the principles of sustainable development.

**Board-level sponsorship:** Board level commitment is essential for successfully implementing an ESG strategy. Therefore, clear communication of the importance of ESG to the Organisation is crucial Stakeholders Cross-functional ESG team engaging with stakeholders, such as employees, customers, and suppliers, to

understand expectations and concerns about ESG policy and action plan is crucial for pursuing sustainability agenda. Due to the interdisciplinary nature of ESG, the commitment and involvement of all stakeholders is essential.

**Risk management:** ESG is playing a key role in defining a renewed perception of risks and opportunities in the Corporate environments. From a mainly financial and compliance perspective, Risk Management Processes involves identifying priorities (e.g. materiality analysis), implementing specific actions in support of sustainability goals and reporting. At each stage of the process, alignment on respect for human rights is a fundamental element in pursuing sustainable success.

**Occupational Health and Safety:** guaranteeing Occupational Health and Safety through the creation of safe and healthy working environments, the psycho-physical health of all personnel and all those people who access rail services, maintenance centres and production centres.

**Ethics, Integrity and Transparency:** acting in compliance with the regulations in force in the individual countries in which the Organisation carries out its activities, implementing controls to prevent and monitor corruption in all its forms and to ensure ethical and transparent business conduct.

**Digital Innovation:** Within Rail's diverse range of rolling stock, signalling, and other operations, digital technologies can be effectively harnessed to deliver improved customer experiences with reduced environmental impacts.

**Reducing carbon emissions:** To reduce these emissions, railways policies should focus on mobility, consumption reduction, energy efficiency improvements, adoption of renewable energy sources, and enhanced waste and water management programmes. Diversity, Inclusion and Engagement cultivating a workforce with diverse talents ,enhancing capabilities to better serve global customers, improve operations, and explore new markets; harnessing diversity to foster innovation and creativity; attracting and retaining top talents through a supportive and inclusive work environment; and ensuring employee engagement and alignment with the organization's strategic vision.

**Energy Efficiency and Consumption:** The issue of resource scarcity, triggered by rising demand and population growth, is a common concern for the entire world. As populations grow and living standards improve, higher volumes of resources are collected, extracted, used, and eventually emitted as waste. Railways should work with customers and society to help

building a world that uses resources more efficiently. New systems are being designed that combine mechanical, electrical, and computer engineering to significantly boost energy efficiency. Produced by ABB, Siemens, and others, these systems are made cleaner thanks to regenerative braking and new propulsion mechanisms. A range of options are becoming available for reducing energy consumption in noncore activities, including the use of LEDs in safety lighting and natural refrigerants in air conditioning.

**Reducing carbon emissions :** Rail companies can pull several levers to reduce their GHG emissions across the value chain. They can reduce their Scope 1 emissions in three ways: deploying cleaner alternative-drive technologies for locomotives, improving energy efficiency in operations, and maximizing the utilization of current assets. They can reduce their Scope 2 emissions by increasing the share of renewable energy purchased for their rail networks, buildings, and other activities and through cleaner locomotive drives, improvements in efficiency, and asset utilization. Companies can help lower both upstream and downstream Scope 3 emissions by actively promoting sustainability across the value chain-engaging with suppliers on de-carbonization levers and setting green procurement criteria.

**New Materials:** The combination of new composite materials and modular design has the potential to reduce energy consumption even further. Under the EU's Shift2Rail project, a consortium of researchers, engineering firms, and suppliers are working to develop the next generation of trains, built to reduce weight while adding room for more passengers.

**Operational Software:** A number of digital tools have recently been implemented to optimize operations for diesel and electric trains. Wabtec's Trip Optimizer, for example, is a smart system that minimizes fuel consumption by calculating best speed, throttle, and braking for each trip.

**Circularity:** Circularity represents an ongoing challenge in the current economic model of production and resource consumption. For companies, material conservation, product longevity through repair and reuse, and eventual recycling are no longer optional choices but imperative necessities.

**Innovation:** innovation requires a structured process that entails a rigorous approach, relevant needs assessment, clear objectives and activities, driven by customer needs. Through an "open innovation" approach, it develops and tests new solutions and technologies to demonstrate their effectiveness



in meeting these while assuring positive impacts on the business and community. It creates prototypes of new products and solutions that, together with the associated skills, enrich the future product portfolio through collaboration with engineering and development departments.

**Sustainability facilitators :** Considering that railways are complex organizations, companies can also put enablers in place to help them develop and embed their ESG strategies. For instance, railways can pay attention to organizational practices and structures that can help to ensure that all aspects of ESG are covered throughout the organization. Often, there is no single point of responsibility for ESG, and multiple departments are responsible for several ESG-related criteria, such as safety, the environment, or the circular economy. A clear structure could help to define roles and responsibilities, and make sure that all the ESG issues in the strategy are being addressed.

**Water and Effluents:** Railways can continually improve water quality by reducing pollution, eliminating waste, and reducing the release of chemicals and hazardous materials, minimizing the percentage of untreated wastewater and substantially increasing recycling and safe reuse.

**The Eco-Design function:** requests process owners to communicate changes, such as:

- train weight matrix; refinements in design for sub-groups/equipment/parts, including possible material sheets from suppliers; supplier-related changes (origin/components); worked hours and resource consumption (energy, auxiliaries) or waste production (air emissions, water discharge, solid waste) in each involved plant for specific projects; simulation results (e.g., improved power equipment performance, energy recovery systems, product mass reduction, optimised auxiliary consumption, enhanced aerodynamics); Improved design of locomotives and rolling stock can significantly reduce drag and lower energy consumption

Eco-Design Strategy Eco-Design or "sustainable design" sensitively improves product design for the purpose of disassembly, reparability, recovery, recycling, including a large set of techniques that are also applied to Circular Economy, going beyond the creation of a "green" product, aiming to meet the needs of consumers in a sustainable way. Companies that incorporate Eco-Design into their long term product innovation strategies strive to alleviate negative environmental, social, and

economic impacts in the product supply chain and throughout its life cycle.

**Environmental Policy :** Environmental Policy places safeguarding the environment at the heart of its management and development strategies, with a constant and targeted commitment to preventing pollution and pursuing continuous improvements in its environmental services. Organization should educate all layers of organisational with risk management skills; standardise the approach across all the whole business; embed a culture of full disclosure to highlight important issues and opportunities to improve; engage with workers as problem identifiers.

**Intelligent Infrastructure :** This includes a range of digital systems that use networking technology to automate signalling and switching, thus reducing delays and disruptions (caused by obstacles on the tracks, for example). Thanks to government funding, these "digital interlocking" systems are already a reality on certain lines in Germany and Switzerland.

**Climate change adaptation and resilient infrastructure:** If rail must attract more traffic, it must remain very safe, boost capacity and reliability. However, the increasing frequency and severity of weather events such as heat waves, heavy rainfall, and storms, and associated hazards such as buckled rail, flooding and landslides pose a significant challenge to railway infrastructure and it's safe and reliable operations. Disruptions to services create significant economic losses. The changing climate must be taken into account both in the management of existing lines, and in the construction of future ones. While railways are increasingly putting in place frameworks to adapt, action must be accelerated.

**Balancing the demands for space between the transport sector and nature:** Despite requiring only 7 m<sup>2</sup> per passenger compared to the 100 m<sup>2</sup> needed for car transport, railways still occupy extensive land areas around the world, encompassing natural rich assets. These areas benefit from adjacent ecosystems by utilising their resources, such as embankment and slope stabilisation, water management, carbon sequestration, cooling, screening and offering natural scenery to passengers. However, line side vegetation and wildlife also pose an operational risk, as falling trees, embankment slips, or collisions with large animals can disrupt rail services. Linear infrastructure like rail can lead to habitat fragmentation by creating barriers to wildlife movement, and can also generate pollution from spills, chemical use, noise and vibrations.

Proactive measures are needed to balance the demands for space between the transport sector and nature, in order to avoid conflict with habitat management strategies, via the inclusion of nature-based solutions as key pillars for future infrastructure development.

**Indian Railways has a major role in contributing India's NDC towards combating Climate Change through several means:**

- To enhance the share of the Railways in the overall land based freight transport from present 36% to 45% by the year 2030.
- Indian Railways is setting up Dedicated Freight Corridors (DFCs) across the country. The first phase of the project alone is estimated to reduce emissions by about 457 million ton CO<sub>2</sub> over a 30 year period.
- Increase the share of renewable energy in its energy mix.
- Railways to further improve its energy efficiency for both diesel and electric traction thereby facilitating the reduction of GHG emissions for the country.
- PAT Scheme to be implemented in railway sector.
- Use of 5% blending of biofuels in traction diesel fuel.
- Improve water use efficiency by 20% upto 2030.
- Tree plantation to increase Carbon sink.
- Waste Management and Pollution control.
- Adopting the good practices on Green Buildings, Industrial Units and other establishments for the management of resources and infrastructure to achieve Environmental Sustainability in growth of IR.
- Contribution in "Swachh Bharat Mission".
- IR has set a target of becoming a "Net Zero" entity by 2030 by completing electrification of all railway tracks.

Indian Railways has taken steps to streamline its initiatives with regards to environmental management, with some notable initiatives including Energy Efficiency Management, Renewable and Alternate sources of Energy, Water conservation, Afforestation, Water Management and Green Certifications.

**The reforms undertaken by Indian Railways since 2014 can be broadly categorized in following areas:**

**Net-Zero Carbon Emission:-**

- IR has planned to gradually reduce its carbon footprint and become Net Zero Carbon Emitter by 2030. IR will attempt to reduce its carbon footprint primarily through sourcing of its energy requirements from renewable energy sources. By 2029-30, expected requirement of installation of renewable capacity would be about 30 GW. IR has installed 142 MW solar rooftop capacity and 103.4 MW of Wind energy till August, 2022.
- Other strategies towards Net Zero emitter includes taking a multi-pronged approach of Electrification of its routes, shifting from diesel to electric traction, promotion of energy efficiency, construction of Dedicated Freight Corridors, Green certification of Railway Establishments etc.
- IR has electrified 52,508 RKM out of total BG network of 65,141 RKM (80.61%).
- With 100% electrification, the demand for electricity will go up to about 72 BUS by 2029-30 from 21 BUS in 2019-20. Carbon emission by 2029-30 as per Business As Usual mode is estimated to be 60 million tons which would be offset by various measures planned by IR.

**Issuance of Water Policy 2017 for effective water management:-**

- Water Policy 2017 has been issued to all Zonal Railways and Production Units for implementation in Railway Stations, Trains, Railway Colonies etc. This is a part of overall efforts to achieve 20% reduction in water consumption by 2020 by the Government of India as part of Nationally Determined Contribution. Main objective of this policy are to improve water use efficiency by effective demand and supply management, installing water efficient systems and setting up Water Recycling Plants on railway land.

**Creation of Additional Carbon sink by Afforestation**

- .Afforestation on vacant railway land and in

between sections is carried out by Railway departmentally. In pursuance of Railways' commitment towards environmental improvement and sustainable development, Forest Departments of States are being involved in plantation as well as maintenance and disposal of trees.

- IR has been planting around 1 crore trees annually since 2017 onwards. 72 lakh saplings have been planted during the year 2021-22.

#### **Waste Management:-**

- Waste to energy/compost/biogas plants/ Material recovery facility have been set at more than 250 stations to manage waste. Separate bins have been provided for dry and wet waste for waste segregation at source.

#### **Green certification/Consent to operate from State Pollution Control Board since 2015**

- Around 700 Railway Stations have been certified for implementation of Environment Management System to ISO:14001
- More than 545 stations have achieved Consent to operate (CTO) from respective State Pollution Control Board.
- 31 railway buildings (including offices, training institutes, hospitals and schools), 32 stations and 55 workshops/PUs have achieved green certification.

#### **Policy for allocating 1% cost in all sanctioned Works for executing environment related works:-**

- To contain the impact of activities on environment and for protection of the environment, policy issued in May 2016 making provision for allocating 1% cost in all sanctioned Works for executing environment related work.

#### **Cleanliness of Trains & Railway Stations:-**

- Cleanliness of Trains & Railway stations have gained increased thrust in last 08 years with the increasing numbers of mechanized cleaning contracts at stations & Coaches in trains, rag picking & garbage disposal contracts at stations

and On Board Housekeeping Service (OBHS) increased in number of trains.

#### **Environment friendly Bio-Toilets for Passenger Coaches:-**

- Environment-friendly Bio-toilets for passenger coaches have been developed by Indian Railways (IR) jointly with Defence Research & Development Organization (DRDO).
- 9,587 bio-toilets were fitted in 3,647 coaches up to March 2014. With the installation of 2,58,990 bio-toilets in nearly 73,110 coaches up to March 2021, the work of fitment of bio-toilets in all the passenger carrying coaches, running on Indian Railways has been successfully completed.
- The direct discharge of human waste from trains has thus been eliminated in line with 'Swachh Bharat Mission'.

#### **Conclusion**

Rail is expected to become the backbone of future mobility in the world as the cleanest and greenest high-volume transport. Sustainable mobility and infrastructure are main global challenges and are important aspects of transport development. Rail transport is part of the solution to the challenge of sustainable transportation. Railways play a crucial role in achieving sustainable transport by offering a more energy-efficient and environmentally friendly alternative to road and air travel, with the potential to significantly reduce carbon emissions. Among the main trends in the Railway transport sector is the growing emphasis on electrification and renewable energy sources to power trains. This shift aims to reduce greenhouse gas emissions and dependence on fossil fuels. Advancements in technology are facilitating the adoption of smart and automated systems to optimise operations, improve safety, and enhance passenger experience. However, several challenges persist. Upgrading existing rail infrastructure to accommodate new technologies requires substantial investments and coordination among stakeholders. Ensuring seamless integration with other modes of transportation and improving accessibility to remote areas are pressing challenges.