सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

INDIAN RAILWAYS

working for Green Environment

ENVIRONMENTAL SUSTAINABILITY

ANNUAL REPORT 2019-20


INDIAN RAILWAYS
Green Footprints
on Sand of Time

Indian Railways

"Earth provides enough to satisfy every man's need but not every man's greed"

- Mahatma Gandhi

भारतीय रेल पर्यावरण प्रबंधन

विजन

भारतीय रेलवे को व्यावहारिक द्रुत परिवहन समाधान के क्षेत्र में ग्लोबल लीडर बनाते समय हरित पर्यावरण तथा स्वच्छ ऊर्जा को बढ़ावा देना।

मिशन

- ऊर्जा संरक्षण उपायों को बढ़ावा देना।
- स्वच्छ ऊर्जा के वैकल्पिक स्वरुपों का अधिकतम उपयोग करना, जिसके परिणामस्वरुप रेलवे में कार्बन फुटप्रिंट को न्यूनतम करना।
- ग्राहकों को स्वच्छ एवं स्वास्थ्यपरक पर्यावरण उपलब्ध कराना।
- जल और अन्य प्राकृतिक संसाधनों के संरक्षण को बढ़ावा देना।
- प्रमुख रेलवे इकाइयों से कचरे का उत्सर्जन न होने देने का प्रयास।
- हरित निर्माण तथा छायादार वृक्ष-क्षेत्र को बढ़ावा देना।
- प्रभावी पर्यावरण प्रबंधन प्रणाली स्थापित करने के लिए संगठन के भीतर क्षमता विकसित करना।
- रेलवे परिचालन में ध्वनि प्रदूषण को कम करना।

INDIAN RAILWAYS ENVIRONMENT MANAGEMENT

VISION

To promote Green environment and clean energy while making the Indian Railways a global leader in sustainable mass transport solutions.

MISSION

- To promote energy conservation measures.
- To maximize the use of alternate forms of clean energy, thereby minimizing the carbon footprint of Railways.
- To provide clean and hygienic environment to customers.
- To promote conservation of water and other natural resources.
- To march towards Zero waste discharge from the major Railway units.
- To promote Green built-up spaces and expand tree-cover.
- Building in house capacity to set up an effective Environment Management System.
- Noise reduction in Railway operations.

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1

Indian Railways – working for Green Environment

Indian Railways (IR) is one of the world's largest rail networks, spread over 67,415 route Km. IR is the lifeline of the country carrying nearly 23 million passengers every day making it the largest passenger carrying system in the world. It is also the 4th largest freight transporter in the world moving 1,225 million tonnes of freight annually, as it traverses the length and breadth of the country.

Rail-based transport is the most environment friendly mass transport system due to the inherent gains it provides in terms of energy efficiency and resource optimisation. Railways are about 12 times more efficient in freight traffic and 3 times more efficient in passenger traffic as compared to road transport. As the Indian economy transitions, with economic growth and sustainable development as twin goals, mobility will play a key role. It has been estimated that for the sustainable development of Indian Economy, the inter-modal share of freight traffic by rail should go up from the current share of 36% to 45% by 2030. Accordingly, Indian Railways is gearing up for a massive growth to achieve such increase in inter-modal share by augmentation of its network and rolling stock fleet along with increase in productivity.

For IR to be a low carbon mass transport system working for a green environment, an integrated approach, which includes resource efficiency at its core, will be critical.

As the country's lifeline, the national transporter, in January 2015, set up the Environment Directorate in the Railway Board, to coordinate all environment management initiatives across the Indian Railways. Since then, the Railways has taken steps to streamline its initiatives with regards to environmental management, with some notable initiatives including Energy Efficiency, Renewable and Alternate sources of Energy, Water Conservation, Afforestation, Waste Management and Green Certifications.

2

Reducing Global Carbon Footprint

India has a population of over 1.3 billion people spread over a vast geography. Mobility will play key role with urbanisation and the growth of cities. The transport sector is and will continue to remain a critical enabler of development and would also have to grow in a sustained manner for the country to meet its developmental objectives.

Transport accounts for more than half of India's total petroleum consumption and more than 25% of the overall energy needs. It accounts for about 13% of the total GHG emissions. Given the relative advantage of the efficiency of rail-based transport, increasing the share of rail for both passenger movement (regional, sub-urban and urban) and freight movement is vital for increasing the energy efficiency of the transport sector thereby, reducing the GHG emissions of the country.

2.1 Nationally Determined Contributions (NDCs)

The Government of India, as part of its Nationally Determined Contributions (NDCs), has set a target of 33% emissions intensity reduction, with the transport sector being one of the key sectors with substantial mitigation potential.

TERI was engaged with the Ministry of Railways for assisting in developing the strategies for emissions reduction for the Ministry with a horizon period of 2030. IR strategies on operational and technical energy efficiency measures, along with efforts to move greater share of traffic to electric traction, were modelled, and resulting numbers for the same were estimated. The strategies, duly approved by the Board, were thereafter shared with MoEFCC for their consideration in the INDC document.

The INDC document submitted by India in October 2015, was widely discussed at the 21st Conference of Parties (CoP 21) organized by the UNFCCC in Paris, in November 2015. TERI also supported the Ministry of Railways, the nodal ministry for India's transport sector dialogue, to set up the Government of India's official transport sector event at COP21.

The INDC was ratified by India the following year, and India now had an officially mandated target of activities for meeting its INDC commitments for 2030.

One of the most vital transportation emissions mitigation strategies agreed to by the Government of India was increasing the share of Indian Railways in the movement of freight from the current ~ 35-36% to 45% by 2030.

Conference of Parties to the UNFCCC in its sixteenth session (COP-16) had decided that developing countries should also submit Biennial Update Report (BUR) as an update to the most recently submitted national communication. India furnished its first Biennial Update Report (BUR-1) in January 2016. India's second Biennial Update Report (BUR-2) was submitted to UNFCCC in December 2018 which included updates on part of Indian Railways coordinated by EnHM directorate. BUR-3 is now being prepared.

2.2 IR's Role in India's NDC for Combating Climate Change

- IR should aim to enhance the share of the Railways in the overall land based freight transport from the present 36% to 45% by the year 2030.
- IR should target setting up of Dedicated Freight Corridors (DFCs) across the country. The first two corridors are already under construction. This first phase of the project alone is estimated to reduce emissions by about 457 million ton CO_2 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% up to 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.
- Role in 'Swachh Bharat Mission'.

3

Conference of the Parties to the UN Convention on Climate Change (UNFCCC)

Climate change has had widespread impact on human and natural systems. Accordingly, Climate Change Conferences are held annually in the framework of the United Nations Framework Convention on Climate Change (UNFCCC). India through Ministry of Environment, Forests and Climate Change (MoEFCC) has been participating in these conferences.

A decisive step to address the issue was taken with the adoption of the Paris Agreement in Conference of Parties (COP-21) in December 2015. Participating countries submitted near-term targets to address GHG emissions, called 'Nationally Determined Contributions' or NDCs and will review and extend these targets every five years. Ministry of Railways were designated as Nodal Ministry by MoEFCC for holding event on 'Transport Sector GHG Emissions' at 'Indian Pavilion' as part of COP-21 at Paris, France.

Ministry of Railways also participated in COP-22 held at Marrakech, Morocco in November 2016, COP-23 at Bonn, Germany in November 2017 and COP-24 at Katowice, Poland in December 2018. Sessions on sustainable transport network were organised at India Pavilion.

25th UNFCCC conference of parties was held at Madrid, Spain from 10th to 13th December, 2019. Theme of COP-25 was "Time for Action". Ministry of Railways delegation led by Sh. Alok Kumar Tewari, PED/EnHM, Ministry of Railway along with Sh. Vijay Garg, ED/EnHM-CE, Ministry of Railway participated in side events in COP-25 from 10th to 13th December, 2019. Ministry of Railways hosted side event at India Pavilion on "Green Railway Infrastructure and implications of Sustainable Mobility Eco System in Climate Action" jointly with FICCI on 10th December. On 11th December, Ministry of Railways participated in the session hosted by CII at India Pavilion on "Practices in Indian Railway Transport and Automobile Sector towards climate mitigation". On 12th December, Ministry of Railways was invited by FICCI to participate in the side event at India Pavilion on the topic "Role of Sustainable finance: Translating Climate ambition into investment opportunities".

On 13th December, Ministry of Railways participated in UNEFCC side event hosted by FICCI on the topic "Implication of sustainable mobility Ecosystem in Global Climate Action". The session was addressed by Sh. Alok Kumar Tewari, Pr. Executive Director/EnHM to showcase the Sustainable Transportation Initiatives of Indian Railways. Before the presentation a short video film on development and benefits of Dedicated freight Corridors for increasing the modal share of Railways in freight transportation was also played.

Through various presentations, Ministry of Railways have been able to arouse the interest of private sector representatives in the green activities of Railways to reduce the carbon footprint. The issues like end connectivity in urban rail transport was also raised to improve the acceptance of public rail based transport by the society.

During the side events, Railway's Eco-friendly initiatives were widely acclaimed and appreciated by all the participants. Railways utilised this forum to showcased them among various stakeholders. This is expected to generate interest of various private business groups in Railway activities.

4

Energy Efficiency in Mass Transportation System

4.1 Improvement in Energy Efficiency in Electric Traction

Introduction of energy efficient Three Phase locomotive technology is expected to reduce 500 tonnes of CO_2 annually. These locomotives are equipped with regenerative braking feature capable to regenerate electricity during braking action which is fed back to grid.

Regenerative braking feature has been developed in Conventional Electric Locomotive WAG7 also and first such locomotive was turned out from BHEL Jhansi in February 2019.

First, made in India 12000 HP WAG12 electric locomotive has been manufactured by Madhepura Electric Locomotive Pvt. Ltd. (MELPL). This is state of the art IGBT based, 3 phase drive and 12000 horse power electric locomotive equipped with regenerative braking system which provides substantial energy savings during operations. These high horse power locomotives will help to decongest the saturated tracks by improving average speed and loading capacity of freight trains.

Other improvements

Fitment of 1000 kVA Hotel load converters to supply electricity for train lighting, air-conditioning and for pantry cars.

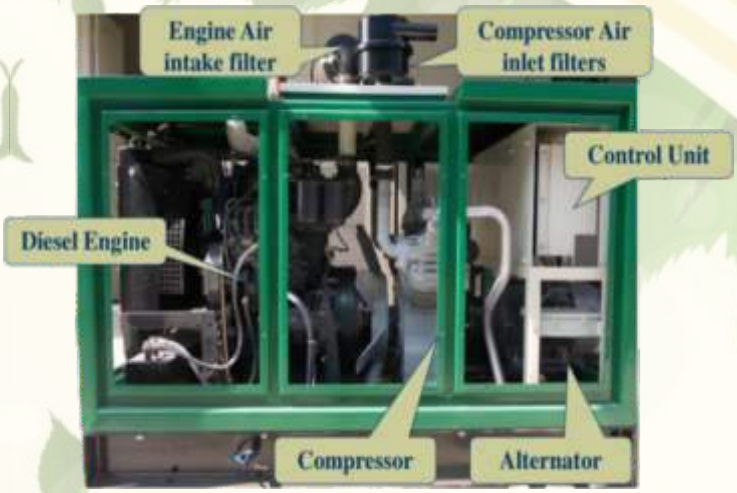
All electric locomotives are provided with Energy cum Speed Monitoring (ESMON) systems for monitoring the performance of Loco Pilots with respect to energy conservation.

Loco Pilots are being encouraging for maximum use of regenerative brakes on three phase electric locomotives for reduction in traction energy bill.

Energy consumption and energy regeneration in each trip by individual crew is being monitored through Crew Management System.

4.2 Improvement in Fuel efficiency in Diesel Traction

a. Auxiliary Power Unit (APU) has been provided in 1161 Diesel Locomotives to save fuel during idling. In APU system, the Main Engine shuts down and a small 25 HP Engine starts for charging batteries and air brakes pipes, when loco idles for more than 10 min. APU consumes only 5 litres of diesel per hour in comparison to 18 litres by the main engine. Besides fuel saving, there would be a reduction in lubricating oil consumption and wear and tear of the main engine. It also results in lower CO_2 emission and other pollutants like HC, NOx, CO etc.



Auxiliary Power Unit

b. Computerized Fuel Management System (FMS) has been developed and RCDs have started daily entry of all HSD issuance and receipt data in the FMS system. The system is being strengthened for real time data entry. This strengthens the data analysis to help in regulating diesel consumption for traction purpose.

c. Diesel Consumption reduction - IR has witnessed a 7.5% reduction in diesel consumption for traction in 2019-20 as compared to 2018-19 due to increase in Electrification. This has resulted in savings to the tune of Rs 1780 crore as compared to the last year.

d. Reduced Carbon Emission: IR has taken up the task of further reducing the emission for diesel locomotives and to standardize then in line with the international emission practices. Diesel Locomotives for Indian Railways are now being manufactured only at Diesel Locomotive Factory/Marhowra and these locomotives comply with UIC-624-I Emission Standards.

e. Dual-mode Locomotive - There are large numbers of stations / yards/ sidings, where traction change takes place over IR due to mix of diesel and electric tractions. With modern electronics, it is much easier to build an electro-diesel locomotive (Dual mode), which is equally capable of running at designated speeds both on electrified and non-electrified territory. In the event of major accident or natural calamities like cyclone and disturbed areas where OHE gets affected, dual mode loco will provide excellent operational flexibility to work on diesel until the normalcy is established. A dual mode loco design has been developed by RDSO. Prototype Dual mode locomotive has been made ready at DLW, Varanasi in March, 2020. It would now be taken up for requisite operational and safety trials.

4.3 Improving Energy efficiency with trailing Rolling Stock

Wagons

- 25 T axle load BOXNS wagon having a higher pay load to tare ratio of 4.05 has been designed and 4500 such wagons have been inducted.
- Prototypes of 25 T axle load container flat BLCS wagons are being taken up for oscillation trials up to 110 kmph.
- Improved design E of BCFC wagon developed for bulk fly ash and cement transportation.
- BCACBM wagon capable of carrying Auto Cars has been developed by RDSO and is being widely used by the automobile sector. Design modification was done in 2019-20 by providing side doors to enable two – wheelers loading from side doors in individual wagons.

Two - wheelers loading from side door

- BFNSM wagons were inducted for Steel Coils in 2018-19, increasing the rake throughput at 4100 tonnes per rake which is 35% higher than conventional BFNS and BRN wagon rakes. BFNV wagon developed to enable loading of steel coils by fork lift from side.
- A dwarf container has been designed which can move with double stack loading even under electrified sections thus enabling increase in throughput.
- Commercial operation of multimodal Road-Railers started in August, 2018.
- These measures will enable higher throughput and/or bring some road traffic on rail, resulting in overall reduction in GHG emissions for the same freight traffic.

Coaches

- Improved design Stainless Steel Coaches provide higher carrying capacity. With increasing share of such coaches, PKM to GTKM ratio will improve resulting in reduced GHG emissions for carrying the same passenger traffic. A record 6277 LHB coaches were manufactured by the 3 Production units of IR – ICF Chennai, MCF Raebareli and RCF Kapurthala in 2019-20 as against total 4429 in 2018-19, 2480 in 2017-18 and 1469 in 2016-17.

4.4 Train Sets

- India's first semi high speed train set manufactured under 'make in India' programme by ICF during 2018-19, Train-18 is an energy efficient train. It has been provided with 3-phase IGBT based under slung propulsion equipments, has advanced regenerative braking system and need for power cars is eliminated. Such features help in saving energy up to the tune of 30%. Further the aerodynamic profile of the train also helps to reduce air drag and thus reduce energy consumption. Two such train sets are presently running in Northern Railway.

Train set : Train -18

4.5 EMU/MEMU

- Induction of energy efficient 3 phase IGBT based propulsion system with regenerative braking feature have been introduced way back and same has been continued as detailed below:
- 3-Phase Non-AC EMU : During 2019-20, 18 non-AC EMU rakes of 12 car with energy efficient 3 phase IGBT based propulsion system with regenerative braking feature have been introduced over IR.

3-Phase Non-AC EMU

- 3-Phase AC EMU : 7 air conditioned EMU rakes of 12 car equipped with energy efficient 3-phase propulsion system with regenerative braking feature in Mumbai suburban (3-CR and 4-WR) has been turned out of which 4 have been commissioned (1-CR and 3-WR) and 3 are under commissioning (2-CR & 1-WR).
- 3-Phase MEMU : During 2019-20, ICF has turned out 29 MEMU rakes of 8 cars with energy efficient on board 3 phase IGBT based propulsion system with regenerative braking feature out of which 26 rakes have been introduced in service and 3 are under commissioning.
- 3-Phase Kolkata Metro : During 2019-20, 4 Kolkata Metro rakes out of which 3 rakes have been turned out, out of which 3 rakes have been introduced in service.

3-Phase Kolkata Metro

- Energy efficient LED based Twin Beam head lights are being used in EMU/MEMU.

4.6 Head on Generation system

The LHB trains running in End- on -Generation (EOG) configuration require power cars equipped with Diesel Alternator (DA) sets for feeding air conditioning, train lighting and other electrical loads in the coaches. Each such train has two power cars, each power car having 2 DA sets. This system has inherent disadvantage of air and noise pollution. In HOG system power is drawn through converters provided in locomotives. The electrical power drawn by the pantograph of the locomotive is suitably converted and supplied for air conditioning, train lighting and other electrical loads in the train. In 2019-20, 337 train pairs (cumulative 505 train pairs) have been converted into HOG, resulting in reduction in diesel consumption.

5

Energy Conservation Initiatives

Given the massive scale of its operation, it is not surprising that the Indian Railways has a growing appetite for the consumption of electricity. Indian Railways consumes nearly 20 billion kWh of electricity annually, comprising around 2 % of the country's total power consumption. With rail traffic projected to register an increasing growth in the coming years, it is estimated that the demand for electricity by the Indian Railways will go up over the next decade.

5.1 Indian Railways has taken a series of measures to cut down its energy consumption and rationalise its energy procurement process by implementing several energy conservation measures, procurement of power under Open Access and harnessing Renewable Energy. Railways also carry out regular energy audits at consumption points. Use of 5 Star rated electrical equipment is emphasised.

5.2 100% LED lighting

- 100% LED replacement done in all railway stations (more than 8,000) and all railway installations & buildings (more than 20,000).
- One time LED provision being done in all residential quarters (about 5 lakhs quarters) has been done.
- 100% LED across Railway installations will reduce about 10% of total energy being utilized on its Non-traction thus leading to savings of about 240 million units of electricity i.e. savings of Rs 180 Cr. per annum.

5.3 Star rated buildings Certified by Bureau of Energy Efficiency (BEE): 50 buildings (including 4 Divisional Hospitals) have been given Star rating by BEE.

5.4 LED lights in coaches

Zonal Railways have been replacing CFL/FL lights in TL/AC and self-propelled (EMU/MEMU) coaches with energy efficient LED lights. During 2019-20, 36500 coaches have been provided with energy efficient LED lights (cumulative 52250 coaches). All newly manufactured coaches from production units are being turned out with LED light fittings. On an average there is a saving of around Rs. 25000/- per coach per annum.

5.5 Energy Efficiency Studies

To facilitate Indian Railways and Confederation of Indian Industry (CII) to work together on Green Rating and Energy Efficiency studies of IR's Production Units and major Workshops, a Memorandum of Understanding (MOU) was signed between IR and CII on 26th July 2016 for a period of 3 years. New MoU was signed with CII on 13th Sept 2019 for Facilitation of Green initiatives on IR for another 3 years.

Energy Efficiency studies were completed in six PUs (RCF, ICF, RWF, DLW, CLW, DMW) and 4 workshops (JUDW, JHS, JMP, GOC) under MOU with CII in 2017-18 in first phase. In second phase, Energy Efficiency studies for 10 additional units - 2 PUs (MCF, RWP) and 8 workshops (BPL, LLH, UBL, AMV, AII, RSK, KGP) were taken up which have been completed in 2019-20. 7% to 15% energy efficiency improvement has been achieved.

The activities included :

- Identification of significant energy saving opportunities in the facilities.
- Awareness workshops and training programs on the technological aspects of energy efficiency, and the best practices adopted by related Indian industries.
- Organising visits of IR officials to some of the best performing units in similar sectors, such as automobile and engineering. Visits to J K Tyre, Chennai (May 2019) and Hero MotoCorp, Gurgaon (Feb 2020) were organised in 2019-20.
- Identification of potential technology suppliers who can offer energy saving technologies to the units.
- Formulation of 'Best Practices Manual' for energy efficiency.
- Organization Energy Efficiency Award for the Indian Railways on the sidelines of the Annual CII Energy Efficiency Award, to felicitate the best performing units.
- Continuous hand holding of the IR units to guide them in the implementation of energy efficiency measures.

The activities led to implementation of more than 250 energy efficiency and renewable energy measures / projects, resulting in an estimated energy saving of 21 million units annually, translating into monetary savings of Rs 16 crore and a reduction of 17,400 tCO_2 emissions per annum. Some of the energy efficiency measures implemented are :

- Optimising pressure settings and distribution / circulation of compressed air as per requirement.
- New energy efficient Screw Compressor to optimize the compressed air power consumption.
- Small blower/LP compressors for aeration in de-greasing tanks etc.
- AC energy saver which provides dual sensors to measure both room and coil temperatures as feedback, and its multiple algorithm in the closed-loop circuit adapts the AC to ambient temperatures and climatic changes to ensure energy saving.
- Regenerative drive system for EOT cranes.

- Power factor improvement by installing additional automatic power factor correction systems where power factor was 0.90 - 0.95.
- Daylight Pipes.

6

Harnessing Renewable Energy

- Indian Railways being a significant consumer of energy, identifying cost-effective options to achieve and realizing an energy system with least environmental impacts is essential. Indian Railways has been taking several steps to install clean and efficient energy.
- Vision 2020 document of the Indian Railways states that the key target is to utilize at least 10% of its energy requirement from renewable sources.
- As a part of this, Indian Railways has planned to set up
- 1000 MW solar power plants, and
- about 200 MW of wind power plants
- across Zonal Railways and Production Units.

Harnessing Solar Energy on IR:

Indian Railways have planned to set up:

- 500 Mega Watt (MW) solar plants on roof top of Railway buildings through developers with 25 years PPA by Railways, which will be used for meeting non-traction power supply loads at Railway Stations etc.
- About 500 MW on land based system for meeting Traction and Non-Traction requirements.
- Out of this about 102.44 MW has already been installed covering about **862 stations**. Further, LoA for about **245 MW** Solar plants are issued by REMCL which are under different stages of execution.
- During 2019-20, 19.65 MW of Solar power and 50.4 MW of Wind power was commissioned over IR.
- **RUMS** (400 MW) (under Optimum Scheduling Mode) – 400 MW land based solar power tied up with Rewa Ultra Mega Solar (RUMS), a JV of Govt. of MP and SECI.
- IR has also taking up two pilot projects for feeding solar power directly to 25 kV AC traction system.
  - Diwana Solar Plant Project (**2 MWp**) through REMCL: PPA signed on 14.06.19.
  - Bina Solar Project (**1.7 MWp**) through BHEL: Work under execution.

Solar Plants along the Railway Track for Traction purpose

Indian Railways has planned to utilize its unused vacant Land parcels for setting up of Land Based Solar Plants for its traction power requirement as **'Green mode of transportation'** and become a 'Net Zero Carbon Emission Railway' by 2030. The plants will be set up on unused vacant land.

There is about 51,000 hectare of Railway land which has a potential of installing 20 GW land based solar plants. The Solar power so generated will be fed to CTU/STU Grid or directly to 25 kV AC traction system.

Harnessing Wind Energy over IR :

- Out of 200 MW target of IR, 103.4 MW wind-based power plants have already been installed.
- Wind based power plants of 10.5 MW (for non-Traction) and 10.5 MW (for Traction) capacity in Tamil Nadu, 26 MW (for traction) capacity in Rajasthan, 6 MW (for non-traction) and 50.4 MW (for traction) capacity in Maharashtra have been installed.
- During 2019-20, 50.4 MW of Wind power was commissioned over IR.
- Further, tenders for 187 MW Wind Power under Hybrid plants also floated by REMCL.

100% Green Powered Station

23 Railway stations have been made "Net Zero" carbon emission Stations, which are meeting their energy needs completely either through Solar or by Wind. Railways are making extensive efforts in this direction to make more and more stations 100% green powered stations.

7

Alternate Fuel and Clean Energy initiatives – IROAF

With growing global population and rising Energy consumption, the expanding use of coal and oil threaten the existence of human kind. These fuels are major sources of Green House Gases (GHG) and pollutants such as NOx, SOx, Volatile Organic Compound (VOCs) and particulate matter (PM). Indian Railways Organisation for Alternate Fuel (IROAF) was established to explore possibilities in proliferating new sources of Environment friendly Fuels / Energy in Indian Railways. Some steps taken by IROAF in this direction are as follows –

7.1 Blending of Bio- diesel with HSD

The Bio- based fuels produced from renewable biomass and other natural products present complete carbon neutrality as CO_2 generated by burning these fuels is captured again by trees and plants thus eliminating the adverse environmental impact. The pollutants created by burning of the conventional fossil fuels arising from Sulphur and other harmful elements contained in fossils fuels are absent in Bio-fuel which results in much lower emission. The substitution of H.S.D with bio-diesel results in reduction of 44 % hydrocarbon (HCs), 89.3 % reduction of carbon mono oxide (CO) and no sulphur content in exhaust. Indian Railways started 5% Bio-Diesel blending with HSD on 5th June 2015. Blending of Bio-Diesel to the extent of 5% has commenced at 76 RCDs of Indian Railways in different Zones.

Top arrange Bio-Diesel in house IR is setting up Two 30 Ton per day (TPD) capacity plants at Tondiarpet /Chennai and Raipur /Chhatisgarh. These two plants will meet 15-20% of total requirement of blending of HSD on IR. Palm oil, jatropha oil, cotton seeds oil, used cooking oil, animal fat etc. can be used as raw material to produce Bio-Diesel in these plants. The construction of plant at Tondiarpet is at advance stage.

7.2 CNG/LNG based Dual Fuel Diesel Engines for DEMU Trains

Natural Gas usage emits less GHG than liquid fuels due to fewer Carbon atoms in its molecular structure.

Environment friendly CNG/LNG in Duel Fuel Mode for Railway Traction

Indian Railways have the distinction of being the only railway in the world to be using CNG run locomotives for passenger transportation. IROAF is pioneering implementation of CNG based dual fuel fumigation technology on CNG DEMUs DPCs of 1400 hp to achieve up to 20% substitution of Diesel. 25 Diesel Power Cars of DEMUs have been converted into CNG based dual fuel engine at Shakurbasti and Vijayawada Diesel Sheds

BGL Installation for CNG filling in Dual Fuel DPCs at DEMU Shed, Vijaywada

IROAF is now moving towards the next level of 40% HSD substitution with CNG / LNG. Contracts have been awarded for conversion of 10 nos. dual fuel DPC with 40% substitution with CNG and conversion of 10 Nos. DPC on dual fuel with 40% substitution with LNG.

7.3 Solar Energy based solutions for Rolling Stock of Indian Railways

7.3.1 Solar Energy based solutions for Passenger Services

The trailer coaches of one rake of 1600 HP DEMU were initially provided with Solar PV system at its roof which takes care of electric supply for the fan and lighting load inside the coach. This results in

- Saving of 5.25 Lakh Litres of Diesel
- Cost saving of Rs. 3 Cr
- Reduction of 1350 Tons of CO_2 per train over life time of 25 years.

The operation of this rake was inaugurated on 14th July 2017 by the then Minister of Railways Shri Suresh Prabhakar Prabhu. 14 nos. solar coaches are based at Shakurbasti, NR.

The trailer coaches (06 nos.) of one rake of 1400 HP DEMU at Jamalpur have been provided with solar PV panels.

Further, contract for provision of Flexi Solar System on 50 nos. Non AC coaches of passenger trains (14203/04, 54334/33, 54255/56 of NR) was awarded. Work of installation, commissioning and testing on first 10 coaches has been completed. Another tender has been floated for providing flexible solar PV panels on the roof top of 450 Nos. trailer coaches of Diesel Electric Multiple Unit (DEMUs).

7.3.2 Provision of Solar Panels on Swachata Express

IROAF has fitted Solar Panels of 4.5 KWp capacity each on 10 Coaches of Swachata Express, which is capable of producing 10 KWh per day for electric supply to lights and fans inside the coach. Swachhta Express is an exhibition train to showcase the achievement of Swachh Bharat Mission.

7.3.3 Solar Energy based solution for guards of freight trains

IROAF has done successful trial of electricity generation from Solar PV modules for Guard comfort system on 50 BVZI wagons used on freight trains. A 400 Wp Solar PV system with batteries has been provided on each guard van to supply round the clock electricity for fan, light and a charging point to the guards who have until now worked without these facilities. E-tender for provision of Guard Comfort Kits for 700 BVZI/BVCM wagons is being processed for further proliferation.

Renewable Solar Energy based Guard Comfort Kit in BVZI wagons

Hybrid system with PV Solar panels and fuel cell, is being planned for 300 nos. brake vans to provide un-interrupted electric supply.

7.4 Solar Panels on Workshops and Stations

Solar PV Plant of 2 MWp capacity at roof top of DMW Patiala was arranged and commissioned successfully by IROAF under CAPEX through BHEL, to meet approx. 25 % of annual requirement of electricity at DMW.

Commissioning of PV solar plants of 30 KWp capacity each on roof top of 03 Railway Stations i.e. Jalandhar City, Jammu Tawi and Pathankot was competed in July-August 2018.

7.5 Use of Natural Gas in Workshops/ Production Units/ Railway premises

CNG is an environment friendly alternate fuel for metal cutting as compared to Dissolved Acetylene (DA) or BMCG. It also has higher thermal efficiency. IROAF coordinated with Matunga Workshop of CR and Kota Workshop of WCR to switch over to the use of CNG for metal cutting, thereby not only improving sustainability but also saving about Rs 1 crore per annum. RWF/Yelahanka also commenced the use of Natural Gas for operation of its furnaces. RWF has reported a saving of 420 KL of HSD as furnace oil per month.

An MoU has been signed between IR and GAIL on 30.08.2018 to streamline the system and develop infrastructure for use of Natural Gas in IR. DLW, Varanasi and RYPS and LGD workshops in SCR are in the process of this change.

To extend the use of Natural gas through Pipes and save the LPG for Ujjwala Scheme, the facilities have been developed by GAIL and its subsidiaries in Bhubaneswar, Badhwar Park and DLW Railway colonies and NAIR. Surveys have been conducted by GAIL subsidiaries at Jhansi, Parel, Lower Parel, Jamshedpur and Danapur townships.

7.6 Fuel Cell Technology-

IROAF is pioneering development of Technical Specifications for manufacture of Hydrogen Fuel Cell Powered Rolling Stock (DPRS) with regenerative braking system. The new technology envisages zero emissions with water as net exhaust. IR will be using DEMU platform for developing this technology. In this regard, an EOI has been floated with a view to tap latest technological trends in vogue across different countries.

IROAF is also exploring the feasibility of using Hydrogen Fuel Cell Technology for Locomotives of Hill Railways such as Kalka-Shimla, DHR- Matheran etc. Round of discussions have been held with potential technology providers, RDSO, Rly.Bd , Parel workshop and DLW/BSB for development of concept itself.

7.7 International Railway Equipment Exhibition (IREE-2019)

IREE-2019 was organised by the Confederation of Indian Industry (CII) on 22-24 Oct 2019, in association with the Ministry of Railways, Government of India. IROAF has participated in this event for displaying its progress in the development of alternate fuel for IR.

8

Water Conservation

Shortage of water in India is becoming a very serious issue. The tube wells drilled are lowering water tables in most parts of the country. This problem gets further compounded in areas where rain fall is poor. To overcome this problem, Railways have taken initiative in Rain Water Harvesting (RWH), Water Recycling Plant (WRP), Water Audits and Water bodies.

8.1 Water Recycling Plants

Water Recycling Plants (WRP) are being provided at major consumption centre locations (stations /sheds etc) where there is heavy demand for water and provision of same is economically justified. 71 Water Recycling Plants were set up on Indian Railways up to the year 2018-19. WRPs have been commissioned at another 14 locations in 2019-20. Besides this, work is in progress for 27 more WRPs.

20 Automatic Coach Washing Plants (ACWP) have been installed over Indian Railways, including 09 installed during 2019-20. Work is in progress at 51 more locations. Automatic Coach Washing Plants are provided with water recycling plants and thus reduce water consumption during exterior cleaning of coaches.

8.2 Water Bodies

Ministry of Railways has decided to assess and review the Water Bodies existing in the Railway Land including the ones which are presently non-functional and take action to ensure that all the existing Water Bodies are protected and nurtured and Water Bodies which are non-functional are restored early.

21 non - functional natural water bodies have been restored and 462 natural water bodies are functional on Indian Railways. The water bodies in the form of pond are also being utilised for fisheries purpose on commercial terms.

Revival of 200 year old Salarjung well at Hyderabad yielding average 2.5 lakhs litres water per day is an example worth emulating.

8.3 Water Audit

To minimize water wastage, Zonal Railways have been asked to conduct water audit at major water consumption centres through third party for quality as well as quantity and to take up Works of water recycling plants based on the report of water audit. Up to the year 2019-20 a total of 530 Water Audits have been conducted by various Zonal Railways out of which 211 were completed in the year 2019-20. Further, water audit at 35 locations is under progress and at 102 locations the same is in planning stage.

8.4 Rain Water Harvesting (RWH)

To promote water conservation, Indian Railways have been providing Rain Water Harvesting (RWH) at various locations as per extant policy. In 2001, railways were asked to adopt roof top rain water harvesting to recharge ground water especially in areas experiencing seasonal shortage of water and to take necessary assistance from Regional offices of Ministry of Water Resources. In 2013, it was decided that RWH scheme shall be an essential sub-set of all the project estimates related to constructions of built assets like service buildings, hospitals, stations buildings (including remodelling etc), railway quarters, workshops/sheds, yard modelling as also in doubling, new line and gauge conversion and sidings. Installation of Roof Top Rain Water Harvesting is being monitored across all Railway Zones. During the year 2019-20, Roof Top Rain Water Harvesting were installed on 805 locations/ buildings having roof top area more than 200 sqm.

8.5 Water Policy

'Water Policy' for IR was issued in March, 2017 covering all aspects of water use efficiency, water recycling, conservation, recharge of ground water and restoration of water bodies.

8.6 44 Quick Watering Systems have been deployed over Indian Railways for watering of coaches at stations, including 29 commissioned during 2019-20. Quick Watering System helps to save water as it limits wastage.

9

Afforestation

Afforestation on vacant railway land in between sections is carried out by Railway departmentally and also with a view to safeguard Railway land against unauthorized occupation.

In pursuance of Railways' commitment towards environmental improvement and sustainable development, Forest Departments of the States are being involved in plantation as well as maintenance and disposal of trees, thus bringing in their expertise in afforestation. For this purpose, Ministry of Railways have finalised a model agreement in consultation with Ministry of Environment, Forest and Climate Change (MoEFCC) in January 2016 to be entered between Zonal Railways and respective State Forest Department for plantation of trees on Railway land along the railway track and station yards without transferring the ownership of the land in favour of State Forest Department. As per this Agreement, plantation along the railway track on railway land boundary can be done by Forest Department without declaring such land as protected forest and can be re-used by Railways at any time without any hindrance to Railway works/ development projects. Cost of the plantation including its protection and maintenance can be borne by State Forest Department or Railway Administration or can be shared by both.

The agreement has already been finalised with State Forest Departments of Maharashtra, Haryana, Punjab, Assam, Andhra Pradesh, Chhattisgarh, Odisha and Karnataka.

Railways have planted around 1.3 crore saplings during the year 2019-20.

150 nurseries are being developed alongside Railway track at some of the major stations in Indian Railways.

10

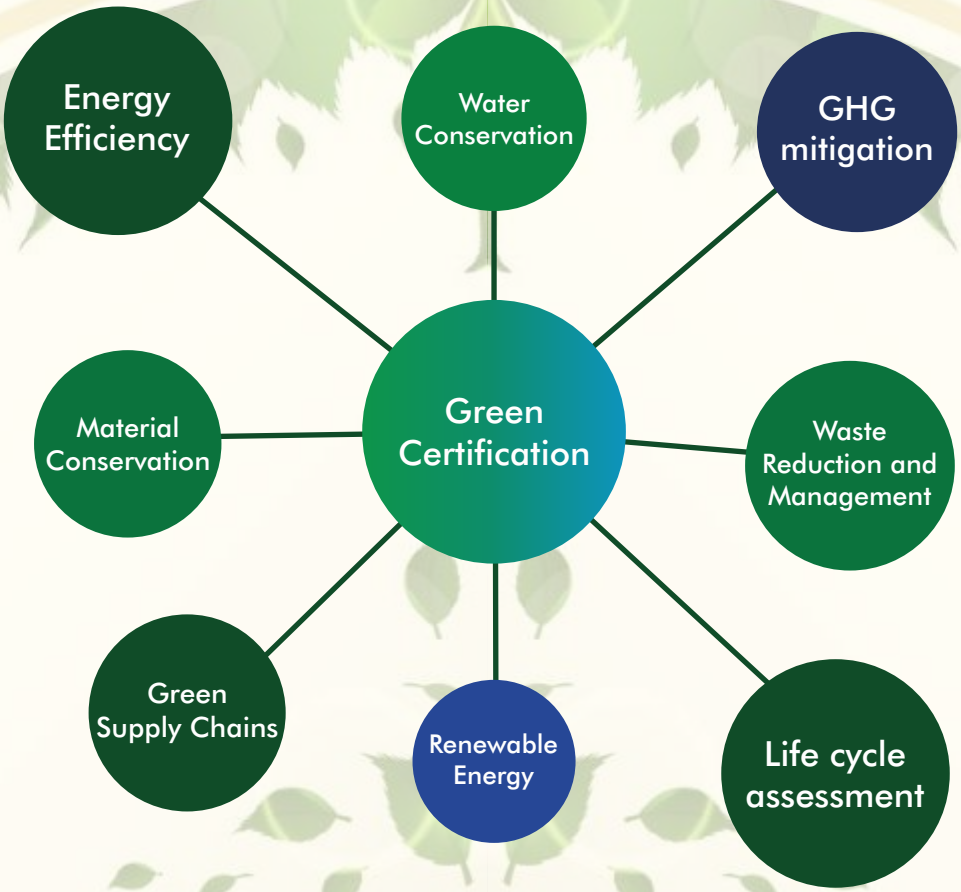
Green Industrial Units

10.1 GreenCo rating developed by Confederation of Indian Industry (CII) offers significant value addition and direction to organizations in terms of resource conservation, waste reduction, climate change mitigation, greener supply chain and superior environmental performance. It has been acknowledged in India's Intended Nationally Determined Contribution (INDC) document, which was submitted to UNFCCC, as a proactive voluntary action undertaken by Indian private sector aimed towards combating climate change.

10.2 In order to facilitate IR and CII to work together on Green Rating and Energy Efficiency studies of IR's Production Units and major Workshops, a Memorandum of Understanding (MOU) was signed between IR and CII on 26th July 2016 for 3 years. New MoU was signed with CII on 13th Sept 2019 for Facilitation of Green initiatives on IR for another 3 years.

New MOU with CII signed on 13 Sept 2019

10.3 Three Units, Diesel Locomotive Works (DLW) (GreenCo Silver), Lallaguda Carriage Workshop (GreenCo Silver) and Perambur Carriage Workshop (GreenCo Bronze) were certified by CII GBC as Green Units by March, 2017. 18 units were certified in 2017-18 and 24 more during the year 2018-19.



Assessment areas for Green Certification

10.4 Eight more units were certified during the year 2019-20. At present, 7 Production Units, 39 Workshops, 6 Diesel Sheds and one Stores Depot, total 53 Units are GreenCo certified. Modern Coach Factory, Rae Bareilly is the first Platinum rated unit, certified in May 2019. 12 more units are GreenCo Gold certified : Integral Coach Factory / Chennai, Diesel Loco Modernisation Works / Patiala, Carriage Repair Shop Tirupati / SCR, Rayanapadu Workshop / SCR, Mysuru Workshop / SWR, Jagadhri Workshop / NR, Liluah Workshop / ER, Pratap Nagar Workshop / WR, Golden Rock Workshop / Trichy / SR and 3 Diesel Loco Sheds - Moula Ali / Hyderabad / SCR, Ratlam / WR and Kazipet / SCR. 17 units are Silver rated.

11

Other Green Built up Spaces

IR has taken the initiative of undertaking Green Rating Certification for different types of Railway establishments, including the industrial units. Such certification mainly covers assessment of parameters having direct bearing on environment, such as, energy conservation measures, use of renewable energy, impact on GHG emission, water conservation, solid and liquid waste management, green cover etc.

11.1 Green Buildings

Green Buildings are an effort to reduce the negative impact of buildings on the environment during its construction and use. The aim of green building is to minimize demand on non renewable resources, maximize the utilization efficiency of resources, and maximize the reuse, recycling and utilization of renewable resources.

The rating systems in India like LEED, GRIHA, IGBC offer green rating for existing buildings as well as new buildings.

- Rail Nirman Nilayam, the construction organization HQ at Secunderabad was the first Green rated Building on Indian Railways when it achieved GRIHA '3 Star' rating.
- Indian Railways Institute of Civil Engineering (IRICEN), Pune achieved the highest LEED **Platinum** and GRIHA **5 Star** rating.
- Integral Coach Factory (ICF) GM office was certified as **Platinum** rated Green Building by CII-IGBC in 2017-18. RWF Administrative Building and DMW Administrative Building have been awarded IGBC **Platinum** rating in the year 2018-19.
- Rail Nilayam Headquarter building, Secunderabad and Hyderabad Bhavan office building, Hyderabad Division of South Central Railway were awarded **Gold** certification in 2017-18 by CII- IGBC.
- In the year 2018-19, Rail Vikas Bhawan - DRM Office, Guntur/ SCR was awarded **Platinum** rating and SWR Headquarters Building - Rail Soudha, was awarded Green Existing Building **Gold** Rating by IGBC. Administrative Building CLW, Chittaranjan was also certified.
- In the year 2019-20, NWR **Headquarters** building / Jaipur and **DRM Office, Guntakal** / SCR have achieved **Platinum** certification, while DRM office, Danapur / ECR achieved Silver certification. NAIR Vadodara campus was also Green certified.

11.2 Green Railway Stations

- Indian Green Building Council – Confederation of Indian Industry (IGBC-CII), have developed Green Railway Stations Rating system to assess and facilitate the transformation of existing railway stations into eco-friendly ones.
- Secunderabad Railway Station and Jaipur Railway Station had achieved Green Railway Station Silver rating during the year 2017-18. Both these stations, SC and JP were upgraded to **Platinum** rating during 2018-19.

- Another 7 stations were assessed and certified in 2018-19. Kachiguda Station and Vijayawada Station of South Central Railway achieved Gold rating. New Delhi Station of Northern Railway and Howrah Station of Eastern Railway achieved Silver rating. Varanasi Station of North Eastern Railway, Katra Station of Northern Railway and Chennai Station of Southern Railway were also certified.
- In 2019-20, Tirupati / SCR, Guntakal / SCR and Tiruchirapalli / SR stations achieved Gold Rating, while Anand Vihar / NR achieved Silver. Hazrat Nizamuddin / NR was also certified.

11.3 Other Green certifications

Supervisor's Training Centre (STC) Secunderabad, SCR had achieved Gold Certification in March 2018 under IGBC Green Campus Rating system. STC, Lucknow / NR achieved Silver Certification 2018-19 which was upgraded to Platinum in 2019-20.

ICF School, Chennai achieved IGBC Green Schools **Platinum** Certification and SECR Higher Secondary School (No. 1), Bilaspur achieved IGBC Green Schools **Gold** certification during the year 2017-18. ICF Silver Jubilee Nursery and Primary School, Chennai achieved IGBC **Platinum** rating in 2018-19. **Railway School Kalyan**, Mumbai / CR has achieved **Platinum rating in 2019-20**. Attempt to certify schools is unique as this will generate environmental awareness among next generation.

Railway Officers Enclave, S.P. Marg, New Delhi of Northern Railway achieved **Platinum** rating in Residential Societies during the year 2018-19.

Divisional Railway Hospital, Ajmer / NWR achieved Silver rating in Green Healthcare facilities in Sept., 2018 and was the first Railway Hospital to be Green certified. **Northern Railway Central Hospital, New Delhi** has achieved **Platinum** rating in this year 2019-20,

12

Environment friendly Bio – Toilets for Passenger Coaches

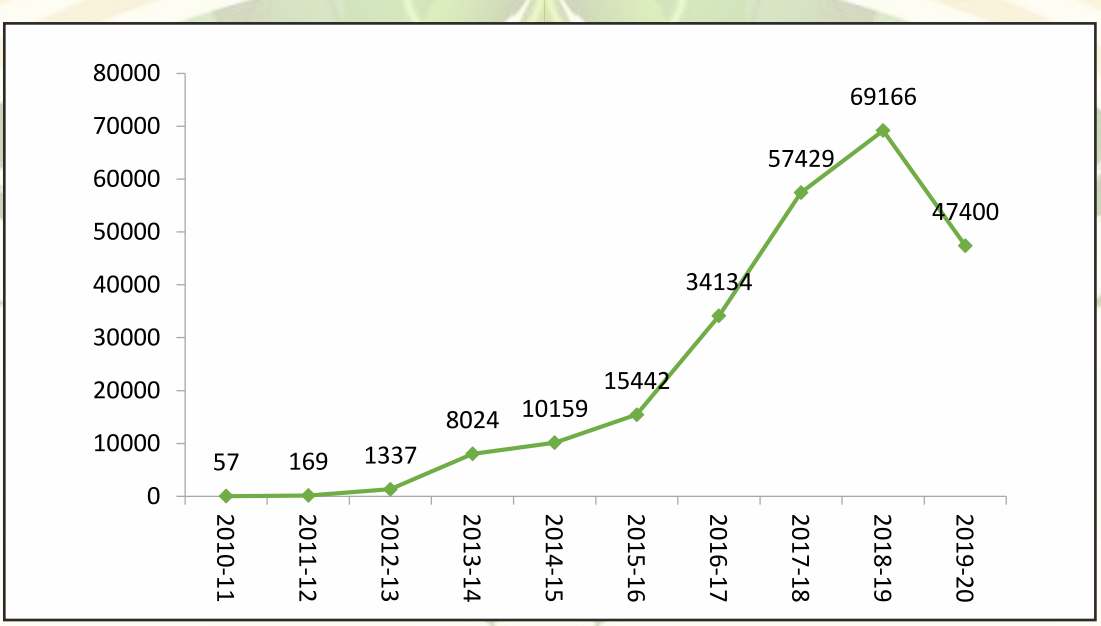
12.1 Indian Railways, in their commitment to provide hygienic environment to passengers and to keep station premises/tracks clean, have developed environment-friendly Bio-toilets for its passenger coaches. The technology has been **developed jointly by Indian Railways (IR) and Defence Research & Development Organization (DRDO).** An MoU has been signed between IR and DRDO for development of bio-toilets.

Bio-toilet tank

This environment friendly, low cost and robust technology, is the first of its kind in Railway Systems in the world. The efficacy of the bacteria used in this system has been tested by DRDO in extreme climates and conditions like those at Siachen Glacier. The anaerobic bacteria used in the bio-digester are hardy enough to survive extreme cold and heat and also survive when subjected to commonly available disinfectants. As stationary application, the technology is being used by Indian Army deputed at high altitude in Himalaya region.

12.2 In these bio-toilets, the waste retention tanks are fitted below the coach floor underneath the lavatories and the human waste, discharged/collected into them, is acted upon by a colony of anaerobic bacteria that convert human waste mainly into water and bio-gases (mainly Methane CH_4 & Carbon Dioxide CO_2). The gases escape into the atmosphere and waste water is discharged after disinfection onto the track. **Raw human waste thus does not fall on the railway tracks and this keeps station premises / tracks clean.**

12.3 The first train, Gwalior-Varanasi Bundelkhand Express, fitted with IR-DRDO bio-toilets was introduced in service in January 2011. After receiving encouraging feedback, these bio-toilets were fitted in more coaches for in-service trials. The pace of fitment of bio toilets has been increased substantially in last 3-4 years. Upto March 2020, more than 2,42,000 bio-toilets have been installed in nearly 68,600 coaches including around 47,000 bio toilets fitted in over 14,700 coaches during 2019-20.



Year-wise progress on installation of bio-toilets in coaches

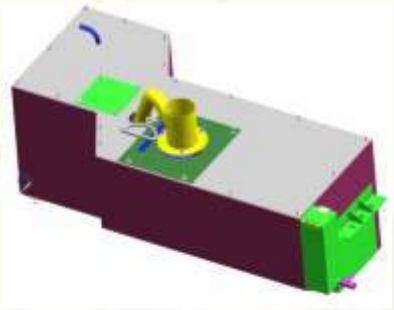
Ministry of Railways has taken a conscious decision in this regard and has instructed Zonal Railways that no passenger carrying BG coach without bio-toilets will be put in passenger services from 1st April 2020 and onward. **The direct discharge of human waste from trains has thus been eliminated in line with 'Swachh Bharat Mission'.**

This large scale deployment of bio-toilets in coaches has resulted in a paradigm shift in the level of cleanliness on railway tracks and especially at railway stations, where the foul smell/sight associated with human waste is not to be felt or seen any more.

12.4 The technology adopted by IR to eliminate direct discharge system from passenger coaches is the best suited one as it is developed indigenously. However, it is sensitive to misuse by passengers habits of throwing of items like plastic bottles, paper cups, cloth rags, sanitary napkin, nappies, plastic/poly bags, Gutkha pouches etc. in toilets that causes choking of these toilets and makes the toilet non-functional. Here, the passengers' cooperation is of paramount importance for the success of these bio-toilets.

For this, awareness programme to educate the passengers on "How to use Bio-toilets - Dos & Donts" are regularily being conducted by Zonal Railways by means of providing stickers in coach toilets, playing audio/video clipping etc.

Bio-toilets fitted in Stainless Steel Bodied LHB Coaches



IR owned Inoculum (Bacteria) Generation Facility at Motibagh Workshop of SECR at Nagpur

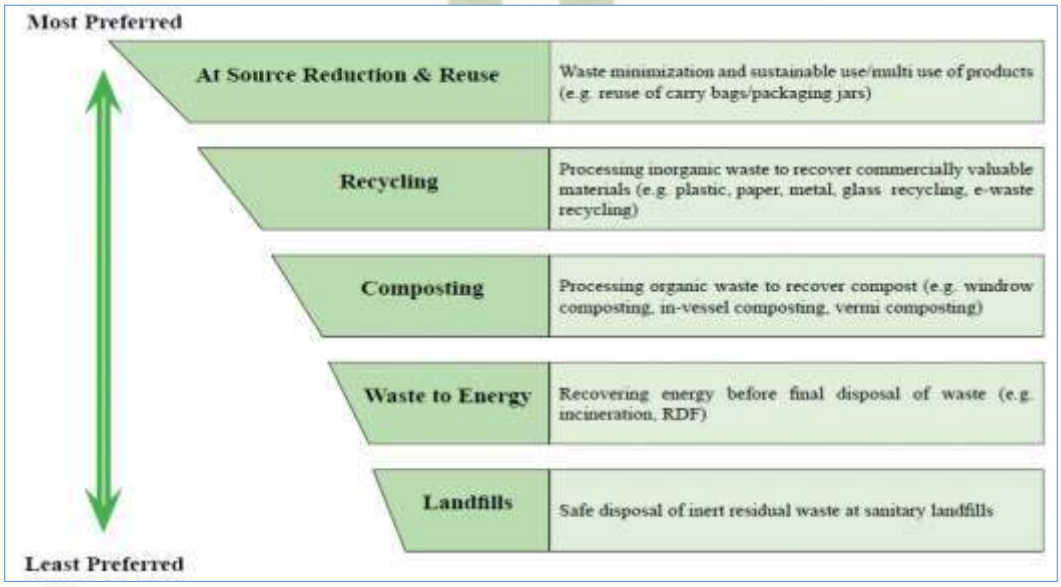
12.5 Bio-Vacuum Toilet in Indian Railways

With an aim to provide clean and efficient toilets and to reduce the water consumption in toilets, IR is doing a trial of Bio-Vacuum toilets. This has aircraft type vacuum toilet on the passenger interface and bio-digester tank is fitted beneath the toilet area on the coach. The faecal matter gets digested in the bio-tanks on board. Up to 2019-20, bio-vacuum toilets have been provided in 729 coaches by ICF, RCF, MCF and NR, including 397 coaches provided in 2019-20.

13

Solid Waste Management

13.1 Solid Waste Management Rules, 2016 identify railways as a bulk waste generator and it also specifies the responsibilities of bulk waste generators. Segregation in three separate streams namely bio-degradable, non biodegradable and domestic hazardous wastes is emphasised. Waste hierarchy is the priority order in which the solid waste is to be managed by giving emphasis to prevention, reduction, reuse, recycling, recovery and disposal, with prevention being the most preferred option and the disposal at the landfill being the least.



Hierarchy of Integrated Solid Waste Management (ISWM)

Road constructed with released sleepers in ER

13.2 Railways had taken up a pilot project for disposal of municipal solid waste (MSW) generated at railway terminals in an environment friendly manner, including conversion of waste to energy. Pilot plants have been set up at Jaipur and New Delhi Railway Stations which convert bio-degradable waste to energy through bio-methanation process. Energy generated from these plants would be utilized for suitable services at/ near Railway Station.

Bio-degradable waste to energy bio-methanation plants have also been set up at Mumbai Central Station / WR, Coaching depots at Puri and Bhubaneswar in ECoR, Liluah Workshop / ER, Mysore Workshop / SWR, NWR HQ Jaipur and RWF Bangalore .

ECoR has commissioned a Waste to Energy Plant based on Polycrack technology at Mancheshwar Workshop.

Waste to Energy Plant - Polycrack technology - Mancheswar Workshop ECoR

13.3 Zonal Railways and Production Units have taken initiatives to set up solid waste management facilities including segregation and waste processing methods such as composting, vermi-composting, bio-methanation for bio-degradable waste and recycling of recyclable waste.

Waste to compost plants have been set up at over 60 locations for conversion of bio-degradable waste into compost. Integrated waste management system is commissioned at ICF where about 6 ton per day bio-degradable waste from the colony is converted as compost.

Segregated waste collection and Composting pits at ICF Chennai

13.4 Detailed instructions regarding waste management have been issued for prompt disposal of waste arising out of catering services at stations and in trains.

Provision of dustbins is being done in sleeper coaches also in addition to AC coaches provided earlier. Dust bins are also being provided in bio-toilets in all coaches.

13.5 Instructions have been issued to keep separate dustbins for dry waste and wet waste to enable segregation. 315 Plastic bottle crusher machines have been installed at 229 stations.

IR is adopting measures to curb single use plastic by educating and motivating passengers and vendors on perils of single use plastics and importance of replacing them with bio-degradable material and recycling the rest in an eco-friendly manner.

Use of plastics of less than 20 micron thickness in packaging is banned.

14

Other Green Initiatives

14.1 Shield on Environment Management

An MR's shield has been instituted to be given for best performing ZR/PU on Environment management. First shield was awarded in April, 2016. Station Cleanliness and Train Cleanliness Shields have been merged with Environment Management Shield from the year 2016-17.

14.2 Affordable potable drinking water

In order to provide potable drinking water on affordable rates to the railway passengers, Ministry of Railways has mandated IRCTC to install Water Vending Machines (WVM) on stations. Detailed policy guidelines have been issued in this regard vide CC No. 36/2015 dated 16/06/2015. This policy also stipulates that the reject water shall be used by Railway for platform washing, apron cleaning, toilets etc. i.e. conservation of water, being a precious natural resource. This is also an important step in the direction of reducing the production and consumption of plastic bottles.

14.3 EMS / IMS Certification

All 8 Production Units and 43 major Workshops are certified to ISO 14001 : Environment Management System (EMS) / Integrated Management System (IMS). 38 Diesel Sheds, 61 Coaching Depots, 21 Freight Depots and 8 Electric Loco Sheds have been certified. 3 MEMU/ DEMU Car Sheds, 2 Engineering Workshops and 1 Stores Depot are also certified.

As a new initiative, 215 Railway Stations have been certified for implementation of Environment Management System to ISO: 14001 in the year 2019-20. This is also in compliance of NGT requirements.

14.4 ISO 50001

Integral Coach Factory, Chennai was the first major establishment over IR to be certified with ISO: 50001 - Energy Management System, in August 2015. All 8 Production Units and 44 major Workshops have achieved ISO: 50001 certification showing commitment to energy conservation and energy efficiency.

14.5 Noise reduction in power car

Present design power car employing two DG sets has noise level of 99 dBA. RCF has manufactured two such power cars with acoustic panel and reorientation of radiator assembly which was introduced in service in April, 2017 and has resulted in reduction of noise level to 81 dBA. The power car is presently running in train no. 22415/16 NDLS-VSKP AC express and 12497/98 NDLS-ASR Shan-e-Punjab express with satisfactory performance. PUs are manufacturing all power cars with low noise feature.

14.6 Plastic Bottle Crusher Machines are being installed at Railway Stations. 315 plastic bottle crushing machines have been installed at 229 stations.

14.7 Sanitary Napkin Vending Machines and Incinerators are being installed at a number of stations.

14.8 Implementation of e – Office

In order to move towards paperless working, Indian Railways have implemented e-Office in 59 units, covering 17 Zonal Railways HQs, 22 Divisional Offices, 08 Training Institutes, 11 Production Units /Workshop and RDSO in Phase-1 with more than 53,000 users during the current year. This will pave the way for paperless office working and will improve transparency and efficiency. Phase-II of e-office project covering 46 Divisional Offices, & approximate 39000 users has also been sanctioned and in progress.

14.9 Provision of TPaaS (Telepresence-as-a-Services)

To make a multiparty Video Conference from far-flung location to Railway Board/ Zonal Offices/Divisional Offices or other locations, Tele presence system has been provided. It covers more than 115 locations, including all divisional offices, zonal offices, Railway Board, Railway PUs, Training Institutes, RDSO and PSUs over Indian Railways. This system is reducing the travel of senior officers for meetings and saving useful and productive time.

14.10 Electrical / Electronic Interlocking and Centralized Traffic Control

84 mechanical lever frame signalling have been replaced this year with Electrical / Electronic Interlocking signalling system including major yards at Danapur, Patratu and Bhilai Exchange yard. This will result in savings in coal and diesel used in maintenance of mechanical lever frames.

24 hours shifts of Centralized Traffic Control (CTC) Tundla started From March 2019 covering 26 stations and 250 Route Km on Aligrah-Kanpur section. Power consumption at wayside stations reduces with CTC operation.

14.11 Saving paper Saving Trees

Railway Recruitment Boards have introduced online examination through Computer Based Test (CBT) for all Group 'C' posts since 2015 and also for Group 'D' posts in 2018. RRBs have dispensed with paper pen examination (OMR sheets).

MCDO portal has been developed with CRIS for online submission of monthly MCDO to Railway Board. Portal has the facility to generate instant reports for performance comparison. The practice of sending hard copies has been discontinued. This initiative has resulted in saving of about 6000 sheets of paper in a year.

Only limited copies of Budget books/ booklets like Pink Book are printed now and all required books are available online. With merger of Rail Budget with General Budget, the requirement has further come down.

14.12 Capacity Building

Capacity building programmes on Environment Management and Sustainability are organised at different Training Institutes. A number of courses were conducted at NAIR, IRITM and IRIMEE during the year.

15

Policy Initiatives of IR towards Environmental Sustainability

With a pan-India network and linkages to various sectors of the economy, the Indian Railways has always considered environmental management as part of the core operating strategy. A renewed focus and thrust has been given in its activities to achieve a better environment with the launching of the new Environment and Housekeeping Management Directorate in the Railway Board. Some important policy initiatives taken in recent years are noted below :

15.1 Policy on Water Management

- Water Recycling plant to be provided at major water consumption centres subject to techno-economic viability
- Rain water harvesting system to be provided
- Water audit to be done at major water consumption colonies / installations / stations
- Revival of water bodies
- Inclusion of Automatic Coach Washing Plant with Water Recycling in all major coaching depots

Automatic Coach Washing Plant with Water Recycling
at Hazrat Nizamuddin Coaching Depot

15.2 Policy on Energy Management

- 10% energy consumption to come from renewable sources
- Retrofitting with efficient lighting and other star-rated appliances
- Production of only energy efficient 3 phase electric locos from 2016-17 onwards
- Provision of LED lights in coaches during POH

- Use of 5% bio-diesel in traction fuel
- 20% CNG substitution for HSD oil in DEMUs
- 100% Green Powered Stations started
- Certification to EMS 50001 Energy Management System
- IR has joined the Perform, Achieve and Trade (PAT) Progamme of Bureau of Energy Efficiency (BEE) showing its commitment for improving energy efficiency

15.3 Waste Management

- IR has converted all existing BG coaches fitted with conventional toilets to those fitted with environment-friendly bio-toilets
- Provision of dustbins in sleeper coaches also in addition to AC coaches
- Provision of dustbins in bio-toilets in all coaches
- Provision of separate dustbins for bio-degradable and non-bio-degradable waste and more dustbins at stations
- Solid Waste Management plants at major railway stations and other locations
- Plastic bottle crusher machines at major railway stations.
- Measures taken to curb single use plastic

15.4 Funding of Environmental Sustainability Works

- Policy frame work to earmark 1% lump sum provision in all works/project estimates towards environment related works has been issued and this has been made part of D&G charges of estimates
- Policy frame work to undertake environmental sustainability works by Zonal Railways through CSR has been put in place

15.5 Other Green policy initiatives

- MOUs with States for planting of trees on vacant railway land
- 150 nurseries being developed alongside Railway track at some of the major stations in Indian Railways
- Use of plastics of less than 20 micron thickness in packaging is banned
- EMS/IMS certification for all PUs, Workshops, Loco Sheds and major Coaching and Wagons Depots
- 215 major Railway Stations have been certified for implementation of Environment Management System to ISO 14001 in 2019-20
- Green Certification of Railway establishments
- Consent to Establish' and 'Consent to Operate' / 'Consent for Operation' for siding and goods sheds to be taken from State Pollution Control Board in accordance with the provisions of SPCB, keeping in view the notified areas / air pollution control areas and categorisation of Industrial Sectors

Some important Waste Management Rules

- G.S.R. 320 (E) [18-03-2016] : Plastic Waste Management Rules, 2016
- G.S.R. 338 (E) [23-03-2016] : e-waste (Management) Rules, 2016
- G.S.R. 343(E). [28-03-2016] : Bio-Medical Waste Management Rules, 2016
- G.S.R. 317(E). [29-03-2016] : Construction and Demolition Waste Management Rules, 2016
- G.S.R No. 395 (E)[04-04-2016] : Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
- S.O. 1357(E) [08-04-2016] : Solid Waste Management Rules, 2016

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