सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

INDIAN RAILWAYS

A Green Transporter

ENVIRONMENTAL SUSTAINABILITY

ANNUAL REPORT 2017-18

INDIAN RAILWAYS

green footprints
on sands of time

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

- Mahatma Gandhi

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.

भारतीय रेल
पर्यावरण प्रबंधन

विज़न

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

मिशन

- ऊर्जा सरंक्षण उपायों को बढ़ावा देना।
- स्वच्छ ऊर्जा के वैकल्पिक स्परूपों को अधिकतम उपयोग करना, जिसके परिणामस्वरूप 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 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।

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1.0 INDIAN RAILWAYS - A GREEN TRANSPORTER

Indian Railways (IR) is one of the world's largest rail networks, spread over 67,000 route Kms. 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 1,100 million tonnes of freight, 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 become a low carbon mass transport system 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.

2.0 REDUCING GLOBAL CARBON FOOTPRINT

India has a population of about 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 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 NDC

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 (Intended Nationally Determined Contributions) 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.

As a follow-up of achieving this target, MoEFCC has again approached the Ministry of Railways to convene a working group to help in meeting this target of the Government of India. With representation from all the other concerned ministries, this group would therefore have to come up with workable solutions to be able to meet the mode share targets for India.

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 and likely to be completed by 2020. 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'

3.0 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.

COP-23 was held at Bonn, Germany from 6th to 17th November 2017. Ministry of Railways was appointed as the nodal Ministry by MoEF&CC for organizing the **transport sector side event on 14th November 2017**. MoR hosted the side event titled "Indian Transport Sector: Marching towards sustainable mobility". Two sessions were organized as a part of this side event. The discussions centred around the role of Indian transport sector, particularly the pivotal role of Indian Railways in contributing towards meeting India's NDC target. The event started with an Audio-Visual film on **INDIAN RAILWAYS- A GREEN TRANSPORTER** showcasing key sustainability initiatives by Indian Railways

In the session on **"Green Transformation: Indian Transport paves the way"**, **Shri Ravindra Gupta, Member** (**Rolling Stock**), Ministry of Railways, GoI presented the quintessential role of Indian Railways in promoting sustainable mobility. He focused on the need for policy framework to stimulate modal shift. He highlighted the innovative steps taken by Indian Railways by way of bio-toilets for having an open discharge free system in line with mission of **"Swachh Bharat" and an ODF free India of Hon'ble Prime Minister of India, Shri Narendra Modi.**

In this session, senior officials from other Transport Ministries such as Ministry of Road Transport and Highways, Ministry of Shipping, and eminent national and international speakers from international organizations, industry, industry associations and think tanks made presentations.

In the first session titled **"Indian Railways on a Low Carbon Pathway"**, the Ministry of Railways highlighted the efforts, achievements, targets and the challenges that it has faced as a nodal agency in moving towards a Green Transformation. **Shri Alok Kumar Tewari,** PED-EnHM, Ministry of Railways, highlighted the various decarbonization initiatives taken by Indian Railways thus far including electrification, energy efficiency, alternative fuels, efforts for water conservation, afforestation and other environmental management initiatives-qualitative and quantitative assessment of these initiatives in GHG emissions mitigation. The session also had presentations on Dedicated Freight Corridors, Renewable energy initiatives and global overview of Railways.

The sessions were followed with interactive audience discussion. **The key point emerging from the presentations and discussions was to have a long term perspective of sustainability as a key factor in the future of mobility.**

FICCI had organised a **session on 13th November 2017. Shri Ravindra Gupta, Member Rolling Stock,** was the keynote speaker in the session. He briefed the

participants on the overall efforts of the IR towards enhanced sustainability. During his presentation in the session, **Shri A.K. Tewari, Principal Executive Director** (**EnHM**), highlighted the details of initiatives of Indian Railways also bringing out opportunities for participation from private sector in the sustainability efforts of Indian Railways.

A **meeting of senior officials of UIC, SNCF and DB** who looks after sustainability in their organisation was also organised on **15th Nov 2017** and attended by IR team along with representatives of **FICCI** and **CEEW**. Various Railways related issues including market share, high speed rail, cost and competitiveness and sustainability were discussed in the meeting.

Dr. Harsh Vardhan, Hon'ble Minister of MOEFCC came to India Pavilion to release book on "Samanvya" **on 16th Nov 2017**. Hon'ble Minister was given a brief on the activities of Transport Session. He appreciated the efforts of **Indian Railways** for going towards low carbon path.

4.0 ENERGY EFFICIENCY IN MASS TRANSPORTATION SYSTEM

4.1 Improvement in Specific Energy Consumption in Electric Traction

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

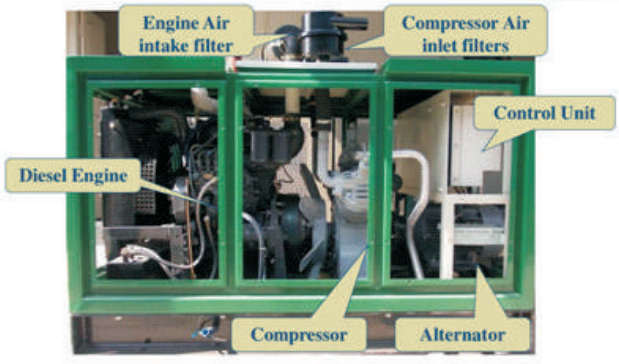
Adoption of 3 phase IGBT Technology for EMUs in Mumbai Suburban area is expected to reduce emission of 600 tonnes of CO_2 per annum per train due to regenerative braking features.

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 encouraged 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

Auxiliary Power Unit (**APU**) is being provided in 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 3 litres of diesel per hour in comparison to 25 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. Expected savings per loco fitted with APU is Rs 9 lakhs/year on account of saving in fuel oil only.



Auxiliary Power Unit

Computerized **Fuel Management System** (**FMS**) has been developed and on pilot basis 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. HSD issuance data is being analysed.

Other measures undertaken / planned to improve Specific Fuel Consumption (SFC) and fuel savings are :

- Hotel load on diesel locomotives to reduce power car fuel consumption.
- Common Rail Electronic Direct Injection (CREDI) / Electronic Fuel Injection (EFI) system.
- Guidance for Optimized Locomotive Driving (GOLD).
- Multi Genset locomotives.
- Smart Multiple Units.

4.3 Improving Energy efficiency on account of trailing Rolling Stock

- BOXNS wagon having a higher pay load to tare ratio of 4.05 has been designed and 1500 such wagons have been inducted.
- Commodity specific wagon like BTAP which was conventionally used for Alumina transportation, has been cleared by RDSO for carrying fly ash and bulk cement.
- BCACBM wagon capable of carrying Auto cars has been developed by RDSO and is being widely used by the automobile sector.
- These measures will enable higher throughput and/or bring some road traffic on rail, resulting in reduced GHG emissions for the same freight traffic.
- 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.

5.0 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. In 2016-2017, Indian Railways consumed about 18.05 billion kWh of electricity, 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 manifold over the next decade.

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.

5.1 Indian Railways have been very conscious about saving energy, as energy saved is energy generated. It began the energy conservation journey much earlier and at every stage, took benefit from the best available technology, such as replacement of T-5 and CFL fittings by LED lights, energy efficient ceiling fans, occupancy sensors, use of star rated equipments etc.

5.2 These steps have reduced its specific electricity consumption by about 2-3% on a yearly basis. As a result, the energy consumption of ZR is static for last 4-5 years despite proving additional passenger facilities like lifts, escalators, air-conditioning of various passenger areas etc. In non-traction areas, due to various initiatives taken in the last two years, energy savings have grown to above 5% on yearly basis. Some of the initiatives include:

a. All Railway Stations have been provided with 100% LED fittings. Further, work is under progress at all Railway installations including service buildings, sheds, hospitals etc through EESL under ESCO model for replacing all lights, fans, ACs etc with energy efficient equipments. 5174 service buildings have been provided with 100% LED lights and balance all shall be covered in the financial year 2018-19.

b. Directions have also been issued by Board's office for one time replacement of existing light fittings with LED lights in all Railway residential quarters.

c. As a part of energy conservation drive, Indian Railways have carried out energy audit of 643 facilities.

d. As part of capacity building of railway staff and to emphasize on energy management system in Zonal Railways, Centre for Railway Information Systems (CRIS) has developed the portal **www.railsaver.gov.in**, online platform for capturing the energy data from railways facilities and to develop further strategies for Indian Railways. Similarly, **www.irgreenri.gov. in** portal has been developed to disseminate the green initiatives adopted across Railways.

5.3 LED lights in coaches :

Instructions have been issued to Zonal Railways to replace all CFL/FL lights in all TL/AC and self propelled (EMU/MEMU/DEMU) coaches with LED lights which is likely to save electrical energy to the tune of Rs. 19764/- per AC coach per annum and Rs. 8424/- per non AC coach per annum. 820 coaches were provided with LED lights from 2014-15 to 2016-17 and 4180 more coaches have been provided with LED lights during 2017-18.

5.4 Energy Efficiency studies

Energy Efficiency studies completed in six PUs and 4 workshops under MOU with CII and 7% to 15% energy efficiency improvement has been achieved. Energy Efficiency studies for 10 additional units (PUs and workshops) has been initiated.

Pipe Cool Day Light System at MCF RBL

LED Lighting at Hyderabad Station

6.0 HARNESSING RENEWABLE ENERGY

6.1 Solar Power

As part of Indian Railway's Solar mission and to reduce dependence on fossil fuels, keeping in line with Budget (2015-16) announcement of Hon'ble MR and directions of PMO, IR has planned to set up 1000 MW of solar power through developers with PPA.

- ❖ 500 MW solar plants on roof top of Railway buildings, for meeting non-traction power loads.
- ❖ 500 MW solar plants on land based systems, for meeting traction as well as non-traction loads.

Railways have set up about 55.48 MW solar power plants at administrative buildings, stations and hospitals including 5 MW solar power plant in Delhi area, 1 MW solar plant at Katra Railway station, 700kW at Guwahati Station, 500 kW at Secunderabad, Jaipur, Varanasi and Bhusawal Station and 400 kW at Kolkata Metro. Further, work is in final stages for about 17 MW.

In addition, for 130 MW Solar Photovoltaic plant on Railway building's rooftop (Phase-II), work has been awarded. For balance roof top of about 323 MW capacity, work has been transferred to REMCL and tender for 100 MW shall be issued soon.

For the first time, solar panels have been provided as shelter/shed at Sahibabad railway station on Northern Railway with a capacity to produce 16 kW solar power.

Here these panels play dual role of shelter/shed and solar panels. Further proliferation of this system will be done on new and existing platforms.

Railways have also tied up 400 MW from the Rewa Ultra Mega Solar Power Plant for meeting its traction power requirement from its upcoming solar park in MP. Further, Railway is setting up 50 MW solar plant at its vacant railway land at Bhilai, Chhattisgarh through REMCL. Accordingly, till date Railways have finalised/ tied up about 450 MW of land based solar plants and further, is considering for setting up solar plants at its vacant land like in Adra for 250 MW solar plant.

6.2 Wind power

Indian Railways has planned to set up 200 MW of wind mill power plants. Out of this 10.5 MW capacity wind mill plant has already been set up in Integral Coach Factory (ICF), Chennai and 26 MW windmill power plant has also been commissioned by Railway Energy Management Company Limited (REMCL) at Jaisalmer in Rajasthan. Further REMCL finalised tenders for harnessing 16.5 MW wind plants in the States of Tamil Nadu and Maharashtra. REMCL is working out modalities for setting up additional capacities.

energy sources

7.0 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 63 RCDs of Indian Railways in different Zones. At present the Bio-Diesel is being procured by Indian Railways from the trade. However IR (IROAF) is setting up Two 30 Ton per day (TPD) capacity plants at Tondiarpet (Chennai) and Raipur (Chhatisgarh). The construction of plant at Tondiarpet as at advance stage. These two plants will meet 15-20% of total requirement of blending of HSD on IR.

7.2. CNG based Dual Fuel Diesel Engines for DEMU Trains

Environment friendly CNG in Duel Fuel Mode for Railway Traction

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

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. There is sanction for conversion of 100 DPCs. 23 Diesel Power Cars of DEMUs have been converted into CNG based dual fuel engine. 02 more DPCs are under conversion. IROAF is now moving towards the next level of HSD substitution by 40%. This innovative effort has been recognised by the Institute of Directors (IOD) by conferring the **Golden Peacock –Eco Innovation award-2017** to IROAF.

7.3. Solar Energy

7.3.1 Solar Energy based solutions for Passenger Services & special trains

The trailer coaches of first rake of 1600 HP DEMU have been provided with Solar PV system at its roof which takes care of electric supply for the fan and lighting load inside the coach. This will result 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 has been inarugated on 14th July 2017 by the then Minister of Railways Shri Suresh Prabhakar Prabhu. This effort of IR (IROAF) was well recognized by Mission Energy foundation by conferring **Solar Innovation & Excellence Award-2017.** IR (IROAF) has also planned for provision of Flexi Solar Panels with Lithium ion batteries on 250 nos trailer coaches.

7.3.2 Provision of Solar Panels on Swachata Express

IROAF has fitted Solar Panels of 4.8 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 Panels on Workshops and Stations

To generate green electricity for use of industrial and commercial organisation by harnessing the Solar Energy, IROAF has arranged and commissioned successfully the PV Solar Plant of 2 MWp capacity at roof top of DMW Patiala under CAPEX through BHEL in less than a year period. In addition, 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 is in final stages.

7.3.4 Solar Energy based solution for guard's comfort in 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.

7.4 CNG as cutting gas

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 has coordinated 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 savings of about Rs 1 crore per annum. RWF/Yelahanka also commenced the use of Natural Gas for operation of its furnaces. It is planned to replace industrial gases by CNG in 15 workshops in those cities where CNG is available.

7.5 Methanol Economy

IROAF is working with RDSO and IIT Kanpur on a project for development of Methanol based Locomotive which has been approved by Deptt. of Science and Technology (DST).

7.6 Development of Bio-Fuels

IROAF has tied up with Indian Institute of Petroleum (IIP), Dehradun and National Institute of Solar Energy (NISE) to develop Solar Assisted Biomass Pyrolysis Technology for production of Methanol and other Bio-Fuels as a next generation of fuel resources for cutting edge commercial application.

7.7 Waste to Energy

IROAF has set up a pilot project at Kishanganj Railway colony, Delhi for converting bio-waste into electricity. This plant can convert 01 ton of Bio-degradable waste to 80 KWH of energy per day.

8.0 WATER CONSERVATION

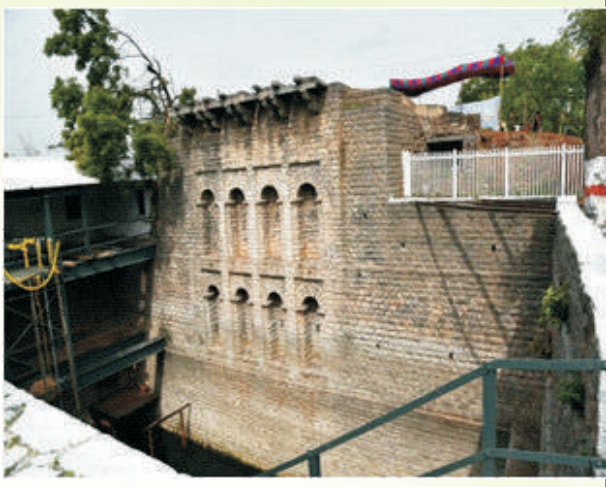
8.1 Water Recycling Plants

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. 43 Water Recycling Plants were set up on Indian Railways up to the year 2016-17, treating around 16 million litres of water per day. WRPs have been commissioned at another 16 locations in 2017-18. Besides this, 26 more WRPs have been sanctioned. A target of commissioning 37 WRPs has been set across Railways for the year 2018-19.

8.2 Water Bodies

Ministry of Railways has decided to assess and revive 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.

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



Salar Jung Well, Hyderabad

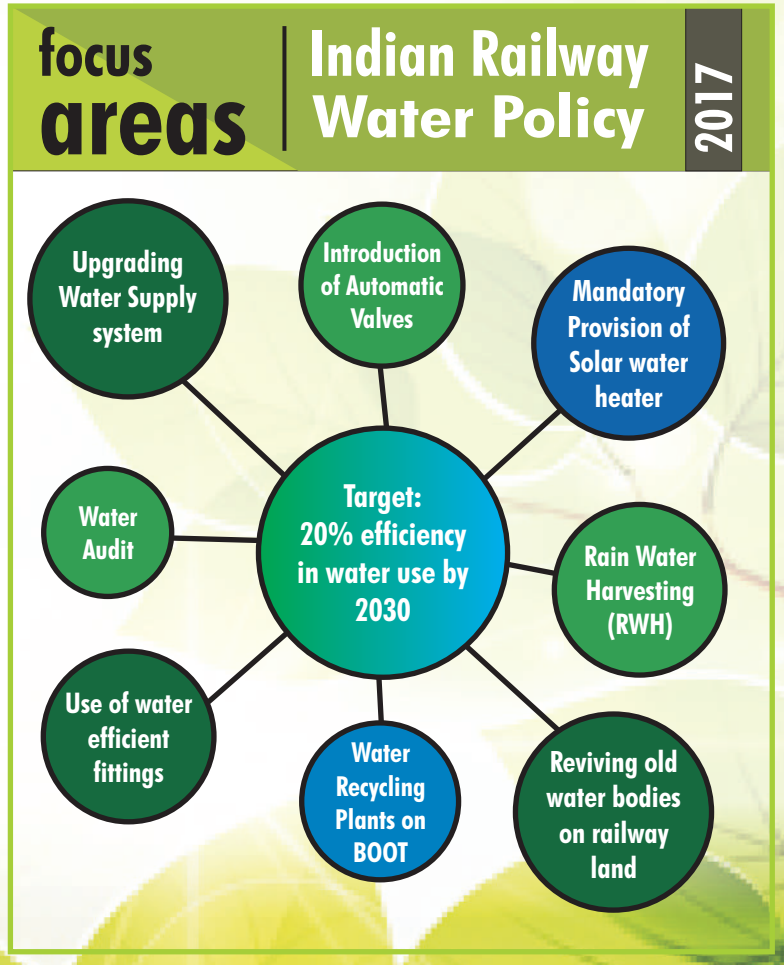
A total of 1559 water bodies are functional on Indian Railways as on March 2018. 54 no. water bodies have been recreated and 44 no. non - functional water bodies have been rejuvenated. The water bodies in the form of pond are also being utilised on commercial term for fisheries purposes.

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 in quality and quantity. Works of water recycling plants are to be taken up based on the report of water audit. Up to the year 2017-18 (i.e. March 2018) a total of 257 Water Audits have been conducted by various Zonal Railways out of which 48 were completed in the year 2017-18 itself. Further, water audit at 34 location is under progress. For the year 2018-19 a target of conducting Water Audit at 106 main water consumption centres has been set across all Railways.

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. 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 2017-18, Roof Top Rain Water Harvesting were installed on 903 locations buildings having roof top area more than 200 sqm. For the year 2018-19, a target of installing 1868 Roof Top Rain Water Harvesting has been set across all Railways.



9.0 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 (MoEF&CC) 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 89 lakh saplings during the year 2017-18. A target to plant 1.65 Cr. saplings has been fixed for the year 2018-19.

10.0 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.

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.

10.4 Eighteen more Units have been certified during the year 2017-18 out of which Diesel Loco Modernisation Works/ Patiala, Carriage Repair Shop/ Tirupati, Rayanapadu Workshop and Mysuru Workshop are **GreenCo Gold** certified. Integral Coach Factory/ Chennai, Carriage Workshop/ Ajmer, Wagon Repair Workshop/ Jhansi and Kharagpur Workshop are GreenCo Silver certified. One Stores depot, Mettuguda is also GreenCo Silver certified.

11.0 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

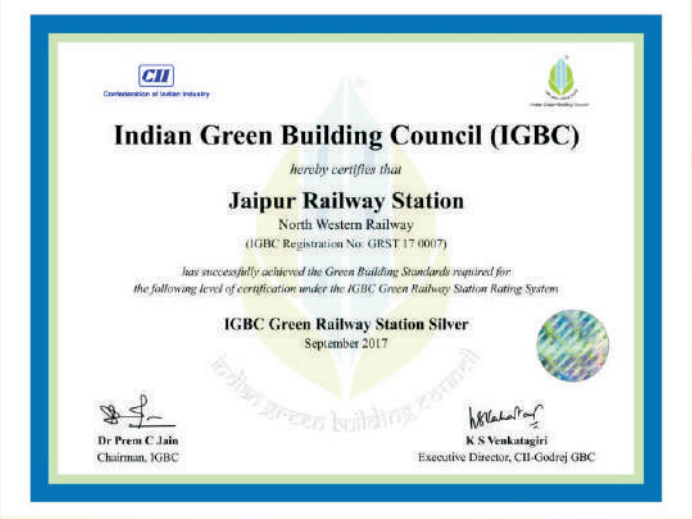
Green Buildings are an effort to reduce the negative impact of buildings on the environment during its construction and use. The aim of green building is to minimize demand on non renewable resources, maximize the utilization efficiency of resources, and maximize the reuse, recycling and utilization of 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 is **Platinum** rated Green Building by CII-IGBC.
- Rail Nilayam Headquarter building, Secunderabad has been awarded Gold certification in 2017-18 by CII- IGBC.
- The Hyderabad Bhavan office building, Hyderabad Division of South Central Railway has been awarded Green Existing Building Gold Rating by Indian Green Building Council (IGBC).

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 have achieved Green Railway Station **Silver** rating during the year 2017-18.


Indian Green Building Council (IGBC)

hereby certifies that

Jaipur Railway Station

North Western Railway

(IGBC Registration No: GRST 17 0007)

has successfully achieved the Green Building Standards required for the following level of certification under the IGBC Green Railway Station Rating System

IGBC Green Railway Station Silver

September 2017

Dr Prem C Jain
Chairman, IGBC

K S Venkatagiri
Executive Director, CII-Godrej GBC

11.3 Other Green certifications

Supervisor's Training Centre (STC) Secunderabad, SCR has achieved **Gold** Certification in March 2018 under IGBC Green Campus Rating system.


Indian Green Building Council (IGBC)

hereby certifies that

Supervisors' Training Centre

South Central Railway, Secunderabad

(IGBC Registration No: GCE 18 0019)

has successfully achieved the Green Campus Standards required for the following level of certification under the IGBC Green Campus Rating System

Gold

Existing Campus

March 2018

This certification is valid for the next 5 years

Jayesh Hariyani
Chairman, IGBC Green Campus

Dr Prem C Jain
Chairman, IGBC

K S Venkatagiri
Executive Director, CII-Godrej GBC

ICF Silver Jubilee Matriculation Higher Secondary School, Chennai has 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. Attempt to certify schools is unique as this will generate environmental awareness among next generation.

12.0 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 & 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**.

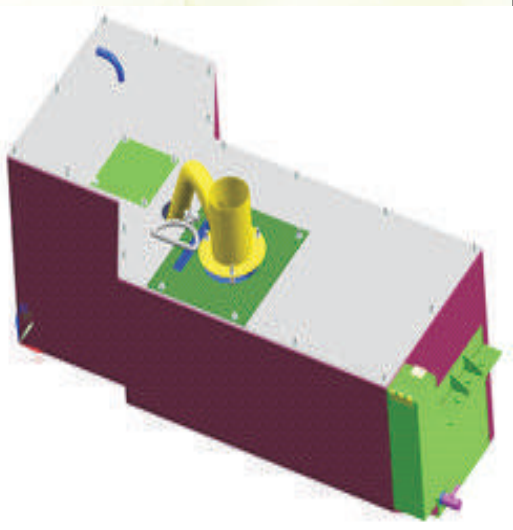
12.3 The first train, Gwalior-Varanasi Bundelkhand Express, fitted with IR-DRDO bio-toilets was introduced in service in January 2011. After receiving encouraging feedback, these bio-toilets were fitted in more coaches for in-service trials. The pace of fitment of bio toilets has been increased substantially. Upto March 2018, more than 1,26,700 bio-toilets have been installed in nearly 34,800 coaches including 57,429 bio toilets fitted in 15,017 coaches during 2017-18.

IR has committed **to eliminate direct discharge toilet system from its entire coaching fleet by 2019 in line with 'Swachh Bharat Mission'.**

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.

12.6 Green Corridors

26 Sections on IR have been declared as Green Train Corridors which have no human waste discharge from trains, as all trains passing to these Sections are fitted with 100% Bio toilets. 21 of these sections were commissioned in 2017-18.

13.0 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 bio-degradable and hazardous wastes is required. **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.

13.2 Railways have 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 are being set up at Jaipur and New Delhi Railway Stations which will 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.

SWM plant at Jaipur

13.3 Municipal Solid Waste Management centres will be set up at five more major stations of Indian Railways in next phase including segregation, recycling and conversion of waste to energy. With this objective, 8 more stations – CSMT, Patna, SDAH, HWH, ALD, BSB, SC and MAS – have been identified for setting up solid waste management plants. RITES have been engaged for bid process management and project management for these 8 plants. Orders for 4 plants are under execution.

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.

Instructions have also been issued to keep separate dustbins for dry waste and wet waste to enable segregation.

13.5 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.

Integrated waste management system is commissioned at ICF, Chennai where about 6 ton per day bio-degradable waste from the colony is converted as compost.

Composting at ICF

14.0 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.

Water Vending Machine

14.3 EMS / IMS Certification

8 Production Units and 42 major Workshops are certified to ISO 14001 : Environment Management System (EMS) / Integrated Management System (IMS). 35 Diesel Sheds, 37 Coaching Depots, 11 Freight Depots, 4 Electric Loco Sheds and 2 MEMU Car Sheds have been certified. TMS/CNB is also certified.

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 41 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 one power car 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. After its satisfactory performance, it has been decided to further manufacture 10 such power cars during 2017-18.

14.6 Plastic Bottle Crusher Machines are being installed at a number of stations.

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

Plastic Bottle Crusher

Sanitary Napkin Vending Machine/ Incinerator

14.8 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.

15.0 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 Plant in all green field coaching depots

15.2 Policy on Energy Management

- Rate of track electrification increased from average 1700 RKM/annum to 4000 RKM in 2017-18, with a target of 6000 RKM in 2018-19.
- 5% energy consumption to come from alternative sources
- Use of 5% bio-diesel in traction fuel
- 20% CNG substitution in DEMUs
- 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
- 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 shall convert all existing coaches fitted with conventional toilets to those fitted with environment-friendly bio-toilets by 2019
- Pilot Plants for Solid Waste Management at major railway stations.
- Provision of dustbins in sleeper coaches also and more dustbins at stations.
- Seprate dustbins for bio-degradable and non bio-degradable waste.

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.
- Policy frame work to undertake environmental sustainability works by Zonal Railways through CSR has been put in place.

15.5 Other Green policy initiatives

- Planting of trees on vacant railway land. MOUs being done with States.
- 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.
- Green Certification of Railway establishments.

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

Rail Chale Paryavaran Bache

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