पीयूष गोयल
PIYUSH GOYAL

सत्यमेव जयते

रेल एवं कोयला मंत्री
भारत सरकार
Minister of Railways and Coal
Government of India

MESSAGE

I am happy to note that Institution of Railways Electrical Engineer (IREE) is organizing a Two-Day International Conference on "Green Initiatives & Railway Electrification". I am sure that this conference will showcase solutions to enhance pace of electrification and develop methods to make Indian Railways one of the world's greenest railways.

Indian Railways has been continuously striving to adopt innovative ways in improving facilities to passengers and reduce cost of operation. Increasing use of renewable energy for its traction and non-traction applications and rapid transformation towards Electric Mobility (or e-mobility) on Indian Railways has been made a major thrust area. 100% Electrification of Railway network has been launched recently. This initiative will improve energy security of the nation while creating a large number of jobs, thereby propelling growth of the economy.

Green energy is an article of faith for India, and Railways is working to change the energy mix towards greener energy while simultaneously moving towards energy efficiency. In this context, use of solar energy, LED lighting and other such initiatives will play a vital role in reducing the carbon impact of Railways.

I wish the conference to be a grand success and hope that the solutions and ideas that emerge will help make Railways a greener transportation system.

Piyush Goyal

Rail Bhawan, New Delhi-110001, Tel. : +91-11-23386645, 23381213 Fax : +91-11-23387333
E-mail : piyush.goyal@gov.in, Website : www.piyushgoyal.in

मनोज सिन्हा
Manoj Sinha

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

MoS (S)/Message-18-/2017
संचार राज्य मंत्री (स्वतंत्र प्रभार) एवं
रेल राज्य मंत्री
भारत सरकार
नई दिल्ली–110 001

Minister of State for Communications
(Independent Charge) &
Minister of State for Railways
Government of India
New Delhi-110 001

MESSAGE

24 OCT 2017

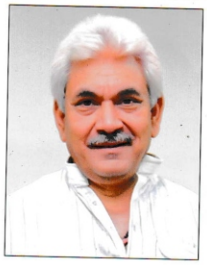
Indian Railways are the largest rail network in Asia and the backbone of the country's transport system. It is not only the single largest consumer of natural resources, but also a major contributor to the green environment due to its impact on reduction of Green House Gas (GHG) emissions.

Indian Railways have been taking a number of steps to become a greener mode of transport by focusing on environmental friendly measures like changing energy mix from fossil fuel based traction to electric traction and further to renewable energy based sources like wind, solar, waste-to-energy, etc. We need to continue to innovate so as to make the Railways cost effective, sustainable and the preferred mode of transport.

100% Railway Electrification programme launched recently is one of the largest railway electrification programmes in the world. It is being keenly watched by all. This form of traction is not only energy efficient but also regenerates energy during braking which further saves energy.

International Conference on Green Initiatives and Railway Electrification organized by the IREE will provide a platform for these initiatives and will also cultivate a positive attitude among the stakeholders for future projects taken up by Railways.

I congratulate IREE in taking lead for organizing this International conference. I wish the conference all the success.



Manoj Sinha

(Manoj Sinha)

राजेन गोहांई
Rajen Gohain

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

MoS (G)/Message....49...../2017
रेल राज्य मंत्री
भारत सरकार
नई दिल्ली-110 001
Minister of State for Railways
Government of India
New Delhi-110 001

24 OCT 2017

MESSAGE

Transport sector is the largest consumer of energy and within the transport sector the Indian Railways share is about 2% of National energy consumption. With rapid economic growth, the energy demands of transport sector are ever increasing.

Mission Electrification, a strategic shift for Railways is a bold initiative taken up by Indian Railways wherein the whole of the railway network shall undergo complete electrification at a rapid pace. With the initiatives of Decarbonization, this will propel increased use of Renewable energy in Railways.

I congratulate IREE for initiating a dialogue on all key issues, which will go a long way in encouraging all the stakeholders to explore various alternatives to fulfill the challenges of electrification and induction of Renewable Energy at a faster rate.

Rajen Gohain

(Rajen Gohain)

Message
CRB

Ghanshyam Singh

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

सदस्य कर्षण, रेलवे बोर्ड
एवं
पदेन सचिव, भारत सरकार
रेल मंत्रालय
रेल भवन, नई दिल्ली–110001
MEMBER TRACTION, RAILWAY BOARD
&
EX-OFFICIO SECRETARY,
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAIL BHAVAN, NEW DELHI-110001

No.2017/Elect(G)/138/1

Message

Railway is one of the most energy efficient modes of transport and generates significantly lower CO_2 emissions compared to other modes. Improving speed, mobility and reducing cost of operation have been identified as some key focus areas.

In the year 2016-17 Railway's total energy bill was about Rs 26,500 Cr with electric traction bill of about Rs 9475 Cr. i.e. 35% of total energy bill with traffic share of more than 60%. IR has embarked upon Mission Electrification. It will reduce the cost of operation by about Rs 10,000 Cr in due course of time. It is one of the largest railway electrification programs in the world. For achieving the target of Mission Electrification, one of the challenges is faster execution of electrification projects. In this process we have taken several initiatives including 1st time award of Engineering, Procurement and Construction (EPC) contracts in Aug 2017.

Indian Railway is manufacturing High speed Passenger locomotive with speed potential of 200 kmph and also up-grading the existing 6000 HP passenger and freight locomotives to 9000 HP. These are made 'Make in India' initiatives already started at CLW. Technological Initiatives such as development of regenerative braking feature in tap changer locomotives, Battery cum 25 kV AC electric locomotives etc. have been embarked upon. In addition IR is planning to acquire high horse power (9000 HP) passenger locomotive capable of running at 200 kmph.

Recently Railways have used PPP model very effectively in energy efficiency sector. Large scale replacement of electric equipment has been carried out with energy efficient equipment like LED lighting, super energy efficient fans & ACs in ESCO model, without any investment by Railways. This is giving huge savings to Railways. Similarly roof top space has been effectively used for putting up solar plants to use greener energy and also generate savings.

I congratulate IREE for bringing all stakeholders together to workout solutions to challenges being faced by IR and wish the conference a great success.

Date: 24th Oct' 17

24.10.17

(Ghanshyam Singh)

V. K. Aggarwal
Additional Member, Electrical &
President/IREE.

सत्यमेव जयते

भारत सरकार
रेल मंत्रालय, (रेलवे बोर्ड)
रेल भवन, नई दिल्ली-110001
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)
RAIL BHAVAN, NEW DELHI-110001

There is an unprecedented focus on strengthening rail infrastructure on Indian Railways under the dynamic leadership of Hon'ble Minister of Railways.

Electrification of Railway tracks is a powerful means to achieve cost economy, improving mobility, use of renewable energy & efficient rolling stock to haul heavy freight and passenger trains at higher speeds. At present about 54% coaching and 65% of freight traffic is being hauled on electric traction at only about 35% of total fuel bill.

To further bring down electric traction bill substantially, Railways have started procuring power through 'Open Access' and in this year electric traction bill is likely to reduce by about 25% on annualized basis as against the 2014-15 bill. Earlier Mission 41K was launched with an aim to generate a cumulative saving of about Rs. 41,000 Cr from 2015 to 2025. The review of savings upto Sept. 2017 brings out that cumulative savings of Rs 5100 Cr have already been achieved which are better by about Rs 1000 Cr as against the target.

In this direction this International conference on Green initiatives and Railway electrification on 27th and 28th October 2017 by Institute of Railway Electrical Engineer (IREE) is timely. The complete electrification now planned requires involvement of all stakeholders in developing solutions for achieving this ambitious target of electrification.

This conference aims to discuss implementable technological solutions and financing towards speedy electrification, induction of high speed locos & solutions to fruitfully use renewable energy models to achieve target of 1200 megawatt installation by 2020 and thus achieve the broader goal of transforming Indian Railways as one of the most efficient rail network in the world.

I am quite sure that this will provide an appropriate platform to disseminate technological knowledge & solutions amongst Railwaymen and industry.

I wish the conference a great success.

Dated: 23.10.2017

(V. K. Aggarwal)

From the General Secretary's Desk

1.0 Introduction

The Institution of Railway Electrical Engineers (IREE) is a professional body of Railway Electrical Engineers. It is a technical body under the auspices of Ministry of Railways sharing knowledge and experience of various Railway Engineers and others connected with Electrical Engineering. The Institution was registered at Nasik on 29th July, 1995 with registration no. Maharashtra/3920/ Nasik/95 and was inaugurated by the then Member Electrical, Railway Board Shri V. Santhanam on 26th August, 1995 at Nasik. The Institution was recognized by Railway Board in the year 1998. IREE is exempted under Section 80G of Income Tax Act as referred to U/s 80G(5)(vi).

2.0 Administration

The Institution is administered by a Governing Council which works under the overall guidance of the President of the Institution. Member Traction, Railway Board is the Patron of the Institution and Addl. Member Electrical, Railway Board is the President. Principal Chief Electrical Engineer, Northern Railway, is the Hony. General Secretary of the Institution. The administrative work of the Institution is controlled by Hony. General Secretary.

3.0 Aim of the Institution

The aim of the Institution is to disseminate and share the technical knowledge among the Railwaymen and industry regarding the available and new technology related to design, construction and maintenance of electrical assets. It is the plaza for adopting new emerging technology to serve the need of Railway Electrical Engineering.

4.0 Objectives of the Institution

- To promote, among persons engaged in or associated with Railway Electrical Engineering, technical knowledge of design, construction and maintenance of Electrical Engineering systems and equipments.
- Diffusion of general knowledge of qualities and specification of all Electrical Engineering material.
- To publish or to circulate for the use of the Members of the Institution any information which is likely to encourage and facilitate interchange of thought and experience.
- To promote and encourage papers, visits and discussions for the information and benefit of the Member of the Institution.
- In order to give further thrust to the objectives of the Institute, the Headquarter of IREE was shifted to New Delhi in the year 1997 so as to have better liaison with the Railway Board as well as Zonal Railways.

5.0 Membership

The Institution has amongst its Members, officers and supervisors belonging to Electrical discipline. Members have basic academic knowledge of Electrical Engineering enriched by long experience in the field of all the disciplines of Electrical Department of Indian Railways. The members also have a vast experience of managing Electrical Multiple Units (EMUs) type sub-urban trains in major Metropolitan cities in India. There are 700 founder members of the Institution. The Present Membership of the Institution is more than 1650. The Institution has chapters at the headquarters of different Zonal Railways & Production Units.

6.0 Activities

Some of the important National & International activities which have been carried out by the Institution during the recent past are as under:-

6.1 *National level Activities*

- The Institution in October 1998 organized a Workshop on the most important subject in today's era i.e. "Emerging Trends in Mass Rapid Transit System". This workshop has helped in finding technology solutions to the problems in the Mass Rapid Transit Systems.
- A Book titled "History of Electric Traction" authored by Late Shri R.K. Vir was released on April 8th, 2011 by the then Chairman Railway Board Shri Vivek Sahai in a grand function. The occasion was also marked with Invitational lecture on "Green Energy Initiative".
- A Technical Lecture on "AT & CL Reduction a challenge – With Power Utilities" was held on August 26th, 2011. It was jointly organized with Institution of Engineers (India), Delhi State Centre.
- A Technical Lecture was organized on "Green Building Initiative" on September 21st, 2011 jointly with Institution of Engineers (India), Delhi State Centre. During the technical lecture various Green Building Initiatives were discussed with concern that Railway Ministry has declared the year 2011-12 as "Year of Green Energy".
- A Technical Lecture on "Hardware in Building Industries – Latest Trends" was held on September 21st, 2011 jointly with Institution of Engineers (India), Delhi State Centre.
- The Institution of Railway Electrical Engineer also joined hands with Institution of Engineers (India), Delhi State Centre and IET (UK) to organize All India Seminar on "High Speed Trains" during November 4th & 5th, 2011. It was inaugurated by Shri K.H. Muniyappa, then Hon'ble Minister of State for Railways and Shri Kul Bhushan, Member Electrical, Railway Board as Guest of Honour. There were three Technical Sessions viz (i) "Emerging trends in high Speed Trains", (ii) "Indian Issues and Option – Finance", (iii) "World Wide Scenario and Socio Aspects".
- A National Seminar on "Emerging Technologies and strategies for Green Energy in Railways" was held at India International Centre, New Delhi. The Seminar was inaugurated by Shri K.H. Munniyappa, then Hon'ble Minister of State of Railways and Shri Kul Bhushan, Member Electrical was Guest of Honour.
- It was decided to celebrate the 3rd February of every year as "Railway Electrical Engineers Day" to mark the running of 1st Electric Train on 3rd February, 1925 between then Bombay VT and Kurla on Harbour Line. The 1st Railway Electrical Engineers Day was celebrated on 3rd February, 2012 at New Delhi. Shri Vinay Mittal, Chairman Railway Board, Shri Kul Bhushan, Member Electrical/Railway Board and Shri A.K. Vohra, Member Staff/Railway Board amongst the other

two graced the occasion. On the occasion, a documentary film titled "Prodigy of Indian Railways" was released by Shri Kul Bhushan, Member Electrical/Railway Board and Shri A.K. Vohra, Member Staff/Railway Board. The same was screened showing the history of Electrical Department in general and electric traction in particular. The 1st Railway Electrical Engineers Day was attended by more than 300 IRSEE Officers with their Spouses.

- IREE and IET (UK) jointly arranged a Seminar on "Mass Transport Systems in Urban Development – Trends and Challenges in India at India International Centre, New Delhi on 29th December, 2012. The Seminar was inaugurated by Dr. Sudhir Krishna, Secretary, Ministry of Urban Development, Govt. of India. Shri Satish Kumar, Director/Elect./DMRC.
- On day Seminar on "Safety in Transportation" was organized with IET (IECI) on 25.10.2013. The event was sponsored by Airport Authority of India, DFCCIL and supported by DMRC, Northern Railway, CRRI and IEI-DSC.
- The 2nd R.K. Vir Memorial Lecture on the Theme : "Electrification & Challenges on Indian Railways" at National Rail Museum, Chanakya Puri, New Delhi – With association of IET & IREE was organized on 04.01.2014.
- A Seminar on "Technological Development in Power Plants & Power Equipments" at India International Centre, Lodhi Road, New Delhi on 11.01.2014. Event sponsored by BHEL and IET.
- A Technical Lecture on Fire in Railway Coaches – A Prospective was delivered by Shri Sudir Garg, Chief Electrical Service Engineer, Northern Railway on 20.02.2014.
- One day Workshop on "Dedicated freight Corridor – Boost to Indian Railways" at India International Centre, Lodhi Road, New Delhi was organized on 11.04.2014. Shri Kul Bhushan, Member Electrical was the Chief Guest & Shri R.K. Gupta, CMD/DFCCIL, was the Guest of Honour.
- One day Seminar on "Emerging Technologies in Tele-Communication Sector – A Perspective was organized on 31.05.2014. The Event sponsored by BSNL and supported by IET Shri R.K. Upadhayay CMD/BSNL – Chief Guest and Shri M. Suresh, Addl. Member (Signal), Railway Board, Shri A.K. Mittal, Sr.DDG/DOT Guest of Honour.
- 3rd R.K. Vir Memorial Lecture on the Theme : "Solar Energy – Opportunities in Rail Sector" was head on 04.01.2015 at the Institution of Engineers (India), Engineers Bhawan, sponsored by IET and IE(I).
- One day Workshop on the Theme : "UTILIZATION OF SOLAR ENERGY IN INDIAN METRO AND RAIL TRANSPORT" was organized at Metro Bhawan on 10.01.2016. Shri Navin Tandon, Member Electrical was the Chief Guest, Shri Mangoo Singh, MD/DMRC was Guest of Honour, Sponsored by DMRC, GIZ and IET supported by The Institution of Engineers (India).
- The 2nd Railway Electrical Engineers Day was celebrated on 3rd February, 2015.
- ICT Day Celebration – World Telecommunication and Information Society Day – 2015 was held on May 18th, 2015 – Member Electrical, Railway Board Shri Navin Tandon was the Chief Guest alongwith Director IIT/Delhi as Guest of Honour. The event was organized by IET & IE(I).
- One day Seminar on Solar Energy – Opportunities for Rail Sector at Vigyan Bhawan, New Delhi under the aegis of UNDO-GEF was organized at Vigyan Bhawan on 04.08.2015. Hon'ble Minister of Railways Mr. Suresh Prabhu was the Chief Guest.

- IET Technical Lecture (4th R.K. Vir Memorial Lecture) on the Theme "Traction for Transport" was held on 04.01.2016 at the Institution of Engineers. Sponsored by IEEE and IREE supported by institution of Engineers.
- 3rd Railway Electrical Engineers Day was celebrated at State Entry Road Club on 03.02.2016.
- A Technical Lecture on Monorail. A medium capacity urban Transport System based on Electric Traction was organized on 14.03.2016 by Mr. Kentatsu Lto, Manager, Railway Systems Company, Hitachi India Pvt. Ltd. Seminar-II, India International Centre, Lodhi Road, New Dlehji-110003.
- A Technical Lecture on Contemporary Management - developed by Shri Ghanshyam Singh, CEE/NR was held at CSOI on 17.03.2016.
- World Water Day 2016 – "WATER and JOBS" by Dr. B. Sakhivel ME Ph.D. SR. Water Resources Engineer DHI (INDIA) WATER & ENVIRONMENT Pvt. Ltd. jointly organized with IET on 22.03.2016. On this occasion, an Exhibition was also organized.
- On 11th & 12th April, 2016 a Conference on "Energy need of Indian Railways" was organized by IREE with the support of Indian Infrastructure at Imperial Hotel, New Delhi. IET/DLN provided the technical support.
- On 21.05.2016 a Workshop on "Latest development in field of Solar Energy and challenges thereof". The Workshop held in coordination with DMRC & IET. Shri Ashwani Kumar Kapoor, Member Traction was the Chief Guest for the event and Dr.Mangu Singh, Managing Director was the Guest of Honour.
- IEEE organized 5th R.K. Vir Memorial Lecture at National Rail Museum, Chanakya Puri, New Delhi on 04.01.2017. The theme of the function was "Gas Insulated Switchgear" by Mr. Guenther Hans Besser GIS factory Head, Siemens Ltd.
- Sixth IREE Day was celebrated on 03.02.2017 in day time Chairman Railway Board was Chief Guest. Member Traction and Railway Board members were present. All retired officers residing in NCR were participated.
- On 06.04.2017 a Technical Lecture on "Innovation in High Speed Railways" held at Institution of Engineers (India), I.T.O., New Delhi. Mr. Ghanshyam Singh, Member Traction, Railway Board was the Chief Guest. Mr. Pankaj Guleria, WoE Test Manager, Hitachi Rail Europe and IET Global Ambassador was the Technical Expert.
- One day Seminar organized on 11.08.2017 alongwith IET & DMRC at India International Centre, New Delhi. The theme of the Seminar was on "High Speed trains and metro technologies - Issues and Options". Shri Ghanshyam Singh, Member Traction, Railway Board was the Chief Guest. Dr. Mangu Singh, MD/DMRC and Shri Achal Khare, MD/National High Speed Rail Corporation were the Guests of Honour.
- A Workshop on "Mission Electrification" was held on 18.08.2017 at DMRC Auditorium, New Delhi. On this occasion Shri A.K. Mittal, Chairman Railway Board was Chief Guest and Shri Ghanshyam Singh, Member Traction/Railway Board & Patron/IREE was Guest of Honour. The objective of the Workshop was to provide an opportunity to Railway GMs and PSUs working on Electrification to discuss and review the present status of Electrification in Indian railway on existing routes and look for new technologies to complete the electrification projects in India.

First information brochure of "Green Initiative and Railway Electrification" on 27th & 28th October, 2017 was released by Shri Ghanshyam Singh, Member Traction/Railway Board.

6.2 ***International level Activities***

- An International Seminar was organized on "Emerging Technologies & Strategies for Energy Management in Railways & Exhibition" at Pragati Maidan, New Delhi on 21st & 22nd October, 2008. The Seminar was inaugurated by Shri Lalu Prasad Yadav, the then Hon'ble Minister for Railways and was spread over seven sessions. This Seminar was significant in the backdrop of liberalization that facilitates technology import and setting up of industries in India. The Seminar had given an opportunity to manufacturers, developers, policy makers, various Govt. Agencies, technical experts and also stake holders to discuss and review and present status on Indian Railways and scope for introduction of new technology in various electrical fields.
- The Institution organized International Seminar on "High Speed Trains – Issues and Options" at Manekshaw Centre, New Delhi on 1st & 2nd February, 2011. The Seminar was inaugurated by Shri Pawan Kumar Bansal, Hon'ble Minister for Railways. The two days affair was spread over five sessions and covered different aspects including various Issues and Options for Indian Railways for going for high speed trains. Deliberations included Financing Models & Commercial Sustainability, Economic, Social, Environmental Issues. The Seminar also focused on Emerging Trends in High Speed Passenger Rail Systems World Wide and their Development in India. Through dissemination of knowledge and discussions, the forum aims to forge recommendations for evolving strategies to hasten the decision for High Speed Trains Projects in India.
- The IREE associated with IET arranged "the Lord Austin Lecture" delivered by Lord Berkley as Board Member of European Rail Freight Association on 29th October, 2012 at National Rail Museum. Lord Berkley created a platform to discuss and debate the opportunities and challenges faced by Rail sector and sharing valuable lessons for the Indian Rail sector.
- A Technical talk of "Safety in Railways" delivered by Peter Shepherd from M/s Bombardier UK and chair IET Transport panel on 1st November, 2012 at Rail Bhawan.
- International Summit on Energy Efficient Technologies in Railways – International Summit on Energy Efficient Technologies in Railways at Taj Palace was held on 6th November, 2015. Shri Suresh P. Prabhu, Hon'ble Minister for Railways was the Chief Guest, Shri Manoj Sinha, Hon'ble Minister for State of Railways was the Guest of Honour and exhibition was also organized, event sponsored by UNDP.
- One day International Conference on "Decarbonization of Indian Railways – Mission Electrification" at Hotel Le-Meridien, New Delhi was held on 3rd November, 2016. The Conference was inaugurated by Shri Suresh P. Prabhu then Minister for Railways. This one day Conference was focused on 100% decarbonization of Indian Railways with sustainable electrification. There were two technical sessions followed by panel discussion. About 700 delegates were participated. The programme was also live telecasted on all the Divisions and Zonal Railways of Indian Railways. More than 600 delegates participated. "RAIL SAVER" Mobile Application was launched by Hon'ble Minister for Railways. Also Hon'ble Minister for Railways handed over the letter of intent for working of Electrification of Railway Track for the first time to Public Sector Undertaking PGCIL, RITES & IRCON. MOU was also signed between Ministry of Railways and Ministry of Science.

- Now Institution is organizing two day International Conference on "Green Initiative and Railway Electrification" at Hotel Le-Meridien, New Delhi on 27th & 28th October, 2017. The Conference will be inaugurated by Shri Piyush Goyal, Hon'ble Minister for Railways & Coal.

7.0 Future Plans

To make Institution more vibrant and to diversify its activities further, it has been decided to appoint an Executive Director of the Institution. The Institution plans to introduce Diploma Courses on Electric Traction to spread general awareness and technical insight about Electric Traction and other Railway related Electrical Engineering subjects. The syllabus for the Course is under finalization and to start with, these will be initiated at four centers i.e. Delhi, Kolkata, Mumbai and Chennai. IRIEEN/Nasik will provide all necessary assistance in organizing contact classes and the examinations to be held after each semester.

All Zonal Railways / Production Units which are the chapters of the Institution headed by respective Principal Chief Electrical Engineers have also been requested to conduct various activities under the banner of IREE and give feed back to the Headquarters Office.

To keep all the members informed of the various on-going activities of IREE, will continue with half yearly News Bulletin and next is also proposed to be released on 3rd February, 2018 which will be celebrated as the 7th Electrical Engineers' Day.

The suggestions from all the members are welcome to make the activities of Institution broad based and purposeful.

(DAYAL DOGRA)
Hony. General Secretary

First Information Brochure of "Green Initiative and Railway Electrification" to be held on 27th & 28th October, 2017 was released by Shri Ghanshyam Singh, Member - Traction / Railway Board on 18th August, 2017.

Steering Committee

Shri V.K. Aggarwal
Addl. Member Electrical
Railway Board
&
President
Institution of Railway Electrical Engineers

Shri Dayal Dogra
Pr. Chief Electrical - Engineer
Northern Railway
&
General Secretary
Institution of Railway Electrical Engineer

Shri Sudhir Garg
Executive Director / EEM
Railway Board

Shri Shaliendra Kumar Singh
Executive Director / RS
Railway Board

Shri T.N. Kakaji
Executive Director / RE
Railway Board

Organising & Inauguration Function Committee

Shri Rajesh Tiwari
CETE/N.Rly.

Shri Gopal Kumar
CMPE/DSL/N.Rly.

Shri R.N. Rajpoot
CPM/RVNL/UMB

Shri Shalabh Goel
ED/Mobility/Rly. Board

Shri H.K. Sharma
Dy.CEE/Plg/N.Rly.

Shri H.K. Kohli
SEE/EMU/N.Rly.

Shri Satyendra Kumar
ADEE/EMU, Ghaziabad

Technical Committee

Shri Sudhir Garg
Executive Director/EEM, Railway Board

Shri S.K. Saha
Executive Director / Dev., Railway Board

Shri Jaideep
Executive Director/Elect./G, Railway Board

Shri A. K. Goswami
Railway Board

Dr. Mahendra Kumar
Director / Elect./G, Railway Board

Shri Sanjay Ganjoo
Director, IFGE

Registration and Publication Committee

Shri Pramod Kumar
CEGE/N.Rly.
Coordinator

Shri Ashish Srivastava
Dy. CEE/TRD/HQ

Shri Swadesh Rai
Sr. DEE/G/NDLS

Shri Ajay Kakkar
SEE/PRS/NDLS

Shri Rajesh Kumar
AEE/Plg/N.Rly.

Shri Sanjay Ganjoo
Director, IFGE

Reception Committee

Shri Pankaj Sharma
CEE/Const./TKJ
Coordinator

Shri Mayank Tiwari
CRSE/O&F

Shri Mohit Chandra
CELE/N.Rly.

Shri Sandeep Srivastava
Sr. DEE/RSO/DLI

Shri P.C. Lochab
Dy. CEE/Const./TKJ

Shri Satish Kumar
Dy. CEE/RS/HQ

Shri Ankur Jain
Dy. CEE/OP/HQ

Programme

DAY - 1 : OCTOBER 27, 2017

0900 - 1000 hrs	:	**Registration & Arrival of the Chief Guest**
1000 - 1115 hrs	:	**INAUGURAL SESSION**
Welcome Address by	:	**Shri V K Aggarwal,** President, IREE & Addl. Member (Electrical), Railway Board
Address by	:	**Shri Ghanshyam Singh,** Patron, IREE & Member (Traction), Railway Board
Address by	:	**Shri Ashwani Lohani,** Chairman, Railway Board
Address by Guests of Honour	:	**Shri Rajen Gohain,** Hon'ble Minister of State for Railways
	:	**Shri Manoj Sinha,** Hon'ble Minister of State for Communication (I/C) & Minister of State for Railways
Address by the Chief Guest	:	**Shri Piyush Goyal,** Hon'ble Minister for Railways & Coal
Vote of Thanks by	:	**Shri Dayal Dogra**, Hony. General Secretary, IREE & Pr. Chief Electrical Engineer, Northern Railway
1115 - 1145 hrs	:	Hi-Tea
1145 - 1300 hrs	:	**TECHNICAL SESSION - I** **Theme :** ***Green Energy Projects - Opportunities for Partnerships***
Chairperson	:	**Shri Krishan Dhawan,** CEO, Shakti Foundation
Rapporteur	:	**Shri Jaideep,** EDEE/G/Rly.Bd.
Papers	:	***IFC's experiences in structuring Green Energy Projects- Rooftop Solar PPPs*** **Shri Sivaram Krishnamoorthy & Shri Sumit Shukla,** Investment Officer, IFC
	:	***NZEB Railway Station Development*** **Shri Tanmay Tathagat & Ms. Apurva Chaturvedi,** Director, EDs & Sr. Clean Energy Specialist, USAID
	:	***Opportunities of Natural Power on Indian Railways*** **Shri Sudhir Saxena,** CEO, REMCL
1300 - 1400 hrs	:	Lunch
1400 - 1530 hrs	:	**TECHNICAL SESSION-II** **Theme :** ***Meeting IR's High Speed Locomotive Requirements***
Chairperson	:	**Shri S.S. Khurana,** EX Chairman Railway Board
Rapporteur	:	**Shri T.N. Kakaji,** ED/RE/Rly.Bd.
Papers	:	***High Power Electric Locos for Indian Railways*** **Shri Camille Thill,** Product Marketing Manager (Locomotives), Bombardier Transportation

: ***Semi High Speed & New Technologies for Speedy Electrification***
Dr. Ing. Andre Dolling, Global Sales Expert, Siemens (Germany)

: ***Feasibility Study HS Mumbai-Nagpur-Kolkata Coordinator***
Shri Joaquin Jimenez Otero & Shri Jose Conrado Martinez, Sub Director de internacional D.G. DE Desarrollo De Negocios Corporativo Direcciion De Internacional, ADIF, Spain

: ***Running of Loco Haul passenger Trains at Higher Speed on IR –A Low Cost Solution.***
Shri Sandeep Srivastava, ED/Infra Systems, Indian Railway

1530 - 1540 hrs : Tea Break

1545 - 1700 hrs : **TECHNICAL SESSION-III**
Theme : ***Energy Efficiency - Technology & Solutions***

Chairperson : **Shri N. Venkateshan,** EX Member - Electrical, Railway Board

Rapporteur : **Shri S.K. Saha,** EDEE (Dev), Railway Board

Papers : ***Strengthening Energy Efficiency Mechanism in Indian railways through PAT***
Shri Abhay Bakre, Director General, BEE

: ***Overview of PV Market Scenario & Technology at a glance***
Shri Goutam Samantha, Head, PV Technology

: ***Energy Efficient ACs***
Shri S Senthil Thangam, Sr. General manager, Blue Star India Ltd.

DAY-2 : OCTOBER 28, 2017

0930 - 1130 hrs : **TECHNICAL SESSION-IV**
Theme : ***Roadmap towards reducing carbon Foot print***

Chairperson : **Shri Sukhbir Singh,** EX Member Electrical, Railway Board

Rapporteur : **Ms. Tarini Baswal,** ED/EnHM/EE, Rly.Bd.

Papers : ***A case for Integrated Solar Power Generation and Storage Systems for Indian Railways***
Prof. Biprodas Dutta, Prof. Physics Department, The Catholic University of America, Washington D.C. & **Shri Mohan R. Krishnan,** President & CEO, Encell Technology, USA.

: ***Lender's perspective on financing Green Energy Projects***
Ms. Prathiba Bajaj, Investment Officer, IFC

: ***Global Best practices for Green Initiatives in Railways***
Shri Subhashis Dey, Program manager, Shakti Foundation

: ***RE procurement Strategy for Indian Railways***
Shri Anurag Mishra, Sr. Energy Specialist, USAID

	:	***Intercity Freight Transport- Modal Choice Shift*** **Shri Chirag Gajjar,** Head Mitigation for WRI India's Climate Program, World Resource Institute
	:	***Road Map on reducing carbon foot-printing in IR*** **Shri Arun Kumar,** CEO(Group), Mittals Group
1130 - 1145 hrs	:	Tea Break
1145 - 1330 hrs	:	**TECHNICAL SESSION-V** **Theme :** ***Moving IR towards 100% Electric Traction***
Chairperson	:	**Shri Kulbhushan,** EX Member Electrical, Railway Board
Rapporteur	:	**Mr. Shalabh Goel,** ED/ Mobility/ EE, Rly.Bd.
Papers	:	***Railway electrification & Mechanization*** **Shri Sandeep Ghalyan,** National Manager, Sales and Technical, GIESMAR
	:	***SFC (Static Frequency Converter) Solutions*** **Shri Shantha Kumar,** MS & ***Arunav Jha,*** ABB Ltd.
	:	***RILA Technology and its applications for electrification projects*** **Shri Jack Vogelaar,** Technical expert and Business Development Manager, Rail, Fugro Geoservices B.V. Netherland, COSMO Energy Pvt. Ltd.
	:	***Adoption of New Technologies for Indian Railways*** **Shri Rajeev Jyoti,** Chief Executive – Railway Business (L&T)
1330 - 1415 hrs	:	Lunch
1415 -1545 hrs	:	**TECHNICAL SESSION-VI** **Theme :** ***Bio Diesel - Technology & Solutions***
Chairperson	:	**Shri Hemant Kumar,** EX Member Mechanical, Railway Board
Rapporteur	:	**Shri G K Gupta,** CME/ IROAF
Papers	:	***"Bio-CNG and Bio-Ethanol" utilizing the waste generated at railway Stations, railway Colonies and catering Hubs*** **Shri Rajiv Agarwal,** Executive Vice President, Praj Industries Limited
	:	***Bio-Diesel : Ethanol & its opportunities*** **Dr. Vidya Murkumbi,** Executive Chairperson, Shree Renuka Sugars Ltd.
	:	***Bio-Diesel- Green commitment of IR*** **Shri Sandeep Chaturvedi,** President & CEO, JSB Green, Bio-Diesel Asso. of India
	:	***Alternate fuels for Indian Railways*** **Dr. Anirudh Gautam,** Executive Director, SRESTHA (RDSO), Ministry of Railways
1545-1615 hrs	:	**VALEDICTORY SESSION**
Chief Guest	:	**Shri Ghanshyam Singh,** Patron, IREE & Member (Traction), Railway Board
1615 hrs onwards	:	Tea

Solar Panel directly mounted on platform structure : first time on Indian Railways

SESSION-I

Theme : **Green Energy Projects - Opportunities for Partnerships**

Experiences on structuring Grid interactive Rooftop Solar (RTS) PPP Projects

ABSTRACT

Sivaram Krishnamoorthy

IFC, a member of the World Bank Group, have more than 60 years of experience in unlocking private investment, creating markets and opportunities. Since 1956, IFC has leveraged $2.6 billion in capital to deliver more than $265 billion in financing for businesses in developing countries.

In this context, the presentation has highlighted the overall working scenario of IFC mainly emphasizing on the different project cycles they follow, financial products of IFC, IFC's diversified roles in supporting renewable energy based technologies. This presentation has further emphasized on its experiences on structuring Grid interactive Rooftop solar (RTS) PPP Projects.

IFC, along with the State government of Gujarat, worked on the implementation of a 5 MW distributed/grid connected rooftop solar project in Gandhinagar, Gujarat through a PPP model. During the development of the same, detailed Feasibility undertaken and project documents have been prepared based on analysing the identified risks and extensive consultations with stakeholders. PV PPP project has been taken up in the state of Orissa as well, the details of which have been further mentioned in the presentation.

The key issues like advisory engagement with regulators, long term financing mechanisms, different phases in rooftop market development, bidding results, various stakeholders concerns, contract structuring model, market discovered Tariff & its Implications, net metering structure, which are required to be considered while developing the successful business model under the same scenario have also been discussed in details.

About the Author

Mr. Sivaram Krishnamoorthy, Operations officer, Clean energy and resource efficiency, International Finance Corporation at New Delhi, India.

Before IFC : 9 years with Confederation of Indian Industry, Green Business centre, India

Education : B Tech (electrical & electronics), University of Calicut, India & MBA, Madras university, India.

Technical Expertise :

Industrial Energy efficiency, Programmatic approaches to energy efficiency & Sector approaches to energy efficiency , Low carbon technologies; Grid connected & distributed renewable energy systems (Solar PV); Utility energy efficiency (street lighting, DSM with end use efficiency); Policy formulation

and recommendations on energy efficiency, gird connected renewables and low carbon technologies; Regulations - Net metering with National regulator (India).

Sector Expertise:

Renewable energy - Grid connected Solar PV roof top systems (5 years); Energy efficiency - Public street lighting systems (4 years); Manufacturing - Energy audits covering energy intensive manufacturing - Cement, Pulp and Paper, engineering, Sugar, fertilizer, chemicals etc, Industrial utilities (6 years); Renewable energy - Co-generation systems (bagasse based); Donor relations management and Programmatic approaches and program management in energy efficiency, renewable energy, clean tech venture scale up and other low carbon technologies (7 years); Working with "aggregators", donors and vendors of equipment / technology - World Business council for sustainable Development, Confederation of Indian Industry, Other Industry associations etc.

Project References & Clients :

- World Business Council for Sustainable development, Geneva, Cement Sustainability Initiative, New Delhi, India, and International Energy Agency (Paris) Development of Low carbon technology road map for Indian Cement Industry (2011 - 2015) http://www.wbcsdcement.org/index.php/technology/india-roadmap
- Energy efficiency and implementation of low carbon technology roadmap at the manufacturing facility (2013 - 2017)1. Ultratech Cement , Vikaram Cements, Madhya Pradesh,2. Shree cements (Ras), 3. Holcim (ACC, Bargah) 4. Holcim Ambuja cements, Ambuja nagar), 5. My Home cement, and 6. Dalmia cements resulting in identification of a potential for US $ 100 Million for investment (5,10,000 Tons per annum of GHG reduction) out of which US $ 20 Million has been implemented, resulting in 1,50,000 Tons per annum of GHG reduction.
- Gujarat Power Corporation Ltd, Government of Gujarat, India and Gujarat Energy Research Management Institute (GERMI) - Grid connected and distributed roof top solar (gross metering) on Public private Partnership (PPP) mode, project development and transaction advisory for the city of Gandhi Nagar (2010 -13) - 5 MW at Gandhinagar and 5 MW at Baroda.
- GEDCOL, Orissa, 4 MW distributed roof top solar PPP project on Govt. buildings in the twin city of Cuttack-Bhubaneswar, which is now under replication at multiple cities across Orissa as well as being replicated by the nodal agency, Oreda for consumer led proliferation.
- Bhubaneswar Municipal corporation, Odhissa state, India, Street Lighting Energy efficiency on ESCO mode- Technical, commercial and legal due diligence and Transaction facilitation (2011 - 2013) and post transaction M&V support - Successful project of 20,000 lamps with more than 75 % savings using LED, now operational for 2 years, operations being undertaken by eSmart Energy solutions Pvt. Ltd.
- Jaipur Municipal corporation, Rajasthan state, India, Street Lighting Energy efficiency on ESCO (shared savings mode)- Technical, commercial and legal due diligence and Transaction facilitation (2012 -14) and post transaction M&V support - Successful project of 70,000 lamps with more than 70 % savings, now under implementation by SMC infrastructure and samudra electronics.

- Various clients/ WRI/ New Ventures India - Successfully raised funds and co ordinated with donors - Foreign and Commonwealth Office, Government of UK for the project - Accelerating Clean Energy Markets & Facilitating Clean Energy Enterprise. The project aimed at contributing climate security by promoting a faster transition to a low carbon global economy through creating an eco system which would support formation and scale up of Clean and Green SMEs. New Ventures India worked with 48 companies and facilitated a total of US $39 million of investment. The portfolio firms which raised funds from various Financial institutions include Husk Power systems, HMX systems etc. (2007-10).
- A member of the team which established CII - Green business centre, Hyderabad India & the Indian Green Building Council (IGBC), the body which pioneered development of Green buildings (LEED rating) in India.

Publications/Papers/Reports Published

- Team member - Harnessing energy from the sun - Empowering rooftops- A white paper on Grid connected rooftop solar PV development- http://www.ifc.org/wps/wcm/connect/259304004643496ea2d0bb9916182e35/Final+-harnessing+Energy+from+the+Sun.pdf?MOD=AJPERES
- Team member - Investors' Manual for Energy Efficiency, published by Indian Renewable Energy Development Agency (IREDA) under a credit from the World Bank - International Bank for Reconstruction and Development (IBRD) / Global Environmental Facility (GEF), under Second Renewable Energy Project", http://www.emt-india.net/Presentations/ NCRChamberof Commerce&Ind_4_5May2007/Investor%20Manual%20for%20Energy%20Efficiency.pdf
- Author - 50 Bulletins on Best practices implemented by the Indian Industry on Energy Management as part of 3country Energy efficiency project whose partners are World Bank, the UNEP Risoe Centre on Energy, Climate and Sustainable Development (URC). Sample bulletin below: http://www.emt-india.net/Documents/CS19Oct09/Textiles/Textile-treatment%20dryer.pdf
- Green Business Directory,(2005) a compendium of over 1000 listed companies offering various services in Energy efficiency, Renewable energy, Environment & Green Buildings in the Indian market, with an objective of establishing businesses linkages with the equipment suppliers and end users. This is one of the first publications in India on Green Business.

About the Company

IFC, a member of the World Bank Group, is the largest global development institution focused on the private sector in emerging markets. Working with more than 2,000 businesses worldwide, we use our capital, expertise, and influence to create markets and opportunities in the toughest areas of the world. In FY17, we delivered a record $19.3 billion in long-term financing for developing countries, leveraging the power of the private sector to help end poverty and boost shared prosperity.

IFC's advisory platform consists of seasoned experts, with 80 percent of our advisory staff based in the field. In FY17, the advisory portfolio is of $1.5 billion, encompassing more than 700 advisory projects in about 100 countries. More than a quarter of our advisory program was climate-related. We help governments design and implement PPPs that are tailored to local needs, help solve infrastructure bottlenecks, and achieve national development goals.

Net Zero Energy Buildings (NZEB) for Indian Railways Station Development

ABSTRACT

Indian Government has committed to reduce emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level. Indian Railways, one of the largest employer in the world has recently embarked on a modernization and expansion plan which will contribute greatly to Govt. of India's vision in reducing overall emissions.

Tanmay Tathagat

Apurva Chaturvedi

New commercial buildings and enhanced infrastructure for over 400 railway stations are to be completed over the next five years in the first phase. In order to support Indian Railways commitment for decarbonization, all new developments are aiming to be net zero (Refer order no. 2016/Elec (G)/150/9). Net Zero Energy Buildings (NZEBs) are buildings that, produce on-site, or procure from the grid, renewable energy equivalent to the amount they consume, when accounted for annually.

The technical presentation will highlight the key aspects of a Net Zero Energy Building and provide concepts for Indian Railways for its new station development & existing stock to attain NZEB status. The architectural design of such buildings follows the logical sequence of achieving NZEB status - focusing on building form and orientation for load reduction, resource efficiency, energy efficiency, and low-energy comfort systems – before strategizing to meet the residual load through renewable means. The presentation shall lay emphasis on various aspects of Carbon Natural Design and outline Performance Specifications to meet the vision of decarbonizing the Indian Railways. Different ways to capitalize on synergies between various aspects such as lighting, envelope, HVAC, etc. to reduce overall capital expenditure will also be presented.

Renewable Energy and other technologies for Net Zero Energy Building's integration will also be discussed which are vital to strengthen IR's vision of decarbonizing Indian Railways. Applying energy efficiency technologies and methods to buildings sectors would have a substantial impact on energy usage and carbon emissions in India. At a time of rising energy prices, energy savings, which reduce primary energy consumption and decrease the need for energy imports, are thus imperative in increasing the security of energy supply given the future scarcity of fossil fuels and in limiting the impact of energy price shocks.

About the Authors

Mr. Tanmay Tathagat, Director (EDS)

Tanmay has a background of architecture and engineering. Over the last 20 years, he has worked on several projects dealing with issues of sustainable development, building energy efficiency, green buildings, and energy efficiency standards and labeling in Asia, Africa and the US.

He led the development of the Energy Conservation Building Code and Eco-Housing program in India. Tanmay also supported the energy efficiency building code development in California, India, Thailand, Philippines, and Vietnam, and conducting energy efficiency training for building professionals. He is an acknowledged expert in building integrated design and energy simulation, and has provided training and assistance to architects, engineers, and facility managers all over the world. Tanmay has also worked closely with government agencies, multilateral and bilateral agencies, banks and other and organizations in designing and structuring energy efficiency programs for the building and appliance sectors.

Tanmay has extensive experience in green building design, energy simulation, architectural and mechanical design, and green building certification process. Tanmay currently leads the Environmental Design Solutions [EDS] team of experts working on climate change policies, energy efficient building design, building code development, energy efficiency policy development, energy simulation and green building certification process.

Tanmay has received the LEED (Leadership in Energy and Environmental Design) Fellow accreditation from the US Green Buildings Council. He is working closely with the Indian Green Building Council (IGBC) in the development of LEED-India and in supporting LEED certified buildings in the country. He has also worked closely with Ministry of New and Renewable Energy in the development of GRIHA rating system in India.

Ms. Apurva Chaturvedi, Senior Clean Energy Specialist, USAID/India

Apurva Chaturvedi is currently working as Senior Clean Energy Specialist in USAID/India. She has over 12 years of experience in clean energy and environment sector. She has designed and managed several clean energy programs at USAID. Her area of expertise is program strategy, design & management. She is currently leading the energy efficiency (including building efficiency) and smart grids portfolio of USAID's clean energy program in India. She also worked as Project Manager-Climate Change at British Council, India.

Renewable Energy Opportunities in Indian Railways

ABSTRACT

Sudhir Kumar Saxena

Indian Railways has given thrust to de-carbonization with their 'Mission Electrification' plan, harnessing of Renewable energy sources and utilizing various energy efficient technologies. Indian Railway and RITES limited has joined hands to form Railway Energy Management Co. Ltd (REMCL), a Joint Venture company incorporated on 16 August, 2013, which caters to de-carbonization need of Indian Railways by implementing the various Renewable energy projects.

In line to this, Indian Railways has set up an ambitious target for harnessing 1000 MW power from Solar Energy and 200 MW power from Wind Energy Sources. In order to achieve this target Railway has set up 50 MW Roof Top solar plant and 100 MW Roof Top Solar Plant is under execution. Wind mill plants of 26 MW at Jaisalmer, Rajasthan & 10.5 MW in Tamil Nadu for captive use of Indian Railways are already operational.

Implementation of solar and wind projects for Indian railways through tariff based competitive bidding are also in pipeline.

A renewable power developer meet is also being organized shortly to finalize modalities for long term purchase of chopped Solar/wind power for Traction use by Railways from Solar/wind power developers to meet its Renewable Power Obligation as Deemed Licensee.

About the Author

Shri Sudhir Kumar Saxena, presently working as Chief Executive Officer in Railway Energy Management Company, is a 1984 batch officer of IRSEE. He holds degree in B-Tech (Electrical) from IIT Roorkee erstwhile University of Roorkee and M-Tech in Power System from IIT Delhi. He has varied experience of about 31 years in indigenous development of imported products for Indian Railways, electrical construction works, setting up of captive power plants, energy conservation, adoption of energy efficient systems, harnessing green energy, optimizing cost of electricity, etc. He has also worked as Director in Department of Telecommunications for 5 years and possesses rich experience in promotion of Indian telecom sector, proliferation of broadband activities etc. Presently he is responsible for power procurement through bidding process, power planning strategy, setting up renewable energy projects, handling regulatory matters etc. for Indian Railways.

SESSION-II

Theme : **Meeting IR's high speed Locomotive Requirements**

High-Power Locomotives for Indian Railways

ABSTRACT

Indian Railways is rapidly expanding the electrified network and requires additional motive power to handle the rapidly increasing passenger and freight traffic. Operational efficiency and locomotive cost per kW may be improved by a high power/axle. In addition to dedicated High-Speed and Heavy Freight locomotives, Universal Locomotives are suggested to enhance operational flexibility. Alternative locomotive building, financing and maintenance schemes may expedite locomotive procurement and reduce the burden on Indian Railways.

Camille Thill

About the Author

Camille Thill is a Graduated Electrical Engineer from ETH Zurich. He is having 35 years of experience in the field of power converters, locomotive system engineering and vehicle integration engineering, Started his professional career with BBC (Brown Boveri & Company) in static converter development; Currently Product Marketing Manager (Locomotives) with Bombardier Transportation, Switzerland.

About the Company

Bombardier Transportation is a global leader in rail technology and offers the broadest portfolio in the industry. It covers the full spectrum of rail solutions, ranging from trains to sub-systems and signaling. The company also provides complete transport systems, e-mobility technology and maintenance services. Headquartered in Berlin, Germany, Bombardier Transportation employs around 37,150 people and its products and services operate in over 60 countries.

Innovative Contact Line solutions by Siemens – Increasing operational speed, improving project excellence and optimization of life cycle costs

ABSTRACT

Dr.-Ing. André Dölling

Siemens AG is a global conglomerate and a recognized leader in providing Rail Electrification solutions as per the customer's specific project requirements. Siemens provides innovative and reliable customer-orientated complex solutions and proven product lines, which cover whole Rail Electrification market needs from a single source.

The presentation shall give a brief overview about Siemens experience to successfully cope with challenges, which upgraded or new requirements (e.g. increasing operational speed) and roll-out significant electrification/ refurbishment plans to the Rail operators worldwide. Focus of the presentation shall be on Overhead Contact Lines (OCL) including the whole process from design to installation including maintenance.

Different projects vary in terms of design and complexity. As a result, Siemens is developing solutions based on the project requirements and its worldwide experience, which brings economic advantages to the end customer. Projects that are subject to functional requirements and therefore are not restricted in the specific solution area have an advantage. Using the example of the electrification project Denmark with the innovative SIEMENS Sicat SX OCL system, possible approaches to optimization are presented.

Classic existing overhead lines can also be improved with regard to the operational speed (for example, upgrade 160 to 200 km/h). Examples will include the overhead line constructions Re 160 / Re200 of DB AG or Siemens Sicat SA. Due to its experience, Siemens is able to carry out the necessary adaptations in the system design as well as to propose adaptations to the basic design for the improvement of the Life Cycle Costs (LCC). The basis to execute this successfully is for e.g. competent employees who have the system understanding and knowledge of local processes and regulations. Modern software tools such as Sicat Dynamics evaluate the interaction between the current collector and the overhead line for the selected system design and variants of the current collector distances in case of multiple current collectors. Project risks are reduced by prior checking of relevant influencing variables and lead to a confirmation of the assumptions by subsequent tests as a result of the use of a certified software like Sicat Dynamics.

The detailed design of overhead lines - especially for large lines to be electrified – can be successfully done with the software Sicat Master for the creation of layout plans and materialization. Thanks to numerous automatic functions, the design of overhead line systems with regard to time requirements and quality is significantly improved. In addition, valuable drawings and information will be provided for the construction of the plants. Optimization of the longitudinal span and the tensioning

length to reduce the installation and maintenance costs are consistently pursued by the software system, taking into account the boundary conditions and specifications from the system design.

The mechanized construction of overhead lines has changed significantly in the last few decades in Europe. Examples are given which have a significant influence on speed and quality. Also in this area, the use of software such as e.g. Sicat Candrop for the calculation of the cantilevers and droppers resulted in a higher quality of the wire location above running rails and a significant reduction in the number of track access (time). This ultimately also affects the maintenance and therefore the service life and life cycle costs.

Starting from the component level (for example Modular Cantilever System) over system level up to construction, vehicle and maintenance technology, an optimal solution has to be found for the respective requirements. Siemens AG, Germany offers you this competence in all the necessary disciplines - combined with the experience in the system design of rail electrification system including interactions with subsystems.

About the Author

Dr.-Ing. André Dölling (38), studied transportation engineering at Dresden Technical University. From 2003 to 2007, he was a research associate, took his doctorate at the Friedrich List Faculty of Transportation Science and became a professor for electric railways. Dr. Doelling joined Siemens AG in 2007, is Senior Key Expert for Contact Lines and has been working on the development of overhead line components and systems, consulting services and customer training as well as product portfolio management in the field of rail electrification and contact lines. He has also been a lecturer for overhead contact lines at the TU Dresden since 2008 and for rail electrification at the Nuremberg Institute of Technology since 2009.

High Speed Rail in Spain: saving energy and increasing sustainable mobility along 25 years of successful experience

ABSTRACT

Taking over its special characteristic of having a new High Speed network developed on Standard gauge that must coexist with the Conventional broad network of 1.668 mm gauge width (quite equal to Indian broad gauge), Spain can offer very important figures on Energy savings and reduction on greenhouse gases emissions when considering both network results.

Joaquín Jiménez

José Conrado Martinez

A very large number of passengers have change to railway from other modes of transport because reduction of travel time and increase to comfort and travel facilities related with HS. Year by year we can show a continuous raise of HS passengers, a recuperated role of railways on the transport scenario. Energy, safety, time saving, GHG reduction, have come together with High Speed.

But not only trains running on HS network give us this good results. HS trains that run over Conventional tracks are also an important part of this environmental success, as we have develop technologies that allow HS trains to use both networks without stopping at interchange points, spreading HS advantages over the full railway`s system.

Speaking only about HS, the first 25 years of services give us savings of CO_2 emissions that reach 13 million tones and savings on Energy over 108.000 Billion GJ. On economical terms, including noise reduction and accidents reduction, 346 million passengers that have been transported by HS trains over HS network along this 25 years have given more than 4.300 Meuros of savings to society.

On one side, Spain has developed a broad network of High Speed lines, reaching more than 3.200 km of length: around 2.600 km of new construction with standard gauge 1,435 mm and 600 km of modernized Conventional lines towards HS performances of 200-220 km/h of maximum speed. HS trains use both networks, in such a way that approximately 25% of 36 Million passengers using HS along 2016 has been transported using partially the "broad" Conventional network.

On other side, we have introduce technological improvements, both on board and on tracks, that has given a reduction of 56% on our carbon footprint from 1990, year of reference for the application of Kyoto's protocol, till 24,2 gr of CO_2 for each transported unit.

Smart metering on energy management, recuperation of braking energy sent by trains (to other trains or also to power network, including DC feed systems…or stored by accumulative devices), catenary designs to improve speed on Conventional lines, of course use of Green energy are experiences that will be shown to audience.

As already exposed, several coincidences between Indian rail system and Spanish one (one of them being the coexistence of two different gauges from HS network and the Conventional one) give important opportunities to share our experience with Indian colleagues. We have been working together through a Government – Government agreement for the last two years and we can offer now the main results for the First Phase of the Mumbai-Kolkata HS Line, till Nagpur. The working strategy has been to apply the Spanish technological and HS services experience to the Indian own strategies and needs.

We can present this new HS line as a Green Initiative, that incorporates results directly linked to the full "Greenfield" project (from Thane new HS Station, on the 29 km of Mumbai-Ahmedabad new HS line already on construction, till Nagpur, 770 km with a design speed of 350 km/h, that will allow a reduction of travel time from the current 15h 10min to 3h34min) or also related with a first stretch of 133 km of ne HSL to Nasik (that will allow a reduction from the current travel time of 3h 35min to only 47min from Mumbai BKC). Only with this first step, around 25.000 passengers per day could benefit the existence of the new HS line in the horizon 2025-2030, being multiplied by more than 2 in 2050, mainly coming from buses and cars, so giving HS railway's Green Economy its biggest mean.

Even more we are studying additional improvements that would be made over the Conventional line between Nasik and Jalgaon/Bushaval, 255 km, incorporating also "green" and "safe" tools to manage traffic and energy (Signaling, Telecommunications, Optimized Traffic Control Operations, Smart Energy management and metering, renewable energy). Travel time reductions (from Mumbai to Bhusaval will go from current 6h 30 min to 2h 20 min, with HS till Nasik and semi-HS in the rest of the line) will give as result additional travelers that will increase substantially the Green Balance (and directly for themselves their own satisfaction provoked by their useful and "sustainable" way of transport).

We have experienced this kind of actuations in Spain, adding the benefits from HS lines newly constructed towards cities linked only by conventional lines with average speeds around 170km/h over the Conventional sections. This experiences can be shared, giving the highest value (environmentally, socially and economically measured) to our money and the maximum satisfaction to citizens that will use Indian Railway as the most convenient and sustainable way of transport.

About the Authors

Mr. Joaquín Jiménez, Senior International Vice Director ADIF, Feasibility Study HS Mumbai-Nagpur-Kolkata Coordinator.

Civil engineer with more than 40 years of experience in the railway sector, in the area of research and development of rail and intermodal technologies, up to the planning and socioeconomic and financial analysis of great investment projects in rail infrastructure.

He has participated in all the great projects that have made up the current Spanish railway success (High Speed, urban transport, modernization of the conventional network, interoperability, incorporation of new technologies to railway, multimodal transport) at national and international

level, also promoting new alternatives such as public and private partnerships and internationalization.

He is currently responsible for international projects and collaboration in ADIF, closely involved in the development of new international railway corridors and in the development of technical and legal initiatives in the European Union.

In the training field, he has directed many first level activities in Spain and other countries within the European and Latin-American area, having directed several international courses at UIMP (International University Menendez Pelayo), the Master degree on Land Transport and the CIDITRANS (Latin-American Center for Integrated Development of Transport).

His great experience places him in a privileged position to support a new role of the railway in transport systems and international commercial relations.

In the year 2000, he received the United Nations Habitat Award as promoter of the "Vías Verdes - Program for the recuperation of abandoned railway layouts as new resources for sustainable mobility and active tourism".

José Conrado Martinez, Expert on Railways Energy management

JOSÉ CONRADO MARTÍNEZ-ACEVEDO is an Industrial Engineer in specialties of Electricity and Mechanics, with 20 years of experience in the railway sector in the areas of construction, maintenance and operation of infrastructure. In the past ten years, his work has focused on the development of new technology for the railway infrastructure (high speed and conventional lines) in different areas: Track, Power Supply System, Safety and Freights. He is Head of R&D Projects Development Area (since 2012) at the Strategic Innovation Deputy Direction. He is a professor of electrical engineering at ICAI. He is a member of the editorial board of the Electrification magazine of IEEE.

Running of Loco Haul Passenger Trains at Higher Speed on IR - A low cost solution

— Sandeep Srivastava

ABSTRACT

Introduction

Indian Railways (IR) imported high speed WAP5 passenger locomotives from M/s. ABB, Switzerland in 1994- 95. IR later on developed WAP7 passenger locomotives from imported freight WAG9 locomotives. The speed capability of WAP7 and WAP5 type of locomotives is 140 km/h and 160 km/h respectively. The WAP5 locomotives are being upgraded to run at 200 km/h by changing the gear ratio as the superstructure, bogie, body and suspension is fit for 200 km/h operation. The HP ratings of WAP7 and WAP5 locomotives are 6122 hp and 5440 hp respectively. Although WAP5 locomotive is available with IR for running beyond 150 km/h, but can haul smaller trains of 18 coaches or so at such speeds. Keeping the requirements of IR of running 22 to 24 coach trains at speeds equal or more than 160 km/h in mind, high speed locomotive with high HP will be required. This can be met by running two WAP5 locomotives in multiple operations. However in multiple operations at higher speed, the oscillations of OHE are quite high and current collection from rear pantograph is not satisfactory. It is therefore felt necessary that current collection should be made through one pantograph only and a high voltage coupling can be provided between the two locomotives. The operation with only one pantograph in double locomotives was not tried earlier on IR. This paper discusses the success story of development of high voltage coupling scheme for WAP5 locomotives on IR for operation of 22 to 24 coach passenger trains with two WAP5 locomotives with single pantograph, at speed 160 km/h or above.

Requirement

Fig-1 shows horse power requirement for hauling a 24 coach train at various speeds and radients. As can be seen from the figure, for running a 24 coach train at speed 160 km/h or above on level track, the horse power requirement will be above 5438 hp. At gradient 1 in 200 the horse power requirement will be more than 9000 hp for speed more than or equal to 160 km/h for 24 coach train. This requires multiple operation of WAP5 locomotive.

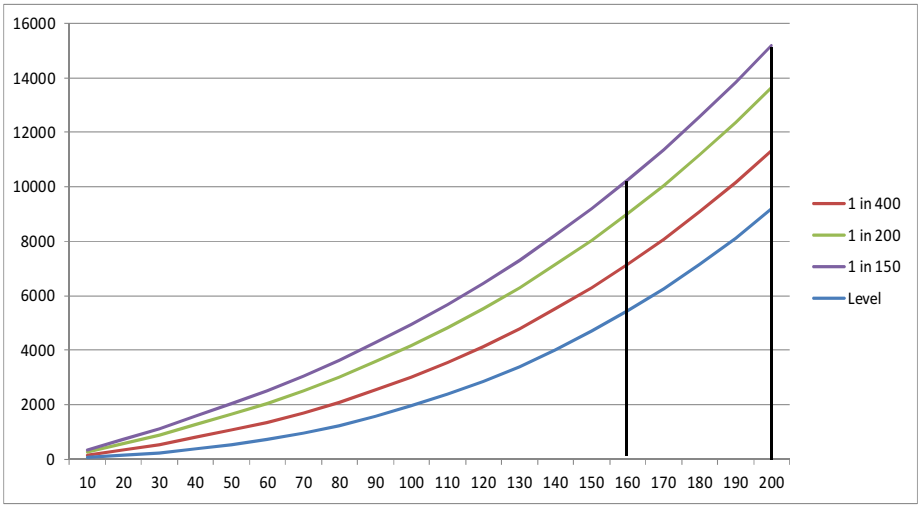


Fig - 1

Scheme of HV coupling of two WAP5 locomotives

The schematic diagram of HV Coupling of two WAP5 locomotives is shown in Fig-2. 25 kV supply is tapped from pantograph base and connected to the HV coupler by flexible XLPE cable via an on load isolator. HV coupler is basically a flexible HV cable laid down on EPDM rubber pads or proper support towards other locomotive passing through the centre of cab roof and shall be connected to the isolator of the other locomotive.

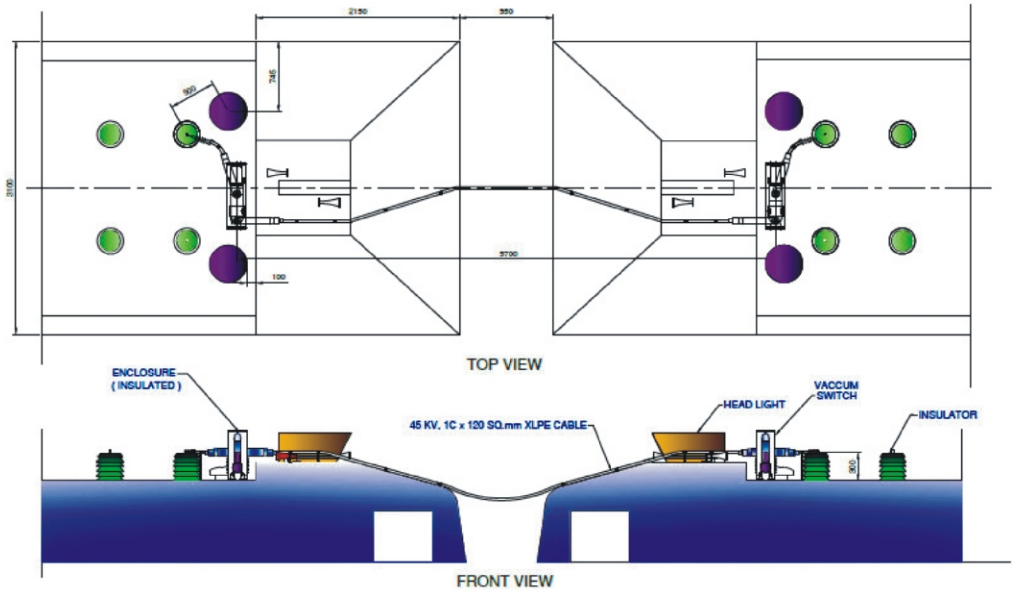


Fig - 2

Technical requirement of various equipment used

Isolator : Pneumatically operated vacuum switch has been used as HV isolator (although off load switch is required) because of compact size and vertical (T) connector which is sealed. The normal current rating of the isolator is 600 A and breaking current rating is 2.5 kA. The vacuum switch is manually operated by a handle. To facilitate its operation from loco, a ROTEX pneumatic cylinder has been provided and connected mechanically to the vacuum switch. To operate the ROTEX pneumatic cylinder, Solenoid (EP) valves has been provided for closing and opening of the isolators, which can be controlled from drivers' desk.

HV Cable : Initially in imported WAP5 locomotives, cable was connected to mica fill bushing on roof. This cable was rated for 45 kV and was of 150 mm2 cross section. Later on cable of same rated voltage 45 kV was developed indigenously which is made of XLPE having 185 mm2 cross section. It was initially thought of using this cable as HV coupler, however 120 sq mm cable having current capacity of approx. 420 A is used as maximum current through the coupler would be approximately 200 A. The approximate length of cable is 6500 mm.

Pantograph : Single arm Pantograph type WBL 85-25 kV supplied by M/s Shunk Metal & Carbon (I) Pvt. Ltd, Bangalore has been used which is rated for 600 Amp current and is fit for 250 km/h speed.

Roof line : The existing roof line and Insulators of WAP 5 locomotive is suitable as same roof bar as in WAG9 i.e., 500 A capacity is used in WAP5 loco also which can carry 900 A current. As per the calculations maximum current passing through the roof bars, if front pantograph of leading loco is raised, will be approximately 400 A.

Software and hardware modifications done

Software and hardware modifications have been made to enable following:

- Any of the Master (leading) locomotive pantographs can be raised;
- Provision of closing/opening the isolators by providing push button on driver desk has been done. The status of isolator (closed/open) has been provided on driver desk through indication lamps; and
- In case of no sensing of OHE voltage by rear loco only (indicating the case of coupler parting or opening of isolators), the VCB of front locos will also trip. The isolators of both the locos will be automatically opened and single loco operation can be done with rear loco dead and attached mechanically.

Development of HV coupler, field trials and implementation

With the above scheme in view, IR got 25 KV HV coupler arrangement developed. The trial installation of this HV coupler was done on two WAP5 locos based at Electric Loco Shed Ghaziabad of Northern Railway, where certain deficiencies in the coupler regarding its mechanical strength were noticed. Subsequently, after undertaking certain modifications, the installation with strengthened 25 kV HV coupler arrangement was undertaken by IR on WAP5 locomotives No.30022 and 30024 based at ELS/GZB of NR.

Further, on load trial of these two locomotives electrically coupled through 25 kV HV coupler arrangement with one pantograph in raised condition was carried out in New Delhi-Panipat Section of Northern Railway. During the field trial, it was observed that the working of the 25 kV MU Coupler, both electrically as well as mechanically was satisfactory.

Three more sets of WAP5 MUs have been manufactured so far. Further field trials have established the efficacy of system.

Conclusion

This development has paved way for operation of WAP5 locomotive connected in multiple configurations for trains having 22 to 24 coaches at 160 – 200 km/h and has presented a low cost option to IR vis-a-vis going for a new high power locomotive.

About the Author

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SESSION-III

Theme : **Energy Efficiency - Technology & Solutions**

Strengthening Energy Efficiency Mechanism in Indian Railways through PAT Scheme: Opportunities, Policy Solutions & Challenges

ABSTRACT

Abhay Bakre

I. Introduction

Although trains are the most efficient motorized transport system, energy efficiency (EE) in the railway sector is often ignored. However, the sector still has significant potential to improve efficiency of its energy use. The potential and opportunities to improve energy efficiency in railways are likely to increase because of the growing rail deployment in emerging economies and transport is a key sector for greener economy. Large increases in the demand for transport have been forecast for the coming years, particularly in developing countries. There is a consensus amongst transport fraternity indicating the problem of the "business as usual" pattern and highlighting the need for a more sustainable direction, in particular shifting activity away from high-carbon modes (eg road and air) through medium-long term investments in rail and public transport (modal shift).

According to the Association of the European Rail Industry, the world rail network is growing by 2.7% every year. Meanwhile, existing railway systems also often need energy efficiency improvements: for instance, the Indian Railways stands as the biggest electricity consumer of the country (1.5 percent of the country's generated power and 3 percent of diesel use in the country). Ministry of Railways is working on comprehensive energy efficiency plan that will radically transform Indian Railways' energy landscape and also for sufficing growing trends of rail transport and plans to increase the share of railways in total land-based transportation from 36% to 45% by 2030 [1].

To accelerate implementation of energy efficiency measures in railways, during the United Nations Climate Summit in September 2014, most of the key players in the field announced their ambition, under an Action Plan prepared by International Railway Association (UIC) to reduce specific final energy consumption of train operations by 50% by 2030 and by 60% by 2050 (both from a relative 1990 baseline). Best practices and technologies exist but need to be more widely shared, for these global objectives to be achieved [2].

II. Indian Railways

Indian Railways (IR) is a State owned national transporter, and responsible for rail transport in India. It is owned and operated by the Government of India through the Ministry of Railways. It is the third

largest railway network in the world comprising 119,630 kilometres of total track and 92,081 km of running track over a route of 66,687 km with 7,216 stations at the end of 2015-16. In 2015-16, IR carried 8.107 billion passengers annually or more than 22 million passengers a day and 1.101 billion tons of freight annually. As of the end of 2015-16, of the total 68,525 km route length or 45% were electrified. The railway network is predominantly a broad gauge network. Small stretches of the network use metre and narrow gauges. All the electrified lines use 25 kV AC electric traction [3].

Indian Railways (IR) is the country's biggest energy consumer and energy is the second biggest expenditure item for the organisation after wages and pensions. Managing energy costs is thus a priority for IR. Currently, Indian Railways pays Rs. 6.5 - Rs.7 for each unit of electricity, primarily because it has relied on state discoms that charge more than other customers. The national transporter is also making more concerted energy conservation efforts in both traction and non-traction areas. It has managed to reduce specific energy consumption in traction by deploying energy-efficient rolling stock with three-phase technology, regenerative braking systems, etc. It is planning aggressively to replaces old rolling stock. In the traction area, IR has been able to reduce its traction electricity consumption by 3 per cent and diesel by 2.5 percent despite of increase in load of 5 per cent. These has been achieved through adopting various energy efficiency initiatives in rolling stocks and use of regenerative braking system. Again, it is hoping to do more in this area.

India is committed to transition towards a low carbon emission pathway, while simultaneously endeavouring to meet all the developmental challenges that the country faces today. As a part of the 2015 International Paris Agreement on Climate Change, India has pledged a reduction in emissions intensity of 33-35% by 2030 from 2005 levels. India has also set a target to transition to non-fossil fuel based energy for 40% of its cumulative electricity generation capacity by 2030. As part of the efforts, Indian Railways' goal as part of its low carbon growth strategy is to reduce emission intensity by 33% in the year 2030 over the year 2005 by improving rail traction energy and fuel efficiency by 8 – 13% over 2013.

Further, Railways has also been included under the Perform, Achieve and Trade (PAT) scheme cycle-II of the Bureau of Energy Efficiency and have notified energy consumption standards for all their 16 zones across traction category and 6 production units for the various Designated Consumers of the Indian Railways [4].

III. Strengthen Energy Efficiency Mechanism in IR

The second cycle of Perform Achieve and Trade (PAT) Scheme is started from 1st April 2016. According to the clause (g) and (n) of section 14 of the Energy Conservation Act, 2001 (52 of 2001), the Central Government, in consultation with the Bureau of Energy Efficiency, has notified the energy consumption norms and standards for the period from 1st April 2016 to 31st March 2019 for the Designated Consumers of 11 sectors including Indian Railways vide Statutory Order 1264(E) dated 31st March 2016.

As per the Statutory Order, Zonal Railways having energy consumption of 70,000 metric tonne of oil equivalent (MTOE) per year or above, six production units of Indian Railways having energy consumption of 30,000 metric tonne of oil equivalent (MTOE) per year or above are notified as Designated Consumers. A total of 22 DCs (16 Zonal Railways and 6 production units) will be covered under the PAT Cycle-II.

Under PAT cycle-II, all 16 zonal Railways' specific energy/fuel consumption norms of electric & diesel traction were considered for setting up the target for reduction of 2.7 percent for diesel-passengers, 1.9 percent for diesel-freight, 1.1 percent for electric-passengers and 3.6 percent for electric-freight considering base year as 2014-15 against a target year of 2018-19 as a "business as usual" scenario. Looking at pace of Indian Railways energy consumption reduction, it is easily expected to achieve the PAT cycle-II targets with saving of 75,469 Ton of oil equivalent (TOE) by the end of 2018-19.

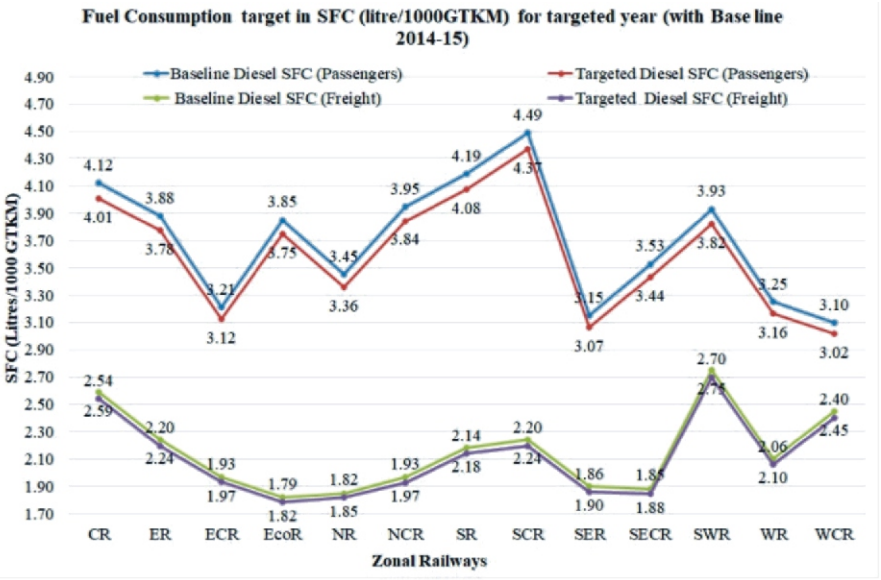

Fig. 1 : PAT target for Indian Railways –Specific fuel consumption (SFC) of Diesel traction (litre/1000 GTKM).

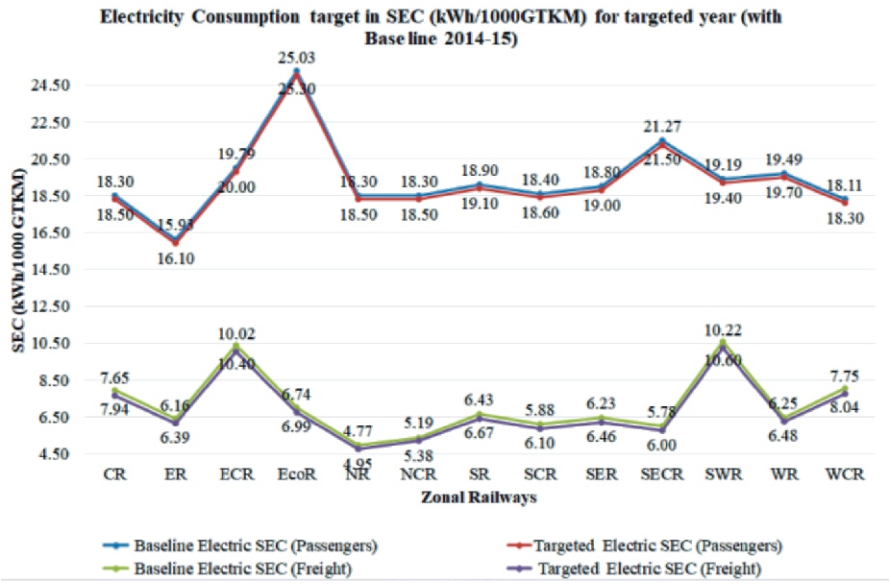

Fig. 2 : PAT target for Indian Railways –Specific energy consumption (SEC) of Electric traction (kWh/1000 GTKM).

Ministry of Railways has taken up copious energy reduction initiatives to standardize use of electricity & diesel fuel especially in traction area, few major initiative are induction of 3 Phase locomotives and EMUs, adopting regenerating braking system for locomotives, all EMUs with 3 phase-capacity, monitoring of regeneration by each loco pilot, speeding up the railway electrification and setting up higher horse power loco manufacturing units. Over the years, the energy and fuel consumption of Indian Railways were reduced slowly like 2.3 percent for diesel-passenger, 4.5 percent for diesel-freight, 1 percent for electric-passenger, 5.4 percent for electric-freight considering year to year comparison from 2006 to end of 2015.

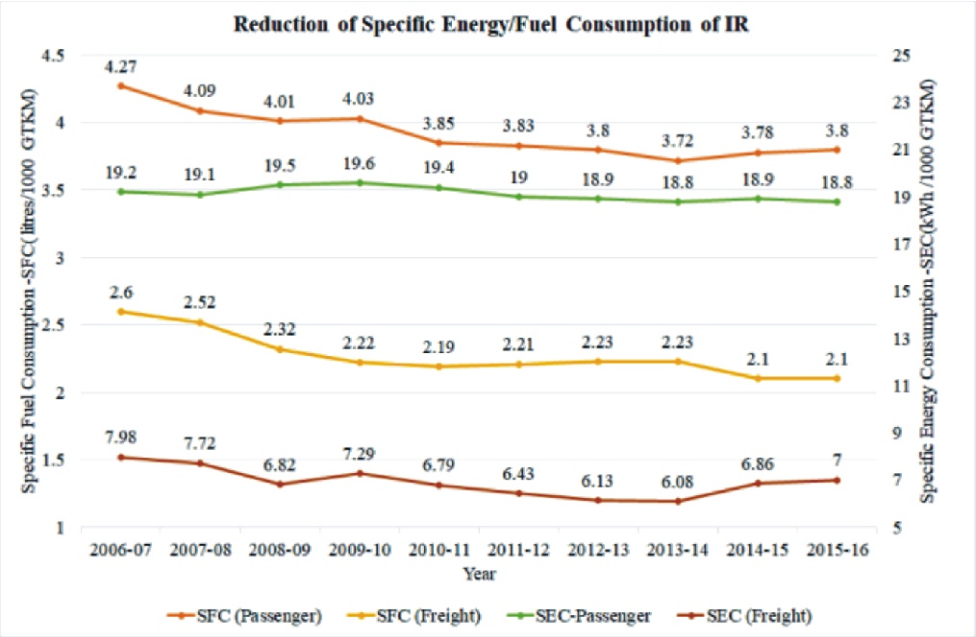

Fig. 3 : Trend of Indian Railways Specific energy/fuel consumption reduction from 2006 to end of 2015.

To further swiftness the energy consumption reduction of zonal railways, Bureau of energy efficiency is planning to stringent the specific energy/fuel consumption targets for electric and diesel traction area in next PAT cycle-V against business as usual scenario looking at progressive trend in Indian Railways' passenger and freight traffic and in energy (electricity and diesel) consumption.

The electricity consumption of Indian Railways is growing at the stride of 4 percent and 3 percent in case of diesel consumption as per year on year basis. Simultaneously, the railways network being electrified at pace of 3.7 percent year on year basis to move towards low carbon emissions and proficient transport segment.

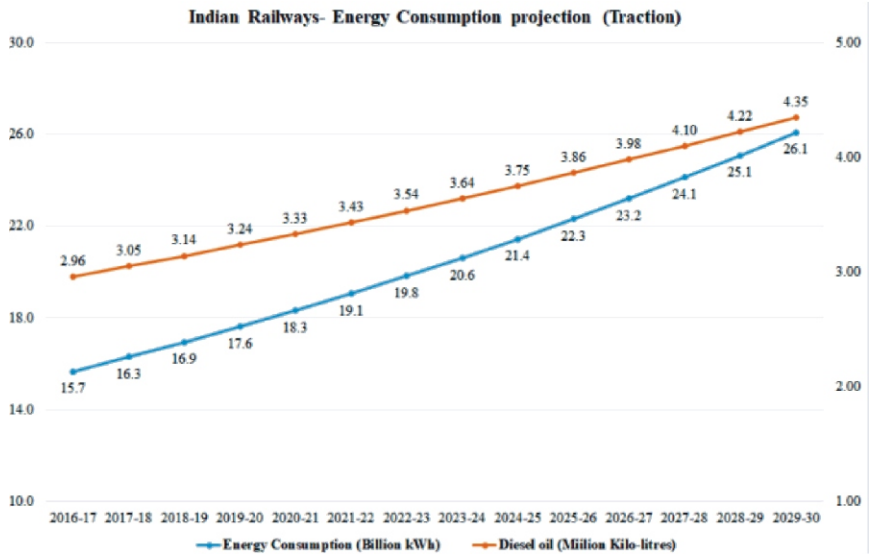

Fig. 4 : Projection of Indian Railways electricity and diesel consumption from 2016 to end of 2030.

For moderating Indian Railways annual energy consumption in forthcoming years, BEE may set up the aggressive targets for specific energy/fuel consumption for zonal railways in next PAT cycle-V against as "business as usual" (BAU) scenario. In case of BAU, it is expected that the energy consumption reduction by 7 percent in diesel-passenger, 13 percent in diesel-goods, 3 percent in electric-passenger and 15 percent in electric-goods considering base year as 2018-19 against a target year of 2021-22. Which is expected to save the energy of 2,99,716 Ton of oil Equivalent (TOE) by end of 2021-22.

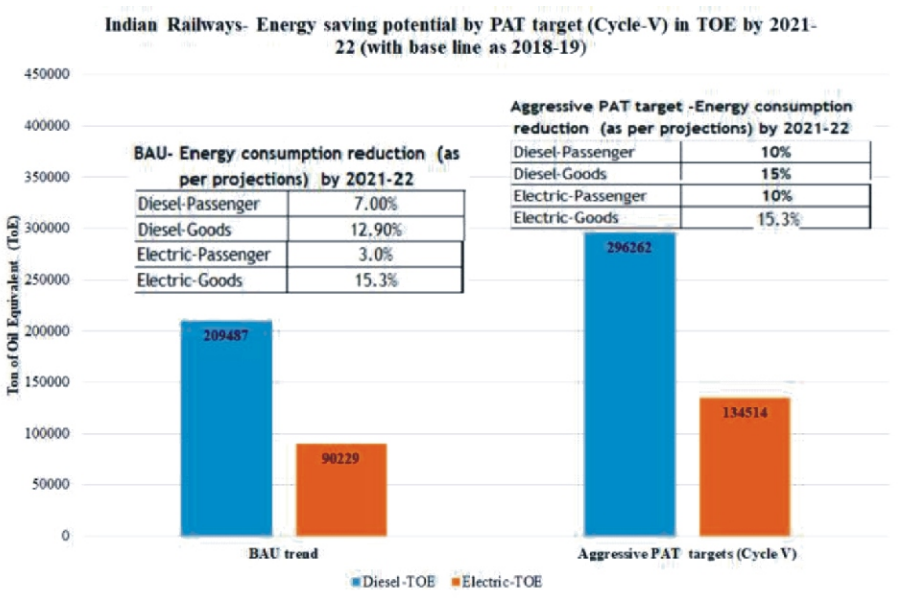

Fig. 5 : Energy saving potential for Indian Railways in PAT cycle–V against business as usual scenario.

Whereas aggressive targets setup for specific energy/fuel consumption, it is projected to reduce the energy consumption by 10 percent in diesel-passenger, 15 percent in diesel-goods, 10 percent in electric-passenger and 15.3 percent in electric-goods considering base year as 2018-19 against a target year of 2021-22. Which is expected to save the energy of 4,30,776 Ton of oil Equivalent (TOE) against business as usual scenario. Indian Railways may also explore to adopt the aggressive and stringent targets in PAT cycle-V for paradigm shift of Indian railways by 2021-22 in energy consumption reduction. Whereas zonal railways may explore to adopt the disruptive technologies in rolling stock especially in electric and diesel locomotives for contributing towards paradigm shift.

IV. Conclusion

The global energy system is moving closer to a historic transformation. India currently stands at a moment of opportunity in which it is evident that transitioning to low-carbon systems can bring about economic growth. Indian Railways ambitious plans for rapid deployment of clean energy technology for accelerating the opportunities, challenges of scaling, financial viability and reversing the increasing trend in fuel bill is an imperative goal, as it constituted more than 25% of ordinary working expenses of Railways.

Improvements in Indian Railways technology continue to modify the outlook for the energy sector, drive change in business models, energy demand and supply patterns as well as regulatory approaches. Which shall drive towards energy security, climate change and zonal railways economic competitiveness.

As Indian Railways is the single largest consumer of electricity in India, consuming about 18 TWh per year comprising roughly 1.5% of country's total power generation, prioritizing decarbonisation of Indian Railways could help India achieve its 2030 emissions reduction goals as well as strengthen energy security by reducing fossil fuel imports. As part of this strategy, IR planning for medium and long term scenario for traction area to introduce latest energy efficient technologies, to produce only 3 phase regenerative type locomotives and EMU's and also take up manufacturing of new locomotives of 12000 HP with similar or better capabilities, speed up electrification to 24,000 kms by 2020 and progressively bring down diesel loco production [5].

To further strengthen the energy efficiency mechanism in zonal railways, Indian Railways may opt for Perform, Achieve and Trade (PAT) scheme cycle-V for setting up the aggressive targets on specific energy/fuel consumption considering base year as 2018-19 against a target year of 2021-22. Which is expected to save the energy of 4,30,776 Tonne of oil Equivalent (TOE) against business as usual scenario. These energy saving certificates (ESCerts) can traded by two Power Exchanges i.e. IEX and PXIL where trading of ESCerts shall take place, which shall gives the monetary benefits to Indian Railways for adopting and implementing the energy efficient technologies in traction area.

References

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[2] International Union of Railways (2014); Low Carbon Rail Transport Challenge Action Plan; http://www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/07/TRANSPORT-Action-Plan-UIC.pdf

[3] Indian Railways annual statistical publication reports http://www.indianrailways.gov.in/railwayboard/view_section.jsp?lang=0&id=0,1,304,366,/54,941

[4] https://beeindia.gov.in/content/programmes

[5] http://www.indianrailways.gov.in/Mission_41K.pdf.

About the Author

Sh. Abhay Bakre, Director General (BEE)

Shri Abhay Bakre is a Post Graduate (M. Tech.) in Elect. Engineering from IIT, Kharagpur. He belongs to 1988 Batch of Indian Railways Electrical Engineering Services, Ministry of Railways. He has worked in several Railway projects including Delhi Metro & Kolkata Metro extension projects.

He has also worked as Joint Development Commissioner in the Ministry of Micro, Small and Medium Enterprises and was Nodal officer for National Manufacturing Competitiveness Programme.

As Executive Director PCRA, Ministry of Petroleum & Natural Gas, he has been instrumental in development and implementation of various programs aimed at petroleum & energy conservation in industry, transport, domestic sector etc.

He has also taken up nationwide mass media campaign through PCRA and other oil companies to generate awareness among consumers on adoption of simple fuel saving measures in day to-day life.

Before joining BEE, he has worked as Executive Director in the newly created Environment Directorate of Ministry of Railways. He was the nodal officer for developing Intended Nationally Determined Contributions (INDC) for the Railway sector alongwith a roadmap for Green House Gas reduction in Indian Railways. He also participated at the transport sector events of COP 21 held in Paris and COP 22 held in Morocco.

Shri Milind Deore, Director, Bureau of Energy Efficiency, New Delhi, India

Shri PVN Kishore Kumar, Senior Associate, CLASP India office, New Delhi, India

Shri Sarabjot Saini Singh, Sector Expert, Bureau of Energy Efficiency, New Delhi, India

About the Company

The Government of India, Ministry of Power set up Bureau of Energy Efficiency (BEE) on 1stMarch 2002 under the provisions of the Energy Conservation Act, 2001. The mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors. The setting up of Bureau of Energy Efficiency (BEE) provides a legal framework for energy efficiency initiatives in the country.

An overview of Global PV Market Scenario & Technology at a Glance

ABSTRACT

Global PV market is to reach 85 gigawatts by end of 2017 -more than double the installed capacity in 2014. PV market is growing significantly faster & predicting cumulative installed capacity beyond 306 GW.

The highest installation is largely driven by China, is expected to install around 40 GW by the end of 2017. The recently released PV connection data from the China Electric Council (CEC) reported that 34.9 GW of PV had been connected in China by the end of July.

Goutam Samanta

The latest forecast of India will hit 20GW installed capacity by end of this year. The news shared by SECI says that it has crossed 12.4 GW mark in April 2017, but expected to slow down due to impact of GST & high module cost. Note that all the Chinese PV module suppliers are re-negotiating module supply contracts with Indian developers due to increase in module price.

Even then, it is expected that Indian PV market to grow at a CAGR of more than 40% to reach 100GW by 2022. The major PV installations is dominated in the Southern (Telangana, Karnataka and Andhra Pradesh), Western (Maharashtra, Gujarat & Rajasthan) & Central (MP, Chhattisgarh & Orissa) region in India.

Crystalline silicon modules with standard ALBSF & advance technologies are dominating in the present global market with market share above 90%. Out of which multi's share is almost 75% & balance 25% is mono. Mono PERC technology module is taking a good lead in near future. The present P type mono cell efficiency is more than 20.5% compared to 18.5% of multi & N type mono is more than 21.5% efficiency. Bifacial N type mono are offering more than 22.5% efficiency.

However, high efficiency mono-crystalline modules with PERC technology predicting to capture 35-40% market share by end of 2018. With the increased in cell vis-à-vis module efficiencies of both P & N-type materials & also in advanced PV modules technologies, PV power plants capacity utilization factor has improved a lot. It is also observed that with the improved quality of crystalline silicon modules the field performance has improved drastically with less degradation on LID & PID. The present cost of new high efficiency module is relatively high, But it may not variable at present scenario with low tariff bidding. However, developers are working to take advantage of these new technologies for future biddings.

About the Author

Mr. Goutam Samanta, Head, PV Technology, Orange Renewable Power Pvt. Ltd, New Delhi

He is having more than 31 years professional experience including last 25 years in PV industry. Core competency in poly-silicon, ingot, wafer, solar cell & module processes includes quality, high

efficiency cell & module technology, new product development, reliability & accelerated tests for life cycle analysis. Also PV project management for setting up cell and module manufacturing facility, capacity ramp up, process optimization, equipment & technology selection and turnkey project solutions.

Successfully installed 400 MW cell & module manufacturing lines in India, Audited more than 30 PV cell & module manufacturing companies in China & India as EDF Auditor for module supplier qualification process.

Worked closely with Mr. Franco Traverso, CEO Helios Technology Srl, Italy for PV technology transfer to Webel Solar, Kolkata in 1993-94. Undergone hands on training for solar cell & module process & technology with Prof. Giuliano Martinelli, University of Ferara, Italy in 1993-94. Also undergone in-depth training in PV manufacturing at Helios, Italy on crystal growth, ingot, wafer, cell & module.

Energy Efficient Products for Indian Railways

ABSTRACT

S Senthil Thangam

Introduction

India is the second largest populated country with over 1.3 billion population with varied air conditioning needs for varied climatic conditions.

The following are the important factors to be considered while designing air-conditioning system for Indian Conditions:

1. Varied Climatic Conditions at different locations. India is a country with varied geographical spread, Plain, Mountain , Coastal areas, deserts
2. Higher Ambient Conditions in most of the places
3. Limited Space Available as cities are becoming congested.
4. Polluted Environment
5. Life of the equipment.
6. Inconsistent Electrical Power Supply
7. Poor Water Quality or Non availability of water
8. Polluted and Corrosive Atmospheric Conditions
9. Crowded Spaces
10. Optimum Cost of equipment

Expectations from Indian Customers

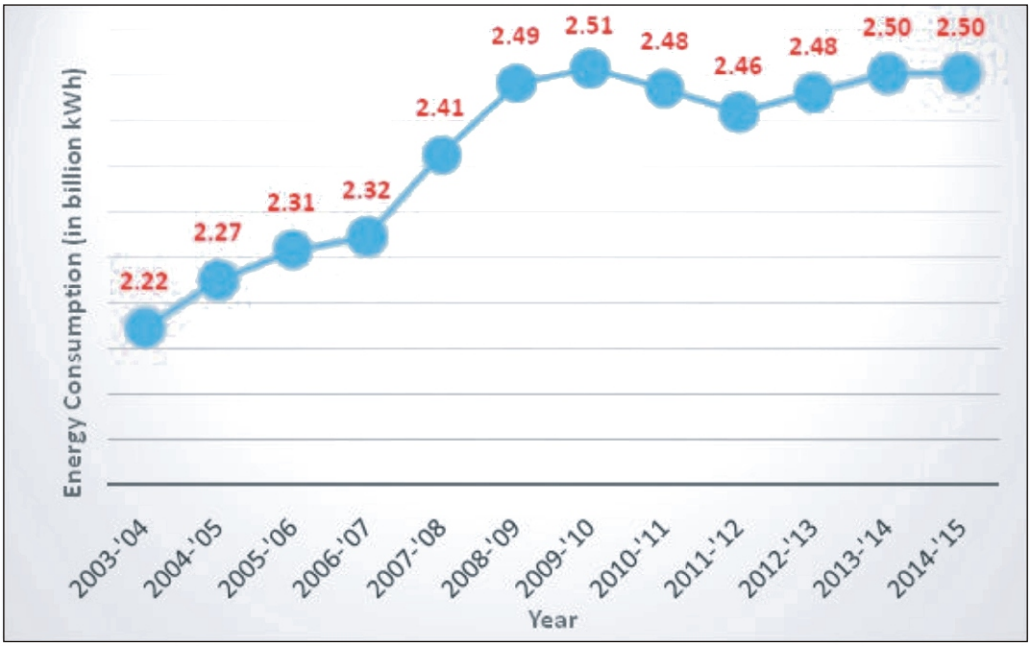
1. Efficient Operation of air-conditioning system at all climatic conditions
2. Maximum efficiency even at higher ambient conditions, which is common in India.
3. Compact, Sleek and Flexible Design
4. Consistent performance even in polluted environmental conditions
5. Robust Design of various components
6. Reliable Performance with fluctuating electrical power supply
7. Less de-ration and longer life even with poor water quality
8. Efficient working even in polluted atmosphere
9. Ability to provide maximum comfort with higher occupancy rates.

10. Optimum Capital Cost and Efficient Operation - Minimum Running Cost.
11. Less capacity Power Back Up System. (Indirect Saving)
12. Ventilation requirement for maximum comfort of occupants- Fresh Air
13. Longer Life of System.
14. Easy to Operate and Maintain
15. Choice of variety of units to select from.

Indian Railways scenario

Indian Railways consume around 2.5 Billion Units of electricity for non-traction usage, spending about 1,700crore rupees per annum. This energy feeds the Station area, Platforms, Manufacturing workshops, Maintenance depots, etc.

Below graph depicts a10-year Non Traction energy consumption until 2015.



BLUE STAR'S Air-conditioning Solutions

The above challenges are met by two popular products in the current market scenario:

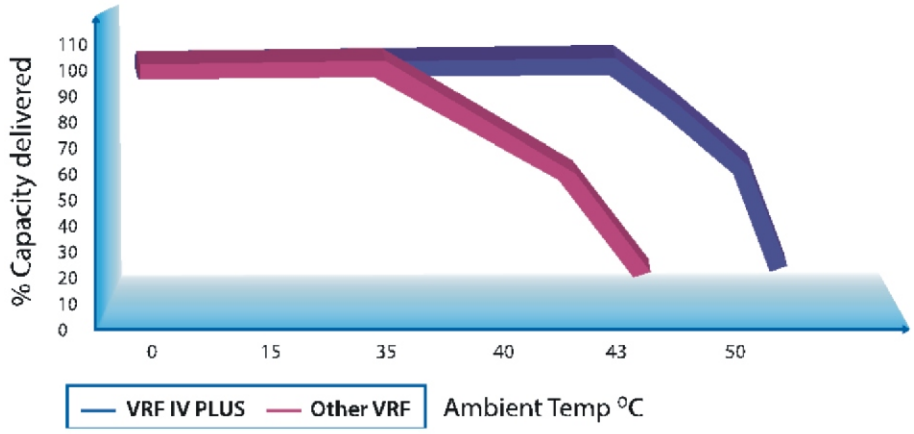
1. VRF Systems
2. Chillers

The Products offered by Blue Star are drastically different from many other products available in the market. These are designed to handle the challenges that are uniquely Indian.

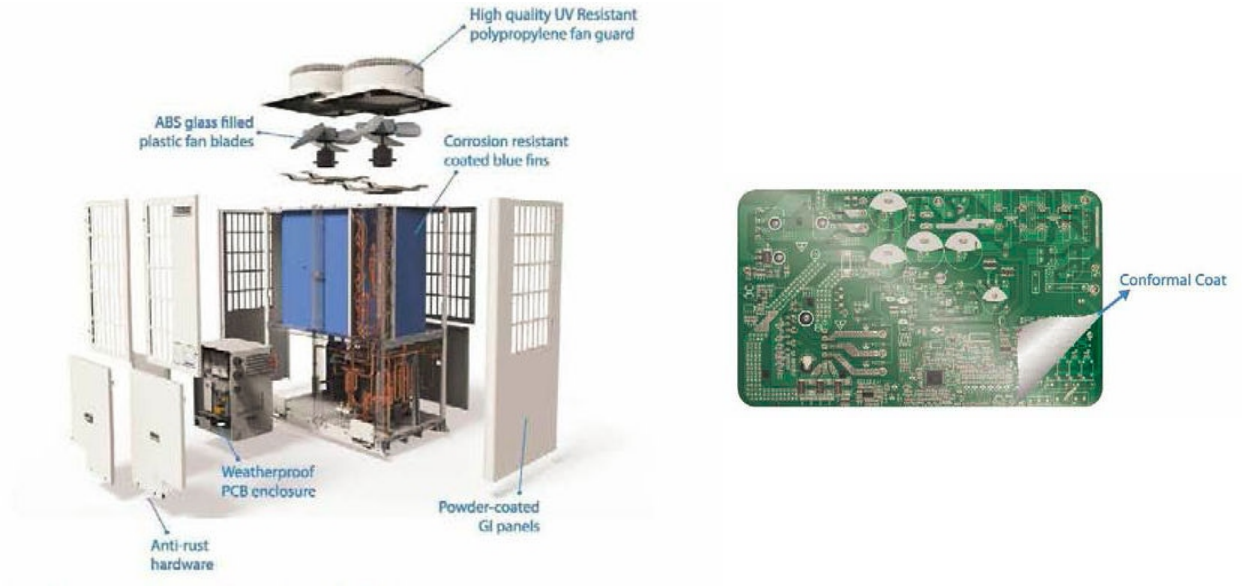
VRF V Plus System

Blue Star's VRF IV Plus System is an energy efficient VRF Air-conditioning System:

1. This system can operate from - 10 deg. C to 56 deg. C. This system can be used for both cooling and heating applications.
2. The system can work without deration in capacity upto 43 deg. C with various specially designed components.



3. Aesthetically Superior Design Units. Refrigerant Piping upto 1 km is possible
4. All units are with special coating for coastal applications. Optional coating for chemical corrosion can be provide to suit the atmospheric conditions.
5. Outdoor units are with weather proof design. Special conformal coating for PCBs improves the reliability



6. Wide Operating Voltage of 320V - 460V is possible
7. Air-handling units can be coupled with these outdoor units with AHU kits.
8. Very high IPLV as high as 7 is possible
9. Low Starting Current results in optimum capacity DG, which is an indirect saving.
10. Sophisticated Electronic Control Options are available: Monitoring of the system though Mobile, PC Monitoring of the system from remote location is also possible.

Inverter Ducted System

1. It is a variable capacity system with inverter compressor. It can offer precise and step less capacity control.

2. With inverter compressor, starting current is very low, which results in less capacity DG.
3. Long refrigerant piping up to 50 rmt is possible
4. Nonstop operation up to 52 deg. C ambient is possible
5. Wide Operating Voltage Range: 340 - 460V

6. Touch Screen Based Control
7. BMS and Group Control Options are available
8. This system can be integrated with air handling units through control kit
9. It is with Eco-friendly R410A refrigerant
10. Blue Star's Inverter Ducted System is Energy Efficient Air-conditioning System. Payback period is less than 1 year as compared to regular fixed capacity system.

Configured Series Screw Chillers

Chillers being installed in Underground Stations for cooling of Concourse and Platform areas needs to be most energy efficient and the focus of this Paper is to dwell on the design aspects of Chillers.

Following are the international and domestic standards which have been used generally to design chillers:

a) Ashrae 90.1 (American Society of Heating Refrigeration and Air Conditioning, a leading international energy stipulating and validation organization)

b) ECBC 2017 (Energy Conservation Building Code – by Bureau of Energy Efficiency under Ministry of Power, Government of India)

Important points to note:

- Both Ashrae and ECBC standards are for Buildings, Underground Metro Stations are not covered in the scope.
- The latest Ashrae 90.1.2016 standards are based on 35 deg centigrade ambient dry bulb temperature for Air cooled chillers and 29.5 deg centigrade condenser entering temperature for Water cooled chillers. The fouling factor for cooler is 0.0001 and condenser is 0.00025 FPS units.
- The latest ECBC 2017 standards stipulate the same operating conditions similar to Ashrae 90.1 as of now.

However India being predominantly tropical country and also due to urban heat effect, the actual ambient temperatures are much higher. Also, the quality of water is also moderate leading to high fouling factors for heat exchangers.

The other important design considerations of Ashrae 90.1 and ECBC are on the annual chiller load distribution pattern as under:

- 100% Capacity – 1%
- 75% Capacity – 42%
- 50% Capacity – 45%
- 25% Capacity – 12%

It is observed that at In-situ conditions most of the chillers will be operating more on part loads than full load and hence the above load distribution may not be realistic.

Hence designing the chiller based on Ashrae / ECBC operating conditions may not yield aspired energy efficiencies in real life situation. Accordingly, taking in to account the vastly different conditions required in India, the Government of India has recently stipulated the Indian Seasonal Energy Efficiency Ratio (ISEER), a measurement for energy efficient chillers.

Design requirements as per ISEER

Ambient air temperature : 39 deg C (for air cooled applications)

Condenser water entering temperature

Fouling factor for Cooler : 0.0005 FPS units

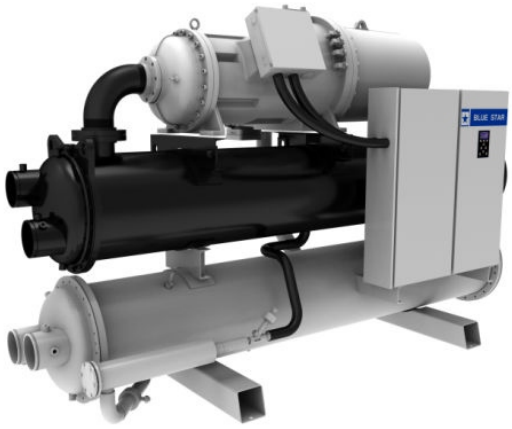
Fouling factor for Condenser : 0.001 FPS units

Co-efficients for load distribution are: 30 deg C (for water cooled applications)

- 100% load – 6%
- 75% load – 48%
- 50% load – 36%
- 25% load – 10%

Even though it can be noted that the ISEER values are more suited to Indian conditions compared to existing standards a better option to design the chillers shall be to take into account the prevailing ambient air and water conditions, for example the ambient air temperatures can vary from 39 deg C to as high as 50 deg C from one city to another in peak summer.

Hence there is no common rule, for example, stipulating the COP (full load energy efficiency) and IPLV (part load energy efficiency) as the required chiller efficiency may not be the right approach.



It is suggested that the most energy efficient chillers shall be selected for the actual project conditions rather than following a general international / domestic standards.

Blue Star's latest energy efficient air cooled and water cooled screw chillers are designed and manufactured exclusively to meet the actual project design requirements. Some of the key features include :

- Chillers are completely customized to match:
  - Exact Capacity (TR)
  - Power consumption
  - Pressure drops across heat exchangers
  - Flow rates
  - Optimized Starting Current, etc.
- Can operate upto 52 deg C ambient temperatures
- Comply the Green Building Norms to qualify for LEED certification

Conclusion

The conditions in India are different and challenging. We need to use differentiated products which can meet the challenges which are unique to India. The latest products offered by Blue Star are not only made in India but perfectly made for India which can set global standards.

About the Author

Mr. S Senthil Thangam, Senior General Manager, Blue Star Limited.

S Senthil Thangam is a Bachelor of Engineering in Mechanical and Master of Business Administration in Marketing from Madurai University. He has also completed the Management Development Programme in IIM Ahmedabad. He has over two decades of experience in the HVAC field and joined Blue Star in 1995.

Senthil Thangam has handled various assignments in the Packaged and Central Air conditioning Products Business in Branch, Regional and All India Operations. He was heading the All India VRF Sales and grew the Business significantly under severe competition from many MNCs. Senthil also played a vital role in the development of many break through differentiated products like VRF IV Plus and Configured series Chillers during his stint as Product Manager.

In 2017, he was elevated as Senior General Manager - PCPD Business. He currently oversees Sales, Marketing, Product Management and Operations pertaining to the Central Air conditioning Products Business.

Senthil Thangam is also a member of ISHRAE and Technical committee of VRF standards for India.

About the Company

Blue Star is India's leading air conditioning and commercial refrigeration company, with an annual revenue of over 4400 crores (over US$ 681 million), a network of 35 offices, 5 modern manufacturing facilities, 2700 employees, 2200 dealers and 600 retailers. Blue Star's integrated business model of a manufacturer, contractor and after-sales service provider enables it to offer an end-to-end solution to its customers, which has proved to be a significant differentiator in the market place. In fact, every third commercial building in India has a Blue Star product installed.

The Company fulfils the cooling requirements of a large number of corporate, commercial as well as residential customers. One of the flagship division of the Company, Packaged and Central Air conditioning Products Division provides the design, manufacturing, installation and commissioning of central air conditioning plants including packaged/ducted systems, variable refrigerant flow (VRF) systems and air cooled& water cooled chillers.

Blue Star is also the largest after-sales AC&R service provider in India, maintaining around 2 million TR of equipment. Its 24x7 call centre handles over 1 million service calls a year.

The Company also offers expertise in allied contracting activities such as electrical, plumbing, fire-fighting and industrial projects, in order to offer turnkey solutions, apart from execution of specialised industrial projects.

Blue Star's other businesses include a complete range of room air conditioners, commercial refrigeration products, residential water purifiers, air purifiers, air coolers, marketing and maintenance of imported professional electronics and industrial products and systems, which is handled by a wholly owned subsidiary of the Company called Blue Star Engineering & Electronics Ltd.

The Company has manufacturing facilities at Dadra, Himachal, Wada and Ahmedabad, which use modern, state-of-the-art manufacturing equipment to ensure that the products have consistent quality and reliability. The Company has a manufacturing footprint of about 1 lakh sq m, producing a complete range of air conditioning and refrigeration products. The Company's mainstay of product development and R&D has been energy efficiency, coupled with eco-friendly and sustainable products.

SESSION-IV

Theme : **Roadmap towards reducing carbon Foot print**

Solar Power Generation & Storage Integrators Engineering, Procurement, Commissioning and Financial Services

ABSTRACT

Mohan R. Krishnan

Prof. Biprodas Dutta

Complete de-carbonization of Indian Railways (IR) is a clear path for: 1) IR to meet its growing demand in energy while lowering its overall costs, and 2) for India, as a country, to achieve its carbon emissions reductions goals set forth by the Paris climate agreement. IR is already transitioning towards electrifying its traction energy needs away from diesel, which in combination with its current infrastructure (stations, warehouses, etc.) ideally positions IR for renewable energy solutions. The heterogeneous public policy landscape (i.e. open access and net-metering implementation) across India presents IR with challenges in the path for complete decarbonization. However, we believe that smart integration of solar power generation systems and advanced, affordable and unique long-life of nickel-iron battery-based energy storage systems that are available today, can surmount these challenges and pave the way towards IR's complete de-carbonization even in regions of India with the most restrictive public policy hurdles. We believe, that such systems will: 1) significantly reduce long-term costs of electricity, 2) reduce IR's reliance on DISCOMs, 3) enhance IR's flexibility in deploying stored energy to reduce/eliminate demand overage costs, 4) reduce IR's carbon footprint, and 5) introduce societal benefits such as creating more employment opportunities and lowering its operational cost which may be translated into societal benefits such as offering concessions to passenger's by way of lowered ticket price and discounted freight charges. In this presentation we present the overall results of a smart solar generation system integrated with a battery-based storage capability which may result in drastic reduction of energy drawn from the grid during sun hours. In addition, stored energy can be deployed to suit IR's best interests.

About the Company

Vivaswan Technologies, Inc. (VTI) specializes in procurement and supply of energy products for private, as well as government organizations across the globe. Our company, has worked very closely with the Indian government, for example, to set up multiple megawatt-scale solar projects since 2009. We served not only in the capacity of engineering, procurement and commissioning (EPC) contractors,

but helped overcome public-policy hurdles that made the first, profitable megawatt-scale solar projects possible in the Indian sub-continent. In addition to EPC, we also specialize in offering financial instruments to fund the projects we design and implement for our clients. VTI has also served in advisory roles for a wide variety of projects that encompass solar-powered irrigation, water desalinization, water pumping, street lighting for public and private entities in the Middle-east, Africa and India.

Encell Technology, Inc. designs and manufactures battery storage and management systems uniquely suited to the requirements of several rapidly growing market segments, including railways, wireless communications, cloud computing, mobile technology, automotive, healthcare and alternative energy such as wind, solar, and wave. Our innovations include patents for battery designs, chemistries, and management tools and enable a complete approach to efficient and renewable power storage that no other available system provides. We serve our markets in two major ways. First, we create environmentally-friendly and highly-efficient battery storage systems to meet the challenges of alternative energy collection and retention. We also develop battery maintenance and monitoring products under the Sentinel™ brand name to enhance the life spans and reliability of these battery systems in power-critical environments.

About the Authors

Mohan R. Krishnan, President and CEO, Encell Technology

- M.S.: Massachusetts Institute of Technology
- B. Tech: Indian Institute of Technology, BHU, Varanasi, India
- COO & CEO, Global Business Development, **The JPM Group**, based in Delhi, India (2010-2013)
- Investment Portfolio Manager and Proprietary Trader, **Deutsche Bank AG** (1999 to 2010)
- Director, , NA Industrial/Marine Business Division , **Rolls Royce** (1993 to 1999)
- Mr. Krishnan started his career at **General Motors** Corporation in 1981 & has experience in advanced aircraft engines and systems, and highly classified weapons and weapon delivery systems

Professor Biprodas Dutta, President Vivaswan Technologies, Inc.

- Ph.D.: Vanderbilt University, Nashville, TN, USA
- M.S.: Georgia Institute of Technology, Atlanta, Georgia, USA
- B. Tech: Indian Institute of Technology, BHU, Varanasi, India
- More than **80 refereed papers published**
- **21 patents** and several book chapters in print
- Solar Power Plant Engineering, Procurement and Commissioning (EPC) Services
- Director, Nanotechnology Center, The Catholic University of America (CUA) Director, Materials Science and Engineering Program, CUA
- Professor of Physics, CUA

Issues in RE Financing : Financing of Solar power plants

ABSTRACT

Pratibha Bajaj

IFC has been one of the earliest and most significant financiers of RE capacity in India, commencing in 2007 when the country had minimal RE capacity. To date, IFC has provided over US$1.1 billion (including mobilization) in financing to 44 RE investments in this sector in India. In the last 5 years, IFC investee companies implemented a total of 4.5GW of capacity, representing 15% of the incremental RE capacity in India. IFC has played an important role by providing global sector knowledge, long-term financing, as well as significant debt and equity mobilization and advisory support on corporate governance and risk management. IFC is also a trusted partner for the central and state governments on policy and regulatory issues.

2017 has been a landmark year in India RE sector. Tariff have fallen below 4.7cents and RE has pierced grid parity in India. At the same time, fall in tariffs has had unintended consequences. State level Government off-takers have increasingly sought to renegotiate/ restructure projects where PPAs have been signed as well as delayed launch of new auctions. Government of India has come out with a New Energy Policy which is seeking to withdraw all incentives and support mechanisms over a period of time as the sector matures. Other issues facing the industry today: (i) Slowdown in project allocation and opportunities to deploy capital (ii) Tariff based competitive bidding and sustainability of the auction model given increase in solar module prices (iii) Deteriorating financial health of state-owned distribution companies in India leading to payment delays to RE developers.

About the Author

Pratibha Bajaj is an Investment Officer at IFC. She has more than 10 years of experience in financing companies in renewables, transport & logistics sector. At IFC, she focuses on debt and equity investments in renewables. Pratibha has a BTech from IIT Bombay and an MBA from The Wharton School, University of Pennsylvania.

About the Company

IFC, a member of the World Bank Group, is the largest global development institution focused on the private sector in emerging markets. Working with more than 2,000 businesses worldwide, we use our capital, expertise, and influence to create markets and opportunities in the toughest areas of the world. In FY17, we delivered a record $19.3 billion in long-term financing for developing countries, leveraging the power of the private sector to help end poverty and boost shared prosperity. For more information, visit *www.ifc.org*.

Low Carbon Development in Indian Railways : Need for a Bold & Ambitious Policy

ABSTRACT

Policy commitment for aggressive low carbon development in Indian Railways

Shubhashis Dey

During 2013, transport sector emitted around 7.5 billion tCO_2 which is 23.4% of global CO_2 emissions. While railways transported 8% of the world's passengers and goods. The CO_2 emissions by railways is only 3.5% of total transport CO_2 emissions.[1] The global emission reduction target set by the International Union of Railways (UIC) is in line with the trajectory of the 2 Degree Scenario (2DS) outlined in the IEA Energy Technology Perspectives publication (IEA 2016a). Countries like China and Russia are leaders in providing low carbon rail services. China has the lowest per passenger-km energy consumption (40 kJ/pkm) and the lowest CO_2 emissions per passenger-km (7.0 gCO_2/pkm), while Russia holds the lowest rate of energy consumption per tonne-km for goods transport by rail (86 kJ/tkm) and the lowest specific CO_2 emissions from freight (9.0 gCO_2/tkm).

Back home, Indian Railways' vision on low carbon growth promotes a green environment and clean energy while making the Indian Railways a global leader in sustainable mass transport solutions. Indian Railways is committed to promoting energy conservation, renewable energy integration and railway electrification. The specific CO_2 emissions of Indian Railways fell by 37% for passenger services and by 24% for freight services between 2000 and 2013.

With around 75kJ/pkm passenger-km energy consumption, India is yet to achieve global leadership.[2] To take a global leadership role in low carbon transportation and contribute extensively to India's climate commitment, Indian Railways must announce time-bound and bold policy commitments. The scale of such commitments must be comparable to the time-bound aggressive commitments taken by other sectors, for example, 175Giga Watts renewable energy integration, affordable housing (Pradhan Mantri Awas Yojana) for all by 2022 and Pradhan Mantri Ujjwala Yojana - providing LPG connections to 50 million below-poverty-line families in three years.

About the Author

Shubhashis Dey, Program Manager, Shakti Foundation

1. Source: Railway Handbook 2016 data
2. Source: Elaboration by IEA and Susdef based on IEA (2016b) and UIC (2015a)

Indian Railway's RE Procurement Strategy

ABSTRACT

Anurag Mishra

In 2015, the PACE-D's engagement with IR started when the National Government set an ambitious RE target of 175 GW by 2022 and requested various government agencies to consider deploying solar energy. IR took the leadership role by setting up a 50 MW solar rooftop program, with the primary goal of reducing the cost of energy in the long term. Initially, the PACE-D Program supported IR in deciding on the procurement strategy through building better understanding of the procurement models (CAPEX and RESCO), selection of railway stations, site surveys to identify potential in selected railway stations, technical issues (integration with existing structures without compromising on the safety, integration with existing system, etc.), and awareness programs. Building on this work IR decided to procure more solar rooftop power for its railway stations, for which the Program provided technical assistance for the second tranche of 100 MW through RESCO and 8 MW under CAPEX model (for small railway stations). With the significant fall in solar prices and response of the initial solar procurement, IR set an objective to meet its 8% Renewable Purchase Obligation (RPO) by 2022 and alternate decarbonisation strategy. With this objective, PACE-D and IR initiated this study to develop a strategy to increase RE in the energy mix of IR in the most cost effective way.

The study covered eight states--Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Rajasthan, Odisha and Madhya Pradesh--and also estimated the potential cost savings that IR can realize through such substitution of 8% (RPO) of RE.

IR has two types of loads traction and non-traction. It has three options to offset non-traction loads viz.; 1) procuring electricity from solar rooftop projects, 2) ground-mounted captive generation plants, and 3) power procured using open access from third-party wind and solar projects. IR, being a Deemed Distribution Licensee, can meet its traction loads under open access by directly procuring power from energy exchanges, and long term contracts with generators anywhere in India. Open access costs vary depending on the location of generating plant and consumption centre, voltage levels, and state or central transmission utility network.

The following analytical framework was applied to arrive at the appropriate RE mix for each state:

i. IR's demand for the selected states was mapped, RPO requirement estimated, and the current procurement sources and costs were analysed.

ii. State wise procurement cost curve was analysed for solar and wind projects and results compared with the utility procured costs to identify best case for sourcing energy.

iii. With a focus on energy cost minimization for IR (for 2022), an optimal RE mix was developed for the states.

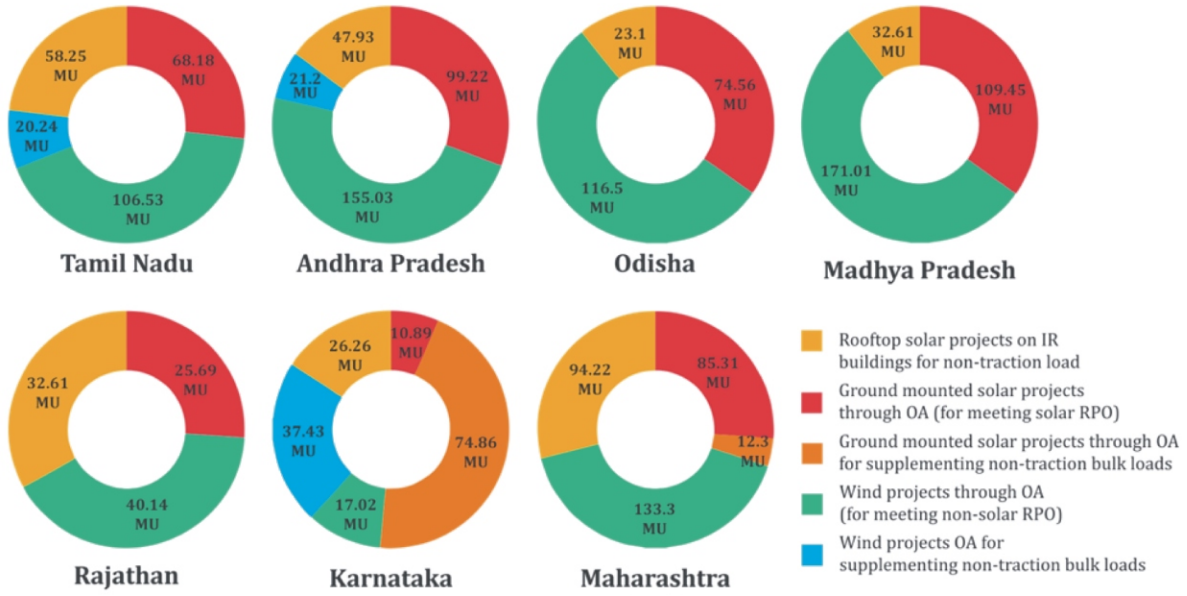


Figure : State wise RE procurement quantum (MU) prescribed to IR for 2022

The output of analysis is depicted below, where the IR's traction and non-traction power demand in the each state is mapped against the potential RE sources and their quantum envisaged.

The strategy to meet 8% RPO will lead to savings of INR 5131.6 million for IR[#], as shown below :

Table : Annual saving potential (in million INR) by opting for RE procurement options for 2021-22

	Odish	Andhra Pradesh	Madhya Pradesh	Rajasthan	Tamil Nadu	Karnataka	Maharashtra
Open Access solar and wind for meeting RPO	529.9	874.6	810.5	105.2	273.6	75.9	767.5
Rooftop PV	30	104.9	77.2	88	139.8	85	483.3
Open Access power for non-traction bulk load	-	64.2	-	-	31.8	452.4	38.7
Total Savings	559.0	1043.7	887.7	193.2	545.2	613.3	1289.5

Source : PACE-D Analysis

The cost of generation (wind/solar) was initially considered to be INR 4.5 as stated by SECI, in 2015. However, with the falling RE prices, revised market derived costs have been considered (INR 3.95 for rooftop, INR 3.00 ground-mounted and wind projects). This is a fundamental assumption considered for all calculations.

This study concluded that 1) procuring renewable energy brings significant cost efficiencies for IR, 2) SRT, Open Access, Solar and Wind and are three major options for IR in all the states, 3) IR needs to analyze the technical feasibility of these options to move to a 100% de-carbonization of IR loads, which poses several implementation challenges due to infirm nature of power. However, as discussed in this study, even with partial de-carbonization, significant savings for IR can be realized. As open access costs, regulations improve and the cost of renewable generation falls in resource rich states, further enhancement of renewable mix can be attempted.

This study helped IR to scale-up its solar rooftop program implementation (150 MW tendered out of 500 MW planned) and has also started to procure energy from large RE plants through open access. IR is also exploring options of captive and net-metering rooftops coupled with marginal energy storage to reach full de-carbonization in stations and buildings. It is also developing inter-state procurement and scheduling options for meeting its increasing traction electrification plans. The framework on this analysis can also be utilized by other large consumers for developing their RE strategies.

About the Author

Mr. Anurag Mishra is Senior Clean Energy Specialist with the Clean Energy & Environment Office of USAID/India. Mr. Mishra holds Master's degree in Environmental Planning from School of Planning, CEPT, Ahmedabad. He has extensive experience in the field of Climate Change, Energy and Sustainable Development. Mr. Mishra has managed Govt. of UK's Low Carbon High Growth Programme with FCO/DFID. He also managed GIZ's ComSolar Program under Indo-German Energy Program and worked with various international organizations and government agencies.

About the Company

The Partnership to Advance Clean Energy - Deployment Technical Assistance (PACE-D TA) Program is a flagship bilateral program under the U.S.-India Energy Cooperation. The six year initiative is led by USAID and the U.S. Department of State and implemented in partnership with the Ministry of Power and the Ministry of New and Renewable Energy. The Program is focused on three key components: energy efficiency (EE), renewable energy (RE) and cleaner fossil technologies, with the overall aim of accelerating the deployment of clean energy. As a part of its renewable energy interventions, the Program has been providing technical assistance to Indian Railways (IR) since 2015 to scale up the organization's adoption of EE and RE technologies with a long term goal of decarbonizing IR's operations and reduce the cost of energy.

Intercity Freight Transport – Modal Choice shift

ABSTRACT

The tool focuses on the 7 corridors that account for major freight traffic in the country. The tool builds on the research around top industrial commodity in these 7 corridors. A mode choice model is used for travel times, distance and cost to forecast tons by model. For port tonnages, Growth rates are applied to calculate future year forecasts. The model can be used to perform scenario analysis that will help understand modal choices for goods movement and give insights on how to increase rail mode share.

Chirag Gajjar

About the Author

Mr. Chirag Gajjar leads Mitigation for WRI India's climate program. In this role, he focuses on carbon pricing, science based targets, GHG measurement and management, and engaging policy makers on long-term de-carbonization strategies. He is the lead author of Internal carbon pricing primer that aims at providing a framework for companies to estimate and implement internal carbon pricing schemes. He has nearly 12 years of experience in working on carbon markets. He has been instrumental in supporting various Indian businesses to adopt internal price on carbon. He also developed an excel based tool which helps determining abatement costs for organizations. Chirag has been involved in some of the ongoing research work on carbon pricing including "Internal Carbon Pricing Primer", "Global Carbon Markets Study", and "Carbon Markets in India: Prospects & Design Considerations".

About the Company

WRI India is a research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being. Our work aims to effect real change and our approach relies on a three-step approach: Count it, Change it, Scale it. More details available on : http:/wri-india.org.

Road Map on Reducing Carbon Footprint in Indian Railway

ABSTRACT

Arun Kumar

The salient features of the presentation will be as follows :

- Transportation sector is the biggest GHG emitter in the world, responsible for more than 22% of the total GHG emission
- It is quite evident and establish facts that Railway transit system is more carbon friendly than other transportation mode; as per some European studies, the CO2 emission (g-CO2/Person Km) for Railway is the lowest (19 g-CO2/Person Km) while Bus, Aviation and Automobile have emissions of 51, 109 & 147 respectively
- As per data published by Planning Commission / NITI Aayog (2014), emissions from road sector was 123.55 million tons of CO2 while rail sector, which is quite extensive and well spread in the country, contributes 6.84 million tons of CO2 in 2007
- To assess and reduce the carbon footprint in Railway we should concentrate in the following three major categories (in the order of priority)
    - Efficiency improvement through
        - Technological retrofits
        - Improvement of energy-mix towards carbon neutral energy sources
            - Conversion of more existing diesel traction to electrical traction
            - Maximum usage of Renewable Power through effective synchronization of demand and supply-side management
            - Utilization of decentralized RE power system for access of power to the remote operative locations
            - Utilization of available rooftop and huge land-base available with Indian Railway to generate Solar Power
        - Lifecycle approach for the New Development
            - Lifecycle Carbon accounting and reduction strategies should be integrated at the planning stage for the new development in Indian railway
                - Material planning
                - Design
                - Operative efficiency
                - Future energy sources and security

About the Author

Mr. Arun Kumar, Group CEO, Mittals Group, carries with him over 24 years of Power Sector experience where he has worked on multiple aspects including in the area of investment banking as well as management consulting with leading global brands.

He has serviced clients globally including the ministry of power, regulators, donor agencies, utilities both state and private as well as leading funds globally looking to invest in power sector. He recently helped the national utility in Afghanistan (DABs) in their Business Process Improvement and supporting their corporate management. Mr. Kumar did his M.A. (Economics) from Delhi School of Economics and MBA (Finance) from IMI, New Delhi.

He has previously worked as Director-Power Utilities with HSBC, as Associate Director with KPMG, as Head Power Practice for CRISIL Infrastructure Advisory & Principal Consultant with PA Consulting Group.

SESSION-V

Theme : **Moving IR towards 100% Electric Traction**

Railway Electrification & Mechanization

ABSTRACT

To meet the demands of modern networks regarding the speed, safety and economy, Geismar group have developed since a very long time particularly equipment adapted to these constraints;

In a context where the working windows time reducesinexorably at the same time than progressively the number of traffic increases, oblige us to think differently our approach of work for railway electrification.

Three modes of catenary equipment are particularly adapted for the respect of this objectives, concerning electrification project on new lines or renewal or transforming.

Sandeep Ghalyan

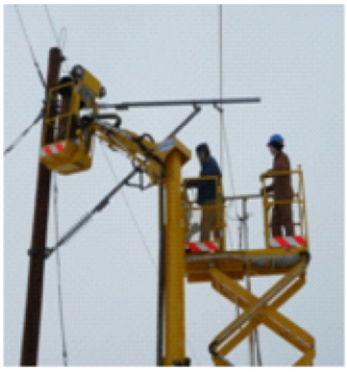
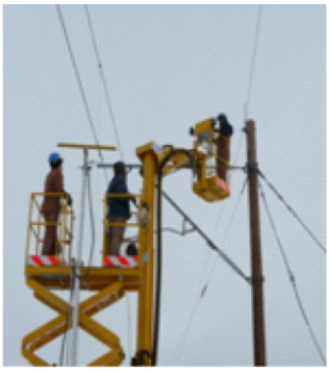
1) Rail Road vehicles

From the civil engineering to the catenary parameters recording, all the catenary works can be done by rail road vehicle;

The KGT can ensure the drilling, digging, mast erecting works from the embankment or on the rail. Those cranes are not classic road cranes but chargers fully designed and dedicated for railway, able to drill holes 3,5m deep at 7m from the track axis or hold a 1 Ton pole at the same distance.

The VCP are light, compact and easily maneuverable equipment with noises and pollution limited. There are able to climbon the rail 1,10m high without any damage. Capable of a long-range of work on rail and out of the rail. 3 people can work simultaneously on the VCP, One on the pole max at 9,5m high and 2 on the catenary at 7,8m high. Can be equipped with a lot of options as generating set, winch, tilting mast, trailer, measuring system.



The V2R are rail-road trucks fully modular able to receive kit fixed by twist lock as containers. On these kit can be installed platforms for 6 people, elevating Jib & cradle, crane, reels stands for 2 cables allow to wire at 1 ton in each and mast for the cables installation and setting.




Why theses rail-road are so efficient? Because easy and fast installed on track, it is not necessary to wait a convoy or a train (sometime for a long period) as soon as you receive authorization. Quick on track and off track at the last minute, you can save a lot of time and money. You can start at the exact place you finished the day before. All our Geismar equipment are manufactured under CE standards and for most popular European railway networks where the safety material requirements oblige sometimes to triple the levels of emergency.

2) Wiring equipment

Many manufacturers are able to design wiring equipment but Geismar have made and provided a lot of dedicated equipment, to be installed on local wagon or self-propelled wagon allowing to unroll until 4 new wires and cables and rerolling simultaneously 4 old one. Of course our system unroll the wires and cable at the definitive tension but as our system increase the tension accordingly to the friction of the wires and cables in dedicated rubber grooves, the wires are stretched and at the outlet of the tensioner, the contact wire is straight without any irregularities and waves. All our system can be fully reversible, also to go faster and easier it is not necessary to choose the side of arriving on the work site.



3) Fast link OHL installation

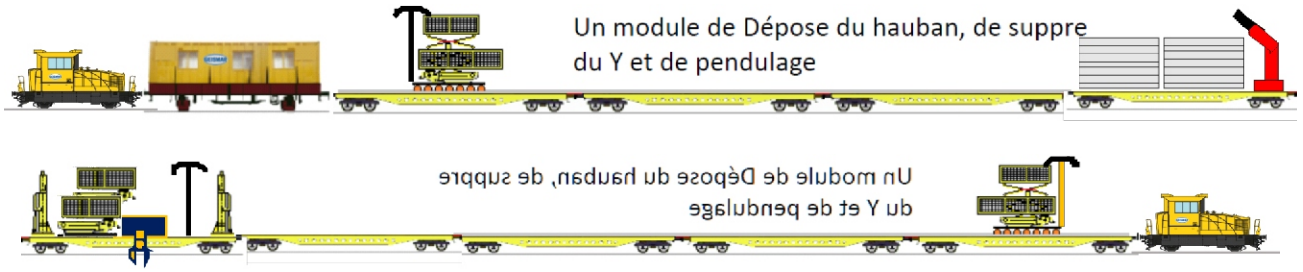
Like the fast link track installation, capable to change and renewal 1km of complete track, ballast and sleepers included per night, the fast links OHL installations are complete and autonomous train, on which run equipment on dedicated guiding ways.

The fast link OHL installation allows continuously replacement of all the catenary structure and wires.

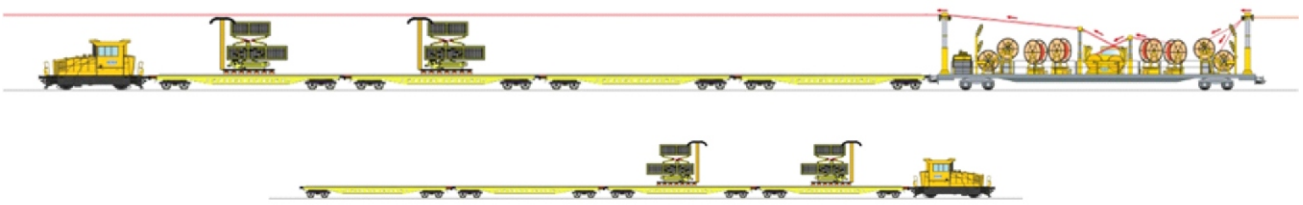
We design and manufacture 3 types of fast links OHL installations:

1) *for the civil engineering works and structure replacement*

2) *for cantilevers, tensioning devices, beams and connecting part change*



3) for wiring, rerolling and droppering



The principle of such a train is to limit the number of machines on the same area.It also limit all the risks of collision, the damage of security and the number of players. However, it increases the speed of execution. Less machines, less workers and best performances contribute to get a lower price.

About the Author

Shri Sandeep Ghalyan, National Manager – Sales and Technical

Sandeep Ghalyan, A First Class Mechanical Engineer, has been working within the Railway Industry for more than 14 Years. Beginning with On Load NO 32 Tap Changers for Electric Locomotives. He has a deep knowledge on Rolling Stock and Railway Infrastructure. He is an expert on "Microprocessor Based Railway Air Brake Systems". He had worked on Delhi Metro RS-2 and RS-10 Projects as well.

Deeply involved in the Technical parts of business of GEISMAR India. He is in-charge of all the commercial and technical matters of GEISMAR India. He is responsible for introducing the Technically Advanced solutions of GEISMAR Group for Railway Electrification and Track Monitoring and Maintenance, to Indian Railway Industry.

About the Company

Société Des Anciens Etablisssements L. Geismar known as ***"Geismar"*** is specialized in the design, manufacture and supply of machinery dedicated to track and overhead line installation, Monitoring, maintenance and renewal.

Established in 1924, Geismar has one of the most comprehensive range of Technically advanced and quality equipment for track and OHL laying, Monitoring, maintenance & control that goes from light maintenance tools (rail saw, portable power wrench…) to heavy duty equipment such as OHL rolling and unrolling wagons or track laying and renewal systems. With a consolidated turnover of €175m in 2014, Geismar is largely international company with 90% of the company's turnover achieved with customers from over 120 countries; a performance which has been acknowledged by several government export awards.

Geismar employees a staff of c.1,000 working for 20 group companies located across the world.

Static Frequency Converter

ABSTRACT

Arunav Kumar Jha

Shantha Kumar

ABB is a pioneering technology leader that works closely with utility, industry, transportation and infrastructure customers to write the future of industrial digitalization and realize value. The presentation will be highlighting the technology solutions like

- Conventional Feeding system, which provides simple solution with certain drawbacks. Few highlights of the system are Non optimal catenary voltage, High catenary short circuit current, higher peak demands, lower overall traction system efficiency, unbalance effect on public grid, high harmonics injected into supply grid from traction vehicles etc. Further, power flow cannot be controlled and regenerative energy cannot be captured in the system.
- Under Static Frequency Converter, the SFC Feeding concept, advantages over conventional feeding concept, Parallel Feeding & advantages and summary of the SFC benefits have been discussed.

Further the schematics, footprint & site observations points have been shown & discussed in details for the Project Wulkuraka.

Details regarding ABB's experience with SFC Technology delivery have been briefly discussed highlighting the following:

- Largest installed base / more than 40units in service, more than 1.2 GW SFC installed power
- More than 20 years of experience in applications for rail power supply
- Proven control and protection algorithms for 50 Hz and 16 Hz
- Satisfies high reliability and availability demands
- For 50 Hz:
  - Wulkuraka, Queensland Rail, AU 1x 16MVA, commissioned in 2016
  - Potteric Car, Network Rail, UK awarded in May 2017, 1x42 MVA

Benefits of the converter based railway power supply system have also been highlighted, e.g. reachable longer feeding distance, reduced active power consumption, improved fault behavior, reduced catenary short circuit current, excellent fault ride through behavior (both sides), continuous stable operation during grid single phase fault, achievable improved system efficiency and many more.

About the Authors

Mr. Arunav Kumar Jha, B.E Electrical & Electronics, with an industry experience of 11+ years has executed several Greenfield projects in Iron & Steel industry, e.g. Steckel Mill & Steel Melt Shop through focusing on expanding FACTS business in India region across businesses from Steel, Utility to Rail for the last seven years.

Mr. Shantha Kumar, M S, M. Tech, with specialization in Static Frequency converters (SFC), AC & DC drives, Motors & Generators, Automation and SCADA, Railway converters, MV FACTS and having more than 20 years industry experience. He has further specialized in large and critical Static frequency converter systems, AC Drives. He has also executed several projects and implemented latest technology based SFC solutions in Power plants, Oil & Gas, Metals and Lift irrigation projects.

Key projects are as follows:

- TATA POWER, Bhira – 14 MW SFC for starting and stopping 180 MW Hydro Generator, very high fault current isolation Reactors
- GSECL, Gujarat – 16 MVA SFC for Gas Turbine Generator
- Kalwakurthy LIS, Telengana - 7 MW SFC for Starting 5x30 MW Pump Motors
- TATA STEEL, Orissa – 3 x 29 MW AC Drives for 132 KV voltage dip mitigation, 70 MVAR filter system
- Indian Railways - Indigenization of GTO converters for Railways as per RDSO specification.

RILA to improve OHL design

ABSTRACT

Jack Vogelaar

India's ambition is to electrify large amounts of their network in a very short time frame. Normally electrification is also a driver for train speed upgrade, therefor not only reducing CO2 emissions but also shortening travel times. A solid design of the track and overhead line is a pre-requisite to achieve the set goals both in timely deliverance and costs. An exact 3D surveyed model of the railway, inclusive of all track geometry parameters (alignment, super elevation) and including a geo-referenced video of the track and is the best basis for designers to engineer the desired track – OHL configuration. New technology applied in the United Kingdom, is now delivering such a dataset; over 3500 km of 3D model has been supplied for OHL engineering input. The RILA technology, now in the Standards of Network Rail, surveys the track and its surroundings on the rear of a (revenue earning) train at line speed. There are no staff in or near the track during the survey. The accuracy of the data is comparable to the best terrestrial survey available. The paper will describe this new exiting RILA technology and its applications for electrification projects.

About the Author

Mr. Jack Vogelaar is one of Fugros principal rail consultants working in the railway industry for over 35 years. Starting as land surveyor Mr. Vogelaar worked his way up to geospatial quality manager of the Dutch rail infrastructure manager Pro Rail involved in numerous construction and electrification programs. In the 20 years Mr. Vogelaar worked for ProRail he was also a designer for track and OHL. During his employment with Dura Vermeer, Mr. Vogelaar was responsible for the design and positioning of the new constructed electrified railway between Amsterdam and Utrecht and monitoring of the environment during construction of railway tunnels and excavations. Now at Fugro Mr. Vogelaar uses his well-known experience in the railway industry to explore new technology like the RILA technology whether these new technologies are able to improve the performance of railway managers, engineers or constructors.

About the Company

Fugro is the world's leading, independent provider of geo-intelligence and asset integrity solutions. We accumulate geo-intelligence by acquiring and analyzing data on topography and the subsurface, soil composition, meteorological and environmental conditions, and by providing related advice. With our geo-intelligence and asset integrity solutions we support the safe, efficient and sustainable development and operation of large facilities and infrastructure and the exploration and development of natural resources. We serve clients in a range of markets both in land and marine environments supported from a global network of offices located in around 60 countries.

Adoption of New Technologies for Indian Railways

ABSTRACT

Adoption of New Technologies that ramp up the speed of execution is of immense importance to achieve the targets of Mission Electrification. L&T has been in the forefront in adoption of new technologies for the electrification of the entire length of WDFC (3145tkm) and also major sections of EDFC. It has recently embarked on the first large scale EPC electrification projects under Mission Electrification.

The presentation would focus on Cylindrical Mast foundations, Constant Tension Conductor Installation Wiring Train and also way ahead in evolving Contractual models for a win-win approach.

Rajeev Jyoti

About the Author

Mr. Rajeev Jyoti, Chief Executive – Railway Business is an Electrical Engineer from Indian Institute of Technology, Delhi and has done Post Graduate Diploma in Management from Indian Institute of Management, Ahmedabad.

Mr. Rajeev Jyoti, Chief Executive-Railway Business Group holds the responsibility of undertaking various Railway Projects in the field of track laying, electrifications and systems including Signalling & Telecom for both Main line and Urban Transit sector for Indian and International markets.

Railway Business Group is a key player in constructing the largest ever infrastructure project by Indian Railways of building 3,300 route kms of Dedicated Freight Corridor (DFC). In this project L&T is executing packages in the domains of Civil & Track, Electrification and Signaling & Telecom with a total value of the order of Rs. 21,000 Cr. (3.4 billion US$).

In addition, it is engaged in over 40 projects across India for Indian Railways, Private Industry and Metros. It has a strong engineering resource base in design, engineering & project. In the Urban sector, Railway Business Group is executing Electrification and Ballast less track packages in numerous metro including Delhi, Chennai, Lucknow, Hyderabad and Riyadh. Railway Strategic Business Group is also currently executing the first of its kind Monorail project in India for Mumbai Metropolitan Region Development Authority (MMRDA) at Mumbai.

Past Experience

Mr. Rajeev Jyoti has over three decades of industrial experience with leading MNCs in the areas of Rail Transportation, Power Sector particularly Transportation, Power distribution and Industry segments.

Prior to joining L & T, Mr. Jyoti was President & Managing Director of Bombardier Transportation India for over a decade leading diverse projects. These include start-up operations from green field, manufacture of Metro coaches by setting up a state-of-art production plant in Vadodara, transfer of

high end technology for Propulsion & Control equipments used in Electric Locomotives and setting up an advanced engineering center in Hyderabad with over 350 engineers to support Bombardier's Global operations.

He has also worked with leading organizations like ABB, Alstom and BHEL in the areas of Strategy, Operation, Marketing, Turn around Management and leading high technology projects.

Industry Associations

In the last decade he had been actively involved as an Industry leader in evolving Public Policy with Government of India (Planning Commission, Ministry of Urban Development, various Metro Authorities and Indian Railways) in the domains of Mass Transit (Metro Rail) and Mainline Railways (Indian Railways) respectively to facilitate private sector investment/ FDI in large infrastructure projects, critical for growth of Indian Industry. He held the position of Chairman of Rail Equipment Division of Confederation of Indian Industry (CII) for the period 2006-2011 and built it up into a proactive body to drive the growth of Rail Transportation Business in India.

SESSION-VI

Theme : **Bio Diesel - Technology & Solutions**

Bio-CNG: A Green alternative to Fossil Fuel

ABSTRACT

Clean and Green Energy is the order of the day, today. Then what is better than Renewable Energy that ensures health of Environment and makes the progress much more sustainable. In this, the answer to the gaseous fuels is only one and that is Biogas or the purer form of Biogas – Bio-CNG.

Bio-CNG is gaining popularity and importance as it is not only providing energy but also helping in a major way in the Waste Management. All organic waste can be commercially bio-methanated using the right technology. Railways in that sense have a lot of solid and water waste generated at the stations due passengers, vendors, visitors and employees. They also have lot of organic waste generated in trains due to passengers and pantries. This is both food waste and sewage waste. Both can be gainfully used for making bio-CNG though from different routes. Lot of sewage waste that goes through the open system not only creates environmental pollution, but is also a threat to the railway tracks as it corrodes them. It will be really beneficial if closed systems are used and the waste is collected at designated stations for conversion to biogas and bio-manure.

Rajiv Agarwal

The purification of the biogas to Bio-CNG makes it equivalent to CNG with a better calorific value. It renders the gas useful for locomotive fuel replacing the expensive Diesel and CNG. At the same time, the Bio-CNG can also be used for replacing LPG in Canteens, Pantries and Restaurants.

Praj has developed suitable and specific solid bio-methanation technologies that are efficient, easy to install and have a long life. This is ably supported with purification systems to obtain Bio-CNG of highest quality.

About the Author

Mr. Rajiv Agarwal, Ex. VP – BCNG, Praj Industries Ltd, Pune

A Chemical Engineer from IIT Kanpur and PGDM from IIM Bangalore, Rajiv has been a techno-commercial person. He has over 30 years of experience in developing new areas of businesses and in guiding Research and Development for launching new products in the market. He has had a rich experience in different industries navigating through Petrochemicals, Fine Chemicals or Pharmaceuticals, Specialty Chemicals, Nano materials, Bio-Technology, Nutraceuticals and now Bio-Fuels.

He has laid foundation of new businesses like Surfactants for India Glycols, Non-Beta Lactums for Max Pharma, and Nutraceuticals for Tata Chemicals. Rajiv has grown the businesses he was responsible for, through introduction of new product concepts and moving up in the value chain to niche areas.

He made his foray into the Bio-Fuels sector while he was in DSM introducing the concept of Bio-CNG for the value addition of biogas. He spear headed the process development and optimization of Biogas production from different substrates. Starting from the traditional cattle manure, to press mud, vegetable waste, and ligno-cellulosic waste, the technologies are now ready for implementation through Praj. In Praj, he is leading the Biogas initiative offering technology and plants to leading distilleries, STPs, Sugar Mills and Municipal Solid Waste to Biogas and bio-manure players.

Bio Diesel- Ethanol & its Opportunities

ABSTRACT

A sustainable approach in terms of increasing the development of an efficient bio - fuel industry could be the best possible scenario to ensure the energy security criteria of the country. In this context, promotion of Ethanol as a fuel through robust policy measures is being rapidly expanded through exploring various options on a larger scale in India. To further explore the benefits of Ethanol, there is a requirement of policy intervention in terms of flexible strategies on pricing as well as incentivizing the industry.

Dr. Vidya Murkumbi

To deal with the financial problems faced by the key stakeholders like farmers and sugar mill owners in the supply chain market of ethanol, the upstream prices of the raw material and supply allocation are required to be streamlined. In order to minimize losses and delay in payments during periods of depressed sugar prices, surplus sugarcane juice can be diverted for ethanol production to stabilize the sugar prices and enhance domestic supply.

To bring stability in the market of supply, farmers involved in the cultivation of sugarcane must be provided with the necessary inputs at affordable rates to encourage them to follow the cultivation cycle of sugarcane without switching to other crops. In order to ensure viability of sugarcane cultivation, farmers must be protected from the various exogenous circumstances also by providing adequate irrigation and resilience support (e.g. relief in the debt structure for the farmers for a short timeline).

At the recent time, by addressing these issues at government level, there has been a growth observed in the ethanol market which has its benefits to the stakeholders.

About the Author

Dr. Vidya Murkumbi, Executive Chair person, Renuka Sugars & Director, Ravindra Energy Limited.

Her industrial experience began with her association with Murkumbi Bio-Agro Private Limited and Murkumbi Industries Private Limited which were engaged in the production of bio-pesticides and bio-fertilizers. She later co-founded Shree Renuka Sugars Limited in year 1998, which has, under her able guidance and within a short span of time, with global revenues of over $1.5 billion, has become one of the largest sugar and ethanol companies in the world.

With her focus, Ravindra Energy Limited which was initially into coal business has now forayed into Solar Energy domain and has quickly covered all the major segments like Solar Pumps, Rooftop Solar and Ground Mount power plants as a EPC player & Project Developer. Ravindra Energy has installed over 1000 solar pumps in the last 2 years and was recently awarded by Ministry of New & Renewable Energy (MNRE) for its efforts in the segment. The company is also in the process of completing design and development of 37 MW of Ground Mount projects in Karnataka and has also emerged the lowest bidder for development of Solar Rooftop projects in Karnataka & Maharashtra under SECI scheme.

In addition, she is also the guiding light for not-for-profit "Shree Renuka Sugars Development Foundation" which works in the areas of education and healthcare, focusing on farmers, agricultural workers and the rural community.

She was conferred with an Honorary Doctorate by Karnataka State Woman's University in the February 2011, & also received many other awards for contribution in Industrial growth of Karnataka & Maharashtra.

Bio Diesel- Green Commitment of Indian Railways

ABSTRACT

Biodiesel has been successfully incubated and includes robust infrastructure. Some support needed in terms of the following:

- Testing facilities
- Tankages

It is further economically & environmentally beneficial. The following issues are to be addressed for more successful implementation of the same:

- The pricing concept needs standardization
- PVC could be considered
- Feedstock could be bench marked

Sandeep Chaturvedi

About the Author

A Chemical engineer with vast international marketing experience for lubricating greases and oleo chemicals. Built a plant for continuous cracking of castor methyl ester to make aromatic chemicals and pioneered Biodiesel in the country. President of Biodiesel Association of India (BDAI) which is promoting the biodiesel industry in India since 2006. Considered an expert on biofuels, ***Mr Chaturvedi*** essayed a key role in bringing amendments to the National Biofuels Policy Direct sales of Biodiesel to Consumers. Was associated with various working groups including the Planning Commission of India (2004-05) & also Member working group on Biofuels MNRE (2012-2017).

Affiliation:

- President , Biodiesel Association of India (BDAI)
- Member BIS committee for Petroleum and their related Products
- Members Biodiesel Implementation Committee of MoP &NG
- Member State level Steering Committee(Bio Energy) UP.

Alternate fuels for Indian Railways

ABSTRACT

Dr. Anirudh Gautam

Indian Railways Organization for Alternate fuels has been actively involved in promoting renewable alternate fuels on Indian Railways. This is being done to reduce dependence on petroleum imports and use indigenous fuels as also reduce emission of harmful emissions and greenhouse gases due to traction and other uses by Indian Railways. In this regard, IRoAF was instrumental in introducing 5% biodiesel on all the diesel locomotives of Indian Railways as well as setting up biodiesel production plants in-house by IR. Biodiesel industry in India has picked up due to the efforts made by Indian Railways and Zonal Railways have started procurement of biodiesel for blending with diesel fuel. RDSO has been conducting experiments with higher blends of biodiesel and has also cleared up to 10% blends of biodiesel with diesel. Thus 10% of foreign exchange will be saved due to this initiative and this money will be circulated in India in Industry, Agriculture and logistics. IROAF has also introduced about 20 natural gas DEMUs power cars by blending diesel with natural gas. This has reduced the diesel consumption on the DEMUs by more than 20%. This work has been made possible by working closely with the OEMs and RDSO. IROAF now plans to build the first LNG based locomotive for Indian Railways for which the project is already sanctioned by the railway board.

As a long term vision and in accordance with the directions from the Hon'ble PM and the MR, use of indigenous high ash content coal to produce methanol for use as fuel has been taken up. DST of GoI has approved a project to convert one HHP diesel locomotive to run on methanol. This is on the initiative of the Niti Ayog and the methanol will be produced from indigenous coal. Similar approach has been taken up China to use coal to methanol fuel to power almost 2 million vehicles. Methanol is also being considered the best form to store renewable energy like solar and wind, therefore all the more reason for IR to make a switch to methanol as fuel.

IRoAF is working with RDSO and ICF to design and develop a methanol fuelled train set for commuter services. A similar prototype has been produced by a company called ALSTOM in Germany which will start commercial service in 2018. Life cycle assessment of this technology has brought out very low well to wheel energy consumption, GHG gases emissions and pollutants emission.

About the Author

Dr. Anirudh Gautam is a mechanical and electrical engineer from prestigious SCRA scheme of Indian Railways. He has served initial years on the Indian Railways in the maintenance of the carriage and wagon, maintenance and operation of steam locomotives, operation and maintenance of diesel locomotives and train and crew management in the challenging Eastern Sector of Indian Railways. He then worked in the area of manufacture of diesel locomotives at Diesel Locomotive Works, Varanasi

and moved to the niche area of design and development of diesel engines for the locomotives. He is credited with design of the first hotel load feature on an export locomotive and was instrumental in building the first indigenous EMD design locomotive in India at DLW. He has developed world's first ALCO locomotive electronic fuel injection system which has been commercially successful. He developed the mobile Emission Test Car which has been used for measuring pollutants levels from diesel locomotives of Indian Railways. He has been working on the research and development of alternate and advanced propulsion systems. His main areas of interest are energy production devices, fuel cells, hybrid power trains and sustainable motive power systems, control systems development and structures optimization.

Dr. Gautam is recipient of various awards by the Ministry of Railways, including the coveted National Award for Outstanding service by the Minister of Railways. He is currently working on development of highly fuel efficient engine technologies for locomotive engines, design and development of natural gas engine technologies, use of methanol on locomotive engines and reduction of emissions from locomotive engines. He is working on developing fuel cell based hybrid train sets which is the future of railway traction. He holds a Masters in Quality management from BITS Pilani, a Masters of Engineering in Engine Systems from University of Wisconsin, Madison, USA and a PhD in renewable energy and transportation from IIT Kanpur.