CHRONICLING PROCESS INDUSTRY INNOVATIONS SINCE 1966 VOL.60 | ISSUE 1 | JANUARY 2025 | MUMBAI | TOTAL PAGES 54 | PRICE ₹ 150

CHEMICAL ENGINEERING WORLD

www.jasubhaimedia.com

Mist Ressonance Engineering Pvt. Ltd.

(MREPL)

MIST TYPE WATER JET & COMBO VACUUM SYSTEM

(FOR CHEMICAL INDUSTRIES & POWER PLANTS)

Nullifies / reduces Steam required for conventional systems

Salient features

- Maintain a constant vacuum of up to 710mmHg (50 Torr abs.) using water only for evaporator, vacuum dryer and heat exchanger application, thus saving 100% steam required for conventional system.
- Constant vacuum up to 0.1 Torr (abs.) using combination of steam & water from our COMBO system, thus ensuring 30% on steam.
- Quick vacuum generation in less than 2 minutes in hot condition.
- Easy operation and Negligible maintenance.
- Less space required as compared to conventional system.
- Life of more than 15 to 20 years due to use of totally non-corrosive MOC of S.S.304 / 316.
- PAY BACK PERIOD OF LESS THAN 1 YEAR.

ENERGY SAVING Green Product

(020) 24472726 / 24471184 / 24474972

"Anandi", 1304/4, Shukrawar Peth, Bajirao Road,Pune 411002 INDIA.

mistcreation@gmail.com

www.mistcreation.com

CHRONICLING PROCESS INDUSTRY INNOVATIONS SINCE 1966 VOL.60 | ISSUE 1 | JANUARY 2025 | MUMBAI | TOTAL PAGES 54 | PRICE ₹ 150

CHEMICAL ENGINEERING WORLD

www.jasubhaimedia.com

Supply Chain Management & Logistics

seal.tech

sealmatic®

MECHANICAL SEALS

Oil & Gas
Refinery
Petrochemical
Chemical
Power
Fertiliser
Pharmaceutical
Paper
Aerospace
Marine

Sealmatic India Ltd.
Bldg A, Indiplex IV, Survey No-12, Hissa No-9A,
Village Ghodbunder, Shanti Vidya Nagri Road,
Mira Road (E). Thane - 401104. India.

T : +91 22 50502700
E : info@sealmaticindia.com

TÜVRheinland®
European Directive 97/23/EC
QS-System (Module H)

TÜV INDIA
CE Ex II 3 G/D c T2
ATEX - 2014/34/EU

UKAS MANAGEMENT SYSTEMS
ISO 9001:2008
ISO 14001:2004
BS-OHSAS 18001:2007

Q1 API Spec Q1 Registered

sealmaticindia.com

HORIZON POLYMER

www.horizonpolymer.com

India's Largest Processor of **FLUOROPOLYMERS**

Valves qualified ISO 15848-Part 1.

Pipework qualified ASTM F 1545

Chemours Co FC LLC - Delaware appoints Horizon Polymer as TEFLON® Licensing Partner for India Under Trademark license agreement to promote and sell PTFE/PFA/FEP Lined Piping products using TEFLON® PTFE/PFA/FEP Fluoropolymer.

TEFLON and Teflon diamond brand logo are registered trademarks of The Chemours Company FC, LLC used under license by Horizon Polymer Engineering Pvt. Ltd.

Horizon Polymer Eng Pvt. Ltd.:
204, Sumer Kendra, Pandurang Bhudhkar Marg, Worli, Mumbai - 400018. India
Contact: +91 22 24965031-36 I **Fax:** +91 22 24961073
Email: **vp@horizonpolymers.com**

CHEMICAL ENGINEERING WORLD
RNI REGISTRATION NO. 11403/1966

CHAIRMAN
Maulik Jasubhai Shah

PUBLISHER & CEO
Hemant K. Shetty

EDITOR
Mittravinda Ranjan

CREATIVES
Arun Parab

GENERAL MANAGER SALES
Prashant Koshti
Amit Bhalerao

BRAND MANAGER
Sudhanshu Nagar

SALES
Godfrey Lobo
Chandrahas M Amin
Yonack Pradeep

Single Copy Price: ₹ 150/-
Annual Subscription: ₹ 1620/-, Foreign: USD 180

Registered Office: 26, Maker Chambers VI, 2nd Floor, Nariman Point, Mumbai 400 021, INDIA.
Tel.: 022-4037 3737 Fax: 022-2287 0502
E-mail: sales@jasubhai.com

PLACE OF PUBLICATION
JASUBHAI MEDIA PVT. LTD.

210, Taj Building, 3rd Floor, Dr. D. N. Road, Fort, Mumbai 400 001, Tel: +91-22-4037 3636

Printed and published by Mr Hemant K. Shetty
Address: 406-D, The Karachi Citizens Co-Op Hosg Soc Ltd., Juhu Varsova Link Road, Andheri West, Mumbai - 400053.

Printed at The Great Art Printers
25, Unique House, S A Brelvi Road, Fort, Mumbai 400 001.

Editor: Ms. Mittravinda Ranjan, 3rd Floor, Taj Building, 210, Dr. D N Road, Fort, Mumbai 400 001.

Published from Jasubhai Media Pvt .Ltd. 3rd Floor, Taj Building, 210, Dr. D N Road, Fort, Mumbai 400 001.

CHEMICAL ENGINEERING WORLD

AD INDEX

Aeron Composite Limited 9

Dip-Flon Engineering & Co. 13

Fenix Process Technologies Pvt Ltd 11

Hi-Tech Applicator 1

Horizon Polymer Engineering Pvt Ltd 5

Mist Ressonance Engineering Pvt Ltd 2

Scientific Research Instruments Company Pvt Ltd 7

Sealmatic India Ltd 4

UNP Polyvalves India Pvt Ltd 15

Published by:

Jasubhai MEDIA

srico
INNOVATIVE LABORATORY TECHNOLOGY

Julabo
THE TEMPERATURE CONTROL COMPANY

PRESTO™ Highly Dynamic Temperature Control System

- Temperature range: -93 °C to +250 °C
- Cooling capacity from 0.5 to 33 kW
- Heating capacity from 2.7 to 36 kW
- Pump Flow rate: 0 to 80 l/min

WIGGENS
THE MAGIC MOTION

ST20 Industrial Rotary Evaporator

- Evaporation Flask: up to 20L (6L, 10L)
- Rotation Speed: 10-150 rpm
- Bath temperature: Rt to 150°C
- Plastic Coated Glassware (Optional)
- ATEX model available

BERGHOF
Products + Instruments
Experts in Lab Equipment

Low Pressure Reactor

- Pressure: up to 25 bar
- Temperature range: +300 °C
- Volumes up to 100 L

Scientific Research Instruments Company Private Limited

www.srico-labworld.com | +91 9900674407 | info@srico-labworld.com

CONTENTS

GUEST COLUMN

The Future of Supply Chain Sustainability in Specialty Chemicals 30

Smitha Shetty
Regional Director - APAC
Achilles Information Limited

Sustainability and Technological Advancements in Road Construction 33

Sanjay Kumar Sinha
Founder and Managing Director
Chaitanya Projects Consultancy

Biobitumen: Paving the Way for Sustainable Infrastructure 36

Dr. Manoranjan Parida
Director
CSIR-Central Road Research Institute

Embracing Electric Mobility for a Sustainable and Efficient Future 38

Pushpank Kaushik
CEO & Head of Business Development (Subcontinent, Middle East, and SouthEast Asia), Jassper Shipping.

Oil & Gas and Power sector: Driving Business Transformation through Sustainable Supply Chains 41

Dharmendra Gangrade
Head of Logistics Management Centre
Larsen & Toubro Limited

Agile Gas Infrastructure to Transport Hydrogen & Gas Mix 44

Akhil Mehrotra
MD & CEO
Pipeline Infrastructure Limited

COVER STORY

Managing Transportation Carbon Emissions in Chemical Supply Chains 26

Dr. Aditya Gupta
Chief Operations Officer
Supply Chain Management Centre
IIM Bangalore

Dr. Mohan Krishna
Manager-Research
TCI-IIMB Supply Chain Sustainability Lab
Supply Chain Management Centre
IIM Bangalore

FEATURES

Beyond Compliance: CO_2 Capture as a Catalyst for Steel Industry Sustainability 47

Nitin Sarna
Co-Founder and Director
Catalyst Environment Technology Solutions Private Limited (CETS)

How sustainable supply chains are driving business transformation 50

Saunak Saha
Partner
Climate Change and Sustainability Services
EY India

NEWS 10

PROJECT UPDATES 20

Published by:

Jasubhai MEDIA

More than
800+
Satisfied
Clients

CORROSION FREE
COMPOSITE SOLUTIONS

FRP CABLE MANAGEMENT SYSTEMS

FRP GRATINGS

FRP HANDRAIL

FRP CUSTOM SOLUTIONS

FRP TRENCH COVER

Approved with all major consultants and EPC Contractors for Chemical and Process Plants

- Corrosion/Chemical Resistance
- High Strength
- Light Weight
- Electrical Non Conductivity
- Thermal Non Conductivity
- Ease of Fabrication
- Low Life Cycle Cost
- Sustainable
- Flame Retardant

MANUFACTURER OF FIBERGLASS / FRP / GRP

Cable Trays | Gratings | Structural Profiles | Ladders | Pitt Covers | Crossovers | Fencing
Handrails | Staircases & Platforms | Safety Marker Line | Cable Cleats

Aéron ©
THE COMPOSITE EXPERT...

www.aeroncomposite.com

AERON COMPOSITE LIMITED

Plot. No. 30/31, Saket Industrial Estate, Opp. HOF Furniture,
Sarkhej-Bavla Highway, Moraiya-382213, Ahmedabad, Gujarat – INDIA.
T : +91-99099 88266, +91-90331 58500 | F : +91-79-26561238
E : info@aeroncomposite.com | W : www.aeroncomposite.com

Dealers & Distributors Inquiry Solicited

Department of Chemicals & Petrochemicals implements new scheme of petrochemicals

New Delhi, India: The Department of Chemicals and Petrochemicals has announced that it has implemented the New Scheme of Petrochemicals with sub-schemes on - Scheme for setting up of Plastic Parks; Scheme for setting up of Centres of Excellence; and The Petrochemicals Research & Innovation Commendation Scheme.

Under the Scheme for Setting up Plastic Parks, the Department promotes setting up of need-based plastic parks with requisite infrastructure and enabling common facilities. The objective is to consolidate and synergize the capacities of downstream plastic processing industry to help increase investment, production and export in the sector as well as generate employment. A total of 10 plastic parks have been approved so far in different states and the same are at different levels of implementation.

With regard to Centres of Excellence (CoEs), the objective is to provide grant-in-aid to educational and research institutions to improve existing technology and promote development of new applications. The emphasis of the Scheme is on modernization and upgradation of existing manufacturing processes as well as improving the quality of products. A total of 18 CoEs have been approved so far.

Union Cabinet approves one-time special package on DAP

New Delhi, India: The Union Cabinet, chaired by the Prime Minister Narendra Modi, has approved the proposal of the Department of Fertilizers for extension of one-time special package on Di-Ammonium Phosphate (DAP) beyond the Nutrient based subsidy (NBS) @ ₹3,500 per MT for the period from 01.01.2025 till further orders to ensure sustainable availability of DAP at affordable prices to the farmers. The tentative budgetary requirement for above would be approximately upto ₹3,850 crore. 28 grades of P&K fertilizers are made available to farmers at subsidized prices through fertilizer manufacturers/importers. The subsidy on P&K fertilizers is governed by NBS Scheme w.e.f 01.04.2010. The Government of India has extended a massive relief to farmers in keeping the price of Di-Ammonium Phosphate (DAP) fertilizer unchanged.

Department of Chemicals & Petrochemicals conducts 2nd training programme on industrial safety

New Delhi, India: As a part of Government of India's action plan for Viksit Bharat@2047, the Department of Chemicals and Petrochemicals conducted a second training programme on 'Chemical and Petrochemical Industrial Safety' at New Delhi. The two-day residential training programme, conducted during 16-17 December 2024, focused on Major Accident Hazard (MAH) units in the chemical and petrochemical sector.

The training programmes, organised by the Department on Industrial Chemical Safety, is with the objective of safety and security for all the 2,393 MAH identified

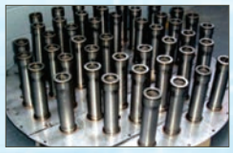
Manali Petrochemicals Appoints Shivaram Narayanan as COO

Pursuant to the recommendation of the Nomination and Remuneration Committee, the Board of Directors of **Manali Petrochemicals Limited** have appointed **Shivaram Narayanan,** as **Chief Operating Officer (COO)** and Senior Managerial Personnel of the company w.e.f. 20 January 2025. Shivaram, aged 55 years holds a Bachelor's degree in Chemistry and an MBA – Marketing from the University of Madras. He also holds a Bachelor of Technology (B. Tech) in Petrochemical from Lakshminarayan Institute of Technology (LIT), Nagpur. He brings a wealth of experience and expertise of over 30 years in the chemical/petrochemical sector, having worked with leading multinational and Indian organizations in various capacities. He was also associated with the company in Procurement, Sales & Marketing function during the period 1994 to 2007.

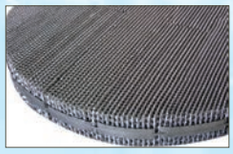
Separator and
Mass Transfer Internals for

Oil & Gas Industry

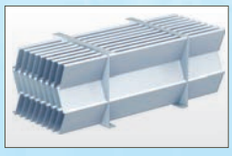
Your Trusted Partner in
- Process Engineering
- Equipments
- Turnkey Systems

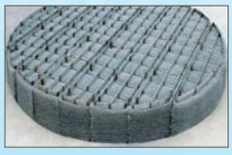

Axial Cyclones


Multi-Cyclones

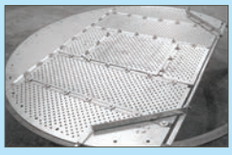

Structured Packing

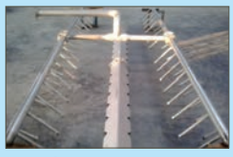

Vane Inlet Device


Vane Pack


Wiremesh Mist Eliminator


Chevron Type Mist Eliminator


Double Skin Perforated Baffle


Sand Jet Assembly

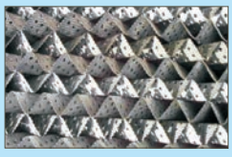
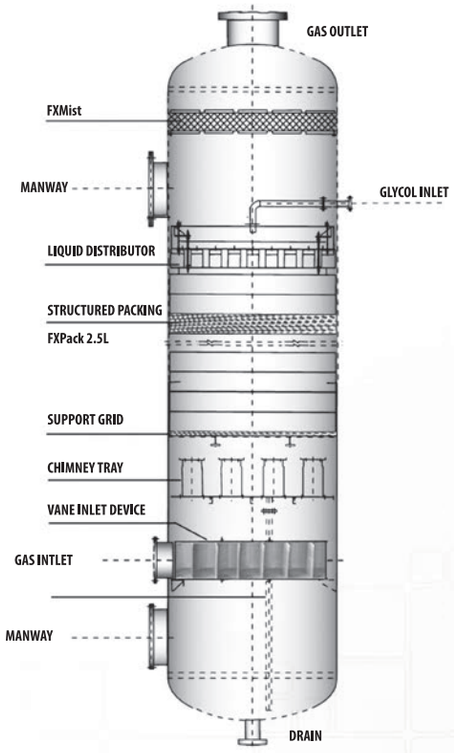


Plate Pack



TEG Contactor for Moisture-Free Gas

Amine Contactors for Sweetening Sour Gas

Fenix® is a leader in process technologies, offering a wide range of engineering services and process equipment solutions that serves the refining, chemicals and petrochemical industries.

Fenix designs and manufactures a large variety of separator internals FXIntSep used in the Oil & Gas industry. Many of these have uses in other industries but some have been developed specifically for processing of natural gas and petro-crude. Our range of design services to support your front-end engineering including process simulations, internals selection and vessel sizing and optimisation. In addition we offer CAD drafting and 3D plant layout design. Our state-of-the-art manufacturing plant spread across 50,000 sqft. enables us to provide related products like structured packing, mixers, trays, internals and various mass transfer equipments. We also provide facilities for Pilot Plant Trials & case studies.

DISTILLATION | EXTRACTION | ABSORPTION | EDIBLE OIL REFINING
BIODIESEL | USED OIL RE-REFINING | OIL & GAS | ENVIRONMENTAL

www.fenix.in

FENIX®

Fenix Process Technologies Pvt. Ltd.

K- 6/1, Malini, Erandwane Co-op. Society
Nr. Deenanath Mangeshkar Hospital,
Pune - 411 004. India
Tel. No.: +91-8237008770 / 72 / 73
Email: info@fenix.in Url: www.fenix.in

across India. A total of 48 training programmes are planned to cover all the MAH units over the period of next five years. Accordingly, 6 such training Programmes are planned to be conducted in the remaining part of the current financial year.

IREDA achieves 'Excellent' rating for 4th consecutive year

Mumbai, India: Indian Renewable Energy Development Agency Limited (IREDA) has achieved 'Excellent' rating for the performance MoU signed with the Ministry of New & Renewable Energy (MNRE) for the financial year 2023-24, with a score of 98.24 (rounded off 98). This marks the fourth consecutive year that IREDA has received 'Excellent' rating, showcasing its unwavering commitment to operational excellence and highest standards of corporate governance.

In the previous three years, IREDA consistently delivered exceptional results, achieving an 'Excellent' rating with scores of 93.50 in FY 2022-23, 96.54 in FY 2021-22 and 96.93 in FY 2020-21. Speaking on the achievement, Pradip Kumar Das, CMD, IREDA, said, "Securing the 'Excellent' rating for the fourth consecutive year is a significant milestone for IREDA. It reflects the tireless efforts of our employees, the unwavering trust of our stakeholders, and the guidance of the Govt. of India. Together, we are committed to accelerating India's green energy transition and achieving our nation's renewable energy goals."

Das also expressed his gratitude to Pralhad Joshi, Hon'ble Union Minister of New & Renewable Energy, Consumer Affairs and Food & Public Distribution; Shri Shripad Naik, Hon'ble Minister of State for Power and New & Renewable Energy; Shri Prashant Kumar Singh, Secretary, MNRE; other senior officials of the ministry; and the Board of Directors for their support and invaluable guidance.

LANXESS increases earnings in Q3 of 2024

Mumbai, India: Specialty chemicals company LANXESS saw a significant earnings increase in the third quarter of 2024: EBITDA pre exceptionals came in at EUR 173 million, up 45.4 per cent from the prior-year quarter's EUR 119 million. "Despite the continuing rough sea and the challenging competitive environment for the chemical industry, we are staying on course. Our timely actions to address the global weakness in demand are paying off. Our plants are operating at higher capacity utilization and our "FORWARD!" action plan has significantly improved our cost situation. We are therefore maintaining our guidance for the full year – even though a broad-based recovery is not yet in sight," said Matthias Zachert, Chairman of the Board of Management of LANXESS AG.

At the beginning of October, LANXESS signed an agreement to sell its Urethane Systems business to Japan's UBE Corporation. The business is valued at EUR 460 million and LANXESS expects to receive proceeds of around EUR 500 million. Zachert said, "We also made strategic progress in this quarter. With the agreed sale of our Urethane Systems business unit we have divested our last polymer business and completed the transformation of our Group into a specialty chemicals company." LANXESS plans to use the proceeds from the sale to reduce debt. The transaction remains subject to the approval of the relevant authorities. LANXESS expects the transaction to close in the first half of 2025.

Rallis India Appoints Kalpa Kadam as Head - Human Resource

Rallis India Limited has announced the appointment of **Mrs. Kalpa Kadam as Head - Human Resource and Administration** and Senior Management Personnel. Kalpa has over 19 years of HR experience across various sectors, including automotive, pharmaceuticals and packaging. Currently, she is the Group HR Head at Astrac Group, where she manages HR functions for employees across five plants in India, GCC, Europe and Mexico. Her expertise includes global HR strategy, talent management, organizational development, mergers and acquisitions, industrial relations and digitization of HR systems.

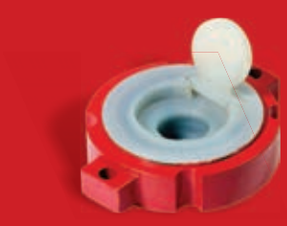
SINCE 1987

SHIELDING AGAINST CORROSION

Make Planet Green Again

33 YEARS EXPERIENCE

Quality is never an accident it is always the result of High Intention, Sincere Effort, Intelligent Direction and Skillful Execution.



SWING CHECK VALVE

BUTTERFLY VALVE

BALL CHECK VALVE

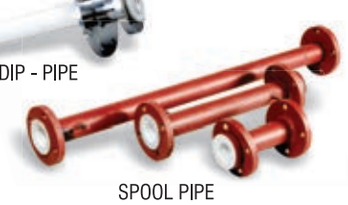
BALL VALVE

PTFE LINED VALVES & PIPES FITTINGS

PLUG VALVE

DIAPHRAGM VALVE

DIP - PIPE



SPOOL PIPE

EXPANSION BELLOW

BELLOW (PTFE)

EQUAL CROSS

ELBOW

REDUCING FLANGE

SIGHT FLOW INDICATOR

REDUCER

REDUCING TEE

INSTRUMENT TEE

DIP-FLON ENGINEERING & CO.
An ISO 9001 : 2015 CERTIFIED COMPANY

DIP-FLON ENGINEERING & CO.

B-413, B. G. Tower, Outside Delhi Gate, Shahibaug Road, Ahmedabad - 380004. Gujarat, INDIA.
Phone: +91-79-25624003, 25624169, Mobile: +91 - 9898794440 | Fax: +91-79-25625665
Email: info@dipflon.com / sales@dipflon.com | **Website : www.dipflon.com**

Sealmatic partners with ValueTech in Egypt

Mumbai, India: Sealmatic India Limited, has entered into a strategic partnership with ValueTech in Egypt, to cater to the varied needs of customers in the Egypt and the whole of Africa. Sealmatic and ValueTech of Egypt have partnered for selling, repair and refurbishment of Sealmatic mechanical seals in Egypt in order to serve customers in the oil and gas, petrochemical, power, water, desalination, chemical and other process industries.

This partnership is aimed to help Sealmatic to get introduced amongst the key players in the Egyptian industrial landscape, including specialists in the Oil & Gas and Power sectors, as well as governmental bodies such as the Ministry of Petroleum and Mineral Resources. Egypt's industrial sectors, particularly Oil & Gas, Refinery and Petrochemicals are experiencing rapid growth. Significant projects in both upstream and downstream operations are underway, attracting global attention and investments.

JSW Energy receives LoI for Mahanadi Thermal Power Plant

Mumbai, India: JSW Energy Limited has been declared successful applicant and has received letter of intent (LoI) from the Resolution Professional for its resolution plan submitted for KSK Mahanadi Power Company Limited under the corporate insolvency resolution process of the Insolvency and Bankruptcy Code, 2016. KMPCL owns a 3,600 MW thermal power plant, utilising domestic coal and located in the state of Chhattisgarh. Presently, 1,800 MW (600 MW x 3 units) is operational which is 95 per cent tied-up under long and medium-term power purchase agreements. An additional 1,800 MW (600 MW x 3 units) is under-construction out of which one unit (600 MW) is 40 per cent completed and balance of plant is in place for remaining 1,200 MW. The plant has a firm arrangement for water and coal transportation for the entire 3,600 MW. Subsequent to this the company's total locked-in thermal generation capacity stands at 7.5 GW and total locked-in generation capacity stands at 28.2 GW.

ENGIE achieves SET certification

Mumbai, India: ENGIE, a global leader in sustainable energy solutions, has achieved the Sustainable Energy Transition (SET) Certification by Bureau Veritas. This milestone highlights ENGIE's continued commitment to develop, build, operate, and dismantle renewable energy projects that are integrated into local communities, respectful of nature, and significantly reduce carbon emissions. The SET label, launched in May 2022, reflects ENGIE's global approach to ensure its renewable energy projects meet the highest standards of sustainability

Narendranath J. Baliga appointed as Whole-time Director of BASF

Based on the recommendation of the Nomination & Remuneration Committee, the Board of Directors of BASF India Limited have approved the appointment of **Narendranath J. Baliga** as the **Whole-time Director of BASF India Limited** for the period effective from 1st January 2025 to 30th June 2027.

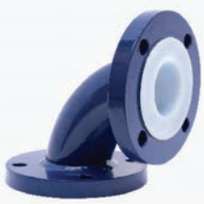
A Chartered Accountant and a graduate in Business Management, Narendranath joined BASF in 1994. Over the past three decades, he has held various leadership positions, managing regional and global responsibilities in India, Singapore, China, and Germany in the area of Finance, Regional Controlling, Global Supply Chain, and Global Process and Enterprise Architecture. Since January 1, 2015, he has served as the Chief Financial Officer (CFO) of the company and holds the additional position of Vice President – Global Business Services.

UNPPolyvalves

Valve Solutions For Corrosive Applications

EXPERIENCE THE WORLD'S MOST RELIABLE LINED PIPES & FITTING

PIPE SPOOL



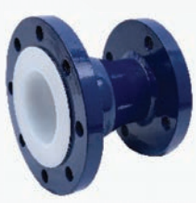
ELBOW 90°

ELBOW 45°

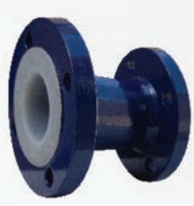
EQUAL TEE

UNEQUAL TEE

INSTRUMENT TEE



CONCENTRIC REDUCER



ECCENTRIC REDUCER

LINED SIGHT GLASS
Double Window

EQUAL CROSS

REDUCING FLANGE

LINING MATERIALS OPTIONS :

PFA / FEP / PVDF / ETFE / PPH / ANTI-STATIC PFA.

SIZE RANGE : 1/2" To 24"

35+ YEARS OF EXPERIENCE

VADODARA - OFFICE & FACTORY
5 to 12 PR Industrial Estate, Por GIDC - Kashipura Road,
Moje : Kashipura - 391 243, Dist. Vadodara. INDIA

Phone: +91 70434 30467/77, 70430 20707
Email : sales.baroda@polyvalve.com

www.polyvalve.in
www.polyvalve.com

and community integration. This milestone highlights ENGIE's focus on developing its portfolio of solar, wind and hybrid renewable projects, reinforcing its commitment to clean energy and strengthening its position in India's sustainable energy landscape.

This certification by Veritas, provides a stringent framework for renewable energy projects to adhere to the highest standards of Environmental, Social, and Governance (ESG) excellence. ENGIE's projects reflect biodiversity conservation efforts, including safeguarding vulnerable species and ecosystems near project sites, while promoting transparent accountability processes to strengthen partnerships with local communities. Through strategic ESG-driven operations, ENGIE ensures sustainable investments and operational efficiency across all phases of project execution.

"The SET certification reaffirms our mission to achieve growth while integrating responsibility at the core of our business," said Amit Jain, CEO and Country Manager, ENGIE India. "Our projects not only deliver clean energy but also foster biodiversity protection, community empowerment, and innovation, shaping a sustainable and resilient energy future for India," Mr. Jain added.

Pradhin Ltd to expand into agricultural waste management

Gujarat, India: Pradhin Limited has announced that the company is expanding its business operations into the domain of agricultural waste management and processing. The company's proposed activities in agricultural waste management and processing include Biogas Production (utilizing agricultural waste to produce biogas as a renewable energy source for domestic and industrial applications); Composting (Developing high-quality organic compost from agricultural residues, aimed at reducing dependency on chemical fertilizers and enhancing soil health); Biofertilizer Production (Recycling agricultural waste into eco-friendly fertilizers, fostering sustainable farming practices); Waste-to-Energy Initiatives (Converting crop residues into energy to reduce reliance on non-renewable sources and Circular Economy Practices (Promoting the reuse of agricultural by-products to minimize waste and create value-added products). By diversifying into this field, Pradhin Limited aims to strengthen its revenue streams while contributing to environmental preservation, rural development, and the circular economy.

Hindustan Zinc's Mines win big at 48th Mines Safety Week

Udaipur, India: Hindustan Zinc's business unit, Zawar Group of Mines, has achieved success at the prestigious 48th Mines Safety Week, organized by the Directorate General of Mines Safety (DGMS), Udaipur Region (NWZ). The event, saw Zawar Group excel across multiple categories. In the Underground Mechanized Mine category, Baroi Mine was awarded 1st place for its exemplary safety protocols and operational efficiency, while Mochia Mine secured 3rd place. Additionally, Zawar Mill was honoured with 2nd place in the Ore Beneficiation Plant category, recognizing its operational excellence and commitment to maintaining stringent safety standards in its processing operations.

Outlook for 2025

"Global expansion in chemical production is anticipated"

"The Indian chemical sector is poised for significant growth, with projections showing that the market size will increase notably from USD220 billion in 2022 to an impressive USD300 billion by 2025. There is a revival of demand for few applications of chemicals, and this positive trend is expected to continue, driven by the end of the destocking cycle, especially within the specialty chemicals segment. Looking ahead, the Indian specialty chemicals industry is projected to reach around USD50 billion by 2025, reflecting robust demand and growth potential. According to the American Chemistry Council (ACC), a global expansion in chemical production is anticipated, with an estimated increase of 3.5 per cent in 2025. This optimistic forecast indicates a significant recovery from the modest 0.3 per cent growth recorded in 2023."

Maulik Patel, Chairman and Managing Director, Epigral Limited

Hindalco flags off EV bulkers at Aditya Aluminium plant

Hindalco has launched Electric Vehicle bulkers at Aditya Aluminium's Lapanga plant for sustainable transport

Bhubaneswar, India: Hindalco Industries Ltd., the metals flagship company of the Aditya Birla Group, has flagged off Electric Vehicle (EV) bulkers at its Aditya Aluminium plant in Odisha for supplying one million tonne of fly ash to the cement industry in the region over the next five years. Additionally, the company has inaugurated two EV recharge stations near the fly ash loading point, marking another step toward green transportation and sustainable operations.

As a result of using electric vehicles, the plant expects to reduce 3,500 tonnes of carbondioxide emissions, and it will help save ₹1.5 crore in freight costs. Fly ash constitutes about 35 per cent of the volume of cement produced. Hindalco supplies ~4 million tonnes of fly ash from across its plants in India, to the cement industry.

Sukanta Das, President & Chief Logistics Officer, Hindalco Industries Ltd., said, "These EVs will play a pivotal role in transporting our critical waste, Fly Ash, to the cement industry as an input material, contributing not only to a greener transportation system but also to the circular economy."

Hindalco is also focused on scaling up the use of LNG and Electric Vehicles in road transport while also expanding the Rail mode of transportation by connecting its new mines and plant locations to the Indian Railways network. Waste materials such as fly ash, ETP sludge, red mud, spent Pot Liner, FGD waste, etc. are used in manufacturing blended types of cement such as PPC (Portland Pozzolana Cement), PPC Super, clinker and composite cement, which help conserve finite natural resources. Hindalco also supplies 1.4 lakh metric tonnes of copper slag for manufacturing ready mix concrete, replacing sand.

Mitsui Chemicals, Mitsubishi Chemical launch joint study of phenol-related products

Chiyoda, Tokyo: Mitsui Chemicals, Inc. and Mitsubishi Chemical Corporation have announced that they have launched a joint study into the stable supply of phenol-related products. Phenol-related products include phenol, acetone, α-methylstyrene, bisphenol A and methyl isobutyl ketone. These products are in turn used in wide-ranging fields as raw materials for polycarbonate resin, phenolic resin, methyl methacrylate, epoxy resin,

Outlook for 2025

"Sustainability remains a defining priority for businesses worldwide"

"Looking ahead to 2025, key industry trends - urbanization, mobility, sustainability, and digitalization - will continue to drive growth. As urban areas expand, advanced bonding technologies are enabling the development of high-performance, sustainable building materials that improve liveability and reduce environmental impact. In e-mobility, adhesives, sealants, and functional coatings will play an increasingly critical role in advancing battery safety, efficiency, and performance - essential for the growth of electric vehicles. Sustainability remains a defining priority for businesses worldwide. The focus on material science, emissions reduction, and circular processes underscores the industry's commitment to delivering long-term value for both customers and the environment. Investing in digital transformation today empowers organizations to streamline workflows, use resources more efficiently, and improve decision-making. Thereby, enabling the futureproofing of businesses to ensure they remain resilient and relevant."

S. Sunil Kumar, Country President, Henkel Adhesives Technologies India

paints and more, making them important to Japan's economic security.

Mitsui Chemicals and Mitsubishi Chemical have reached a mutual understanding about the importance of reaching across company lines to implement various measures for improving the stable supply of phenol-related products and to contribute to the reduction of GHG emissions so that they may continue helping customers to generate value. Specifically, the companies will jointly consider approaches for maintaining product supply during regular major maintenance or facility issues, as well as for the efficient operation of both companies' tanks and reduction of GHG emissions through the rationalization of logistics.

This joint study will proceed while, where necessary, obtaining approval from competition regulators and other such related bodies. Mitsui Chemicals and Mitsubishi Chemical will endeavor to respond flexibly to changes in the external environment and ensure stable supply for phenol-related products.

Indorama Ventures acquires Kemelix and Flowsolve brands

Bangkok, Thailand: Indorama Ventures Public Company Limited, a global sustainable chemicals company, has announced that its Indovinya business segment—through its flagship subsidiary Indorama Ventures Oxides LLC—has agreed to acquire two leading brands in the energy extraction sector, targeting Demulsifiers and Flow Assurance products, from Cargill Bioindustrial UK Limited. The acquisition includes valuable trademarks, customer relationships, 25 patents, tolling rights, and a research and development facility in Houston, Texas. The renowned Kemelix and Flowsolve brands are central additions to Indovinya's growing portfolio of innovative solutions, which are celebrated for their high-quality formulations and outstanding performance in optimizing operations in the oil and gas sector. These products are vital for demulsification and flow assurance processes, addressing critical challenges in energy extraction and enhancing operational efficiencies for customers.

The Kemelix brand includes high-performance demulsifiers that facilitate the economical separation and removal of water from crude oil. Its best-in class product range covers alkoxylates, polyamine derivatives, and modified polyols. They are highly effective under the most demanding field conditions, including heavy oil, low temperature, and low/high water applications.

The Flowsolve brand includes leading asphaltene and wax inhibitors that improve the end-to-end flow of crude oil from the reservoir to the refinery. Its optimized range of additives are designed to suit different crude oil types, such as onshore, offshore, and deepwater.

Outlook for 2025

"Focus will remain on strengthening India's position as a global economic leader"

"India's infrastructure sector stands at a defining juncture, having achieved remarkable milestones that solidify its role as the backbone of the nation's growth. Historic investments — ₹2.78 lakh crore to the Ministry of Road Transport and Highways and ₹2.62 lakh crore to the Ministry of Railways — have not only enhanced connectivity but also created millions of opportunities, fueling job creation and contributing to a robust economy. A strong commitment to sustainable development is reflected in the installation of over 25,000 EV charging stations and innovations like the use of recycled materials in infrastructure development, marking a significant shift toward eco-conscious growth. Looking ahead to 2025, the focus will remain on strengthening India's position as a global economic leader with boosting the infrastructure industry and Indian Railways with sustainability and inclusivity. Innovations in green technology, smart cities, and eco-friendly transport will lay the foundation for a more inclusive and sustainable future."

Sanjay Kumar Sinha, Founder and Managing Director, Chaitanya Projects Consultancy

Nan Ya Plastics, Taiwan Mitsui Chemicals to focus on biomass-based plastic products

Tokyo, Japan: Taiwan Mitsui Chemicals, Inc., a wholly owned subsidiary of Mitsui Chemicals, Inc., and Nan Ya Plastics Corp. (NPC) has announced that they have embarked on efforts to develop the market for biomass-based plastic products. Under this initiative, NPC will procure biomass-based acetone produced by Mitsui Chemicals and use it to manufacture biomass-derived bisphenol A (BPA) in Taiwan.

In August 2024, Taiwan Mitsui Chemicals acquired certification under the International Sustainability and Carbon Certification (ISCC) PLUS system for certifying sustainable products. Having also acquired ISCC PLUS certification in September 2024, NPC will procure biomass feedstocks from Taiwan Mitsui Chemicals to manufacture biomass-derived BPA under this mass balance system. NPC then intends to start developing biomass plastics such as epoxy and polycarbonate resins using this BPA. Biomass-based acetone, BPA and plastics can easily be used to replace existing products, because they all have the same physical properties as conventional petroleum-derived chemicals and plastics. As such, biomass-derived materials help to reduce greenhouse gas emissions throughout the product life cycle and thereby assist in achieving carbon neutrality.

Taiwan Mitsui Chemicals has kicked off the initiative between the two companies in January 2025 with the supply of biomass-based acetone produced under the mass balance system.

BPCL posts remarkable growth

Mumbai, India: BPCL has recorded a quantum jump in its Profit After Tax (PAT) from ₹2,397 crore in Q2 to ₹4,649 crore in Q3. This performance is driven by improved refining and marketing margins and sales growth. The company recorded a 37 per cent growth in PAT compared to the corresponding quarter of the previous year with sales volume witnessing a 4 per cent growth. For the current year April-December 2024, the company has posted an EBITDA of ₹20,001 crore.

Despite scheduled maintenance, the company demonstrated remarkable operational efficiency by achieving capacity utilisation of 107 per cent during the current quarter.

BPCL has drawn up a comprehensive five-year strategic framework, 'Project Aspire', aimed at enhancing BPCL's overall business and financial performance under two core themes, 'Nurture the Core' and 'Future Big Bets.'

The company remains committed to growing its core businesses, which include refining, marketing of petroleum products and upstream, and is equally focused on future big bets comprising petrochemicals, gas, green energy, non-fuel retail, and digital. The company will be investing around ₹1.7 lakh crores over the next 5 years in the above areas.

One of the largest projects under Aspire is the Bina Refinery Expansion and Petrochemical Project. Towards this, BPCL has secured ₹31,802 crore loan. The project is progressing as scheduled, with technology licensors onboard for all critical packages, detailed engineering completed for few units, and others nearing completion. This project along with the polypropylene plant in Kochi will boost the petrochemical intensity of the company up to 8 per cent by FY 2028-29.

JIRE targets strategic acquisitions to achieve RE target

Mumbai, India: BC Jindal Group, India's leading conglomerate with over ₹18,000 crore turnover, has announced that its renewable energy arm, Jindal India Renewable Energy (JIRE), is planning expansion and is actively pursuing aggressive acquisitions of operational assets both domestically and abroad. This is in line with the company's goal to expand its capacity to 5 GW within the next four years. These acquisitions are anticipated to be finalised in the 1-2 years and will be funded through a mix of internal accruals and debt. JIRE aims to generate 5 GW of power from solar, wind, hybrid, hydro and FDRE modes. To achieve this JIRE is focused on acquisition of operational portfolio in the initial couple of years. In parallel JIRE is focused on establishing its presence in renewable energy-rich states by developing Renewable projects connected to grid at CTU and STU to meet the energy demands of utilities as well Industrial and Commercial (C&I) customers. JIRE operates under the BC Jindal Group, founded in 1952 by B.C. Jindal. ■

PROJECT UPDATES

HPCL commissions LNG Regasification Terminal

Mumbai, India: Hindustan Petroleum Corporation Limited (HPCL) has announced the successful commissioning of LNG Regasification Terminal of 5 MMTPA capacity at Chhara, Gujarat set up by Mis HPCL LNG Ltd, wholly owned subsidiary of HPCL. The ship, Maran Gas Coronis, carrying LNG cargo was berthed on 6th January 2025 and the cargo commissioning of LNG Regasification Terminal set up by wholly owned subsidiary HPCL LNG Limited discharge into the on shore LNG tanks was successfully completed on 12th January 2025. The terminal has been set up at an approx. investment of ₹4,750 Crores (₹47.50 billion) at Chhara Port in Gir-Somnath District in Gujarat. It has facilities for receipt of LNG through ocean tankers, marine unloading, storage, LNG Road Tanker loading, regasification, and supply of regasified LNG to the gas grid. HPCL LNG Ltd. would operate the Terminal on a "tolling" model and is open to third party users, through long term capacity booking contracts and/or through Master regasification agreement for spot cargoes. HPCL has brought its first cargo and the terminal will start the commercial operations shortly.

IREDA, SJVN, GMR & NEA seal partnership for hydropower project

Mumbai, India: Indian Renewable Energy Development Agency Ltd. (IREDA) has finalized a joint venture agreement with SJVN Ltd., GMR Energy Ltd., and Nepal Electricity Authority (NEA) for the development of the 900 MW Upper Karnali hydro-electric project in Nepal. This strategic initiative aims to strengthen regional energy security and accelerate renewable energy growth. The joint venture agreement lays out a comprehensive framework for the project development, construction, operation, and maintenance under a Build-Own-Operate-Transfer (BOOT) model, with 25-years project term from the Commercial Operation Date (CoD).

The agreement was formalized in New Delhi in the presence of senior officials from IREDA, SJVN, and GMR Energy Ltd. Speaking on the occasion, Pradip Kumar Das, CMD, IREDA, said, "This agreement marks a significant step towards realizing our collective vision of sustainable energy development in the region. By leveraging hydropower's vast potential, the Upper Karnali project will serve as a model of cross-border collaboration, delivering both economic and environmental benefits."

Gensol Engineering secures EPC contract of Solar PV Project

Mumbai, India: Gensol Engineering Limited, a prominent leader in the renewable energy sector specializing in solar power engineering, procurement, and construction (EPC) services, has secured a significant EPC contract from renowned public sector undertaking for development of 275MW solar PV project at RE Solar Park, Khavda Rann of Kutch, Gujarat, with a total bid value of approximately ₹1061.97 crores (including GST), including three years of operations and maintenance.

Commenting on the development, Shilpa Urhekar, Chief Executive Officer, Solar EPC (India) at Gensol Engineering Ltd., stated, "We have started Calander Year 2025 on a high note. We have been awarded a prestigious Solar PV project contract from Renowned Public Sector Undertaking at RE Solar Park, Khavda Rann of Kutch, Gujarat. This partnership holds immense value for us, and we are grateful for the continued trust and confidence placed in us by such large RE corporation."

TKIL Industries signs strategic alliance with SoHHytec

Mumbai, India: TKIL Industries Pvt. Ltd. (formerly known as thyssenkrupp Industries India Pvt. Ltd.), a leading player in industrial engineering and manufacturing, has forayed into the green hydrogen sector marking a significant milestone in its journey to diversify its business portfolio. The company has made an undisclosed strategic investment in SoHHytec SA, based in Lausanne, Switzerland. SoHHytec is a cutting-edge innovator and solutions provider in green hydrogen field using its proprietary artificial photosynthesis (photo-electrolysis) technology, to produce green hydrogen from renewable energy sources, including solar and wind, for industrial applications.

Currently, SoHHytec holds the world record for the highest direct solar hydrogen production efficiency and is globally the most cost-efficient technology for producing Green Hydrogen. In addition to this investment, TKIL Industries will be the exclusive partner

in India for SoHHytec to manufacture and supply specific equipment and machinery as well as implement and install Green Hydrogen projects. TKIL Industries will also support SoHHytec in developing the supply chain for manufacturing Green Hydrogen equipment locally in India, giving a major boost to 'Make in India' for this critical sector.

The green hydrogen produced will serve critical industrial sectors such as steel, fertilizers, bio-chemicals, cement, and transportation— industries essential to India's energy transition and industrial decarbonisation goals.

Honeywell to provide automation solutions to Exide Energy Solutions

Mumbai, India: Honeywell has been awarded a contract to provide building automation solutions to Exide Energy Solutions Limited (EESL), a fully owned subsidiary of Exide Industries Ltd, India's largest battery maker. This technology deployment underscores Honeywell's commitment to the Make in India initiative and also supports Honeywell's alignment of its portfolio to three compelling megatrends, including automation and the energy transition.

Honeywell will equip EESL with digital solutions to help improve operational efficiency and deliver faster incident response, energy savings and increased security for the phase one of its new 80-acre lithium-ion gigafactory campus in Bengaluru. Key to this will be Honeywell's Enterprise Buildings Integrator (EBI) platform, which will provide an integrated view, centralized monitoring and control of building management across the gigafactory campus. The gigafactory is expected to be completed in 2025 and will be Bengaluru's first multi-gigawatt-hour lithium-ion cell manufacturing facility. It will produce lithium-ion batteries to help address the growing global demand for electric vehicles.

Dr. Mandar Deo, CEO of Exide Energy Solutions Ltd, said, "Honeywell's automation and safety solutions align with our vision to create the most technologically advanced and sustainable unit for manufacturing Li-ion cells. We are confident that Honeywell's expertise makes them an ideal partner to help us meet these requirements."

INOXAP commissions India's first Ultra-High Purity Electronic Grade Nitrous Oxide Plant

Mumbai, India: India's largest industrial gases manufacturer, INOX Air Products (INOXAP), has announced the commissioning of India's first Ultra High Purity (UHP) Electronic Grade Nitrous Oxide Plant with a capacity of 1700 Tons Per Annum (TPA) at Manali, Chennai. The state-of-the-art facility would produce UHP Electronic Grade Nitrous Oxide with an exceptional 6N (99.9999 per cent) purity level, adhering to tightly controlled specifications for ensuring minimal contamination.

With ready availability of Nitrous Oxide, a critical input for the solar and semiconductor segment, the commissioning of this plant strengthens the gases and chemicals supply chain for the electronics industry through import substitution.

Nitrous Oxide's unique properties contribute to the precision, efficiency, and environmental sustainability of processes crucial for creating the electronic devices. Nitrous Oxide plays a critical and multi-faceted role in the electronic devices industry, particularly in gas-phase chemical deposition for the production of solar PV cells and semiconductors (chips, circuits, and transistors). It reacts with Silane or other silicon precursors to create high-quality oxide films, used as electrical insulators in microelectronic transistors. It also serves as an oxygen precursor for silicon oxide, silicon oxynitride, low-k dielectric thin films and metallic oxides.

Tiger Logistics renews 3 PSU agreements

New Delhi, India: Tiger Logistics (India) Limited, a pioneer in global logistics services, has announced that three prominent Public Sector Undertakings (PSUs) — Bharat Heavy Electricals Limited (BHEL), Bharat Earth Movers Limited (BEML), and Bank Note Paper Mill India Limited (BNPLIPL) — have renewed their agreements with the company.

Earlier this year, the company achieved a significant milestone by securing a warehousing services deal with BHEL and completing vital logistics assignments for the Airports Authority of India (AAI) and Hindustan Aeronautics Limited (HAL). Besides, the company also

recently announced its empanelment by Hindustan Petroleum Corporation Limited (HPCL). The company will support HPCL's critical freight and customs handling operations, ensuring smooth processes for imports and exports.

JSW Energy's Utkal Thermal Power Plant synchronises Unit-2

Mumbai, India: JSW Energy (Utkal) Limited, a subsidiary of JSW Energy Limited has successfully synchronised Unit-2 (350 MW) of Utkal Thermal Power Plant (formerly known as Ind-Barath) located at Jharsuguda district of Odisha. Following the acquisition of the plant under NCLT proceedings in December 2022, JSW Energy has fully revived and synchronised the entire 700 MW (2x350 MW) capacity at the Utkal Thermal Power Plant in approximately 24 months.

The plant runs on domestic coal and currently is not tied-up under long-term power purchase agreement. The company's locked-in thermal capacity stands at 7,458 MW and with the commissioning of Unit-2 (350 MW) the operating thermal capacity will increase to 3,858 MW. The company's total locked-in generation capacity stands at 28.2 GW. This positions JSW Energy to achieve its target of 20 GW significantly before 2030 and is committed to a net zero target by 2050.

Praj builds sustainable road using lignin-based bio-bitumen

Pune/Nagpur, India: Praj Industries, India's leading industrial biotech company, has announced the inauguration of the country's first sustainable road made using lignin-based bio-bitumen. This road is at the Nagpur-Mansar Bypass project, NH 44. Praj's proprietary technology refines crude lignin into Lignin Bio-Bitumen and has the potential to replace fossil-based bitumen and offer sustainable solutions to the road infrastructure industry. This green construction material, with a blending capacity of up to 15 per cent, offers a 70 per cent reduction in greenhouse gas (GHG) emissions compared to fossil-based bitumen.

Commenting on this development, Nitin Gadkari, Hon. Minister of Road Transport and Highways, congratulated Praj on the successful development of this technology saying, "The bio-bitumen used in this project, developed by Praj Industries in collaboration with CSIR- Central Road Research Institute (CRRI), is a significant step toward sustainability. It reduces our dependency on imported bitumen and provides an innovative solution by turning agricultural waste into a valuable resource."

Praj laid a service road in Halol, Gujarat using Lignin Bio Bitumen as one of the components. After 2.5 years and 3 monsoon seasons, CSIR-CRRI conducted the performance evaluation, and the results were found satisfactory with no signs of distress on the road. This success was one of the key factors in building the Nagpur-Mansar project.

Coromandel International unveils advanced soil and leaf testing lab

Chennai, India: Coromandel International Limited, India's leading agri-inputs company, has inaugurated an advanced soil and leaf testing laboratory at its plant in Kakinada. Equipped with state-of-the-art technologies, this facility is designed to provide precise soil and plant nutrient analysis, helping farmers across India better understand their soil and its nutrient composition. This empowers them to make informed decisions on agri-input usage, promoting sustainable agricultural practices while safeguarding soil health for future generations.

The laboratory features advanced equipment such as Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), which provides precise detection of essential soil and plant nutrients; Energy Dispersive X-ray Fluorescence (ED-XRF) which enables detailed leaf nutrient analysis. Other advanced technologies present at the lab include spectrophotometers, microwave digesters, and near-infrared spectrometers, ensure comprehensive and precise testing capabilities.

To boost engagement with farmers, the laboratory has automated soil testing service requests and the

delivery of detailed test reports using Salesforce CRM. Farmers receive timely, data-driven recommendations directly on their mobile phones. Additionally, the laboratory's services are integrated with the Gromor Nutri Advisory Portal, which offers stage-wise fertilizer recommendations tailored to soil data and crop needs.

PTC Industries commissions Advanced Titanium VAR Facility

Lucknow, India: Aerolloy Technologies, a wholly owned subsidiary of PTC Industries, has become the first and only Indian private company to commission a Vacuum Arc Remelting (VAR) furnace and produce aerospace-grade Titanium alloy ingots. This state-of-the-art, German manufactured VAR furnace, positions Aerolloy to manufacture Titanium alloy ingots for critical applications in aerospace and defence industries. This VAR furnace has an annual melting capacity of 1,500 MT (based on double-melt quality standards). It can produce Titanium alloy ingots up to 1,000 mm in diameter and weighing up to 10 MT. The VAR process operates under vacuum, ensuring the elimination of impurities while preventing contamination and oxidation during melting. This meticulous process ensures a superior metallurgical structure and uniform alloy composition, essential for applications in jet engines, airframes, and industrial gas turbines.

NIRL, APDCL to develop solar power project in Assam

Guwahati, Assam: A joint venture agreement was signed between NLC India Renewables Limited (NIRL), a wholly-owned subsidiary of NLC India Limited, and Assam Power Distribution Company Limited (APDCL). The agreement between outlines the establishment of a Joint Venture Company (JVC) aimed at developing 1,000 MW of green energy projects in Assam. The JVC will be established with an equity shareholding of 51 per cent by NIRL and 49 per cent by APDCL. NIRL will bring its expertise in renewable energy project development. APDCL will facilitate land acquisition, regulatory approvals, and power evacuation infrastructure. Power Purchase Agreements (PPAs) will be signed with Assam DISCOMs for the sale of 100 per cent of the generated power for 25 years. The joint venture aims to address Assam's growing energy demands by developing renewable energy projects, ensuring affordable and reliable power supply, and contributing to the state's long-term energy security.

JSW Neo Energy completes acquisition of assets from Hetero Group

Mumbai, India: JSW Neo Energy Limited, a wholly owned subsidiary of JSW Energy Limited, has completed the acquisition of 125 MW of renewable energy assets from Hetero Labs Limited and Hetero Drugs Limited housed under three SPVs. The 125 MW portfolio comprises of wind projects located in the states of Andhra Pradesh and Maharashtra and have long term power purchase agreements. The portfolio has a blended tariff of ₹5.22/ KWh and average remaining plant life of ~15 years. The total locked-in capacity of the company stands at 24.7 GW which consists of a diverse fuel mix and offtakers. The transaction values the Hetero portfolio at an Enterprise Valuation of approximately ₹630 crores, excluding net current assets and other adjustments under SPAs (Share Purchase Agreements).

Hartek bags largest solar plant in Jammu Kashmir

New Delhi, India: Hartek Group's Commercial & Industrial (C&I) rooftop solar business unit has won complete solar EPC contract of 8 MW from Kandhari Beverages Private Limited, one of the largest bottling plants of Hindustan Coca Cola. This will become Jammu & Kashmir's largest rooftop solar installation. The project is under execution and will be commissioned this quarter. The installation will improve the region's renewable energy capability and drastically lower the facility's energy expenses by producing a million units a year. Notably, this is the third project awarded to Hartek by Kandhari Beverages in the past two years, bringing their total installations for the beverage company to 14 MW. The scope encompasses a comprehensive turnkey solution, including engineering and design, procurement of solar modules, inverters and associated equipment, testing & commissioning, and one year of operations and maintenance (O&M).

L&T Heavy Engineering wins new orders in India and abroad

Mumbai, India: The Heavy Engineering arm of Larsen & Toubro (L&T) has won multiple orders in Q3 of FY25 in the overseas and domestic markets. In the overseas market, it has secured an order for LNG equipment for a project in the USA. The business also secured an order for a loop reactor in a Propane Dehydrogenation (PDH) Polypropylene (PP) plant in Turkey. Further, the business has secured a prestigious repeat order from a leading oil and gas customer in Saudi Arabia for a Fluid Catalytic Cracking Unit (FCCU) revamp project. The business has then bagged an order from a prestigious client in Kuwait. This is for the supply of critical components for hydrocracker reactors and high-pressure heat exchangers. On the domestic front, Heavy Engineering has secured orders for three urea reactors – from Southern Petrochemical Industries Corporation for India's longest urea reactor, Indian Farmers Fertiliser Cooperative Ltd, and Indorama India Private Limited. These have taken the number of urea reactor orders that the business has received in recent years to 17 in a row.

Inox Wind bags order from Serentica Renewables

Noida, India: Inox Wind Limited (IWL), India's leading wind energy solutions provider, has announced that it has bagged a 60 MW order from Serentica Renewables (Serentica), a leading Commercial & Industrial focused renewable energy company in India. This order is for the supply of 3 MW class turbines to be delivered within H1 CY25. Additionally, IWL will provide multi-year post commissioning operations and maintenance (O&M) services for these wind turbine generators (WTGs), which will be erected at the hybrid renewable energy project site being developed by Serentica in Karnataka. The power generated from this project will be supplied to Serentica's partners, including the Vedanta Group. Inox Wind Limited (IWL) is India's leading wind energy solutions provider servicing IPPs, Utilities, PSUs and Corporate investors. IWL is a part of the US$ ~ 12 BN INOXGFL Group which has a legacy of over nine decades and is primarily focused on two business verticals - chemicals and renewable energy.

Sadara, ASMO sign MoU to strengthen supply chains and logistics efficiency

Dammam, Saudi Arabia: Sadara Chemical Company has signed a Memorandum of Understanding (MoU) with ASMO, a joint venture between Saudi Aramco and DHL. The collaboration aims to enhance operational processes and drive logistics excellence within Sadara's supply chain. The strategic partnership reflects Sadara's commitment to adopting innovative and sustainable procurement, inventory management, and logistics solutions.

Sadara produces locally manufactured materials and applications, including elastomers, polyurethanes, health and medical applications, and specialized oil, gas, and water treatment chemicals. The company continues to explore new supply channels and adopt advanced, sustainable technologies to enhance its manufacturing operations.

ASMO combines Saudi Aramco's expansive supply chain network with DHL's global logistics expertise to deliver integrated supply chain solutions.

The partnership reaffirms both companies' commitment to supporting the national economy and sustainable development. It reinforces their roles as key contributors to Saudi Vision 2030 and leaders in driving the Kingdom's industrial growth and global competitiveness.

Sekisui Chemical to commence production of Perovskite Solar Cells

Tokyo, Japan: SEKISUI CHEMICAL Co. Limited has decided at the meeting of its board of directors, to begin mass production of Perovskite Solar Cells. The company has been working to develop and establish mass production technology for lightweight and flexible perovskite solar cells utilizing the Green Innovation Fund, aiming to commercialize the technology in 2025. Expanding production capacity and reducing manufacturing costs were bottlenecks. Recently the company was selected for the GX Supply Chain Construction Support Project by the Ministry of Economy, Trade and Industry.

The company would like to play a central role in realizing the government's goal of establishing a gigawatt (GW) level supply system by 2030, and has therefore decided to make a capital investment with the aim of starting

operation of a 100 MW manufacturing line in 2027. The company will take over the buildings as well as power supply, cooling, and other facilities of the main factory of Sharp Corporation in Sakai City, Osaka Prefecture, and install perovskite solar cell manufacturing facilities to carry out manufacture and sales. To begin mass production, a new company (SEKISUI SOLAR FILM CO., LTD.) will be established and operated for the purpose of designing, manufacturing, and selling perovskite solar cells. SEKISUI SOLAR FILM CO., LTD. will initially focus on introducing the product on low load-bearing roofs and in the public sector (such as gymnasiums that serve as evacuation centers during disasters) by taking advantage of the product's lightweight and flexible characteristics. It will then aim to expand the business by reducing costs through mass production and creating demand by targeting roofs and exterior walls of private-sector buildings such as factories and warehouses.

BASF, research partners collaborate to optimize mechanical recycling of plastics

Spectroscopic analysis of a plastic in a BASF laboratory in Ludwigshafen.

New York, United States: BASF has teamed up with Endress+Hauser, TechnoCompound and the Universities of Bayreuth and Jena, to study how the mechanical recycling of plastics can be improved. With funding from the German Federal Ministry of Education and Research (BMBF), the SpecReK project aims to reliably and precisely identify the composition of plastic waste during the recycling process and thus improve the quality of recycled plastics. This will be achieved by combining state-of-the-art measuring techniques with Artificial Intelligence (AI).

The researchers are using spectroscopic methods which interpret how the material interacts with light to gain information about the chemical structure of the recycled plastics. The project partners want to use this data to determine in real time during processing which plastic grades, additives and contaminants are contained in the material. In a subsequent step, an AI algorithm will recognize patterns in the measurement data and recommend which additional components should be added or how the recycling process should be adapted to improve the quality of the recycled plastic output.

The total project volume is €2.2 million, with two-thirds financed by BMBF funds from its quantum systems research program and one-third financed by the project partners. ■

Managing Transportation Carbon Emissions in Chemical Supply Chains

Chemical supply chains involve a complicated network of processes, technologies and participants involved in the creation, production, transportation and delivery, storage, use and disposal of chemical products. Of these, transportation occupies a significant pie owing to inbound, intraplant and outbound logistics. The emissions associated with transportation and freight in the chemical supply chains impact the climate extensively. This article looks at methods for measuring and mitigating transportation carbon emissions within chemical chains.

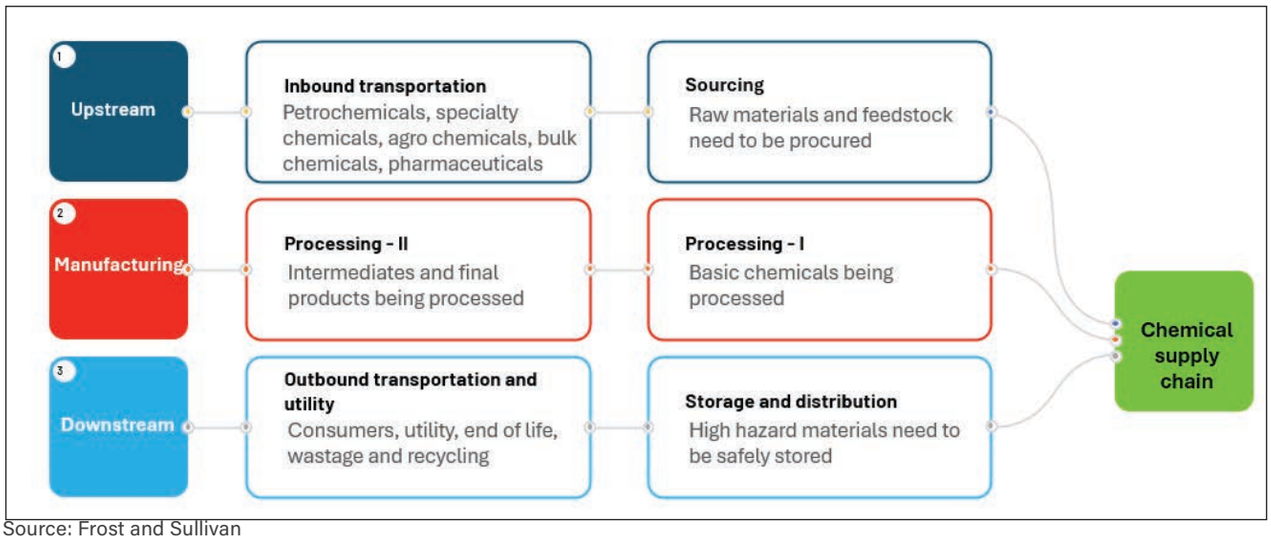
DR. ADITYA GUPTA
Chief Operations Officer
Supply Chain Management Centre
IIM Bangalore

DR. MOHAN KRISHNA
Manager-Research
TCI-IIMB Supply Chain
Sustainability Lab
Supply Chain Management Centre
IIM Bangalore

Global warming is growing at alarming levels, fuelled by the increasing concentration of greenhouse gases like carbon dioxide into the atmosphere. This has led to several devastating consequences across the globe in the form of rising sea levels, increase in frequency and intensity of heatwaves and wildfires, and weather pattern disruptions threatening food security and human health. Energy and carbon intensive industries are the single largest point sources of greenhouse gas emissions across the world. This includes the chemical, fertilisers and allied industries, who, apart from being major drivers of healthcare, wellness, agro economy, etc. also play a major role in accelerating this climate crisis. The industry's production processes are heavily dependent on fossil fuels. Manufacture of products like plastics and refrigerants have a substantial carbon footprint throughout their lifecycle. This has in turn led to increased pressures on chemical companies to be more environmentally responsible.

Chemical supply chains involve a complicated network of processes, technologies and participants involved in the creation, production, transportation and delivery, storage, use and disposal of chemical products. Of these, the transportation occupies a significant pie owing to inbound, intraplant and outbound logistics. The emissions associated with transportation and freight in the chemical supply chains impact the

climate extensively. This article looks at methods for measuring and mitigating transportation carbon emissions within chemical chains.



Source: Frost and Sullivan

Importance of Transportation Carbon Accounting in Chemical Supply Chains

The chemical value chain can be grouped into 3 baskets, namely, the upstream, manufacturing and downstream.

It is critical to account for the transportation carbon emissions in chemical supply chains for the following reasons:

- **Environmental Impact:** Major emission hotspots within the transportation chain is identified, thereby, initiating targeted emission reduction strategies. Accounting for the emissions accurately avoids penalties and ensures compliance.
- **Business Advantages:** Cost effective enhancements in logistics are ensured, giving rise to increased savings in capital. Competitive advantage for the company by demonstrating commitment to sustainability, thereby attracting consumers and investors who are environmentally conscious. Innovation in sustainable transportation solutions is also encouraged, such as electric vehicles, alternative fuels, and optimized logistics.
- **Risk Management:** A high carbon footprint damages the reputation of chemical industry. Managing carbon emissions help mitigate risks associated with reputational damage. Factors in supply chain disruptions as well by allowing for proactive adaptation to potential future regulations or market shifts.
- **Transparency and Accountability:** Environmental impact data could be transparently communicated to stakeholders across the chemical value chain. This data would aso be leveraged for internal decision-making processes related to sourcing, transportation, and overall supply chain strategy.

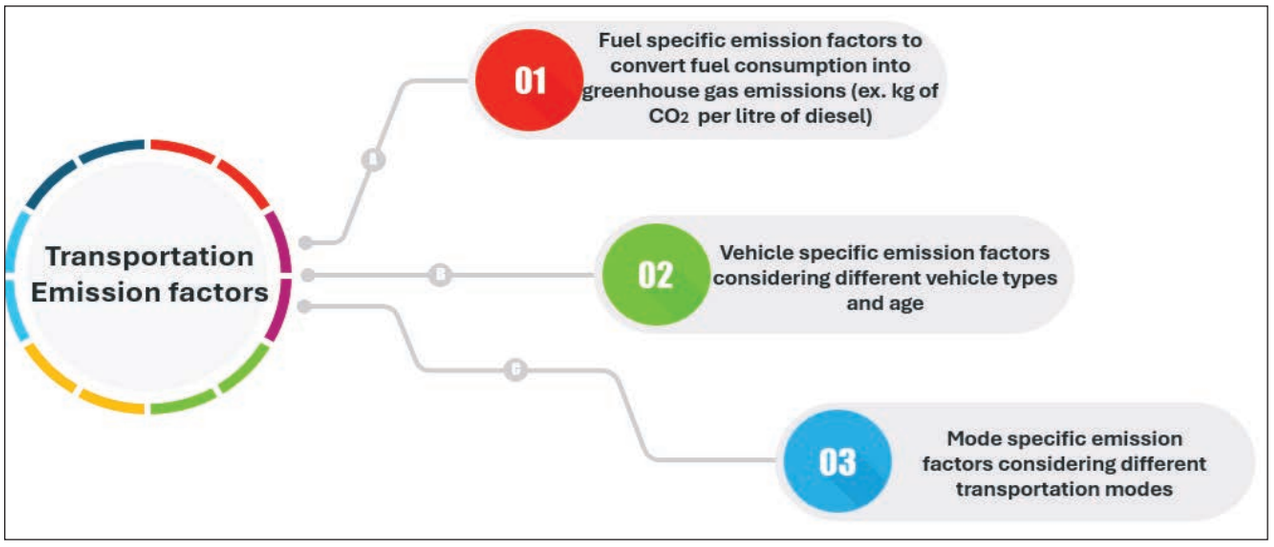
Elements of Transportation Carbon Accounting in Chemical Supply Chains

The process of measuring and quantifying the greenhouse gas emissions pertaining to the various transportation activities in the chemical supply chain is known as transportation carbon accounting. It is made up of several elements:

Data Collection:

- Tracking the fuel type and consumption by different vehicle segments across the supply chain (cars, trucks, trains, ships, planes).
- Collating and compiling the distances covered by each vehicle or mode of transport in terms of Route kilometres travelled (RKM)/ Vehicle miles travelled (VMT).
- Information related to the vehicle types (e.g., gasoline, diesel, electric) and their characteristics (age, fuel efficiency, gross tonnage and volume).
- Factoring in instances of multi modal transportation used (road, rail, air, sea) and their respective distances.

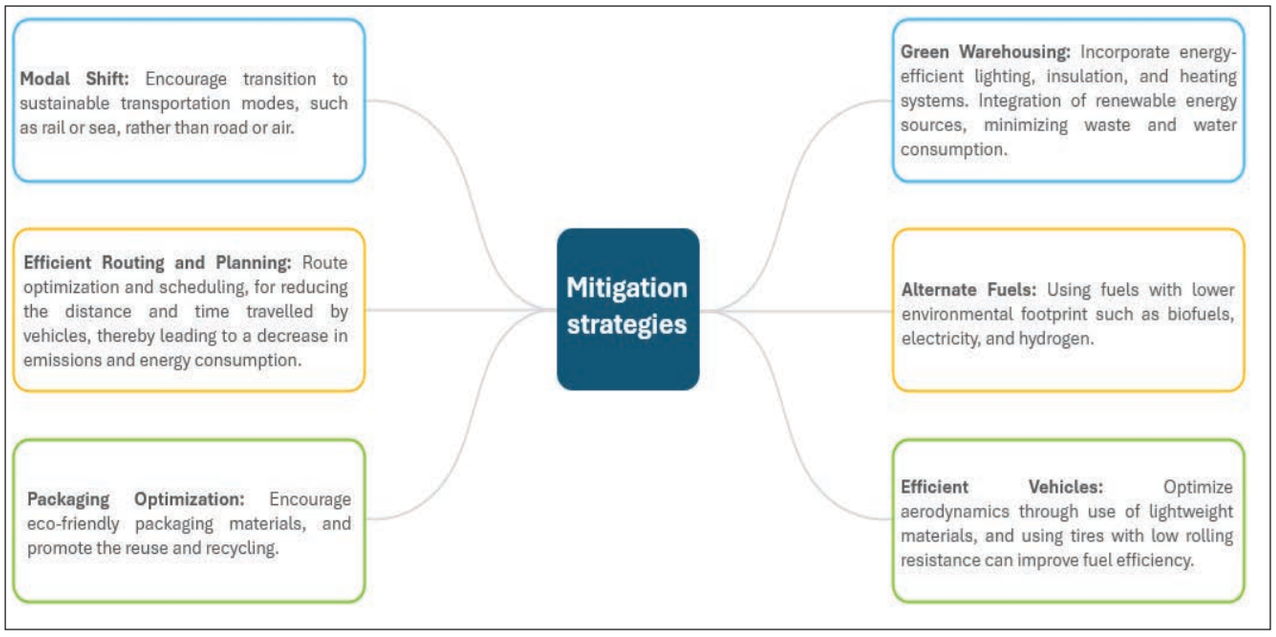
Emission Factors



Methodology, Scope and Boundaries:

Various methodologies are employed in transportation carbon accounting for emission assessment. Life Cycle Assessment (LCA) is one such tool which holistically considers the emissions across the entire product or service lifecycle, including transportation. There are different operational boundaries which could be considered along the value chain, namely, cradle-to-grave, cradle-to-gate, gate-to-grave, gate-to-gate and cradle-to cradle (closed loop approach). Specifically, Well-to-Wheel analysis considers emissions from production of the fuel to the vehicle's wheels, while Tank-to-Wheel analysis confines to emissions from the fuel tank to the wheels. Properly defining the scope and choosing the boundary is crucial in transportation carbon accounting. Operational boundaries consider the transportation activities and geographical areas, while the period of analysis and the time stamp is defined in temporal boundaries. Emissions can be inventorised into different scopes depending on direct or indirect operations, ownership and control.

Reporting and Verification: By utilizing established frameworks and guidelines, such as the GHG Protocol, standardized reporting ensures consistency and transparency. This also sets in place benchmarking and comparability across organizations. Also, it is important to undertake third-party verification and assurance to enhance the credibility of carbon



accounting data. This reflects the intent of the company in communicating its sustainable value chain practices and providing stakeholders with greater confidence in the reported emissions.

Mitigation Strategies for Transportation Carbon Emissions in Chemical Supply Chains

Technological Innovations to Promote Sustainability in Chemical Supply Chains

Emission hotspots can be identified through emissions measurement, data analytics and artificial intelligence (AI), which could then be used to optimize supply chains. Transportation routes could also be tracked and optimised. To promote sustainable logistics in chemical supply chains, the TCI-IIMB supply chain sustainability lab has come up with the first ISO-certified Transport Emissions Measurement Tool (TEMT). The software-as-a-service (SaaS) based platform measures emissions with India specific emission factors, which ensures precision. This goes a long way in managing and controlling the freight emissions in the chemical industry.

The tool has incorporated multiple modes of transport namely, road, rail, air, maritime, and inland waterway transport mainly covering fuel combustion and electricity consumption. Users of the tool can compute emissions for both past and future shipments. The emissions between different transport modes can be compared for a given origin-destination pair, thus enabling users with the flexibility to build customized transportation chains. Explore the tool here: https://iimb.freightemissions.com/

Conclusion

Measuring and mitigating transportation carbon emissions within chemical supply chains is one of the primary ways to address climate change and the long-term sustainability of the industry. Continuous improvement and innovation are essential in developing and implementing cleaner transportation processes and efficient logistics solutions. A low-carbon future would help the chemical industry enhance its environmental performance, improve resource efficiency, and contribute to a more sustainable and resilient society. ■

GUEST COLUMN

The Future of Supply Chain Sustainability in Specialty Chemicals

Smitha Shetty
Regional Director - APAC
Achilles Information Limited

The future of supply chain sustainability in specialty chemicals hinges on innovation, collaboration, and technology. By building resilient and sustainable supply chains, the specialty chemicals sector is not only responding to global demands for accountability but also unlocking new opportunities for growth and innovation.

The specialty chemicals industry occupies a vital niche, crafting specialized solutions for diverse sectors ranging from pharmaceuticals and agriculture to automotive and aerospace. Unlike their commodity counterparts, specialty chemicals are precisely formulated in smaller batches to meet unique demands, prioritizing quality, safety, and consistency. This focus on tailored solutions drives a thriving market, projected to grow at an annual rate of 5.1 per cent through 2030, fueled by factors such as performance enhancement, sustainability demands, and expanding applications in sectors like healthcare and construction.

This growth trajectory, however, intersects with an increasingly complex landscape where sustainability is no longer a choice but a necessity. Driven by consumer awareness, evolving regulations, and the inherent advantages of responsible practices, the industry is embracing innovation to navigate this new era.

Renewable Sourcing & Circular Economy

Renewable sourcing is a cornerstone of sustainable supply chain strategies for specialty chemicals. By transitioning to renewable feedstocks, companies are reducing their reliance on finite fossil resources and

lowering carbon emissions. The circular economy amplifies these efforts by enabling waste materials to be reused in production processes.

The packaging industry provides an example, where biodegradable materials derived from plant-based chemicals are replacing traditional plastics. Another instance is the growing adoption of bio-based surfactants in the personal care sector, which aligns with consumer preferences for sustainable and ethical products.

Collaboration across supply chains is essential to scale renewable sourcing initiatives. Partnerships between manufacturers, suppliers, and end-users foster innovative solutions, ensuring the viability and scalability of renewable materials.

Green Chemistry: Transforming Processes and Products

Green chemistry has become an important area of focus for the specialty chemicals industry. By designing processes and products that minimize environmental impact, companies are reducing hazardous substances, improving energy efficiency, and enhancing the sustainability of their supply chains. This approach resonates with global efforts to curb emissions and conserve resources while meeting customer expectations for eco-friendly solutions.

For example, the automotive sector is increasingly turning to Metal-Organic Frameworks (MOFs) to enhance fuel storage in vehicles, as these structures optimize energy efficiency and reduce environmental impact. Similarly, bio-based polymers derived from agricultural waste are replacing traditional petroleum-based products in industries ranging from packaging to healthcare. Such innovations demonstrate environmental commitment and offer cost savings through reduced reliance on fossil fuels.

Health & Safety with Sustainability Focus

The specialty chemicals industry has always placed a premium on health and safety. However, the integration of sustainability into these practices is now reshaping the landscape. Advances in digital technology allow for real-time tracking of compliance with Health, Safety, and Environmental (HSE) regulations, providing transparency and reducing risks to workers and the environment. Technology, coupled with periodic ethical on-site audits, further strengthens the mission of workplace health and safety by ensuring supply chains remain compliant and watchful to HSE issues.

Ethical audits go beyond regulatory compliance by evaluating the real-world application of safety protocols, labour practices, and environmental management. These audits create opportunities to identify gaps that may not be apparent through remote assessments or self-reporting. By engaging with suppliers and their teams on-site, businesses can better understand operational challenges and foster a culture of continuous improvement.

One example is the adoption of closed-loop systems for hazardous chemical handling. These systems safely recycle chemicals, minimizing exposure and environmental contamination. Regular audits ensure that these systems function as intended and that any deviations are promptly corrected, further protecting workers and the environment. Similarly, the development and monitored use of low-toxicity materials reduce inherent risks in production and application, aligning with global sustainability goals like the United Nations Sustainable Development Goals (SDGs). Incorporating ethical audits into their operational frameworks allows companies to drive greater accountability and resilience throughout their supply chains.

AI-Powered Risk Management: Enhancing Resilience

The specialty chemicals industry operates within highly intricate supply chains that are vulnerable to disruptions caused by natural disasters, geopolitical instability, or material shortages. Artificial intelligence (AI) is emerging as a critical tool to mitigate these risks and strengthen supply chain resilience.

AI-enabled risk management platforms provide real-time monitoring of supply chains, identifying vulnerabilities and issuing predictive alerts about potential disruptions. For instance, during the COVID-19 pandemic, AI-driven platforms helped several chemical companies adjust sourcing strategies by predicting material shortages and optimizing inventory management. These systems also offer insights into compliance risks, ensuring suppliers adhere to environmental and safety standards.

By integrating AI into their operations, companies also enhance efficiency. Tools that optimize inventory

management, logistics and procurement reduce waste and minimize emissions. These capabilities are particularly valuable as organizations strive to balance resilience with sustainability. AI-powered systems empower decision-makers to make smarter, quicker and well-informed decisions, helping companies remain resilient and future-proofing them against the evolving landscape.

Supply Chain Visibility & Resilience

Transparency is vital for managing the complexities of specialty chemical supply chains. Multi-tier mapping provides a comprehensive view of supply networks, identifying potential vulnerabilities beyond direct suppliers. Studies have shown that up to 85 per cent of supply chain disruptions occur in sub-tier levels, highlighting the importance of extending visibility across the value chain.

Technology is instrumental in achieving this transparency. For instance, blockchain provides an immutable record of a product's lifecycle, ensuring traceability and compliance with sustainability criteria. Meanwhile, the Internet of Things (IoT) and sensor technologies enable real-time monitoring of conditions like temperature and humidity during transportation, ensuring the safe handling of sensitive chemicals and reducing spoilage.

Companies are also leveraging predictive analytics tools to model scenarios and prepare for potential disruptions. These tools enhance agility, enabling businesses to adapt quickly and maintain continuity in the face of challenges.

Examples of Proactive Supply Chain Strategies

Recent geopolitical shifts have highlighted the importance of supply chain diversification. For example, companies in the electronics sector, such as Apple, have strategically expanded their supplier base to countries like Vietnam and India to reduce dependency on single-source suppliers. This approach is equally relevant to specialty chemicals, where the geographic concentration of raw materials or suppliers can pose significant risks.

In addition to diversification, collaboration with suppliers is key. Gartner reports that 77 per cent of companies are investing in stronger supplier partnerships to drive innovation and mitigate risks. In the specialty chemicals industry, this could mean engaging with suppliers on sustainability initiatives, co-developing environmentally friendly products, or aligning on shared goals for compliance and transparency.

Role of Technology in Enabling Collaboration

Supply chain sustainability digital platforms are fostering deeper collaboration by integrating supply chain data across stakeholders. For instance, AI-driven monitoring systems can send customized alerts about regional disruptions and provide heatmaps or supplier performance, enabling companies to respond swiftly.

Technology also helps organizations stay ahead of regulatory requirements. Automated systems can monitor evolving environmental and regulatory standards globally and alert compliance officers to changes, ensuring adherence to laws while avoiding costly penalties.

Conclusion

The future of supply chain sustainability in specialty chemicals hinges on innovation, collaboration, and technology. By building resilient and sustainable supply chains, the specialty chemicals sector is not only responding to global demands for accountability but also unlocking new opportunities for growth and innovation. This commitment to a sustainable future will ensure the industry remains a vital partner in addressing some of the world's most pressing challenges. ■

Sustainability and Technological Advancements in Road Construction

Sanjay Kumar Sinha
Founder and Managing Director
Chaitanya Projects Consultancy

India's road construction sector is undergoing a transformative journey, embracing sustainability and technological advancements to meet the aspirations of a modernizing nation. By integrating green practices, smart technologies, and efficient delivery methods, the country is poised to build infrastructure that supports economic growth while preserving the environment.

India, a nation renowned for its diverse geography and burgeoning economy, boasts the second-largest road network in the world, spanning approximately 6.7 million kilometres. This vast infrastructure facilitates the transportation of 64.5 per cent of all goods and serves as a commuting network for 90 per cent of the nation's total passenger traffic. Roads play a pivotal role in connecting remote villages to bustling metropolises, catalysing economic growth and social development.

In the era of rapid urbanisation and industrial growth, sustainability is no longer a choice but a necessity for modern India. As the backbone of economic and social connectivity, the road sector must evolve to address mounting environmental challenges while meeting the demands of a dynamic economy.

Under the Union Budget 2024-25, ₹2.72 lakh crore (USD32.68 billion) has been allocated to the Ministry of Road Transport and Highways, underscoring the sector's priority. Furthermore, the National Highways Authority of India (NHAI) achieved record-breaking capital expenditure of ₹2,07,000 crore (USD24.79 billion) in FY24.

GUEST COLUMN

The pace of road development in India has been remarkable. From constructing rural roads to building world-class expressways, India has steadily upgraded its infrastructure to meet the demands of its growing economy. National highways now form the backbone of this network, enabling efficient freight movement and passenger travel. Significant investments and progressive policies aimed at enhancing connectivity while adopting sustainable and technological innovations underscore the importance of this network.

Nearly 40,000 kilometres of rural roads have been built using plastic waste, with 13,000 kilometres constructed in the past two years alone under the Pradhan Mantri Gram Sadak Yojana (PMGSY). This initiative highlights India's commitment to integrating sustainable practices into infrastructure development. Green and new technologies commonly being used under PMGSY include Full Depth Reclamation (FDR), waste plastic, cold mix technology, cement stabilization, Interlocking Concrete Block Pavement (ICBP), paneled cement concrete, cell-filled concrete, surface dressing, and Terrazyme.

These technologies emphasize cost-effective and environment-friendly construction methods, significantly reducing carbon footprints while conserving natural resources.

However, road construction and maintenance remain significant sources of CO2 emissions, exacerbating the impact of fuel-operated vehicles. Road transport contributes around 12 per cent of India's energy-related CO2 emissions and is a major driver of urban air pollution. With the growing demand for private mobility and goods transport, energy use and emissions from road transport could double by 2050, according to the International Energy Agency (IEA).

The rapid expansion of India's road network, driven by initiatives like the Bharatmala Pariyojana, has been instrumental in its economic progress. However, the evolving needs of a modernising India necessitate a shift towards more sustainable and technologically advanced road construction practices.

The IEA's Announced Pledges Scenario (APS) outlines a path to align the road transport sector with India's 2070 net-zero goal. Through ambitious policies, India could reduce energy demand by 30 per cent by 2050 compared to current frameworks, saving 70 million tonnes of oil equivalent—equivalent to 80 per cent of the sector's current energy needs. CO2 emissions are expected to peak by the mid-2030s and decline to 20 per cent below current levels by 2050, potentially avoiding up to 4 Gt CO2 between 2021 and 2050. These strategies demonstrate the potential for balancing infrastructural growth with environmental sustainability.

Sustainability & Technological Advancements in Road Construction

India's road construction sector is at the forefront of adopting green practices and leveraging technological advancements to address the demands of modern India. These innovations aim to create a resilient and efficient road network while ensuring environmental sustainability.

Green Practices Driving Sustainability

Full Depth Reclamation (FDR), combined with soil stabilization, minimizes the need for stone aggregates by up to 85 per cent, significantly cutting carbon emissions. FDR reuses existing soil and incorporates natural mineral-based additives to create robust sub-base layers, reducing the environmental impact of mining and material transportation.

The integration of recycled materials, such as plastic waste in road construction, showcases innovative ways to address plastic pollution sustainably. Cities like Chennai and Pune have successfully implemented this technology, resulting in durable and cost-effective roadways. Additionally, green highway initiatives promote plantations along roadways, offsetting carbon footprints and enhancing biodiversity.

Smart Technologies Revolutionizing Road Construction

Technologies such as intelligent compaction, IoT, and AI are transforming road construction processes. GPS-enabled rollers ensure uniform compaction of asphalt layers, enhancing road durability and reducing material wastage. IoT sensors monitor parameters

like traffic density and structural health, enabling predictive maintenance and reducing costs. AI tools optimize road design, predict wear and tear, and streamline project timelines. For instance, smart roads in Bengaluru leverage sensors for dynamic traffic management, reducing congestion and emissions.

Advanced materials like self-healing asphalt and geosynthetics are improving road durability while minimizing maintenance needs. Automation technologies, including autonomous equipment, enhance construction precision and safety, significantly reducing project timelines.

Enhanced Project Delivery Methods for Efficiency

Prefabrication and modular construction methods have reduced construction time and environmental impact. Projects like the Eastern Peripheral Expressway demonstrate the effectiveness of these approaches in minimizing on-site disruptions and waste. Public-private partnerships (PPPs) attract private investment and expertise, ensuring efficient project delivery. The Delhi-Meerut Expressway is a prime example of successful PPP implementation, benefiting from policy reforms like the Hybrid Annuity Model (HAM) and Build-Operate-Transfer (BOT) concessions.

Geosynthetics, increasingly used in flood-prone and coastal regions, enhance soil stability and drainage, reducing the need for extensive earthwork and improving road longevity. These methods align with the goals of cost-effective and resilient infrastructure development.

Challenges and the Way Forward

Despite these advancements, challenges such as high initial costs and limited technical expertise persist. Addressing these require robust policy frameworks that incentivize sustainable materials and technologies. Training programs for engineers and contractors must be integrated into development strategies to ensure the effective adoption of innovative practices.

Collaboration among government, private sector, and academia is essential to overcome barriers and foster innovation. Initiatives like the National Electric Mobility Mission Plan and Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) should extend support to sustainable road construction, bridging gaps in policy and practice.

India's road construction sector is undergoing a transformative journey, embracing sustainability and technological advancements to meet the aspirations of a modernizing nation. By integrating green practices, smart technologies, and efficient delivery methods, the country is poised to build infrastructure that supports economic growth while preserving the environment.

The road ahead requires a commitment to innovation, collaboration, and sustainability. By prioritizing these principles, India can pave the way for a resilient and future-ready road network that balances progress with environmental stewardship. ■

Biobitumen: Paving the Way for Sustainable Infrastructure

Dr. Manoranjan Parida
Director
CSIR-Central Road Research Institute

The world is at a critical juncture where the need for sustainable alternatives to traditional materials is not just desirable but essential. There is no reason why road infrastructure should not be a part of this revolution. Traditional bitumen derived from petroleum sources not only poses environmental concerns but also makes economies vulnerable to fluctuations in global oil prices, creating financial instability for nations heavily reliant on imports.

As per the Oil Ministry sources, nearly 50 per cent of the bitumen demand in India is met through imports, resulting in an annual expenditure of ₹25,000–30,000 crore in foreign exchange. This dependency not only increases the cost of infrastructure projects but also ties economic growth to the volatile crude oil market. Such volatility can disrupt budgetary allocations for large-scale infrastructure development, delaying projects and increasing financial strain.

Roads are not just pathways; they are the lifelines of economic development of a country, connecting communities, driving economies, and paving the way for progress. In the fiscal year 2023-2024, India constructed approximately 12,400 kilometers of national highways, achieving a construction rate of 34 kilometers per day. This marks a significant increase from previous years, reflecting the government's commitment to enhancing the country's road infrastructure. The Ministry of Road Transport and Highways has set a provisional target of constructing 10,421 kilometers of national highways for the fiscal year 2024-2025. As of December 2024, India has operationalized 4,693 kilometers of High-Speed Corridors (HSCs). The Ministry of Road Transport and Highways aims to increase this to 4,827 kilometers by the end of the current fiscal year. These targets and achievements highlight the ongoing efforts to expand and enhance India's road infrastructure.

The bitumen required to achieve these targets and the expenditure in foreign exchange is going to be extraordinarily large. By adopting sustainable alternatives like biobitumen, which can replace up to 15 per cent of traditional bitumen, nations can potentially save ₹4,000-4,500 crore annually in foreign exchange.

One such innovation making waves in infrastructure development is biobitumen — a renewable, eco-friendly alternative to fossil-based bitumen. As governments and industries globally work towards reducing carbon footprints, biobitumen offers a compelling solution to address both environmental and economic challenges.

What is Biobitumen?

Biobitumen is derived from lignin, a by-product of agricultural residues such as sugarcane bagasse, rice straw, and bamboo. Unlike conventional bitumen, which is derived from non-renewable petroleum, biobitumen is produced through a sustainable process that transforms waste into a high-value material. This aligns perfectly with the principles of the circular economy, where waste is minimized and resources are reused efficiently. It blends with the petroleum derived bitumen and can be used in the construction of roads.

Advantages of Biobitumen

Environmental Sustainability: By replacing fossil-based bitumen with biobitumen, greenhouse gas emissions can be reduced by up to 70 per cent. This significant reduction is further enhanced as it utilizes agricultural residues, which would otherwise contribute to pollution through practices like stubble burning.

The availability of biomass in India is approximately 220 million metric tons, that includes rice straw, sugarcane, cotton stalk, and other hard wood and energy crops. This feedstock can produce approximately 20-25 million metric tons of lignin bio-bitumen can be blended with fossil bitumen.

Enhanced Durability and Road Safety: Roads constructed with biobitumen have shown superior performance compared to traditional asphalt. Biobitumen enhances binding properties, providing roads with increased resistance to short term ageing and better performance under high temperature weather conditions.

Strength and durability of the roads: Central Road Research Institute's (CRRI) studies indicate that biobitumen roads can be up to 40 per cent stronger, requiring less maintenance and reducing long-term costs. This results in stronger and more durable roads, reducing the likelihood of potholes, rutting, and surface degradation. Roads that maintain their structural integrity over time are less likely to pose hazards such as uneven surfaces, which can lead to accidents.

Improved Performance in Extreme Hot Weather Conditions: Biobitumen exhibits better resilience to high temperature conditions. It provides better rutting performance, moisture resistance and short term ageing which are critical for the performance and durability of the roads. This stability reduces the risks associated with weather-induced road failures, enhancing driver safety year-round.

Economic Benefits: India imports nearly 50 per cent of its bitumen requirement, incurring substantial foreign exchange expenses. By adopting biobitumen, the nation could save ₹4,000-4,500 crore annually while reducing dependency on volatile global oil markets.

Waste Valorization: Agricultural residues, often discarded or burned, are transformed into valuable raw materials for biobitumen. This not only provides a sustainable alternative to bitumen but also addresses the environmental issues of air pollution and soil degradation caused by residue burning, in addition to creating a new revenue stream for the farming community.

Job Creation & Rural Development: The production of biobitumen opens avenues for rural employment, as the process involves collecting and processing agricultural waste. This fosters economic growth in agricultural communities and helps integrate sustainability into rural development.

A Milestone in India

Praj Industries, a leader in industrial biotechnology, has played a key role in scaling biobitumen technology for road construction, in collaboration with CRRI. Using its proprietary processes, Praj refines lignin in the agri residues into a sustainable binder that has been successfully used in constructing India's first biobitumen-based highway at the Nagpur-Mansar Bypass project. This project demonstrates the potential of biobitumen to transform road infrastructure, achieving both environmental and economic goals.

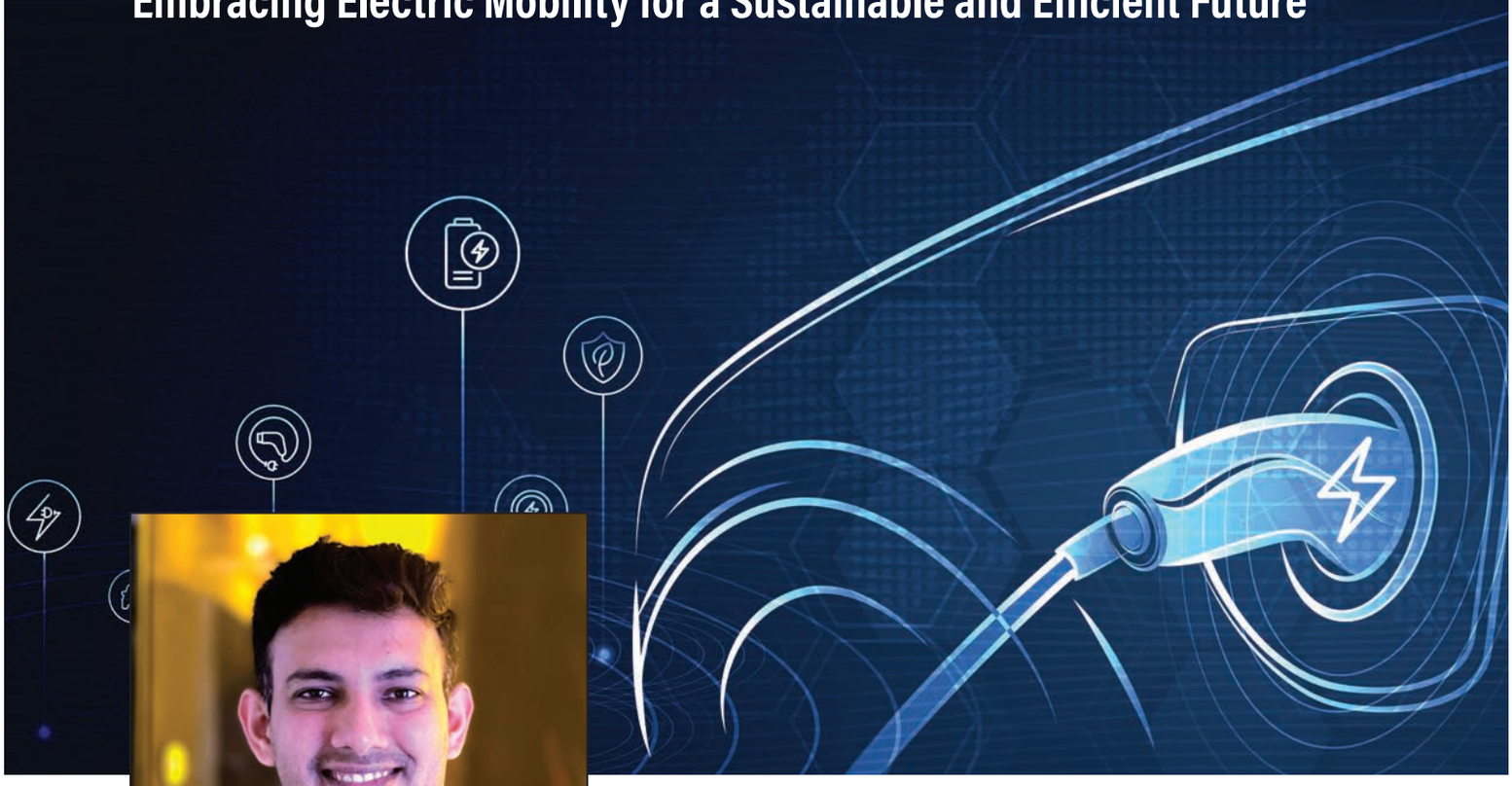
The Road Ahead

As the demand for sustainable infrastructure grows, biobitumen stands out as a promising solution. Scaling its adoption will require investments in production capacity, supportive policies, and awareness about its benefits. Governments and industries must collaborate to ensure that innovations like biobitumen become the norm rather than the exception.

The use of biobitumen exemplifies how science and innovation can lead us towards a greener future. By turning agricultural waste into wealth, biobitumen not only addresses pressing environmental concerns but also sets the foundation for resilient and sustainable infrastructure. ■

GUEST COLUMN

Embracing Electric Mobility for a Sustainable and Efficient Future



Pushpank Kaushik
CEO & Head of Business Development (Subcontinent, Middle East, and SouthEast Asia), Jassper Shipping

Electric mobility presents a transformative opportunity for the logistics sector, enabling companies to reduce their carbon footprint, lower operational costs, and meet the growing demand for sustainable practices. While challenges remain, the potential for electric mobility to foster a sustainable and efficient future in logistics is undeniable, opines **Pushpank Kaushik, CEO & Head of Business Development (Subcontinent, Middle East, and SouthEast Asia), Jassper Shipping.**

The logistics industry is very important for the global economy, helping businesses and customers by transiting goods smoothly across domestic and international borders. According to the Ministry of Shipping, about 95 per cent of India's trade by volume and 70 per cent by value happens through shipping. As reported by India Brand Equity Foundation (IBEF), India's main ports handled 817.97 million tonnes of cargo in FY24, which is a 4.45 per cent increase from 784.305 million tonnes in FY23. With more people moving to urban areas and the need for faster and more reliable shipping services, many shipping companies are opting for electric vehicles.

Current Logistics Industry Scenario

The logistics industry leads to major greenhouse gas emissions, due to heavy dependency on diesel-powered vehicles. With stricter government rules on emissions, logistics companies have to find a way to follow regulations while still making a profit.

Fluctuating fuel prices impact operational costs significantly, making it essential for logistics firms to seek alternative solutions. Geopolitical tensions across the globe force shippers to change routes, longer transit times consume more fuel, energy and resources, leading to increased costs.

Shift Towards Electric Mobility

Electric mobility is the shift towards using electric vehicles including hybrids and plug-in hybrid vehicles to make transportation better and cut down on environmental pollution. Electric Vehicles (EVs) are becoming a popular choice as they don't produce any exhaust emissions, making them a better choice for the planet. Due to improvements in battery technology, EVs can now travel longer distances, charge faster, and perform better, making them a good fit for a lot of logistics applications.

Advantages of Using EVs in Logistics

- **Reduced Emissions:** Switching from diesel vehicles to electric vehicles can greatly reduce greenhouse gas emissions, helping meet both national and international climate goals. This supports companies in matching global sustainability standards and legal requirements.
- **Lower Operating Costs:** Even though EVs might cost more at the initial stage, they can save money in the long run because they use less fuel and require less maintenance. With fewer moving parts, businesses can cut down on overall expenses.
- **Better Performance:** EVs can accelerate faster and deliver more power than regular gas engines, leading to quicker deliveries. Also, advancements in battery technology ensure longer trips and quicker charging times.
- **Improved Brand Image:** As people become more aware of environmental issues, they are choosing companies focused on sustainability. By using EVs, logistics companies can enhance their reputation, attract eco-conscious customers, and meet their social responsibility goals.
- **Technology Improvements:** The rise of electric vehicles in logistics is encouraging new technological developments. Innovations in self-driving technology, smarter route planning, and enhanced battery systems are advancing because of increased interest and funding. These improvements help logistics operate more efficiently and raise safety standards.

Challenges and Considerations

Despite the numerous benefits of implementing EVs in logistics, the widespread adoption of electric mobility faces several challenges. The availability of charging stations is a significant concern. Logistics companies often need specific charging setups to keep their fleets running, especially for long trips. Creating a strong and easy-to-use charging network is essential to meet the rising demand for EVs. Although technology is improving battery capacity, concerns about the range of EVs remain a barrier for logistics operations, particularly for long-distance deliveries. Therefore, companies must critically work on resolving the issue to increase EV adoption in logistics. Despite long-term savings, the upfront costs associated with purchasing EVs and installing charging infrastructure can be daunting. It is important for logistics companies to actively find solutions to these challenges to boost EV implementation in the industry.

As the demand for EVs grows, so does the need for sustainable battery production and disposal. The sourcing of raw materials for batteries and the environmental impact of battery disposal must be addressed to ensure that electric mobility is a truly sustainable solution.

Roadmap for Successful Implementation

To successfully integrate electric mobility into the logistics sector, a multi-pronged approach is necessary. The central government can play a vital role by providing financial incentives, investing in charging infrastructure, and implementing policies that encourage EV adoption. Also, increased collaboration between logistics companies, vehicle manufacturers, and technology providers is essential to develop and implement innovative solutions.

To keep up with rapid technological advancements on a global scale, continued research and development in battery technology, charging infrastructure, and vehicle design are crucial. Moreover, raising public awareness about the benefits of electric mobility and addressing concerns about range anxiety and charging infrastructure is essential for its widespread adoption.

Role of Technology in Electric Mobility

- **Advancements in Battery Technology:** The development of better battery technology is essential for enhancing the efficiency and effectiveness of electric vehicles. Innovations such as solid-state batteries promise higher energy densities, shorter charging times, and improved safety.
- **Smart Logistics and the Internet of Things (IoT):** Integrating IoT technology into logistics can optimize the use of electric vehicles. Real-time tracking and monitoring of fleet performance can lead to better route planning, reduced energy consumption, and improved delivery times.
- **Data Analytics and AI:** Data analytics can identify patterns in logistics operations, allowing companies to determine the optimal use of EVs in their fleets. Artificial intelligence (AI) can enhance route optimization, leading to greater efficiency and lower operational costs.

Future of Electric Mobility in Logistics

As technology continues to advance and costs decrease, EVs will become increasingly competitive with traditional vehicles. The integration of artificial intelligence, machine learning, and other emerging technologies will further enhance the efficiency and sustainability of electric logistics operations. This will enable better route planning, fleet management, and real-time monitoring, allowing logistics firms to optimize their operations.

The state and central government play a crucial role in facilitating the transition to electric mobility. Incentives, subsidies, and grants can help logistics companies navigate initial cost challenges and encourage further investment in electric vehicles. Additionally, regulations promoting low-emission zones and stricter fuel economy standards can drive demand for electric mobility.

Electric mobility presents a transformative opportunity for the logistics sector, enabling companies to reduce their carbon footprint, lower operational costs, and meet the growing demand for sustainable practices. While challenges remain, the potential for electric mobility to foster a sustainable and efficient future in logistics is undeniable. By championing electric mobility, the logistics industry can pave the way for a future that is not only more efficient and cost-effective but also aligns with global sustainability goals. ■

Oil & Gas and Power sector: Driving Business Transformation through Sustainable Supply Chains

Dharmendra Gangrade
Head of Logistics Management Centre
Larsen & Toubro Limited

Globally, in the last 12 months project sector has performed well as compared to previous 2 years when world was battling against Covid pandemic and consequent slowdown in almost all sector except healthcare. Increase in the demand has been fuelled by capital expenditure outlay on mature hydrocarbons and power, mature renewables and cleantech and energy transition projects, beside infrastructure development and construction sectors. At the same time, there has been muted performance or decline in project sectors impacted by ongoing Russia-Ukraine war in the affected EU region. However, many other negative factors such as high inflation and stressed financial sector have pushed the large global economies in to recession leading to certain hold back position on capex decisions by affected sectors.

All above developments are essentially pointing to increased activities in entire global supply chain where 'disrupted supply chain' is almost new normal and no stakeholders can claim to be not affected due to numerous breakdowns in global supply chains from time to time.

Therefore, there is immediate need to re-look at the existing supply chain more holistically than before for ensuring it remains agile, resilient and proactive to meet business requirements. And this also offers opportunity to transform the entire supply chain with respect to alignment with sustainability objectives which help supply chains to be not only sensitive and caring to planet but help to achieve the major business objective of Deliver MORE from LESS.

World over EPC companies have been aiming to achieve significant progress to transform their supply chain to meet sustainability objectives for business. While there are many ways specific to each industry/ sector to address the sustainability requirements, there are some established and best practices have now emerged which has helped many large companies to achieve their stated goals on sustainability.

Even before embarking on the journey to transform business processes, its important to understand what does sustainable supply chain means to business? As experts have defined and is also widely known, sustainable supply chain refers to the management and integration of environmental, social, and economic considerations throughout the entire supply chain process, from the sourcing of raw materials to the delivery of products or services to end consumers. It involves adopting practices that minimize negative impacts on the environment, respect human rights and labour standards, and contribute to the long-term economic viability of all stakeholders involved.

Benefits of implementing a sustainable supply chain include reduced environmental impact, improved brand reputation, enhanced risk management, increased operational efficiency, cost savings, and access to new markets and customers who prioritize sustainability.

To achieve a sustainable supply chain, organizations require a strategic approach to assess their supply chain processes, engage suppliers and stakeholders, set clear sustainability goals and targets, integrate sustainability criteria into supplier selection and evaluation, monitor performance through metrics and reporting, and continuously improve practices based on feedback and emerging sustainability trends. Here are some key points to help achieve this goal.

Understand industry-specific sustainability challenges: Recognize the unique environmental and social challenges in the oil and gas sector. These may include greenhouse gas emissions, water usage, waste management, ecosystem impacts, health and safety, and community engagement. Gain a deep understanding of these challenges to develop effective sustainability strategies.

Develop a sustainability strategy: Create a comprehensive sustainability strategy that aligns with business objectives. Identify specific goals and targets for sustainable supply chains within the EPC sector, considering aspects such as reducing emissions, minimizing waste, and improving social responsibility. Ensure your strategy accounts for the entire project lifecycle, from design to construction and operation.

Set clear sustainability goals: Start by defining your sustainability objectives and setting measurable goals. These goals should align with overall business strategy and reflect commitment to environmental, social, and economic sustainability.

Conduct a supply chain assessment: Assess current supply chain to identify areas where sustainability improvements can be made. This assessment should consider environmental impacts, such as carbon emissions, water usage, and waste generation, as well as social factors like labour rights and working conditions.

Engage suppliers committed to sustainability: Collaborate with suppliers that share commitment to sustainability. Prioritize suppliers with established sustainability practices and encourage others to adopt sustainable approaches. Evaluate suppliers based on their environmental performance, social responsibility, safety records, and adherence to industry standards. Establish clear sustainability criteria for supplier selection.

Incorporate sustainability requirements into contracts: Integrate sustainability requirements into contracts. Include specific clauses that outline expectations for suppliers to comply with sustainability standards and provide evidence of their sustainability practices. This can cover aspects like emissions reduction targets, waste management plans, worker health and safety measures, and community engagement activities.

Foster innovation and technology adoption: Encourage innovation and the adoption of technologies in the supply chain processes to bring predictability of demands to plan better in advance. Simplify and standardise supply chain processes across geographies and operations to reduce the complexity and non-contributing layers. Explore and implement solutions that reduce environmental impacts, such as using renewable energy in warehouses and increase share of vehicles run on alternate fuels including electric, reduce the freight miles and find alternate modes and ways to ship cargo.

Promote transparency and traceability: Enhance transparency and traceability within supply chains. Implement systems that enable tracking and reporting of environmental and social performance indicators throughout the project lifecycle. This includes tracking the carbon footprint of every leg in the supply chain irrespective of status of stakeholder. Utilise digital solutions and emerging technologies like blockchain to improve transparency and traceability.

Monitor and report progress: Establish key performance indicators (KPIs) to monitor and measure the sustainability performance of supply chain. Regularly report on progress to stakeholders, including clients, investors, regulators, and local communities. Transparent reporting builds trust and demonstrates commitment to sustainable practices.

Continuously improve and learn: Embrace a culture of continuous improvement and learning. Regularly evaluate your sustainability initiatives, identify more areas for improvement, and implement corrective measures. Stay updated on emerging trends, best practices, and regulatory changes in sustainable practices within the oil and gas sector.

Engage with stakeholders: Involve employees and customers in sustainability journey. Educate and train employees on sustainable practices and encourage their active participation. Engage customers by communicating your sustainability efforts and offering sustainable products and services that align with their values.

Collaborate with industry initiatives: Engage with industry initiatives and organizations focused on sustainable supply chains. Collaborative efforts can help drive systemic change and provide opportunities for shared learning and best practice sharing.

By following these steps, one can drive business transformation through sustainable supply chains in the EPC sector of the oil and gas industry, contributing to a more sustainable and responsible approach to project delivery. ■

Agile Gas Infrastructure to Transport Hydrogen & Gas Mix

AKHIL MEHROTRA
MD & CEO
Pipeline Infrastructure Limited

Much of the talk today around hydrogen (H_2) focuses on the need to upscale production to meet Net-zero targets and the vast demand that will be soon required, but a major factor to achieving this is how will we provide access of H_2 to the end users. The most promising approach is using existing natural gas pipelines for transporting hydrogen. It is technically possible as studies suggest that about 20% hydrogen can be blended into natural gas for transportation via gas pipelines, without any major investments.

As the world moves towards Energy Transition, the possibility of repurposing existing fossil fuel infrastructure to distribute "clean" energy is attracting a lot of attention. Hydrogen being one of the prominent candidate as a clean energy source a lot of talk has been going on about upscaling it's production. However, after scaling up, we need to transport it to end users and this part has added challenges towards provisioning of H_2 gas across end users due to inherent properties of H_2 gas towards metals.

Transportation of hydrogen can be done through the following three ways depending on the distance, volume, and state (Liquid / gaseous) in which hydrogen need to be transported:

- Pipelines tend to be the cheapest way to move hydrogen over longer distances. Constructing pipelines usually requires volume and demand certainty to justify investment. Additionally, existing natural gas pipelines can be repurposed provided they meet the technical criteria to reduce the risk of embrittlement. Repurposing of existing pipelines also enables blending of hydrogen within the existing natural gas networks for end uses where blended hydrogen can accelerate demand creation.

- Trucks are used to transport hydrogen in smaller volumes, both in gaseous and liquid form, for local distribution and longer distances.

- Ships are beginning to be used for larger volume,

longer distance transport, mainly moving liquid hydrogen (LH2), LHOCs, and ammonia. Shipping of hydrogen is currently expensive due to added conversion costs (liquefaction or chemical conversion) in addition to the necessary structural design to reduce risk of embrittlement.

Transportation of hydrogen through gas pipelines will be a cost-effective method as compared to the other alternatives. Reducing the cost of transporting hydrogen is crucial to make it economically viable. Time is also a factor as building new infrastructure has a significant lead time and multiple greenfield project risks, which may delay the growth of hydrogen as a key energy vector. Natural Gas pipelines already exist in abundance and repurposing them with minor technical upgradation would be the quickest way. Speed is of the essence if countries are to meet their Paris Accord nationally determined contributions (NDCs) to reduce greenhouse gas (GHG) emissions.

To establish the H_2 economy, hydrogen producers need to be connected to the users, and an optimum transport solution is via the existing gas infrastructure. There are many global projects investigating this scenario, one of them being the European Hydrogen Backbone (EHB) which is a collaborative effort with an estimated total investment of $50-100 billion involving the major transmission operators across Europe which envisages expanding the network to appx. 39,700 Km of hydrogen pipelines by 2040. This will be achieved by adding 12,300 Km of new H_2 pipelines, with the remaining 27,400 Km (i.e., 69%) of the network being made up of repurposed natural gas pipelines. The requirement to design and repurpose pipelines for H_2 service is of global importance for the safe and efficient transportation of hydrogen from producers to users.

Gas infrastructure provides the backbone for the economy, as without this key energy infrastructure, cities, homes, and industry wouldn't be able to function. But how does this relate to H_2. The complex infrastructure required to move H_2 to end users requires many critical components. These components range from pipelines, compression stations and valves, through to metering stations and city gate stations that enable transportation of gas to the end user. In all of this, pipelines make up most of the infrastructure and are designed and operated under a series of codes to ensure safety and efficiency of delivery.

Blending of hydrogen in Natural Gas Pipeline network

Hydrogen blending process consists of injecting concentrations of hydrogen into existing natural gas pipelines whose purpose can be either economical (to foster hydrogen market) or environmental (to reduce the carbon intensity of the methane). The injection of hydrogen into the existing gas grid could provide a quick and affordable transitional solution to handle the lack of an immediately available dedicated hydrogen infrastructure. Moreover, the injection of hydrogen provides the option of having access to renewable and low-carbon energy, up to a certain level, for all gas consumers connected to the gas network.

Depending on the share of hydrogen to be injected, the gas network might need concrete retrofitting actions. The extent to which modifications are required depends on multiple aspects related to technical characteristics of the gas network. The retrofitting of the networks brings challenges that can be technically solved in an affordable way for hydrogen shares up to a certain limit. Few studies have revealed that at relatively low hydrogen concentrations (up to 10% H_2 in volume), the gas system may not require major investment or modifications, while higher shares of hydrogen concentration may require significant investment - depending on the topology of the gas grid, distance of transport, equipment in the gas system and acceptance of H_2 and natural gas mixtures by the end user.

Repurposing natural gas pipelines for hydrogen is 10-30% of the cost of building new pure hydrogen networks. Blending hydrogen with natural gas in existing infrastructure will facilitate the use of a cleaner gas by end consumers. The possibility of blending H_2 to the Natural Gas network also comes with huge opportunities and additional challenges. This would require a detailed understanding of blending threshold during normal and transient operations in to eliminate the potential material, integrity, and operational issues as well the pipeline design implications.

Pipeline Infrastructure Limited (PIL) has proactively undertaken a key initiative to be ready for future energy transition by assessing the blending of Hydrogen in pipeline. Strategic projects are in progress to evaluate possibility of hydrogen blending/ transportation or readiness of PIL pipeline. This is one of the first hydrogen blend related projects in the transmission space in India. PIL has partnered with DNV for assessing the technical

impacts on gas pipelines of using hydrogen at different blending ratios (5%, 10%, 15%, 50% and 100%) covering assessment of pipeline integrity, pipeline safety and network operations with blended hydrogen. PIL has also signed a Memorandum of Understanding (MoU) with GAIL (India) for cooperation and collaboration towards development and strengthening of the hydrogen-based ecosystem in India.

Key Challenges

- On the technical side, modifications in some parts of compressors as well as installation of new and more turbines or motors and more powerful compressors to deliver the three-times higher volume flow of hydrogen compared to natural gas will be required. This will totally depend on the admixture of hydrogen.

- Hydrogen and natural gas have slightly different densities. This is a key factor in pipeline management as fuels in transit must be pressurized to optimal levels that balance volume with commercial viability. The fuels are also different in calorific heating value as well as corrosive propensities (which matters for the longevity of pipelines).

Conclusion

Hydrogen is expected to play a critical role in the future energy transition and cost-effective transportation is a key driver to expand the footprint of hydrogen. To move H_2 over distances, users either must ship it, build new pipeline infrastructure, or repurpose existing gas networks. Every time hydrogen is converted between energy vectors along the chain from production, through transportation and on to storage and use, this would result in efficiency losses. The selection of H_2 transportation method and vector is multi-faceted and requires early evaluation to ensure the process is optimised. . ■

Beyond Compliance: CO_2 Capture as a Catalyst for Steel Industry Sustainability

The global steel industry, long recognized as a cornerstone of economic development, is facing unprecedented challenges in the wake of increasing concerns about climate change. The industry is a major contributor to carbon dioxide (CO_2) emissions accounting between 7% - 9% of global emissions. **Nitin Sarna, Co-Founder and Director of Catalyst Environment Technology Solutions Private Limited (CETS)** draws attention on the mounting pressure to adopt sustainable practices that go beyond mere compliance with environmental regulations. In response he affirms that CO_2 capture has emerged as a transformative solution, promising to propel the steel sector into a new era of sustainability. This article aims to explore in depth the potential of CO_2 capture technologies in reshaping the future of the steel industry.

Steel production emits approximately 2.5 metric tons of CO_2 per ton of steel. In China the carbon emissions are higher, with a ratio of 3 tons of CO_2 per ton of steel.

The Carbon Footprint Challenge

Traditionally characterized by energy-intensive processes that heavily rely on fossil fuels, steel manufacturing has by extension contributed significantly to the industry's substantial carbon footprint. As global regulatory bodies tighten emission standards, particularly the EU zone, the steel sector is compelled to explore innovative approaches to reduce its environmental impact.

Revolutionizing CO_2 Reduction in the Steel Industry

In a bid to combat carbon emissions, the steel industry is embracing innovative approaches to capture and utilize CO_2. Two prominent methods gaining momentum are carbon capture and storage (CCS) and carbon capture and utilization (CCU).

- **Carbon Capture & Storage (CCS):** Involves capturing CO_2 emissions at their source and safely storing them underground, effectively preventing their release into the atmosphere.
- **Carbon Capture & Utilisation (CCU):** On the other hand, CCU aims to transform CO_2 into valuable products like chemicals or construction materials providing a dual advantage of reducing emissions and maximizing resource utilization. These cutting-edge technologies are revolutionizing the steel industry's approach to CO_2 reduction, paving the way for a more sustainable future.

Understanding Carbon Capture Technologies

Using either of the above goals, CO_2 is captured in the following parts of the steel manufacturing process

- **Post-Combustion Capture** : One of the most common methods of carbon capture is post-combustion capture. This technology involves capturing and separating CO_2 from flue gases after the combustion process. Chemical absorption and physical adsorption are two prevalent techniques used for post-combustion capture. Chemical absorption involves using solvents to absorb CO_2,

while physical adsorption relies on solid materials to trap CO_2 molecules.

- **Pre-Combustion Capture** : Pre combustion capture involves the removal of CO_2 before the combustion process. This is achieved by converting carbon-containing fuels into a mixture of hydrogen and carbon monoxide, known as synthesis gas or syngas. The CO_2 is then separated from the syngas, leaving a hydrogen-rich fuel that can be used for combustion. Pre-combustion capture with absorption is considered one of the most promising technologies due to its high efficiency.

- **Looping Cycles**: Another approach to carbon capture is the use of looping cycles. These cycles involve the circulation of a solid material between two reactors. In the first reactor, carbon dioxide is captured, while in the second reactor, the captured CO_2 is released, allowing for its separation and storage. Looping cycles offer the advantage of high CO_2 capture efficiency.

Decarbonizing the steel industry is crucial for achieving global sustainability goals. Carbon capture technologies offer promising solutions to reduce carbon emissions from the steelmaking process. Through a systematic review of various carbon capture technologies, we have explored the potential of post-combustion, looping cycles, and pre-combustion technologies for carbon capture in the steel industry.

Evaluating the Deployment of Carbon Capture Technologies

To evaluate the effectiveness of different carbon capture technologies, several key performance indicators (KPIs) are considered. These KPIs include an energy penalty, carbon emissions abatement potential, cost, technology readiness level, and practical deployment considerations. A comprehensive analysis of these KPIs helps in making informed decisions regarding the selection and integration of carbon capture (CC) technologies in the steelmaking process.

- **Energy Penalty:** The energy penalty refers to the additional energy required to implement carbon capture technologies. It is important to minimize the energy penalty to ensure the overall efficiency of the steelmaking process.

  Different Carbon Capture technologies have varying energy penalties based on the type of furnace and careful consideration is required to strike a balance between carbon capture and energy consumption.

- **Carbon Emissions Abatement Potential:** The carbon emissions abatement potential varies depending on the technology used. Technologies with higher abatement potential contribute significantly to achieving carbon reduction targets.

- **Economic Assessment:** Beyond the evident environmental advantages, CO_2 capture presents a compelling economic case for the steel industry. As governments and consumers increasingly prioritize sustainable practices, companies that proactively embrace carbon capture technologies gain a significant competitive edge.

  Carbon-neutral steel production not only meets regulatory requirements but also appeals to environmentally conscious customers fostering brand loyalty and market differentiation.

- **Technology Readiness Level:** Technology readiness level (TRL) indicates the maturity and practical applicability of a technology. Different CC technologies are at varying TRLs, with some technologies already being commercially viable and others still in the research and development phase. Considering the TRL of a technology is essential for its successful integration into the steelmaking process.

- **Collaborative Initiatives:** Transitioning to sustainable steel production necessitates collaboration among various industry stakeholders, including manufacturers, government bodies, and technology providers. Governments can play a crucial role in incentivizing the adoption of CO_2 capture technologies through grants and tax benefits, fostering a conducive environment for innovation. Additionally, industry leaders can form strategic partnerships to share knowledge, resources, and best practices, thereby accelerating the industry's shift towards sustainability.

- **Environmental Impact:** The incorporation of CO_2 capture technologies has the potential to significantly reduce the steel industry's carbon footprint. By capturing CO_2 emissions at the source, these technologies mitigate the release of greenhouse gases into the atmosphere, contributing to global efforts to combat climate change. Furthermore, the captured CO_2 can be repurposed or safely stored, preventing its contribution to the greenhouse effect.

- **Practical Deployment Considerations:** Apart from technical factors, practical deployment considerations also impact the implementation of Carbon Capture (CC) technologies. Factors such as infrastructure requirements, availability of raw materials, regulatory frameworks, and public acceptance play a significant role in the successful deployment of these technologies.

Emergence of a Circular Economy

While challenges exist, ongoing research and development efforts aim to overcome these barriers and pave the way for a sustainable and decarbonized steel industry. By integrating carbon capture technologies with the steel and chemical industries, a transformative and merged industry can be achieved contributing to a circular economy and a low-carbon future.

Challenges & the Need for Intervention

While carbon capture technologies show promise in decarbonizing the steel industry, several barriers need to be addressed for their practical implementation. The high costs associated with these systems remain a significant challenge, requiring further research and development efforts to reduce costs. Additionally, infrastructure requirements, policy frameworks, and public acceptance need to be considered to ensure the successful deployment of these technologies.

In conclusion, the steel industry's investment in CO_2 capture technologies, including post-combustion and pre-combustion capture, holds great potential for decarbonization. These technologies not only contribute to emissions reduction but also offer opportunities for resource utilization. By revolutionizing the steel industry's approach to CO_2 reduction, we can pave the way for a more sustainable and environmentally friendly future. ■

Author

Nitin Sarna
Co-Founder and Director
Catalyst Environment Technology Solutions Private Limited (CETS)

How sustainable supply chains are driving business transformation

A large proportion of the socio-environmental impact that organisations cause, including the overall impact on the climate, comes from their supply chains. This can be as high as 90% or even more. As per "CDP 2020 Global Supply Chain Report", the greenhouse gas (GHG) emissions from an organization's supply chain can be as high as 11.4 time of its own operational greenhouse gas emission. Therefore, as more companies take urgent actions and set ambitious goals towards sustainability and decarbonization in order to mitigate the adverse impacts of climate change, these figures suggest, supply chains have to be an integral part of their sustainability agenda. Without focusing on the sustainability of their supply chains, the embedded socio-environmental footprint of the procured materials/ services for an organization cannot be managed and this may lead to serious challenges for organizations to progress well on their sustainability commitments.

Earlier, many companies were primarily concerned with their own operational impact on the environment, on its stakeholders, and on the society at large. The solutions for making the organizations sustainable were also focused more around their operational impacts. However, the understanding that supply chain operations can significantly influence the environment, society and corporate governance has triggered a fundamental shift in how organisations approach sustainability and responsible business.

With multiple adverse evidence of global warming, various companies are setting their climate goals around reducing greenhouse gas (GHG) emissions, conserving natural resources and protecting ecosystems, there is a surge in Environmental, Social and Governance (ESG) factors being incorporated into supply chain management. The global ESG guidelines and frameworks have significant focus on design of sustainable supply chains in order to ensure product stewardship and long-term value creation for the suppliers and the consumers. Companies across sectors have therefore started embedding sustainability considerations in their supply chains - to create a sustainability driven DNA for their organizations as well as a sustainable ecosystem, and also comply with the requirements of the global standards/frameworks.

Several other factors are tilting the scales towards enterprises with sustainability strategies. Increasingly companies are acknowledging the fact that sustainability goes beyond mere compliance and risk management, and that it serves as a competitive advantage. Many investors, too, consider the long-term sustainability, and ethical impact of the companies they are investing in. Growing stakeholder expectations and recognition of the potential advantages for businesses have driven companies to adopt ESG as a strategic priority. They perceive ESG as a way to foster innovation, enhance reputation, achieve cost-saving and create long-term value.

One of the sectors to have gained significant attention under the ESG lens is chemicals. It is one of the largest industrial energy consumers and an industry sub-sector in terms of direct CO_2 emissions. Therefore, it is vital to manage the entire supply chain of the chemical industry, which entails managing the full lifecycle of products, starting from raw material sourcing to production, distribution, and end-of-life management.

Easier said than done but a global chemical major has implemented various sustainable supply chain practices, and developed a "Sustainable Solution Steering Methodology", which assesses the sustainability performance of their products. The company also actively engages with suppliers to promote sustainable practices, conduct audits, and provide training and support to help them improve their sustainability maturity.

Currents trends

Several factors are at play in supply chain management, and each has a critical role in making it sustainable and seamless. As organisations address climate change,

there is a need to actively measure and manage GHG emissions across supply chains. To this end, businesses are setting science-based targets, incorporating renewable energy sources, optimising transportation routes, and promoting energy-efficient practices. A US-based multinational retail corporation's initiative has set the target of reducing 1 billion metric tonnes of GHG emission from its supply chain by 2030. Similarly, there are examples of organizations recommending their suppliers to follow similar standards on energy and emissions management, water management, waste management, health and safety management, and promote diversity and inclusion, equal opportunity etc. Many organizations have also started collecting information on supplier's sustainability practices.

But even the best laid plans can fail if the data lacks credibility. To ensure transparency, companies are employing technological solutions such as blockchain and traceability platforms to achieve comprehensive visibility throughout their supply chains. The integration of technology enables improved risk management, identification of inefficiencies, and effective resolution of environmental and social concerns. For instance, there are blockchain-based platforms that empower consumers to trace the origins and trajectory of food products, fostering transparency and sustainability within the food supply chain. Many organisations have seen positive results from such interventions. For high end speciality products, global consumers have also started demanding such information in order to ensure that they consume products which are made sustainably, and procured from organizations that promote good governance and sustainable behaviours.

Climate change is a reality for the entire world and mitigatory measures need scale and speed. It is, therefore, crucial that sustainable practices are built as well as implemented in collaboration with stakeholders. Various collaborative initiatives and multi-stakeholder partnerships are being established to address intricate supply chain challenges such as deforestation and carbon emissions. Such collaborations have enabled knowledge sharing, pooling of resources and collective action in mitigating the impact of climate chain. The Fashion Industry Charter for Climate Action, initiated by the United Nations, brings together stakeholders from the fashion industry to collectively tackle climate change impacts and commit to sustainable practices.

When discussing sustainability, one cannot ignore the importance and relevance of adopting circular economy. With the aim to reduce, reuse and recycle, companies are redesigning products, implementing closed-loop systems, and emphasising recycling and waste reduction across the entire value chain. Embracing circularity helps minimise resource consumption, which also saves on cost; decrease waste generation, and establish a more sustainable and resilient supply chain. A multinational electronics company, for example, has successfully implemented a closed-loop recycling program to recover valuable materials such as gold from used products and reintegrating them into manufacturing. The effect is widespread, from lower natural capital costs to reduced social and environmental impact of mining.

While environmental considerations have traditionally taken centre-stage in ESG discussions, the social aspect is now receiving greater attention. There is increasing emphasis on matters such as diversity and inclusion, fair labour practices, human rights, and community engagement.

The road ahead

In building resilient and adaptable supply chains, ESG considerations will continue to play a crucial role as by incorporating these principles, organisations can enhance supply chain agility, adaptability, and sustainability. However, to reach that level it is imperative for them to assess and address risks associated with climate change, resource scarcity, social disruptions, and technological advancements.

Technology has much to offer in the form of artificial intelligence, Internet of Things (IoT), data analytics and more. These enable more advanced monitoring and measurement of ESG performance across supply chains. Integration with different functions will facilitate real-time decision-making, predictive analytics and improved risk management. For example, IoT sensors can provide instant data on energy consumption, waste generation, and worker safety, empowering organisations to take proactive measures.

Even as the corporate world moves forward on its sustainability agenda, the regulatory landscape is also changing. More governments and regulatory bodies are expected to introduce stricter regulations and reporting requirements related to ESG practices in supply chains. Notably, some countries have taken the taxation route to further the sustainability agenda. Some developed

countries are imposing taxes on imported goods based on the latter's carbon footprint. This tax aims to reduce carbon leakage while incentivizing companies to adopt more sustainable practices and reduce carbon footprint. This is especially relevant for companies with operations spread across geographies. And this is even significant for investors as they continue to prioritise ESG considerations in their investment decision-making.

Along with internal sustainability targets, external factors such as consumers demand, investors evaluation etc. are also driving organisations to further embed the principles into their supply chain strategies, ensuring overall compliance and accountability.

Conclusion

Sustainability in supply chain management is set to witness advancements in technology, a heightened focus on social impact, increased regulatory and investor influence, and a greater emphasis on supply chain resilience. Organisations will create more resilient and sustainable supply chains, benefiting not only their bottom line but also the society and environment. For any organization, sector or even a country to effectively move towards a sustainable transformation, sustainable supply chain management would eventually become one of the key enablers to bring a positive change in their entire ecosystem. ■

Author

Saunak Saha
Partner
Climate Change and Sustainability Services
EY India

Meet Over 250+ Exhibitors **PLAN TO VISIT** → SAVE THE DATE **5 6 7** MARCH 2025

CHEMTECH FOUNDATION 1974-2024
Inspiring Intelligence...
..Igniting Innovation

International Integrated **ENERGY** Exhibition & Conferences

Oil Gas & Power
World Expo 2025

Supported by
Ministry of Power
Government of India
Ministry of Coal
Government of India
सत्यमेव जयते

5-7 March 2025

Venue: Bombay Exhibition Center, Goregaon (East), Mumbai, India

INTERNATIONAL CONFERENCES 2025

Over **1000 Delegates** and **200+ Global Speakers** across **7 concurrent conferences**

Oil&GAS World Expo 2025

6 -7 March 2025

Theme: Unlocking E&P Potential Through Innovations, Digital Solutions & Decarbonization

Mr. Pankaj Kumar
Director (Production)
ONGC Limited & Chairman, CAB,
Oil & Gas World Expo 2025

Mr. Subramanian Sarma
Wholetime Director & President (Energy)
Larsen & Toubro & Co-Chairman, CAB,
Oil & Gas World Expo 2025

Mr. Rajarshi Gupta
Managing Director
ONGC Videsh Ltd and Head International Committee
Oil & Gas World Expo 2025

Mr. R K Srivastava
Former Director Exploration & Addl Charge- CMD, ONGC Ltd & Convener, Oil & Gas World Expo 2025

Call: +91-98704 41920 | monisha_karkera@jasubhai.com

GAS WORLDTECH Expo 2025

Wednesday, 5th March 2025

Theme: Fueling India's Sustainable Energy Future – Investment, Innovations & Growth In Natural Gas Sector

Mr. Rajeev Kumar Singhal
Director Business Development
GAIL Ltd & Chairman, CAB,
Gas World Tech Expo 2025

Mr. Rajeev Mathur
Director, Haryana City Gas Group & Convener
Gas World Tech Expo 2025

Call: +91-11-4708 6252 | anusha_kaur@jasubhai.com

Refining Petro CHEMICALS 2025

Thursday, 6th March 2025

Theme: Innovating For Resilience: The Future of Downstream In A Decarbonized Economy*

*Tentative

Mr. Sarthak Behuria
Chairman and Chairperson of the Board of Directors, RelianceBP Mobility Limited (RBML) & Chairman, CAB, Refining & Petrochemicals World Expo 2025

Ms Sukla Mistry
COO, Haldia Petrochemicals Ltd. & Patron
Refining & Petrochemicals World Expo 2025

Mr. P D Samudra
Independent Director, Deepak Nitrite Ltd & Former CEO & MD, thyssenkrupp Uhde India Pvt Ltd & Convener, Refining & Petrochemicals World Expo 2025

Call: +91-98704 41920
monisha_karkera@jasubhai.com

SCAN QR
DELEGATE VISITORS

POWER + COAL World Expo 2025

Thursday, 6th March 2025

Theme: Way Forward For Sustainable Energy Security With Clean & Green Energy Transition

Mr. K. Shanmugha Sundaram
Director Projects
NTPC Ltd. & Chairman, CAB,
Power + Coal World Expo 2025

Mr. U K Bhattacharya
Former Director Projects
NTPC Ltd. & Patron
Power + Coal World Expo 2025

Mr. A K Jha
Former CMD, NTPC Ltd.
Convener
Power + Coal World Expo 2025

Call: +91-22-4037 3610 | vaishali_pednekar@jasubhai.com

Nuclear ENERGY World Expo 2025

In Collaboration with INDIAN NUCLEAR SOCIETY

Wednesday, 5th March 2025

Theme: Nuclear Energy To Meet Net Zero Carbon Emission Targets

Mr. Ranjay Sharan
Former Director Projects,
Nuclear Power Corporation of India Ltd & Chairman, CAB,
Nuclear Energy World Expo 2025

Call: +91-22-4037 3614
reshmi_menon@jasubhai.com

GREEN ENERGY & HYDROGEN World Expo 2025

Wednesday, 5th March 2025

Theme: India's Green Transition: Accelerating Towards A Net-Zero Future

Dr. Alok Sharma
Director (R&D)
Indian Oil Corporation Ltd.
Chairman, CAB,
Green Energy & Hydrogen 2025

Call: +91-22-4037 3610
vaishali_pednekar@jasubhai.com

Surface Engineering Coating & Corrosion World Expo 2025

Thursday, 6th March 2025

Theme: Corrosion Management for Sustainable Operations

Mr. N Senthil Kumar
Director (Pipelines), Indian Oil Corporation & Chairman, CAB,
Surface Engineering Coating & Corrosion Control 2025

Call: +91-22-4037 3614 | reshmi_menon@jasubhai.com

Platinum Partner: NTPC

Gold Partner: GRE PIPING CPP GRP PIPING www.cppiping.com

Silver Partners: CESC LIMITED, Dynamic Forge

Support Partners: MAHANAGAR GAS, NHPC A Navratna Company, outokumpu sustainable stainless steel, worley DELIVERING SUSTAINABLE CHANGE, BERGER PROTECTON PROTECTIVE COATINGS DIVISION, ADVANCE VALVES

Organised by: Jasubhai MEDIA

Tel: +91-22-4037 3636 | **Email:** sales@jasubhai.com | **www.chemtech-online.com**

R.N.I. No. 11403/1966 Date of Publication: 29th of every month. Postal Registration No: MCS/095/2023-25
Posted at Patrika Channel Sorting Office, Mumbai 400001, on 30th of every month. Total Pages No.: 54

Supported by

CHEMTECH FOUNDATION 1974-2024
Inspiring Intelligence...
..Igniting Innovation

World Meet of the CHEMICALS, PETROCHEMICALS, BIOPHARMA & PROCESS Industry in India

Supported by

DECHEMA Society for Chemical Engineering and Biotechnology e. V
VDMA Process Plant and Equipment

ChemTECH WORLD EXPO 2026
SPECIALTY ChemICAL WORLD EXPO 2026
Bio Pharma World Expo 2026

32nd International Exhibition and Conferences

3-6 February 2026

Venue: Bombay Exhibition Center, Goregaon (East), Mumbai, India

Concurrent Events

EPC 2026 | Specialty ChemICAL | Refining & Petro CHEMICALS 2026 | Bio Pharma | Industry AUTOMATION & Control 2026 | PVF | WaterEX WORLD EXPO 2026 | Surface Engineering Coating & Corrosion WORLD EXPO 2026 | Chlor-Alkali World Expo & Conferences 2026

Scope for ChemTECH World Expo 2026

- Plant Machinery & Industrial Consumables
- Engineering Consultants
- OEMs for Chemicals & Pharmaceutical Processing Equipment
- Metals & Metallurgy
- Bioprocessing Equipment
- Construction Services Providers
- Plant Maintenance Services Providers
- Logistics & Supply Chain Solutions Providers
- Instrumentation & Process Control
- Industry Automation (Process & Factory)
- Systems Integration & ERP Solutions Providers
- Water & Waste Water Treatment Consultants
- Environment Solutions Providers
- Waste Management Consultants
- Financial Institutions
- Fire & Safety Solutions Providers
- Material Handling Solutions
- Certification Bodies
- Welding Solutions
- Quality Health & Environment Solutions
- Analytical & Laboratory
- Packaging Materials, Machinery & Systems
- Business Consultants

Scope for Specialty Chemicals World Expo 2026

- Agrochemicals Intermediates
- Adhesives & Sealants
- Agrochemicals & Crop Protection
- Bulk Drugs & Intermediates
- Enzymes
- Colorants, Dyes & Pigments
- Cosmetics & Personal Care Ingredients
- Hygiene & Cleaning Chemicals
- Laboratory Chemicals
- Surfactants
- Water Treatment Chemicals
- Catalysts
- Electronic Chemicals
- Flavours & Fragrances
- Contract Manufacturers

Scope for Biopharma World Expo 2026

- Materials Processing
- Pharma Machinery
- Pharma Ingredients
- Plant Engineering, Process Plants & Equipment
- Laboratory & Analytical Solutions
- Process Measurement & Inspection
- Sterilization & Clean Room Solutions
- Biopharma R&D And Manufacturing
- IT Solutions
- Water & Waste Treatment Solutions

FACT & FIGURES 2024

- 750 EXHIBITORS FROM 15+ COUNTRIES
- 25871 VISITORS FROM 53 COUNTRIES
- SCALE@CHEMTECH World Expo 2024: 60+ GLOBAL CLIMATE TECH STARTUPS FROM 20 COUNTRIES; 40 TECHNICAL PRESENTATIONS
- 8 TECHNICAL CONFERENCES
- 1500+ BUSINESS DELEGATES
- 250+ GLOBAL SPEAKERS
- BRICS WORKING GROUP BRAIN STORMING SESSION
- 2500+ ENGINEERING PHARMA & SCIENCE STUDENTS AT STUDENT OUTREACH PROGRAM FROM 28 STATES & UNION TERRITORIES

Organised by:

Jasubhai MEDIA

Jasubhai Media Pvt Ltd

Taj Building, 3rd Floor, 210, Dr. D N Road, Fort, Mumbai – 400 001, INDIA.
Tel: +91-22-4037 3636, **Email:** sales@jasubhai.com
Ahmedabad - 09833104834 | Bangalore - 09892644177 | Chennai - 09176963737
Delhi - 09891469629 | Hyderabad / Pune - 09822209183 | Vadodara - 09820544904