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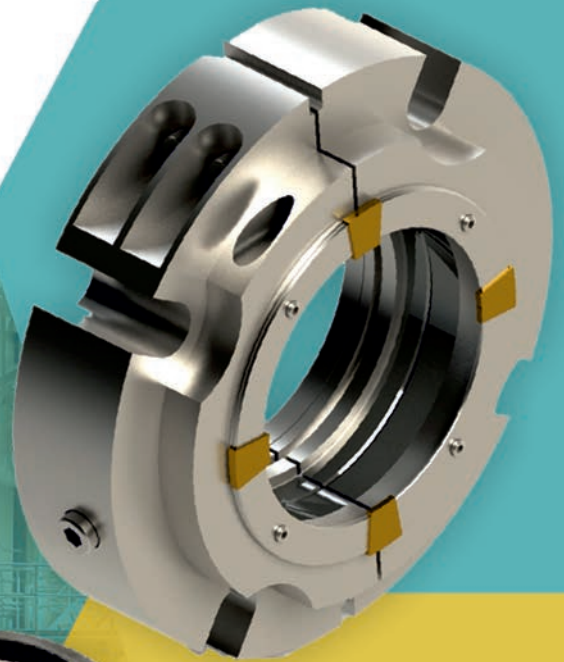
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India set to increase sedimentary basin exploration to 16% by 2025: Hardeep Singh Puri



Hardeep Singh Puri, Minister of Petroleum & Natural Gas

New Delhi, India: “Energy today has become the spinal cord for economic growth and development,” said Hardeep Singh Puri, Minister of Petroleum & Natural Gas. With India’s fuel demand growing at three times the global average, Puri highlighted that 67 million people visit petrol pumps every day

in India. This surging demand is expected to drive 25 per cent of the global increase in energy consumption over the next two decades. India’s energy landscape is rapidly evolving, with the country boasting 651.8 million metric tons of recoverable crude oil reserves and 1,138.6 billion cubic meters of recoverable natural gas reserves within its sedimentary basins. Puri pointed out that exploration of India’s sedimentary basins has risen to 10 per cent from 6 per cent, and with further exploration activity under the Open Acreage Licensing Policy (OALP) rounds, this is set to increase to 16 per cent by 2025. By 2030, the government aims to expand the nation’s exploration acreage to 1 million square kilometers, further bolstering India’s energy security.

The Minister also outlined several significant reforms implemented to stimulate growth in India’s energy sector. Key reforms include simplifying the approval process for exploration and production activities, reducing 37 approval processes to just 18, of which nine are now available for self-certification. Additionally, the introduction of the Oilfields (Regulation and Development) Amendment Bill in 2024 ensures policy stability for oil and gas producers, allows for international arbitration, and extends lease periods. Furthermore, the government has reduced ‘No-Go’ areas in the Exclusive Economic Zone (EEZ) by almost 99 per cent, opening up vast new areas for exploration.

Dedicated task force to be set up to achieve goal of 500 GW by 2030: Pralhad Joshi

Bhubaneswar, Odisha: Union Minister of New and Renewable Energy Pralhad Joshi has announced that a dedicated task force with all stakeholders will be set up by the Ministry of New and Renewable Energy (MNRE) in collaboration with the Ministry of Power to achieve the goal of 500 GW by 2030.

The Union Minister emphasized the need to install 288 GW of renewable energy capacity over the next six years, requiring a substantial investment of ₹42 lakh crore, including transmission infrastructure. He reiterated India’s commitment to the ‘Panchamrit’ goals announced by Prime Minister Narendra Modi, emphasizing the 2030 target of 500 GW of renewable energy capacity.

Arvinder Singh Sahney appointed as Chairman of IndianOil



Arvinder Singh Sahney, an industry veteran with nearly three decades of experience, has taken charge as the Chairman of **Indian Oil Corporation Ltd (IndianOil)**. A Chemical Engineer from Harcourt Butler Technical University, Kanpur, Sahney began his career with IndianOil in 1993. Over the years, he has held key positions across various functions, including Refinery Operations, Technical Services, Health, Safety, and Environment (HSE) and Petrochemicals. He played a crucial role in the commissioning of the 15 MTPA Paradip Refinery, which has significantly bolstered India’s refining capacity and energy security.

The Minister also said that MNRE will organize hackathons for startups in the RE sector, with assured offtake to promote indigenization of renewable energy technologies and solutions. A new Joint Centre of Excellence for R&D will also be established in collaboration with the Ministry of Power to foster innovation and technological advancements in the RE sector. The Minister called for the early finalization of Power Purchase Agreements (PPAs) and strict enforcement of Renewable Purchase Obligations (RPOs) to ensure the success of renewable energy projects.

India's nuclear power plant safety beyond doubt: Dr. Jitendra Singh



Dr. Jitendra Singh

New Delhi, India: Union Minister of State (Independent Charge) for Science and Technology; Earth Sciences and Minister of State for PMO, Department of Atomic Energy, Department of Space, Personnel, Public Grievances and Pensions, Dr. Jitendra Singh recently assured the Rajya Sabha that

India's nuclear power plants are among the safest in the world, with stringent safety protocols and international

oversight. He was responding to a question on nuclear safety during Question Hour.

The Minister emphasized the rigorous safety protocols followed at every stage of nuclear plant development and operation, assuring the nation that India's nuclear energy program is both secure and sustainable. Dr Singh declared that safety is the cornerstone of India's nuclear energy policy. "In the Department of Atomic Energy, we follow the rule of 'safety first, production next.' Every stage, from site selection to operational checks, is governed by stringent protocols," he said. He outlined the extensive inspection regimen, which includes quarterly reviews during construction, semi-annual inspections after a plant becomes operational, and a mandatory five-year license renewal process.

India's nuclear safety framework is further bolstered by international oversight. The World Association of Nuclear Operators (WANO) and other global bodies periodically review India's facilities, reinforcing their safety standards.

Dr. Jitendra Singh highlighted evidence-based achievements in reducing radiation emissions, which he called a testament to the Department of Atomic Energy's meticulous efforts. "Globally, the critical safety benchmark for radiation emissions from nuclear plants is 1,000 microsieverts. In India, our plants consistently operate well below this threshold," he explained.

Trailukya Borgohain appointed as Director (Operations) of OIL



Trailukya Borgohain has been appointed as **Director (Operations) of Oil India Limited (OIL)**, India's oldest oil and gas Exploration and Production (E&P) company and a Maharatna CPSE under the Government of India. Borgohain is a seasoned oil and gas professional with over three decades of experience spanning the entire spectrum of E&P operations. He holds an MSc in Applied Geology from IIT Roorkee and an MBA in Energy Leadership from Texas A&M University, Texarkana, USA.

Coal Production soars by 33% as Ministry charts path to energy security



New Delhi, India: The Ministry of Coal conducted a comprehensive review of 127 coal blocks recently. The review meeting was chaired by Additional Secretary and Nominated Authority, Rupinder Brar. The review encompassed 64 producing coal blocks and 63 non-operational captive/commercial coal blocks which are in advanced stages of operationalization, spanning Arunachal Pradesh, Assam, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, and West Bengal. These blocks achieved an impressive production of 100.08 MT as of November 8th, 2024, marking a substantial 33.35 per cent increase from the previous year. Demonstrating robust operational efficiency, the total dispatch reached 107.81 MT, recording a significant 34.38 per cent year-on-year growth. This achievement underscores India's growing capability in managing its domestic coal resources efficiently, with 55 blocks already in production, one block commencing operations this year, and nine more poised to begin production in FY 2024-25.

IFSC's first finance company for power & infrastructure lending to commence operations



New Delhi, India: PFC Infra Finance IFSC Limited (PIFIL), a wholly owned subsidiary of Power Finance Corporation Limited (PFC), has received approval from International Financial Services Centres Authority (IFSCA) to commence business as a finance company in IFSC GIFT City Gujarat.

PIFIL, part of India's largest non-banking financial company (NBFC) group, will be the first finance company in IFSC dedicated to power and infrastructure lending. PFC Infra Finance IFSC Limited aims to provide lending in India and in other countries in foreign currency, catering to both government and private players. The establishment of PIFIL will position PFC as a global brand and contribute to strengthening India's position as a global financial hub.

REnergy Dynamics appoints Shashank Adlakha as Chief Operating Officer



REnergy Dynamics (RED), a company dedicated to advancing the bioenergy sector in India, has appointed **Shashank Adlakha** as its **Chief Operating Officer**.

A performance driven professional with over 27 years of experience, Shashank has held various leadership roles in project development, execution, and business development. Notably, he led the execution of over 2 GW of renewable energy projects and India's first commercial green hydrogen project. As the COO, Shashank will be responsible for overseeing the day-to-day operations, driving operational efficiencies, and helping to scale RED's ambitious growth plans in the renewable energy sector.

K. Rajaraman, Chairperson IFSCA, congratulated PFC for being the first government NBFC for receiving the Certificate of Registration (CoR) as a Finance Company for its IFSC subsidiary – PFC Infra Finance IFSC Ltd, for undertaking lending business. Smt. Parminder Chopra, Chairperson PFC & PFC Infra Finance IFSC Limited stated, “We are proud to be the first finance company in the IFSC focused on infrastructure including power sector lending. As we commence operations, funding for energy transition will be a key focus, aligning with India’s strong push towards clean energy sources.”

HP Green R&D Centre partners with EIL for HP-PSA technology



Mumbai, India: HP Green R&D Centre (HPGRDC), a pioneering research and development facility of Hindustan Petroleum Corporation Limited (HPCL), has announced a landmark partnership with Engineers India Limited (EIL) for the commercialization of its indigenously developed Hydrogen Pressure Swing Adsorption (HP-PSA) technology.

As per the agreement, HPCL will serve as the ‘Technology Licensor,’ while EIL will act as the exclusive ‘Technology & Engineering Partner’ for engineering, marketing, and commercialization of the HP-PSA technology in India.

The HP-PSA technology, developed by HPGRDC, has successfully demonstrated its capabilities through a commercial-scale greenfield 6-bed H2 PSA unit at Visakh refinery, operating seamlessly for over nine years. This breakthrough technology positions HPCL as India’s first and the world’s third Hydrogen PSA Technology Licensor.

HP Green R&D Centre, Bengaluru, is HPCL’s premier R&D hub, established in 2016. HPGRDC has established 20 nos. of state-of-the-art laboratories on carrying out research on diverse fields of crude evaluation, petrochemical, process modelling, engine, battery, water, global technology centre etc.

AES Andes submits EIA report for proposed green hydrogen project

Chile, South America: AES Andes has submitted an Environmental Impact Assessment (EIA) to Chilean permitting authorities for a proposed industrial-scale green hydrogen project called ‘Inna.’ The project, which is in early-stage development, could include a variety of solutions, including green hydrogen for export or domestic consumption, aligned with Chile’s National Green Hydrogen Strategy. To support this potential project, a Memorandum of Understanding (MOU) has been signed between AES Andes and Samsung C&T, a

ONGC appoints Arunangshu Sarkar as Director - Strategy & Corporate Affairs



Arunangshu Sarkar, an industry veteran with over 37 years of experience, has joined **ONGC** as its first-ever **Director (Strategy and Corporate Affairs)**.

Two years ago, the ONGC Board underwent a reorganization, introducing a key position of Director (Strategy & Corporate Affairs). This ground breaking role, will drive new strategies in renewables, downstream sectors, E&P space, while strengthening global and local partnerships. With a keen focus on marketing and IT innovation, this strategic shift will enhance JV management and position ONGC for sustained growth.

major Korean company with experience in energy and construction. The two companies will evaluate the joint development of the project, focusing on opportunities to produce green hydrogen for domestic consumption or for export to international markets. The proposed project could include the production of green hydrogen and ammonia, as well as deploying solar, wind and battery storage to support the country's electricity needs.

Cairn Oil & Gas reduces 229,000 tonnes of carbon emissions over last four years

New Delhi, India: Cairn Oil & Gas, part of Vedanta Group and the first Indian O&G company committing to Net Zero by 2030, said it has achieved significant progress in its Environmental, Social, and Governance (ESG) roadmap. With the reduction of 119,000 tCO_{2e} in 2024, the company has totalled its carbon emission reduction to 229,000 tCO_{2e} over a four-year period - equivalent to saving over 12 million trees.

The company has also signed a Memorandum of Understanding (MoU) with United Nations Environment Programme's (UNEP) flagship methane reporting and mitigation initiative - Oil & Gas Methane Partnership (OGMP) 2.0, committing to the effective methane emission management. The company reported reduction of 60 per cent of potential gas flare volume in the last four years to curtail methane emissions.

The company has released the third edition of its sustainability report for FY'24. The report underlines significant achievements made across ESG priorities.

JSW Neo Energy to acquire O2 Power

Mumbai, India: JSW Neo Energy Limited, a wholly owned subsidiary of JSW Energy Limited, has signed a definitive agreement to acquire a 4,696 MW renewable energy platform from O2 Power Pooling Pte. Ltd., a platform jointly established by EQT Infrastructure & Temasek. The transaction entails acquisition of O2 Power Midco Holdings Pte. Ltd. and O2 Energy SG Pte. Ltd and is subject to approval of the Competition Commission of India (CCI) and other customary approvals standard to a transaction of this size.

The transaction values the platform at an Enterprise Valuation of approximately ₹12,468 crores, after adjusting for net current assets. O2 Power is a renewable energy platform with a capacity of 4,696 MW - where 2,259 MW will be operational by June 2025, 1,463 MW is currently under construction, and an additional 974 MW are in the pipeline, all scheduled for commissioning by June 2027. The platform has a blended average tariff of ₹3.37/KWh with remaining life of ~23 years. The capacities are spread across seven resource-rich states of India. This acquisition will leapfrog the company's locked-in generation capacity by 23 per cent, from 20,012 MW to 24,708 MW.

Hindalco secures Meenakshi Coal Mine

Mumbai, India: Hindalco Industries Limited, the Aditya Birla Group's metals flagship, has achieved a significant milestone with the allocation of the Meenakshi coal mine in Odisha through a vesting order by the Ministry of Coal. This development follows the successful

Abhijit Majumder appointed as CFO of Oil India Limited



Abhijit Majumder, Director (Finance) has been appointed as the **Chief Financial Officer (CFO) of the company** w.e.f. 18-12-2024. He is a distinguished member of the Institute of Cost & Management Accountants of India, holder of a Bachelor's degree in Economics, Law, a post graduate diploma in Forex Management, ICFAI and an alumni of IICA Valuation Certificate Program. He is an eminent senior finance professional with an illustrious career spanning over 32 years. His expertise encompasses Financial Management, Corporate Governance & Compliances, Risk Management, Project Management, Corporate Business Development etc.

signing of the Coal Mine Development and Production Agreement (CMDPA) on November 22, 2024.

The Meenakshi coal mine, located in Odisha, is a fully explored block with a Peak Rated Capacity (PRC) of 12 million tonnes per annum and ~285.23 million tonnes of geological reserves. With a favourable coal-to-waste stripping ratio of less than 1, the G12 grade mine is poised to be a cost-effective and sustainable energy source for company's operations.

The mined coal will replace the company's dependence on auction and linkage coal which is currently estimated at approximately 40 per cent higher than Meenakshi coal mine.

The project is expected to create approximately 16,000 direct and indirect employment opportunities, improving local livelihoods and fostering community development. The company expects to commence coal production in CY2028, subject to receipt of regulatory clearances and requisite approvals.

Tata Chemicals North America to explore deployment of 8 BWXT Advanced Nuclear Reactors

Green River, Wyoming: Tata Chemicals North America has announced that its subsidiary, Tata Chemicals Soda Ash Partners LLC (TCSAP) has signed a letter of intent (LOI) with BWXT Advanced Technologies LLC (BWXT) to explore the deployment of up to eight nuclear microreactors. BWXT and TCSAP have been

collaborating since September of 2023 on the feasibility of integrating BWXT's Advanced Nuclear Reactor (BANR) for electricity and industrial processing at TCSAP's Green River, Wyoming manufacturing site.

With this LOI, TCSAP and BWXT agree to expand their collaboration to include the development of commercial terms and conditions to conditionally purchase BANR microreactors from BWXT and establish the schedule and key milestones along the path to deploying them by the early 2030s, as well as jointly determining the techno-economic parameters necessary to turn conditional reactor purchase commitments into an energy purchase agreement.

Once deployed, BANR microreactors would deliver on-demand electricity and process heat that is both carbon-free and resilient from external disruptions for one of the world's leading producers of high-quality soda ash. ■

Sanjay Kumar Singh appointed as Director (Projects), NHPC



Sanjay Kumar Singh has taken over as **Director (Projects), NHPC Limited**. Singh holds a degree in Bachelor of Engineering (Civil) and has more than 32 years of vast and varied experience in power and infrastructure sector in respect of execution of mega and prestigious projects in India and Bhutan.

Prior to his appointment as Director (Projects), NHPC, Singh held the position of Chief General Manager at SJVN Limited. He has also served as Chief Executive Officer of STPL (wholly owned subsidiary of SJVN Limited).

GAIL re-engages process licensor for revival of PTA manufacturing plant



New Delhi, India: GAIL (India) Limited, through its wholly owned subsidiary GAIL Mangalore Petrochemicals Limited (GMPL), has re-engaged with process licensor INEOS to support the plant's revitalization. The renewed collaboration was formalized through an amendment agreement signed recently. This is a significant step towards the revival of GMPL's 1.25 MMTPA Purified Terephthalic Acid (PTA) manufacturing plant located in the Special Economic Zone (SEZ), Mangalore.

The original agreement with INEOS was executed by JBF Petrochemicals (JBF), which could not be realized due to insolvency proceedings. Following GAIL's acquisition of JBF through the Corporate Insolvency Resolution Process (CIRP) under the National Company Law Tribunal (NCLT) in June 2023, the company is now working to overcome the legacy challenges and ensure the plant's successful on-streaming and long-term operational stability.

Speaking on the occasion, Ayush Gupta, Chairman, GMPL and GAIL Director (HR), said, "Through this strategic partnership and renewed focus, GAIL aims to position GMPL as a key player in the domestic PTA market while supporting the country's growth in petrochemical manufacturing."

Centre aims to develop Odisha as a major hub for renewable energy

Delhi, India: Union Minister of New and Renewable Energy Pralhad Joshi noted Odisha's immense renewable energy potential, with 140 GW of solar capacity and significant opportunities in green hydrogen, owing to its long coastline and port infrastructure. He was speaking during the valedictory session of the two-day Chintan Shivir event organised by the Ministry of New and Renewable Energy (MNRE) in Bhubaneswar, Odisha.

The Centre aims to develop Odisha as a major hub for renewable energy and explore the scope of green

hydrogen production in the state. The potential for floating solar panels in Odisha will also be explored, he said. He also highlighted that a 6,000 MW manufacturing capacity for production of solar modules, solar cells and ingot-wafer at Dhenkanal District, Odisha with expected investment of around ₹9,000 crore is being set up by an agency. He also said that another agency is setting up 1,000 MW manufacturing capacity for production of solar modules and cells, at Infovalley-II, Khorda, Bhubaneswar, Odisha, with expected investment of around ₹730 crore.

CCL launches two new coal handling projects



New Delhi, India: Central Coalfields Limited (CCL) has launched two new projects. Union Minister of State for Coal and Mines Satish Chandra Dubey laid the foundation stone of Karo Coal Handling Plant and Konar Coal Handling Plant in Bokaro and Kargali area of CCL. The capacity of these two projects is 7 million tonnes per annum and 5 million tonnes per annum respectively.

Karo and Konar coal handling plants will prove to be an important step in the direction of First Mile Rail Connectivity, under which arrangements will be made to take the coal produced from the coal mines to the nearest railway circuit, from where it will be transported to thermal power plants and other consumers across the country. Currently, coal from these mines is brought to the railway siding by road.

These closed-loop, fully mechanized systems will bring speed and efficiency in the dispatch of coal by eliminating transportation by road and thus reduce diesel consumption. It will also help in reducing dust and vehicle-borne pollution in the area.

WABAG secures order from Chennai Petroleum Corporation Limited

Chennai, India: VA TECH WABAG has secured order worth ₹145 crores from Chennai Petroleum Corporation Limited (CPCL) towards Design, Engineering, Supply, Fabrication, Installation and commissioning of Desalination Water pipelines between CPCL Manali Refinery & CPCL Desalination plant at Kattupalli. The project is to be completed over a span of 12 months.

Commenting on this order win, S. Natrajan, Head-Sales & Marketing, India Cluster said, "CPCL has been a key customer of Wabag and we are happy to be chosen to deliver this project. We thank CPCL for their continued trust and confidence reposed in WABAG."

Mahanagar Gas ventures into cell manufacturing

Mumbai, India: Mahanagar Gas Limited (MGL) signed a Share Subscription Agreement (SSA) and a Shareholding Agreement (SHA) with International Battery Company, Inc. (IBC US) through which both parties will invest in International Battery Company India Private Limited (IBC) to form a joint venture company, which is currently a 100 per cent subsidiary of IBC US.

IBC US is based in California, USA. The company has put up a state-of-the-art pilot facility in Seoul, South Korea for development and production of Li-ion cell and has secured certifications such as UN 38.3, BIS, and AIS for their prismatic Nickel, Manganese and Cobalt (NMC) cells. To address the local market requirement, IBC US and MGL are setting up a state-of-the-art giga factory at Bangalore. MGL is planning to take at least 40 per cent stake in IBC. The India facility will be a technology agnostic plant which will initially produce prismatic NMC Li-ion cells having wide application across mobility and battery storage sector.

MTAR receives order for supply of combustors

Hyderabad, India: MTAR has received ₹15.4 crore order for manufacturing and supply of full-scale and sub-scale combustors for the development of cutting-edge air-breathing engine technology for defence programs. The company shall execute the order by September 2025 as per the contract terms. MTAR has seven strategically

based manufacturing units including an export-oriented unit each based in Hyderabad, Telangana. MTAR caters to clean energy – civil nuclear power, fuel cells, hydel and others, space and defence sectors.

Sterlite Power completes Goa-Tamnar Transmission Project



Mumbai, India: Sterlite Power, a leading global power products and solutions business, has successfully completed the Goa-Tamnar Transmission Project, implemented through its Special Purpose Vehicle, Goa-Tamnar Transmission Project Limited (GTTPL). The project strengthens Goa's power infrastructure with four vital elements, three of which have now been successfully commissioned and the final component, the Xeldem-Narendra transmission line, is set to commence soon. This project brings Goa's first 400 kV Gas-Insulated Substation (GIS) at Dharbandora live, providing a high-quality power supply that reaches South Goa at 400 kV for the first time.

The new infrastructure will stabilize power delivery, minimizing outages, especially in South Goa, and will enable high-quality power supply across industrial, commercial, and residential segments. The enhanced transmission capacity will also provide a direct feed from the new Dharbandora substation to South Goa, reducing the load on existing substations and making the network more resilient against fluctuations. This is particularly crucial for Goa's economic hubs, including its tourism and hospitality sectors, which have long been burdened by reliance on costly diesel generators to manage frequent power outages.

Gensol Engineering Limited secures new Solar PV Project

Mumbai, India: Gensol Engineering Limited, a leading player in the renewable energy sector specializing in solar power engineering, procurement, and construction (EPC) services, has secured a large turnkey EPC order from a leading public sector utility in Maharashtra. The project involves the development of a 150 MWac ground-mounted solar PV power plant, with a total contract value of ₹780 crore, is set to be executed over a 15-month period.

Gensol's role will encompass the entire gamut of the project's lifecycle — from the complex and critical task of land acquisition, highlighting the scale and intricacy of the undertaking, to the precise and detailed phases of design, engineering, procurement, and logistics. The scope also includes the manufacturing, supply, erection, inspection, installation, testing, and commissioning of a 150 MWac grid-connected ground mounted solar PV power plant, along with the development of the associated power evacuation infrastructure to the STU substation. Additionally, the contract includes three years of operation and maintenance (O&M) services for the project, inclusive of maintenance of the plant's switchyard and its extensive transmission infrastructure.

NTPC Green Energy signs MoU with Chhattisgarh State Power Generation Company



Mumbai, India: A Memorandum of Understanding (MoU) was signed recently in Raipur between NTPC Green Energy Limited (NGEL) and Chhattisgarh State Power Generation Co. Ltd. (CSPGCL) to develop up to 2000 MW renewable energy projects including floating solar. The MoU was exchanged between Chief Engineer (CP & BD) CSPGCL, G. K. Gupta and General Manager (Engineering) NGEL, D. Joshi, in the esteemed presence of S. K. Katiyar, Managing Director, CSPGCL, P. K. Mishra, Regional Executive Director (WR-II) NTPC, and other dignitaries from NGEL, NTPC, and CSPGCL.

Ace Green Recycling lays vision for India's largest LFP battery recycling facility



Bags of lithium carbonate produced by Ace

Houston, Texas: Ace Green Recycling, Inc., a leading provider of sustainable battery recycling technology solutions, has announced that it has finalized a lease agreement for a site to build India's largest battery recycling facility. To be located in Mundra, Gujarat, the facility will build on Ace's existing Indian commercial operations, which have been recycling lithium-ion batteries since 2023 including lithium iron phosphate ('LFP') chemistries. As a part of this expansion, Ace has announced plans to establish 10,000 metric tons of LFP battery recycling capacity per year in India by 2026, to meet the growing demand for LFP battery recycling. This strategic deployment of LithiumFirst™ LFP battery recycling technology in India will be phased in along with the planned deployment of the company's technology in Texas.

Ace's strategic location in Mundra, near major ports handling over 10 per cent of India's maritime cargo, significantly streamlines the transportation of battery recycling feedstock and off-take products. The new facility will utilize Ace's innovative and modular LithiumFirst™ technology to recycle LFP batteries at room temperature in a fully electrified hydrometallurgical process producing no Scope 1 carbon emissions, and with zero liquid and solid waste. Throughout this process, the proprietary Ace technology has maintained commercial lithium recoveries from LFP batteries at levels of around 75 per cent, producing lithium carbonate of purities exceeding 99 per cent, which is fed back into the battery materials value chain. In addition to recycling LFP batteries, Ace plans to use its GreenLead® recovery technology to recycle lead batteries at its Mundra recycling park. ■

Small and Large-scale Wind Energy Systems: A Resource of Immense Potential

Small-scale and micro wind turbines are often overlooked in the energy sector, despite their significant potential. Since 1887, wind energy systems have been harnessed to generate electricity, and turbine design has evolved considerably, improving both efficiency and ease of manufacturing. While advancements are well-documented in large-scale megawatt turbines, it is crucial to assess whether these improvements also apply to smaller-scale systems.

In renewable energy systems, the term 'capacity factor' is crucial for evaluating how a particular system performs compared to other renewable technologies and products. The capacity factor measures the actual energy output of a system relative to its maximum possible output. For wind turbines, the average capacity factor ranges from 20 per cent to 30 per cent, meaning only 20 to 30 per cent of the turbine's theoretical maximum energy production is achieved. Solar energy systems typically have a capacity factor between 10 per cent and 25 per cent.

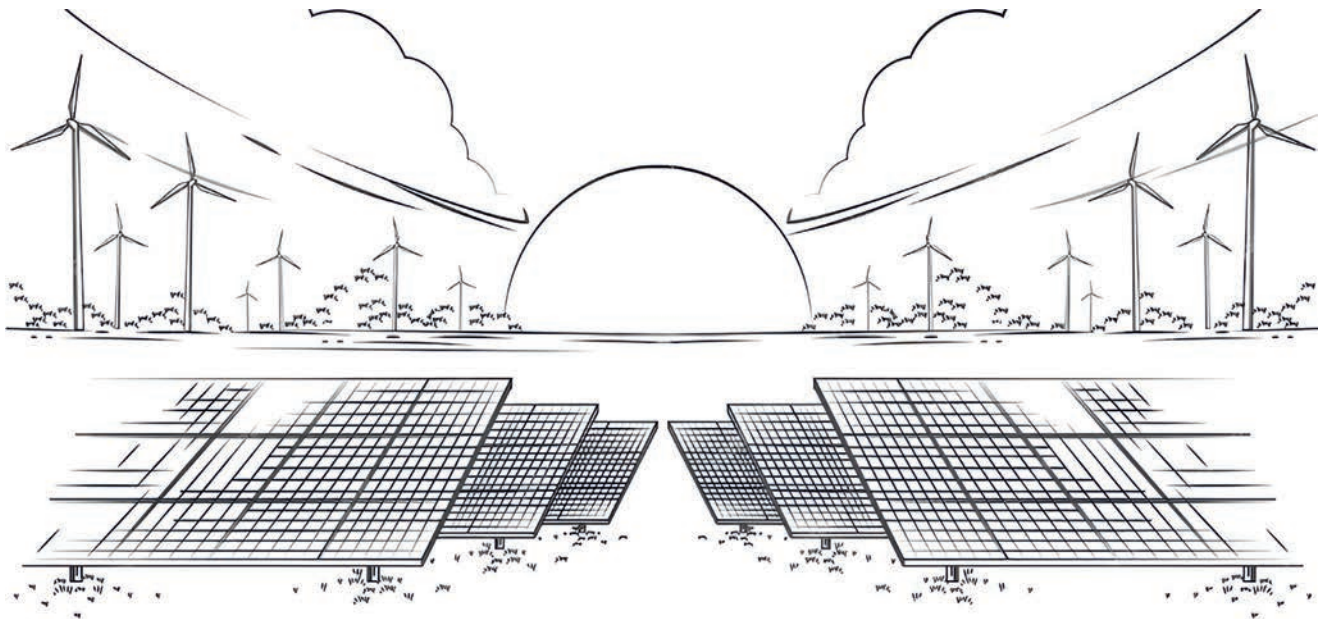
The choice of the most suitable energy harnessing system — whether solar, wind, or a hybrid — depends on the specific renewable resources available at the installation site.

Small-scale wind turbines with a capacity of under 10 kW can be effectively installed in off-grid locations to harness wind energy, meeting the lighting needs of several households. These turbines are designed to operate at a specific wind speed known as the rated wind speed, which is the wind speed required to generate 10 kW of power. Wind speeds below this rated level significantly reduce energy production because wind energy is proportional to the cube of the wind velocity. Typically, the rated wind speed for such turbines ranges from 15 to 18 m/s, a relatively high speed at ground level. Achieving this high wind speed is challenging near the ground, where small turbines are often installed, usually about 7 to 10 meters above the surface. Consequently, if the wind speed does not approach the rated level, the turbine's energy production can be considerably diminished.



Powerzest's Adaptable Disc Turbine: Boosting Small Wind Turbine Performance

To tackle this challenge, Powerzest has developed an innovative wind turbine design known as the Adaptable Disc Wind Turbine. Unlike traditional turbines that use



aerofoil blades, this design incorporates three conical-shaped discs. These conical sections enhance the turbine's starting torque significantly, enabling it to rotate effectively at lower wind speeds. As illustrated in the image (Powerzest Adaptable Disc Turbine), this design allows the turbine to operate at reduced wind speeds and generate rated power at wind speeds as low as 8 to 9 m/s.

Wind turbine systems can be connected directly to the grid, known as on-grid systems, or they can be configured to store energy in batteries for future use. On-grid systems feed all the generated power into the local electrical grid, from which power can be drawn as needed for load applications. In contrast, off-grid systems store the produced energy in batteries for later use, eliminating the need for a local grid connection. For off-grid systems, a separate energy storage system is required to hold the energy, and an inverter system is necessary to convert the stored battery energy into usable AC power for load applications.

With growing energy demands, India stands on the cusp of a transformative energy shift with the potential of wind turbines playing a pivotal role. India has a high wind energy potential of about 695 GW at 120 meters height above ground level. With its vast and diverse geographical landscape, India possesses significant wind energy resources, particularly in coastal and high-altitude regions. The government's commitment to expanding renewable energy infrastructure, coupled with technological advancements and favorable policies, underscores the promise of wind power. As the nation

strives to meet its ambitious climate targets and reduce reliance on fossil fuels, wind turbines offer a sustainable and economically viable solution. Harnessing wind energy can contribute to energy security, create jobs, and stimulate regional development. By addressing challenges such as infrastructure and grid integration, India can unlock the full potential of wind power, positioning itself as a global leader in renewable energy. The path forward is clear: with continued investment and innovation, wind turbines could significantly shape India's energy future. ■

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“Natural gas sector will play a major role in use of clean fuels in India”



Sandeep Trehan

CEO

THINK LNG Investments Pvt Ltd

Over the next decade, natural gas is expected to serve as a transition fuel, helping India reduce its reliance on coal and oil while increasing its share of renewable energy sources. To achieve this, India will need to expand its domestic natural gas production and increase imports of liquefied natural gas (LNG). Despite having an extensive network of trunk pipelines, the lack of interconnectivity between them presents a major obstacle. In an exclusive interview with **Mittravinda Ranjan, Mr. Sandeep Trehan, CEO, THINK LNG Investments Pvt Ltd**, emphasizes the need for investment in the development of new infrastructure, including pipelines, storage facilities, and LNG terminals. Addressing these challenges will be crucial to unlocking the full potential of natural gas and realizing India's vision of a gas-based economy.

India is seeing a growing shift towards cleaner energy sources, including natural gas. How do you see the role of natural gas evolving in India's energy mix over the next decade, especially in the context of India's commitment to achieving Net Zero by 2070?

India's energy landscape is undergoing a significant transformation, with natural gas playing a crucial role in the country's transition to cleaner energy sources. Over the next decade, natural gas is expected to serve as a transition fuel, helping India reduce its reliance on coal and oil while increasing its share of renewable energy sources. Natural gas will likely become an essential component of the country's energy mix, as India strives to achieve Net Zero by 2070. The government has

set ambitious targets, aiming to increase the share of natural gas in the energy mix from 6.5 per cent to 15 per cent by 2030.

Economic growth, urbanization, and industrialization will increase India's energy demand. For too long, India has relied heavily on coal and other polluting fuels. On the demand side, we will have to change the mindset of the consumers. By creating awareness and educating consumers about the benefits of natural gas as a clean fuel, we can drive demand and support a gas-based economy.

On the supply side, I see a few trends - India will need to expand its domestic natural gas production and

increase imports of liquefied natural gas (LNG). We will need to invest in the development of new infrastructure, including pipelines, storage facilities, and LNG terminals that will be crucial to support this growth.

I believe that CGD companies are not only in the business of selling gas but also are about bringing a change in the mindset of the consumers, so that they opt to choose clean, green natural gas over conventional polluting fuels.

What do you consider as the key challenges in the development of natural gas infrastructure in India, particularly in terms of pipeline networks and LNG terminals?

India's natural gas sector faces significant challenges that hinder its growth and adoption. Despite having an extensive network of trunk pipelines, the lack of interconnectivity between them poses a major obstacle. Critical interconnections are missing, preventing southern regions from accessing gas from the Indian Gas Exchange and high-pressure high-temperature gas fields.

The high cost of pipeline transportation, exacerbated by the current Unified Tariff model, places an undue burden on end-consumers leading in consumers delaying in adoption of natural gas. Exorbitant regasification and truck loading charges at LNG terminals, hinder market expansion.

The absence of natural gas from the Goods and Services Tax (GST) regime, is resulting in a fragmented and cascading taxation structure that inflates retail prices and creates disparities across states.

To unlock the full potential of natural gas and achieve India's vision of a gas-based economy, these challenges must be addressed. The government, industry stakeholders, and consumers must work together to create a sustainable energy future for India.

With recent government policies like the National Gas Grid and the government's push for increasing the share of natural gas in India's energy mix, how do you foresee these initiatives impacting companies in the gas distribution and infrastructure sector?

Positively, with the government's focus on increasing the share of natural gas in India's energy mix, companies in the gas distribution sector can expect a surge in demand for their services. The development of the

National Gas Grid will require significant investment in infrastructure, creating opportunities for companies in the sector to expand their operations and increase their revenue. As the demand for natural gas increases, companies in the sector can expect to benefit from economies of scale, reducing their costs and increasing their competitiveness.

It is very easy to spend money and lay the infrastructure to create the natural gas ecosystem on the ground. However, it is very difficult to make the consumers adopt to the change and opt for natural gas. The governments' focus should also be to encourage adoption by consumers, particularly in areas where the natural gas infrastructure is in place. By doing this, we will be able to make a positive impact on the environment and also help achieve the government's goal.

Today companies need to navigate a complex regulatory framework, with multiple agencies involved in the approval process for new infrastructure projects. There should be single window clearance system to help in faster deployment of infrastructure.

Could you provide an update on the status of Think Gas' merger with AG&P? What synergies are you expecting from this collaboration, and how will it impact your ability to scale up infrastructure development and expand your reach in India?

We are proud to present our two brands, AG&P Pratham and THINK Gas, united under one banner. Over the last five years, both the brands have been able to build unique advantages and innovations in their respective geographies. With this merger, today, our footprint spans across 50 districts in the 10 states of Andhra Pradesh, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Punjab, Rajasthan, Uttar Pradesh and Tamil Nadu, covering over 10% of India's landmass. Today, we present a stronger brand and an even stronger eco-system for the use of natural gas.

Over the next few years, our network will comprise of more than 24,000 inch-km of steel pipelines, 2000+ CNG stations catering to the needs of more than 180 million customers and cover 324,000 square kilometres.

As India pushes for a cleaner energy future, how is Think Gas investing in sustainable solutions like bio-CNG, hydrogen, or green gas? What role do you see these alternatives playing in the country's gas infrastructure?

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Today we are poised to serve 180 Mn customers in our respective markets through the eco-system that we have created. We are present in over 450 CNG stations, have commissioned 49,000 domestic household connections and added over 500 industrial and commercial customers to our fold. We have crossed a historic milestone of 1.3 MMSCMD in overall sales.

We understand the clean energy market dynamics and would like to keep our focus on our core business of clean fuels. We are closely monitoring the sector and keep evaluating various solutions from time to time. We would like to take the plunge at an appropriate time, we think that suits us.

What are the key regulatory hurdles facing the gas infrastructure sector today? How do you see the government's role in facilitating or hindering the development of the sector, especially in terms of policy alignment and regulatory clarity?

The gas infrastructure sector in India faces several key regulatory hurdles that impact its development and growth. The absence of a comprehensive and consistent policy framework for the gas sector creates uncertainty and ambiguity for investors and developers.

As mentioned earlier, the sector is overseen by multiple regulatory agencies, which often leads to overlapping jurisdictions, conflicting regulations, and delays in project approvals. Gas infrastructure projects often face delays and challenges due to environmental and land acquisition issues, which can be time-consuming and costly to resolve. The tariff structure for gas transmission and distribution is not conducive to attracting investments, as it does not provide adequate returns on investment.

To start with the government can provide a clear and consistent policy framework for the gas sector, aligning regulations with the country's energy security and environmental goals. It can also help simplify and streamline the regulatory approval process, reducing the time and cost associated with obtaining necessary permits and approvals. The government could also invest in gas infrastructure development, including pipelines, storage facilities, and LNG terminals, to support the growth of the sector.

Currently, the infrastructure has been laid by the companies, but it is not sufficiently utilized as adoption is not happening at the same pace. The government should

also help push the consumers by introducing relevant policies, incentives and subsidies that help in faster adoption of clean fuels. Adoption in households will lead to a better penetration of natural gas and optimal utilization of the laid infrastructure. The special policies offering incentives to use natural gas to industries like rolling mills, ceramic industries etc., will help increase in substantial volumes thereby reducing pollution and making a big impact on the carbon footprint.

Looking ahead, what are Think Gas' expansion plans in the domestic market, and are there any particular regions or states where you see significant growth opportunities? How do you view the competitive landscape in the natural gas sector in India?

We are a regulated sector, where in all the geographical areas are bid for and allocated based on their respective bids, ensuring a fair and transparent allocation of districts to various gas companies. With 12 bidding rounds completed, all districts have been allocated, providing a clear framework for gas distribution and infrastructure development. We are now present in 10 states, 50 districts serving and changing the quality of lives of 180 Mn people.

We see a lot of growth opportunities in the automotive, households, industrial and commercial segments. As stated earlier, we are working towards changing the consumer's mindset to adopt natural gas over polluting fuels and move towards a cleaner and greener environment. We have allocated and spent marketing budgets to create overall awareness through media campaigns, targeted digital media campaigns, street plays, industrial seminars, workshops involving relevant stakeholders. We now need the government's support to help us in policies that will help in faster adoption of clean fuels.

The natural gas sector is expected to grow and play a major role in the use of clean fuels in India. ■



Pioneering the Future of Biofuels in India

VARUN KARAD

CEO

REnergy Dynamics (RED)

*India is at a crossroads in its pursuit of sustainable energy. As the country continues to grow, the demand for energy increases, making it essential to find renewable and sustainable sources to power our future. Among the various options, biofuels stand out as a key player in reducing carbon emissions, enhancing energy security, and contributing to rural development. **Varun Karad, CEO, REnergy Dynamics (RED)**, throws more light on this growing phenomenon.*

The concept of converting organic waste into biofuels is not new, but the scale at which it can be implemented in India presents a unique opportunity. India's vast agricultural resources and waste materials could be harnessed to create a sustainable and economically viable energy source.

Biofuels are derived from organic materials, such as agricultural residues, animal waste, and other biodegradable materials. These fuels offer a renewable alternative to fossil fuels, which are not only finite but also contribute significantly to greenhouse gas emissions. In India, the potential for biofuels is immense, given the country's large agricultural base and the availability of vast amounts of organic waste.

The Indian government has recognized the importance of biofuels in its National Policy on Biofuels, which sets ambitious targets for blending ethanol with petrol and promoting the use of biodiesel. Biofuels can play a crucial role in achieving India's energy security by reducing dependence on imported fossil fuels. Additionally, they contribute to environmental sustainability by lowering carbon emissions and providing a cleaner alternative to traditional energy sources.

Feedstock Aggregation: The Backbone of Biofuel Production

A reliable and consistent supply of feedstock is critical to the production of biofuels. Feedstock refers to the organic materials used to produce biofuels, such as agricultural residues, animal waste, and other biodegradable waste. One of the primary challenges in biofuel production is

aggregating these materials efficiently, especially in a country as vast and decentralized as India.

India's large agricultural base offers immense potential for feedstock, but the collection and transportation of these materials from rural areas to production facilities can be challenging. Effective feedstock aggregation systems are essential to streamline the collection process and ensure that biofuel plants have a consistent supply of raw materials.

Many organizations are exploring innovative solutions to this challenge. Technologies such as digital platforms, blockchain, and geospatial mapping are being used to optimize feedstock supply chains, reduce costs, and enhance transparency. By improving the logistics of feedstock collection, the biofuel industry can increase efficiency and ensure a reliable supply of materials for production.

Advancements in Biofuel Production Technologies

Technology is playing a transformative role in the biofuels sector. Advancements in biofuel production technologies are helping to improve efficiency, increase yields, and reduce costs. For example, modern biofuel plants are increasingly incorporating automation and real-time data monitoring to optimize the production process.

Automation allows for precise control over the various stages of biofuel production, from feedstock processing to fuel conversion. By monitoring and adjusting the



Baler Machine

process in real-time, biofuel producers can maximize yields and ensure that their operations are as efficient as possible. This not only improves the quality of the biofuels but also reduces the amount of waste generated during production.

In addition to automation, innovations in microbial and enzymatic processes are being explored to improve the efficiency of converting organic waste into biofuels. These technologies can break down organic materials more effectively, leading to higher biofuel yields and making production more cost-competitive with traditional fossil fuels.

Distribution and Market Integration

Producing biofuels is only part of the equation. For biofuels to make a meaningful impact, they must be effectively integrated into the energy market and distributed to end-users. One of the key advantages of biofuels is that they can be blended with conventional fuels and used in existing infrastructure, such as vehicles and industrial machinery, without the need for major modifications.

In India, ethanol can be blended with petrol, and biodiesel can be blended with diesel, providing an easy-to-implement solution for reducing fossil fuel consumption. However, scaling up the production and distribution of biofuels will require the development of efficient supply chains, as well as the establishment of market mechanisms to support biofuel producers and consumers.

Challenges and Opportunities in the Biofuel Sector

While the potential of biofuels in India is immense, the industry still faces several challenges. One of the primary challenges is the high cost of production, which can make biofuels less competitive compared to fossil fuels. However, with ongoing advancements in technology and economies of scale, we are confident that these costs will decrease over time.

Another challenge is the need for supportive government policies and incentives. While the Indian government has made significant strides in promoting biofuels, there is still room for improvement. Streamlining regulatory processes, providing financial incentives, and ensuring consistent policy implementation across states will be crucial for the industry's growth.

Despite these challenges, the opportunities in the biofuel sector are vast. India's commitment to reducing carbon emissions and achieving energy security creates a favorable environment for the growth of biofuels. Additionally, the increasing global focus on sustainability and renewable energy presents opportunities for Indian biofuel producers to tap into international markets.

The Social and Environmental Impact of Biofuels

Beyond their economic and energy-related benefits, biofuels also have significant social and environmental impacts. By converting waste materials into valuable energy resources, biofuels help reduce the environmental burden of waste disposal. This is particularly important in India, where waste management is a growing concern.

Moreover, the biofuel industry has the potential to create jobs and provide additional income for farmers and rural communities. By engaging in feedstock production and supply, farmers can diversify their income streams and reduce their reliance on traditional agriculture. This can contribute to rural development and poverty alleviation, particularly in regions where agricultural productivity is low.

Looking Ahead: The Future of Biofuels in India

As we look to the future, we see biofuels playing an increasingly important role in India's energy landscape. With the right support from the government, continued innovation, and strategic partnerships, the biofuel industry can achieve significant growth and make a substantial contribution to India's energy security and sustainability goals. ■

FSRUs: Maximizing value in LNG operations

In a dynamic market, Liquefied Natural Gas (LNG) operators are under pressure to enhance efficiency while controlling costs. As a result, more energy companies are pivoting from investing in land-based terminals to Floating Storage and Regasification Units (FSRUs) for LNG storage and regasification. **Andrew Stafford, Technical Director at Trelleborg Marine and Infrastructure**, discusses how standardizing equipment and operational practices within FSRUs can optimize safety and efficiency, while reducing operational costs.

With their ability to serve as both storage units and regasification plants, Floating Storage and Regasification Units (FSRUs) present a versatile option for LNG operators. They allow for more agile responses to fluctuating demand and supply constraints, minimizing the need for extensive onshore infrastructure. The International Energy Agency (IEA) projects a 2.3 per cent increase in LNG demand in 2024, driven largely by industrial use in Asia. As the market grows, the efficiency gains offered by FSRUs will become even more crucial in managing operational costs.

The global LNG supply chain, however, is not without challenges. Supply growth has slowed and is expected to remain constrained in the coming years, exacerbating the need for cost-effective and flexible solutions. FSRUs can help mitigate these challenges by reducing the reliance on fixed infrastructure and enabling operators to quickly adjust to supply and demand shifts, thereby controlling operational expenses.

In response to these market dynamics, the LNG industry is increasingly moving towards flexible, short-term contracts instead of long-term commitments. This shift underscores the importance of operational



flexibility and cost-efficiency – areas where FSRUs excel. By reducing the need for bespoke infrastructure and enabling ship-to-ship (STS) transfers, FSRUs are positioned to lower capital expenditures (CAPEX) and operational costs (OPEX), making them a strategic choice for LNG operators looking to optimize their operations.

A new era in LNG operations

As the FSRU fleet grows, standardizing systems for FSRUs is crucial to support their repeat build. Given that an FSRU is essentially an LNG carrier equipped with a regasification plant, there is no longer a need for each unit to be bespoke, as sufficient

industry experience and feedback exist. Avoiding the unnecessary customization seen in previous projects is key to reducing CAPEX.

Establishing common specifications for operations such as STS transfers will enhance the commercial viability of FSRUs by making them more easily transferable between projects. Custom vessels, tailored for specific projects, often lead to inflexibility, resulting in vessels that are not easily transferable or adaptable for other uses in other ports. By standardizing designs, the industry can avoid these pitfalls, ensuring that FSRUs can be efficiently utilized across a range of operational contexts. To achieve this, it's essential to consider the full lifecycle of the FSRU from the outset, encompassing design, development, and a consistent approach to training, maintenance, and obsolescence management.

Another crucial element in optimizing flexibility involves the integration of advanced interface solutions across various systems. From Trelleborg's perspective, our focus is on seamless connectivity between our Port and Terminal interface equipment, including Fiber Optic Ship-to-Shore Links (SSL) with Quick Release Hooks (QRH), the hose transfer system, and the Navigation and Piloting (N&P) berthing aid system. These integrations are designed to enhance operational efficiency and situational awareness by establishing a common architectural framework, ensuring that FSRU operations are both adaptable and resilient in dynamic maritime environments.

Improving connectivity for cost efficiency

As STS transfers become increasingly common, modernizing and harmonizing systems are essential – not just for reducing risks and enhancing operational efficiencies, but also for driving down operational costs. In a dynamic market where systems and processes can vary significantly due to geographical or operational differences, achieving uniformity is key to lowering expenses related to maintenance, training, and system compatibility.

Enhancing STS connectivity is crucial for minimizing compatibility issues between ship systems, particularly with legacy Emergency Shutdown (ESD) links. Many of

the large-scale LNG analog fiber optic links, originally developed in the 1980s, adhered to the technological standards of that time. Although successful efforts were made in the 1990s to reverse-engineer these links for compatibility, the lack of standardized design specifications introduced complexity, inefficiencies and potential incompatibility, leading to higher operational costs due to the need for custom solutions and specialized support.

To ensure effective and safe performance during STS LNG transfers, one vessel must effectively replicate shoreside operations. Continuous advancements over the past 30 years have re-engineered STS systems, eliminating traditional hardware barriers that previously led to inefficiencies. As a result, LNG carriers equipped with the latest SSL models can now engage in STS transfer processes using any of their ESD links, including the fiber optic system. This evolution reduces the need for costly custom hardware and ensures that vessels can operate with increased flexibility and cost-effectively.

Looking ahead, FSRUs, as key components of modern LNG infrastructure, will need to adopt standardized practices to ensure compatibility and interoperability with other elements of LNG supply chains. By doing so, LNG operators can significantly reduce operational costs associated with training, maintenance, and regulatory compliance. Standardization not only simplifies operations but also enhances cost management, supporting the financial sustainability of FSRUs in a rapidly evolving energy market.

Cost-reduction in the long-term

Since FSRUs are crucial for supplying energy infrastructure, maintaining seamless operation is vital – the use of integrated solutions ensures that equipment operates at peak efficiency, thereby reducing maintenance costs and preventing costly downtime.

The choice of transfer systems can play a critical role. Some operators install fixed loading arms on FSRUs, which might limit the vessel's versatility when there is no regasification contract, making it less competitive as a traditional LNG carrier. Conversely, using hose

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transfer systems preserves the standard manifold, allowing the FSRU to maintain its trading capabilities as an LNG carrier. By optimizing equipment choices and operational strategies, operators can enhance the vessel's flexibility, reduce maintenance needs, and ultimately lower long-term operational costs.

Proactive, continuous support

Proactive and predictive maintenance planning are vital for ensuring the continuous operation of FSRUs, minimizing unplanned downtime and avoiding unnecessary replacement costs. These can include elements such as regular site maintenance, operational service contracts with 24/7 call assistance, and critical spare parts availability. These are particularly important to consider during the operational startup phase, where ensuring all interfaces – between FSRU and shore, and FSRU and LNG carrier – are fully functional. Maintaining close collaboration with engineering solutions providers and FSRU owners and operators can ensure that any issues can be quickly addressed, keeping the equipment functional and the operations running smoothly.

It is also recommended that LNG operators access support throughout the lifecycle of an FSRU, utilizing services from the design stage through to ongoing operation. In terms of safety interfaces, standardizing solutions will ensure consistency across systems and operations. This is crucial as it allows for a uniform approach to lifecycle support, including team training, remote assistance, and obsolescence management. Taking this more holistic approach can contribute to reduced downtime and operational costs, offering long-term value to LNG operators by ensuring that FSRUs remain efficient and reliable throughout their operational life.

Looking ahead

As LNG demand continues to rise, particularly in regions with limited infrastructure, the strategic deployment of FSRUs will be essential in meeting global energy needs while maintaining financial sustainability.

By standardizing equipment and operational practices, LNG operators can realize significant safety, efficiency and long-term cost management benefits.

The integration of advanced systems and the shift towards uniform designs not only improve operational agility but also reduce the need for costly custom solutions.

To fully harness the potential of FSRUs, however, industry stakeholders must prioritize collaboration in developing and adopting standardized practices. Regulatory bodies should work closely with industry leaders to create a framework that supports innovation while ensuring safety and efficiency. Furthermore, continuous investment in technological advancements will be key to maintaining the competitiveness of FSRUs in a rapidly evolving energy market. ■

Author



Andrew Stafford
Technical Director
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“It is not just about building a road – it is about creating a more sustainable future”



Sanjay Kumar Sinha

Founder and Managing Director
Chaitanya Projects Consultancy

Chaitanya Projects Consultancy, recently successfully completed the dedicated 4-lane Coal Corridor Road from Bankibahal to Bhedabahal (SH 10) in Odisha. Designed to optimize coal transportation efficiency while prioritizing safety and environmental sustainability, the 7km road is built with concrete instead of bitumen, with an investment of ₹277 crore. In an exclusive interview with **Mittravinda Ranjan, Sanjay Kumar Sinha, Founder and Managing Director, Chaitanya Projects Consultancy**, throws more light on this ambitious project and its role in the ongoing pursuit of sustainable development and environmental conservation.

How can the Bankibahal to Bhedabahal Coal Corridor model be replicated and scaled up to other coal-rich regions in India? What are the key factors to consider for successful implementation?

The success of the Bankibahal to Bhedabahal Coal Corridor lays a solid foundation for similar projects in other coal-rich parts of India. To recreate this success elsewhere, it is necessary to consider the unique challenges each region faces, both logistically and environmentally. Building strong connections with local communities, governments, and key stakeholders will be essential for smooth project execution. Customizing the approach to fit each area's specific needs, and employing modern construction methods, can help ensure these projects not only succeed but also benefit the communities they serve.

One of the first steps is creating a detailed project plan, with a focus on boosting local economies, creating jobs, and improving infrastructure. It is also crucial to ensure these roads are built to withstand heavy traffic and harsh weather conditions, so the infrastructure lasts and serves its purpose effectively. Incorporating sustainable practices into construction will reduce the environmental impact, while alternative routes for larger corridors can help manage high traffic flow. Addressing community concerns, like resettlement and rehabilitation, is equally important to make sure the project doesn't disrupt lives more than necessary.

Strict monitoring by experts in both socio-economic and environmental areas will help keep the project on track and ensure it benefits local communities in the long run. To fund infrastructure, coal mining companies involved

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in coal extraction could be encouraged to invest upfront, or the government might introduce tolls on these roads to generate revenue for future maintenance. By paying attention to these factors — adapting the approach to local needs, ensuring quality construction, and keeping an eye on long-term social and environmental impacts — this model can be replicated successfully across India, benefiting both the coal industry and the people living in those regions.

Can you elaborate on the expected economic benefits of the coal corridor beyond efficient coal transportation, such as job creation, local business development, and overall regional growth?

The benefits of the coal corridor extend far beyond just transporting coal more efficiently. By improving infrastructure, we are creating jobs and boosting local businesses. The construction phase alone brought numerous employment opportunities to the area, and once operational, the corridor will continue to support local commerce by making the region more accessible. This improved connectivity is a magnet for investment, which helps diversify the local economy. Ultimately, the corridor is about more than just moving coal — it is about driving long-term economic growth and improving the quality of life for the entire community.

How does the concrete road construction contribute to long-term environmental sustainability compared to traditional bitumen roads, especially in terms of reducing carbon emissions and minimizing the ecological footprint?

Choosing concrete over traditional bitumen for the coal corridor is a deliberate move towards sustainability. While concrete production, particularly the cement used, can be energy-intensive, the long-term benefits far outweigh the initial impact. Concrete roads are much more durable, lasting 20 to 30 years with minimal

maintenance, which reduces the need for frequent repairs and the environmental toll of continually sourcing materials. This longevity not only conserves resources but also reduces the overall carbon footprint of maintaining the infrastructure.

Another key advantage is that concrete reflects more sunlight than bitumen, keeping the surface cooler. This helps combat the urban heat island effect, indirectly lowering the need for air conditioning and reducing energy consumption in nearby urban areas. By helping mitigate heat absorption, these roads play a small but meaningful role in reducing greenhouse gas emissions.

Concrete roads also offer practical benefits, such as smoother surfaces that improve fuel efficiency. Vehicles use less fuel on concrete due to its lower roughness and better rolling resistance, which in turn leads to fewer emissions over time. In the long run, concrete roads are more energy-efficient, consuming 73 per cent less energy than asphalt equivalents over their lifespan.

By focusing on durability, energy efficiency, and lower emissions, choosing concrete helps align this project with environmental goals. It is not just about building a road — it is about creating a more sustainable future.

What role do you see for public-private partnerships in accelerating the development of coal corridors across India? How can these partnerships be structured to maximize benefits for all stakeholders?

Public-Private Partnerships (PPPs) are key to accelerating the development of coal corridors in India. By combining the investment power and technical expertise of private companies with government support in areas like land acquisition and regulation, these collaborations can drive infrastructure projects forward more efficiently. Private companies can bring in advanced technology to enhance coal transportation,

making operations faster and more cost-effective, while the government ensures that environmental regulations are upheld, promoting sustainable development.

To make these partnerships successful, it is crucial to have clear agreements that outline the roles and responsibilities of each party. Setting realistic timelines, performance expectations, and penalties for delays or non-compliance ensures that both sides stay accountable. Equally important is the fair sharing of risks and rewards, which keeps both public and private sectors motivated to achieve the project's goals while maintaining affordable coal prices.

In addition to building the necessary infrastructure — such as railways, roads, and ports — these partnerships should also include plans for the long-term maintenance and operation of the coal corridors. This ensures the infrastructure remains efficient and functional over time, providing ongoing benefits to the communities and industries it serves. When structured well, PPPs not only speed up development but also create infrastructure that is cost-effective, sustainable, and transformative for everyone involved.

Can you discuss the potential for integrating advanced technologies, such as IoT sensors, AI, and automation, into coal corridor management to optimize operations and enhance safety?

The integration of advanced technologies like IoT, AI, and automation into the management of coal corridors is transforming how these projects are run. IoT sensors, for instance, can continuously monitor road and bridge conditions in real time, allowing maintenance teams to address issues before they escalate into serious problems. This is especially important in high-traffic areas where the wear and tear from heavy trucks can cause significant damage. AI further enhances this process by analyzing traffic patterns and optimizing the flow, helping to reduce congestion and improve overall safety. It can also identify potential risks by examining data from sensors, enabling preemptive actions.

Automation is another powerful tool, streamlining operations and reducing the need for manual labour in tasks that are often hazardous, improving both efficiency and worker safety. For example, automated systems



can handle regular load-bearing tests on bridges, particularly river bridges, where erosion (or scouring) can compromise structural integrity. Optical fiber cabling along coal corridors/highways can also provide dual benefits: improving connectivity in surrounding areas and enabling accident management systems to quickly respond to any incidents on the roads, reducing delays and keeping transportation running smoothly.

By embracing these technologies, coal corridors can operate more efficiently, ensure safer conditions, and maintain higher reliability in coal transportation. This proactive approach to monitoring and management paves the way for a smarter, more sustainable infrastructure that benefits everyone involved.

What are Chaitanya Projects Consultancy's future plans in the infrastructure sector, particularly in the development of transportation corridors and logistics solutions for the mining and energy industries?

At Chaitanya Projects Consultancy, we are excited about the future. We are committed to leading the way in developing infrastructure that supports the mining and energy industries, with a focus on transportation corridors and logistics. Our future projects will continue to prioritize sustainability, integrating new technologies that reduce environmental impact while improving efficiency. We are also keen on expanding our efforts to build infrastructure that not only supports economic growth but also uplifts the communities we serve. By staying true to these principles, we believe we can contribute to a more connected and prosperous India. ■

Transforming India's energy sector with AI



VEDANG TAMHANE

Founder and Managing Director
Xenvolt Technologies

*Artificial Intelligence (AI) can play a crucial role in managing the flow of energy through the various components of power grids. By leveraging AI-powered solutions for predictive maintenance, grid optimization, demand response management, and anomaly detection, India can build a smarter, more efficient, and sustainable energy future, opines **Vedang Tamhane, Founder and Managing Director, Xenvolt Technologies.***

The energy landscape is undergoing a paradigm shift, driven by the emergence of renewable energy sources, electric vehicles (EVs), and the increasing demand for energy fuelled by industrial growth. This transformation presents both opportunities and challenges for power systems. Historically, power systems relied on centralised generation, transmission, and distribution models. The recent integration of distributed renewable energy resources (DERs) like solar and wind power is disrupting this paradigm due to their intermittent nature of unregulated power generation. Therefore, they possess significant challenges to grid stability and reliability.

The rapid adoption of Electric Vehicles (EVs) and the increasing penetration of renewable energy sources are further complicating the energy mix. These factors, coupled with the growing energy demands of data warehouses and industrial applications, are placing immense pressure on existing power grids. The integration of Distributed Renewable Energy Resources (DERs) into the grid presents several challenges. Characteristic fluctuation of renewable energy generation can lead to grid frequency deviations, impacting power quality and system stability. Thus, ensuring a reliable and consistent power supply, especially during peak demand periods, becomes

increasingly difficult with the intermittent nature of renewable energy sources.

The enormous volume and complexity of the data generated from day to day power management operations requires a robust computational infrastructure to process. Utilisation of Artificial Intelligence (AI) and Machine Learning (ML) techniques makes it possible.

Artificial Intelligence

AI can play a crucial role in managing the flow of energy through the various components of power grids including energy sources, distribution centres, consumers storage facilities, etc. AI-powered energy distribution management systems, like those developed by AutoGrid, can optimise energy distribution networks by analysing real-time data on energy consumption patterns and grid conditions, learning from historical data. This enables efficient allocation of energy resources and minimises energy losses. The power is routed to deficit areas from places where it is abundant by incentivising consumers to save it. AI algorithms can identify optimal demand response strategies and effectively manage peak loads. It enables the system to reduce energy consumption by up to 15 per cent, making the operations greener and economically viable.

A smart grid is an advanced electricity network that integrates digital technologies to improve efficiency, reliability, and sustainability in energy distribution. The integration of AI takes this concept to a new level, enabling smarter, more responsive, and adaptive grid operations. Companies like Google DeepMind are at the forefront of developing AI-driven solutions for smart grid management. These solutions can optimise energy flow, enhance grid resilience, and improve energy efficiency.

AI-powered predictive maintenance systems, such as those developed by Xenvolt AI, can analyze sensor data from power equipment to predict potential failures before they occur. This proactive approach can significantly reduce downtime and maintenance costs. Xenvolt's explainable AI models provide insights into the decision-making process, enhancing transparency and accountability. This strategy can reduce downtime

by up to 20 per cent through proactive maintenance strategies, thus boosting energy production significantly and reducing contingency and maintenance costs.

While AI holds immense potential, AI models can be susceptible to biases in the training data, leading to unreliable outcomes. To ensure transparency and accountability, it is crucial to develop explainable AI models that can provide clear explanations for their decisions.

India: A Promising Market

India, with its growing energy demands and increasing focus on renewable energy, presents a promising market for AI-powered energy solutions. AI can play a pivotal role in developing smart grids and microgrids, enhancing grid resilience, and optimizing energy consumption. Government institutions are actively participating into strengthening of renewable energy sector. The National Institute of Solar Energy (NISE) and the National Institute of Wind Energy (NIWE) are two prominent research and development institutions in India, dedicated to advancing renewable energy technologies.

In conclusion, AI is capable of revolutionizing India's energy sector by addressing the challenges posed by the increasing integration of renewable energy sources, the growing demand for electricity, and the need for a more sustainable and resilient energy system.

By leveraging AI-powered solutions for predictive maintenance, grid optimization, demand response management, and anomaly detection, India can build a smarter, more efficient, and sustainable energy future. Continued research and development in AI, coupled with a robust regulatory framework and a skilled workforce, will be crucial to unlocking the full potential of AI in transforming India's energy landscape. AI will be instrumental in realizing Prime Minister's vision of a 'Viksit Bharat' by 2047. ■

Impact of Select Climate Policies on India's Emissions Pathway

The Council on Energy, Environment and Water (CEEW) has recently unveiled a new study titled 'Impact of Select Climate Policies on India's Emissions Pathway'. The study assesses the impact of India's climate policies across the power, residential, and transport sectors, focusing on their role in reducing emissions and supporting the country's 2070 net-zero target. Excerpts from the report.

Impact of Select Climate Policies on India's Emissions Pathway' - has been carried out using Global Change Assessment Model (GCAM) which is an Integrated Assessment Model.

India's current climate policies are already helping reduce its long-term emissions curve and are projected to reduce CO₂ emissions by almost 4 billion tonnes between 2020 and 2030. This policy brief highlights how policies promoting renewable energy, particularly solar and wind, have transformed India's power generation mix, reducing dependency on coal.

Overview

In the transport sector, policies like the FAME scheme and Bharat Stage norms are accelerating the adoption of electric vehicles and improving the efficiencies of conventional vehicles, while energy efficiency measures in the residential sector, such as the Standards & Labelling scheme, are improving the efficiency of household appliances like air conditioners and lighting. Despite these advances, challenges remain, such as the rebound effect in energy consumption, where efficiency improvements lead to higher overall usage. The study also underscores the

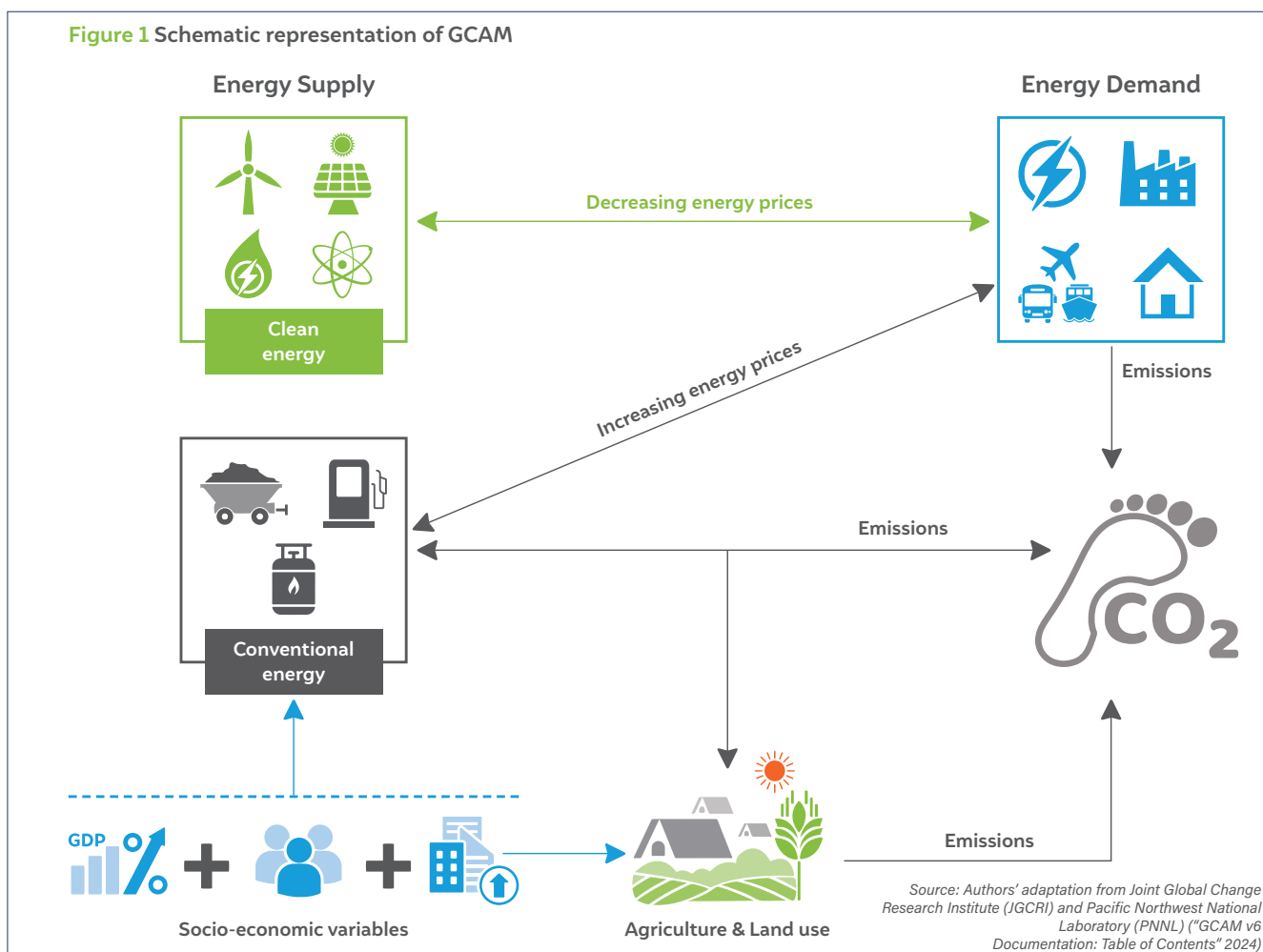


Figure 1: Schematic representation of Global Change Assessment Model (GCAM).

need for further policy innovation to address areas like heavy-duty transport and industrial emissions, which remain less decarbonized.

Key Highlights

- India's climate policies have already saved 440 million tonnes of CO₂ (MtCO₂) from 2015 to 2020, and are projected to save 3,950 MtCO₂ from 2020 to 2030, 22,670 MtCO₂ from 2030 to 2050, and 44,070 MtCO₂ from 2050 to 2070. This translates to a 23 per cent reduction in cumulative emissions between 2015 and 2070 compared to a no-policy scenario.
- Policies like National Solar Mission have played a key role in promoting renewables, resulting in a projected 43 per cent share for solar and wind in India's electricity mix by 2050. Without these policies, coal would still dominate, with renewables contributing under 10 per cent.
- Coal-based power is expected to decline significantly in the overall energy mix, with reductions of 24 per cent by 2030, 34 per cent by 2050, and 36 per cent by 2070 when compared with a No-Policy Scenario.
- India's FAME (Faster Adoption and Manufacturing of [Hybrid] & Electric Vehicles) schemes (I & II) have been instrumental in incentivising EV adoption, resulting in a dramatic increase in electric two- and four-wheelers. By 2050, EVs are projected to make up over 65 per cent of on-road stock in both two-wheeler (2W) and four-wheeler (4W) segments. Combined with Bharat Stage VI norms for vehicle efficiency, this will significantly reduce the transport sector's oil demand by 55 per cent in 2050 and 83 per cent in 2070.
- The UJALA (Unnat Jyoti by Affordable LEDs for All) scheme, which promotes LED lighting, has reduced lighting electricity consumption in the residential sector and is projected to lead to reductions of 48 per cent by 2030, 59 per cent by 2050, and 62 per cent by 2070 compared to the no-policy scenario.
- The Standards & Labelling (S&L) scheme for appliances, particularly air conditioners, has also been impactful. Although AC energy efficiency has improved, the rebound effect (greater use due to lower operating costs) has led to an increase in total electricity demand for cooling. AC-related electricity use is projected to increase 10.2 times

between 2020 and 2050 and 1.5 times between 2050 and 2070.

- With the necessary policy assistance, electricity demand is growing, partly due to the electrification of transport. In contrast, EV-related electricity demand will grow by 9.4 terawatt-hours (TWh) in 2030, 103 TWh in 2050, and 440 TWh in 2070.

Policies focussing on solar and wind in the power sector have managed to propel the electricity generation mix towards these segments in a big way, instead of being dependent on coal as the only mainstay. India's push on solar and wind has managed to avoid 80 GW of coal-based power plants that would have otherwise been installed before 2030 to meet India's burgeoning power demand. The policy push towards electrification of two- and four-wheelers is on path to significantly reduce the dependence of passenger road transport on oil and gas. In the residential sector, however, while there is significant energy efficiency improvement in air-conditioning, the consumption of electricity to meet air-conditioning demand increases due to the rebound effect (i.e., higher consumption of a fuel as its effective price declines due to energy efficiency improvements). This essentially leads to a higher amount of electricity use, but it delivers even higher social welfare gains.

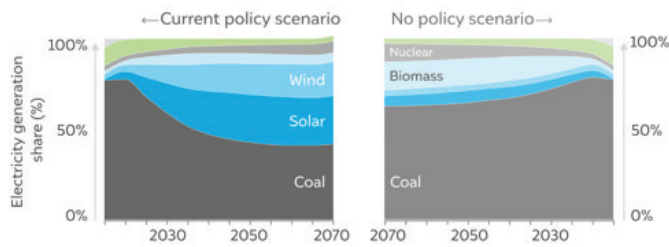
Finally, in terms of emissions savings, India's current policies are decisively able to lower India's long-term emissions curve. In terms of cumulative carbon dioxide emissions saved, India's current policies in the three sectors have already saved 440 million tonnes of carbon dioxide (MtCO₂) between 2015 and 2020, and are on track to save 3,950 MtCO₂ emissions between 2020 and 2030, 22,670 MtCO₂ emissions between 2030 and 2050, and 44,700 MtCO₂ emissions between 2050 and 2070, amounting to 23 per cent of India's cumulative emissions between 2015 and 2070, compared to the no policy scenario.

Future research would expand the ambit of policies to include other important, recently introduced policies related to the National Green Hydrogen Mission, Carbon Credit Trading Scheme (CCTS), PM Suryaghar Yojna (focussing on rooftop solar) and PM-eBus Sewa Scheme.

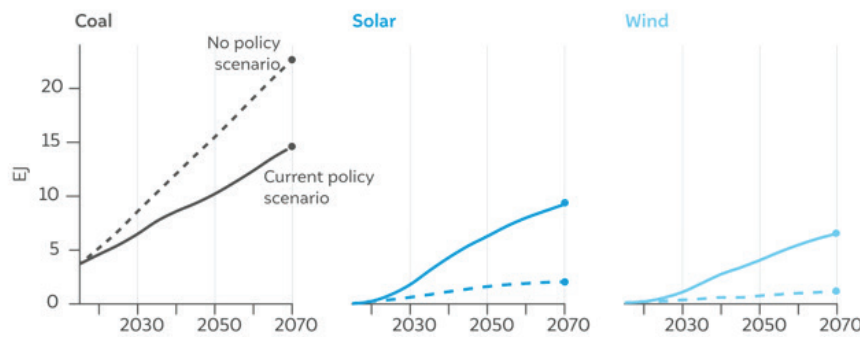
This study highlights that the adoption of the 2070 net-zero target has been a watershed moment in India's climate policy. While policies without an end goal in terms of a quantitative target are successful in pushing low-carbon technologies to a good extent, they still would not deliver on the climate ambition

FEATURES

India's climate policies are projected to push the share of solar and wind to 43% of electricity generation by 2050



Policies such as the National Solar Mission, Onshore Wind Auction, etc. are projected to tangibly increase solar and wind in the energy mix



Source: Impact of Select Climate Policies on India's Emissions Pathway (2024)



needed to achieve the goals of the Paris Agreement. India's recently announced domestic Carbon Credit Trading Scheme (CCTS), according to the study, would be instrumental in decisively bending the country's emissions curve on the path towards the 2070 net-zero target.

Key Recommendations

- Policies must continue to promote large-scale deployment of solar and wind energy, building on existing successes. This can be achieved by maintaining incentives, reducing financial risks, and fostering innovation in renewable energy technologies to further reduce costs and increase integration into the grid.
- While current policies have driven meaningful progress, achieving the net-zero goal will require further measures. Policies like the National Green Hydrogen Mission, Carbon Credit Trading Scheme (CCTS), PM Suryaghar Yojna (rooftop solar), and PM-eBus Sewa Scheme for public EVs are expected to help reduce emissions further.
- Given the industrial sector's importance in

India's economy and emissions profile, setting robust emission reduction targets is crucial to aligning with the country's goal of becoming a global manufacturing hub while reducing its carbon footprint.

- With the shift toward renewables, policymakers must develop transition plans for coal-dependent regions to ensure economic stability and social equity. This could include retraining workers and investing in alternative industries.

The study concludes that while India's current policies are bending the emissions curve, achieving the ambitious 2070 net-zero target will require continuous and vigorous policy development, particularly in energy-intensive sectors, and greater integration of new technologies like green hydrogen and new market-based instruments like Carbon Credit and Trading Scheme ■

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XtraFlo™ DRA: For Sustainable Pipeline Transportation of Crude Oil & Petroleum Products

Xtraflo™ DRA is a groundbreaking additive that significantly reduces drag in pipelines, enabling more efficient and sustainable transportation of petroleum products. Commercially available through Indian Oil Corporation Limited (IOCL) licensee Dorf Ketal Chemicals India Pvt Ltd, Xtraflo™ DRA has gained widespread adoption among pipeline operators in India due to its superior performance and cost-effectiveness.



Dr. Gurmeet Singh

DGM
IOCL R&D Centre



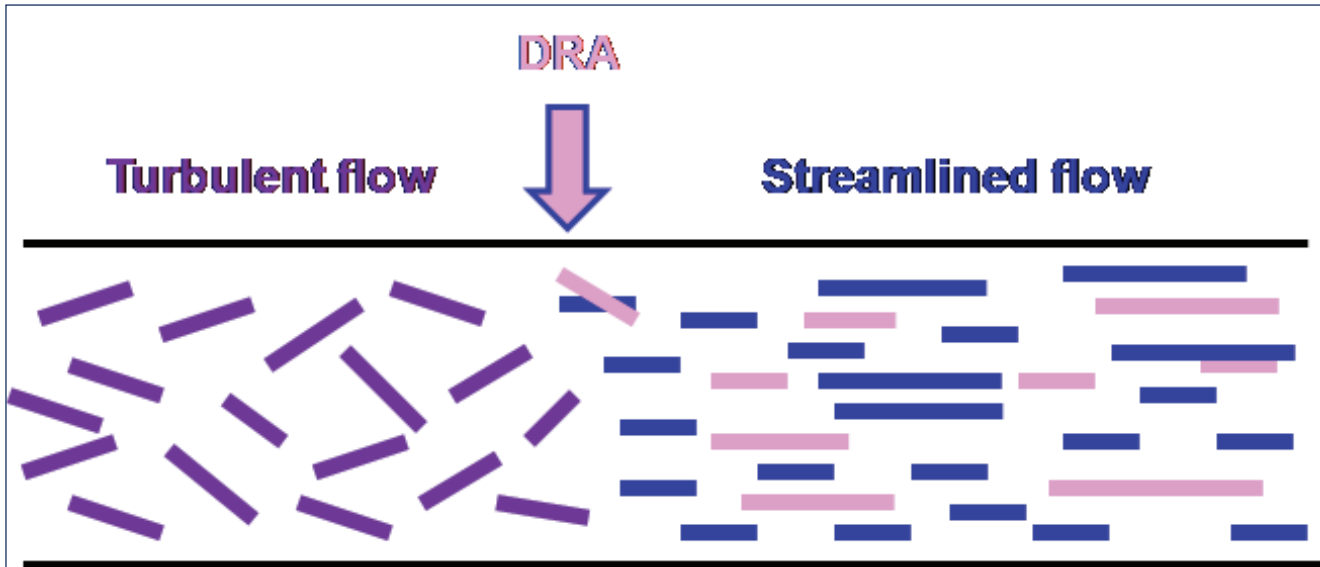
Dr. Alex Pulikottil

ED (PC&CAT)
IOCL R&D Centre

Drag Reducing Additives (DRA) are formulations containing ultra-high molecular weight poly (alpha-olefins) along with other components, which enable oil and pipeline industries to reduce the frictional pressure within the flow of a pipeline or conduit. DRAs, due to their unique comb-like structure with pendant groups attached to ultra-long hydrocarbon chains, reduce energy dissipation caused by turbulence. These DRAs have ultra-high molecular weight polyolefins, molecular weight ranging from 10 to 20 million Daltons, which enable the decrease in the amount of energy lost due to turbulent formation in pipeline transportation. These are the niche products that have been extensively patented by a few global players.

Till 2021, the DRA consumed within the country was 100 per cent imported, predominantly from the USA. Apart from IOCL, the other major pipeline operators in India, Hindustan Petroleum Corporation Limited (HPCL), Bharat Petroleum Corporation Limited (BPCL), and HPCL-Mittal Pipeline Limited (HPCL-MPL), are consuming DRA.

Considering the importance of this guarded product, IOCL embarked upon indigenization of this technology. In the ensuing journey, IOCL developed, patented, and successfully commercialized its Drag Reducing Additive (DRA) technology by licensing it to Dorf Ketal Chemicals India Pvt Ltd, a leading multi-national Indian company, for manufacturing in India and worldwide supply against royalty to IOCL in 2021.



Pictorial representation of the DRA action

IOCL's development of DRA is a pioneering achievement, marking the first successful development of this technology within India and possibly in developed countries. The effective replacement of imported DRA with domestically produced XtraFlo™ DRA is evident in the significant increase in sales of XtraFlo™ DRA from ₹25.27 crore in FY22 to ₹63.72 crore in FY23 and further to ₹105.32 crore in FY24.

The successful domestic production of XtraFlo™ DRA has triggered a spiraling effect, marked by reduced costs, improved logistics, and enhanced product availability. As a result, adoption by pipeline operators, including IOCL, BPCL, HPCL, and HPCL-MPL has steadily increased. Building upon this success, IOCL is committed to further deepening import substitution

and expanding market penetration. Imports have already dropped to a mere 4.8 per cent in FY24 from 100 per cent in FY20.

Energy Savings & Green House Gas Reduction

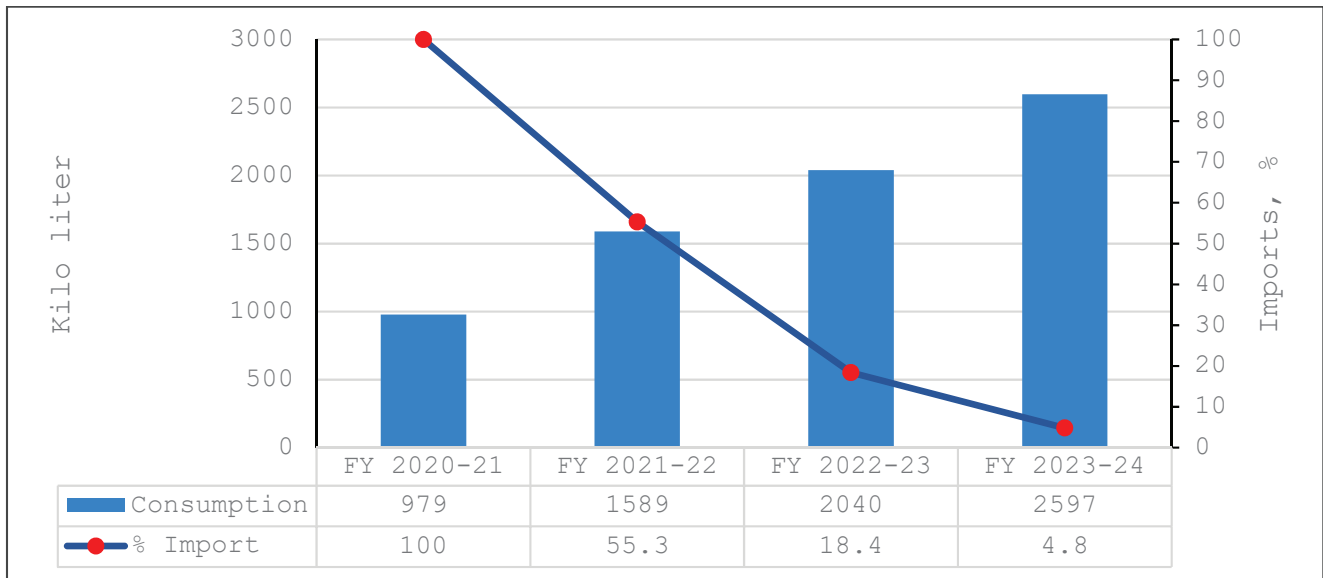
With the usage of XtraFlo™ DRA, saving on the cost of energy (power and fuel) on account of reduced operational cost per ton of hydrocarbon transported can be achieved, i.e., enhanced throughput within the existing operational setup or by shutting down pumps at intermediate booster stations. Energy (power and fuel) savings translate to approximately ₹106 crore for 2023-24 for the IOCL pipeline network. Lower energy consumption due to DRA usage is estimated to reduce CO₂ emissions by 56,800 MT CO₂ annually for the IOCL pipeline network. These figures are expected to nearly double on a national basis, including BPCL, HPCL, and HPCL-MPL. Thus, the use of XtraFlo™ DRA is contributing significantly to environmental sustainability.

Environmental Impact

The product has been developed to be environmentally benign and non-hazardous. There is zero generation of effluent in the process, making it highly sustainable. It reduces pipeline pressures while maintaining the same throughput, enabling the utilization of degraded pipelines. This eliminates the need for new pipelines, thus providing a sustainable solution to the old assets and saving on CAPEX on account of the requirement of new pipeline assets and road/rail transportation.



Main Features of IOCL XtraFlo™ DRA Technology



Total Consumption (in KL) and Import (%) of DRA in India

Innovative Technologies & Processes

Production technology for producing such a high molecular weight polymer was established for the first time in India. The technology involved overcoming mass and heat transfer challenges while handling high-molecular-weight polymers and their dispersion. A bulk polymerization process was developed to avoid the usage of solvents and make the process sustainable while achieving >95 per cent conversion levels. The technology for obtaining the final formulation was developed and established by converting bulk ultra-high molecular weight poly (alpha-olefins) into dispersible form. This stable dispersible form was suspended in a special formulation to produce the industrially usable DRA product.

Drop-in Technology

The technology has been designed and developed such that no additional hardware over a conventional system is required for usage of XtraFlo™ DRA. The ease of XtraFlo™ usage and comfort of dosing have been the main focus during the formulation development.

Additionally, opportunities are being explored to expand XtraFlo™ DRA's applications, capitalizing on its potential for energy savings and greenhouse gas reduction for hydrocarbon transportation. ■



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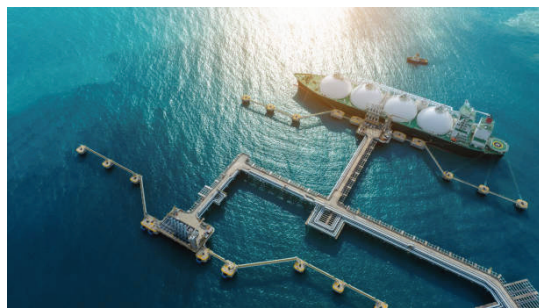
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